The developments in the location preferences of logistics establishments in Belgium and the Netherlands

Master Thesis

Erasmus Universiteit Rotterdam

26-07-2016

Student: Lucas Grummels
Student number: 346224
Supervisor: Martijn Streng
Lucas Grummels

List of Contents:

Introduction:

Over the past 40 years, the business of moving goods around the world has changed. Factors such as globalisation, the fragmentation of production strategies and changes in consumer demand could be seen as some drivers behind these changes. In the maritime and logistics sector, these developments have been responded for example by the use of larger vessels, containerisation and the use of more accurate communication systems (Palmer, 1999). To make sure that the efficiency gains made at sea (due to containerisation and the use of larger vessels) result in actual benefits, an efficient hinterland transportation network is key. Seaports play an important role in the hinterland transportation network since it is the landside origin of hinterland transport flows. Since manufacturers choose the port that best fit in their entire value chain and because hinterland transportation is a significant cost factor, the connection of seaports with their hinterlands is of great importance for the success of seaports (Notteboom and Winkelmans, 2001).

Seaports are essential nodes within transport chains as they enable the transfer of freight between maritime transportation and several modes of inland transportation. With their maritime access they provide access to overseas markets and resources. The availability of infrastructure in port areas offers logistics firms to make use of multimodal options to transfer freight via hinterland transportation networks to inland consumption markets (Carbonne and De Martino, 2003). Furthermore, seaports could be seen as attractive locations for business and industrial purposes. In order to manage the transhipment and the transportation of freight, various companies performing supporting services such as insurance offices and lawyers are attracted to seaports as well. Moreover, high numbers of industrial firms are located in seaports because of their optimal access to raw materials (BRV, 2013). The clustering of economic activity is argued to yield economies of agglomeration. The three most well-known drivers behind the benefits resulting from the agglomeration of economic activity are labour market pooling, knowledge spillovers between firms and input sharing (Van den Heuvel et al., 2014a). These drivers are argued to increase the productivity of firms and stimulate the formation of new firms (Porter, 1998).

Because of the access to markets and resources, the infrastructure available and the possible benefits resulting from the agglomerations of logistics and other economic activities in seaports, they might be attractive locations for the establishment of logistics sites. However, besides yielding benefits, the clustering of logistics firms also yields agglomeration diseconomies. Frequently mentioned agglomeration diseconomies in seaport areas are congestion, high land prices and low availability of land (Rivera et al., 2014). Diseconomies such as congestion significantly reduce hinterland transport efficiency and might make firms decide to establish their business activities further away from major seaports. A location for logistics activities that has been chosen frequently by logistics firms is Venlo in the south of the Netherlands. As the Port of Rotterdam requires container terminals to transport a larger part of containers by barge and rail, a location that is able to handle both and can be reached by several ports (Venlo can also be reached from the port of Antwerp for example) can be a strategic location for firms to locate their logistics functions. Another important aspect in the success of Venlo as a logistics hub is its preferable location towards important consumer and industrial markets in the hinterland, as Germany and its important Ruhrgebied is perfectly reachable from Venlo (Raimbault et al., 2015). As can be seen in the success of Venlo as a logistics hub, logistics activities that have originally been performed in seaport areas have in some cases been moved to more distant locations. To establish itself as such a logistics hub, Venlo has had close contacts with the ECT terminal in the port of Rotterdam and the port authority of the Port of Rotterdam. This phenomenon can be seen as a form port regionalisation, in which ports evolve from simple load centres to highly integrated networks where regions in the hinterland play an increasingly important role (Notteboom and Rodrigue, 2005).

In this paper, it is the goal to demonstrate whether this port regionalisation is actually taking place and to indicate what factors force logistics firms to eventually locate their business activities in hinterland locations instead of locations in seaport areas. In order to study this, the following question will be leading in this paper:

What are the developments in the location preferences of logistics establishments concerning seaport locations and inland locations?

The structure of this paper is as follows. Chapter two discusses the theory behind the location decisions of logistics firms and the third chapter discusses the methodology. In the fourth chapter the data, the results and a comprehensive analysis will be presented. The fifth chapter provides concluding remarks and the sixth chapter discusses the findings presented in the paper.

Chapter 2: Theoretic Framework:

The purpose of this paper is to identify the factors determining the location decision of logistics firms and especially investigate whether logistics firms value a seaport location over a hinterland location or vice versa. To study these factors, it is helpful to consider general location factors first. These location factors are considered by each firm making a decision on where to locate their business activities. This will be discussed in the first part of this chapter. Part 2 will consider factors explaining the location decision of logistics firms more specifically. Part 3 will consider why seaports could be an attractive location for logistics firms in comparison with locations further inland.

Part 1: Location decisions of firms:

The locational attractiveness of regions and the factors determining a location decision of firms have been studied extensively. In industrial location literature, factors such as market access, labour costs, access to raw materials and transportation costs have traditionally been the most dominant factors for firms deciding where to locate. This follows for instance from influential location models such as the Weber industrial location model and the Hotelling model in which these factors determine the establishment's optimal location (McCann, 2001). Over time, other factors such as productivity, education, taxes and business climate have been added to the set of potential location factors (Blair and Premus, 1987).

Models, such as the Weber industrial location model and the Hotelling model, are obviously simplifications of reality and by focusing on a few factors, they seek to find the effect of certain factors. In reality, there is a wide set of possible factors explaining the location decisions of firms. Some of these factors might be valuable to one firm but might be worthless to others. Therefore, a firm's actual location decision is made by trading off a wide set of possible location factors (McCann, 2001). In the following, the hereafter listed location factors are discussed since they are argued to be the most important factors driving the location decision of firms:

1. Access to markets and resources
2. Labour market considerations
3. Transportation costs and infrastructure
4. Land costs
5. Taxes and policies
6. Agglomeration economies

Factors driving the location decision of firms:

1. **Access to markets and resources:**

Influential papers on the location of economic activity and on the desired location of investment consider market access and access to resources as some of the most important factors describing the location of firms (Dunning, 2000; Krugman, 1998). As location choice models follow the assumption that the optimal location is the location that maximises a firm's profit, the access to both consumer markets and suppliers is obviously of great importance for a firm seeking to maximise its revenues and minimise its trade costs (Devereux et al., 2007; Hong, 2007; Venables, 1996). The Weber industrial location model for instance seeks to determine the optimal location of industrial activity by considering labour costs, but most importantly it considers the transportation costs resulting from the location's access to raw materials and end markets. Assuming a firm is likely to minimise transportation costs, the favourable location of industrial activity is the transportation cost minimising location that provides the firm optimal and affordable access to its end market as well as its input sources (McCann, 2001; Venables, 1996). In the Hotelling model, a company chooses the location that enables it to reach the greatest amount of clients.

Fujita and Krugman (2004) argue that market potential determines the location of economic activity. This could be explained by a simple example considering the financial service industry in London. Obviously, London offers a firm and its employees more amenities than many other cities, but one of the most important causes of the clustering of financial services is London's market potential for firms in the financial service industry. The internal market size of London in this case, seems to attract a more that proportionate share of firms from the same, but also from related industries to the London region (Krugman, 1998; Ottaviano, 2001).

2. Labour market considerations:

According to Venables (1996), the most optimal location for the establishment of economic activities considers both market access and production costs. Since labour costs determine a considerable part of the total production costs, they are argued to have a significant impact on the location decision of firms. By logic and found by various researchers, a negative relation between labour costs and a region's attractiveness for attracting firms to the region exists (Figuereido et al., 2002; Chen and Kwan, 2000). Guimaraes et al. (2000) consider the location of FDI in small districts in Portugal. However, in their paper, labour costs do not seem to have a significant effect on the location of FDI. The insignificance of labour costs in their study might be caused because wage differences are of greater importance for firms deciding on in which country to locate, than for firms choosing between regions within a country (Guimaraes et al., 2000).

Furthermore, a firm searching for the optimal location, not only considers labour costs, but also the quality of a potential working force. Potential employees need to be skilled in order to provide the required quality. The effect of the availability of skilled employees is tested by several authors. The quality of labour is often measured as the percentage of a region with a certain degree, which generally has a positive effect on the region's attractiveness for firms (Holl, 2004; Cheng and Kwan, 2000). However, certain industries require more specific skills. Hong (2007) for example only considers the percentage of technical workers to have an effect on the location of foreign direct investments by logistics firms in China.

Moreover, the importance of knowledge in the location decision of firms is for instance also measured by the effect certain institutions have on the number of establishments. Audretsch et al. (2005) for instance studied the spillovers occurring from universities to closely located establishments. Spillovers from universities to newly established firms are argued to promote innovation and performance, which attracts firms to a region. Besides knowledge spillovers between universities and firms, firms closely located to a university might benefit from reduced search costs to new employees. However, a location in proximity to a university is associated with high costs. Hence, future employees must be compensated by higher wages, so a trade-off between the benefits of such a strategic location and the higher costs it takes should be made (Audretsch et al., 2005).

3. Transportation costs and infrastructure:

Transportation costs are included in some of the traditional models of industrial location. As explained before, the Weber model for industrial location determines the optimal location by minimising transportation costs (McCann, 2001). Obviously oil prices affect transportation costs, but also the implementation of environmental taxes and the increase of congestion in urban areas for instance affect real transportation costs. These factors might affect a firm's optimal location since high real transportation costs requires proximity to clients, employees and resources, whereas lower transportation costs lower the necessity of proximity to them (McKinnon, 2009).

The availability of the required infrastructure positively affects the ease of transportation. A location in proximity to infrastructures such as highways, rail stations or seaports could be valuable to firms as it enables access to markets, suppliers and employees (Holl, 2004; Hong, 2007; Venables, 1996). Ambroziak (2014) argues that better infrastructure has a positive effect on the productivity of production factors and generates positive externalities which are reflected in local attractiveness for (further) development and (foreign) investment.

4. Land costs:

In the example on the financial service industry in London, the positive effect of the possible availability of a large amount of clients seems clear. However, not all such firms concentrate their activities in London. According to Krugman (1998), this can be explained partly by the fact that many other clients will not be situated in London but elsewhere and partly by the fact that moving business activities to London requires firms paying high amounts of rent. The benefits of moving business to London must outweigh the higher rents to be paid. In his paper, Krugman (1998) describes high rents in urban areas such as London as centrifugal forces, which means that such factors provide disincentives for further concentration in such areas. The trade-off between rent and distance from a central business district (such as the financial district in London) is captured by theories designed by Alonso, Mills and Muth. Under certain assumptions and conditions, a firm trades off rent against distance from a central business district. The further the firm is located from the central business district, the lower the rent it is willing to pay (Mieszkowski and Mills, 1993). These theories are obviously applicable to firms from other industries as well as their willingness to pay is highest on their most favourable location and decreases when distance increases from that most desired location.

5. Taxes and policies:

According to Porter (2000), a region's business environment indicates the possible attractiveness of a region for business purposes of any industry. The business environment is determined by factors as for example the road system, corporate tax rates and the legal system. Countries, but on a smaller scale provinces and municipalities, need to offer potential establishments an attractive environment to protect themselves from losing business to other regions. Lowering corporate taxes, providing free trade zones, offering employment subsidies, grants and possibly offering firms more attractive deals in land price negotiations (within the boundaries of the competition rule on state aid) are potential instruments for regions to increase their attractiveness (Buss, 2001; Head et al., 1999; Bernini and Pellegrini, 2011).

However, as is the case with many location factors, the effects of corporate taxes and grants for instance, are balanced against other factors. Brühlart et al. (2012) find that although tax differentials do have an effect on the location decision of firms, it seems that agglomeration economies partly offset the effect. High corporate tax, as is expected, is deterrent, but the effect of high corporate tax seems to be weaker in clusters. Devereux et al. (2007) find similar results when studying grants. They argue that grants do have small effects, but the responsiveness of firms to grants seems to be smaller in clustered areas than in areas with few firms from the same industry. This indicates that new establishments are more attracted to an existing industrial base, than to grants.

6. Agglomeration economies:

As follows from Devereux et al. (2007) and Brühlart et al. (2012), firms seem to be attracted to locations with established concentrations of firms. Although improvements in communication technology and transport modes are argued to have lowered the need for proximity, many researchers document the benefits of the clustering of industrial activity (Rivera et al., 2014). Alfred Marshall (1956) can be seen as one of the first economists addressing the possible advantages of industrial clustering. He described three major drivers behind the clustering of economic activity, namely labour market pooling, knowledge spillovers between firms and input sharing (Van den Heuvel et al., 2014a).

According to Porter (1998), the clustering of economic activity increases productivity; it drives innovation and growth, which ensures future productivity and it stimulates the formation of new firms. All in all, it enables members of a cluster to take the benefits of the greater scale of the cluster, without losing their flexibility (Porter, 1998). The benefits available from the clustering of economic activity are called agglomeration economies and the closer the connection between firms, both organisationally and geographically, the more such synergies are argued to occur (Torre and Rallet, 2005).

Frenken and Van Oort (2007) define three types of external agglomeration economies, namely localisation economies, urbanisation economies and Jacob's externalities. The benefits from locating in proximity to firms from the same industry are called localisation economies. The 'local' benefits for firms belonging to such a cluster are for example the availability of a skilled labour pool and specialised suppliers and the possibility of knowledge spillovers between firms from the same industry. Furthermore, the clustering of establishments from different industries are expected to yield urbanisation and Jacob's externalities. These externalities are best described as the benefits arising from urban size and density. The possibility to interact with people from various industries and the availability of urban amenities are argued to benefit firms as it stimulates innovation and productivity (Frenken and Van Oort, 2007).

However, following the logic of Fujita and Krugman (2004), two important diseconomies might arise because of agglomeration as well. Firstly, overconcentration of economic activities might cause problems such as congestion. Secondly, concentration indicates increasing demand for plots at particular locations, which increases land prices (Van den Heuvel et al., 2014a). Diseconomies of agglomeration are centrifugal forces and hence provide incentives against further concentration.

Part 2: The logistics industry

In part one, the most important general factors explaining the location choices of firms have been studied. Since this study is concerned with the location patterns of logistics firms, the factors driving their choices need to be examined more specifically. To specify these factors, it is helpful to define the logistics industry first to discover the variety of firms belonging to this industry. Moreover, the logistics industry underwent major changes over the past decades and as they might affect location decisions of logistics firms too, these developments are considered in paragraph 2.2. Thereafter in paragraph 2.3, the specific factors explaining the location decisions of logistics firms are examined.

2.1 Defining the logistics industry:

The term logistics refers to the variety of operations required to make goods available on markets. In this definition, the use and the application of logistics, enables market players to move goods efficiently from origin to destination. By choosing the right mode(s) of transport, determining the most efficient route, picking the appropriate terminal and moreover by scheduling and sharing information throughout the entire process, logistics helps to deliver the right product, in the demanded quantity, on time, at the right location, in proper condition and at the right price (Rodrigue et al., 2013, p. 174). Logistical operations, such as transportation, stock management and order processing, add value and increase the competitiveness of firms (Rivera et al., 2014; McKinnon, 2009; Rodrigue et al., 2013, p. 174).

According to Hesse and Rodrigue (2004) the two major components of logistics are the physical distribution of goods and materials management. Firms active in the physical distribution perform functions that are concerned with the movement and the handling of goods in order to physically move goods from origin to destination. Examples of such functions are: transportation, transhipment and storage/warehousing. Materials management is concerned with the activities needed to support the manufacturing of goods. These activities are for example: production planning, warehousing, demand forecasting and sales. Companies performing activities related to the physical distribution of goods and/or materials management are assumed to belong to the logistics industry.

A tool that is used to identify industries is the categorisation of industries made by the European Union (NACE: Nomenclature statistique des activités économiques dans la Communauté européenne). This report categorises industries into broad sections, but also more specifically into divisions, groups and classes (Eurostat, 2008). However, following the NACE Rev. 2, it seems that the logistics industry is not identified by an exact code. Van den Heuvel et al. (2014b) seek to specify the logistics industry in their attempt to identify employment concentration areas. From their work, it follows that to define the logistics industry, companies involved in the wholesale trade of goods and parts should be considered in addition to firms involved in freight transportation, storage, warehousing and other supporting transport activities such as cargo handling activities at terminals (Eurostat, 2008; Van den Heuvel et al., 2014b). In the following table, the variety of firms belonging to the logistics industry is tabulated following the work of van den Heuvel et al. (2014b).

Table 1: The logistics industry by subsectors and their corresponding NACE Rev. 2 codes:

Name (from NACE Rev. 2)	Code (from NACE Rev. 2)
Wholesale trade and commission trade, except of motor vehicles and motorcycles	G: 46
Freight transport via railways	H: 4920
Freight transport by road, except for removal transport	H: 4941
Inland freight water transport	H: 5040
Air freight transport	H: 5121
Storage and warehousing	H: 5210
Other supporting transport activities	H: 5224 and H: 5229

Sources: NACE Rev. 2 (2008) and Van den Heuvel et al. (2014b).

2.2 How did the logistics industry change over the years?

The logistics industry has seen major changes over the past decades. Factors as for example globalisation, the increased adoption of internationally fragmented business strategies and changing demand requirements have had their impacts on the industry (Palmer, 1999). In this paragraph, the major drivers of these changes are discussed as well as some of the responses from the maritime and logistics industry. At first, globalisation and its major drivers are examined. Secondly, fragmented organisation and production structures are discussed. Thirdly, macro-economic changes that have had an effect on the requirements of logistics functions are considered and fourthly, the adoption of supply chain management is discussed.

1. **Globalisation:**

Demand for transportation and logistics is usually seen as a derived demand. This means that as a result of the demand for goods and services, demand arises for transportation and logistics services to enable the movement of goods and people. As a result of globalisation and the increase in world trade, distances over which freight is supposed to move have increased, which obviously increased the complexity of logistics processes (Hesse and Rodrigue, 2004). Globalisation already started after the Second World War, but according to Soubbotina (2004), it accelerated during the mid-1980s. Two factors can be seen as important drivers of this acceleration: technological advances and the liberalisation of trade and capital markets.

Improvements in transportation modes and infrastructures increased the speed and capacity of transportation systems considerably. The adoption of pallets and containers as standardised load units for instance, significantly increased the efficiency of handling cargo at terminals and could therefore be seen as facilitators of trade (Kuipers, 2014; Rodrigue et al., 2013, p. 59). Moreover, container vessels have increased in size over the years, which enabled economies of scale in maritime transportation (Palmer, 1999). Besides the improvements in transportation systems, communication systems improved as well. This allowed for the required efficiency in the distribution of information and therefore lowered the necessity of proximity (Krugman et al., 1995). Both have facilitated globalisation since they increased the efficiency in the distribution of physical goods and information.

Moreover, the second important driver of globalisation is the liberalisation of trade and capital markets. Important trade agreements, such as the General Agreement on Tariffs and Trade (GATT), have led to the liberalisation of foreign trade and investments and to the deregulation and removal of domestic regulation of markets and industries. This increased the ease of doing business with foreign partners and as a consequence they have facilitated foreign trade and investments as well (Urata, 2002). In Europe, the Single European (SEA) act is an example of a facilitator of trade between member states. This act was signed in 1986, which completed the European internal market. The SEA has been important for the four freedoms (the free movements of goods, capital, people and services) and hence the expansion of trade between Member States (Lodge, 1986; Moravcsik, 1991).

2. Fragmented organisation and production structures:

The cancellation of various trade barriers and the technological improvements in transportation and communication systems enabled multinational enterprises to adopt flexible organisation and production structures. These flexible structures are more global in scale and rely on a network of globally dispersed inputs and functions (Nielson et al., 2014; Notteboom and Rodrigue, 2005). Since distances could be covered way faster and communication between locations improved, multinational enterprises have been able to exploit the benefits of the lower costs of inputs and services at distant locations (Henderson et al. 2002; Gereffi et al., 2005). A clear example of a firm that adopted such a flexible organisation structure is Nike, operating in the apparel and sportswear industry. Nike subcontracts its production almost entirely within an Asian production network to Asian third parties to exploit lower input costs, whereas it performs its designing and marketing activities in the United States (Feenstra, 1998). The adoption of fragmented structures and the outsourcing of production functions to Asian countries to exploit the benefits of their lower wages resulted in enormous growth in merchandise exports from Asia to the rest of the world.

Along with the rising integration of world markets, disintegration can thus be notified in production processes. This increased the complexity of global production networks, on the one hand because distances between parties within the value chain became larger, but on the other hand because the organisation of production became more fragmented (Henderson et al., 2002; Feenstra, 1998). The logistics industry used to deal with the simple movement of goods from locations with surpluses of certain products and raw materials to locations where such products were not, or not sufficiently available. However, the intensification of globalisation and use of fragmented production strategies has increased the complexity of supply chains and hence, the need for sophisticated logistics services (Rodrigue, 2012).

3. Macro-economic changes:

In their paper, Notteboom and Winkelmans (2001) discuss structural changes in logistics, comparing the Fordist era (1920s-1970s) to the post-Fordist era (1970s-). The Fordist era is characterised by highly standardised products, mass production and hence by economies of scale. It follows from their work that the increase in productivity from standardisation and mass production at a certain moment reached its limits. In addition, consumer preferences changed towards customisation and as a result Fordism evolved into Post-Fordism. In the Post-Fordian era, customers are argued to desire a greater variety of products and to attach higher value to the quality, the availability and the reliability of the goods produced and the services delivered. This can be seen as a macro-economic transition from mass production towards more customised production and furthermore, it leaded to suppliers altering their strategies. Instead of pushing large amounts of mass produced products into the market, they adopted strategies in order to react more closely to market demand (Bowen Jr., 2008; Hesse and Rodrigue, 2004).

The costs of bringing a product to the market has always been a critical factor for the success of logistics services. However, higher customer requirements on the variety, the quality and the availability of products in addition to the global production structures adopted, increased the importance of time as a critical success factor of logistics services (Hesse and Rodrigue, 2004). Strategies such as lean management and just-in-time management increased in popularity. Both strategies assume lower inventory levels and can therefore be described as 'demand pull' strategies instead of 'supply push' strategies. Responsiveness is of vital importance when adopting such strategies since being responsive allows firms to hold lower inventory levels while maintaining a high service level. In order to provide the variety of products and make sure products are delivered on time, firms started making use of more frequent and smaller batch shipments (Chopra and Meindl, 2013). The success of such firms is amongst others determined by the costs for which these product can be presented, but also how quickly the firm is able to respond to demand.

A development in line with the increased importance of time, is the growth in the use of e-commerce. An e-commerce business environment clearly shows the need for firms to be able to respond quickly, since online shopping enables customers to shop 24/7 and to scan the inventory of several shops easily and fast (Delfmann et al., 2002). To be successful, a great variety of products from varying origins across the globe should be managed, they need to be offered at a reasonable price and the delivery of such products must be fast and reliable. These requirements increase the complexity of supply chains, which will be discussed in the following paragraph (Cho et al., 2008).

4. Supply chain management:

Fragmentation of production, changed customer demand and the rise of Internet based e-commerce have increased distances and complexity in the movement of goods. Where transportation and logistics have traditionally been seen as tools to overcome space, they have evolved into factors being critical in terms of time (Rodrigue, 2012; Hesse and Rodrigue, 2004). In order to ensure efficiency in transportation, the distribution of information and the alignment of all players within the supply chain is important (Bowen Jr., 2008). Supply chain management allows for the distribution of information and the synchronisation and organisation of transport flows. This increases efficiency in transportation and hence increases the amount of space that could be covered within a certain amount of time (Rodrigue et al., 2013, p. 15). The use of real time information, the alignment of players within a supply chain and the increased efficiency in transportation, due to the use of supply chain management, allows for the implementation of modern business strategies and enables firms to react quickly to changes in volatile markets (Christopher, 2000).

The ability to react quickly enables firms within the chain to alter the 'supply push' processes, that have originally been used by the majority, to 'demand pull' processes. Supply push strategies require high inventories in order to fulfil demand, whereas with a demand pull strategy, firms take on a more responsive role and react to demand. In order to face these challenges, supply chains are required to be agile, responsive and flexible to react and modify when necessary (Christopher, 2000; Gligor and Holcomb, 2012). To manage logistics processes, logistics activities are increasingly outsourced to third parties, which is in line with the trend of non-core activities being outsourced to other parties. These logistics providers make sure information flows are actively managed and have the knowledge and expertise to design distribution networks in such a way that they are able to react quickly to demand changes in volatile markets (Delfmann et al., 2002).

2.3 What factors affect the location decision of logistics firms?

As explained in part one of this chapter, every firm balances the benefits of a location against the costs. The value one firm attaches to a factor does not necessarily mean that another firm values that factor equally. In this paragraph, important factors for firms belonging to the logistics industry will be discussed. The factors discussed in part one will be examined again, but they are now more specifically applied to the logistics industry.

1. **Access to markets and resources:**

A report by Cushman and Wakefield (2009), listing the potential top locations in Europe for the establishment of European Distribution Centres (large distribution centres), shows that one of the most important reasons for firms establishing such a centre is the access to markets. A location from which a wide range of European markets could be easily reached is argued to be ideal. Belgium and the Netherlands are argued in many papers to be attractive locations for logistics activities amongst others because the European heartland, that is accountable for approximately 60% of the European gross national product, is reachable within a reasonable amount of time (Vanelslander et al., 2014). In figure 1, the European heartland in terms of gross national product is visualised. Furthermore, it is clearly visible that Belgium and the Netherlands provide optimal access to many important economic and industrial centres within the European heartland, which is highlighted by the yellow shaded area.

Notteboom and Rodrigue (2006) argue that logistics companies seem to be attracted to identical location factors. Proximity to markets and the availability of intermodal facilities are mentioned to be important drivers for the location choice of logistics firms. Since these factors count for many logistics firms, they tend to locate in proximity to others. According to Raimbault et al. (2015), the most strategic location for logistics firms is a location that can be reached by several modes of transport, by several ports and where accessibility to markets and resources is superior. Due to globalisation and the fragmentation of production, products are sourced and delivered globally. Therefore, maritime access could be an attractive location for logistics firms reliant on global and maritime flows (Verhetsel et al., 2015).

Figure 1: Key European consumption areas, key European hubs and expected expansion routes:

Source: Cushman and Wakefield (2009) p. 12

2. Labour market considerations:

The report by Cushman and Wakefield (2009), also lists labour considerations as important factors explaining the attractiveness of a region to locate logistics activities. Obviously a region is more attractive to logistics firms if costs on labour are low. The importance of labour costs in the costs structure of logistics firms follows from the NEA report (2006) on the international road freight sector. From this report it follows that labour costs determine a significant component of the total costs made by international freight moving firms. Since margins are low in this sector, limiting labour costs is considered to be an important way to succeed, which amongst others exemplifies the great amount of Eastern European drivers that are employed in this sector (Gregson, 2015).

Obviously productivity, logistics knowledge and expertise are considered to increase the attractiveness of regions for logistics firms (Cushman and Wakefield, 2009). However, Vanoutrive and Verhetsel (2014) argue the diversity of a labour force to have a positive impact on a region's attractiveness as well. Since because of the variety of functions carried out by logistics firms a variety of personnel is needed. Lower skilled and cheap personnel, but also higher skilled technical or commercial personnel is are argue to be potential employees. Moreover, because logistics is a global task, multilingualism is argued to have a positive effect on the attractiveness of a region for logistics firms as well (CBRE, 2011).

3. Transportation costs and infrastructure:

Logistics firms are considered to perform transporting activities and/or perform activities related to the distribution of goods. Since transporting goods is the core of their business, they consider transportation costs and the availability of infrastructure when determining their optimal location (Verhetsel et al., 2015). Since the logistics industry consists of various firms, performing a variety of tasks, it is hard to draw conclusions about factors being important to all logistics firms. Therefore, in the following, logistics firms concerned with the storage, warehousing and the wholesaling of goods are distinguished from logistics firms concerned with the actual movement of goods or firms performing supporting activities.

- *Firms active in the storage, warehousing or wholesaling of goods:*

As mentioned before, the time to market seems to be an increasingly important determinant of a company's and supply chain's success. Furthermore, it is argued that business strategies have more or less evolved from supply push strategies towards demand pull strategies in which lower levels of inventories are held (McKinnon, 2009). The reliance on warehousing, storage and distribution centres has therefore increased as these are argued to be vital links enabling the required flexibility, responsiveness and reliability in supply chains. The use of real time information technology and the improved productivity in current distribution centres enable the coordination of scheduled and frequently incoming deliveries, which enhances efficiency in the distribution of goods and improves the customer service level while holding lower volumes of inventory (Bowen Jr., 2008; Tyagi and Das, 1997).

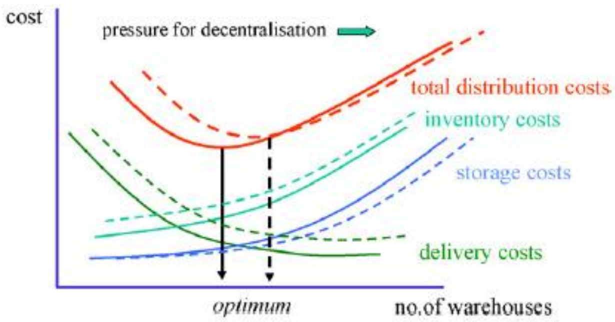
Distributors seek to balance their desired service level against the logistical costs when designing the optimal distribution configuration (Tyagi and Das, 1997). However, a general distribution configuration does not exist since an optimal configuration depends on a variety of logistical characteristics of the transported product. Examples of a product's logistical characteristics could be the product life cycle, the market response flexibility, the demand uncertainty and the desired trade-off between the service level and costs (Chen and Notteboom, 2012). A firm might opt for the opening of a high number of small distribution centres (a decentralised approach). This is argued to have a positive effect on the responsiveness and results in low transportation costs. However, such a configuration results in high inventory costs. Contrary to this approach, a firm might opt for the opening of one, or a few large distribution centres (a centralised approach). Such configurations are argued to enable economies of scale resulting in lower costs made on inventory, however, the costs made on transportation will be higher in this case. These are two extreme examples of possible distribution configurations, but firms might opt for hybrid solutions in which a few large distribution centres are supported by smaller distribution centres as well (Chen and Notteboom, 2012, Chopra and Meindl, 2013 pp. 111-112).

