Exploring the relation between economic diversity and economic resilience in the Netherlands and Europe

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Abstract

One of the main aims of regional (economic) policies and planning policies is to create sustainable and resilient regions. Although the notion of resilience appears in increasingly more policy documents, less is known about what factors contribute to the resilience of regions and how to develop resilient regions. This research focused on the relation between the diversity of economic activities and economic resilience of metropolitan, conurbation, COROP (the Netherlands) and NUTS-2 (European) regions. A quantitative approach is used to define the diversity of a region with the *Simpson's diversity index,* the *Shannon-Wiener index* and the *Equitability index*. An economic resilience index is developed, which is based on the relative deviation of the development of the unemployment rates in a region with the national trend. The findings of this research show that on conurbation level, the *Equitability index* shows a positive relation between an increase in diversity and an increase in economic resilience.

Keywords

Resilience – Diversity – Economic regions – Resilience planning – Resilience index

Preface

Dear reader,

Five years ago, I moved from IJmuiden to Wageningen to study Landscape Architecture and Planning. The motivation to choose this study is based on my fascination for the landscape around us. Since I was a little child, I was fascinated by the complex infrastructure networks, the chaos and structure and all the developments in the Netherlands. I knew one thing for sure: I wanted to contribute to these ongoing developments and improvements!

Five years later, I'm about to finish my MSc and start my professional working career. This thesis is the final piece of art to complete my MSc and my life as a student. A great and honourable time, in which was able to enjoy the full range of student activities.

This thesis was never here without the help of two persons in particular. Jos has given me the opportunity to do my internship at Royal HaskoningDHV in September 2016. Due to close cooperation with you, I was able to see different aspects of the work of a consultant in the field of sustainability and area development. Thanks to the chance you have given me, I'll start my working career as a sustainability consultant, which is a real dream coming true.

I also have to thank Martha for her supervision. Without her clear mind and cooperation, I was never able to finish this thesis in the way I wanted. It was a real journey with all new routes for me and I discovered so many new aspects of doing research. Sometimes we struggled, but above all you gave me the clear direction and guidelines that form the basis of this thesis.

I hope that the reader of this thesis gains some new insights and discovers how interesting quantitative research is. In the end, we I hoped that I contribute with the thesis to a more sustainable and resilient future.

Bart Steman

September 2017, Wageningen

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Summary

One of the main aims of regional (economic) policies and planning policies is to create sustainable and resilient regions. Although the notion of resilience appears in more and more policy documents, less is known about what factors contribute to the resilience of regions and how to develop resilient regions, which is an important challenge for long-term sustainable. Therefore, it is necessary to better understand what contributes to the resilience of a region.

This research is focused on economic resilience of regions. What type of regional economies are successful in withstanding the impacts of a financial recession or not is subject of an ongoing discussion. This discussion is centred around the divide between on the one hand scholars who argue that specialisation is beneficial, whilst others argue that differentiation of economic activities is beneficial for a regional economy. This research tries to move forward our understanding of how regional economies function. Therefore, the aim of this research is to explore and assess if the diversity of economic activities contributes to economic resilience of regions.

I used a quantitative approach to define a regions' diversity of economic activities and its resilience. I used four different levels of economic regions, both within the Netherlands (metropolitan, conurbation and COROP) and Europe (NUTS-2), to define the diversity of economic activities. This is done based on data of employees and businesses per economic sector per region. I used the *Simpson's diversity index, Shannon-Wiener diversity index* and the *Equitability index* to compute the diversity of economic activities. The resilience of an economic region is based on unemployment rates, with which a relative resilience index is computed. This resilience index represents the difference in the development of unemployment rates between the national level and the regional level. The relation between the diversity of economic activities and resilience is analysed with a simple linear regression analysis.

The findings of this research show that an increase in diversity of economic activities is positively related to an increase in resilience, at least for the *Equitability index* in conurbation regions. However, this conclusion is fragile and highly dependent on how the indices are constructed and chosen, because the *Simpson's diversity index* and *Shannon-Wiener diversity index* show in most cases a negative relationship (though not significant) between diversity and resilience and on which level this relation is analysed. Therefore, more research on the relation between diversity and resilience should be done to further establish solid arguments that can inform spatial (economic) policies and strategies.

An increasing popularity of the term resilience in the field of planning practices and policies has made the term itself almost incontestable. Resilience is perceived as something 'good', the same as for sustainability. However, when this term is used as a buzzword without any critical reflection on how the terms is used, what resilience consists of and what contributes to resilience, the power of the concept and term itself lose its significance. Therefore, more efforts should be done in the operationalization of the term resilience and how it can contribute to the field of spatial planning.

Samenvatting

Een belangrijk doel van regionale (economische) visies en planningsvisies is om duurzame en veerkrachtige regio's te ontwikkelen. De term 'veerkracht' komen we steeds meer tegen in beleidsdocumenten, maar nog weinig is bekend over welke factoren bijdragen aan de veerkracht van een regio en hoe een veerkrachtige regio ontwikkeld kan worden, wat een belangrijke uitdaging is voor duurzame planning. Daarom is het noodzakelijk om beter te begrijpen wat bijdraagt aan de veerkracht van een regio.

Dit onderzoek focust zich op economische veerkracht van regio's. Wat voor type regionale economie is meer succesvol in het weerstaan van de impact van een financiële recessie en welke niet, is onderwerp van een voortdurende discussie. In deze discussie is er een groep wetenschappers die claimen dat economische specialisatie voordeliger is, terwijl een andere groep wetenschappers claimt dat differentiatie van economische activiteiten voordeliger is. Dit onderzoek hoopt deze discussie een stap verder te brengen en draagt bij aan het begrijpen van het functioneren van regionale economieën. Het doel van dit onderzoek is daarom om te verkennen en beoordelen of een diversiteit aan economische activiteiten bijdraagt aan de economische veerkracht van regio's.

Voor dit onderzoek heb ik een kwantitatieve methode gebruikt om de diversiteit aan economische activiteiten en de veerkracht van regio's vast te stellen. Ik heb vier verschillende niveaus van economische regio's gebruikt, waarvan drie in Nederland (grootstedelijke agglomeraties, stadsgewesten en COROP) en een op Europees niveau (NUTS-2). Om de diversiteit aan economische activiteiten vast te stellen heb ik data gebruikt over het aantal medewerkers en bedrijven per economische sector in een regio. Met deze data heb ik de *Simpsons diversiteitsindex,* de *Shannon-Wiener diversiteitsindex* en de *Equitability index* per regio berekend. De veerkracht van een regio is gebaseerd op de ontwikkeling van de werkloosheidspercentages in een regio, gecorrigeerd voor de ontwikkeling van de werkloosheidspercentages op nationaal niveau. De relatie tussen diversiteit aan economische activiteiten aan economische activiteiten en economische veerkracht is geanalyseerd door middel van een simpele lineaire regressieanalyse.

De resultaten van dit onderzoek laten zien dat een toename in een diversiteit aan economische activiteiten gecorreleerd is met een toename in economische veerkracht voor de *Equitability index* van stadsgewesten. Ik moet echter ook concluderen dat het slechts een klein bewijs is dat een toename van diversiteit ook daadwerkelijk leidt tot een toename van veerkracht. Deze conclusie is namelijk fragiel en hangt af van op welke manier de indexen worden berekend en op welk niveau deze relatie wordt getoetst. De *Simpon's diversiteitsindex* en de *Shannon-Wiener diversiteitsindex* laten bijvoorbeeld een negatief verband zien tussen diversiteit en veerkracht. Daarom is het noodzakelijk dat meer onderzoek gedaan wordt naar de relatie tussen diversiteit en veerkracht om tot houdbare conclusies te komen.

Een toename in de populariteit van de term 'veerkracht' in het domein van ruimtelijke planning en beleid heeft de term bijna onbetwistbaar gemaakt. Veerkracht wordt gezien als iets goeds, wat ook geld voor de term 'duurzaamheid'. Echter, de term komt nu terug als een modewoord en wordt gebruikt zonder enige kritische reflectie over wat veerkracht is en wat bijdraagt aan veerkracht. Daarmee gaat de kracht van het concept weg en verliest het zijn significantie. Daarom is het van belang dat de term veerkracht verder geoperationaliseerd wordt ten behoeve van het gebruiken in het domein van ruimtelijke planning.

1. Introduction

1.1 A societal aspiration for resilient regions

One of the main aims of regional (economic) policies and planning policies is to create sustainable and resilient regions (Adger, Amell, & Tompkins, 2005; Béné et al., 2017). Resilient regions have the notion of being 'good' regions, because "to argue that society, the economy, cities, or infrastructure should be less resilient is illogical, akin to a planner suggesting that development should by 'unsustainable'" (White & Hare, 2014, p. 934). Resilience is understood as the capacity of regions to deal with unpredicted (external) circumstances, such as climate events, terrorist attacks and financial crises (Meerow, Newell, & Stults, 2016). A major external factor that is well known is the worldwide financial crisis of 2008-2010, also known as the *Great Recession*. The financial markets on global level collapsed after the sublime mortgage market in the USA got stuck. The effects had a global scope, which impacted many national and local economies. Such shocks that occur on a global or national level "are rarely spatially neutral or equitable in their impact or implications" (Martin & Sunley, 2015, p. 2). This means that some regions (and nations) are more affected by this economic shock then others.

In the field of environmental and land-use policy making, there is a tension between on the one hand specialisation or uniformity and on the other hand variation and diversity (Hooijmeijer, Kroon, & Luttik, 2001). This duality has an explicit economic-geographic dimension, because whether a region depends on one strong economic sector or on multiple economic sectors influences the way in which a region functions. When a region faces economic growth, it is seen as something 'positive' in the field of policy making. Recently, spatial or regional economic policies have broadened their scope from a focus on economic growth towards developing resilient regions (Raco & Street, 2012), as a response to the increasingly more diverse range of external shocks as financial crises, climate change, and other extreme events (Pike, Dawley, & Tomaney, 2017).

Although the notion of resilience appears in more and more policy documents, less is known about what factors contribute to the resilience of regions and how to develop resilient regions, which is an important challenge for long-term sustainable planning (Adger et al., 2005; Andreoni & Duriavig, 2013). Therefore, it is necessary to better understand what contributes to the resilience of a region.

1.2 An ongoing scientific debate on resilience and diversity

Resilience is a highly-debated term. There is not one single definition of resilience, but in general there are three main perspectives on and definitions of resilience. The first is '*engineering resilience'*, which is understood – in a narrow sense - as the return rate to an equilibrium after a perturbation or a shock to a system. From this point of view, there is one stable state (equilibrium) to which the system returns (Holling, 1996).

The second perspective is *'ecological resilience*' which differs from engineering resilience in the sense that there are multiple equilibria. It implies that a perturbation to a system can push the system over a certain threshold, from where it will not return to its original stable state, but to another stable state in which the system still functions (Holling, 1996).

A third perspective of resilience is social-ecological resilience, also known as evolutionary resilience (Davoudi & Porter, 2012). From this perspective, it is recognised that complex systems are constantly changing, so there is no single equilibrium state that a system can return to or move forward after a

disturbance. This means that resilience of social-ecological systems is the ability to 'change, adapt and transform' in response to disturbances in the system (Folke et al., 2010).

One of the factors that could positively contribute to the resilience of a system is diversity. The claim that an increase in diversity enhances the resilience of a system is based on findings within ecological systems and it goes back for decades. For example, MacArthur (1955) suggested that the addition of species to an ecosystem enhances the different functions of this ecosystem, which in turn increases its stability and resilience. Although this is simplistic, the basic assumptions still hold today (Charnley, Spies, Barros, White, & Olsen, 2017; Douglas et al., 2017; Schnecker et al., 2017).

However, the assumptions that an increase in diversity leads to more resilience are rarely substantiated with empirical evidence. Especially in human and economic systems, this relation between diversity and resilience is not clear yet and highly controversial. Recently, researchers have pursued to transfer the metaphor of resilience from ecology, psychology, and disaster studies to the field of regional economic developments (Pendall, Foster, & Cowell, 2007; Swanstrom, 2008). The aim of this exercise is to find out how resilient local or regional economies are. The notion of resilience became increasingly relevant after the Great Recession of 2008-2010, because the whole global economic system was impacted by a major shock. Major recessions like this "can be viewed as 'system-wide' shocks that periodically interrupt and disrupt the process of economic growth and development" (Martin, 2012, p. 3). This shock was one of the factors that scholars started to further develop the notion of economic resilience.

One of the scholars who contributed to a better theoretical underpinning of resilience in economic literature is Martin (2012; 2015). He argues that, at the moment, there is "much ambiguity and difference of view as to the precise meaning of the notion or regional or local economic resilience, how it should be measured, whether resilience is a positive or a negative attribute and what it implies for policy intervention" (Martin, 2012, p. 2). Besides that, the impacts of a recession are not spatially even distributed and "how regional economies adapt over time, and why some regions appear more successful in this respect than others, are largely unresearched issues" (Martin, 2012, p. 11). Therefore, he developed the notion of regional economic resilience further to agree on a common understanding amongst scholars.

What type of regional economies are successful in withstanding the impacts of a financial recession or not is subject of an ongoing discussion. This discussion is centred around the divide between on the one hand scholars who argue that specialisation of economic activities is beneficial (Wirtz, Tuzovic, & Ehret, 2015), which are based on theories on economies of scale and agglomeration benefits (Duranton & Puga, 2000; Koster, van Ommeren, & Rietveld, 2014), whilst others argue that differentiation of economic activities is beneficial for a regional economy (Davies & Tonts, 2010; Deller & Watson, 2017). This long-lasting debate on specialisation versus differentiation ends up in a 'who is right' debate, in which different authors try to convince the other party that they are right (van Oort, de Geus, & Dogaru, 2015). The only way forward in this discussion is to add empirical data and evidence in this debate to support the arguments and findings for either specialisation of differentiation, and to move forward in our understanding or how regional economies function.

1.3 Aim of this research

The central aim of this research is to contribute to the understanding of the relation between diversity and resilience in general. Since these are two broad terms which are difficult to research, I focus on

economic systems. More specifically, this research focuses on the diversity of an economy and whether this relates to economic resilience in different economic regions. Therefore, the aim of this research is to explore and assess if the diversity of economic activities contributes to economic resilience of regions.

Based on this, the main research question is:

- What is the relationship between regional economic diversity and regional economic resilience?

I formulated two sub-research questions to further explore what the characteristics are of this relationship. These are related to the scale level of economic regions and how the diversity of a regional economy can be measured:

1. On which scale level is the relationship between diversity and resilience the strongest?
2. Which diversity index shows the strongest relationship with resilience?

Besides these two sub-research questions, I formulated two additional sub-research questions that are focused more on the 'why' question. When a relationship is found or not between economic diversity and economic resilience, it is interesting to analyse if there are some general spatial patterns to observe in terms of the location of the regions where this relationship is the strongest or the least strong, and whether there are some economic sectors that influence this relationship or not. Therefore, the following two sub-research add an extra layer to this research:

3. What type of regions in terms of geographical location do or do not show a relationship between diversity and resilience?
4. Which dominant economic sector in a region influences the relationship between economic diversity and resilience?

1.4 Approach

For this research, I use a quantitative approach to define a regions' diversity of economic activities and its resilience. I use four different levels of economic regions, both within the Netherlands and Europe, to define the diversity of economic activities. This is done based on data of employees and businesses per economic sector per region. The resilience of an economic region is based on unemployment rates, with which a resilience index is computed. The relation between the diversity of economic activities and resilience is analysed by a simple linear regression analysis.

In this report, I first further introduce the basic theoretical underpinnings of resilience and diversity in chapter 2. I further develop the notion of regional economic resilience and I identify what the relationship is between diversity and resilience. In chapter 3, I further specify regional economic resilience and develop a resilience index. Besides that, I introduce three diversity indices that are used to measure the diversity of an economic region. Based on this, the steps for the statistical analysis are explained. The outcomes of this analysis are presented in chapter 4. In chapter 5, I aim to answer the sub-research questions and the main research question, which form the basis for the conclusion and recommendations in chapter 6.

2. Theoretical framework

2.1 Resilience

The main idea behind resilience is that it describes how an entity or a system reacts to shocks and both internal and external disturbances. The world resilience originates from the Latin *resilire*, which means something like 'to leap back'. One of the main contributors the literature on resilience is the ecologist Holling, who made the distinction between two types of resilience.