The costs made on transportation play a role in the decision on which configuration firms choose. Of course oil prices affect transportation costs. Higher oil prices might lead to a situation in which firms seek to locate their facilities closer to its consumption markets in an attempt to limit distances. In addition to oil prices, other factors affect the relative costs of transportation (McKinnon, 2009). Recently governments and municipalities pay a lot of attention to sustainability. For instance, for the Port of Rotterdam and its

Maasvlakte 1 and 2, the local authority, the port authority and the national government seek to limit air pollution. In order to limit pollution and improve air quality in this area, they require trucks to contain cleaner engines and drive on cleaner fuels (Gemeente Rotterdam, 2014). Ultimately, they desire the amount of cargo transferred by truck to be limited and shifted towards more environmentally sustainable transport modes such as train and barge transportation. In addition to these requirements on transportation, the imposition of environmental taxes and the worsening of congestion in certain areas are considered to increase the relative costs of transportation. These forces might alter the desired location for storage activities as increasing relative transportation costs seem to hint towards decentralised distribution configurations (McKinnon, 2009).

Figure 2 clearly displays that the optimal distribution configuration changes towards a more decentralised configuration if the (relative) costs of transportation increase, for instance as a result of rising oil prices, the imposition of environmental taxes and the worsening of congestion. The optimum shifts to the right in case of increasing (relative) costs. This means that more facilities should be used, which increases storage and inventory costs. However, since savings on delivery costs are higher than the extra costs made on inventory and storage, total distribution costs are minimised in the new situation with the opening of more facilities. This is shown in figure 2 with the optimal number of warehouses shifting along the x-axis to the right (McKinnon, 2009; Chopra and Meindl, 2013 pp. 111-112).

Figure 2: Decentralisation forces on the optimal distribution configuration



Source: McKinnon (2009, p. 297).

It follows from several papers that distribution centres tend to be built at strategic locations, away from the city centres with optimal access to highways, railways, inland waterways and main ports (Erickson and Wasylenko, 1978; Andreoli et al., 2010; Cidell, 2010, CBRE, 2011; Cushman and Wakefield, 2009). As follows from Raimbault et al. (2015), the logistics cluster of Venlo is an example of such an optimal location. It is reachable via two main ports (the ports of Rotterdam and Antwerp), via all modes of transport and it contains optimal transport infrastructure. These locations offer firms the required flexibility in transportation, improved accessibility and proper infrastructure, which are all factors lowering the relative costs of transportation (McKinnon, 2009).

- *Firms concerned with freight transportation and/or performing supporting activities:*

Freight transportation firms move freight via road, rail or water. According to the type of freight and with which speed it has to be transported, a decision is made between the following modal options: air, road, rail, sea and inland waterway transport. Maritime and air transport are mostly used for moving freight over large distances. Air transportation is more suitable to move goods and parts fast, whereas maritime transportation is used to ship high volumes of all types of freight. Truck, rail and barge transportation are used for inland transportation. Of these transportation modes, truck transportation is the most flexible and on average the fastest mode of transport. Rail and barge transportation are on average slower and are both limited to the availability of railways, inland waterways and terminals. However, they offer a much greater capacity than trucks, which makes these modes suitable to transport high volumes of goods and hence they enable economies of scale in transportation (Rodrigue et al., 2013).

The reliance of firms on a specific mode of transport obviously affects their location decision. A firm that for instance moves freight via rail or inland waterways, will attach high value to a location in proximity to a rail, barge or multimodal terminal. Obviously, these infrastructures are expected to be frequently available in seaports. Besides the provision of infrastructure, seaports seem to be the origin at the landside of a major part of the freight that is transported via inland waterways and railways. According to CBS (2015), from the total amount of freight that was loaded in barges in the Netherlands, approximately 60% found its origin in the port of Rotterdam and in the Port of Amsterdam. For the transportation by rail, this percentage was even more extreme as approximately 80% of the total weight was loaded in these ports. However, according to PBV (2015), the number of inland terminals and other facilities has increased which positively affected the attractiveness for the establishment of logistics facilities in vicinity to these terminals (Notteboom and Rodrigue, 2009). As McKinnon (2009) states, the growing attention to environmentally sustainable transport modes might increase the attractiveness for performing logistical activities in proximity to intermodal terminals even more, since it will cause a modal shift from transportation by truck to rail and inland waterway transportation.

Furthermore, as already mentioned, fuel costs take on a significant component of the total costs made by road transportation firms (Gregson, 2015; NEA, 2006). However, saving on fuel is not a simple task as covering distances is inherent to transportation. Cruijssen et al. (2010) argue that inefficiency has been a major issue in the road transportation sector. In their research they reviewed the highly fragmented Flemish road transportation sector and argue that horizontal cooperation could serve as a possible resolution. A form of inefficiency the road transportation sector experiences is the fraction of empty truck movements. Lowering these empty mileages could thus save road transportation firms money. Ergun et al. (2007) agree with Cruijssen et al. (2010) that collaboration could reduce the need for the repositioning of trucks as collaboration stimulates the consolidation of freight, resulting in more full truck loads and more efficient tours. According to Sheffi (2013) co-location and agglomeration stimulate such practices.

4. **Land costs:**

As mentioned before, the reliance on distribution centres has increased and these centres have turned into highly automatized centres. In addition to these developments, distribution centres have grown in size as well (Andreoli et al., 2010). But besides that the construction of distribution centres already requires large plots of space, Weterings (2014) argues that companies value the option to further develop and expand their sites if desired. The price of land and the availability of land are naturally related. Central locations are associated with higher costs whereas more peripheral locations are associated with relatively lower land costs. According to Verhetsel et al. (2015) logistics firms make an important trade-off between the accessibility of a location and the costs of land. The willingness to pay for a certain location will be affected by the dependency of a firm on the access to a seaport, highways, a rail terminal or a barge terminal for instance. A trucking firm for example, is expected to be willing to pay a higher price for a location with optimal access to major highways and a firm primarily transporting cargo via rail attaches high value to a location's access to a rail terminal. It follows from several papers that wholesaling and distributing activities tend to be increasingly performed in peripheral locations. Factors such as land availability, land prices and the possibility to expand are important factors describing this move towards peripheral locations. Moreover, peripheral locations are associated with lower congestion and may provide proper access to all sorts of infrastructure (Wagner, 2010; Cidell, 2010; Weterings, 2014).

5. Taxes and policies:

A firm searching for a location to establish business considers the business environment (Porter, 2000). It follows from many reports that the Netherlands and Belgium are considered to offer an attractive business environment for logistics firms. Factors that shape the attractive business environment for logistics firms are for instance the well-developed infrastructure, the already established logistics industry, language knowledge and relatively low corporate taxes (CBRE, 2013).

Governments, whether national or local, play an important role in the creation of a pleasant business environment. The Dutch government for instance, is well aware of the significant contribution of trade to the Dutch economy and it therefore seeks to create an attractive business environment for internationally operating firms. For instance the efficient tax environment acts as an incentive for firms to locate certain activities in the Netherlands (European Logistics Hub, 2016). Examples of the possible attractiveness of the Netherlands as a location for logistical activities due to its tax system are the relatively low corporate tax, the highly automated customs procedures and the probability to postpone VAT and import duties (CBRE, 2013; NDL/HIDC, 2014). On a smaller scale, local governments seek to attract firms from certain industries as well. Local governments play a major role in granting licences, developing and offering land and initiating investments in infrastructures (Vanoutrive and Verhetsel, 2014). Besides the economic impact, the local development of the logistics industry creates a great amount of jobs for a variety of skilled people. This is an incentive for local governments to support the development of the logistics industry which is expressed by the public-private partnerships that are commonly formed to finance the development of logistics sites and infrastructure (Strale, 2015).

6. Agglomeration economies:

Although improvements in transport and communication technology are argued to have decreased distances relatively and have lowered the need for proximity, many researches document the benefits of the clustering of industries (Rivera et al., 2014). Notteboom and Rodrigue (2006) argue that logistics clusters arise since logistics firms attach value to the same location factors. The availability of an existing pool of logistics firms attracts other logistics firms because of potential synergies, which increases the attractiveness of locating in such an area even more.

Classical agglomeration economies drive the location decision of logistics firms in the same way they drive firms from other industries. Firstly, because of better access to skilled personnel, as it is expected that skilled workers are attracted to locate themselves in and around such areas. Furthermore, applied schooling programs tend to be located near clusters to provide connections and links with firms which benefits both (Van den Heuvel et al.,2014a). Secondly, synergies are expected to occur because co-located logistics firms transfer knowledge. Proximity facilitates the transfer of knowledge as it encourages face to face contact (Storper and Venables, 2004). Thirdly, because of the clustering of logistics firms, suppliers tend to follow them and locate themselves in the same areas as well, which results in a well-developed supplier base (Van den Heuvel et al., 2014a; Vanoutrive and Verhetsel, 2014).

Besides the classical agglomeration economies, some benefits and synergies that might occur in logistics clusters are specific for the logistics industry. Sheffi (2013) divides agglomeration advantages for logistics firms into two categories: transportation advantages and operational advantages. Firms within a logistics cluster might benefit from the economies of scope, scale, density and frequency in transportation. Furthermore, resource sharing will increase the liquidity of assets and enables a higher level of services (Sheffi, 2013; Rivera et al., 2014). In the following, transportation and operational advantages of clusters are summarized first. Furthermore, the clustering of economic activity could also cause negative effects, which will be discussed thereafter.

- *Transportation advantages of clusters:*

Economies of scope: Freight movements are often asymmetric, whether on a global or on a regional scale. In many cases, load units go one way fully loaded but have to be returned empty. Repositioning empty loads is of course an expensive task, so carriers will charge higher prices to move freight into areas where little freight is originated. Spatial concentration of logistics firms results in the spatial concentration of loads, which increases the probability to combine loads. Moreover, the average distance between customers declines compared to a situation in which customers are more fragmented. As a result, the costs made on transportation will be lower in clusters (Sheffi, 2013; Van den Heuvel et al., 2014a).

Economies of scale: Increasing load volumes in concentrated areas such as logistics clusters enable economies of scale. As freight flows increase, carriers are likely to move to solutions with greater capacity, resulting in lower transport rates. Greater capacity can be achieved through the use of larger transportation modes. Clusters might thus provide the right scale for multimodal transport (Cambra-Fierro and Ruiz-Benitez, 2009). Multimodal transport not only offers the possibility for economies of scale in transportation, it also offers greater flexibility and efficiency in transportation since an increasing variety of transport modes and routes becomes available (Cambra-Fierro and Ruiz-Benitez, 2009).

Economies of density: In a desired situation, freight moves directly from origin to destination, but this is not always economically feasible as it would result in many less-than-full unit loads. The solution to such a problem is to consolidate freight at certain locations to build full unit loads and then transfer to the final destinations (Sheffi, 2013). Logistics clusters enhance the efficiency in the 'last mile' because of their density. Such dense areas lower distances for pick up (or delivery) tours, which results in decreasing transportation costs, among other things because of lower empty mileage. Furthermore, the increased efficiency in the 'last mile' results in increasing service levels of firms from within the cluster. Obviously, the increased efficiency is better for the environment as well (Ergun et al., 2007; Cruijssen et al., 2010).

Economies of frequency: In line with the economies of density, logistics clusters enhance economies of frequency since the capacity of a delivery or pickup shuttle is more easily reached. This enables more frequent as well as more direct shipments between a consolidation area and the logistics cluster, which positively affects the service level of firms (Rivera et al., 2014).

- *Operational advantages of clusters:*

Shared assets and increased services to customers: Locating within a logistics cluster enables players to arrange shipments with other parties and share assets such as warehouses. As mentioned in paragraph 2.2 of this chapter, currently agility, flexibility and speed are required in order to be successful in an increasingly global and competitive industry. Sharing assets such as warehouses, enables firms to store products if needed, but at the same time it offers liquidity as floor space could be supplied to other parties in case of overcapacity (Van den Heuvel et al., 2014a). In logistics and supply chain management, to ensure flexibility and efficiency, collaboration is needed. Collaborations in transportation processes require efficiency in the collection and distribution of information. Clusters stimulate the transfer of (tacit) knowledge which should result in better alignment between parties and a higher service level to (potential) clients (Storper and Venables, 2004; Bathelt et al., 2004). Moreover, building relationships with partners requires knowledge about physical and intangible assets and the capabilities of such a partner which makes the screening of a decent partner a difficult task (Cruijssen et al., 2007). Agglomeration intensifies face-to-face contact and besides transferring knowledge, face-to-face contact enables the screening of potential partners and hence simplifies finding a trusted partner (Storper and Venables, 2004).

- *Agglomeration diseconomies:*

Following the logic of Fujita and Krugman (2004), two important diseconomies might arise because of agglomeration. Firstly, concentration of activity, and in the case of logistics this often means the concentration of freight flows, might lead to congestion. Secondly, concentration indicates increasing demand for plots at a certain location which increases land prices (Van den Heuvel et al., 2014a). Diseconomies of agglomeration might stimulate firms not to locate their activities within a cluster.

Part 3: Seaports as locations for logistics activities versus inland locations

Seaports could be an attractive location for logistics firms to establish their business. For attracting logistics firms, seaports compete with locations somewhat further inland. In the following, the decision on where to locate logistics establishments is discussed. Firstly, the evolution of business strategies and the integration of seaports within supply chains are quickly discussed. Thereafter, the most important factors driving logistics firms to establish business activities in port areas as well as driving them to establish business activities further inland are discussed following the location factors mentioned in part 1 and part 2.

3.1 The evolution of business strategies and the integration of seaports in supply chains:

According to Van der Lugt et al. (2007), firms choose the location that best fits their strategy. Following their work, these strategies have evolved over the years. The moment firms started to operate globally, they focussed primarily on market development. During this period, they mainly made use of distribution strategies in which goods where directly shipped to these newly discovered markets. This focus gradually shifted towards a focus on logistics costs, which resulted in firms establishing centralised distribution centres from which entire continents where supplied. This enhanced economies of scale and logistics efficiency. However, driven by customer requirements, hybrid solutions emerged, in which both strategies were combined. The exact decision on which strategy to choose is, as mentioned in paragraph 2.2, dependent on various logistical characteristics (Theys et al., 2009).

The emergence of hybrid solutions indicate the management focus on supply chain efficiency (Van der Lugt et al., 2007). It follows from several papers that supply chain alignment and integration enhance supply chain efficiency. According to Carbonne and De Martino (2003) firms do not necessarily compete as autonomous entities, but rather compete as supply chains in which each player seeks to increase the supply chain's collective value. Seaports could be seen as important players within these chains. Besides performing their traditional functions such as transhipment and consolidation, seaports have established themselves as attractive locations where value added logistics activities could be performed (Robinson, 2002; Pettit and Beresford, 2009). For instance in the Port of Rotterdam, logistics parks have been developed in order to offer services such as (temporary) storage, consolidation, redistribution, sampling, product customisation and inventory management. These platforms indicate the seaports' functions as integrated intermodal logistics centres, where traditional functions are performed that belong to their role as a nodes in transport chains, but also where value added logistics activities are performed (Van der Lugt et al., 2007; Pettit and Beresford, 2009).

3.2 Factors in favour of establishing logistics firms in seaports versus establishing them further inland:

In the following, factors that positively affect logistics firms to establish business in port areas will be discussed. Thereafter, factors that might decide logistics firms to establish their activities somewhat further inland will be examined.

<u>Factors in favour of locating logistics activities in proximity to a seaport:</u>

Considering the location factors discussed in part one and part two, the following factors seem to be the most important drivers for firms to attach value to a location in a seaport area:

- Access to markets and resources
- The availability of infrastructure
- Agglomeration economies (e.g. a transportation efficiencies, possibility to share assets and knowledge, an existing supplier base and a skilled labour pool)

Seaports are essential nodes within transport chains as they enable the transfer of freight between maritime transportation and several modes of inland transportation. *The availability of infrastructure* in port areas offers logistics firms to make use of multimodal options to transfer freight into the hinterland (Carbonne and De Martino, 2003). The opportunity to choose between transport modes enables shippers to match the transport mode to the requirements according to the transported volume, the speed with which freight has to be transferred, the costs of transferring freight and the required environmental impact which results from the transfer of freight (Port of Rotterdam, 2015; Strale, 2015; Valentina et al., 2009). Furthermore, the core business of logistics firms is facilitating the transfer of freight. Since maritime transportation is the main mode for global transportation, a seaport location is attractive for firms that perform activities concerning global trade since it enables *access to global markets and resources* (Verhetsel et al., 2015).

A seaport location thus provides logistics firms global access and the required infrastructure to transfer and handle freight, but in addition to transhipment and handling activities, firms in seaport areas provide value added logistics services (Pettit and Beresford, 2009; Van der Lugt and De Langen, 2005). As already mentioned, logistics clusters arise amongst others since logistics firms attach value to the same location factors. The availability of other firms from the same sector might enhance the attractiveness of these locations even more because of potential *agglomeration economies* (Notteboom and Rodrigue, 2006). As argued in part two, potential agglomeration economies specific for logistics firms are the potential *economies of scale, scope, frequency and density in transportation* as well as the possibility to *share assets* and *knowledge* (Sheffi, 2013; Van den Heuvel et al., 2014a). Furthermore, clusters are associated with the availability of a *skilled labour pool* and a rich *supplier base*, since workers and suppliers are attracted to establish themselves in proximity to clusters (Van den Heuvel et al., 2014a; Vanoutrive and Verhetsel, 2014). In order to manage the distribution, the storage and the transportation of freight, companies from other industries such as insurance offices and lawyers are attracted to seaports as well. Furthermore, industrial firms seem to be located frequently in seaports because of the optimal access raw materials. The concentration of a variety of industries in seaports, from pure transporting firms to firms active in other segments, stimulates the interaction between them and is argued to increase the total efficiency and value added in seaport (Valentina et al., 2009; Vanoutrive et al., 2014).

Factors in favour of establishing logistics activities somewhat further inland:

As followed from part two, time and costs seem to be important determinants for the success of a supply chain. Supply chain excellence is achieved through superior customer services offered at the lowest possible costs. Due to increasing customer requirements on the customisation, the variety and the costs of products and the fact that these products must be delivered fast and reliable, firms increasingly started to perform logistics activities closer to consumer markets (Theys et al., 2009). The key drivers for logistics firms to establish their activities further inland are considered to be the following:

- Proximity to consumer markets
- Agglomeration diseconomies (e.g. congestion, the lack of available land, high land prices in seaports)
- Restrictions on port developments

These factors are mentioned by several authors to have moved some logistics functions further inland. However, the availability of multimodal transport options is a prerequisite for logistics firms to consider an inland location (Raimbault et al., 2015; Notteboom and Rodrigue, 2006). Poor connectivity would mean that firms cannot fully rely on their accessibility, which lowers the reliability of a firm's services. Therefore, in case of underdeveloped corridors, Theys et al. (2009) argue that a seaport location would always be preferred over an inland location.

Seaport areas seem to experience negative externalities as a result of increasing demand for transportation. *Congestion forces* and *increasing waiting times* at terminals are for example factors that decrease the efficiency and reliability of transportation systems (Van der Lugt et al., 2007). Besides congestion forces, additional *diseconomies of agglomeration* are experienced in seaport areas. Several researchers report the *scarcity of land* as a result of the saturation of logistics activities in seaport areas to be a local constraint (Strale, 2015). Obviously, since *land prices* are determined by supply and demand, the prices for available land in port areas are relatively high (Fläming and Hesse, 2011). Furthermore, logistics firms require large plots of space to perform their activities and attach high value to the option to expand their sites when desired. Their options are limited in port areas because of the high prices and the scarcity of land, but also because port development is increasingly restricted as a result *environmental constraints and local opposition*, which amongst others is the result from concerns about the amount of emission and air pollution (Notteboom and Rodrigue, 2005).

These forces seem to move functions that are not necessarily performed in seaport areas away from seaports towards inland locations with proper connections to seaports. Raimbailt et al. (2015), argue that storing freight that is destined for the seaport's hinterland in seaports does not add any value. Moving it quikcly into the hinterland and performing logistics services in *proximity to consumer markets* seems to be a better solution as it increases responsiveness and hence improves service levels. Because of these developments, logistics firms seem to started clustering in proximity to inland terminals as well (Van den Heuvel et al., 2014b). *Agglomeration economies* such as *the availability of a skilled labour pool* and a *strong supplier base* might therefore also be experienced in inland logistics clusters.

Logistics activities in seaport areas:

It is already mentioned that the location where logistics services take place is determined by the logistics requirements of the product. As is discussed in part one and part two, (logistics) firms balance several factors against eachother. Verhetsel et al. (2015) argue that in case of logistics firms deciding where to locate, a major trade-off will be made between the accessibility of a location and the costs of land. Of course, a central location (and in this case a seaport location) is associated with higher costs than more peripheral locations. A firm determines its willingness to pay a higher rent for a seaport location on how dependent it is on a seaport location (Verhetsel et al., 2015). Following this theory, logistics activities that are not necessarily performed in port areas, will be performed further inland in order to avoid high rents and possible congestion in port areas. Therefore, Veenstra et al. (2012) forecast that seaport areas in the future will be strictly used for logistics functions that are truly port related. In their studies, Chen and Notteboom

(2012) and Dervaux (2004) summarise the following activities as being truly port related logistics activities according to their logistics characteristics. The following activities are thus best performed in port areas:

- Logistics activities that result in significant reductions of the volume transported.
  ➔ *Because of reductions in transportation costs.*
- Logistics activities related to voluminous bulk cargoes, suitable for further navigation by barge and rail.
  ➔ *Because of the availability of infrastructure.*
- Logistics activities carried out in ports because their end-users are located in proximity to ports.
  ➔ *Because of its access to important consumer markets.*
- Logistics activities on products with a high dependency on short-sea shipping.
  ➔ *Because a seaport provides optimal access to overseas markets and hence transportation costs to and from inland logistics locations are avoided.*
- Logistics activities related to cargo that is subject to demand fluctuations or irregular supplies and is thus in need for flexible storage.
  ➔ *Because it allows for flexibility in the delivery of cargo as it can be shipped when needed.*

Furthermore, port areas offer firms global reach, which could be interesting for firms active in global trade. Therefore, it is argued that port areas might be an interesting location for the establishment of large distribution centres, offering firms the possibility to consolidate freight in case of exporting and strip cargo in order to distribute further in case of importing global products (Chen and Notteboom, 2012). Moreover, many products arrive in gateways despite of their destination being located elsewhere. These products are simply re-exported, without the addition of much value. Kuipers and Vanelslander (2015) document the extent of re-exportation in the total value of exports for Belgium and the Netherlands. Although, the value added by re-exportation is low, the share of re-exportation in Belgium took on approximately 55% of the total exported value in 2011. Moreover, it follows from ING (2015) that in the Netherlands at the moment, the growth rate in the export of re-exported products is higher than the growth rate of exported products that are produced in the Netherlands itself.

Especially wholesale firms are concerned with the re-exportation of goods as is expressed by the 54% of the total value added by wholesaling firms to re-exported products in 2009 (Kuipers and Vanelslander, 2015). A location in proximity to a seaport seems to be an attractive location for consolidating goods that are supposed to be re-exported. Furthermore, the availability of an airport, a high quality hinterland transportation network and other conditions such as supporting governmental policies are argued to stimulate the extent of re-exportation as well since they ensure efficiency in transportation and provide political and legal conditions to handle and further transfer products efficiently (Kuipers and Vanelslander, 2015).

Are there any benefits for seaports from the emergence of inland terminals and inland ports?

On the one hand, seaports compete with hinterlands in attracting logistics establishments. On the other hand, in order to remain competitive to other seaports, they are increasingly looking for solutions to relieve bottlenecks. Notteboom and Rodrigue (2005) argue that inland transportation determines about 40% to 80% of logistics costs and that the majority of all bottlenecks occur in inland transportation. The development of inland terminals as logistics poles and the improvement and development of corridors towards these inland corridors might relieve some of the congestion seaports experience. Since shippers choose the port of entry that best fits into its transport chain, optimal hinterland connections with developed hinterland logistics centres also benefit seaports (Van Klink, 1998).

Furthermore, the importance of a well-developed multimodal hinterland network is expected to increase. European and national institutions increasingly stimulate the transfer of freight with more environmentally friendly transport modes such as rail and barge transportation. To stimulate this shift, a well-developed multimodal network and distribution network must be available. The development of such a distribution network is described in the port regionalisation stage, which is discussed by Notteboom and Rodrigue (2005) In this stage, seaports and inland ports jointly function in a distribution network with the goal to enhance efficiency. An important condition for such a network to function is the provision of efficient multimodal transfers between seaports and inland ports/terminals. Veenstra et al. (2012) expect that in such networks, with the increased focus on the environment and hence more sustainable transport modes, the amount of trucks travelling in port areas will diminish and a modal shift towards rail and barge transportation will occur.

Part 4: Concluding remarks concerning the theoretic framework:

In order to study the location pattern of logistics firms, the theoretic framework firstly summarised general factors explaining the location decisions of firms. The factors considered to be the most important factors describing the location decision of firms are: access to markets and resources, labour market considerations, transportation costs and infrastructure, land costs, taxes and policies and agglomeration economies.

In the second part of the theoretic framework, the logistics industry has been considered more specifically. It is described that a variety of companies are argued to be involved in logistics services. Obviously, firms active in the physical distribution of freight, such as the ones moving freight through the air and over sea, inland waterways, railways and roadways are considered to be logistics firms. But in addition to these firms, firms active in the wholesale of goods and parts and firms providing storage, warehousing and other transportation services such as cargo handling and forwarding are considered to belong to the logistics industry. Furthermore, this chapter has summarised factors that have had an impact on the logistics industry such as globalisation, the fragmentation of production, macro-economic changes and the application of supply chain management. These factors have amongst others increased the complexity of supply chains, they have changed the customers' requirements regarding the quality, availability and variety of products and the requirements on the reliability and speed of services. Furthermore, because of these changed requirements, firms have adopted different strategies in which they increasingly tend to respond to demand instead of holding high levels of inventories. In order to succeed while holding lower inventory levels, supply chains must be more responsive and flexible. At last, in order to capture important factors determining the location choice of logistics firms, the location factors from part one are re-examined and applied to the logistics industry.

Thereafter in part three, seaports as attractive locations for logistics firms are compared to locations further inland. It follows that seaports have established themselves as suitable locations for logistics activities besides their traditional function as nodes in transport chains. The main factors that positively affect the decision of logistics firms to locate their activities in seaports are argued to be: the quantity and quality of the available infrastructure, the access they provide to markets and resources and the possibility for firms to benefit from agglomeration economies. These factors create conditions that are favourable for a variety of logistics functions and therefore it is expected that strong concentrations of logistics firms are to be found in seaports.

However, it seems that seaports and the areas surrounding seaports experience some negative externalities as the result of the increasing demand for transportation and the saturation of seaports. Increasing waiting times at terminals and congestion forces could be seen as bottlenecks that occur because of the overconcentration of transport flows in seaports. Moreover, as a result of the overconcentration of business activities in seaports, they become saturated through which other local constraints such as scarcity of available land, high land prices and restrictions on seaport developments are experienced as well. These factors are argued to have moved some logistics functions that are not necessarily performed in seaport areas further inland. A strong prerequisite for the movement of these activities further inland is the availability of efficient multimodal connections of inland locations with seaports. In order to make these connections available, supporting (local) governments are important as they are supposed to involve in public-private partnerships to invest in the required infrastructure and shape a favourable business environment for logistics firms. According to several papers the attractiveness of performing logistics functions further inland has increased especially because of its closer proximity to consumer markets, the greater availability of land at more reasonable prices and lower road congestion in such areas. Furthermore, because of the clustering of logistics firms in and around logistics hubs, benefits resulting from the clustering of logistics activities might be experienced here as well. Therefore, it is expect that over time logistics firms have increasingly established their firms on strategic inland locations in proximity to multimodal inland terminals, industrial sites or consumption markets.

Chapter 3: Methodology and Data:

In this study, location patterns and preferences of logistics firms are considered. The first goal of the paper is to study whether there are more logistics activities in seaport areas than in locations further inland. Furthermore, it is researched whether this pattern has changed over time and if the actual location choices could be explained by the location factors mentioned in the former chapter. In order to capture the location of logistics firms, a method that is able to identify the location of industrial activity is required. In the following, some frequently used industrial cluster identification methods are discussed. Thereafter, the most appropriate model to study the location of logistics firms will be discussed in more detail and it will be explained how this research method is able to research whether the attractiveness of seaports and inland locations has changed over time. Moreover, theoretical analysis will be needed to identify which location factors impact the location decision of logistics firms.