The first definition of resilience is "how fast a system that has been displaced from equilibrium by a disturbance or shock returns to that equilibrium" (Holling, 1973). This definition of resilience is called 'engineering resilience', because it assumes that any system should return to its original state, which is called the equilibrium (Holling, 1996). It emphasizes 'efficiency, constancy, and predictability', attributes that engineers are in favour of, because their designs can be calculated and simulated on beforehand. In this definition, "resistance to disturbance and speed of return to the equilibrium are used to measure the property" (Holling, 1996, p. 33).

The second notion of resilience is called 'ecological resilience', because this fits more with how ecosystems function. The main assumption here is that when "a shock to a system exceeds that system's absorptive capacity, or 'ability to bounce back, then the system will be pushed into some other alternative (equilibrium) state or form" (Martin & Sunley, 2015, p. 5). Therefore, instead of one single equilibrium or stable state of the system that is used in engineering resilience, there exist multiple equilibria in ecological resilience (Holling, 1996). In this definition, "the magnitude of disturbance that can be absorbed before the system changes its structure" (Holling, 1996, p. 33) is used to measure resilience.

The third notion of resilience that can be found in the literature is 'adaptive resilience' (or socio-ecological resilience). This notion of resilience is often used within the bodies of literature about complex adaptive systems (CAS) theory and evolutionary theory. Here, the focus is on the dynamics between continuity and change in self-organizing systems in which both internal as well as external pressures influence the system, and "the capacity of such systems to absorb and adapt to such pressures" (Martin & Sunley, 2015, p. 6).

In every field where the concept of resilience is used, the following four questions need to be addressed to make sure that all important aspects of resilience are covered (Carpenter, Walker, Anderies, & Abel, 2001):

1. Resilience of what?
2. Resilience to what?
3. Resilience by what means?
4. Resilience with what outcome?

The first question (resilience of what?) relates to the defining the characteristics of the system - so in this case the regional economy – that need to be resilient and how this is measured. This means that there need to be criteria that describe how a regional economy has changed due to a shock, which implies that a 'meaningful reference state' has to be defined, "against which the impact of a shock can be measured and the extent and nature of recovery from that shock can be judged" (Martin & Sunley, 2015, p. 12).

The second question (resilience to what?) refers to the shock to the system that is of interest here. So, what is the shock about, what is "its intensity, duration and its effects?" (Martin & Sunley, 2015, p. 12). Therefore, the shock to the system should be defined, because this allows the researcher to draw better conclusions from the data and analysis. An environmental shock, for example, differs from an economic shock, because the first causes environmental damage which might hinder an economic system, while the latter does not have to influence the environment but can influence, for example, people's lives due to unemployment.

The third question (resilience by what means) deals with "the mechanisms and processes by which a regional or local economy reacts and adjusts to a shock" (Martin & Sunley, 2015, p. 12). The aim of this question is, amongst others, to analyse what mechanisms, processes and local or regional factors determine the impact of the shock. Differences between regions might influence the resilience of a regional economy to a shock.

The fourth and final question (resilience with what outcome?) is concerned with the reaction of the system that is researched to the shock. Besides the interest in how a regional economy recovers and how long it takes to recover, the way how it recovers is also of interest here. Does the regional economy returns to the pre-shock state (the reference situation as mentioned in 'resilience of what'), does it move forward to a more positive or negative economic development path?

The above-mentioned definitions of the three types of resilience are necessary to understand to following section, where the notion of regional economic resilience is introduced.

2.2 Regional economic resilience

Within the discipline of planning and economic geography, the notion of resilience has gained ground over the past years, not without the necessary struggles. Transferring a concept from one kind of system (ecosystem) to another kind of system (local or regional economy) involves all kind of ontological questions. This need to be overcome before one can use the basic ideas. The key contribution of the notion of resilience to that of regional economies is that it focuses on the impact of shocks and their role in constructing the trajectories of regional economic development. This contributes to the understanding of regional differences in economic developments and enables us to explore how regional economies vary in their vulnerability and reaction to shocks (Martin & Sunley, 2015).

The idea of regional economic resilience is mainly based on the insights from both engineering as well as ecological resilience. On the one hand, it analyses the difference of economic growth to the pre-shock growth path (engineering resilience), but on the other hand it acknowledges that new economic development paths (both positive as well as negative) might be developed after a shock to the system occurs.

A definition of regional economic resilience as developed by Martin and Sunley is (2015, p. 13): "the capacity of a regional or local economy to withstand or recover from market, competitive and environmental shocks to its developmental growth path, if necessary by undergoing adaptive changes to its economic structures and its social and institutional arrangements, so as to maintain or restore its previous developmental path, or transit to a new sustainable path characterized by a fuller and more productive use of its physical, human and environmental resources". They take the development

growth path as a reference state, which means that the equilibrium they refer to is not a single state, but an evolving state that changes every year. It is therefore a relative instead of absolute measure.

Based on the four questions which are introduced in paragraph 2.1, the outlines of the resilience of a regional economy can be introduced. First, the resilience of the economic system is measured. Martin (2012) argues that employment levels give a better representation of how a region responds to external (financial) shocks. For example, the output of a company might remain the same, while they sacked several administrative and supportive functions to reduce their costs. However, these people are unemployed, which has all sorts of negative externalities. They might face for example personal health problems (e.g. mental illness due to stress), must apply for a minimum unemployment payment from the government and do have to search for other jobs in insecure times. Unemployed people do also impact local governmental finances, as they must increase their grants and payments (*ibid)*. Besides that, the aim of planning professionals is not only to foster economic growth, but also to stimulate the welfare and well-being in a region. They measure and analyse more than only the economic output of a region to assess how the region functions and develops (Lichfield, Kettle, & Whitbread, 2016).

Second, as introduced before, the external shock is the *Great Recession*. This financial crisis impacted the international and national financial markets from 2008 onwards, which caused an increase in debts, bankruptcies, and unemployment levels. Third, regions differ from each other in the distribution and diversity of economic activities. Whether this diversity of economic activities contributes to resilience or not will be addressed in this study.

Finally, how the economic system (i.e. unemployment levels) reacted to the external shock will be analysed using the following to concepts:

- Resistance to an external shock;
- Recovery to a reference situation.

2.2.1 Resistance

The resistance of a regional economy can be observed by analysing the trends in (un)employment. The resistance of a regional economy indicates how it responds to a negative external financial shock, which leads to an increase in unemployment levels. When there is an increase in unemployment levels on national level, the increase in unemployment levels in a region can be lower (Region B in), the same or higher (Region A). In the first case, the region is more resistant than the national level to the financial shock. In the last case, the region is less resistant than the national level to the financial shock (Martin & Sunley, 2015).

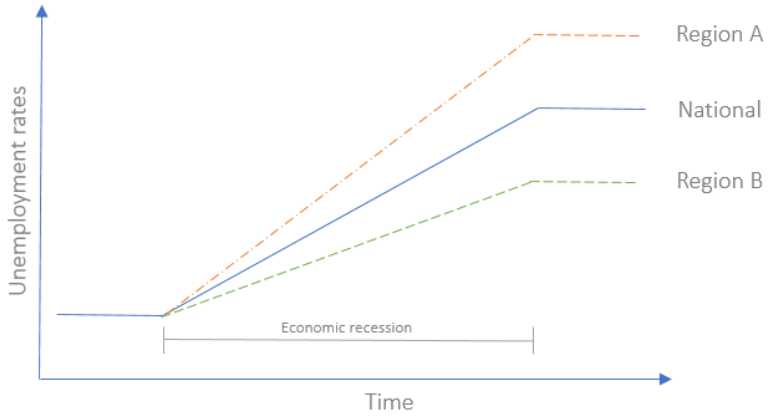

Figure 1. Illustration of regional economic resistance

2.2.2 Recovery

The recovery of a regional economy indicates how it responds after a financial shock in times of recovery, indicated by a decline in unemployment levels. When there is a decrease in unemployment levels on national level, the decrease in unemployment levels in a region can be lower (Region A in), the same or higher (Region B). In the first case, the region recovers less than the national level to the economic growth. In the last case, the region recovers better from the financial shock (Faggian, Gemmiti, Jaquet, & Santini, 2013; Martin & Sunley, 2015).

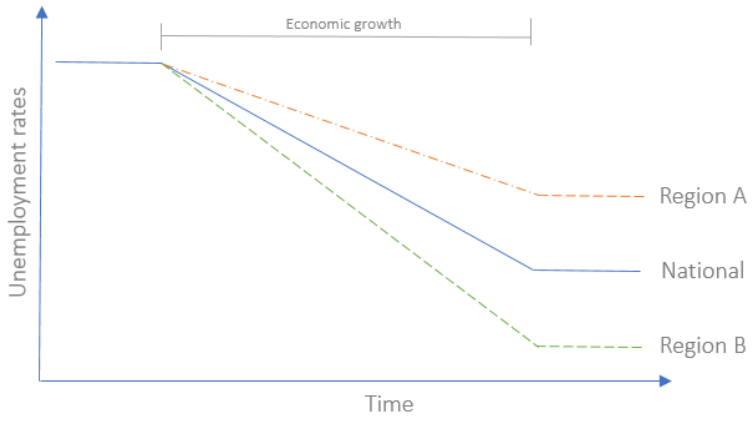

Figure 2. Illustration of regional economic recovery

2.3 Diversity versus specialisation

The concept of resilience is often related to the concept of diversity. For example, Folke et al. (2002) argue that an increase in diversity generates more capacity of the system to react on pertubations (i.e. shocks) in the system and therefore increases the resilience of the system. Also, Andreoni and Duriavig (2013, p. 126) state that the diversity in a system reduces "the socio-economic impacts" caused by such unexpected shocks like economic crises. Here we touch upon a largely debated issue within the field of economic geography.

Within the field economic geography, there has been a long-lasting debate around diversity versus specialisation. Davies and Tonts (2010, p. 232) argue that "those places with diverse economies are more resilient in socio-economic terms than those with a narrow economic base". The argument for

this is that different types of industries and businesses have “different elasticities of demand, different export orientations, different labour and capital intensities, and different exposure to external competition” (Martin & Sunley, 2015, p. 26), which reduces impacts of a shock to the region (decreases its vulnerability) and enhances the economic recovery after a shock. Here, the notion of diversity of economic activities reflects “differences in economic structures” (Milizia & Shanzi, 1993, p. 222). Thus, the more diverse the region’s economy is, the more resilient it theoretically would be when shocks occur. This means that on the contrary a region with a low diverse economy is more vulnerable to shocks and economic recovery after a shock will take longer.

According to Milizia and Shanzi (1993), the more diverse a metropolitan area is in terms of economic activities, the more stable the economic growth pattern is, and the less unemployment there is than in more specialized areas. They claim this because a diverse economy has all kind of different sectors that experience different economic fluctuations during different times. This, however, does not mean that in a metropolitan area no specialized sectors might exist, but that in a metropolitan area a sufficient amount of different specialisations need to be present in order to be stable, because more diverse metropolitan areas “tend to have more industries that can remain relatively healthy during difficult times and retain their employment levels” (Milizia & Shanzi, 1993, p. 223).

On the contrary, there are arguments that specialisation of economic activities or clustering of industries is beneficial for both innovation and economic growth. Van Oort et al (2015) conclude based on a study of 205 European regions between 2000 and 2010 that diversity of economic activities is strongly related to growth of employment levels, whilst on the other hand specialization of economic activities is related to productivity growth. The latter is related to theories of agglomeration benefits (Glaeser, Kallal, Scheinkman, & Shleifer, 1992). It is assumed here that a clustering of economic activities leads to knowledge exchange and competition, which stimulates innovation and economic growth of the sector. Economic growth leads in turn to more economic power and the capacity to withstand certain shocks, which in turn makes it more resilient. However, when a region only depends on one sector, this region might be vulnerable to economic conjunctures in that specific sector, which makes the region less resilient in that sense. Here, we touch upon a relevant aspect of this debate, because more authors concluded that both aspects matter in terms of regional economic performance (see e.g. Duranton and Puga (2000) and O’Hualloachain and lee (2011)).

What should be noticed here is that this long-lasting debate on specialisation versus differentiation ended up in a ‘who is right’ debate, in which different authors try convince the other party that they are right (van Oort et al., 2015). Instead of seeing this debate as an ‘either-or’ debate, the outcomes of this type of research are largely dependent on how diversity and resilience are measured. Therefore, it is difficult to argue that one is right and another is wrong, but only solid arguments can be given based on research findings why a certain claim is made.

2.4 Diversity and resilience

The claim that an increase in diversity enhances the resilience of a system is based on findings within ecological systems and it goes back for decades. For example, MacArthur (1955) suggested that the addition of species to an ecosystem enhances the different functions of this ecosystem, which in turn increases its stability and resilience. Tilman et al. (1996) concluded that diverse plots (4 x 4m) have a greater stability of the ecological function and that it was more stable. This was also found in an earlier study by Frank and McNaughton (1991), who concluded that after the 1988 Yellowstone drought, the

more diverse natural grassland communities recovered faster than less diverse communities. Peterson et al. (1998) argue that "the consequences of species loss may not be immediately visible, bus species loss decreases ecological resilience to disturbance or disruption. It produces ecosystems that are more vulnerable to ecological collapse and reduces the variety of possible alternative ecological organizations". This means that a more diverse ecosystem positively contributes to the resilience of that ecosystem.

Furthermore, on landscape level the influence of diversity is also noticed. Schippers et al (2014) analysed both small-scale and large-scale landscapes in order to assess the resilience of ecosystems. They conclude that a more diverse landscape leads to a greater genetic and species diversity, which "stabilizes populations and strengthens the different ecosystem elements in the landscape" (Schippers et al., 2014, p. 193). The main conclusion is thus that a more diverse ecosystem serves more ecosystem services, which increases the systems' resilience.

2.5 Economic diversity and economic resilience

Based on the above-mentioned introduction of economic resilience and the notion of diversity, I developed a hypothesis for economic resilience. It is argued that a more diverse system is more resilient that a less diverse system. When this assumption is translated to an economic system, it means that a more diverse economic system should be more resilient than a less diverse economic system (see Figure 3). I will explain this relation with the following example of two fictive and simplified regions.

Region A is a diverse region in terms of economic activities. There is a wide range of businesses and employees present, varying between agriculture, healthcare, education, services and governmental organisations. Region B contains a less diverse range of economic activities, because its' economic structure is based on industrial activities. When there is an economic recession, not all sectors will have the same impact in terms of loss of consumption, production and output, which means that (as said) the impact of an economic recession is not geographically equal. In this case, imagine that both regions are negatively impacted by a recession, which leads to an increase in unemployment rates. In Region B, people work mainly in the industry sector and are skilled for that type of work. With the economic recession, people get unemployed and face the situation that on the hand, they are not skilled to do other work, and on the other hand there are no other sectors in that area which have vacancies. In region A, the economic recession will influence not all sectors with the same impact, which means that some sectors do face more loss of jobs than others, or even some sectors have no impact of the recession at all. I assume that this diversity enables people who lose their job in a sector might find a new job in another sector. To conclude this example, the unemployment levels in region An increase less than in region B, due to its diversity of economic activities. This, hypothetically, makes the region more resilient.

Whether this claim holds or not is what is being researched in this thesis. When a more diverse economic system proves to be more resilient than a less diverse economic system, then the theory of diversity holds. However, when there is no proven relationship between economic diversity and resilience, other factors than diversity might contribute more to the resilience of an economy than the diversity of economic activities. These other factors, however, are not included in this research.

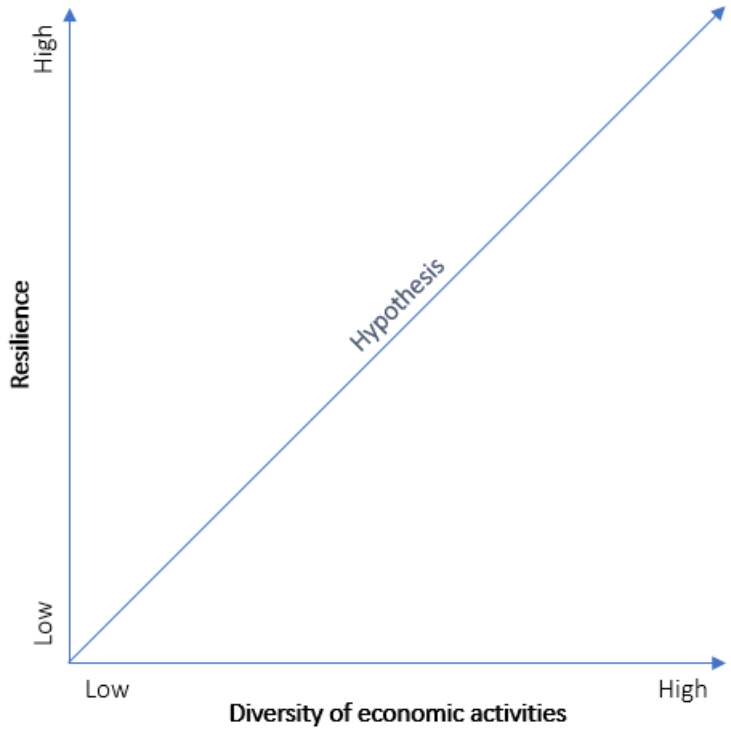

Figure 3. Hypothesis of relationship between diversity of economic activities and economic resilience

3. Methodology

3.1 Research areas

I conduct this study for the Netherlands and Europe. What can be observed in Figure 4 and 5 is that the unemployment rates did not only increase in the Netherlands, but it did in almost the rest of Europe. However, there are some major differences in terms of impact of the economic crisis in unemployment rates in the period between 2008-2014. For example, Greece had an unemployment rate of 30,2% in 2013, whilst Norway only had 3,2%. Next to that, in some countries the unemployment rates started to decline already in 2010 (e.g. Estonia), whilst other reached their peak in 2014 (e.g. Spain). This means that there are major differences in where and how the economic recession impacted the unemployment levels. In this paragraph, I give a brief introduction of the economic developments and characteristics of both the Netherlands and Europe.

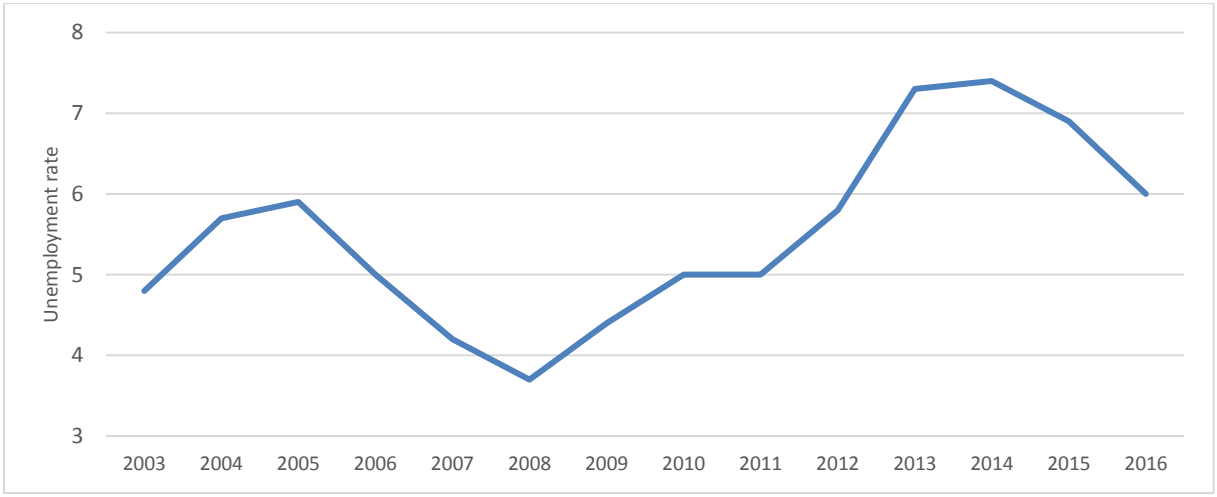

Figure 4. Development of unemployment rates in the Netherlands (CBS, 2017)

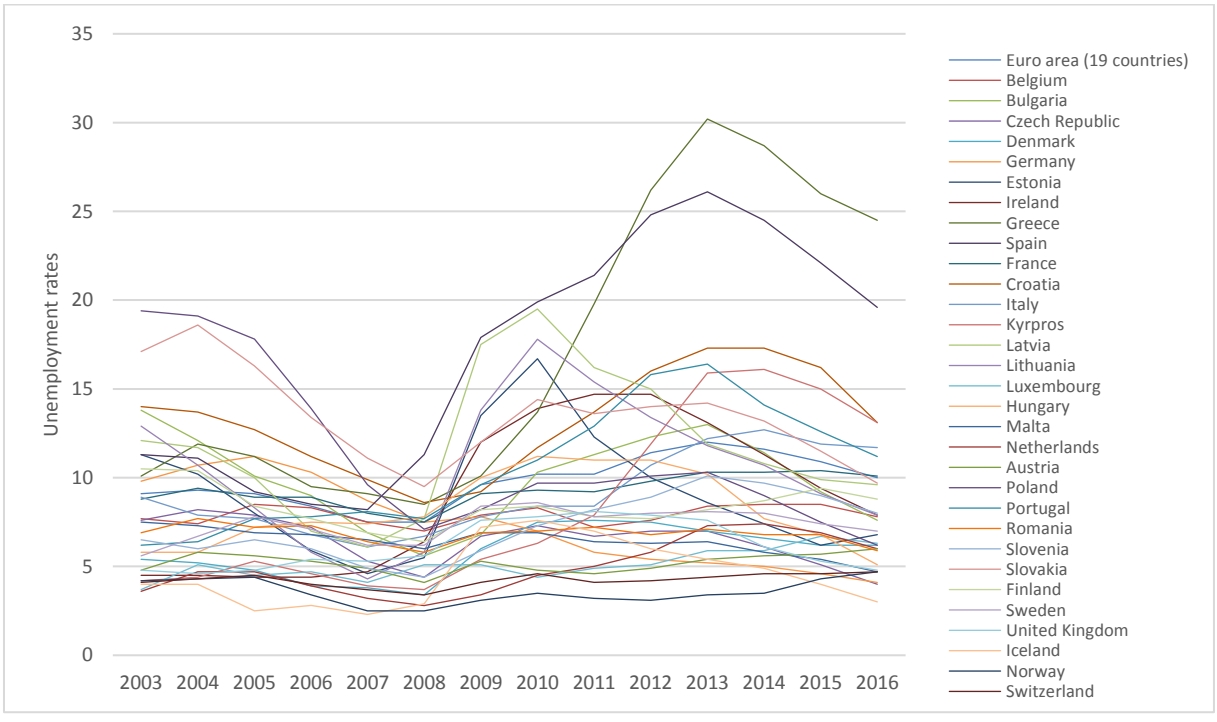

Figure 5. Development of unemployment rates in Europe, per country (EUROSTAT, 2017)

Europe is characterized by a wide range of countries in terms of difference in population size and gross domestic product (GDP) per capita (Figure 6). For example, Iceland had 329.000 inhabitants in 2015, while France had 66,4 million inhabitants in 2015. The GDP per capita ranges between €3.500 in Albania and €91.900 in Luxembourg (2015). This wide range shows that not all regions in Europe do have the same economic standard and that both economic as well as living conditions differ within Europe.

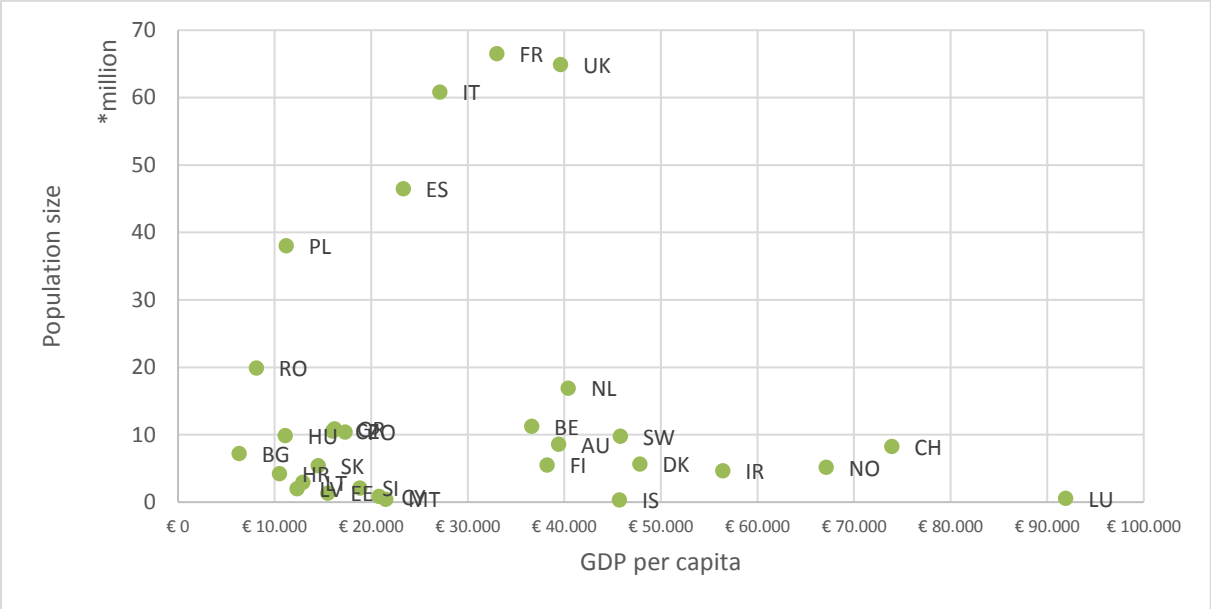

Figure 6. Population size and GDP per capita for European countries in 2015 (EUROSTAT, 2017)

Next to the diversity in population size and GDP, the economic structures of each country differ as well. As can be observed in Figure 7, one can identify that there is a difference in the distribution of the primary (agriculture, forestry and mining), secondary (industry and construction) and tertiary (service) sectors in Europe (EUROSTAT, 2017). In this figure, the development of these sectors is presented too for period 2004-2014. The primary and secondary sector are mainly situated in the more rural areas of Europe, whilst the tertiary sector is mainly centred in capitals and urban areas, especially in the Western part of Europe.

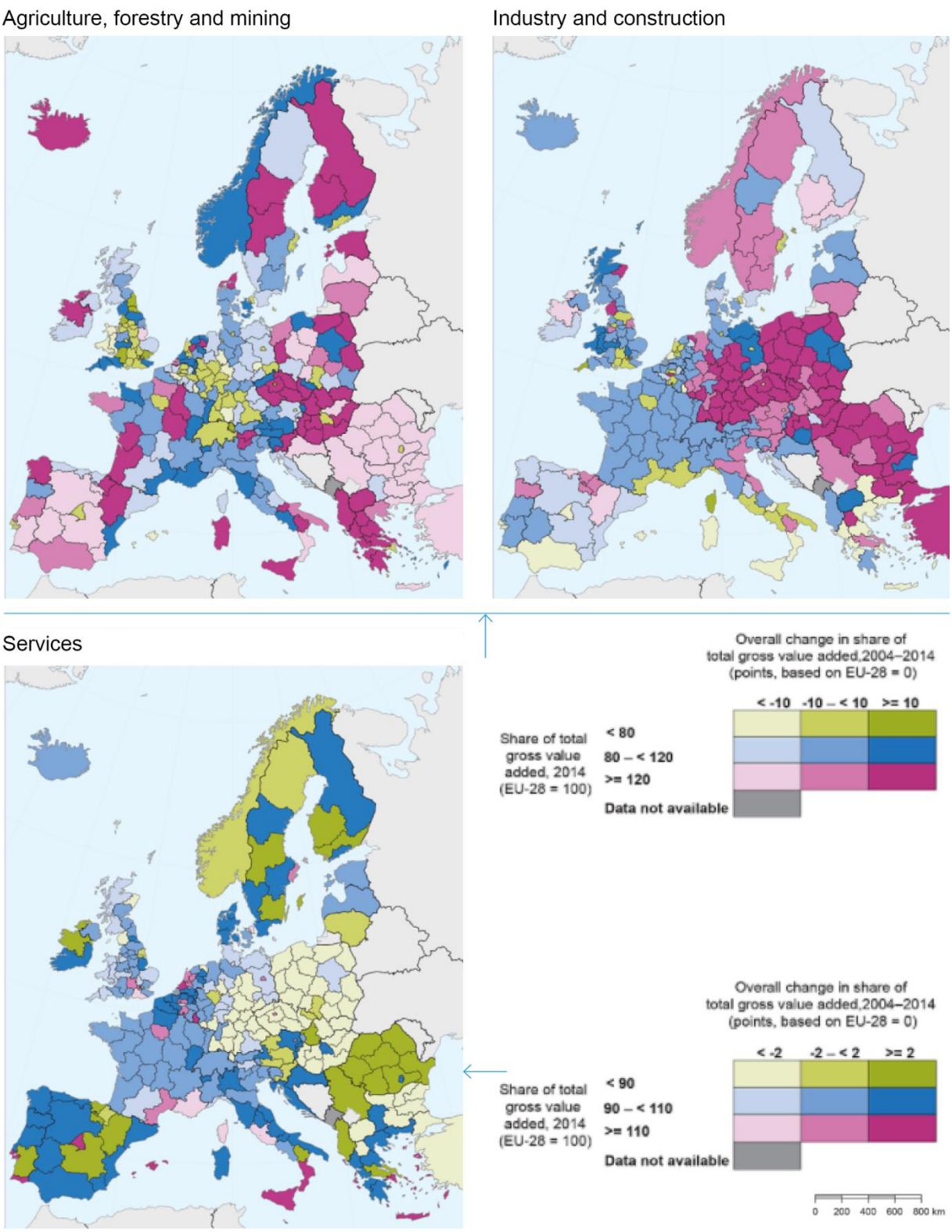

Figure 7. Share and overall change in the share of a sector in total gross value added, by NUTS-2 regions, 2004-2014. Source: EUROSTAT, 2017

3.2 Economic regions

For this research, the matter of scale is important, because the boundaries of the measurement units influence the outcomes of this research. Two input variables for the indices, which will be explained later in this chapter, are unemployment data and data of economic activities of employees and businesses. When I want to relate these variables, I face the following problem. An employee who lives in city A does not necessarily work in that city, but for example in city B, which may be 50 km farther. When this employee gets unemployed, it means that the employer (s)he is working for dismisses him/her in city B, but the unemployment does not increase here but in city A. This implies that an employee has a source (where he/she lives) and a destination (where he/she works). I call this the 'source-destination' issue.

Data on unemployment is available for the source of the employee (city A). Data on diversity of economic activities is available for the destination of that employee (city B). This means that the relation between economic diversity and economic resilience cannot be derived at a too fine scale, e.g. at municipal level. Therefore, I used four different levels of economic and administrative regions to minimize this 'source-destination' issue, while maintaining sufficient regional variability.

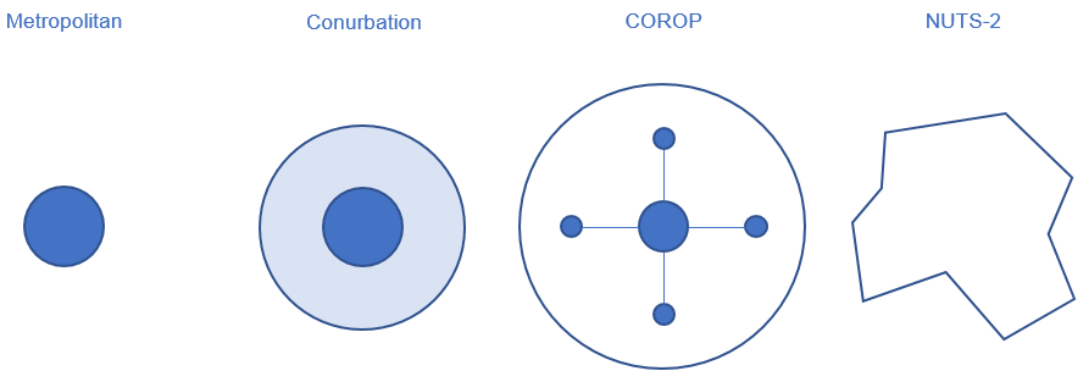

Figure 8. Schematic overview of different economic regions

In the Netherlands, three different levels of economic regions can be separated: metropolitan (NL: grootstedelijke agglomeraties), conurbation (NL: stadsgewesten) and COROP regions[1]. The first, metropolitan, is based on morphological characteristics of an area. A metropolitan region is characterised by a form of connected residential, industrial, or business area that goes beyond administrative boundaries (i.e. municipalities) (Pumain, Daint-Julien, Cattan, & Rozenblat, 1992). Based on historical developments, a city and its surrounding villages might have become one large metropolitan area, but still can have their administrative boundaries. The main criterion is that the main city in a metropolitan region does have more than 100 thousand inhabitants (CBS, 2005). There are 22 metropolitan regions in the Netherlands.