3.1: Cluster Identification Methods:

3.1.1 Discrete versus continuous methods:

The tendency of economic activities to cluster has increased the interest in statistical methods measuring the degree of industrial concentration and specialisation in regions. According to Tian (2013), these concentration measures can be roughly subdivided into two divisions: discrete measures and continuous measures. Traditionally, researchers have made use of discrete methods. In discrete methods, the researched area is subdivided into discrete and exclusive zones, like provinces divide the Netherlands into twelve discrete zones. This enables the discrete method to measure the extent to which industrial activity is divided over the regions (Bickenbauch and Bode, 2008). Measures such as the Gini coefficient, the Ellison Glaeser Index and the Herfindahl Hirschman Index are examples of discrete measures that have been frequently used to measure the extent to which industrial activity tend to localise.

With improvements in the availability of data and software, new methods such as distance-based (or continuous) models have been developed. These measures do not divide regions into sub-regions but treat space as being continuous and analyse the distance separating firms. It follows from several papers that in case all data and software is available, using continuous models is preferred over the use of discrete models. Since these models make use of the actual location of firms, they avoid possible border biases resulting from the use of discrete measures (Marcon and Puech, 2012). However, the extensive data and software requirements of continuous models makes the use of these models nearly impossible for this study. Continuous methods for instance require exact coordinates of companies and disaggregated data. This makes discrete cluster identification methods to have the clear advantage over continuous models for this research, since these methods could be used with data that is aggregated by region and industry. Such data is argued to be more frequently available in databases that are publicly accessible (Guimaraes et al., 2011).

3.1.2 Discrete measures:

Many of the discrete measures find their origin in the measurement of income inequality but are used by researchers to measure other types of inequalities as well (Lerman and Yitzhaki, 1984). Commonly used measures are for instance: the Gini coefficient, the Herfindahl Hirschman Index and the Ellison Glaeser Index (Bickenbauch and Bode, 2008; Rhoades, 1993). These methods are quickly discussed hereafter.

The Gini Coefficient:

The Gini coefficient is a coefficient that is derived from the Lorenz-Curve and is still used by the World Bank to indicate the degree of inequality in the distribution of wealth. Besides using the Gini coefficient as a measure of income inequality, it is often used as a measure to indicate other types of inequalities (Notteboom, 2006).

The Gini coefficient represents the space that occurs when the Lorenz curve deviates from the 45 degree equality line. The more the Lorenz curve curves away from this 45 degree equality line, the more unequally the researched indicator is distributed over the total number of observations. Therefore, a Gini coefficient of zero indicates a situation in which the indicator is perfectly distributed over the observations, and a Gini coefficient of one indicates that the indicator is perfectly unevenly distributed over the observations (Rodrigue et al., 2013). Besides the simple understanding of this measure, a Gini coefficient is comparable across countries, across industries and it can be used at various moments in time to see whether over time concentration patterns have changed. Furthermore, the Gini coefficient is a relatively simple measure to construct and the data requirements are often lower than for most other measures.

The Herfindahl Hirschman Index and the Ellison Glaeser Index:

The Herfindahl Hirschman Index is mainly used to describe market circumstances and in particular to describe the market power of market players within an industry. Although this measure would provide some interesting information about the logistics industry and its market circumstances, the measure is not used for the identification of concentrations of industries in regions. However, the Ellison Glaeser Index, another concentration measure, incorporates the Herfihndal Hirschman Index in its formula (Dumais et al., 2002).

The main advantage of the use of the Ellison Glaeser Index is that it controls for the size of industrial plants, whereas the Gini coefficient does not take this into account. Therefore, in the case of calculating Gini coefficients for very small regions with employment as an indicator, it is important to make sure that high levels of employment do not necessarily indicate the existence of a cluster. High levels of employment could for instance also be the result of a very large plant with many employees. The Ellison Glaeser Index takes this into account by incorporating the Herfindahl Hirschman Index in the formula (Dumais et al., 2002; Fratesi, 2008). In this formula, the Herfindahl Hirschman index represents the plant-level employment concentration, so in order to calculate the Ellison Glaeser Index, in addition to the (regular) regional employment data, data on the relative plant sizes must be available.

3.1.3 Problems with discrete measures:

Despite the frequent use of discrete measures, there are two specific problems that derive from the use of these methods. Firstly, discrete measures are able to indicate the presence of clusters, but they are not able to indicate whether these clusters are situated in proximity to eachother or whether they are situated separately from eachother (Liu, 2014). Secondly, it is argued that the use of discrete measures might cause biased results as a result of the strict definition of areal units. Continuous models do not carry these problems as they make use of the exact location of firms. Therefore, the distance between firms could be measured, which indicates whether firms are situated in proximity or not and these results are not affected by the discrete zoning of space (Guimaraes et al., 2011). The two problems resulting from discrete measures are called the checkerboard problem and the modifiable areal unit problem and these are discussed in the following with the help of two simple examples (Bickenbauch and Bode, 2008).

Checkerboard Problem:

The checkerboard problem illustrates the inability of discrete measures to identify the actual location of clusters. Over a researched space, clustered regions might be located in proximity to eachother, or they might be located separately from eachother. However, it follows that various spatial patterns might lead to the same outcome of the measure when using discrete methods (Arbia and Piras, 2009). Figure 3 illustrates this problem and explains why this problem occurs.

Figure 3: The Checkerboard Problem: Different distributions of activity but with the same outcome using discrete methods.

3	3	3	0	0
3	3	3	0	0
3	3	3	0	0
0	0	0	0	0
0	0	0	0	0

a.

3	0	0	0	3
0	3	0	3	0
0	0	3	0	0
0	3	0	3	0
3	0	0	0	3

b.

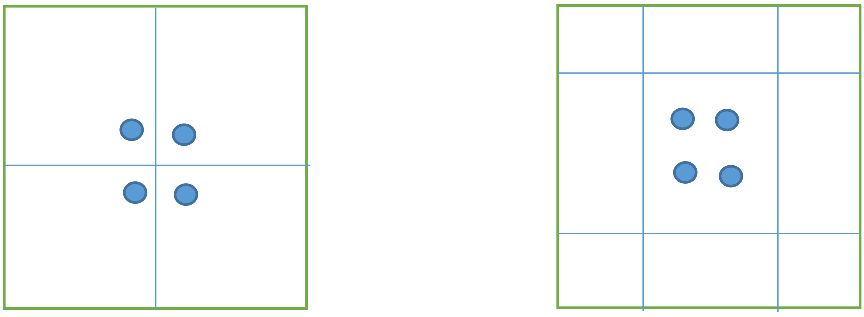
Source: Arbia and Piras (2009, p. 4472).

When considering figure 3, one can clearly identify the clustering of activity in figure 3a in the top left corner. The pattern in figure 3b is more fragmented and hence more equally distributed over the entire square. However, assuming that the numbers represent employees and that the squares represent regions, the discrete measure only takes into account that all employees are active in only nine regions, so it will give the same outcome for the degree of concentration in both figures. The concentrated regions in figure 3a might be part of a greater cluster, but are treated identically to the situation in figure 3b where the pattern is far more fragmented (Guimaraes et al., 2011). Therefore, discrete measures should be used with caution and must be seen as descriptive measures and not as explanatory measures from which one can directly derive conclusions. Other methods should support discrete measures in order to reach a proper conclusion about a certain situation (Notteboom, 2006).

The Modifiable Areal Unit Problem:

The other major drawback of using discrete measures is the modifiable areal unit problem (MAUP). This problem is the result of the use of data that is aggregated by administrative regions. Obviously, these administrative regions, such as provinces in the Netherlands, are not made out of functionality for research. Since strict regional boundaries are set, researchers active in spatial studies must not ignore the potential measurement bias that results from the discrete division of space (Guimaraes et al., 2011). The MAUP is explained in another paper by Arbia (2001b) via the squares in figure 4.

Figure 4: The Modifiable Areal Unit Problem: Different boundaries alter concentration outcomes:



a: *b:*

Source: Arbia (2001b, p. 414).

In figure 4a and 4b, the locations of the firms are exactly the same, but because of the discrete zoning of space, a disproportionality measure would indicate fragmented economic activity in figure 4a and concentration of economic activity in figure 4b (Arbia, 2001b). The sensitivity of discrete measures to the way boundaries are set causes biased results. Therefore, evaluating whether clusters are eventually being located on the boundaries of administrative units could be helpful. Van den Heuvel et al. (2014b) for example evaluate discrete measures and combine neighbouring regions if both measures reach above a certain cut-off point. In their study, such areas are combined and hence are treated as greater clusters.

Methods to limit the bias caused by the MAUP and checkerboard problem:

The checkerboard problem and the MAUP problem show that a discrete measure should be used with caution and that it does not have the exploratory power on its own that is required to conclude where concentrated areas are located. As argued before, distance-based models require sophisticated software and extensive data, which is not likely to be available, so researchers started to combine discrete measures with other methods in an attempt to limit the occurring problems. As mentioned, Van den Heuvel et al. (2014b) developed a method to limit the MAUP problem by combining regions from which both measures reach above a certain cut-off point. Furthermore, as argued by Schweizog and Collins (2014), the use of greater regions decreases the probability that a cluster is spread across borders as well. However, it is obvious that the use of large regions might complicate more detailed analysis, so this will not always be the most desirable option.

Furthermore, in order to limit the checkerboard problem, Arbia (2001a) proposed the combination of a discrete measure, the Gini coefficient in this case, with the Moran's I statistic, which is a statistic indicating spatial autocorrelation. The Moran's I measures if (dis)similar values tend to cluster and is positive (0→1) in case similar values cluster and negative (-1←0) if dissimilar values cluster. The Moran's I is therefore a statistic used to capture the dynamics of firms' location patterns and is able to provide answers about whether concentrated regions tend to be located in proximity to eachother or not. However, it still does not cover the checkerboard problem entirely, since it does not explain anything about the actual location of cluster(s) (Jing and Chai, 2010).

In addition to the method used by Arbia (2001a), other methods are developed to avoid drawing conclusions purely on discrete measures. Chhetri et al. (2014) argue that the visualisation of the results retrieved from discrete measures in choropleth maps, might help drawing conclusions. This argument is supported by Schweizog and Collins (2014), who argue that using a simple measure such as the Location Quotient (LQ) supplemented by actively studying choropleth maps offers valuable insights in the location patterns of clusters. This method does not provide an answer to the MAUP problem, so there might still be a problem to identify clusters on the borders of administrative areas, however by visualising the results, the checkerboard problem is somewhat limited (Chhetri et al., 2014; Schweizog and Collins, 2014). In addition to partly limiting the checkerboard problem, the visualisation of fractions or location quotients is helpful for the further analysis on the location patterns of logistics firms.

3.1.4 Method decision:

The purpose of the study is first to identify the location of logistics firms and in particular if they tend to establish their activities in seaport areas or further inland. Therefore, the measure must be able to identify the regions in which logistics firms agglomerate. Furthermore, the measure must be comparable over time, in order to analyse the changes in the location patterns of logistics firms over a certain time period. Moreover, since the discrete measures do not have the explanatory power that enable drawing conclusions purely on this measure, further analysis should complete the method in order to provide further insight in the most important location factors for logistics firms.

Indicator:

According to Tian (2013) the decision on which method to choose is constrained and therefore partly determined by the availability of data. Most discrete measures make use of employment data, so the number of employed people seems to be the most desirable indicator to use in this study. Furthermore, the number of people employed is argued to properly indicate the size of an industry within a certain region (Schweizog and Collins, 2014). Data on the number of employed people in the logistics industry needs to be collected through public databases as for instance Eurostat (the European statistical office) and national statistical offices. By quickly scanning through their databases, it follows that collecting the required employment data is a tough job. The Ellison-Glaeser method requires data on the plant level as well. Since such data is even more specified than the ordinary employment data, it is not likely that this data is available for this research. Therefore it seems that the Gini coefficient is the most appropriate method to measure the employment concentration areas for the logistics industry in this research.

A simple method using the Gini coefficient:

Schweizog and Collins (2014) argue that attempts to limit the checkerboard problem, such as the Moran's I, provide some insights in the spatial patterns of industrial activities. However, such methods are still unable to identify the exact location of the clustering of industrial activities. Therefore, in their work, they argue that combining a simple location index with an intensive analysis of choropleth maps produces more meaningful results than using all kinds of complicated spatial models. This view is supported by Chettri et al. (2014), who argue that visualising the results (the concentrated areas) is important in order to identify the possible spatial clustering around strategically important areas such as seaports or inland hubs. Therefore in their model, Schweizog and Collins (2014) have used the Balassa Index to calculate the relative industrial specialisation of a region. Furthermore, these Balassa Indices have served as input for the calculation of the Gini coefficients that are used as descriptive statistics. Thereafter, choropleth maps are used to visualise the results which limits the checkerboard problem and enables the identification of regions in which industrial activities tend to be concentrated. Analysing the most concentrated areas enables Schweizog and Collins (2014) to draw conclusions about the underlying reasons for the clustering of industrial activities in these regions. This method seems to be suitable to identify whether logistics firms tend to locate their activities in seaport areas or locate them further inland. Furthermore, by using this method for two time periods, the Balassa Index outcomes, the maps and the Gini coefficients might indicate changes over time. Moreover, intensive analysis of concentrated areas might yield some answers to the question which of the location factors are important in the location decision of logistics firms.

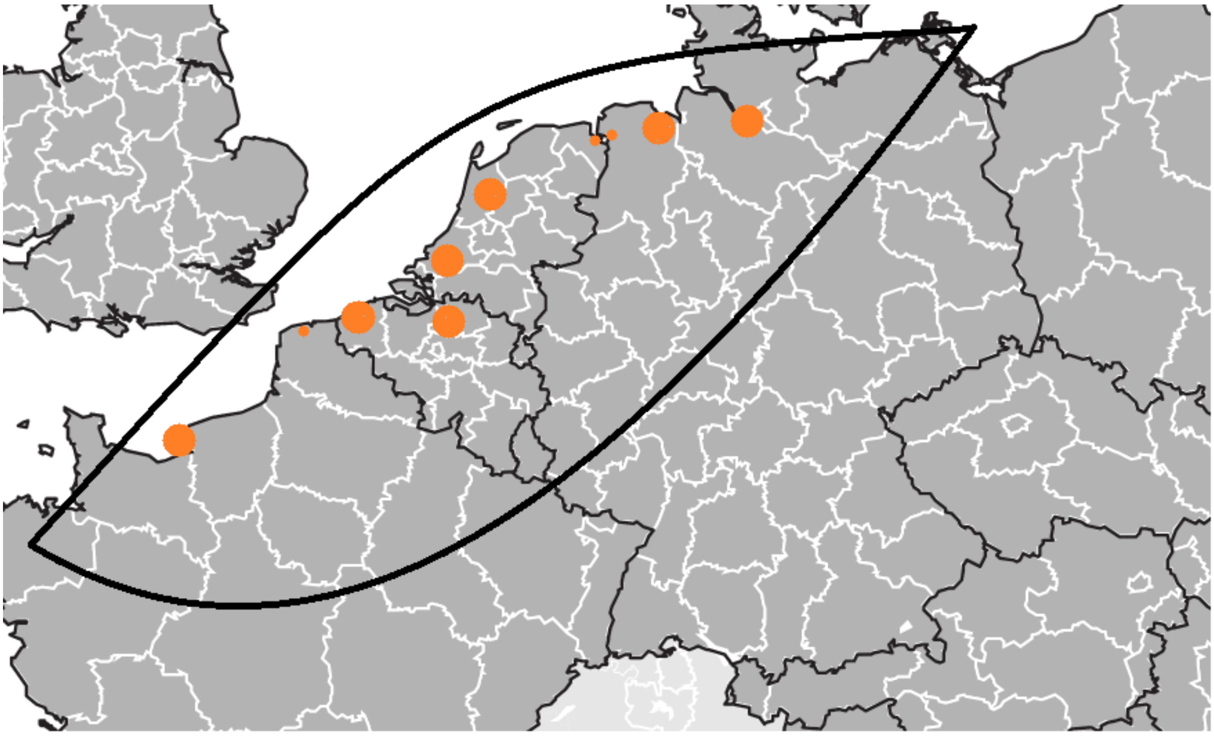
The regions to observe:

In their work, Schweizog and Collins (2014) identify the differences in the location patterns for four exemplar manufacturing industries in the EU and USA. The data they have used has been aggregated to the NUTS 1 level. For the Netherlands that would mean that the country is divided into Northern Netherlands, Southern Netherlands, Western Netherlands and Eastern Netherlands, which means that the specification towards regions is quite low. A negative consequence of such a low geographic specification is that it is only possible to generally analyse the results. However, for the sake of limiting the problems occurring from the use of discrete concentration models, the greater the observed geographical areas, the less likely it is that a cluster might spread across borders. Therefore the MAUP problem is somewhat limited by the authors' choice to make use of NUTS 1 regions (Schweizog and Collins, 2014).

Despite limiting the MAUP problem, observing such great areas will not be desirable in this research. Obviously, by using data that is aggregated to NUTS 1 regions, it will still be possible to indicate whether the logistics industry is concentrated or distributed evenly over the regions. However, for the further analysis, it will improve the research a lot if data that is aggregated to the NUTS 2 or NUTS 3 level is used. For instance because the location factors mentioned in the former chapter, such as the availability of an intermodal terminal, possible agglomeration economies and diseconomies are argued to have much more impact on a shorter distance than on a larger distance. In order to capture the effect of these location factors, the data is required to be more specified. Therefore in this research, the data is required to be aggregated to the NUTS 2 level (provinces in the Netherlands and Belgium) or NUTS 3 level (COROP areas in the Netherlands or arrondissements in Belgium).

For investigating whether logistics firms prefer a seaport location or a location further inland, an interesting region to investigate is the Hamburg-Le Havre range of seaports. According to Notteboom (2016), six seaports that are situated in the Hamburg-Le Havre range find themselves in in the top fifteen container ports in Europe with respect to throughput. In order to draw conclusions about location preferences of logistics firms related to a seaport location, it is logical to include the most important seaports. Furthermore, port authorities of the greater seaports record a lot of data, which might be helpful throughout the research and analysis as well. In figure 5, the most important seaports within the Hamburg-Le Havre range are highlighted. Moreover, the desired area to research is represented by the area between the lines. Obviously, the hinterland of the seaports might be greater than is indicated in this figure. However, for this research it is important to evaluate whether firms prefer a seaport location or a location somewhat further inland. Therefore, the hinterland considered is not too large, since firms considering the establishment of their sites in the far hinterland might not even think about a seaport location.

Figure 5: The area to research:



Source: www.wikipedia.nl

3.2 The method:

In the former paragraph, several concentration measures and methods to identify clustered regions have been discussed. It is argued that a method similar to the method proposed by Schweizog and Collins (2014) is the most suitable method to use in this study. In the following subparagraphs, the relevant method for this thesis is discussed in more detail. The first subparagraph will discuss the calculation and the meaning of Balassa Indices. The second subparagraph will discuss the calculation and the meaning of Gini coefficients and the third subparagraph will discuss the additional value of choropleth maps and the classification method that is used to indicate in which regions logistics firms tend to agglomerate.

3.2.1 Balassa Index:

The Balassa index is a simple index that has originally been used to measure the relative value of exports of industries and countries. However, similar to other concentration measures, the Balassa Index has been used for other purposes as well. A frequently used measure for the identification of the relative industrial specialisation of regions is the Location Quotient (LQ). This LQ follows the same formula as the Balassa Index and is calculated by the following formula:

$$Location\ Quotient = \frac{\frac{Regional\ Employment\ Industry\ (i)}{National\ Employment\ Industry\ (i)}}{\frac{Regional\ Total\ Employment}{National\ Total\ Employment}}$$

As follows from this equation, the numerator of the LQ calculates the share of a region's employment within a certain industrial activity. The denominator measures the region's share in the total employment. By only calculating a region's share in the total number of people that are employed in a certain industry, one would be able to identify the regions in which most people are employed in that industry in absolute terms. Although this is an important indicator for the location of logistics activities, it does not necessarily indicate the specialisation of a region in logistical activities, since the size of logistics employment could be the result of the general employment size of a region. In order to capture the relative specialisation of a region, fractions are divided by the regions' shares of employment in all industries. A calculated LQ greater than one will indicate the relative specialisation of a region in a particular industrial activity.

In order to calculate the LQ for each region for the logistics industry, regional data on the number of employed people that are active in the logistics industry is required. As mentioned before, the possible lack of data that is geographically specified to the NUTS 2 or NUTS 3 level (provincial or regional level) and sufficiently specified towards industrial activities, might cause problems for calculating the LQ. Bowen (2008) argues that besides the total number of employed people, also the total earnings and the number of establishments could be used to estimate the existence of industries at the regional level. Therefore, in case the desired employment data is not available, the number of establishments and the total earnings could serve as alternatives. Bowen (2008) argues in his work that because of the protection of firms' confidentiality, only data on the number of establishments was available for his research. Besides the logical reasoning behind using the number of establishments as an indicator for evaluating the existence of an industry in a region, he finds the correlation between the industry's employment and the number of establishments to be close to one, which also statistically certifies the decision to make use of the number of establishments as the input variable. Therefore, the following formula describes the calculation of the Balassa Index with data on the number of establishments as input.

$$Balassa\ Index = \frac{\frac{Regional\ number\ of\ establishments\ (industry\ (i))}{National\ national\ number\ of\ establishments\ (industry\ (i))}}{\frac{Regional\ total\ number\ of\ establishments}{National\ total\ number\ of\ establishments}}$$

Balassa Indices are calculated for each region to indicate the relative specialisation of the regions in logistical activities. Furthermore, by calculating Balassa Indices for 2000 and 2014, one might be able to identify changes over that time period. A Balassa Index that increases over time, indicates an increase in the relative specialisation in the logistics industry of a region. Moreover, the Balassa Indices and fractions are visualised in choropleth maps. The visualisation of them limits the checkerboard problem since the actual location of the fractions and Balassa Indices is indicated on the maps, but it also helps identifying whether logistics activities are concentrated in seaports or in inland locations. The identification of clustered regions enables further theoretic analysis regarding the underlying factors that affect the attractiveness of these clustered regions. Finally, the calculated fractions (the Balassa Index numerators) serve as inputs for the calculation of the Gini coefficients.

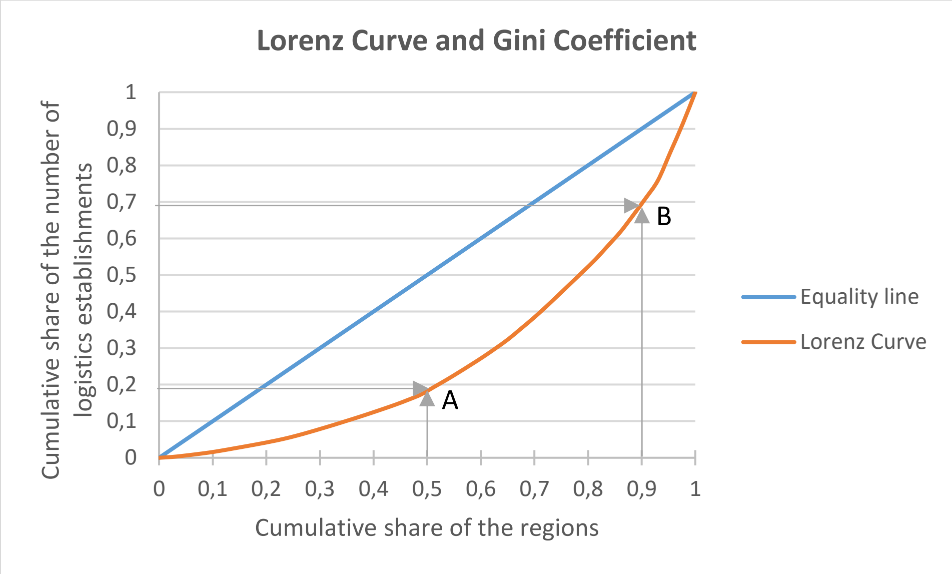
3.2.2 Calculation of Gini coefficients:

The Lorenz Curve:

In the study of Schweizog and Collins (2014), the Gini coefficient serves as a first indicator for the degree of concentration of industrial activities in Europe and in the United States of America. The Gini coefficient is best calculated by first constructing a Lorenz curve, in which the Gini Coefficient measures the area that is enclosed by the Lorenz curve and the 45 degree line (or the perfect equality line) (Rodrigue et al., 2013).

For the construction of a Lorenz curve, one uses the numerators of the Balassa Indices. These numerators calculate a region's share in the total number of people employed in the logistics industry or in the total number of logistics establishments, depending on the available data. The Lorenz curve indicates the inequality from the 45 degree equality line. In the case employment or the number of establishments are distributed perfectly even across regions, the Lorenz curve will not curve away from the 45 degree line. In this situation, the Gini coefficient is zero, since the Gini coefficient measures the surface that appears between the equality line and the Lorenz curve. In the other most extreme situation, the Gini coefficient is equal to one, which means that all employment or establishments are concentrated in one region. In this situation, the Lorenz curve is curved away from the equality line completely to the lower right corner of the graph. In the following graph, an example of the Belgian road freight transportation sector and its number of establishments in 2000 is given to illustrate the Gini coefficient calculation and the reasoning behind the Lorenz curve.

Graph 1: Lorenz curve and Gini coefficient:



Data source: StatBel (statistical office Belgium)

In this graph, one can indicate the blue 45 degree equality-line and the red Lorenz curve. The y-axis represents the cumulative share of the number of logistics establishments and the x-axis represents the cumulative share of regions. The graph should be read as follows: starting from the origin, an equal situation would mean that for instance out of the total of establishments approximately 20 percent of the establishments would be situated in approximately 20 percent of the regions. However, as is indicated by point A on the Lorenz curve, in the case of the Belgian road freight transportation sector in 2000, approximately 20 percent of the total of establishments is situated in 50 percentage of the regions. Point B indicates that approximately 70 percent of the total number of establishments is situated in approximately 90 percent of the regions. Put differently, point B indicates that 30 percent of the total number of establishments is situated in only 10 percent of the regions.

The Lorenz curves are used to graphically indicate the distribution of the number of logistics firms over the regions in Belgium and the Netherlands, but most importantly, the construction of Lorenz curves enables the calculation of Gini coefficients. By visualising Lorenz curves for each logistics subsector, one is able to read from the Lorenz curves which subsectors tend to be concentrated and which ones tend to be more fragmented. The most concentrated subsectors show Lorenz curves that curve towards the lower right corner of the graph. The more the Lorenz curve curves towards the lower right corner, the closer the Gini coefficient approaches one.

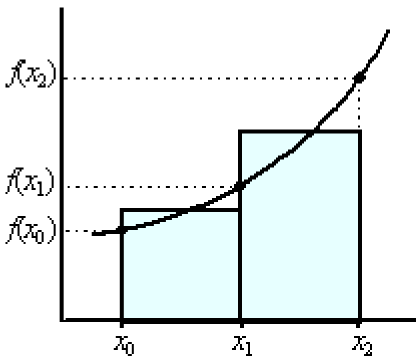
The Gini Coefficient:

The Gini coefficient is calculated by the surface that appears between the Lorenz curve and the equality line. The most convenient method to measure this surface is to calculate the surface under the Lorenz curve first. This area is estimated by using the Riemann sum. In order to estimate the Riemann sum, the fractions of the number of establishments are accumulated first and ranked in ascending order. Secondly, the Riemann sum could be calculated using the following formula:

$$Riemann\ Sum = \sum \frac{Cumulative\ fractions\ (i) + Cumulative\ fractions\ (i-1)}{2} * \frac{1}{number\ of\ regions}$$

In this formula the cumulative fractions of establishments enable the estimation of the surface under the Lorenz curve, which becomes clear in figure 6. In this figure, the area under the curve is estimated by calculating the surface of bars between each two data points. In order to estimate the height of the bar, the cumulative fractions are summed and divided by two. The width of each bar is calculated by dividing one by the total number of observed regions.

Figure 6: Riemann sum: the calculation of the area under the Lorenz curve:



Source: [*http://www.hhofstede.nl/modules/riemann.htm*](http://www.hhofstede.nl/modules/riemann.htm)

Since the Riemann sum calculates the area under the Lorenz curve and the Gini coefficient is calculated by the area between the Lorenz curve and the equality line, a few more simple calculations are needed. Since the maximum on the x-axis and the y-axis is one, the area under the equality line equals a half. Therefore, the Gini coefficient should be calculated by subtracting the Riemann sum from a half. Finally, since the maximum Gini coefficient in this case can only be a half, the Gini coefficient needs to be multiplied by two.

The Lorenz curve and the Gini coefficient could be used as descriptive measures indicating the degree of industrial concentration, but they are not able to indicate the relative position of the concentrated areas. Therefore, the following paragraph discusses the classification method that is used for the construction of choropleth maps. Besides the fact that the visualisation of the fractions and Balassa Indices limits the checkerboard problem, these maps also enable the identification of the regions in which logistics firms tend to agglomerate.

3.2.3 Choropleth maps and classification method:

The classification method for classifying fractions:

The visualisation of fractions and Balassa Indices in choropleth maps is already argued to limit the checkerboard problem which occurs naturally as a result of the use of the Gini coefficient. Furthermore, it enables the identification of clusters around important hubs such as seaports and inland ports. In order to make sure the fractions are visualised properly in the maps, they need to be classified. Besides that class breaks could be set by hand, the following methods are argued to be used frequently for the classification of data:

- The equal interval method
- The quantiles method
- The standard deviation method
- The natural breaks method

The purpose of this paper is to identify the regions in which logistics firms tend to be located. From the theory it follows that logistics firms tend to be attracted to the same location factors which is one of the reasons why logistics firms tend to agglomerate. It is therefore expected that the logistics industry is not perfectly evenly distributed over the researched regions and is more concentrated in a few regions. Therefore, a method that is able to handle an unevenly distributed dataset is needed. In the following, the above listed methods are briefly discussed.