At the second level, the conurbation, the metropolitan region is taken as starting point. From there, two analyses are made based on the regional labour market and the housing market (CBS, 2005). The scope of a conurbation is based on the reciprocal relations in a certain region. This implies that the people who work in that conurbation live there and vice versa. Besides that, most the alterations in

[1] See appendix 1 for an overview of the different regions in the Netherlands

the regional housing market should include rehousing within the conurbation. Based on these criteria, 22 conurbation regions are identified in the Netherlands.

The first two levels are based on economic arguments. The third level, COROP[2] regions, are not per se based on economic reasons, but spatial reasons in general. The division of regions is based on the 'nodal-point' principle, in which a central point (a city) and its area around it (in which it functions as the central point of activities) form one region, not only in economic sense but also in terms of services. There are 40 COROP regions in the Netherlands, which are similar to the European classification of NUTS[3]-3 levels.

On European level, different (1, 2 and 3) NUTS[4] levels can be identified. For this research, I used the most common level for statistical analyses: NUTS-2. This level normally follows existing administrative boundaries and national identified statistical regions. For example, in the Netherlands the provinces are the NUTS-2 regions. For countries where that is not the case, the rule of thumb is that the population size of a NUTS-2 region should lie between 500 thousand and three million inhabitants.

3.3 Measuring regional economic resilience

3.3.1 Input data

The input data that I needed to calculate the resilience of an economic region are the unemployment rates. In the Netherlands, unemployment is defined as the percentage of the labour force between 15-75 years who do not have a payed job, who recently searched for a job and who are immediately available for a job. On European level, the unemployment rate is the unemployed percentage of the labour force between 25-64 years. For the Netherlands, I extracted the data from the Dutch Bureau of Statistics (CBS). For the European level, I extracted the data from EUROSTAT (see Table 1). For the Netherlands, the data was available on two levels: the municipal level and the COROP level. Therefore, the data had to be aggregated to both the metropolitan and the conurbation level. This is done by taking the average unemployment rates of all municipalities per economic region. For the analysis of the NUTS-2 regions, I only included the countries with at least two NUTS-2 regions, because only then is it possible to determine the regional economic resilience. With only one region in a country available, the unemployment rate of that region is the same as the national unemployment rate, which means that there is no deviation. This, however, is necessary to assess whether a region is resilient or non-resilient.

Table 1. Source of data on unemployment

Scale	Level	Data source	Data available on level of	Data available for years	Unemployment of labour force
Netherlands	Metropolitan	CBS	Municipality	2007-2014	15-75 years
Netherlands	Conurbation	CBS	Municipality	2007-2014	15-75 years
Netherlands	COROP	CBS	COROP	2007-2014	15-75 years
Europe	NUTS-2	EUROSTAT	NUTS-2	2007-2014	25-64 years

[2] Coördinatie commissie Regionaal OnderzoeksProgramma, also known as NUTS-3 areas on European level.
[3] An overview of NUTS-2 regions can be found at http://ec.europa.eu/eurostat/documents/3859598/5916917/KS-RA-11-011-EN.PDF
[4] French: Nomenclature des Unités Territoriales Statistiques

3.3.2 Resilience index

As explained in chapter 2, the economic resilience of a region consists of two aspects that can be measured.

1. **Resistance** to a recessionary shock
2. **Recovery** from a recessionary shock

Based on these two aspects, I developed a resilience index. The shortcoming of using one index is that the outcomes of this research are largely dependent on the quality of this index (Irwin et al., 2016). However, the aspects of this index are based on previous research done on regional economic resilience and proved to be a useful index. Therefore, a resilience index should consider these two aspects (Faggian et al., 2013; Fingleton, Garretsen, & Martin, 2012; Martin, 2012).

Next to that, there are two other factors that should be considered for a resilience index. First, the factor time is important, because resistance and recovery of unemployment levels can only be observed when there is a time difference. Second, it should be a relative measure, because based on the unemployment rates of a region alone, one cannot see how the local system reacts to the 'stable state'. I defined the stable state as the difference in unemployment rates on national level between year *t* and *t-1*. This is in line with how Martin (2012) defined his stable state of regional economic resilience. However, Martin (2012) works with employment rates, whereas I work with unemployment rates.

Based on this stable state, I defined the regional economic resilience as difference in unemployment rates on national level minus the difference in unemployment levels in a region between year *t* and *t-1*. This results in formula 1.

$$(\mathbf{1})\ R = (Un_t - Un_{t-1}) - (Ur_t - Ur_{t-1})$$

Here R is the resilience index, U the unemployment rates, while subscripts n and r stand for the national and the regional level, respectively. A shorter and simplified version of this formula is (2):

$$(\mathbf{2})\ R = dUn - dUr$$

When $R > 0$, it means that the region is more resistant to a recessionary shock, because the unemployment rate increases less than on national level, and/or has a relatively high recovery in case of a decline of unemployment rate on national level, because the unemployment rate in that region decline faster than on national level. When $R < 0$, it means that the region is less resistant to a recessionary shock, because the unemployment rate increases more than on national level, and/or has a relatively low recovery, because the unemployment rate in that region decline less than on national level. An overview of the interpretation of R is included in Table 2.

Table 2. Interpretation of regional economic resilience indices

$R < 0$: non-resilient		$R > 0$: resilient	
National level	**Regional level**	**National level**	**Regional level**
Increase in unemployment rates	means that the region is less resistant	Increase in unemployment rates	means that the region is more resistant
$dUn > 0$	$dUn < dUr$	$dUn > 0$	$dUn > dUr$
Decrease in unemployment rates	means that the region has less recovery	Decrease in unemployment rates	means that the region has more recovery
$dUn < 0$	$dUn > dUr$	$dUn < 0$	$dUn < dUr$

For the three different levels in the Netherlands, the developments in unemployment rates for the Netherlands are used as *Un*. For the NUTS-2 level, the unemployment rates of each country are used as *Un*, which means that a region in, for example, Spain is compared with the unemployment developments in Spain, and not Europe in total.

3.4 Economic Diversity

3.4.1 Input data

To calculate the diversity of economic activities, I made use of data on employees and businesses per economic sector. Therefore, I extracted data from the CBS and EUROSTAT. There was no data available on the metropolitan and conurbation level, but only on municipality level. Therefore, I aggregated the number of employees or businesses per sector per municipality for all the municipalities in a metropolitan or conurbation region (see Table 3).

Table 3. Source of data on diversity of economic activities

Scale	Level	Data source	Data available on level of	Data available for the years
Netherlands	Metropolitan	CBS	Municipality	2008
Netherlands	Conurbation	CBS	Municipality	2008
Netherlands	COROP	CBS	COROP	2008
Europe	NUTS-2	EUROSTAT	NUTS-2	2008

In the Netherlands, the CBS uses the *Standaard Bedrijven Index 2008*[5] classification to specify the main activity of a business (see Appendix 2 for an overview of the SBI2008 classification). This classification is based on the classification of the European Union, the *Nomenclature statistique des activités economiques dans la Communauté Européenne* (NACE Rev 2), which is used to classify the activities of economic activities on European level (EUROSTAT, 2008)[6].

There are two notes that must be shared of this input data. First, there is a difference in the availability on input data for employees and businesses in the CBS data. For the sectors 'public administration, public services and compulsory social security' (O), 'education' (P) and 'human health and social work activities' (Q), there is no data available on the number of businesses in these sectors per region, whilst this data is available for the number of employees. Second, in some sectors (mostly in sectors 'electricity, gas, steam and air conditioning supply' (D) and 'water supply, sewerage, waste management and remediation activities' (E)) there are in some regions businesses present, but in that same regions there are no employees. This mismatch in data cannot be explained, but because I'm dependent on the quality of this secondary data, I had to deal with this shortcoming. I was not able to improve the quality of the secondary data and there is no agency that provides this type of data for free, so I decided that I would use the available data.

3.4.2 Diversity indices

In the course of the years, many indices are developed to measure the diversity of systems. In this research, I will use three different diversity indices: the *Simpson's diversity index,* the *Shannon-Wiener*

[5] Standard Businesses Index, SBI 2008
[6] A complete overview of the SBI 2008 and NACE Rev 2 is included in appendix 2.

diversity index and the *Equitability index*. All indices are derived from the field of ecology, where they are used to measure, amongst others, the biodiversity of ecosystems. Each index is constructed in a different way, which makes it useful to use three different diversity indices (Irwin et al., 2016). This also allows me to compare these with each other.

In general, there are two aspects which are relevant for indicating the diversity of a system. First, the number of species present in a system (the species richness), and second, the relative abundance (dominance or evenness) are of importance. Both aspects influence the diversity of an ecosystem, as is made clear by the following example. Let's imagine ecosystem A and B. Ecosystem A has five different species, which seems to be not that much. However, when these five species are equally present in numbers, the relative diversity is high. Ecosystem B, on the contrary, has 50 different species, but one species dominates the whole ecosystem. That means that it is not diverse at all. Therefore, species richness alone does not always say enough to interpret how diverse a system is. To address this interpretation problem, all three indices take a different approach to calculate the diversity of a system (Magurran, 2004).

Simpson's Diversity Index

The *Simpson's Diversity Index* (S) is developed by the ecologist Simpson to measure the diversity of an ecosystem. It is based on the probability that two different entities that are randomly selected from a sample are different (Simpson, 1949). Thus, it measures that dominance of a system, and since dominance and evenness can be seen as two sides of the same coin, their measures are complementary to each other. The more dominance of one species, the less evenness there is and vice versa. S can be calculated as follows (3):

$$(\mathbf{3})\ S = 1 - \sum_{i=1}^{n} p_i^2$$

Here, p_i is the proportion of individual employees or businesses[7] in sector i and n is the total number of employees or businesses in a region. The value of S ranges between 0 and $1 - \frac{1}{m}$, with m representing the total number of sectors. The sum of p_i^2 should be interpreted as a measure of dominance, which means that when it increases, the diversity of the system decreases and vice versa. To make S more intuitive to interpret and easier to work with, the negative value is used..

Shannon-Wiener Index

While the *Simpson's Diversity Index* is only based on the dominance, the *Shannon-Wiener Index* (H) is based on both dominance and richness. H can be calculated as follows (4).

$$(\mathbf{4})\ H = -\sum_{i=1}^{n} p_i \ln(p_i)$$

Here, p_i is the proportion of individual employees or businesses in sector i and n is the total number of employees or businesses in that region. The maximum value of H is $\ln(n)$. The outcomes of H

[7] Here, the species are 'employees' or 'businesses'

generally range between 1,5 and 3,5. The higher the value, the more richness and evenness there is in the system.

Before I could work with this index, I had to do one manual step. In some sectors, there are no business and employees. This gives in turn $\ln(0)$, which is not possible. Therefore, where $p_i = 0$ I adjusted the outcomes of $\ln(0)$ to 0 to make it feasible to work with. This comes down to the same as assuming that in such cases there is one employee or one business active in that sector.

The outcome of H is difficult to interpret when multiple systems (i.e. regions) are compared with each other, because the maximum value is dependent on n, which differs per system. Therefore, the *Equitability index* is developed.

Equitability Index

The third and final diversity index that I used is the *Shannon-Wiener Equitability Index (E)*, or simply the *Equitability Index*. As mentioned above, the *Simpson's diversity index* ranges between 0 - $1 - \frac{1}{m}$, where the closer to 1 means the more diverse the system is. The *Shannon-Wiener index* also uses the logic of the higher the index, the more diverse the system is. However, the latter, as mentioned, did not allow me to compare different economic regions with each other, as illustrated by the following example. When the H index of region A is 2 and region B is 2,5, one could say that the latter is more diverse. However, I don't know what the maximum possible value of region A and B is. The maximum possible H index can be computed with $H_{max} = \ln(n)$, where n is the sum of all employees or businesses in a region. By dividing the H value with the H_{max} value, you get a more representative index of how diverse a region is in comparison to other regions, because it is a relative measure ranging from 0 to 1. When, for example, the maximum value of region A is 4 and of B 4,5, it means that the E index of region A is 2 and of region B is 1,8. With this representation, region A is more diverse instead of region B. Therefore, I also used this index (see formula 5) in this research to determine the diversity of an economic region and to give a more representative image of the diversity of economic regions in comparison with each other.

$$(\mathbf{5})\ E = \frac{-\sum_{i=1}^{n} p_i \ln(p_i)}{\ln(n)}$$

3.5 Regression analyses

To analyse the relationship between the diversity of economic activities and economic resilience, I executed a simple regression analysis. To execute the analysis, I used the diversity indices based on the data of 2008 and computed the average resilience index based on the R values for the period between 2008 and 2014[8]. In this way, I analyse how the diversity of an economic system at the start of a period influences the resilience of that system in the years following.

For the regression analysis, I used the diversity indices as the independent variable and the resilience index as dependent variable. This is because I expected that the diversity of an economic region influenced the resilience of that region. An overview of all indices that are used for the regression analysis is included in Table 4.

[8] The data is available for the period 2007-2014, but to calculate this index an unemployment rate is needed for the year-1. Therefore, with this data the first R can be calculated for the year 2008.

Table 4. Overview of input variables for the regression analysis

Level	Dependent variable Input data	Resilience index	Independent variable Input data	Diversity index
Metropolitan	Unemployment	R (avg. 2008-2014)	Employees per sector	$S(emp)$ (2008) $H(emp)$ (2008) $E(emp)$ (2008)
			Businesses per sector	$S(bus)$ (2008) $H(bus)$ (2008) $E(bus)$ (2008)
Conurbation	Unemployment	R (avg. 2008-2014)	Employees per sector	$S(emp)$ (2008) $H(emp)$ (2008) $E(emp)$ (2008)
			Businesses per sector	$S(bus)$ (2008) $H(bus)$ (2008) $E(bus)$ (2008)
COROP	Unemployment	R (avg. 2008-2014)	Employees per sector	$S(emp)$ (2008) $H(emp)$ (2008) $E(emp)$ (2008)
			Businesses per sector	$S(bus)$ (2008) $H(bus)$ (2008) $E(bus)$ (2008)
NUTS-2	Unemployment	R (avg. 2008-2014)	Employees per sector	$S(emp)$ (2008) $H(emp)$ (2008) $E(emp)$ (2008)
			Businesses per sector	$S(bus)$ (2008) $H(bus)$ (2008) $E(bus)$ (2008)

I needed two outcomes of the regression analysis to assess the relationship between diversity and resilience. First, I needed the correlation coefficient (*b*), which quantifies the relationship, but which will be used by me primarily to examine whether a relationship is positive or negative. Second, I needed the R square value, which indicates which percentage of the outcome can be predicted with the linear regression, also known as the 'goodness-of-fit'. The closer to 1, the stronger the relationship between the two variables. Whether this relationship is statistically significant or not can be inferred from the p value. I used the criteria of $p < 0.05$ to identify whether a correlation is statistically significant or not.

3.6 Deviation

The hypothesis is that a more diverse region has a higher resilience and vice versa. When these values are plotted, there are four possible options, as can be seen in Figure 9. Based on the average y value ($\bar{y}$) and x value ($\bar{x}$), a region can deviate in a positive or negative sense.

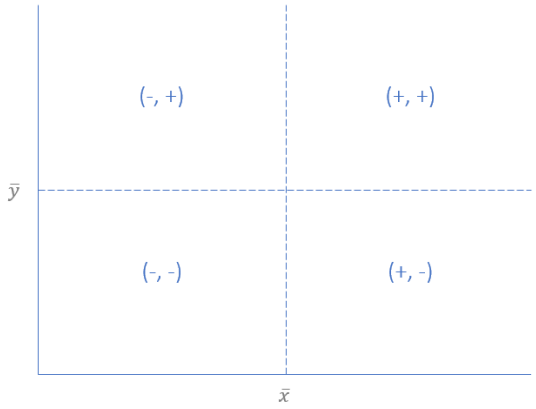

Figure 9. Possible x and y coordinates of resilience (x) and diversity (y) indicators

As mentioned, the hypothesis is that the economic regions mostly are placed in the lower-left quadrant and upper-right quadrant. For every region i, the degree to which this region confirms the hypothesis can be calculated with the formula 6.

$$(\mathbf{6})\ d_i = (\bar{x} - x_i) * (\bar{y} - y_i)$$

This formula gives the deviation of a region i, which indicates whether a region confirms the hypothesis or not. The x values represent the diversity indices and the y values represent the resilience index. How the outcomes of d_i should be interpreted can be read in Table 5.

Table 5. Deviation values and interpretation

Coordinates	Positive/negative d	Hypothesis
-, +	-	Does not confirm
+, +	+	Confirms
-, -	+	Confirms
+, -	-	Does not confirm

I calculated for every region of all the scale levels the d values in order to assess whether the region does or does not contribute to the hypothesis. Based on these outcomes, I aimed to identify some spatial patterns in terms of regions that do or do not confirm the hypothesis. It does, however, not say anything about 'why' a region does or does not confirm the hypothesis. That question lies behind the scope of this research.

After this analysis, I made one additional step to analyse whether particular economic sectors influence the deviation value of a region or not. This is only done for the diversity indices which show a significant relation with the resilience index. For this analysis, I first identified the largest sector per region for either the number of employees or the number of businesses (which depends on the index used). Secondly, I calculated the average d value for the regions where sector j is the dominant sector. Thirdly, I made a box-plot analysis, which shows the average d values and the range of the values, which gives an overview of whether a sector negatively or positively contributes to the hypothesis. This also shows whether there is a statistically significant ($p < 0{,}05$) relationship or not, so whether sector j positively or negatively contributes to the deviation value. When the average d value for the regions with largest sector j is positive, it means that this sector positively influences the hypothesis, and vice-versa.

4. Results

4.1 Final outcomes

In Table 6, the outcomes of the regression analysis are presented: the regression coefficient and the R square value. A positive regression coefficient was expected, which is only the case in ten out of the 24 regression analysis. Besides that, there are only two diversity indices that show a statistically significant correlation with resilience: on conurbation level for the E index of businesses and for NUTS-2 level for E index of employees.

Here should be noticed that a higher R square value does not automatically lead to a significant relationship, due to the relatively low or high n. For example, the E index of employees of NUTS-2 regions have a R square value of 0,022 and shows a significant relationship, due to $n = 235$. On the other hand, the R square value of the E index of employees on the conurbation level is 0,147, but this relationship is not significant due to $n = 22$. The underlying results of this analysis will be explained in the following paragraphs.

Table 6. Overview of regression coefficients and R2 values (in brackets)

Level	*S(emp)*	*H(emp)*	*E(emp)*	*S(bus)*	*H(bus)*	*E(bus)*	Average
Metropolitan	-1.616	-.043	-.068	.317	-.217	-.176	
(n=22)	(.098)	(.045)	(.008)	(.001)	(.006)	(.001)	(.027)
Conurbation	-.886	-.170	.479	-2.758	-.441	1.591	
(n=22)	(.096)	(.147)	(.151)	(.092)	(.066)	(.213*)	(.128)
COROP	-1.445	-.198	.166	.657	-.256	1.020	
(n=40)	(.031)	(.069)	(.016)	(.002)	(.009)	(.039)	(.028)
NUTS-2	-.236	-.080	3.149	.207	.078	1.843	
N=235)	(.001)	(.001)	(.022*)	(.001)	(.002)	(.016)	(.007)
Average	-1.046	-.123	.932	-.394	-.209	1.070	
	(.057)	(.066)	(.049)	(.024)	(.021)	(.067)	

$^{*}\ p < 0,05$

4.2 Economic Resilience

4.2.1 Metropolitan

Based on Figure 10, where the average R values for the period 2008-2014 are presented, one can identify ten metropolitan regions (45%) that are relatively resilient, because on average their R value is higher than zero. These are also presented spatially in Figure 11. Besides that, nine other regions are relatively non-resilient, because they have an average R value lower than zero. Three regions (Arnhem, Amersfoort and Eindhoven) have an average R value of zero, which means that the region is neither resilient, nor non-resilient, but it is as on average as close as possible to the stable dynamic state of the national development of the unemployment rates. It does not consequently mean that there is no deviation to the national unemployment rate at all in some years, but on average they are equal to the national trend for the period 2008-2014.

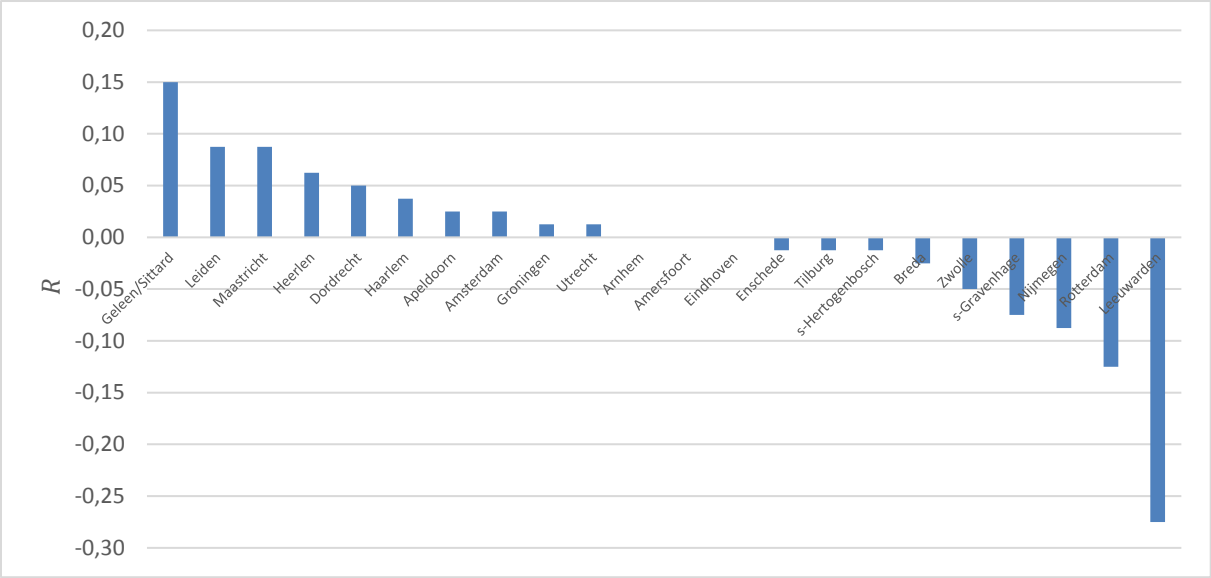

Figure 10. Average R 2008-2014, metropolitan

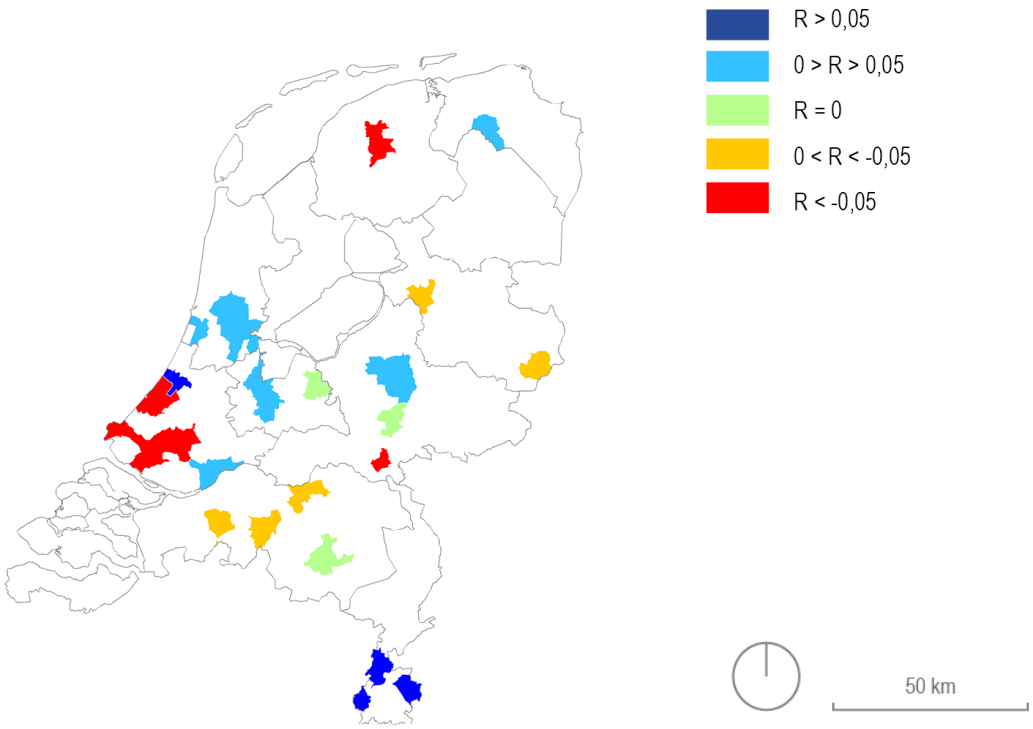

Figure 11. Average R 2008-2014, metropolitan (spatial)

4.2.2 Conurbation

Based on Figure 12, where the average R values for the period 2008-2014 are presented, one can identify seventeen conurbation regions (77%) that are relatively resilient, because on average their R value is higher than zero. These are also presented spatially in Figure 13. Besides that, four other are relatively non-resilient, because they have an average R value lower than zero. One region (Nijmegen) has an average R value of zero, which means that the region is neither resilient, nor non-resilient, but

it is as on average as close as possible to the stable dynamic state of the national development of the unemployment rates.

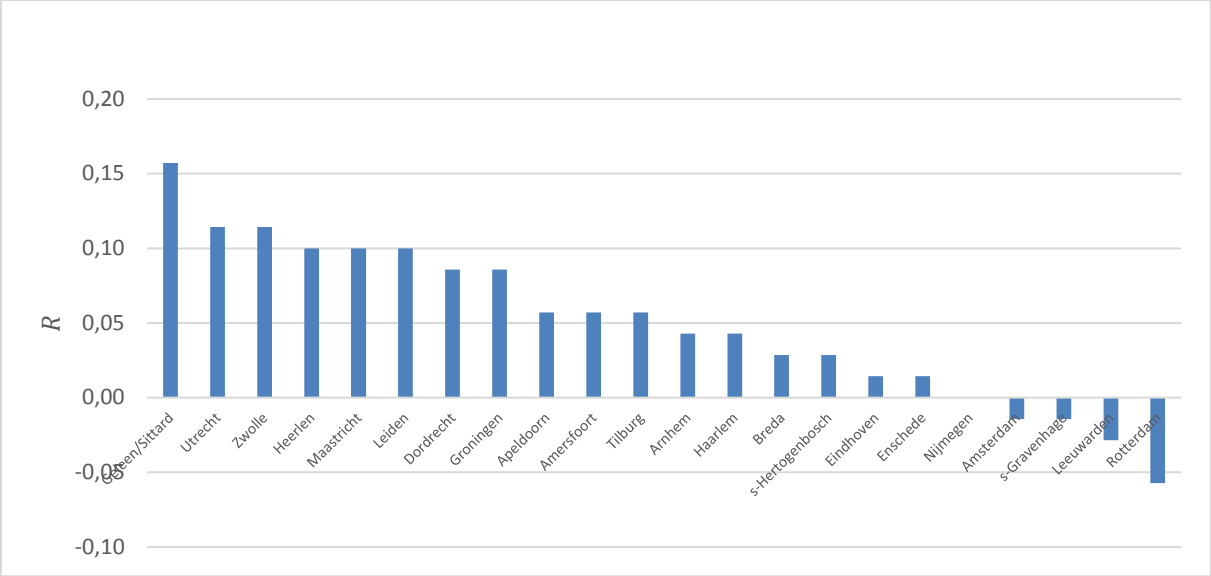

Figure 12. Average R 2008-2014, conurbation

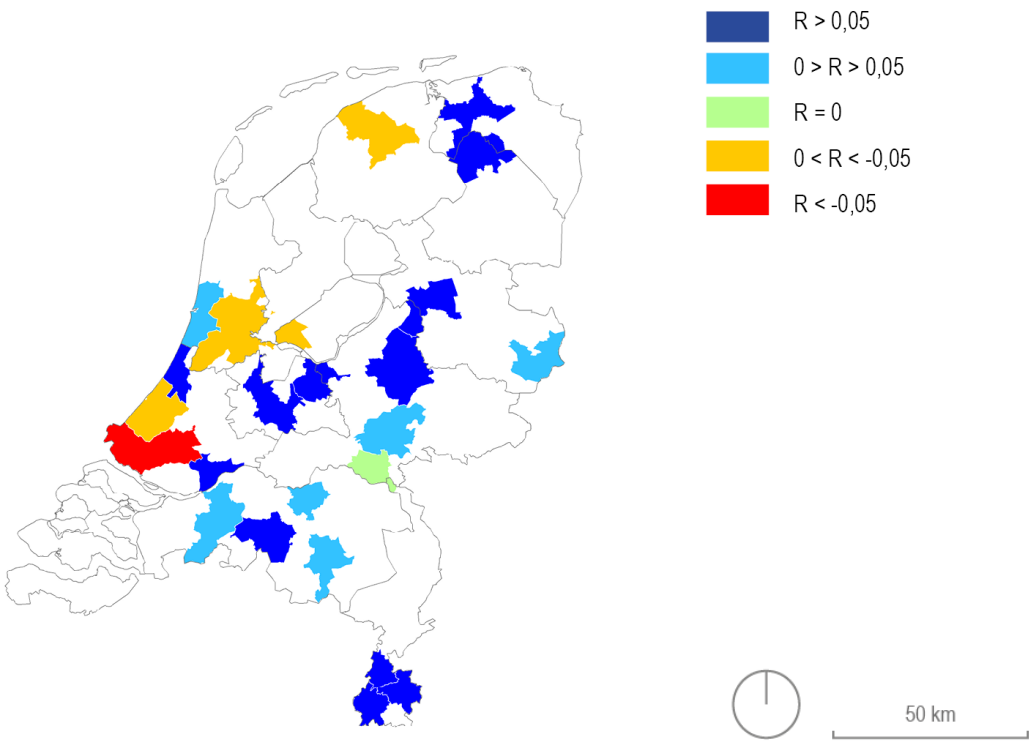

Figure 13. Average R 2008-2014, conurbation (spatial)

4.2.3 COROP

Based on Figure 14, where the average R values for the period 2008-2014 are presented, one can identify 24 COROP regions (60%) that are relatively resilient, because on average their R value is higher than zero. These are also presented spatially in Figure 15. Besides that, thirteen other regions are relatively non-resilient, because they have an average R value lower than zero. Three regions (CR12, CR23 and CR24) have an average R value of zero, which means that the region is neither resilient, nor non-resilient, but it is as on average as close as possible to the stable dynamic state of the national development of the unemployment rates.