- *The equal interval method:*

The equal interval method is a method that is used to classify data into equal classes. A dataset with data points ranging from 0 to 20 could for instance be divided into 4 classes. The first class will then consist of values ranging from 0 to 5, the second class from 6 to 10 and so on. This method is relatively easy to interpret and is a suitable method to classify data in case the data is distributed fairly evenly (ArcGis 9.1, 2006). However, since it is likely that the data is not distributed evenly the equal interval method might not be the most suitable to classify the data used in this paper since this might lead to some classes having many data points, while others have a very low number of data points.

- *The quantiles method:*

In the quantiles classification method, each class contains an equal number of data points. In a dataset with 40 data points and 4 classes, each class will thus contain 10 data points. Therefore, as well as the equal interval method, the quantiles method is well suited to classify evenly distributed data. However, in case of unevenly distributed data, some data points are put together in the same class, despite their values being very different from eachother. Since the classification method is used in this paper to map the results into choropleth maps, it is key to add data points to classes in such a way that within these classes values tend to be similar to eachother. Otherwise, the choropleth maps would not have the explanatory power that is desired. Therefore, a method that is able to put similar values into classes is the method that is preferred.

- *The standard deviation method:*

By using the standard deviation method, one is able to visualise the deviation within a dataset from the mean. However, for using this method, an assumption that the data approximately follows a normal distribution should be made. Additionally, very high or very low values might have a great impact on the mean and will therefore skew the mean, which negatively affects the effectiveness of using this classification method. Furthermore, no actual values are shown in this method, which makes interpreting the results more difficult than the other methods (ArcGis 9.1, 2006).

- *The natural breaks (Jenks) method:*

The natural breaks (Jenks) method seeks to pick the class breaks that minimise the variance within the classes and maximise the variance between the classes. For this study, the visualisation of the data is an important part and therefore a method that is able to put similar values into classes and maximises the difference between groups is desired. A drawback from the use of this method is that the method is tailored to each dataset, which makes comparing maps more difficult since the class breaks alter for each dataset.

With the potential uneven distribution of the fractions of the number of logistics establishments, the most appropriate method to classify the fractions would be the natural breaks (Jenks) method. In the Appendix, the tables A, B and C summarise the lower bound, the upper bound and the number of data points that fit into each group when classifying the logistics industry in Belgium in 2000. The tables consider the natural breaks (Jenks) method, the equal interval method and the quantiles method. Most importantly, it follows from these tables that the variance within the classes is minimised when making use of the natural breaks (Jenks) method.

However, as is discussed, the Natural Breaks method is tailored to each dataset. Therefore, comparing results seems to be complicated as the class breaks would alter for each situation. In order to be able to compare different time periods(the years 2000 and 2014 in this study), the Natural Breaks method will be used to classify the data for 2000 first, which helps classifying the data in the most efficient way. Thereafter, the same intervals will be used for the year 2014 in order to be able to compare the choropleth maps for both time periods.

The classification method for classifying Balassa Indices:

A calculated Balassa Index of below one would indicate a region not to be specialised in a certain industrial activity. A first cut-off point of one would therefore make sense, since any region which has a Balassa Index of one or higher is argued to have a more than proportionate share in the total amount of establishments active in a certain activity.

According to Tian (2013) several researchers have discussed how to further analyse LQ and Balassa Indices. Obviously, a value of one or higher indicates the relative industrial specialisation of a region, however the remaining question is what outcomes for the LQ or the Balassa Index indicate a cluster or a seriously specialised region? The computation of standardised location quotient is mentioned to be one method to analyse the extension to which industries are concentrated. However, according to Tian (2013), computing standardised LQs, simply being the z-statistics of the ordinary LQs, yields unreliable results in the case the data does not follow a normal distribution. It is more likely in this research that the data is skewed and hence is not normally distributed so this method would not be suitable for this research. Moreover, in this research the LQ or Balassa Index is used as a simple descriptive measure which is supplemented by theoretical analysis. Therefore, the decision is made to ignore other complicated bootstrapping methods and make use of the values set by several researchers. Tian (2013) mentions researchers to frequently make use of 1.25 and 2.00 as the cut-off values for the Balassa Index.

Chapter 4: Results:

In this chapter the results are presented. Firstly, the preparations related to the obtained data are discussed and secondly the results will be presented and discussed. An interpretation of the results is presented in the final paragraph of this chapter.

4.1 Data obtained and data preparations:

As expected before, the lack of available employment data necessitates the use of the number of logistics establishments as the input variable. Table 1 in the second chapter of the paper tabulated subsectors that altogether form the logistics industry. It follows that data on the number of firms active in air freight transportation is difficult to obtain. Therefore, the decision is made to focus on the logistics subsectors tabulated in table 2.

Table 2: The logistics industry and its subsectors:

Name (from NACE Rev. 2)	**Code (from NACE Rev. 2)**
Wholesale trade and commission trade, except of motor vehicles and motorcycles	G: 46
Freight transport via railways	H: 4920
Freight transport by road, except for removal transport	H: 4941
Inland freight water transport	H: 5040
Storage and warehousing	H: 5210
Other supporting transport activities	H: 5224 and H: 5229

Sources: NACE Rev. 2 (2008) and Van den Heuvel et al. (2014b).

The need for the geographical and industrial specification impedes the use of most of the available datasets. From intensive contact with statistical offices it follows that for the previously mentioned research area(the Hamburg-Le Havre range), the desired data is only available for Belgium and the Netherlands. Their statistical offices record this industrially specified data on the NUTS 3 level. Belgium consists of 43 NUTS 3 level regions and the Netherlands consists of 40 NUTS 3 level regions. This geographical division of regions enables more detailed analysis than if NUTS 2 regions would be used.

Furthermore, in table 2, firms active in wholesale trade and commission trade are considered to be logistics establishments. Not all researchers include them when determining the impact of the logistics industry. In this study, these firms are accounted to be logistics firms amongst others because of their involvement in (international) trade (CBS, 2016)[1]. According to Kuipers and Vanelslander (2015), many value added logistics activities are performed in facilities that are in some way related to the wholesale sector.

In order to use the data on the number of logistics establishments per arrondissement in Belgium and per COROP region in the Netherlands, the obtained data must be prepared and adjusted in some instances. In

[1] See for more information on the net revenues of wholesale firms and trade agents from foreign and domestic activities table G in the appendix.

the following, the data preparations needed for Belgium are discussed first. Secondly, the preparations and adjustments to the Dutch data are discussed.

4.1.1: Belgium data preparations:

The data on the number of logistics establishments per arrondissement in Belgium for the year 2014 is obtained from the Belgian Statistical Office's website. By selecting all the NACE Rev. 2 codes as previously explained, the number of logistics establishments is calculated for each arrondissement in 2014. However, the publicly available historical data only dates back to the year 2003. Fortunately, the data could be obtained via the Belgian statistical office after sending them a request.

The 2000 data is specified to four (or sometimes to five) digits, but instead of following the NACE Rev. 2 classification, this data follows the older NACE Rev. 1.1 industry classification scheme. For some sectors, this means that the data must be modified in order to prevent the over- or underestimation of these sectors, since the data consists of firms active in sectors that are not assumed to belong to the logistics industry. In the following table, the NACE Rev. 1.1 codes are matched to their corresponding NACE Rev. 2 codes.

Table 3: Conversion table NACE codes Belgium:

Code (from NACE Rev. 2)	Code (from NACE Rev. 1.1)
G: 46	51
H: 4920	6010
H: 4941	60242
H: 5020	6110*
H: 5040	6120*
H: 5210	63121 and 63122
H: 5224	63111 and 63112
H: 5229	63401-63406

Source: NACEBel 2003

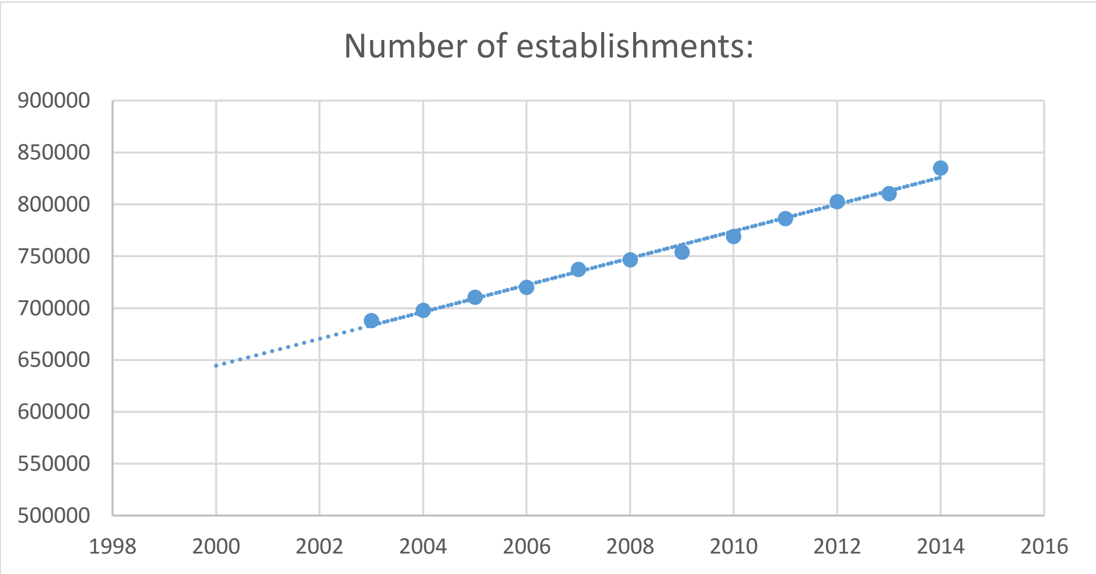
The two highlighted and underlined sectors (NACE Rev. 1.1: 6110 and 6120) include firms that are active in the transportation of passengers and freight over sea, coastal and inland waters. In order to estimate the number of the firms that are actually active in the transportation of freight, data from 2008 to 2014 is used, since from the year 2008 a distinction is made between water transportation of freight and water transportation of passengers. Therefore, for the years 2008 to 2014, the percentage of firms active in the transportation of freight over water out of the total number of water transport firms is calculated.

For the subsector H5020 (NACE Rev. 2), which is best described as the class of firms that is active in sea and coastal water transportation, it follows that on average, the percentage of freight transporting firms out of the total sea and coastal transporting firms diminishes slightly over the period from 2008 to 2014. Furthermore, on average, the transportation of persons takes on just a minor part of the sea and coastal water transportation sector, which is exemplified by the 4% share of firms active in the movement of persons within this subsector. Since the value has diminished slightly over the period from 2008 until 2014, the 2008 percentages will be used for the estimation of the 2000's number of establishments per arrondissement.

Moreover, the other water transportation sector (H5040 in the NACE Rev. 2) includes firms that are active in the transportation of freight and persons over inland waterways. Within this sector, as expected, the percentage of firms active in the movement of persons is on average greater than in the sea and coastal water transport sector, namely around 26%. Furthermore, these percentages seem to be fairly constant over the period from 2008 until 2014. Therefore the average percentage over this period is assumed to be a proper proxy for estimating the values for the number of establishment per arrondissement for the year 2000. Furthermore, it becomes clear from table 3 that most of the other sectors are easily converted into NACE Rev. 2 codes. The NACE Rev. 2 sectors H5210, H5224 and H5229 could be retrieved by summing NACE Rev. 1.1 sectors, while the sectors G46, H4920 and H4941 have exact equivalent sectors in the NACE Rev 1.1.

Moreover, for the calculation of the Balassa Indices, the total number of establishments per arrondissement is important. In order to estimate this number, the total number of establishments for the years 2003 until 2014 are tabulated. The relation between the number of establishments and time seems to be fairly linear over time, which is visualised in graph 2. Therefore, the assumption is made that this linear relation also holds for the period of 2000 until 2014, so the 2000's number of establishments is calculated by extrapolation.

Graph 2: The total number of establishments in Belgium:



Source: StatBel (statistical office Belgium)

4.1.2: The Netherlands:

The data for the number of logistics establishments per COROP area in the Netherlands is obtained via the Dutch Statistical office. Data for both years, 2000 and 2014, is publicly available. However, similar to the issues mentioned for the Belgian data, the 2000 data for the Netherlands follows another sector classification scheme. Fortunately, the Dutch Statistical Office has data available for the year 2000 that is further specified than is the case for Belgium. The following table summarises how the NACE Rev. 1.1 codes correspond to the NACE Rev. 2 codes.

Table 4: Conversion table NACE codes the Netherlands:

Code (from NACE Rev. 2)	Code (from NACE Rev. 1.1)
G: 46	51
H: 4920	6010*
H: 4941	60242
H: 5020	601101
H: 5040	61201 + 61202 + 61203
H: 5210	63121 + 63122 + 63123*
H: 5224	63111 and 63112
H: 5229	634

Source: CBS

It follows from this table that the sector in which firms are active in the transportation of freight over railways needs to be estimated. The Dutch Statistical Office specifies the data in such a way that the data consists of firms active in the transportation of freight as well as firms active in the transportation of persons. The 2014 data shows that five firms are active within this sector in 2014. Since this number is extremely small compared to the other sectors, assuming that in 2000 five firms where active in the sector will not harm the calculations. Furthermore, because of the small number of firms active in this sector, as well as the complexity of the rail freight sector, as a result of its former market regulation, the size and the location of firms active in this sub-sector are better examined theoretically.

Moreover, when comparing the table 3 and table 4, one is able to see that the NACE Rev. 2 sector H5210, which consists of firms active in the storage of goods, is obtained differently in the Netherlands than in Belgium. This difference lies in the fact that the Dutch Statistical Office further specified the 'storage' sector into three smaller sectors, namely: the storage of goods in tanks (NACE REV. 1.1: 63121), the storage of goods in refrigerated warehouses (NACE REV. 1.1: 63122) and the storage of goods in all other locations (NACE REV. 1.1: 63123). The Belgian Statistical Office only specified the 'storage' sector into two subsectors: the storage of goods in refrigerated warehouses (NACE REV. 1.1: 63121) and the storage of goods in all other locations (NACE REV. 1.1: 63122).

Furthermore, over the period from 2000 to 2014, the number of NUTS 3 areas in the Netherlands diminished by three regions since some regions have merged. This has been the case for Amsterdam and 'the rest of Greater-Amsterdam', Rijnmond and 'rest of Greater-Rijnmond' and for Den Bosch City and 'the rest North-East North-Brabant'. These regions have merged and are now known as: Greater Amsterdam, Greater Rijnmond and North-East North-Brabant. The data for 2000 thus consist of 43 regions instead of 40 regions in 2014. Because these regions have merged, their values can be calculated by simply summing the old regions' values.

4.2 The Results:

The in the following presented results consider the logistics industry and its subsectors in Belgium and The Netherlands. These are presented in the following order: first, tables with the number of establishments in the logistics industry and in the logistics subsectors are presented to give a first impression of the magnitude of the logistics sector and its subsectors. Secondly, Gini coefficients and Lorenz curves are shown in order to deliver an impression of the degree of industrial concentration. Thirdly, maps with the fractions of the number of establishments and Balassa Indices will be presented in order to define the location of the regions in which logistics firms tend to locate. Thereafter, all regions in which seaports are situated are compared to regions in which there are no seaports. Both absolute and relative values (calculated via Balassa Indices) are compared.

The logistics sector in Belgium and the Netherlands descriptive statistics:

As previously mentioned, in order to calculate the number of logistics establishments, several (sub)sectors must be added up. Table 5 summarises the total number of logistics establishments for Belgium and the Netherlands in 2000 and 2014. Furthermore, each subsector's share in the total number of logistics establishments is presented.

Table 5: The number of logistics establishments and logistics subsectors in Belgium and the Netherlands in 2000 and 2014:

	The number of establishments							
	Belgium				**The Netherlands**			
Subsector (NACE Rev.2 code):	***2000***	***Percentage***	***2014***	***Percentage***	***2000***	***Percentage***	***2014***	***Percentage***
Wholesale and Trade Agents (G46)	69155	83,5%	54788	81,5%	62125	77,9%	85660	81,2%
Rail Freight Transportation (H4920)	19	0,0%	22	0,0%	5	0,0%	5	0,0%
Road Freight Transportation (H4941)	9677	11,7%	8505	12,7%	10410	13,1%	10400	9,9%
Sea and Coastal Water Freight Transportation (H5020)	173	0,2%	265	0,4%	535	0,7%	640	0,6%
Inland Water Freight Transportation (H5040)	1349	1,6%	834	1,2%	3190	4,0%	3315	3,1%
Storage and Warehousing (H521)	429	0,5%	551	0,8%	690	0,9%	1820	1,7%
Cargo Handling (H5224)	445	0,5%	396	0,6%	380	0,5%	535	0,5%
Transportation Supporting Activities (H5229)	1562	1,9%	1864	2,8%	2390	3,0%	3135	3,0%
Total number of Logistics establishments	82809	100,0%	67225	100,0%	79725	100,0%	105510	100,0%
Total number of establishments (all sectors)	628537		834881		773340		1363250	

Data sources: StatBel and CBS.

From table 5, it follows that the logistics industry in Belgium consisted of 82809 establishments in 2000 and of 67225 establishments in 2014 whereas the Dutch logistics industry consisted of 79725 establishments in 2000 and of 105510 establishments in 2014. Furthermore, the table shows that when considering wholesale firms and trade agents to be logistics firms, the size of the logistics industry is predominantly determined by these firms. The second most comprehensive subsector is the road freight transportation sector.

Moreover, the bottom row represents the countries' total number of establishments. From these numbers it relatively easy to calculate the size of the logistics industry in both countries. It follows that the total logistics industry took on about eight percent of the total number of establishments in both countries in 2014. This percentage has been higher for both countries in the year 2000, where logistics establishments determined about thirteen percent of all establishments in Belgium and approximately ten percent in the Netherlands.

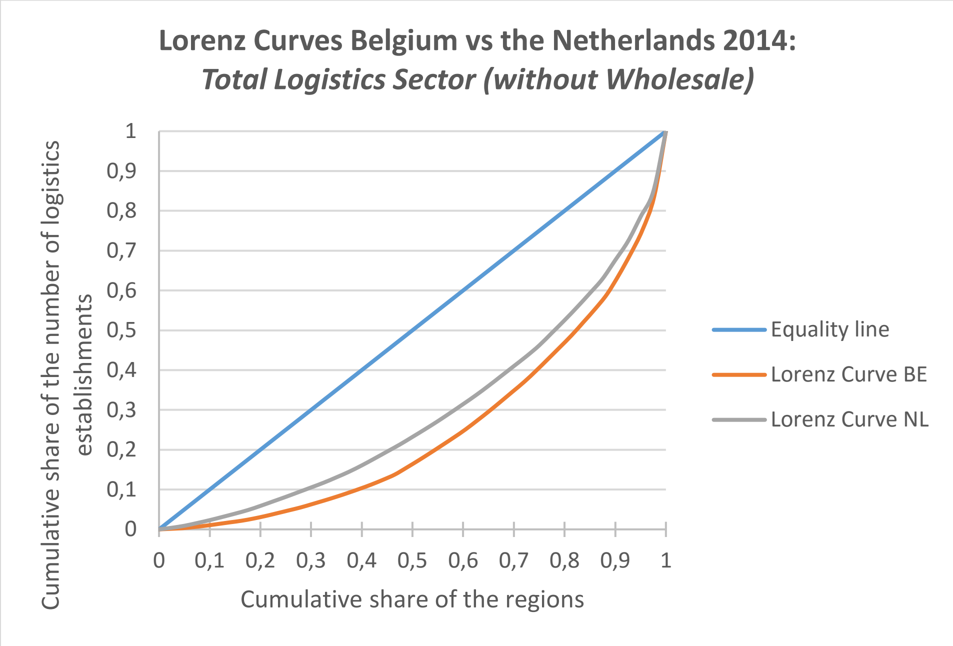
Furthermore, it is clearly visible in table 5 that the rail freight transportation sector consists of only a few firms in Belgium and the Netherlands. According to Railcargo (2015), this is caused by the former regulation of the rail freight market. Since the deregulation of the rail market, the number of rail freight transporting firms has surely increased. Because of this minority, the impact of the rail freight transportation sector on the results is negligible.

Moreover, the percentage of the number of sea and coastal water freight transportation firms in the total number of logistics firms is fairly similar for Belgium and the Netherlands, however, firms active in the transportation of freight via inland waterways seem to be taking on a more prominent role in the Dutch logistics industry compared to their Belgian counterparts. From the modal split, as it is calculated as the percentage of each inland mode in the total freight transport performance measured in tonne-kilometres, it follows that shipping over inland waterways takes on a more prominent role in the Netherlands than in Belgium. This might be an explanation of the relative and absolute differences between the number of establishments active in the movement of freight over inland waterways in Belgium and the Netherlands. Table D in the appendix summarises the modal split for Belgium and the Netherlands in 2000 and 2014.

Gini coefficients and Lorenz curves:

In order to study the degree of concentration of the logistics industry in Belgium and the Netherlands, Lorenz curves are constructed and Gini coefficients are calculated. Graph 3 is constructed to compare the degree of concentration of the logistics industry in Belgium with the degree of concentration in the Netherlands. Because of the predominance of the number of wholesaling firms and trade agents in the calculation of the number of logistics firms, the decision is made to present the Lorenz curves for the logistics industry without considering wholesale firms and trade agencies as being logistics firms. The Lorenz curve for the total logistics industry with the inclusion of wholesale firms and trade agencies can be found in graph A in the appendix.

Graph 3: Lorenz Curves Belgium and the Netherlands in 2014:



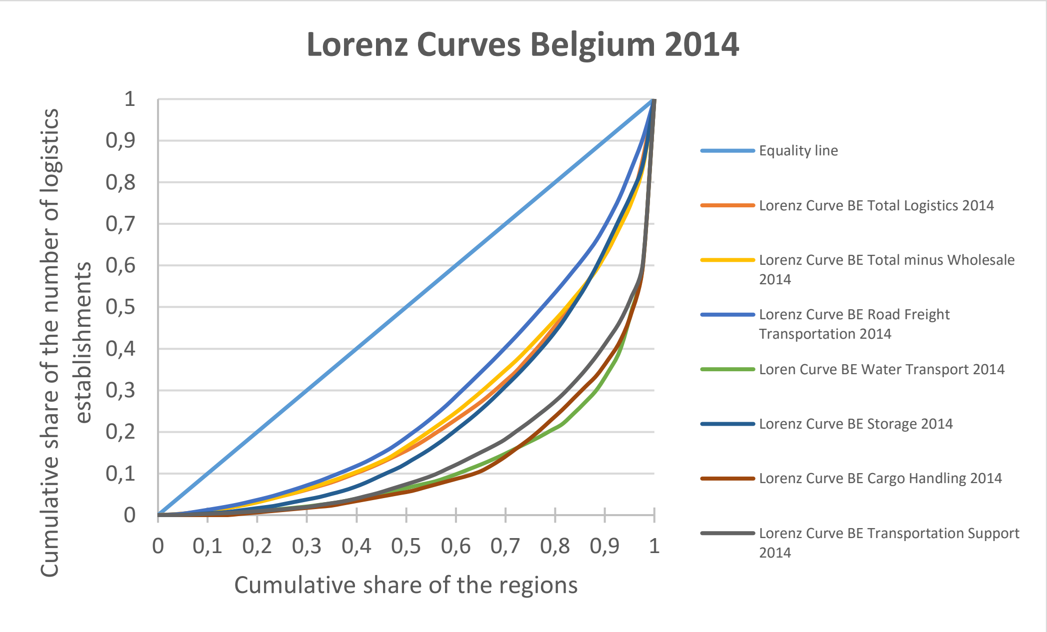
Data obtained from StatBel and CBS

The Lorenz curves in graph 3 indicate a more concentrated pattern for the logistics industry in Belgium than the logistics industry in the Netherlands. However, in the calculation and construction of these Lorenz curves, one should not underestimate that in these calculations the relative number of road freight transportation firms is high. Therefore, the Lorenz curves are predominantly determined by the location of road freight transportation firms. Since the road freight transportation sector seems to be the most evenly distributed subsector of all logistics subsectors, the Lorenz curves do not extremely curve away from the equality line. The resulting Gini coefficients, 0.50 for Belgium and 0.41 for the Netherlands, indicate that the logistics industry is somewhat concentrated in both countries.

It follows from the graph that in Belgium approximately 60% of the total number of logistics establishments is located in roughly 25% of the regions with the highest fractions of logistics establishments. Furthermore, it follows that approximately 16% of the total number of logistics establishments is located in roughly 50% of the regions with the lowest fractions of the number of logistics establishments. In the Netherlands the pattern is less extreme according to the approximate 54% of the total number of establishments that is located in roughly 25% of the regions with the highest fractions of logistics establishments and the 23% of the total number of establishments that is distributed over approximately 50% of the regions with the lowest fractions of the number of logistics establishments. These outcomes indicate that the logistics industry in the Netherlands is more evenly distributed than in Belgium.

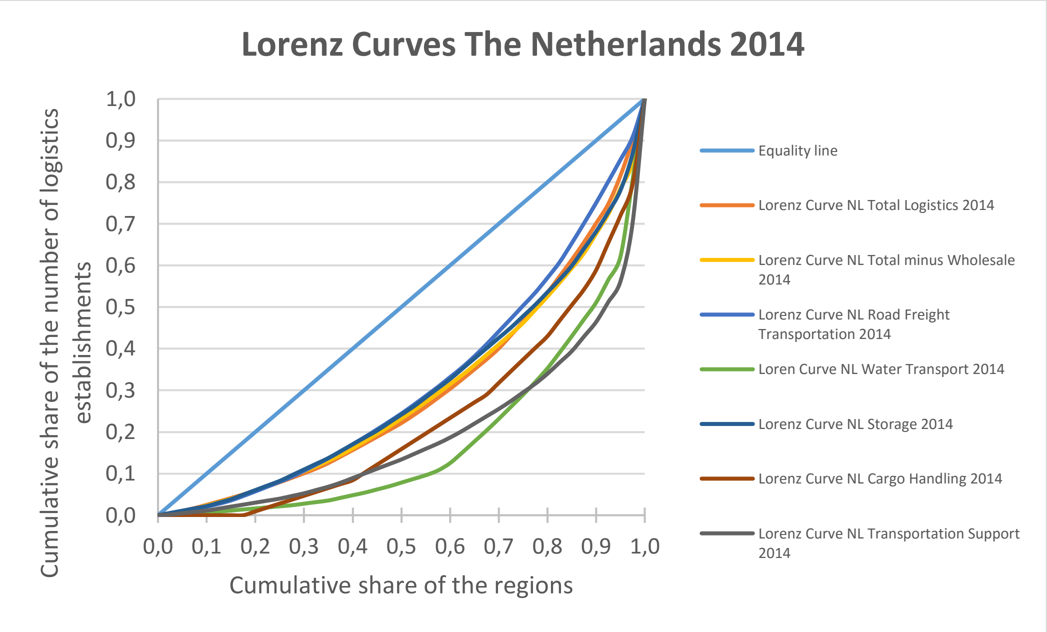
In order to visualise the differences in degree of concentration between the logistics subsectors and to limit the road freight transportation sector to dominate the results, graph 4, graph 5 and table 6 are constructed. In these graphs, firstly for Belgium and secondly for the Netherlands, Lorenz curves show the degree of concentration of each subsector for the year 2014. Thereafter, table 6 presents the corresponding Gini coefficients for both years. The graphs and tables visualise the results for the total logistics sector, the total logistics sector without considering wholesaling firms and trade agents and the subsectors road freight transportation, water transportation, storage and warehousing, cargo handling and transportation supporting activities.

Graph 4: Lorenz Curves per subsector for Belgium in 2014:



Data obtained from StatBel

Graph 5: Lorenz Curves per subsector for the Netherlands in 2014:



Data obtained from CBS

Table 6: Gini Coefficients 2000 and 2014 per (sub)sector for Belgium and the Netherlands:

Gini Coefficients Belgium and The Netherlands 2000 and 2014:				
	Belgium		**The Netherlands**	
(Sub)Sector:	**2000**	**2014**	**2000**	**2014**
Total Logistics Sector	0,525	0,514	0,420	0,406
Total Logistics Sector (minus wholesale)	0,506	0,501	0,420	0,410
Road Freight Transport	0,443	0,438	0,356	0,368
Water Transport	0,798	0,747	0,664	0,636
Storage	0,620	0,543	0,477	0,395
Cargo Handling	0,752	0,744	0,576	0,539
Transportation Supporting activities	0,717	0,704	0,698	0,610

Data obtained from StatBel and CBS

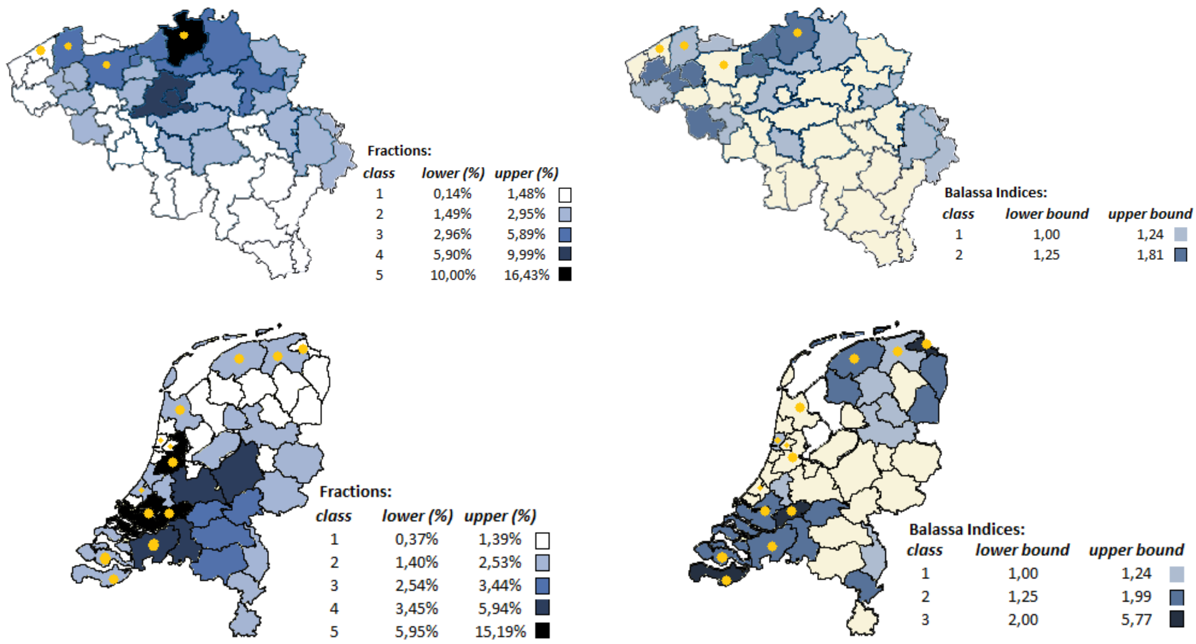
It is clear from graph 4 and 5 and from table 6 that the logistics industry in total cannot be argued to be highly concentrated. However, it follows that between the subsectors that form the total logistics industry major differences exist in the degree of concentration. The Lorenz curves that are least curved in graph 4 and 5 describe the road freight transportation sectors in both countries. These curves and the corresponding Gini coefficients of 0.44 for Belgium and 0.37 for the Netherlands for the year 2014, indicate that the road freight transportation sector is the most equally distributed subsector of all the logistics subsectors. Over time these Gini coefficients have remained relatively stable. Moreover, the storage and warehousing subsector seems to be the next least concentrated logistics subsector. Again, the Gini coefficients for Belgium of 0.54 and for the Netherlands of 0.40 indicate the pattern to be more concentrated in Belgium than in the Netherlands. Furthermore, these coefficients seem to have changed more than the other subsectors. Both, for Belgium and the Netherlands, the Gini coefficient has decreased over time, which indicates the storage and warehousing subsector to be more evenly distributed over the regions in 2014 than in 2000.

The other subsectors, freight transportation over water, cargo handling and transportation supporting activities seem to be the more concentrated logistics subsectors. Also for these subsectors, the Belgian curves curve more extremely away from the equality line than the Dutch curves, which is visible in graph 4 and graph 5 and in table 6 with the help of Gini coefficients. The Gini coefficient for 2014 of 0.54 for the cargo handling subsector in the Netherlands indicates a concentrated pattern. However, there is a major difference with the Belgian cargo handling subsector that seems to be highly concentrated, indicated by the Gini coefficient of 0.74. For both countries, the Gini coefficient slightly decreased, which indicates a pattern of de-concentration over time. That same pattern applies to the transportation supporting activities subsector and the water transportation subsector. From these, the water transportation subsector is the most concentrated subsector in both countries indicated by Gini coefficients of 0.75 and 0.64 in 2014 respectively. The transportation supporting activities subsector seems to be the second most concentrated subsector in the Netherlands indicated by a Gini coefficient of 0.61 and the third most concentrated subsector in Belgium indicated by a Gini coefficient of 0.70.

Mapping the logistics industry's fractions and Balassa Indices (2014):

It seems that the logistics industry is somewhat more concentrated in Belgium than in the Netherlands, but from their Gini coefficients of the total logistics industry it cannot be concluded that the logistics industry is highly concentrated in both countries. The drawback of the Gini coefficient is that it could only be used as a descriptive measure and not as an explanatory measure. A useful tool to enrich the Gini coefficient is the visualisation of the 'concentration' pattern. Therefore, the following maps are constructed in order to visualise the actual regions in which logistics firms tend to be located. In the these maps, the fractions of the number of logistics firms in each region are displayed as well as the Balassa Indices, which are used to describe a region's relative specialisation in logistics activities. In the construction of the maps, the number of wholesale firms and trade agents is omitted because of its potential domination of the results[2]. The regions in which seaports are situated are highlighted with the orange dots[3].

Map 1: Total Logistics Sector (without wholesale establishments and trade agents) in Belgium and the Netherlands 2014, fractions left, Balassa Indices right:



In Belgium, it follows from the upper left map that the Antwerp-Brussels axis, the Antwerp-Bruges axis and the Antwerp-Genk axis seem to be the most important logistics regions in Belgium. It is clear from this map that the southern Wallonian regions do not attract a great proportion of logistics firms. The Balassa Indices in the upper right map indicate the region of Antwerp and its neighbouring arrondissement Sint-Niklaas, Dendermonde, Roeselare, Diksmuide, Moeskroen, Tielt and Tournai to be the regions to contain a more than proportionate share of logistics establishments.

[2] For the maps visualising the total logistics industry with wholesale firms and trade agents, see Map A in the appendix.
[3] For a table containing all the regions in which seaports are situated see table E and F in the appendix.

In the Netherlands, the greatest fractions of logistics firms can be found in the Greater Rijnmond region and in the Greater Amsterdam region. Furthermore, great concentrations can be found in North Brabant, Utrecht and in Gelderland. However, it should be noted that this result is partly affected by the great number of road freight transportation establishments in Utrecht and Gelderland, which also follows from map C in the appendix. Considering the relative speciality of regions, South-East South-Holland, Zeeuwsch-Vlaanderen and Delfzijl and its surroundings seem to be the most specialised regions in the Netherlands, as they all have Balassa Indices exceeding the second cut-off point of 2.00. Moreover, it follows that the relatively specialised regions tend to be located in the south-western part of the Netherlands, the north-eastern part of the Netherlands and in the south-eastern province Limburg.

Comparing regions with a seaport with regions without a seaport:

In order to answer the question whether there are more logistics activities in seaport areas than in the seaports' hinterlands, all seaports in Belgium and the Netherlands are identified following the identification of seaports by Van der Lugt et al. (2015) for the Netherlands and Merckx and Neys (2015) for Belgium. Tables E and F in the appendix summarise the seaports, eventually the seaport's area name and the region in which they are situated. The identification of the seaports and their corresponding regions enables the calculation of the number of logistics establishments in regions with a seaport and in regions without a seaport. This calculation enables the comparison of both absolute and relative numbers of establishments, which should indicate whether there are more logistics activities in seaport areas or not and how this pattern has changed over the researched time period. In the following tables 7 and 8, the absolute and the relative growth of the number of logistics establishments in regions with and without a seaport is described for Belgium. Thereafter, in table 9 and in table 10, the absolute and relative growth of the number of logistics establishments in the Netherlands is described.

Table 7: The number of establishments and the absolute growth of the number of logistics establishments in seaport regions and non-seaport regions in Belgium:

(Sub)Sector: Total Logistics	***Seaport Areas***	***Percentage***	***Areas Without a Seaport***	***Percentage***	***Total***
2000	19998	24,2%	62810	75,8%	82809
2014	16185	24,1%	51040	75,9%	67225
Average annual percent growth:	-1,50%		-1,47%		-1,48%
(Sub)Sector: Total Logistics (minus Wholesale)	***Seaport Areas***	***Percentage***	***Areas Without a Seaport***	***Percentage***	***Total***
2000	3809	27,9%	9844	72,1%	13654
2014	3327	26,8%	9110	73,2%	12437
Average annual percent growth:	-0,96%		-0,55%		-0,66%
(Sub)Sector: Road Freight	***Seaport Areas***	***Percentage***	***Areas Without a Seaport***	***Percentage***	***Total***
2000	1670	17,3%	8007	82,7%	9677
2014	1419	16,7%	7086	83,3%	8505
Average annual percent growth:	-1,16%		-0,87%		-0,92%
(Sub)Sector: Water Transport	***Seaport Areas***	***Percentage***	***Areas Without a Seaport***	***Percentage***	***Total***
2000	988	65,0%	533	35,0%	1522
2014	676	61,5%	423	38,5%	1099
Average annual percent growth:	-2,68%		-1,64%		-2,30%
(Sub)Sector: Storage	***Seaport Areas***	***Percentage***	***Areas Without a Seaport***	***Percentage***	***Total***
2000	122	28,4%	307	71,6%	429
2014	132	24,0%	419	76,0%	551
Average annual percent growth:	0,56%		2,25%		1,80%
(Sub)Sector: Cargo Handling	***Seaport Areas***	***Percentage***	***Areas Without a Seaport***	***Percentage***	***Total***
2000	245	55,1%	200	44,9%	445
2014	204	51,5%	192	48,5%	396
Average annual percent growth:	-1,30%		-0,29%		-0,83%
(Sub)Sector: Transportation Support	***Seaport Areas***	***Percentage***	***Areas Without a Seaport***	***Percentage***	***Total***
2000	783	50,1%	779	49,9%	1562
2014	891	47,8%	973	52,2%	1864
Average annual percent growth:	0,93%		1,60%		1,27%

In this table it is visible that if one considers wholesale firms and trade agents to be part of the logistics industry, approximately 24% of all logistics establishments are located in the four regions in which seaports are situated. In the case the logistics industry is perfectly evenly distributed over the regions, it would mean that approximately 9% of all the logistics establishments should be located in the four seaport areas. The outcome of approximately 24% of the total of logistics establishments to be located in seaport areas thus indicates that on average there are approximately 2.6 times more logistics establishments in the Belgian seaport areas than there would be in a situation in which the industry is distributed evenly over the regions. As follows from the annual percentage growth, the number of logistics firms decreased in both in seaport regions and in regions without a seaport at almost the same rate. Furthermore, when considering wholesale firms and trade agents not to be part of the logistics industry, it follows that the percentage of logistics establishments that is located in seaport areas is somewhat higher. The growth rate is negative, both in seaport regions as well as in regions without a seaport, but the difference is small.

From graph 4, graph 5 and table 6, it followed that the road freight transportation subsector and the warehousing and storage subsector where the least concentrated logistics subsectors in Belgium and the Netherlands. From table 7 it follows that these both subsectors tend to be less predominantly located in seaport areas than the other subsectors. Approximately 17% of all road freight transportation establishments are located in the seaport areas Oostende, Bruges, Ghent and Antwerp. The average percentage growth of road freight transportation firms is negative for the regions with as well as the regions without a seaport. However, this effect is only small. The storage and warehousing subsector is more predominantly located in the in regions with a seaport indicated by the approximate 24% of all warehousing and storage establishments being located in these regions. Growth in the number of storage and warehousing establishments is positive, however it seems that the number of warehousing and storage firms is growing at a higher rate in non-seaport regions than in regions with a seaport.

The cargo handling subsector, the transportation supporting activities subsector and the water transportation subsector have been constituted to be more concentrated than the other subsectors. It follows from table 7 that these activities tend to be concentrated in seaport areas. Out of the total of all firms transporting freight over water, approximately 62% seems to be located in seaport areas. Growth in the number of these establishments is negative and seems to be more negative in seaport regions than in non-seaport regions. Furthermore, of all firms active in the handling of cargo, approximately 52% was located in seaport areas in 2014. The number of cargo handling establishments has decreased over time, however it decreased at a higher rate in seaport areas than in areas without a seaport. At last, approximately 48% of the firms performing transportation supporting activities has been located in seaport areas in 2014. The number of firms performing transportation supporting activities has increased over time. The growth rate in regions without a seaport seems to be higher than the growth rate in areas with a seaport.

Table 7 described the absolute number of establishments in regions with and regions without a seaport and the average annual growth rate over time. Table 8 will summarise the relative number of logistics establishments, calculated via the Balassa Index. Furthermore, it will summarise the average annual growth rate of this Balassa Index.

Table 8: Relative growth of the number of logistics establishments in seaport regions and non-seaport regions in Belgium (Balassa Index and the growth of the Balassa Index):

(Sub)Sector: Total Logistics	***Seaport Areas***	***Areas Without a Seaport***
2000	1,24	0,94
2014	1,21	0,95
Average annual percent growth:	-0,14%	0,04%
(Sub)Sector: Total Logistics (minus Wholesale)	***Seaport Areas***	***Areas Without a Seaport***
2000	1,43	0,90
2014	1,35	0,91
Average annual percent growth:	-0,42%	0,14%
(Sub)Sector: Road Freight	***Seaport Areas***	***Areas Without a Seaport***
2000	0,88	1,03
2014	0,84	1,04
Average annual percent growth:	-0,36%	0,08%
(Sub)Sector: Water Transport	***Seaport Areas***	***Areas Without a Seaport***
2000	3,32	0,44
2014	3,10	0,48
Average annual percent growth:	-0,51%	0,70%
(Sub)Sector: Storage	***Seaport Areas***	***Areas Without a Seaport***
2000	1,46	0,89
2014	1,21	0,95
Average annual percent growth:	-1,34%	0,46%
(Sub)Sector: Cargo Handling	***Seaport Areas***	***Areas Without a Seaport***
2000	2,82	0,56
2014	2,59	0,61
Average annual percent growth:	-0,59%	0,57%
(Sub)Sector: Transportation Support	***Seaport Areas***	***Areas Without a Seaport***
2000	2,57	0,62
2014	2,41	0,65
Average annual percent growth:	-0,46%	0,36%

The 2014 outcome for the Balassa Index (1.24) does indicate that the regions with a seaport in Belgium are relatively specialised in logistics activities. However, as discussed, a Balassa Index that exceeds 1.00 indicates the relative specialisation of a region in a particular industrial activity, but a value must exceed the 1.25 cut-off point or the 2.00 cut-off point to be more certain about the clustering of logistics activities. The Balassa Index calculated for regions without a seaport equals 0.95 in 2014, which means that these regions are on average not specialised in logistics activities when considering wholesale firms and trade agents to belong to the logistics industry. Moreover, the growth rate of the Balassa Index is positive in regions without a seaport and negative in regions with a seaport. However, these effects seem to be small.

It follows from the Balassa Index for the total logistics industry, without considering wholesaling firms and trade agents, that the relative specialisation of regions with a seaport increases compared to the situation in which wholesale firms and trade agents where considered to be logistics firms. The 2000 and the 2014's

Balassa Indices exceed the first cut-off point of 1.25, which increases the likelihood that indeed logistics activities tend to be clustered in seaport areas. Also this Balassa Index decreased over time for the seaport regions and increased slightly for the regions without a seaport. However, the effects are small as well.

Considering the Gini coefficients presented in table 6, a low Balassa Index for regions with a seaport for the transportation of freight over roadways, does not come at a surprise. A Balassa index of 0.84 in 2014 implies that the regions with a seaport on average have a less than proportionate share in the total number of establishments in the road freight transportation industry. Regions without a seaport score average with a Balassa Index of 1.04. Again, the same pattern of a negative growth rate for the relative specialisation of seaport regions and a positive growth rate for the relative specialisation of regions without a seaport is visible, but the effects are small. Furthermore, besides the road freight transportation subsector, the storage and warehousing industry is also argued to be less concentrated than the other subsectors. This subsector seems to be more than proportionally existent in regions with a seaport, indicated by the Balassa Index of 1.21 in 2014. However, as follows from the table, the relative specialisation of regions with a seaport in storage and warehousing seems to have diminished over time, which is indicated by the negative annual percentage growth of 1.34%. Regions without a seaport on average seem to have gained a slightly more proportionate share in the total number storage and warehousing establishments.

As might be expected, the transportation of freight over water, cargo handling and transportation supporting activities, seem to be the activities that are most frequently located in seaport areas. Balassa Indices for 2014 of 3.10 for the water transportation subsector, 2.59 for the cargo handling subsector and 2.41 for the transportation supporting activities subsector, indicate the relative specialisation of seaport regions in these activities. Their relative specialisation seems to decrease over time, however, from their Balassa Indices one might expect these activities to be frequently clustered in seaport areas.

For Belgium it seems that in absolute and in relative terms, the water transportation subsector, the cargo handling subsector and the transportation supporting activities subsector, are more frequently located in seaport regions than in regions without a seaport. Storage and warehousing establishments are more evenly distributed than these subsectors, but on average seaport regions seem to house a more than proportionate share of them as well. However, seaport regions seem to house a less than proportionate share of establishments in the road freight transportation subsector. In conclusion, it follows from table 8 that regions without seaports on average have gained a slightly more proportionate share of the total number of logistics firms over time. In the following, the results for the Netherlands will be presented.

Table 9: Absolute growth of the number of logistics establishments in seaport areas and non-seaport areas in the Netherlands:

(Sub)Sector: Total Logistics	Seaport Areas	Percentage	Areas Without a Seaport	Percentage	Total
2000	32850	41,2%	46875	58,8%	79725
2014	41415	39,3%	64095	60,7%	105510
Average annual percent growth:	1,67%		2,26%		2,02%
(Sub)Sector: Total Logistics (minus Wholesale)	Seaport Areas	Percentage	Areas Without a Seaport	Percentage	Total
2000	8575	48,7%	9025	51,3%	17600
2014	9540	48,1%	10310	51,9%	19850
Average annual percent growth:	0,76%		0,96%		0,86%
(Sub)Sector: Road Freight	Seaport Areas	Percentage	Areas Without a Seaport	Percentage	Total
2000	3785	36,4%	6625	63,6%	10410
2014	3855	37,1%	6545	62,9%	10400
Average annual percent growth:	0,13%		-0,09%		-0,01%
(Sub)Sector: Water Transport	Seaport Areas	Percentage	Areas Without a Seaport	Percentage	Total
2000	2460	66,0%	1265	34,0%	3725
2014	2475	62,6%	1480	37,4%	3955
Average annual percent growth:	0,04%		1,13%		0,43%
(Sub)Sector: Storage	Seaport Areas	Percentage	Areas Without a Seaport	Percentage	Total
2000	330	47,8%	360	52,2%	690
2014	915	50,3%	905	49,7%	1820
Average annual percent growth:	7,56%		6,81%		7,17%
(Sub)Sector: Cargo Handling	Seaport Areas	Percentage	Areas Without a Seaport	Percentage	Total
2000	255	67,1%	125	32,9%	380
2014	360	67,3%	175	32,7%	535
Average annual percent growth:	2,49%		2,43%		2,47%
(Sub)Sector: Transportation Support	Seaport Areas	Percentage	Areas Without a Seaport	Percentage	Total
2000	1740	72,8%	650	27,2%	2390
2014	1930	61,6%	1205	38,4%	3135
Average annual percent growth:	0,74%		4,51%		1,96%

In the Netherlands, according to van der Lugt et al. (2015), thirteen COROP regions consist of a seaport. This means that if activities are perfectly evenly distributed, in total a fraction of approximately 33% must be located in the regions with a seaport. From table 9 it becomes clear that the percentage of the total number of logistics firms is higher than this average, namely about 39% in 2014. Furthermore, it follows that the number of logistics firms positively grows in both, regions with and without a seaport. However, the average annual percent growth rate seems to be higher for regions without a seaport. The same growth pattern is visible when wholesale firms and trade agents are considered not to be part of the logistics industry. In this situation, the fraction of logistics establishments being located in seaport regions is somewhat larger as follows from the approximate 48% of the logistics firms being located in seaport regions in 2014.

Moreover, it follows that the road freight transportation sector tends to be less predominantly located in seaport regions than the other subsectors. Approximately 37% of all road freight transportation establishments are located in the seaport regions, which is slightly higher than would be the case if the firms where perfectly evenly distributed. Moreover, the number of road freight transportation firms located in regions with a seaport increased over time, while the number of road freight transportation firms located in regions without seaports has declined. However, the effects are small. The storage and warehousing subsector in the Netherlands shows that approximately 50% of all of the subsector's firms are located in regions with a seaport in 2014[4]. The growth in the number of storage and warehousing firms is positive and somewhat stronger for seaport regions than for regions without a seaport.

Similar to the situation in Belgium, the cargo handling subsector, the transportation supporting activities subsector and the water transportation subsector tend to be relatively overrepresented logistics subsectors in regions with a seaport in the Netherlands. Out of the total of all water transportation establishments, approximately 63% seems to be located in seaport regions in the year 2014. Growth in the number of these establishments is positive and seems to be more positive in non-seaport regions than in seaport regions. Moreover, of all firms active in the handling of cargo, approximately 67% was located in seaport regions in 2014. The number of this subsector's establishments has increased over time and the growth rate is approximately similar for seaport regions and non-seaport regions. At last, approximately 62% of the firms performing transportation supporting activities have been located in seaport regions in 2014. Despite that the number of firms performing transportation supporting activities has increased over time, the growth of the number of establishments in non-seaport regions seems to be more significant than the growth in seaport regions.

It is argued that in absolute terms, the cargo handling, the water transportation and the transportation supporting activities subsector are logistics subsectors that are more predominantly located in regions with a seaport in the Netherlands. Table 10 will discuss the relative specialisation in logistics activities of regions with a seaport and regions without a seaport.

[4] It should be noted that in the Netherlands thirteen regions are considered to have a seaport, while Belgium only counts four regions with a seaport. Therefore the absolute numbers in table 9 might be more extreme than the ones in table 7.

Table 10: Relative growth of the number of logistics establishments in seaport areas and non-seaport areas in the Netherlands (Balassa Index and the growth of the Balassa Index):

(Sub)Sector: Total Logistics	***Seaport Areas***	***Areas Without a Seaport***
2000	1,09	0,94
2014	1,00	1,00
Average annual percent growth:	-0,62%	0,41%
(Sub)Sector: Total Logistics (minus Wholesale)	***Seaport Areas***	***Areas Without a Seaport***
2000	1,29	0,82
2014	1,23	0,85
Average annual percent growth:	-0,37%	0,26%
(Sub)Sector: Road Freight	***Seaport Areas***	***Areas Without a Seaport***
2000	0,96	1,02
2014	0,95	1,03
Average annual percent growth:	-0,14%	0,09%
(Sub)Sector: Water Transport	***Seaport Areas***	***Areas Without a Seaport***
2000	1,75	0,55
2014	1,60	0,62
Average annual percent growth:	-0,66%	0,87%
(Sub)Sector: Storage	***Seaport Areas***	***Areas Without a Seaport***
2000	1,27	0,84
2014	1,28	0,82
Average annual percent growth:	0,08%	-0,17%
(Sub)Sector: Cargo Handling	***Seaport Areas***	***Areas Without a Seaport***
2000	1,78	0,53
2014	1,72	0,54
Average annual percent growth:	-0,25%	0,13%
(Sub)Sector: Transportation Support	***Seaport Areas***	***Areas Without a Seaport***
2000	1,93	0,44
2014	1,57	0,63
Average annual percent growth:	-1,46%	2,68%

The 2014 Balassa Index outcome of 1.00 for the total logistics industry indicates the logistics industry not to be more than proportionally located in seaport regions than in regions without a seaport. It follows that the Balassa Index for regions without a seaport equals the value for regions with a seaport. Differences occur when the total number of logistics establishments is calculated without considering wholesale firms and trade agents to be logistics firms. In this scenario the seaport regions' Balassa Index of 1.23 for the year 2014 seems to indicate a more than proportionate share of seaport regions in the total number of logistics establishments. The 2014 Balassa Index for regions without a seaport is below 1.00, which indicates the logistics industry to be on average less than proportionally existent in these areas. The relative specialisation of regions without a seaport seems to have increased over the researched time period in comparison to the regions with a seaport, however, the effects are small.

The Balassa Indices for the road freight transportation sector show that this sector is neither significantly more than proportionately existent in seaport regions neither in regions without a seaport. Furthermore, the growth rate for the Balassa Index in seaport regions is negative while in regions without a seaport it is positive, however these effects are small.

The water transportation subsector, the storage and warehousing subsector, the cargo handling subsector and the transportation supporting activities subsector all show Balassa Indices that are above the first cut-off value of 1.25. When comparing these indices with the indices found for Belgium, it follows that the values for the Netherlands are less extreme than the values found for Belgium. This might be caused by the fact that the number of areas with a seaport is larger in the Netherlands than in Belgium and differences between the size of the ports within the Netherlands are large. However, regions with a seaport seem to house a more than proportionate share of the number of establishments active in the transportation of freight over water, cargo handling and transportation activities. The Balassa Index for establishments active in storage and warehousing is less extreme, however it is still above the first cut-off point (of 1.25). Furthermore, the specialisation of regions with a seaport in storage and warehousing activities seems to have increased over time, while for water transportation and cargo handling the specialisation of regions with a seaport has diminished slightly. Regions without a seaport seem to have increased the specialisation in transportation supporting activities, indicated by the approximate 3% growth of the Balassa Index.

In the Netherlands, it seems that in absolute and in relative terms, the water transportation subsector, the cargo handling subsector and the transportation supporting activities subsector, seem to be more than proportionately located in seaport regions than in regions without a seaport. Storage and warehousing establishments are more evenly distributed than these subsectors, but these are still more than proportionately located in seaport regions than in regions without a seaport. However, seaport regions seem to house a moderate proportionate share of establishments in the road freight transportation subsector.

Concluding remarks concerning the results:

This study attempts to identify the location pattern of logistics firms with the help of Balassa Indices, Gini coefficients and choropleth maps. Firstly, the Gini coefficients indicate the logistics industry to be somewhat more concentrated in Belgium than in the Netherlands. However, considering the Gini coefficients for the total logistics industry, 0.51 for Belgium and 0.41 for the Netherlands in 2014, it cannot be concluded that the industry is highly concentrated in both countries. Further studying the subsectors that form the logistics industry indicates that the subsectors road freight transportation and wholesale firms and trade agents due to their size are important determinants of the results. It follows that these subsectors are also on average more evenly distributed over the regions than the other subsectors storage and warehousing, cargo handling, water transport and transportation supporting activities. Moreover, it follows that the logistics industry in total, as well as most of the subsectors, experience declining Gini coefficients over the researched time period, which indicates a pattern of de-concentration.

Considering the maps, it follows that in Belgium logistics firms concentrate in the Antwerp arrondissement, the region Brussels and its surroundings and along the axis connecting them. Furthermore, great fractions of logistics firms can be found in seaport regions Bruges and Gent, the arrondissements along the Antwerp-Bruges axis and the arrondissements along the Antwerp-Genk axis. Southern Wallonian arrondissements seem to attract far smaller fractions of logistics firms. Moreover, in the Netherlands the greatest fractions of logistics firms are found in the Greater Rijnmond region and the Greater Amsterdam region. Furthermore, Utrecht and regions in North Brabant, Gelderland and Limburg seem to attract a great fraction of logistics firms as well.

Thereafter, the number of logistics firms in regions with and regions without seaports have been compared. It follows from these results that in absolute and relative terms, the logistics industry is somewhat overrepresented in regions with a seaport in Belgium according to the 24% of the number of logistics firms that is located in these regions and the Balassa Index of 1.21 for regions with a seaport. The road freight transportation sector is the subsector that is the least overrepresented subsector (and is even relatively underrepresented) in regions with a seaport according to the Balassa Index of 0.84 for the year 2014. The storage and warehousing subsector is according to the approximate 24% of these firms that is located in regions with seaports and the Balassa Index of 1.21 for the year 2014, the next least overrepresented subsector in regions with a seaport. Despite the Balassa Index not reaching above the first cut-off point of 1.25, the absolute and relative fraction indicate a slight overrepresentation in regions with a seaport. From the results, it can be concluded that the other subsectors (water transportation, cargo handling and transportation support) are significantly overrepresented in regions with a seaport. These results are more or less the same, but less extreme for the Netherlands. However, it follows that when including wholesale firms and trade agents in the calculations, the Balassa Index for the logistics industry of 1.00 for the year 2014, does not show a concentration pattern in regions with, nor it shows a concentration pattern in regions without a seaport.

Differences between the growth rate of the number of logistics firms in regions with and regions without a seaport one are on average small. In Belgium, the number of logistics establishments decreased over the researched time period. It follows from the tables 7 and 8 that in case of a decreasing number of establishments in a certain subsector, the decline is on average less extreme for regions without a seaport and more positive in the case of an increasing number of establishments in that particular subsector. Furthermore, the on average increasing Balassa Index for regions without a seaport indicates a relative decrease in the overrepresentation of logistics establishments in regions with seaports. However, these effects are small. In the Netherlands, the number of logistics establishments has grown over the researched time period. From the tables 9 and 10 is follows that the road freight transportation sector and the cargo handling sector on average grew at a slightly higher rate in regions with a seaport, while the water transportation and the transportation supporting subsector grew at a higher rate in regions without a seaport. On average, the growing Balassa Indices for all subsectors except for the storage and warehousing subsector indicate the slight increase in the specialisation of regions without seaports in logistics activities. The most remarkable growth is the growth of the transportation supporting activities subsector in areas without a seaport. The other differences in the growth rates are less significant.

4.3 Interpretation of the results:

The theoretic framework of this study has provided insights in the location patterns of logistics firms. Seaports are argued to be attractive locations for logistics firms because of the infrastructure available in seaports, the access they provide to markets and resources and the possibility firms might experience from the agglomeration of logistics firms in seaports. Therefore, it is expected in the theory that logistics firms are overrepresented in regions with a seaport. However, besides deciding to locate logistics activities in seaports, logistics firms have the decision to locate their activities on strategic inland locations as well. The theory has described factors such as lower land prices and rents, greater availability of land, proximity to consumer markets and lower road congestion as attractive factors for logistics firms to locate their facilities further inland. Therefore, it is expected that logistics firms have increasingly established themselves on strategic inland locations over the researched time period.