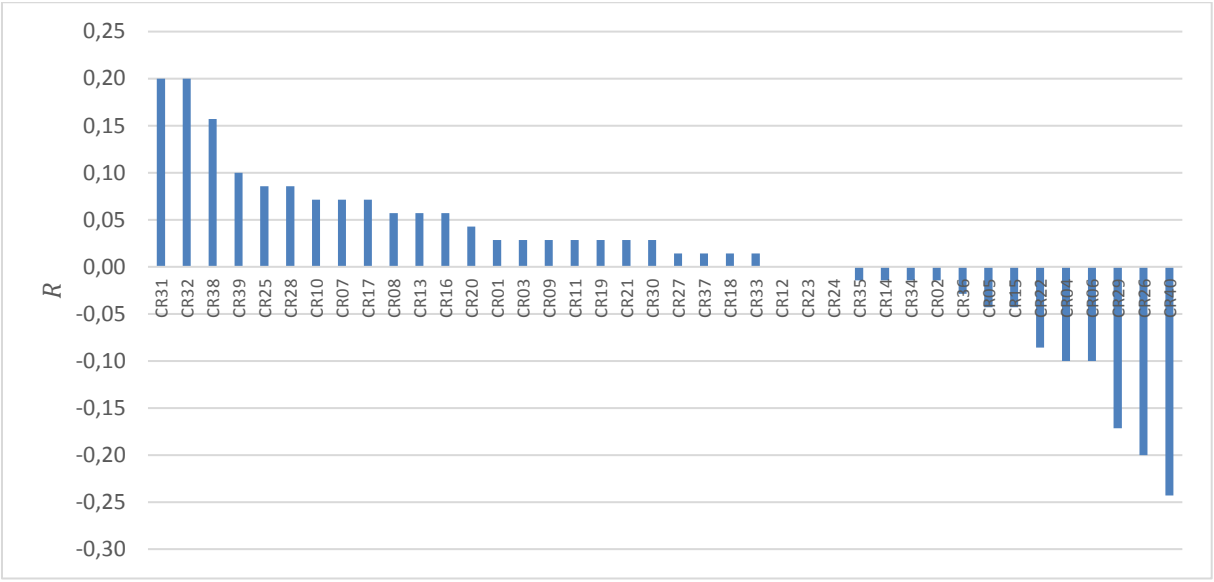

Figure 14. Average R 2008-2014, COROP

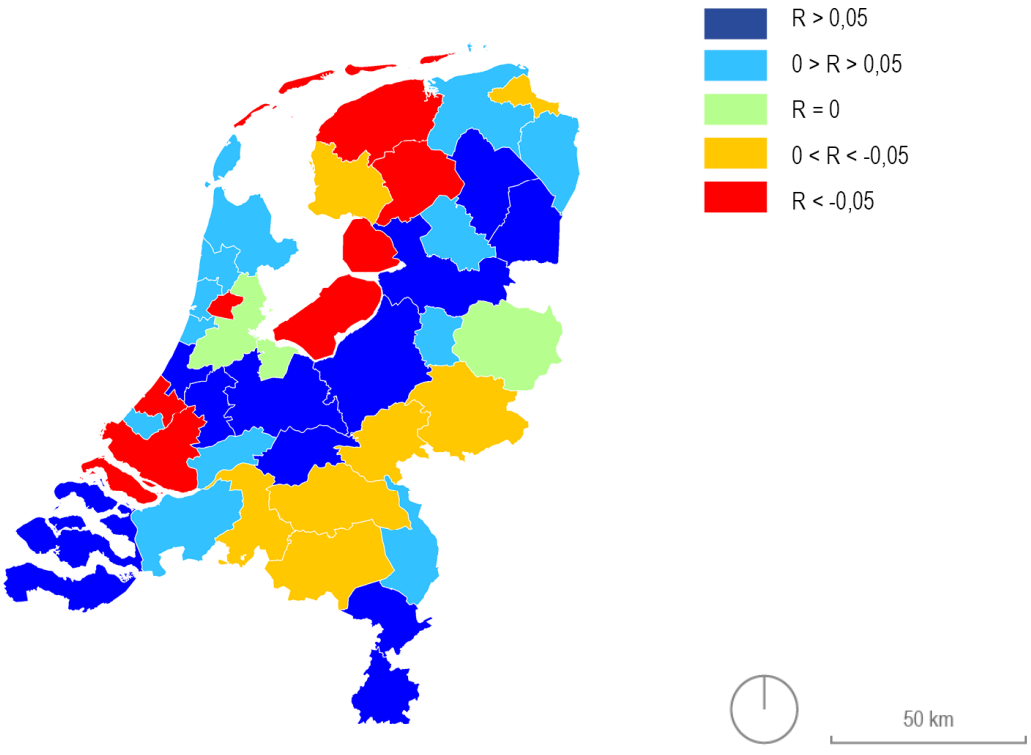

Figure 15. Average R 2008-2014, COROP

4.2.4 NUTS-2

In Figure 16, the average R value for the period 2008-2014 is presented for NUTS-2 regions[9]. Based on the figures, 106 (45%) regions are identified as relatively resilient and 122 (52%) regions are identified as relatively non-resilient. Seven regions (3%) have an average R value of zero, which means that the region is neither resilient, nor non-resilient, but it is as on average as close as possible to the stable dynamic state of the national development of the unemployment rates.

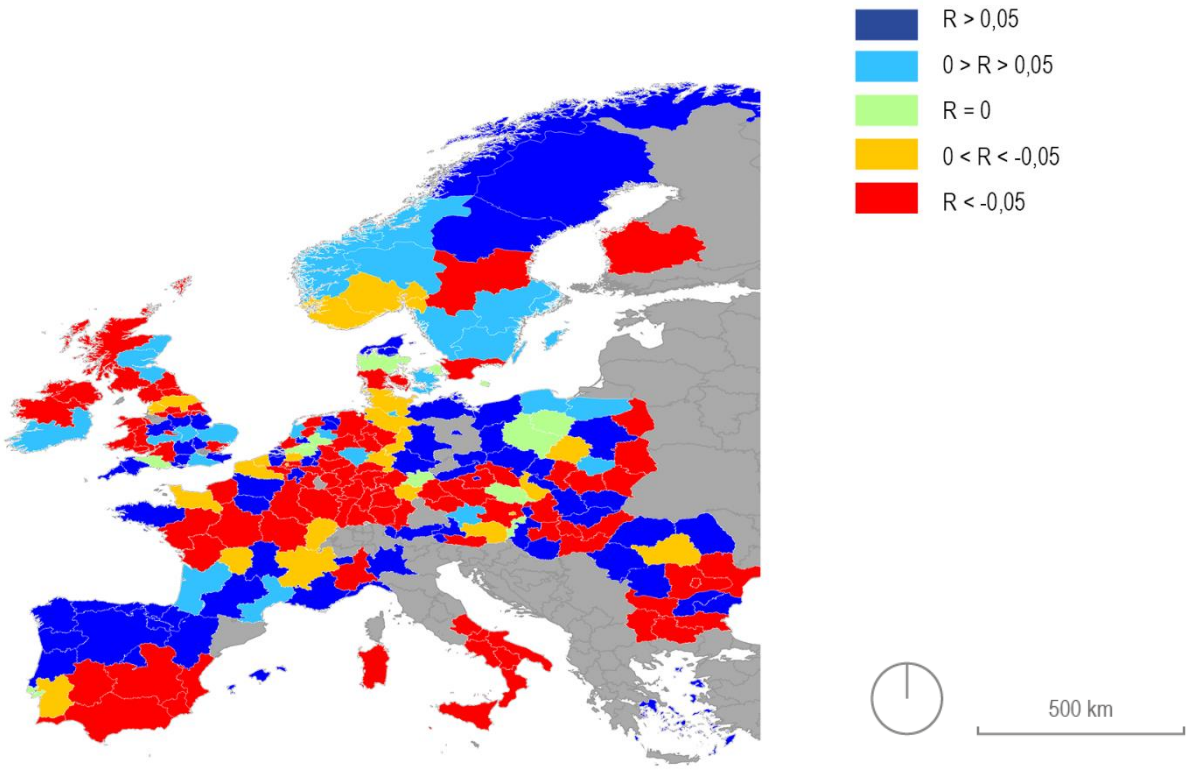

Figure 16. Overview of resilient and non-resilient regions, NUTS2

4.3 Diversity of Economic Activities

4.3.1 Metropolitan

On metropolitan level, the diversity indices are calculated for the year 2008. One can observe that employees have a higher S (Figure 17) and E index (Figure 19), whilst businesses have a higher H index (Figure 18) (see also the average values in Table 7). The fact that all three indices show a different pattern implies that it matters which diversity index is used for the analysis. For example, metropolitan region Utrecht has the highest S index for employees, but one of the lowest for businesses.

The H index and E index, which are related to each other, show an interesting pattern. The H index of businesses show a relatively stable and high diversity index between 2,1 and 2,3, whilst on the other hand the H index of employees ranges between 0,9 and 2,5. However, a high H index does not automatically lead to a high E index, because the H index is an absolute index whilst the E index is a

[9] Due to the large number of regions with data (n=235), the variables of NUTS-2 regions are included in Appendix 3

relative index. The latter is measured relatively to what is maximum possible. Therefore, this index shows a different pattern. Here, one can observe that, in most of the regions, employees do have a higher E index than businesses.

Table 7. Average diversity indices (and minimum-maximum values in brackets), metropolitan

Diversity Index	Employees	Businesses
S	0,885 (0,837 - 0,909)	0,867 (0,857 – 0,878)
H	1,861 (0,960 – 2,474)	2,274 (2,209 – 2,329)
E	0,398 (0,179 – 0,565)	0,240 (0,200 – 0,264)

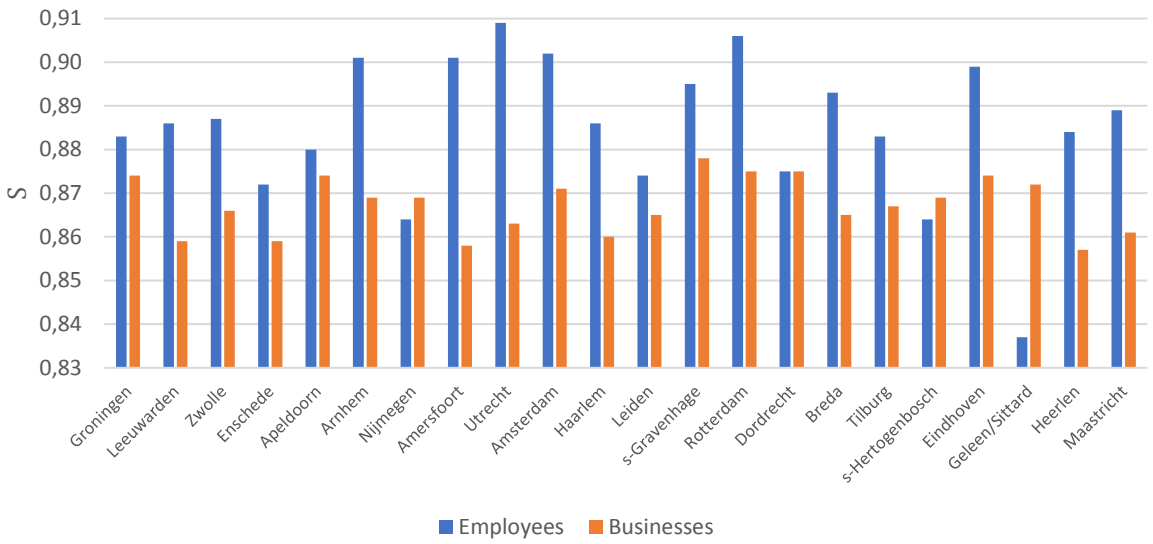

Figure 17. S index of employees and businesses in 2008 of metropolitan regions

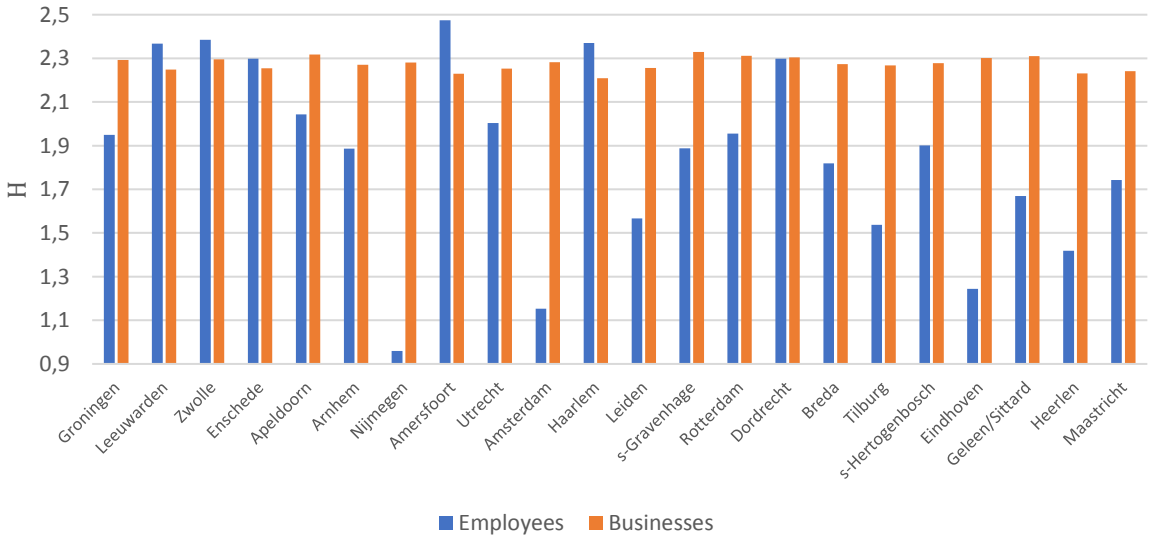

Figure 18. H index of employees and businesses in 2008 of metropolitan regions

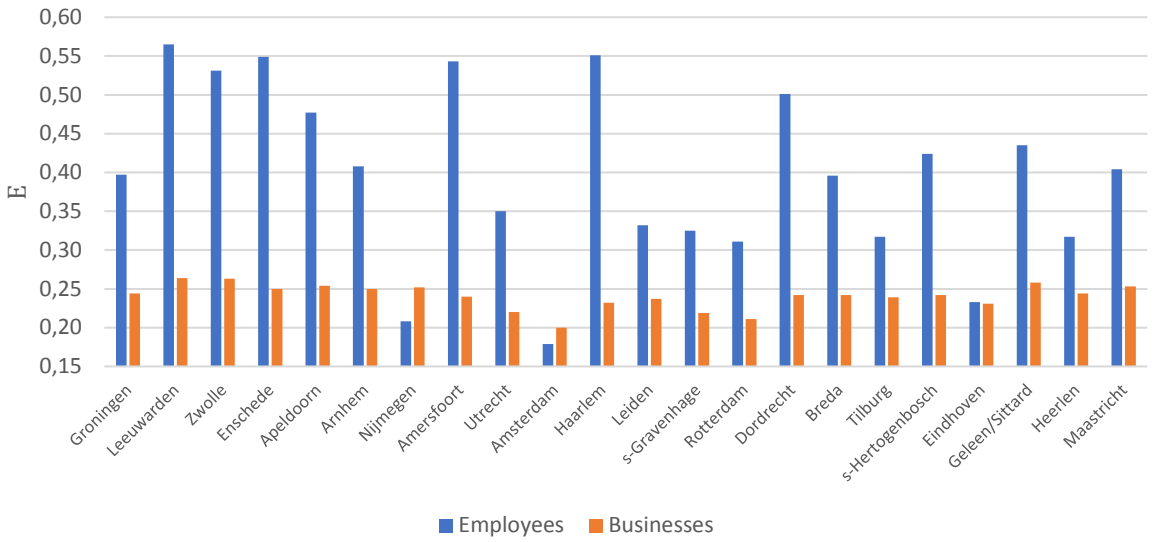

Figure 19. E index of employees and businesses in 2008 of metropolitan regions

When observed spatially (Figure 20), one can observe that at first sight the S and H indices show (more or less) the same pattern. On the other hand, the E index shows a different pattern. For example, while the regions in the province Limburg have a low diversity according to the S and H index, they have a high diversity according to the E index. This indicates that they have a relatively low diversity, but when measured relative to what is maximum possible, they have a relatively high diversity index. This difference is also present in South-Holland (e.g. Rotterdam), that has both in

terms of employees and businesses a high S and H index, whilst it has a low E index.

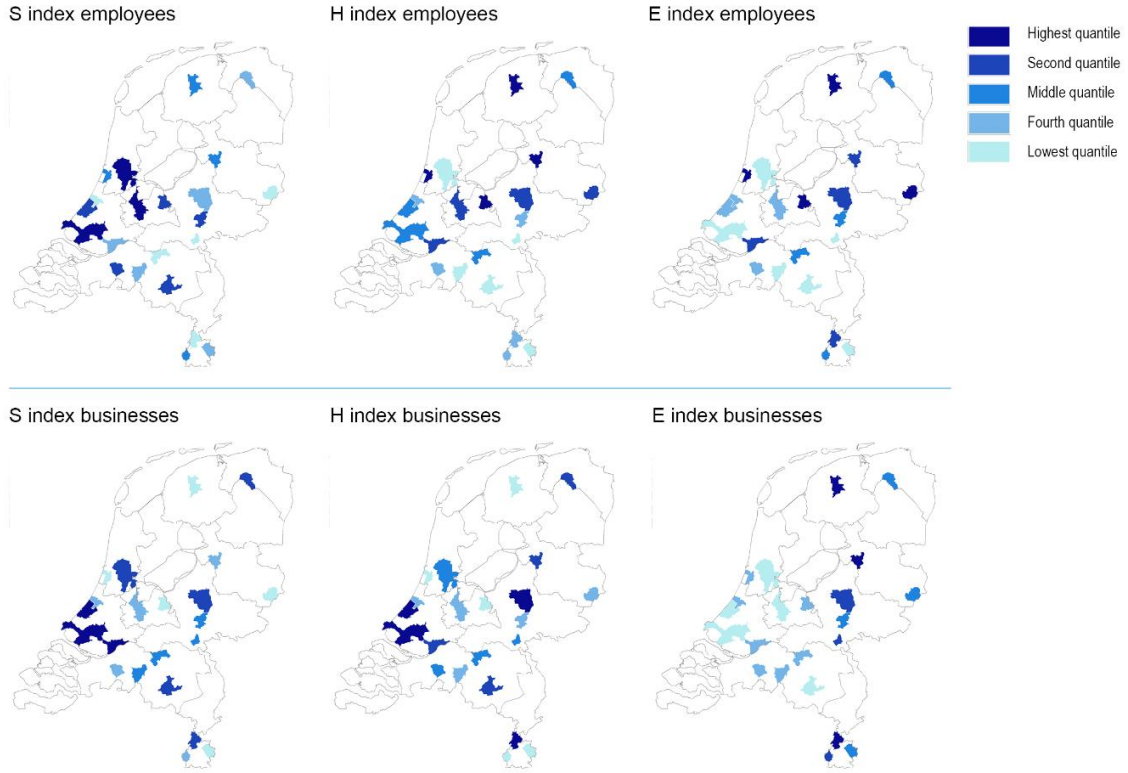

Figure 20. Overview of diversity indices per metropolitan region in 2008

4.3.2 Conurbation

On conurbation level, the diversity indices are calculated for the year 2008. One can observe that employees have a higher S (Figure 21) and E index (Figure 23), whilst businesses have a higher H index (Figure 22) (see also the average values in Table 8). The H index and E index show the same pattern as observed with the metropolitan regions, meaning that a high H index does not automatically results in a high E index.

Table 8. Average diversity indices (and minimum-maximum values in brackets), Conurbation

Diversity Index	Employees	Businesses
S	0,885 (0,830 – 0,907)	0,873 (0,862 – 0,884)
H	2,181 (1,885 – 2,408)	2,309 (2,255 – 2,365)
E	0,440 (0,352 – 0,526)	0,233 (0,197 – 0,258)

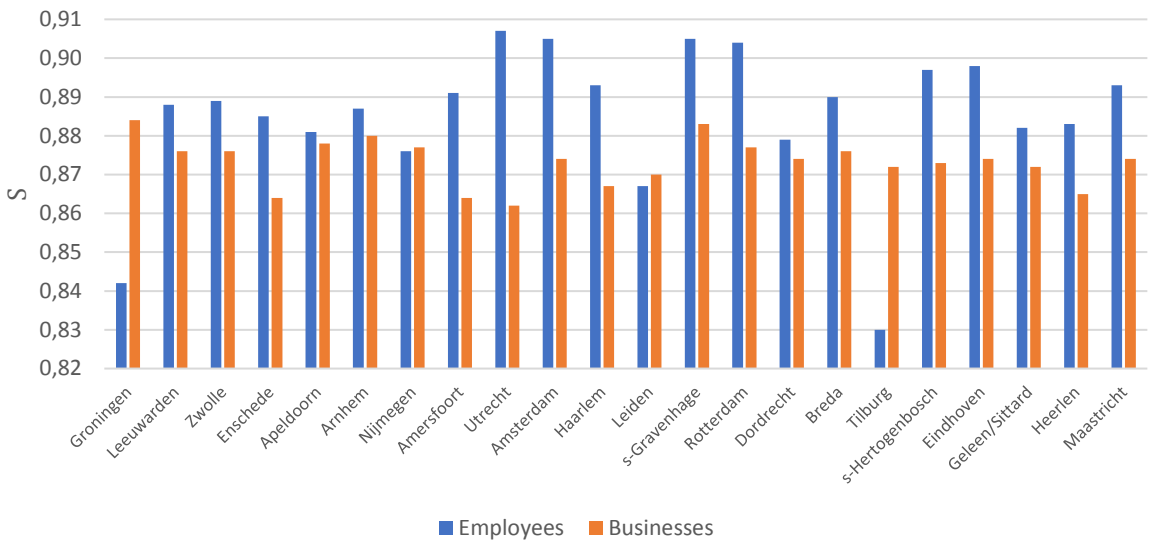

Figure 21. S index of employees and businesses in 2008 of conurbation regions

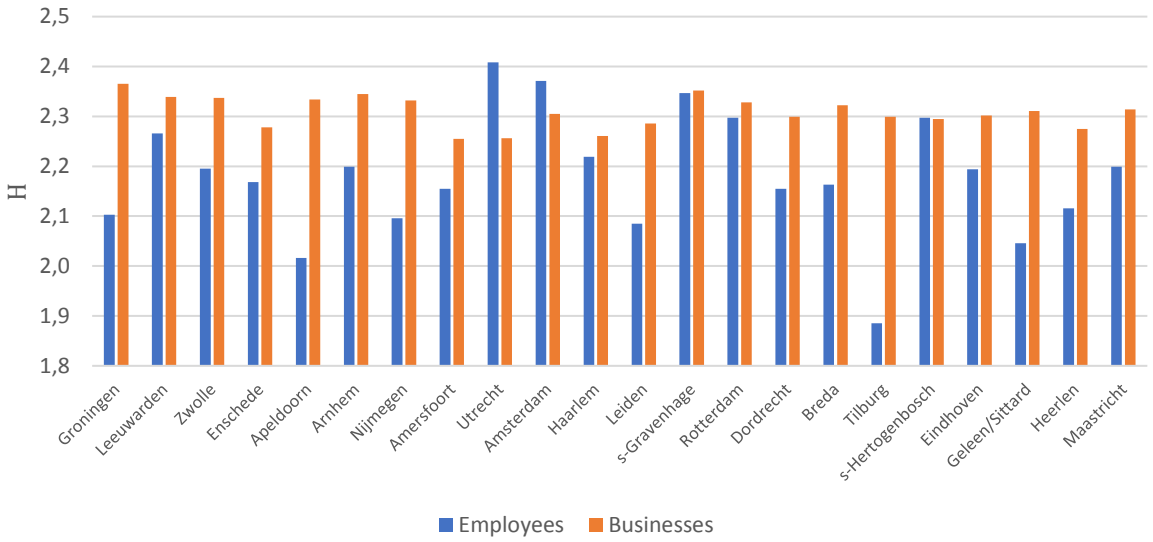

Figure 22. H index of employees and businesses in 2008 of conurbation regions

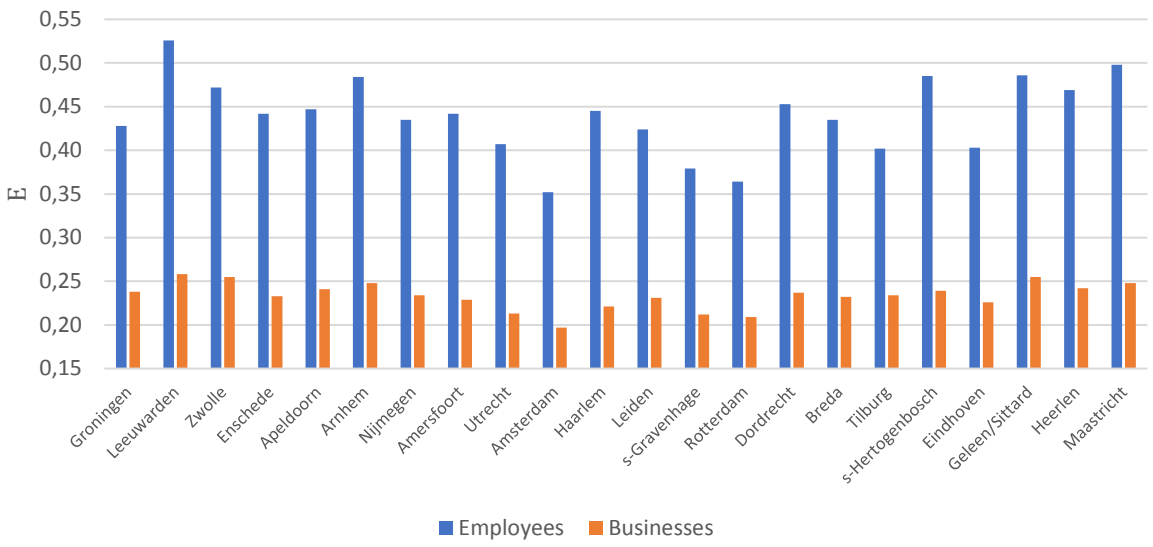

Figure 23. E index of employees and businesses in 2008 of conurbation regions

When observed spatially (Figure 24), one can observe that on the first sight the S and H indices show (more or less) the same pattern. On the other hand, the E index shows a different pattern. For example, where the regions in the province Limburg do have a relatively low diversity with the S and H index, they have a high diversity with the E index. This indicates that they have a relatively low diversity, but in terms of what is maximum possible, they have a relatively high diversity index. This difference is also present in South-Holland (e.g. Rotterdam), that has both in terms of employees and businesses a high S and H index, whilst it has a low E index.

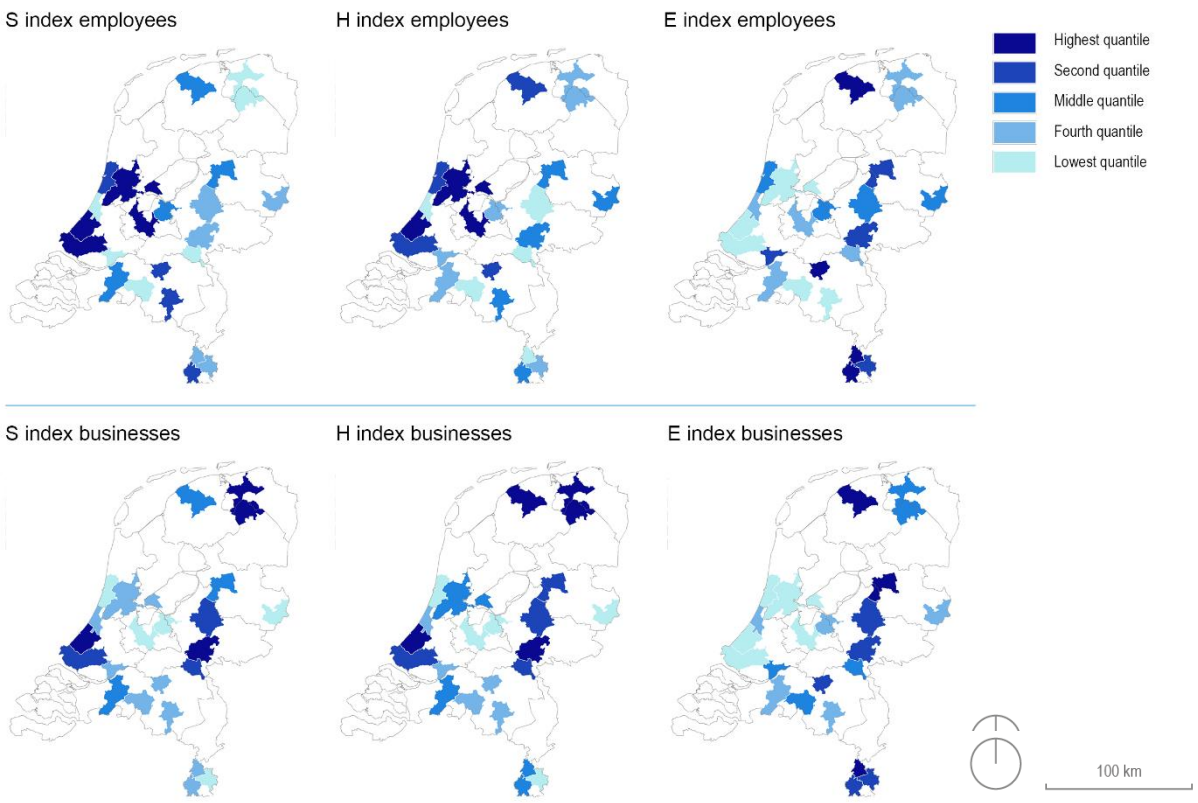

Figure 24. Overview of diversity indices per conurbation region in 2008

4.3.3 COROP

On COROP level, the diversity indices are calculated for the year 2008. One can observe that, on average, employees do have a higher S (Figure 25) and E index (Figure 27), whilst businesses do have a higher H index (Figure 26) (see also the average values in Table 9). This implies that it matters which diversity index is used for the analysis, because all three indices show a different pattern. For example, CR17 does have the one highest S index for employees, but one of the lowest for businesses.

The H index and E index, which are related to each other, show an interesting pattern. For the first, businesses show a relatively stable and high diversity index between 2,05 and 2,25, whilst on the other hand the employees ranges between 1,8 and 2,4. However, a high H index does not automatically lead to a high E index. The latter index shows a different pattern. Here, one can observe that, in all regions, employees do have a higher E index than businesses.

Table 9. Average diversity indices (and minimum-maximum values in brackets), COROP

Diversity Index	Employees	Businesses
S	0,890 (0,886 – 0,908)	0,833 (0,867 – 0,897)
H	2,127 (1,876 – 2,380)	2,153 (2,061 – 2,216)
E	0,442 (0,350 – 0,669)	0,218 (0,186 – 0,275)