The theory expected great fractions of logistics firms in regions with seaports and in the more populated and industrialised regions. According to the maps in appendix A and B, this expectation seems to be correct as the greatest fractions correspond to the most densely populated and industrialised regions in the Netherlands as well as in Belgium. In the Netherlands, great fractions could be found in the Randstad area and in Belgium the area around Brussel could be identified. Furthermore, the seaport in Ghent, Zeebrugge and obviously Antwerp and Rotterdam attract a significant fractions of logistics firms. Moreover, the concentrations in the Liege and Hasselt area could be explained because of the demand for transportation and logistics services that arises because of industrial activities. Also from the relative concentrations (Balassa Indices), several regions indicate a great demand for logistics services as a result of its strong industrial base. An example is the relative concentration in the south of West-Vlaanderen, which for instance has a strong food industry. This results in a great fraction of wholesale firms and road freight transportation firms active in the wholesale and distribution of food (Statbel, 2016; Rebel Group Advisory, 2010). The CBS (2011) constitutes that in the Netherlands the most industrialised zones besides the Randstad area could be found in the alley between Bergen op Zoom and Nijmegen/Arnhem and in the areas surrounding Eindhoven, Enschede and in the south along the Meuse river. In appendix A, these regions seem to fairly correspond to the regions that attract the greatest fractions of logistics firms.

In table 6, the declining Gini coefficients indicated a de-concentration pattern for the logistics industry and practically all of its subsectors. By calculating the differences between the Balassa Indices for the total logistics industry over the researched time period, it follows that significant differences occur in the regions Utrecht, Rotterdam, Amsterdam, Antwerp, Halle Vilvoorde, Brussels and Ghent. For both countries, these regions are calculated to be in the top five when it comes to decreasing Balassa Indices. Because of the predominance of wholesale firms in the calculations, this relative stagnation might be explained by the suburbanisation trend that is experienced in the wholesale and distribution sector as is presented by Weterings (2014) and Strale (2015). At the regional level, logistics centres and wholesale facilities are primarily located at sites in proximity to important transport corridors through which consumption and industrial markets are easily accessible and where the availability of land against lower prices is more likely to be found. It follows from the report published by Cushman and Wakefield (2009) that these regions perform poorly when it comes to congestion, land prices and land availability. Examples of regions that experience the greatest increase in the Balassa Indices are Tielt, Moeskroen, Zuid-Oost Drenthe and Twente. Despite that the regions Tielt and Moeskroen are not actually considered in the Cushman and Wakefield (2009), the relative growth in the number of logistics firms could be explained by greater availability of land against lower prices and less congested roadways.

Road freight transportation firms:

Although congestion on roadways will affect the efficiency of the services provided by road freight transportation firms, the greatest fractions of these firms are found in the most populated regions. These areas do not only provide access to consumer markets, also road density is argued to be greater in these regions which partly compensates for congestion problems (Van den Heuvel et al., 2014a). This clearly ensures firms flexibility since more roadways are quickly accessible (Cushman and Wakefield, 2009). According to ABN AMRO (2011), the main sectors demanding road freight transportation services are the construction, the industrial and the retail sector. According to the CBS (2015) the greatest fraction of the total weight that is transported is loaded and unloaded in the Greater Rijnmond region. This fraction is obviously partly determined by the amount of freight that is loaded in the Port of Rotterdam. For the construction and industrial sectors the Port of Rotterdam provides access to materials such as metals and minerals and it provides the retail and consumption sector access to goods such as textiles, electronic but also various types of food. Besides being the origin of a great proportion of the loads, the Greater Rijnmond region obviously serves as an important industrial and consumption area as well.

It is constituted by the CBS (2015) that road freight transportation is mainly used for domestic transportation, which clarifies the great fractions in the Netherlands in the Randstad area as well as in central regions such as South-West Gelderland and de Veluwe. The Randstad offers access towards the most densely populated and industrialised regions while these central locations offer firms the possibility to supply a sizeable market area in the Netherlands. The firms in the regions in North Brabant and Limburg consider parts of Germany and Belgium as their market area as well. This also counts for the regions in the southern part of West-Vlaanderen who consider Northern France, with for instance Lille as an important consumption and industrial market, as their market area.

Storage and Warehousing firms:

It is explained in the theory that distribution strategies are tailored to the logistics characteristics of the product. This is for instance indicated by the location pattern of logistics firms that are involved in the storage of cargo. This subsector could be divided into firms that operate tanks and silos that enable the storage of all kinds of bulk goods, firms that operate refrigerated warehouses to store fresh products and firms operating general warehouses. It follows from CBS (2016) that most of the firms operating tanks and silos are located in the regions with seaports. The most likely explanation is the availability of infrastructure in seaports such as tanks and the possibility to further transfer the cargo by all sorts of transport modes. Moreover, the firms active in the storage of products in refrigerated and general warehouses are distributed more evenly, however there are still considerable fractions found in seaports (see appendix E).

In the theory it is argued that great connections to mainports and consumer markets are important prerequisites for inland locations to become attractive locations for logistics purposes. Moreover, it is argued that the growing container traffic asks for efficient hinterland links to relieve seaports from congestion forces. According to Vanelslander et al. (2015) the development and implementation of extended gates enhances the responsiveness to demand changes in the hinterland since these sites are normally located in closer proximity to shippers. Furthermore, freight could be consolidated and bundled, which enhances efficiency in transportation and enables the use of more sustainable transport modes. The Flanders Extended gate concept is an example of an initiative to relieve the Port of Antwerp from congestion by providing efficient connections between the port and prime logistics locations along the Albert Canal such as Genk and in proximity to rivers that connect with the Scheldt river in the South of West-Vlaanderen in the regions Roeselare and Moeskroen. Multimodal platforms in these regions provide great connections with the port of Antwerp and European consumption markets (Rebel Group Advisory, 2010).The attention paid to this project and the investments made by the government indicate the support by the authorities. Their support and investments improved the available infrastructure, which enhanced the efficiency in transportation. More intense use of these extended gates increase the demand for storage facilities which explains the relative increase in the number of storage and warehousing firms in regions such as Hasselt, Moeskroen, Tournai and Kortrijk. In the Netherlands the relative growth in the number of storage and warehousing firms in Northern Limburg might be explained because of the development of the extended gate in Venlo as well. Furthermore, the relative concentration of warehousing and storage firms in Flevoland could be explained because of its buffer function for the Port of Amsterdam and especially for Schiphol Airport. Flevoland has a greater availability of space against more reasonable prices which increases the region's attractiveness for facilities that require large plots of space (CBRE, 2011).

Freight transporting freight over water, cargo handling firms and firms performing transportation supporting activities:

Although the total logistics industry cannot be considered to be significantly overrepresented in regions with seaports (according to tables 8 and 10), the results for some logistics activities seem to be quite significant. It follows from table 8 and 10 that freight transporting firms over water, cargo handling firms and firms performing transportation supporting activities are overrepresented in seaports. The in the theory mentioned location factors for logistics companies to locate their activities in seaports seem to be applicable to these subsectors. Firms transporting freight over inland waterways and railway, but also cargo handling firms require infrastructure to perform their activities such as terminals, quays, cranes and areas to stack containers or other types of freight. The great concentrations of these firms in seaports can therefore be explained by the availability of infrastructure. Furthermore, it is likely that firms benefit from agglomeration economies resulting the great concentrations of logistics activities and other logistics firms in seaports, for instance in the form of supplier-client relationships that occur between them. Also firms performing transportation supporting activities are likely to be found in seaport areas because of the clustering of logistics activities. Proximity to important transportation nodes increases the efficiency in the coordination of their activities. Furthermore, it is likely that the demand for their services such as customs clearance, the organisation of inland transportation operations, the forwarding of freight and the issue and procurement of transport documents is high at the most important transport nodes. All in all, proximity is considered to strengthen relationships between logistics companies and is considered to enhance cooperation (Van den Heuvel et al., 2014a). Vanoutrive and Verhetsel (2014) constitute in their study to the location factors for logistics firms in Belgium that many supplier-client relationships exist in the Belgian seaports.

Besides their presence in seaports, cargo handling companies and firms active in the freight transportation over inland waterways are found in regions that are crossed by some well-known inland waterways such as the Albert Canal, the Scheldt river, the Meuse and the Rhine. In appendix D and E, concentrations in the Belgian hinterland appear in Liege, Brussels and Charleroi and in the Netherlands in regions in North Brabant, Nijmegen/Arnhem, Utrecht and Middle Limburg. However, there are also regions that do not appear to attract great concentrations of these firms, but where expected because of the size of their inland ports. Examples of these regions are North and South Limburg in which sizeable inland ports are situated such as Venlo, Venray, Masstricht, Geleen/Sittard and Born and Twente, with the sizeable ports of Enschede and Hengelo (Buck Consulants, 2015). Since the cargo handling subsector considers the handling of cargo despite of the transport mode, the concentrations of cargo handling firms in regions with an airport such as Brussels and Liege consist of these firms as well.

A notable growth in the number of firms performing transportation supporting activities can be identified in the regions in North Brabant in Appendix G. These and regions such as Nijmegen/Arnhem and Northern Limburg score well in several rankings, ranking the top locations for logistics facilities (Logistiek Magazine, 2015; JLL, 2015). This is not clearly demonstrated by most of the results in this study, however the already existent and growing concentrations of firms performing transportation supporting activities in these regions confirm the rise of these regions as logistics hotspots. The multimodal connections with seaports and with important consumer and industrial markets, the availability of land, the potential benefits from the clustering of logistics firms and the supporting local authorities are argued to have increased the attractiveness of these regions for logistics purposes (BrabantStad, 2015; Van Breedam, 2007).

According to Rodrigue and Notteboom (2009), an increasing number of logistics activities will be moved to hinterland locations since the conditions at these locations are considered to be better when it comes to the availability and prices of land, congestion forces and the inland location of consumption markets for instance. In this study, it is researched whether these theories could actually be verified by the use of Gini coefficients, Balassa Indices and choropleth maps. Although the results did show that on average the relative specialisation of regions without seaports in logistics activities increases, it cannot be concluded that this effect is highly significant. Nevertheless, I expect greater fractions of logistics firms to locate their activities in hinterland locations in the future. That expectation is based amongst others at the repeated presence of regions such as North Brabant and Northern Limburg in rankings ranking the top locations for logistics facilities. I expect that the importance of such locations for relieving the greater seaports from congestion will increase. Vanelslander et al. (2015) for instance expect an increase in the container traffic to hold on until 2040. Moreover, they argue increasing economies of scale in maritime transportation in the form of ever increasing container vessels to force shipping lines to make fewer calls. So instead of making calls at for instance the Port of Antwerp and the Port of Rotterdam, they call at only one of them. This increases the inter-mainport traffic, but I also expect that the role of the inland terminal networks increases to help preventing the overconcentration of loads in seaports and to ensure efficient hinterland transportation.

Furthermore, Vanelslander et al. (2015) argue the economic centre of gravity to gradually shift in an eastwards direction. It follows that the locations with the highest economic growth rates in Eastern Germany, Czech and Poland for instance are not reachable in an economically efficient way from the ports of Antwerp, Zeebrugge and Rotterdam. Developments such as the TEN-T program by the European Union and the provision of frequent shuttles between logistics platforms are argued to help increasing the efficiency in transportation networks. In such networks, extended gates could play an important role as they are argued to relieve seaports from congestion and enable the consolidation and bundling of cargo which creates the right scale for multimodal transport. The increased flexibility of hinterland networks, as a result of investments in infrastructure and the implementation of extended gates might provide the right conditions to reach such locations in a cost efficient and sustainable way.

Moreover, JLL (2015) and Prologis (2013) document E-commerce to have had a great impact on the demand for distribution centres. Specialists in logistics real estate JLL and Prologis expect this trends to hold on for the near future, which means that demand arises for sizeable distribution centres at locations from which great consumption areas could be reached. Because of the size of these centres and the desire to efficiently reach consumption markets, the supply and the price of land and the access to motorways are important factors. Therefore, I expect semi-peripheral locations to attract great fractions of national distribution and logistics centres. Examples of firms active in E-commerce, that chose such locations for their distribution centres are Bol.com, Wehkamp and Coolblue. Bol.com decided to develop a highly efficient distribution centre in Waalwijk, Coolblue opened a centre in Tilburg and Wehkamp build a highly automated distribution centre in Zwolle (Van Geyte, 2015; Dijkhuizen, 2015).

Chapter 5: Conclusion:

It has been the purpose of this paper to identify whether the location patterns of logistics establishments have changed over time, or not. It is especially researched whether changes have occurred in the attractiveness of seaport areas and inland areas for the establishment of logistics sites. In order to find answers to this problem, the theory has summarised the location factors that are most applicable to the logistics industry first. It follows that seaports are seen as attractive locations for logistics firms because of the access they provide to markets and resources, the infrastructure that is likely to be available in seaports and because of the potential agglomeration economies that are likely to occur as a result of locating in proximity to firms from the same, but also from other industries (Carbonne and De Martino, 2003; Sheffi; 2013). Factors that are likely to positively affect a logistics firm's decision to locate its business activities further inland are the high prices and low availability of land in seaport areas, the congestion problems that occur in and around seaport areas and the inland location of important consumption and industrial markets (Notteboom and Rodrigue, 2005; Strale, 2013).

This study has attempted to identify the locations of logistics firms by the use of the Lorenz curves, Gini coefficients and Balassa Indices, but is enriched by choropleth maps to find whether the clustering of logistics firms occurs around seaports and/or around other logistics hubs. In the calculations on the size of the logistics industry wholesale firms and trade agents are initially included. These results show that the logistics industry, with the inclusion of these firms, is not highly concentrated in Belgium and in the Netherlands. However, subsectors such as freight transportation over water, cargo handling and transportation supporting activities, can be constituted to be concentrated logistics sectors. Over time, the Gini coefficients indicate a pattern of de-concentration for practically all the logistics subsectors.

From further calculations and the visualisation of the logistics industry and its subsectors in maps, it can be concluded that the most concentrated subsectors water transport, cargo handling and transportation supporting activities are overrepresented in regions with a seaport. The most likely explanatory factors describing this pattern are the infrastructural requirements of firms active in the transportation of freight over water and cargo handling and the possible benefits that all these logistics firms could experience from the agglomeration of these activities in seaports (Verhetsel et al., 2015; Van den Heuvel et al., 2014a). Although the Gini coefficients showed a pattern of de-concentration and the absolute and relative fractions of logistics firms showed that the logistics industry relatively grows at a higher rate in regions without a seaport, it cannot be stated that this growth pattern is highly significant. The most remarkable growth rates can be found in the absolute and relative growth rate of the transportation supporting activities subsector in the Netherlands. Especially in the regions in the southern part of the Netherlands, it confirms the image that these regions are increasingly important and attractive logistics locations. Their growing importance as transport nodes is likely to have increased the demand for transportation supporting activities. Moreover, it is argued that amongst others lower land prices, higher availability of land, supporting local authorities and proper connectivity to seaports and hinterlands have positively affected the attractiveness for logistics purposes of these regions (Van Breedam, 2007).

Although not all the results have been significant, the significant existence of the cargo handling and the water transportation subsector in seaports and the growth of most of the subsectors in regions without a seaport has strengthened my believe in the theory of Veenstra et al. (2012) that seaports in the future will be used for strictly port related logistics activities. Logistics activities that are related to voluminous bulk cargoes for instance and are therefore suitable for the further transportation by barge and rail, will be performed in seaport areas because of these activities' dependency on infrastructure (Chen and Notteboom, 2012; Dervaux, 2004). However, for instance logistics activities related to containers that are destined for distant inland consumption markets on the other hand are better performed further inland since as it would increase the responsiveness (Raimbault et al., 2015).

Growing container vessels and increasing container traffic will intensify the pressure on seaports. Efficiency in hinterland transportation networks will therefore become increasingly important. Logistics platforms that are in closer proximity to consumer markets and have proper connections with seaports might develop themselves into large logistics poles since these locations consist of the required infrastructure, provide access to markets and resources and enable logistics firms to profit from the clustering of logistics activities around these poles (Rodrigue and Notteboom, 2009).

Chapter 6: Discussion:

In the process of writing this paper, some decisions on for instance which model to choose, which indicators include and which databases to use have been made. In order to study the location pattern empirically, several methods have been considered. The motivations to choose the Gini coefficient and enrich that method with choropleth maps has been discussed extensively in chapter three, so there is no need to further discuss the method decision in this chapter in detail. Therefore, in this chapter some additional assumptions are discussed.

Most researchers make use of employment data to calculate the Gini coefficient. According to Tian (2013) the relatively low data requirements of the Gini coefficient makes this method a relatively easy method to calculate the extent to which industries are concentrated in an observed region. According to Bowen Jr. (2008) three indicators that could be used to describe the significant existence of an industry in a certain region are the total number of establishments, the total number of employees and total earnings. Most of the researchers making use of Gini coefficients or Balassa Indices (Location Quotients) apply employment data. The advantage of the use of employment or total earnings data over the data on the number of establishments might be that the economic importance of an industry is even better described in the form of employment or by total earnings than by describing it with the use of the number of establishments. However, by logical reasoning one might expect these indicators to be, at least somewhat, related. Moreover, Bowen Jr. (2008) statistically confirms the relationship between the number of employed people and the number of establishments to be strong. Therefore, because of the lack of data on the number of employed people and total earnings, the decision is made to make use of data on the number of establishments for the calculation of the Gini coefficients.

As is argued before, the need of this study for geographically and industrially specified dataset impedes the use of most of the available datasets. From the initially desired research area, the Hamburg-Le Havre range, only the statistical offices of Belgium and the Netherlands have recorded the number of establishments in such a specified ways that their data is suitable to use in this study. Eurostat for instance records the number of establishments on the NUTS 2 level (province level), but only aggregates industries towards two digits (in the NACE Rev. 2 report). This means that for most of the sectors, the number of establishments would be overestimated when making use of these datasets, in particular because establishments that are in some way concerned with the movement of passengers are included in these datasets. In an attempt to filter these establishments from the dataset, (too) many assumptions had to be made, which made me decide to focus the study on Belgium and the Netherlands.

For Belgium and the Netherlands, data on the number of establishments has been obtained that is sufficiently specified towards industries and is specified to the NUTS 3 region geographically. For the Netherlands, this data could be easily obtained from the CBS, the Dutch statistical office. These datasets contain the numbers of logistics establishments, but these are rounded to multiples of five. For the subsectors with a great number of establishments, the rounding of the number of establishments does not affect the results that much. In the case of subsectors with really low numbers of establishments, the rounding has a relatively larger impact and it might result in various sectors having the exact same number of establishments. After verifying the results, it seems that there is enough variety in the outcomes.

For Belgium, only the data for 2014 is publicly available. Fortunately, the 2000 data is obtained contacting their statistical office. It stands out that the number of logistics establishments is higher in 2000 than in 2014, while for the Dutch logistics sector the 2000 number of logistics establishments is lower than in 2014. Furthermore, the total number of establishments in both countries show a growing pattern of the total number of establishments over the researched time period. Since historical data on the number of logistics establishments is available back to 2003, I have calculated the average yearly growth rate over this time period (2003-2014). Assuming this rate to be approximately the same for the 2000-2003 period enables me to estimate the number of logistics establishments for 2000. It follows that in that case approximately 81186 establishments are active in the logistics industry. This is still not as extreme as the 82809 that is calculated from the obtained dataset, but it does show that the number of logistics establishments in Belgium has declined over the past decade and that this number of establishments could be correct. Furthermore, in paragraph 4.1.1, it is explained how the total number of establishments of all industries is estimated by extrapolation.

The method used in this study has not been able to identify a significant development in the location decision of firms. It might be interesting for further research to make use of data that is more specified geographically than to the NUTS 3 level. This might enable a more exact identification of some trends such as the suburbanisation trend of distribution facilities and wholesale firms that is reported by several authors (Strale, 2013; Weterings, 2014; Cidell, 2010). Furthermore, it enables more detailed analysis on the effect of infrastructures such as terminals and highways and the effect agglomeration economies have on the attractiveness of locations for logistics firms. These factors are argued to have greater effects on shorter distances (Van den Heuvel et al., 2013).

Furthermore, for the visualisation of Balassa Indices and fractions of logistics establishments in choropleth two classification methods are used. Because in case a Balassa Index is below one a region is argued not to be relatively specialised in a certain industrial activity, it is logical to take one as a cut-off point. Moreover, since the data used is not expected to be normally distributed, the use of standardised location quotients would yield biased results. Therefore, the decision is made to follow the frequently mentioned cut-off points 1.25 and 2.00 (Tian, 2013). Also the decision to make use of the Jenks Natural Breaks method is extensively discussed in paragraph 3.2.3. The most important feature from this method is that it seeks to group similar values and separate dissimilar ones. The Jenks Natural Breaks method minimises the variance within the classes and maximises the variance between the classes. It is clearly described in the texts following the tables A,B and C in the Appendix that this method is better able to group similar and separate dissimilar values than the other two classification methods. In my opinion, the ability of a method to group similar values and separate dissimilar values is important when classifying data that is supposed to be visualised in choropleth maps. The explanatory power of choropleth maps diminishes if regions with clearly dissimilar values are attached to the same class (and therefore visualised in the same colour in a choropleth map for instance). However, it seems that the Jenks Natural Breaks method yields strange results for the water transportation subsector (H5020 and H5040) and the transportation supporting activities subsector (H5229). The main reason for these outcomes is that for these subsectors there are many very low values. When using the Jenks method, the upper three classes will consist of only a very few regions and therefore these subsectors are classified by hand. The class breaks are set in such a way that similar values are grouped together as much as possible.

In the calculations of the total number of logistics establishments in the Netherlands and Belgium, only a very small fraction of establishments appears that is active in the transportation of freight over railways. It is argued that the former regulation of the railway market is one explanation for the appearance of such a low number of these establishments (Railcargo, 2015). According to CBS (2015), more than 80% of the cargo that is transferred via railways finds its origin in the ports of Rotterdam and Amsterdam. Since these seaports have the infrastructures that are required to load and unload the cargo (traditionally heavy bulk goods, but the amount of containers transferred by rail is increasing), important transport nodes such as seaports will be attractive locations for these firms. The data that has recorded the number of firms moving freight over railways shows that in the Netherlands all of them are located in the Greater Rijnmond region and in that in Belgium most of them are located in Brussels and Antwerp.

Appendix:

Jenks Classification method motivation: The Natural Breaks (Jenks) method in comparison to the Equal Interval method and the Quantiles method:

As is explained, the Natural Breaks method seeks to find the class breaks that minimise the variance within classes and maximises the variance between classes. If, for the logistics industry in Belgium in 2000, the Natural Breaks method is able to classify the data into five classes, the following output will be shown:

Table A: The natural breaks (Jenks) method:

The Natural Breaks (Jenks) method:			
class	*Lower*	*upper*	*count*
1	0,002	0,012	20
2	0,015	0,028	13
3	0,030	0,041	6
4	0,059	0,072	3
5	0,171	0,171	1
GVF	0,001	0,034	0,982

In this table, the left column represents the classes, the next two columns represent the lower bound and the upper bound of each class and the last column represents the number of data points that are allocated into each class. In the bottom row, the number underneath the lower bound (=0.001), represents the sum of the squared deviations from the mean within each class by using the Jenks method. The number underneath the column that represents the upper bound of each class (=0.034), is the sum of the total squared deviations from the mean in the total dataset. The last number (=0.982) represents the 'Goodness of Variance fit' and is calculated by subtracting the ratio of the sum of squared deviations from within the classes to the total sum of squared deviations from one (=1-0.001/0.034) (Zaiontz, 2016).

If these calculations are done for the equal interval method and the quantiles method as well, the following two tables could be made:

Table B: The equal interval method:

The Equal Interval method:				
Data range	0,2% - 17,1%			
Class range	3,38%			
Class	*Lower*	*upper*	*count*	*sum of squared deviation*
1	0,002	0,036	35	0,003
2	0,036	0,070	6	0,001
3	0,070	0,103	1	0
4	0,104	0,137	0	-
5	0,137	0,171	1	0
GVF	0,004	0,034	0,895	

Table C: The quantiles method:

The Quantiles method:				
Data points	43			
Interval points	9			
Class	*lower*	*upper*	*count*	*sum of squared deviation*
1	0,002	0,005	8	1,125E-05
2	0,006	0,009	8	1,291E-05
3	0,010	0,018	8	5,181E-05
4	0,019	0,030	10	1,574E-04
5	0,035	0,171	9	1,492E-02
	0,015	0,034	0,557	

As follows from these tables, containing information on the equal interval method and the quantiles method, the variance within the classes is higher for the equal interval as well as the quantiles method. Therefore, the 'Goodness of Variance fit' is lower for these methods than for the Natural Breaks method. As already discussed, the equal interval method and the quantiles method are not preferred to use with an unevenly distributed dataset (Zaiontz, 2016). As follows from the table on the equal interval method, most of the data points are grouped into the first class while the fourth class for instance has no data points. In the quantiles method, the variance within classes is highest because each class is required to contain of the same amount of data points. This leads to a situation in which more extreme values are grouped in the same class as moderate values, which results in a high variance within classes. Since the goal of this paper is to properly visualise the regions in which logistics firms are concentrated, the Natural Breaks method is used.

Remaining tables and graph:

Table D: Modal split 2000 and 2014 for Belgium and the Netherlands (described as the percentage of each inland mode in total freight transport performance and measured in tonne-kilometres)

	2000			2014		
Country:	*Rail*	*Road*	*Inland Waterway*	*Rail*	*Road*	*Inland Waterway*
Belgium	11,6%	77,4%	10,9%	14,7%	64,2%	21,1%
Netherlands	3,7%	63,4%	32,9%	4,9%	56,1%	39,0%

Data source: Eurostat

Table E: Seaports and the corresponding NUTS 3 regions in Belgium:

Belgian Seaport:	***Belgian Arrondissement:***
Antwerp	Antwerp
Ghent	Ghent
Zeebrugge	Bruges
Oostende	Oostende

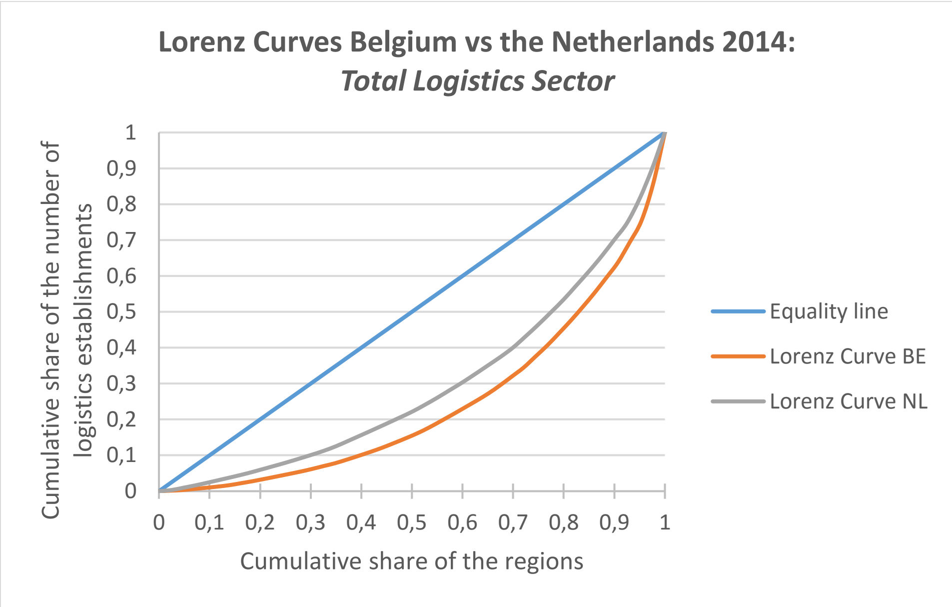
Table F: Seaports, seaport areas and the corresponding NUTS 3 regions in the Netherlands:

Dutch Seaport area name:	***Consisting of the following Seaports:***	***Dutch COROP region:***
Noordelijke Zeehavens	- Delfzijl - Eemshaven - Harlingen - Den Helder	- Delfzijl en omgeving - Overig Groningen - Noord-Friesland - Kop van Noord-Holland
Noordzeekanaalgebied	- Amsterdam - Beverwijk - Velsen/IJmuiden - Zaanstad	- Groot Amsterdam - IJmond - IJmond - Zaanstreek
Rijn- en Maasmond	- Dordrecht and 'Drechtsteden' - Moerdijk - Scheveningen - Rotterdam/Rijnmond	- Zuid-Oost Zuid-Holland - West-Noord-Brabant - Agglomeratie 's-Gravenhage - Groot-Rijnmond
Scheldebekken	- Vlissingen - Borsele - Terneuzen	- Overig Zeeland - Overig Zeeland - Zeeuwsch-Vlaanderen

Table G: Wholesale firms and trade agents: establishments, persons employed and net revenues:

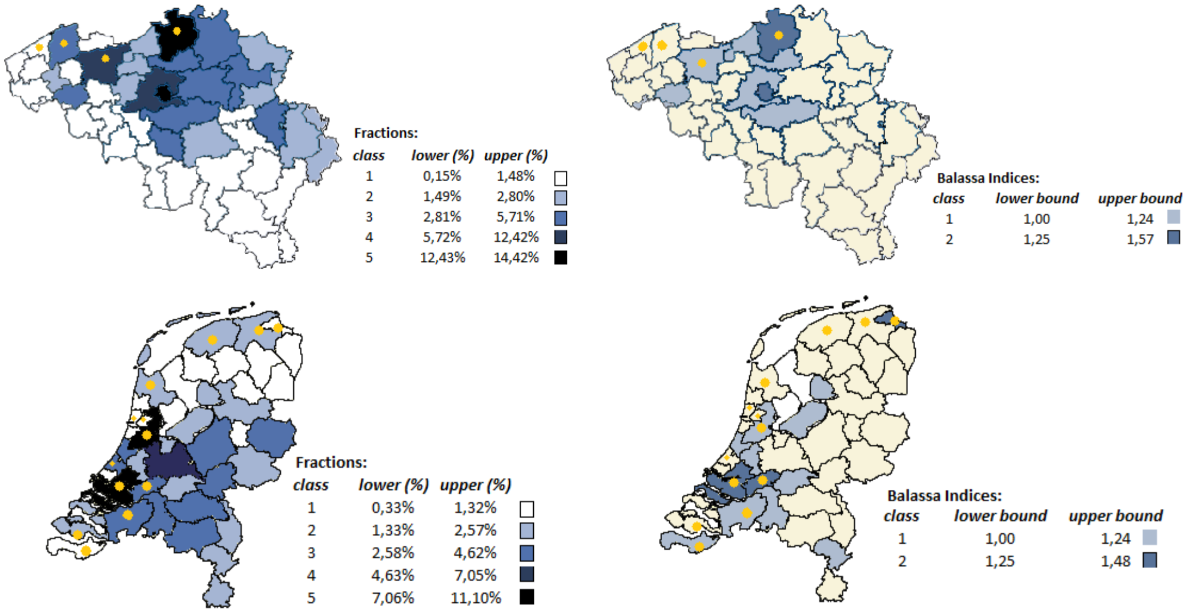
Sector G46: Groothandel en handelsbemiddeling					
Jaren:	**2009**	**2010**	**2011**	**2012**	**2013**
Algemeen:					
Aantal vestigingen	83745	85625	85855	87080	85870
Aantal werkzame personen (x1000)	583,1	585,7	601,9	599,2	596,8
Gemiddeld aantal werkzame personen per vestiging	7,0	6,8	7,0	6,9	7,0
Omzet:					
Netto omzet totaal (x miljoen euro's)	347017	389009	437813	446432	436386
Netto omzet buitenlandse activiteit (x miljoen euro's)	221147	226666	275621	254471	224321
Percentage omzet buitenlandse activiteit	64%	58%	63%	57%	51%
Netto omzet binnenlandse activiteit (x miljoen euro's)	125871	162344	162192	191960	212065
Percentage omzet binnenlandse activiteit	36%	42%	37%	43%	49%
Netto omzet groothandels in olie en steenkool (x miljoe	44741	65805	82006	85062	74081
Percentage groothandels in olie en steenkool	13%	17%	19%	19%	17%

Graph A: Lorenz Curves Belgium and the Netherlands 2014:

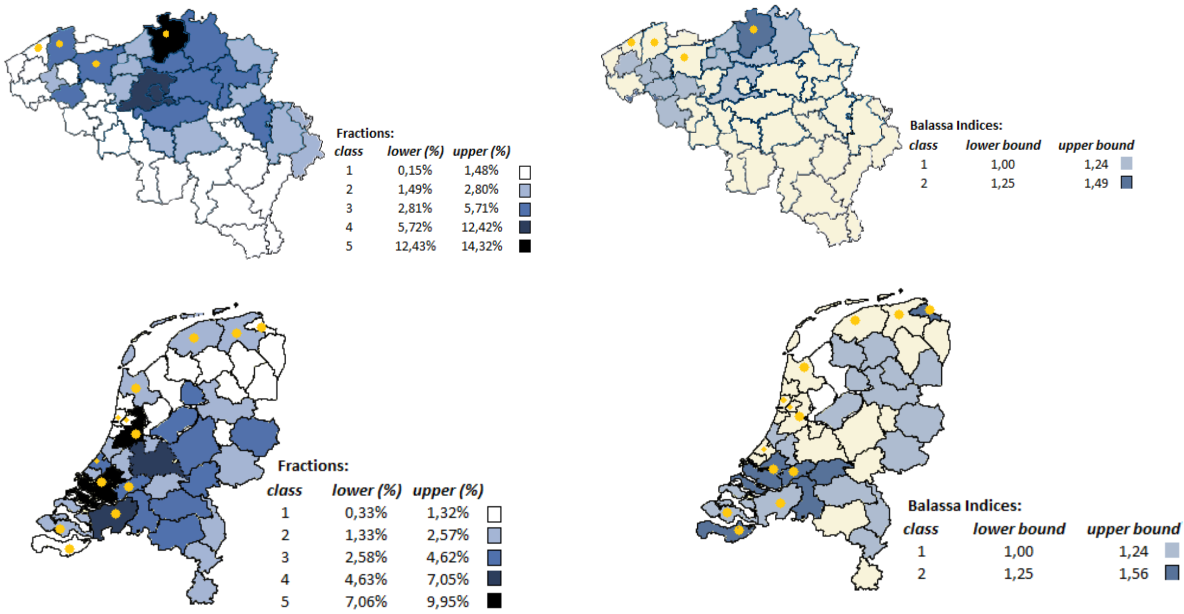


Choropleth maps Belgium and the Netherlands per (sub)sector and year:

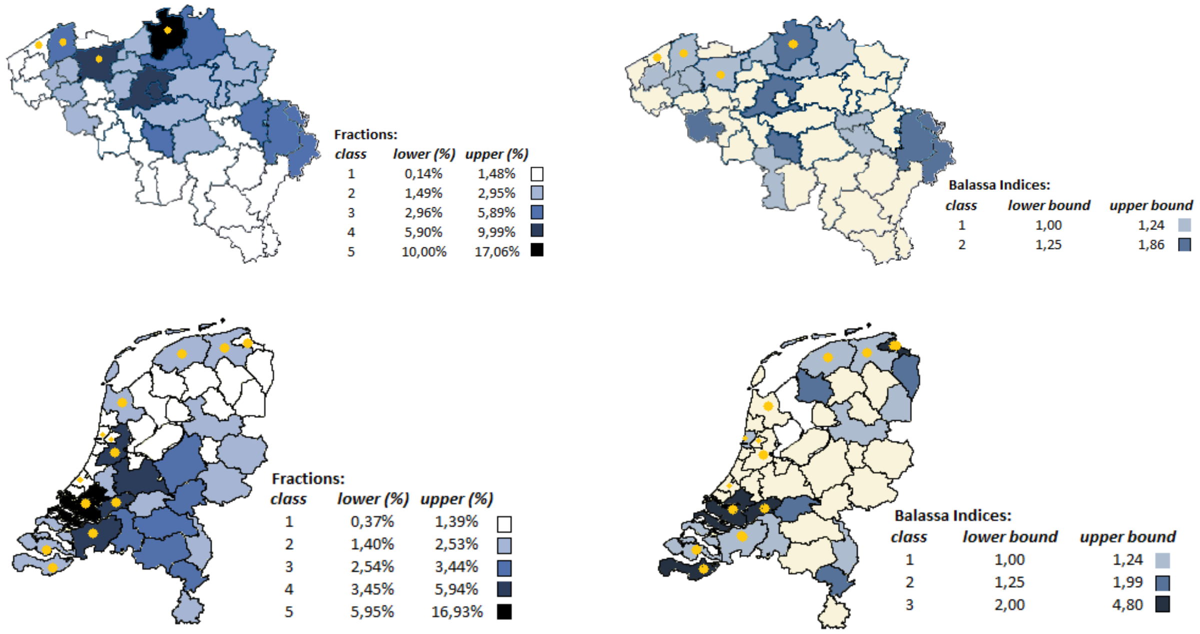
Map A1: Total Logistics Sector in Belgium and The Netherlands 2000, fractions left, Balassa Indices right:



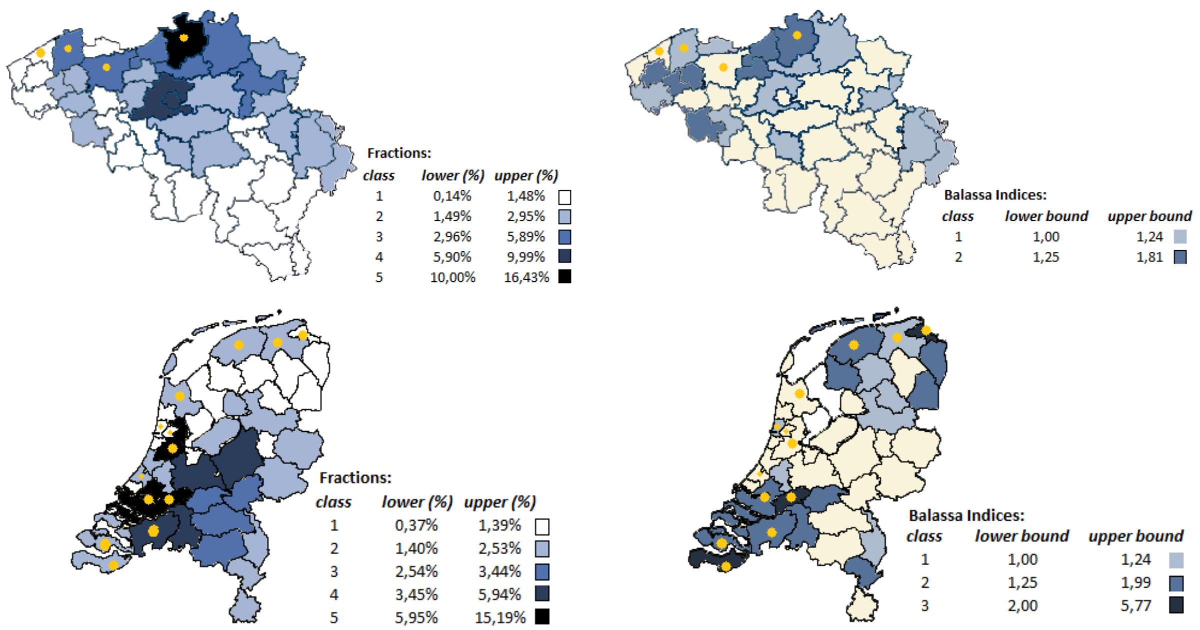
Map A2: Total Logistics Sector in Belgium and The Netherlands 2014, fractions left, Balassa Indices right:



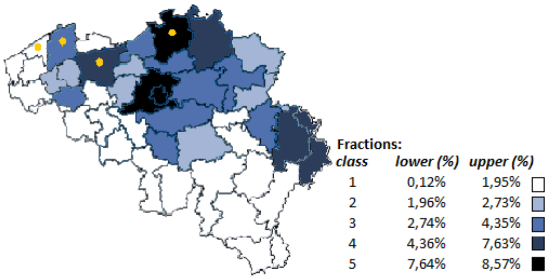
Map B1: Total Logistics Sector (without wholesale establishments and trade agents) in Belgium and The Netherlands 2000, fractions left, Balassa Indices right:

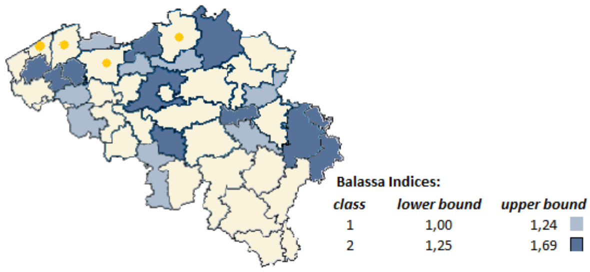


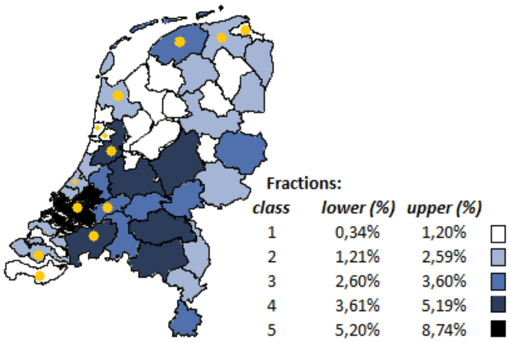
Map B2: Total Logistics Sector (without wholesale establishments and trade agents) in Belgium and the Netherlands 2014, fractions left, Balassa Indices right:

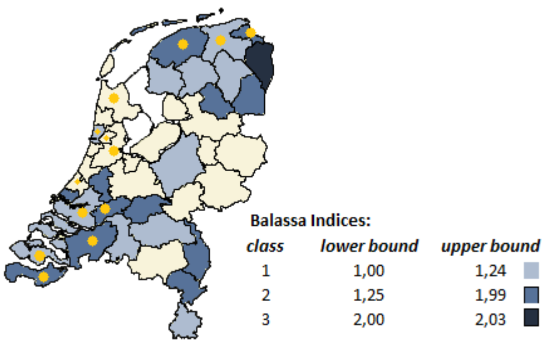


Map C1: Road Freight Transportation in Belgium and The Netherlands 2000, fractions left, Balassa Indices right:

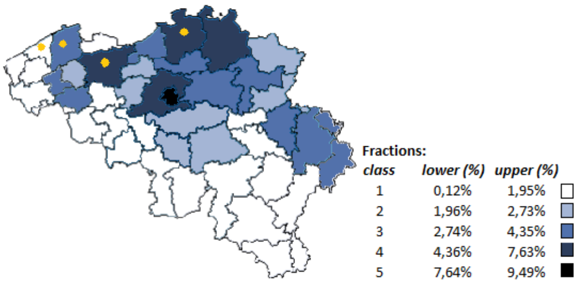


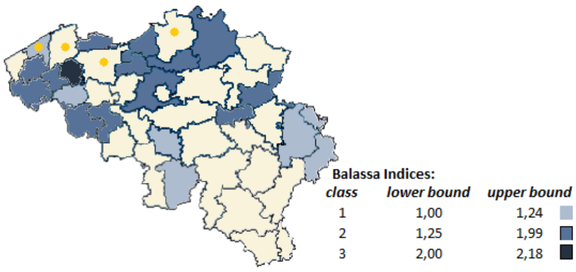


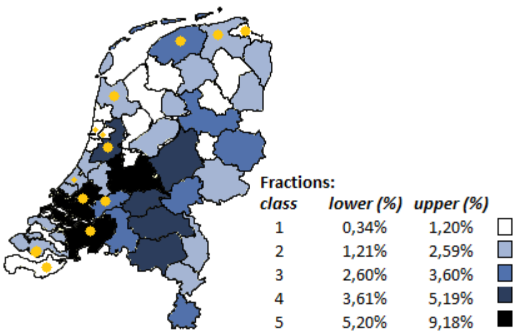


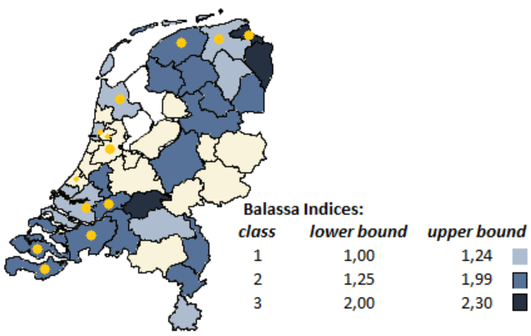


Map C2: Road Freight Transportation in Belgium and The Netherlands 2014, fractions left, Balassa Indices right:

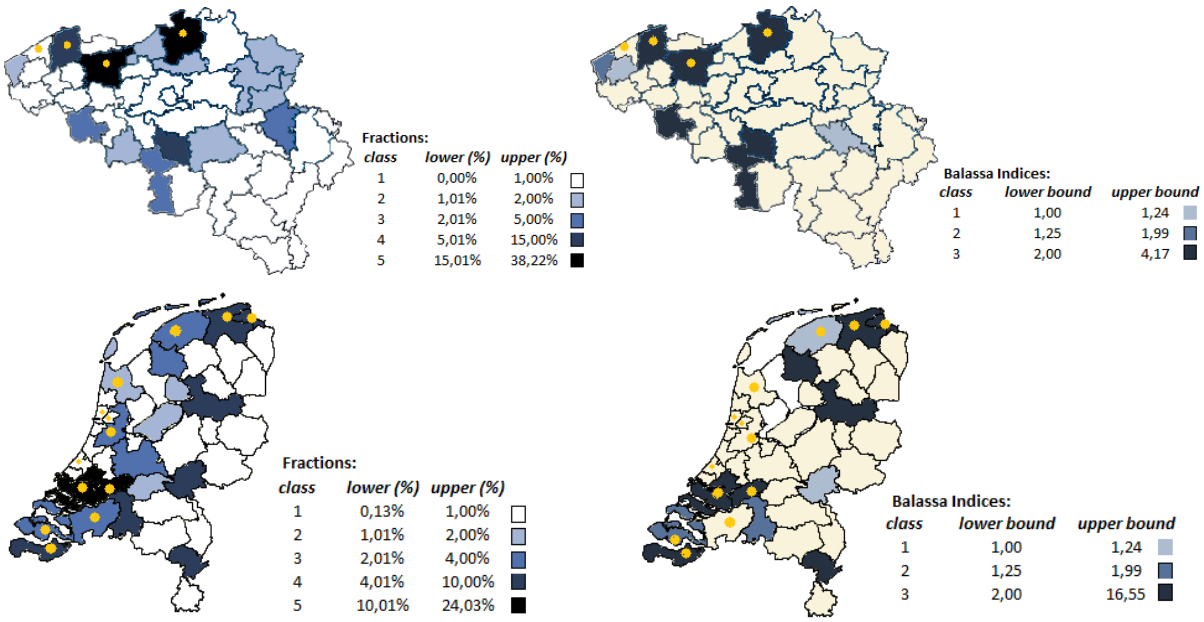




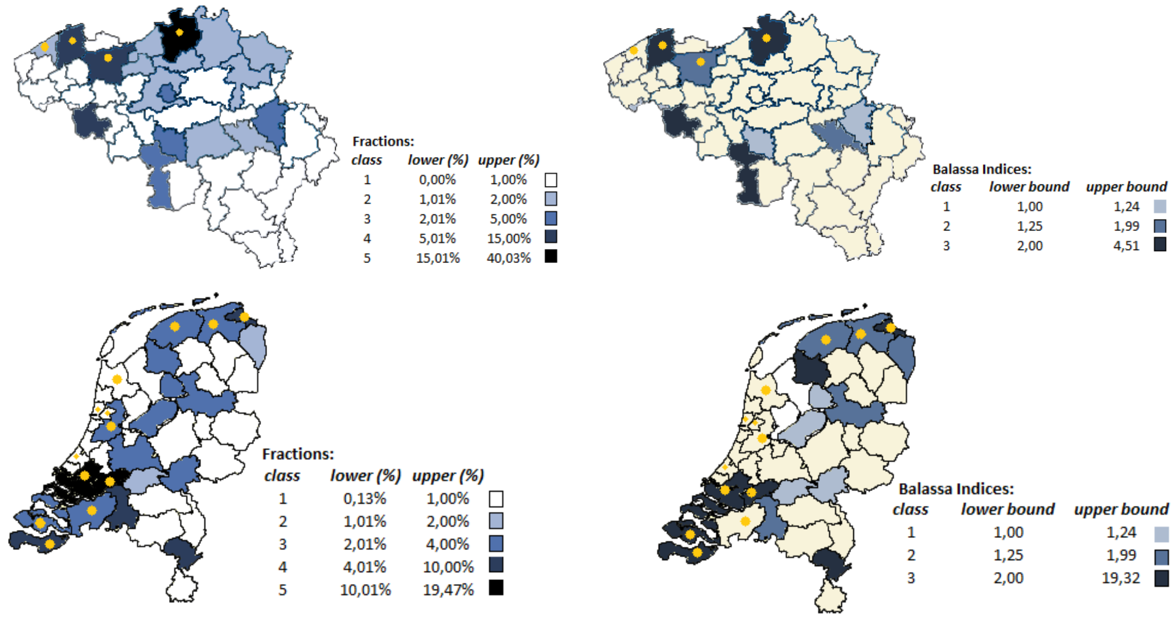




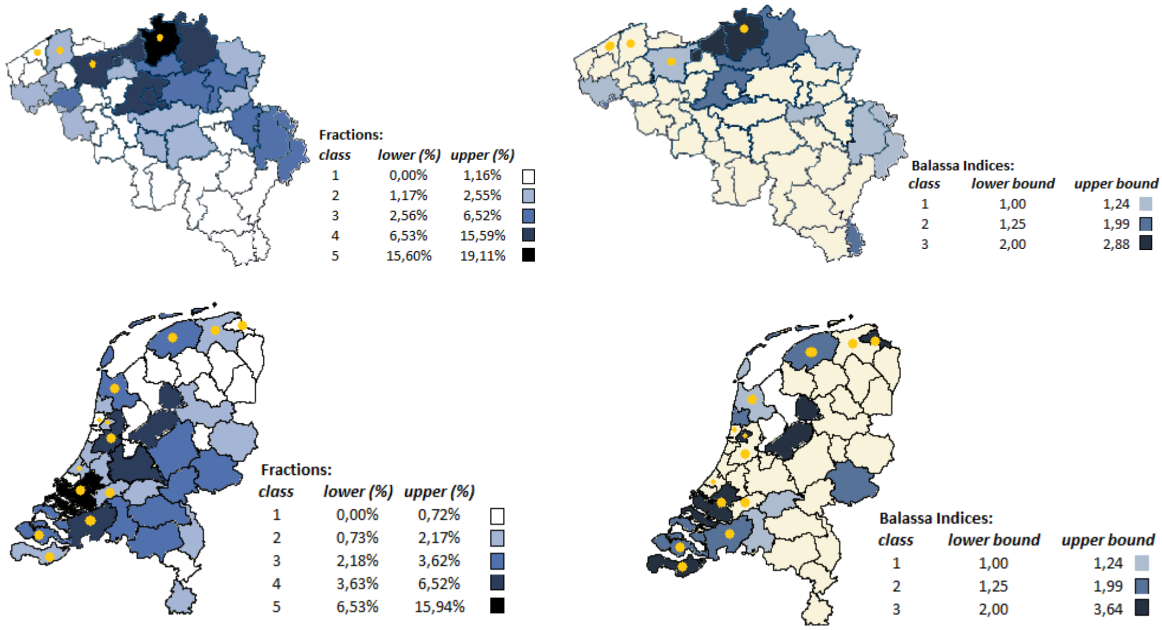
Map D1: Water Transportation in Belgium and The Netherlands 2000, fractions left, Balassa Indices right:



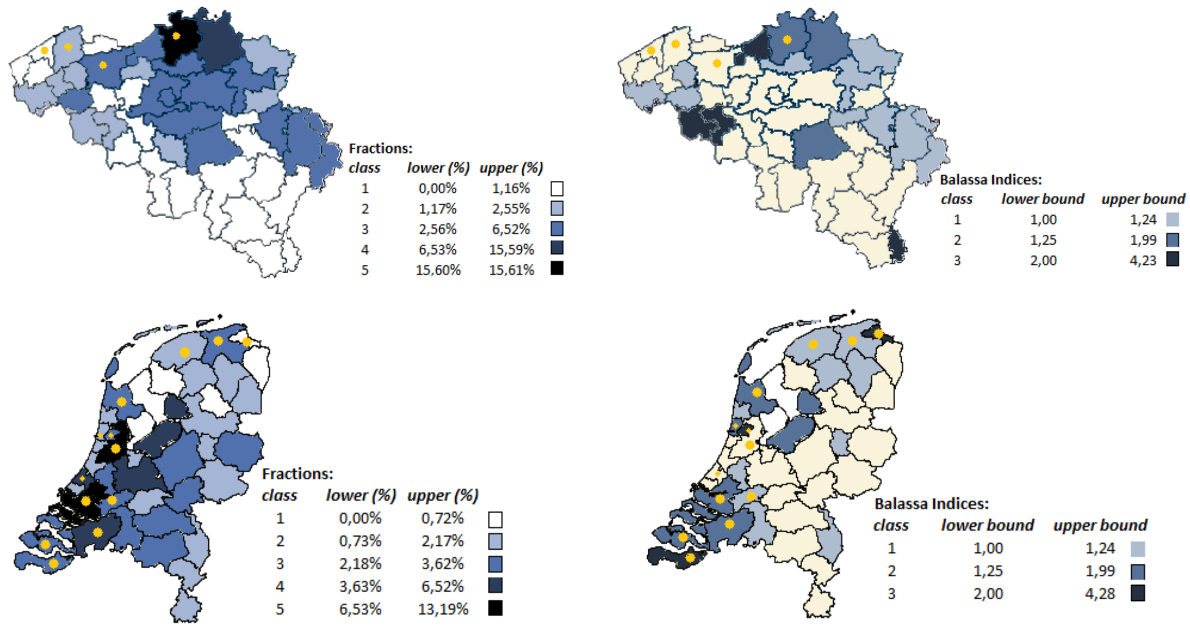
Map D2: Water Transportation in Belgium and The Netherlands 2014, fractions left, Balassa Indices right:



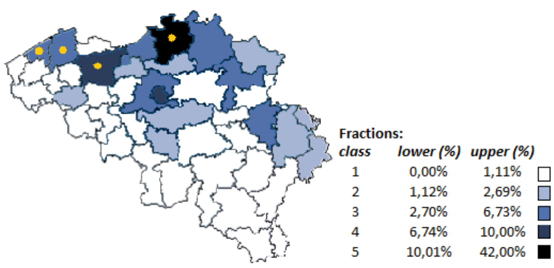
Map E1: Storage and Warehousing in Belgium and The Netherlands 2000, fractions left, Balassa Indices right:

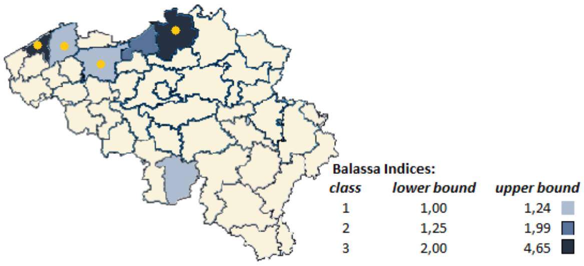


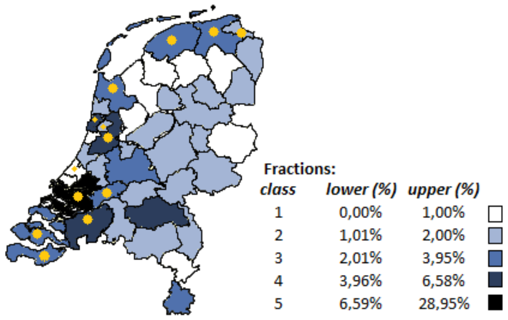
Map E2: Storage and Warehousing in Belgium and The Netherlands 2014, fractions left, Balassa Indices right:

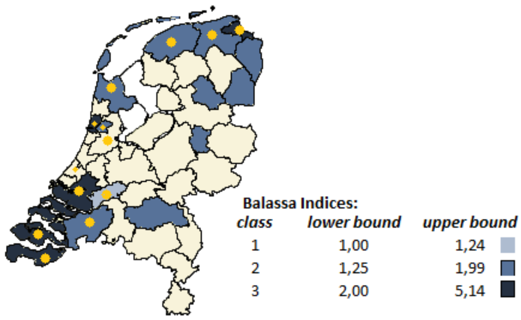


Map F1: Cargo Handling in Belgium and The Netherlands 2014, fractions left, Balassa Indices right:

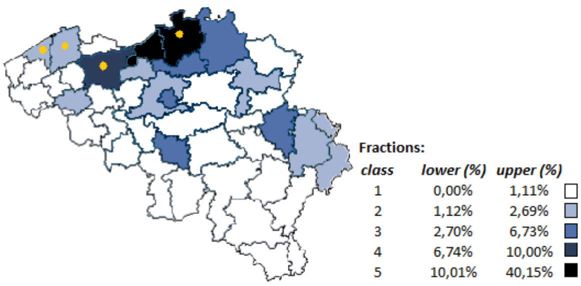


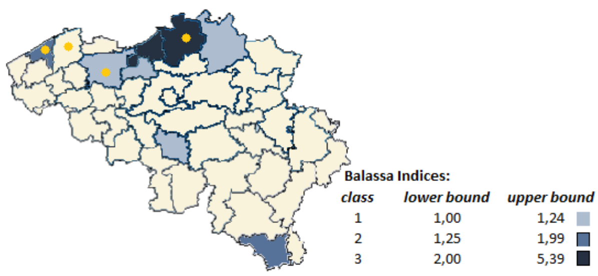


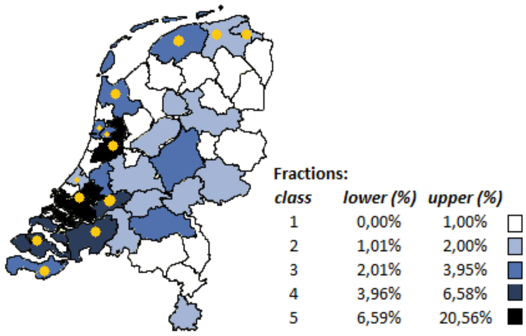


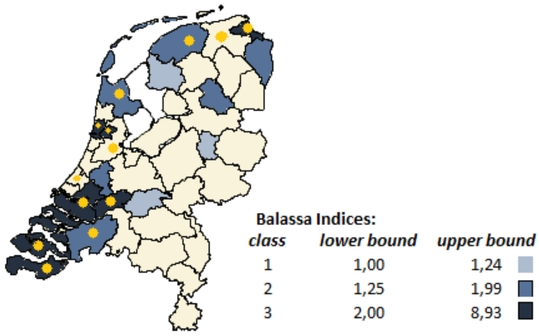


Map F2: Cargo Handling in Belgium and The Netherlands 2014, fractions left, Balassa Indices right:

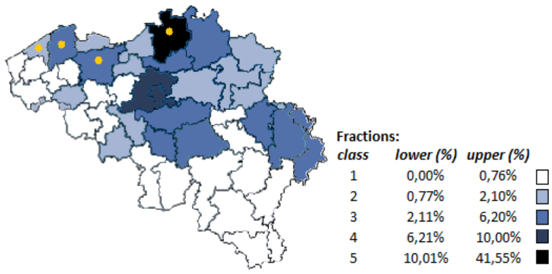


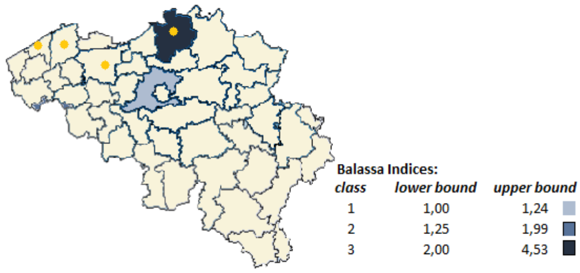


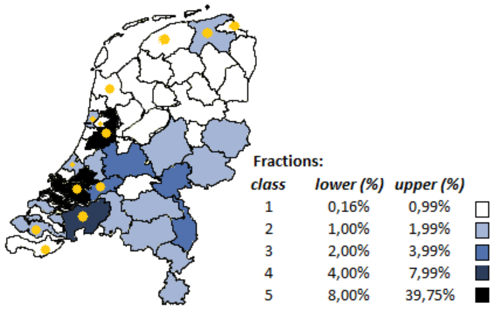


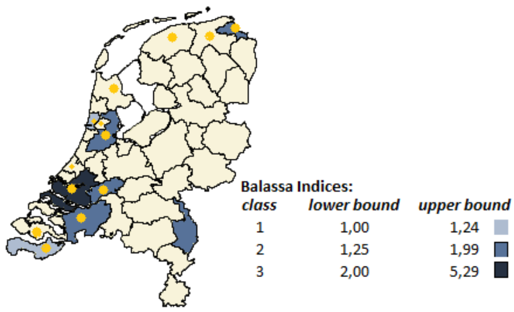


Map G1: Transportation Supporting Activities in Belgium and The Netherlands 2000, fractions left, Balassa Indices right:

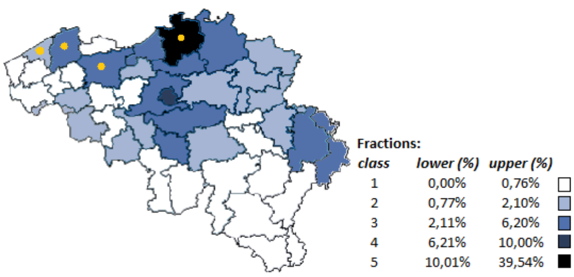


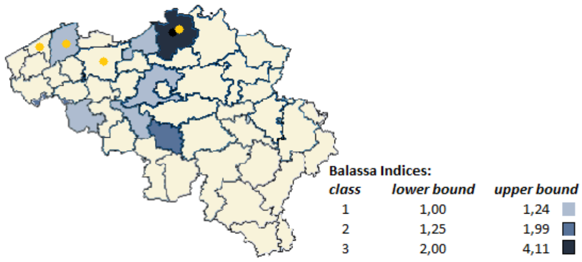


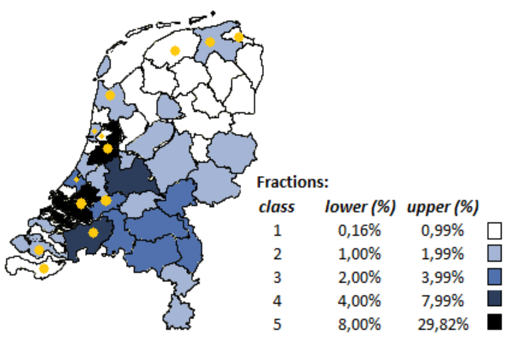


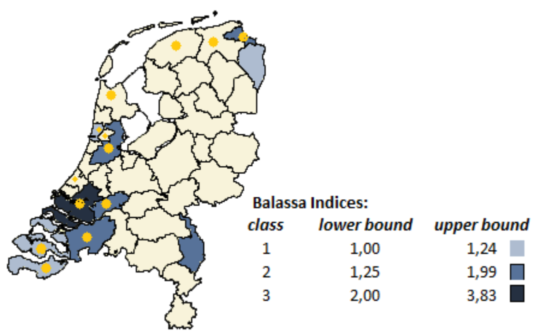


Map G2: Transportation Supporting Activities in Belgium and The Netherlands 2014, fractions left, Balassa Indices right:









Bibliography:

ABN AMRO (2011). *Visie op transport en logistiek, sectorupdate 2011*. Amsterdam: ABN AMRO.

Ambroziak, A. A. (2014). *Review of the Literature on Determinants of the Locational Attractiveness of Regions.* In: New Cohesion Policy of the European Union in Poland (pp. 1-28). Springer International Publishing.

Andreoli, D., Goodchild, A. & Vitasek, K. (2010). *The rise of mega distribution centers and the impact on logistical uncertainty.* Transportation letters: The International Journal of Transportation Research, 2, 75-88.

Arbia, G. (2001a). *The role of spatial effects in the empirical analysis of regional concentration.* Journal of Geographical systems, 3(3), 271-281.

Arbia, G. (2001b). *Modelling the geography of economic activities on a continuous space*. Papers in Regional Science, 80(4), 411-424.

Arbia, G., & Piras, G. (2009). *A new class of spatial concentration measures. Computational Statistics & Data Analysis,* 53(12), 4471-4481.

ArcGIS 9.1. (2006). *Help topic "Standard Classification Schemes".* ESRI Inc.

Audretsch, D. B., Lehmann, E. E., & Warning, S. (2005). *University spillovers and new firm location.* Research policy, 34(7), 1113-1122.

Badri, M. A. (2007). *Dimensions of industrial location factors: review and exploration*. Journal of Business and Public Affairs, 1(2), 1-26.

Bathelt, H., Malmberg, A., & Maskell, P. (2004). *Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation.* Progress in human geography, 28(1), 31-56.

Bernini, C., & Pellegrini, G. (2011). *How are growth and productivity in private firms affected by public subsidy? Evidence from a regional policy.* Regional Science and Urban Economics, 41(3), 253-265.

Bickenbach, F., & Bode, E. (2008). *Disproportionality measures of concentration, specialization, and localization.* International Regional Science Review.

Blair, J. P., & Premus, R. (1987). *Major factors in industrial location: A review*. Economic Development Quarterly, 1(1), 72-85.

Bowen, J. T. (2008). *Moving places: the geography of warehousing in the US*. Journal of Transport Geography, 16(6), 379-387.

Buck Consultants (2015). *Monitor Logistiek en Goederenvervoer voor Nederland*. In opdracht van: Ministerie van Infrastructuur en Milieu. Nijmegen/Den Haag: Buck Consultants.

Buss, T. F. (2001). *The effect of state tax incentives on economic growth and firm location decisions: An overview of the literature.* Economic Development Quarterly, 15(1), 90-105.

BrabantStad (2015). *Logistieke Agenda Brabant*. Noord Brabant: BrabantStad.

Brülhart, M., Jametti, M., & Schmidheiny, K. (2012). *Do agglomeration economies reduce the sensitivity of firm location to tax differentials?*. The Economic Journal, 122(563), 1069-1093.

BRV (Beleidsplan Ruimte Vlaanderen). (2013). *Situatie-analyse Vlaamse Zeehavens. Ondersteuning Witboek Beleidsplan Ruimte Vlaanderen.* Accessed on 7th of June at https://www.ruimtevlaanderen.be/NL/Beleid/Beleidsontwikkeling/BeleidsplanRuimte/Onderzoekifvwitboek BeleidsplanRuimte

Cambra-Fierro, J., and R. Ruiz-Benitez. 2009. *Advantages of Intermodal Logistics Platforms: Insights from a Spanish Platform.* Supply Chain Management: An International Journal 14 (6): 418–421.

Carbonne, V., & Martino, M. D. (2003). *The changing role of ports in supply-chain management: an empirical analysis.* Maritime Policy & Management, 30(4), 305-320.

CBRE. (2011). *Understanding Logistics in the Netherlands.* Amsterdam: CB Richard Ellis.

CBS (2011). *Bijna 1 miljoen bedrijfsvestigingen in Nederland*. Accessed 13th of July 2016 at: https://www.cbs.nl/nl-nl/nieuws/2011/52/bijna-1-miljoen-bedrijfsvestigingen-in-nederland

CBS (2015). *Transport en Mobiliteit*. Den Haag: Centraal Bureau voor Statistiek.

CBS (2016). *Groothandel en handelsbemiddeling; arbeid en financiën (dataset).* Accessed 13th of July 2016 at: http://statline.cbs.nl/Statweb/selection/?DM=SLNL&PA=81164NED&VW=T

Chen, L., & Notteboom, T. (2012). *Determinants for assigning value-added logistics services to logistics centers within a supply chain configuration*. Journal of International Logistics and Trade, 10(1), 3-41.

Cheng, L. K., & Kwan, Y. K. (2000). What are the determinants of the location of foreign direct investment? The Chinese experience. Journal of international economics, 51(2), 379-400.

Chhetri, P., Butcher, T., & Corbitt, B. (2014). *Characterising spatial logistics employment clusters.* International Journal of Physical Distribution & Logistics Management, 44(3), 221-241.

Cho, J.K., Ozment, J., & Sink, H. (2008). *Logistics capability, logistics outsourcing and firm performance in an e-commerce market.* International Journal of Physical Distribution & Logistics Management, 38(5), 336-359.

Chopra, S., & Meindl, P. (2013). *Supply chain management. Strategy, planning & operation* (Fifth edition). Essex: Pearson Education Limited.

Christopher, M. (2000*). The agile supply chain: competing in volatile markets*. Industrial marketing management, 29(1), 37-44.

Cidell, J. (2010). *Concentration and decentralization: the new geography of freight distribution in US metropolitan areas*. Journal of Transport Geography, 18(3), 363-371.

Conceição, P., & Galbraith, J. K. (1998). *Constructing long and dense time-series of inequality using the Theil index.* Levy Economics Institute Working Paper No. 259. Available at SSRN: http://ssrn.com/abstract=148008 or http://dx.doi.org/10.2139/ssrn.148008

Cruijssen, F., Dullaert, W., Fleuren, H. (2007). *Horizontal cooperation in transport and logistics: a literature overview.* Transportation Journal 46, 22–39.

Cruijssen, F., Dullaert, W. & Joro, T. (2010). *Freight Transportation Efficiency Through Horizontal Cooperation in Flanders.* International Journal of Logistics: Research and Applications 13 (3): 161–178.

Cushman & Wakefield (2009). *Comparison of Prime Locations for European Distribution and Logistics*. Cushman & Wakefield, 2009.

Delfmann, W., Albers, S., & Gehring, M. (2002). *The impact of electronic commerce on logistics service providers.* International Journal of Physical Distribution & Logistics Management, 32(3), 203-222.

Demirbas, D., Flint, H., & Bennett, D. (2014). *Supply chain interfaces between a port utilizing organisation and port operator.* Supply Chain Management: An International Journal, 19(1), 79-97.

Derveaux, H. (2004). *Port logistics: the Antwerp case.* in S. Licheng and T. Notteboom (eds.), Proceedings of the first international conference on logistics strategy for ports, Dalian Maritime University Press, pp. 394-407

Devereux, M. P., Griffith, R., & Simpson, H. (2007). *Firm location decisions, regional grants and agglomeration externalities.* Journal of Public Economics, 91(3), 413-435.

Dijkhuizen, B. (2015). *Bol.com bouwt grootste dc van Nederland in Waalwijk.* Accessed 13th of July at: http://www.logistiek.nl/warehousing/nieuws/2015/3/bol-com-bouwt-grootste-dc-van-nederland-in-waalwijk-101102124

Diziain, D., Ripert, C., & Dablanc, L. (2012). *How can we bring logistics back into cities? The case of Paris metropolitan area.* Procedia-Social and Behavioral Sciences, 39, 267-281.

Dumais, G., Ellison, G., & Glaeser, E. L. (2002). *Geographic concentration as a dynamic process*. Review of economics and Statistics, 84(2), 193-204.

Dunning, J. H. (2000). The eclectic paradigm as an envelope for economic and business theories of MNE activity. International business review, 9(2), 163-190.

Ergun, O., G. Kuyzu, and M. Savelsbergh. (2007). *Reducing Truckload Transportation Costs Through Collaboration.* Transportation Science 41 (2): 206–221.

Erickson, R. A. and Wasylenko, M. (1980) *Firm relocation and site selection in suburban municipalities.* Journal of Urban Economics, 8, pp. 69–85.

Eurostat. (2008) *NACE Rev. 2, Statistical classification of economic activities in the European Community.* Eurostat Methodologies and Working papers. Luxembourg: European Commission.

Feenstra, R. C. (1998). *Integration of trade and disintegration of production in the global economy*. The journal of economic perspectives, 31-50.

Ferrari, C., Parola, F., & Morchio, E. (2006). *Southern European ports and the spatial distribution of EDCs.* Maritime Economics & Logistics, 8(1), 60-81.

Figueiredo, O., Guimaraes, P., & Woodward, D. (2002). *Home-field advantage: location decisions of Portuguese entrepreneurs.* Journal of Urban Economics, 52(2), 341-361.

Fratesi, U. (2008). *Issues in the measurement of localization.* Environment and Planning A, 40(3), 733.

Frenken, K., Van Oort, F., & Verburg, T. (2007). *Related variety, unrelated variety and regional economic growth.* Regional studies, 41(5), 685-697.

Fujita, M., & Krugman, P. (2004). *The new economic geography: Past, present and the future.* In: Fifty Years of Regional Science (pp. 139-164). Springer Berlin Heidelberg.

Gemeente Rotterdam (2014). *Achtergrondinformatie toegangseisen vrachtverkeer Maasvlakte 1 en 2.* Accessed 2nd of February 2016, at http://www.rotterdam.nl/milieuzonemaasvlakte_achtergrond

Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). *The governance of global value chains.* Review of international political economy, 12(1), 78-104.

Gligor, D. M., & Holcomb, M. C. (2012). *Understanding the role of logistics capabilities in achieving supply chain agility: a systematic literature review*. Supply Chain Management: An International Journal, 17(4), 438-453.

Gregson, N. (2015). *Logistics at Work: Trucks, Containers and the Friction of Circulation in the UK.* Mobilities, 1-22.

Guimaraes, P., Figueiredo, O., & Woodward, D. (2000). *Agglomeration and the location of foreign direct investment in Portugal.* Journal of Urban Economics, 47(1), 115-135.

Guimaraes, P., Figueiredo, O., & Woodward, D. (2011). *Accounting for neighboring effects in measures of spatial concentration*. Journal of Regional Science, 51(4), 678-693.

Head, C. K., Ries, J. C., & Swenson, D. L. (1999). *Attracting foreign manufacturing: Investment promotion and agglomeration.* Regional Science and Urban Economics, 29(2), 197-218.

Henderson, J., Dicken, P., Hess, M., Coe, N., & Yeung, H. W. C. (2002). *Global production networks and the analysis of economic development.* Review of international political economy, 9(3), 436-464.

Hesse, M., & Rodrigue, J. P. (2004). *The transport geography of logistics and freight distribution.* Journal of transport geography, 12(3), 171-184.

Holl, A. (2004). *Manufacturing location and impacts of road transport infrastructure: empirical evidence from Spain.* Regional Science and Urban Economics, 34(3), 341-363

Hong, J. (2007). *Transport and the location of foreign logistics firms: The Chinese experience.* Transportation Research Part A: Policy and Practice, 41(6), 597-609.

ING (2015). *Groothandel groeit weer. Kwartaalbericht groothandel.* Accessed 3rd of May at: https://www.ing.nl/media/ING_EBZ_Groothandel-groeit-weer-mei-2015_tcm162-84655.pdf

Jing, N., & Cai, W. (2010). *Analysis on the spatial distribution of logistics industry in the developed East Coast Area in China.* The Annals of Regional Science, 45(2), 331-350.

JLL (2015). *Ranking Logistics Locations. An overview of the Dutch logistics real estate market.* Amsterdam: Jones Lang Lasalle.

Krugman, P. (1998). *What's new about the new economic geography?* Oxford review of economic policy, 14(2), 7-17.

Krugman, P., Cooper, R. N., & Srinivasan, T. N. (1995). *Growing world trade: causes and consequences.* Brookings papers on economic activity, 327-377.

Kuipers, B. (2014). *De container is de uitvinding van de eeuw.* Accessed 14th of October 2015, at http://www.alcotrans.nl/

Kuipers, B., & Vanelslander, T. (2015). *De toegevoegde waarde van zeehavens. Antwerpen en Rotterdam: centra van hoogwaardige logistieke toegevoegdewaardecreatie?* Tijdschrift Vervoerswetenschap (TVW), 51(3), 83-97.

Lerman, R. I., & Yitzhaki, S. (1984). *A Note on the Calculation and Interpretation of the Gini Index*. Economics Letters, 15(3), 363-368.

Lodge, J. (1986). *The Single European Act: Towards a New Euro-Dynamism?* JCMS: Journal of Common Market Studies, 24(3), 203-223.

Logistiek Magazine (2015). *Logistieke Kaart 2015*. Logistiek Magazine bijlage, juni 2015.

Liu, Z. (2014). *Global and Local: Measuring Geographical Concentration of China's Manufacturing Industries*. The Professional Geographer, 66(2), 284-297.

Khan, T. (2004). *How regional authorities can achieve economic development through investments in the logistics sector* (Doctoral dissertation, Massachusetts Institute of Technology).

Marcon, E., & Puech, F. (2012). *A typology of distance-based measures of spatial concentration.* Accessed 9th of December 2015, at https://hal-enpc.archives-ouvertes.fr/halshs-00679993/document

Marshall, A., & Guillebaud, C. W. (1956). *Principles of economics* (Eighth press). London: MacMillan.

McCann, P. (2001). *Urban and regional economics* (First press). Oxford: Oxford University Press.

McCann, P., & Shefer, D. (2003). *Location, agglomeration and infrastructure*. Papers in regional science, 83(1), 177-196.

McKinnon, A. C. (2007). *Increasing fuel prices and market distortion in a domestic road haulage market: the case of the UK.* European Transport, 35, 5-26.

McKinnon, A. (2009). *The present and future land requirements of logistical activities*. Land Use Policy, 26, 293-301.

McKinnon, A. (1988). *Physical Distribution*. In: Marshall, J.N. (Ed.), *Services and Uneven Development* (pp. 133-159). Oxford: Oxford University Press.

Mieszkowski, P., & Mills, E. S. (1993). *The causes of metropolitan suburbanization*. The Journal of Economic Perspectives, 135-147.

Moravcsik, A. (1991). *Negotiating the Single European Act: National Interests and Conventional Statecraft in the European Community*. International Organization, 19-56.

NEA (2006). *Selected recent statistics on road freight transport in Europe.* Final report on goods road transport. Rijswijk: Union Internationale des Transport Routiers.

Nielson, J., Pritchard, B., & Yeung, H. W. C. (2014). *Global value chains and global production networks in the changing international political economy: An introduction*. Review of International Political Economy, 21(1), 1-8.

Notteboom, T. E. (2006). *Traffic inequality in seaport systems revisited*. Journal of transport geography, 14(2), 95-108.

Notteboom, T.E. (2016). *Portgraphic: Top 15 European Container Ports.* Accessed 5th of May 2016 at: http://www.porteconomics.eu/2016/02/23/portgraphic-top-15-european-container-ports-in-2015/

Notteboom, T. E., & Winkelmans, W. (2001). *Structural changes in logistics: how will port authorities face the challenge?* Maritime Policy & Management, 28(1), 71-89.

Notteboom, T. E., & Rodrigue, J. P. (2005). *Port regionalization: towards a new phase in port development.* Maritime Policy & Management, 32(3), 297-313.

Notteboom, T., & Rodrigue, J. P. (2006). *Challenges in the Maritime-Land Interface: Maritime Freight and Logistics.* Report prepared for the Korean Government, Ministry of Maritime Affairs & Fisheries, The Master Development Plan for Port Logistics Parks in Korea.

Ottaviano, G. I. (2001). *Footloose capital, market access and the geography of regional state aid*. Centro Studi Luca d'Agliano, Queen Elizabeth House Development Studies Working Paper, (155).

Palmer, S. (1999). *Current port trends in an historical perspective.* Journal for Maritime Research, 1(1), 99-111.

Pettit, S. J., & Beresford, A. K. C. (2009*). Port development: from gateways to logistics hubs.* Maritime Policy & Management, 36(3), 253-267.

Porter, M. E. (1998). *Cluster and the new economics of competition*. Harvard Business Review 76 (6): 77–90.

Porter, M. E. (2000). *Location, competition, and economic development: Local clusters in a global economy.* Economic development quarterly, 14(1), 15-34.

Prologis (2013). *Europe's most desirable logistics locations*. Logistics facility user survey. July 2013.

Rivera, L., Sheffi, Y., & Welsch, R. (2014). *Logistics agglomeration in the US.* Transportation Research Part A: Policy and Practice, 59, 222-238.

Railcargo (2015). *De ontwikkeling van het spoorvervoer.* Accessed 13th of May at: http://www.railcargo.nl/bibliotheek/studentenrubriek/ontwikkeling_spoorvervoer

Raimbault, N., Jacobs, W., & Dongen, F. (2015). *Port Regionalisation from a Relational Perspective: The Rise of Venlo as Dutch International Logistics Hub.* Tijdschrift voor economische en sociale geografie.

Rebel Group Advisory nv (2010). *Potentieanalyse geïntegreerd logistiek platform Roeselare-Izegem (Voor provincie West-Vlaanderen en West-Vlaamse Intercommunale).* Antwerpen: Rebel Group Advisory nv.

Rhoades, S. A. (1993). *Herfindahl-Hirschman Index*, The Federal Reserve Bulletin., 79, 188.

Robinson, R. (2002). *Ports as elements in value-driven chain systems: the new paradigm.* Maritime Policy & Management, 29(3), 241-255.

Rodrigue, J. P. (2012). *Supply chain management, logistics changes and the concept of friction.* In: Cities, Regions and Flows, London: Routledge.

Rodrigue, J. P., Comtois, C., & Slack, B. (2013). *The geography of transport systems* (Third press). New York: Routledge.

Rodrigue, J. P., & Notteboom, T. (2009). *The terminalization of supply chains: reassessing the role of terminals in port/hinterland logistical relationships*. Maritime Policy & Management, 36(2), 165-183.

Rodrigue, J. P., & Notteboom, T. (2010). *Comparative North American and European gateway logistics: the regionalism of freight distribution.* Journal of Transport Geography, 18(4), 497-507.

Rodrigue, J. P., & Notteboom, T. (2013). *Containerized freight distribution in North America and Europe*. In: Handbook of Global Logistics (pp. 219-246). Springer New York.

Roso, V., Woxenius, J., & Lumsden, K. (2009). *The dry port concept: connecting container seaports with the hinterland*. Journal of Transport Geography, 17(5), 338-345.

Sainz, R., Baños, J., Val, S., & Kattour, S. J. (2013). *The economic impact of logistics infrastructure: the case of PLAZA–the Zaragoza Logistics Platform.* Transportation Planning and Technology, 36(4), 299-318.

Schweizog, R., & Collins, A. (2014). *A simple location index plus some maps and no apologies: back to basics on the development of links between economic integration and spatial concentration of industries.* Tijdschrift voor economische en sociale geografie, 106(1), 17-35.

Sheffi, Y. (2013). *Logistics-intensive clusters: global competitiveness and regional growth*. In Handbook of Global Logistics (pp. 463-500). Springer New York.

Soubbotina, T.P. (2004). *Beyond Economic Growth* (Second edition). Washington: World Bank.

Storper, M., & Venables, A. J. (2004). *Buzz: face-to-face contact and the urban economy*. Journal of economic geography, 4(4), 351-370.

Statbel (2016). *Aantal BTW plichtige ondernemingen volgens economische activiteiten en plaats maatschappelijke zetel (Database).* Brussel: Belgische Overheid.

Strale, M. (2015). *The location of logistics activities in Northwest Europe: an empirical analysis*. In: Europa Regional 21.2013 (2015), 4, pp. 165-176. URN: http://nbn-resolving.de/urn:nbn:de:0168-ssoar-457146

Tian, Z. (2013). *Measuring agglomeration using the standardized location quotient with a bootstrap method.* Journal of Regional Analysis & Policy, 43(2), 186.

Torre, A., and A. Rallet. 2005. *Proximity and Localization.* Regional Studies 39 (1): 47–59.

Tyagi, R., & Das, C. (1997). *A methodology for cost versus service trade-offs in wholesale location-distribution using mathematical programming and analytic hierarchy process*. Journal of Business Logistics, 18(2), 77.

Urata, S. (2002). *Globalization and the growth in free trade agreements*. Asia Pacific Review, 9(1), 20-32.

Van Breedam, A., Vannieuwenhuyse, B., Vanroye, K. (2007). *Logistieke Poort Limburg. De Extended Gateway in de praktijk.* Antwerpen: Vlaams Instituut voor de Logistiek.

Van Geyte, J. (2015). *Coolblue neemt nieuw distributiecentrum in Tilburg in gebruik*. Accessed 13th of July at: http://www.retaildetail.nl/nl/news/coolblue-neemt-nieuw-distributiecentrum-tilburg-gebruik

van den Heuvel, F. P., De Langen, P. W., van Donselaar, K. H., & Fransoo, J. C. (2013). *Spatial concentration and location dynamics in logistics: the case of a Dutch province.* Journal of Transport Geography, 28, 39-48.

Van den Heuvel, F. P., de Langen, P. W., van Donselaar, K. H., & Fransoo, J. C. (2014a). *Proximity matters: synergies through co-location of logistics establishments.* International Journal of Logistics Research and Applications, 17(5), 377-395.

van den Heuvel, F. P., de Langen, P. W., van Donselaar, K. H., & Fransoo, J. C. (2014b). *Identification of employment concentration areas*. European Planning Studies, 22(1), 204-226.

Van der Lugt, L. M., & De Langen, P. W. (2005). *The changing role of ports as locations for logistics activities.* Journal of International Logistics and Trade, 3(2), 59-72.

Van der Lugt, L., Witte, J.J,, de Jong, O. (2015). *Havenmonitor. De economische betekenis van Nederlandse zeehavens 2002-2014*. Rotterdam: Erasmus Universiteit.

Van Klink, H.A. (1998). *Land access to seaports: Spatial and Functional Integration of Container Port Systems and Hinterland networks in Europe.* 113 Round Table on Transport Economics. Paris. Economic Research Centre ECMT-OECD.

Valentina, I., Burgering, C., Van den Broek, F., Groen, R., Van der Meulen, S. (2009). *Nederlandse Zeehavens; Onderscheid door Netwerkfocus. Toekomstige kracht door innovatieve samenwerking en duurzame achterlandlogistiek.* Amsterdam: ABN AMRO.

Vanelslander, T., Kuipers, B. , Hintjens, J., Van der Horst, M. (2015). *Vlaams-Nederlandse Deltamonitor 2001-2013.* Antwerpen/Rotterdam: Universiteit Antwerpen en Erasmus Universiteit Rotterdam.

Vanoutrive, T. & Verhetsel, A. (2014). *Logistiek en locatie 1: verkennende ruimtelijke analyse van de cluster logistiek en transport.* Steunpunt Ondernemen en Regionale Economie

Vanoutrive, T., Verhetsel, A., Vanelslander, T. (2014). *Logistiek en locatie 2: enkele relevante elementen voor een ruimtelijk economisch beleid met betrekking tot de logistiek.* Steunpunt Ondernemen en Regionale Economie

Veenstra, A., Zuidwijk, R., & van Asperen, E. (2012). *The extended gate concept for container terminals: Expanding the notion of dry ports*. Maritime Economics & Logistics, 14(1), 14-32.

Venables, A. J. (1996). *Equilibrium locations of vertically linked industries*. International economic review, 341-359.

Verhetsel, A., Kessels, R., Goos, P., Zijlstra, T., Blomme, N., & Cant, J. (2015). *Location of logistics companies: a stated preference study to disentangle the impact of accessibility.* Journal of Transport Geography, 42, 110-121.

Wagner, T. (2010). *Regional traffic impacts of logistics-related land use.* Transport Policy, 17(4), 224-229.

Weterings, A. (2014). *What makes firms leave the neighbourhood?* Urban Studies, 51(8), 1613-1633.

Woo, S. H., Pettit, S., & Beresford, A. K. (2011). *Port evolution and performance in changing logistics environments.* Maritime Economics & Logistics, 13(3), 250-277.

Zaiontz, C. (2016). *Jenks Natural Breaks.* Accessed 5th of May at: http://www.real-statistics.com/multivariate-statistics/cluster-analysis/jenks-natural-breaks/.