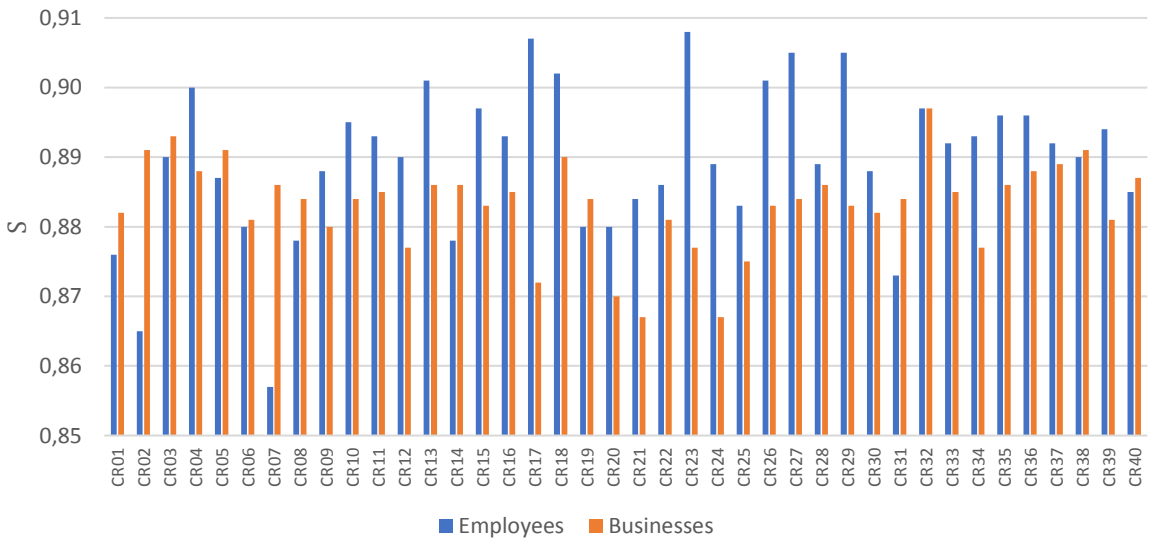

Figure 25. S index of employees and businesses in 2008 of COROP regions

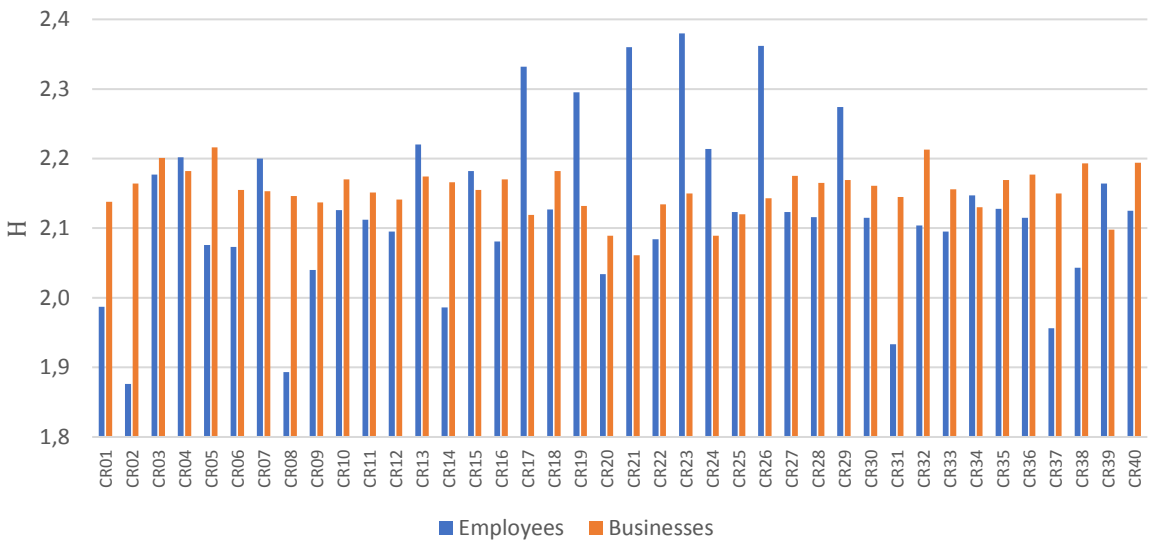

Figure 26. H index of employees and businesses in 2008 of COROP regions

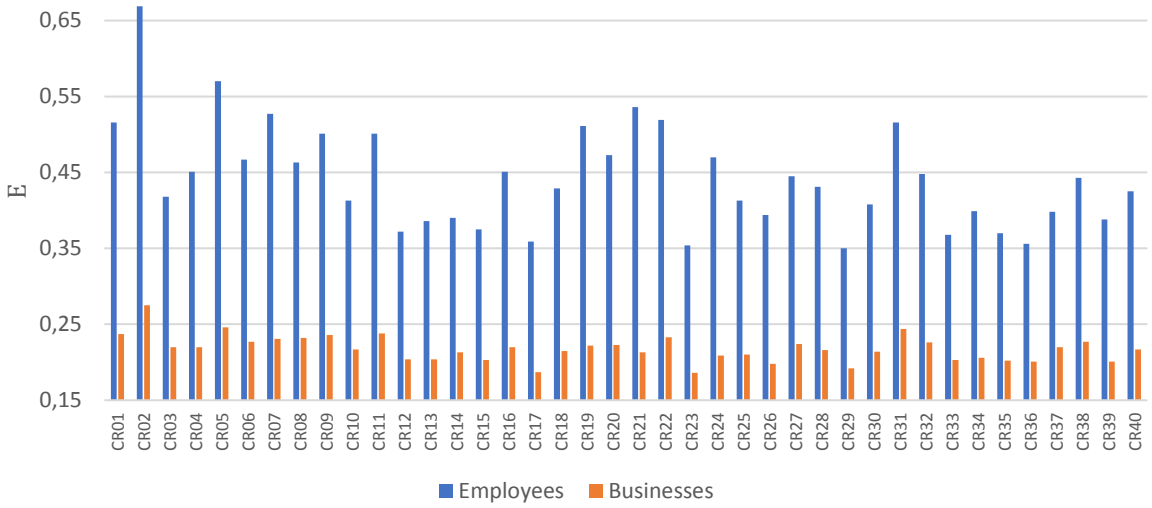

Figure 27. E index of employees and businesses in 2008 of COROP regions

When observed spatially (Figure 28), one can see that on the first sight the S and H indices show (more or less) the same pattern. On the other hand, the E index shows a different pattern. For example, where the regions in the central part of the Netherlands do have a relatively high diversity with the S and H index, whilst they have a low diversity with the E index. This indicates that they have a relatively high diversity, but in terms of what is maximum possible, they have a relatively high diversity index.

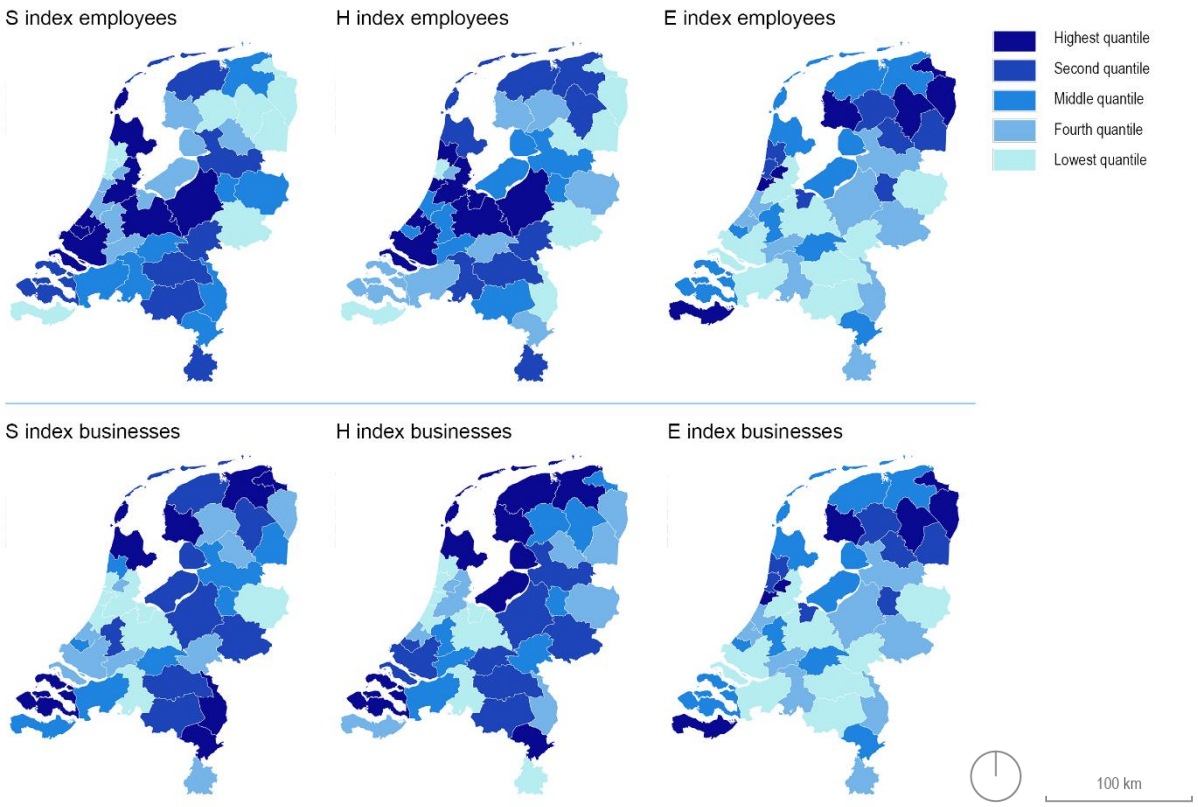

Figure 28. Overview of diversity indices per COROP region in 2008

4.3.4 NUTS-2

On NUTS-2 level, one can observe that, on average, employees do have a higher S and H index, whilst businesses do have a higher E index (Table 10 and Figure 29). A high H index thus does not automatically lead to a high E index.

Table 10. Average diversity indices, NUTS-2

Diversity Index	Employees	Businesses
S	0,809 (0,657 – 0,869)	0,799 (0,545 – 0,860)
H	2,914 (2,567 – 3,152)	2,866 (2,144 – 3,159)
E	0,230 (0,190 – 0,299)	0,266 (0,206 – 0,329)

When observed spatially (Figure 29), one can identify that the Western parts of Europe are in general more diverse than the Eastern parts. What can also be observed is the difference between the H and E index. For example, Spain does have a relatively high H index, but a relatively low E index.

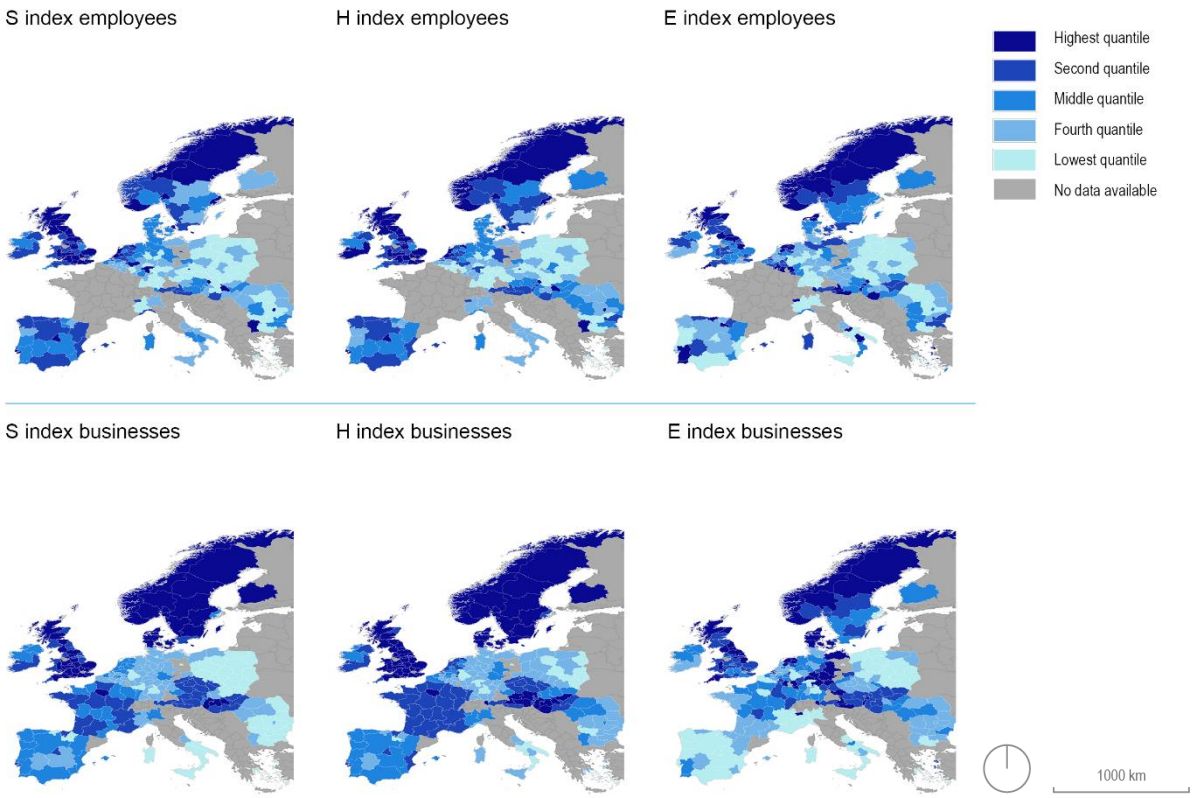

Figure 29. Overview of diversity indices per NUTS-2 region in 2008

4.4 Relation between economic diversity and economic resilience

4.4.1 Metropolitan

On metropolitan level, there are no statistically significant relation between the diversity of economic activities and economic resilience (c). The S index of businesses is the only relation which has a positive correlation coefficient, which is in line with the hypothesis. However, this relation is not significant.

What can be observed is that for all three indices (Figure 30, Figure 31 and Figure 32), businesses diversity is hardly related to economic resilience, whilst there is a negative relation between the diversity of employees and economic resilience. This means that the lower the diversity of employees and businesses, the more resilient an economic region is (although not significant).

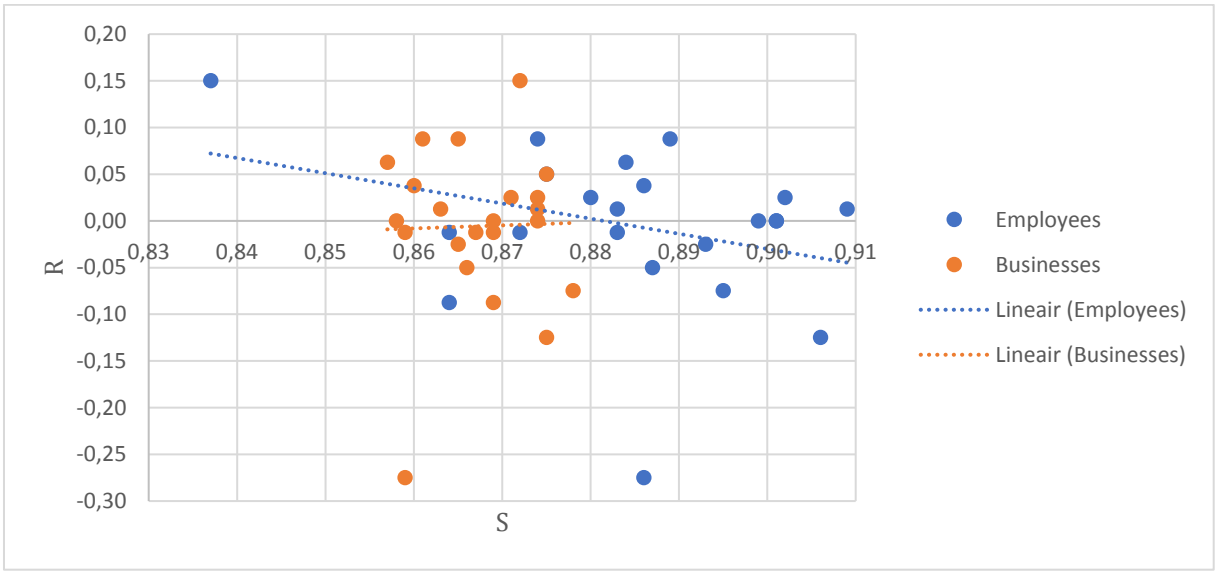

Figure 30. Relation between S and R, metropolitan

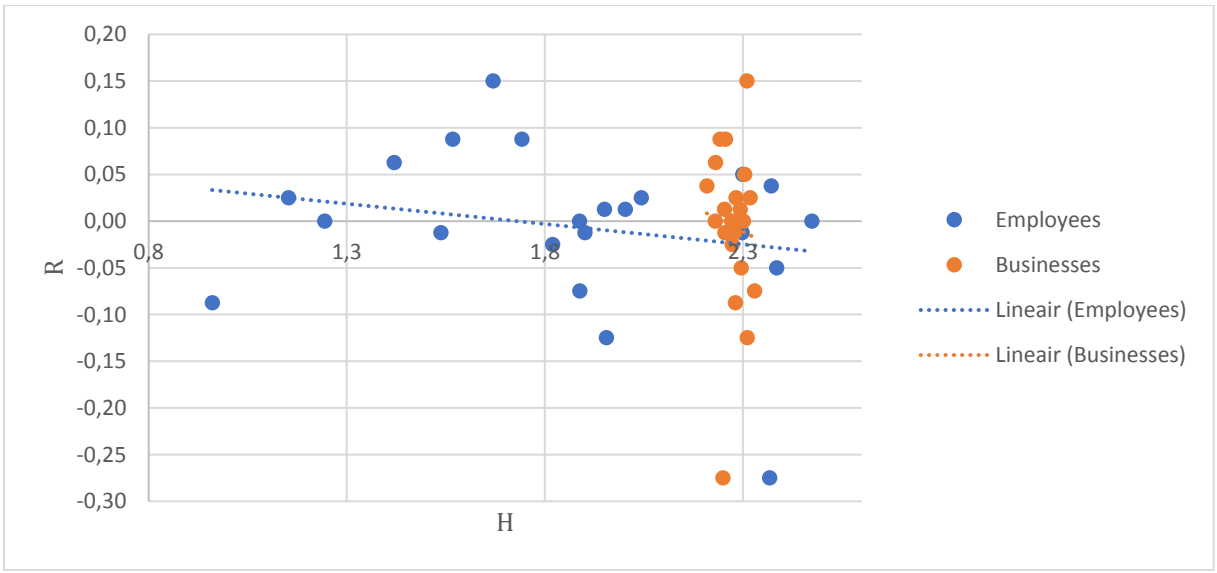

Figure 31. Relation between H and R, metropolitan

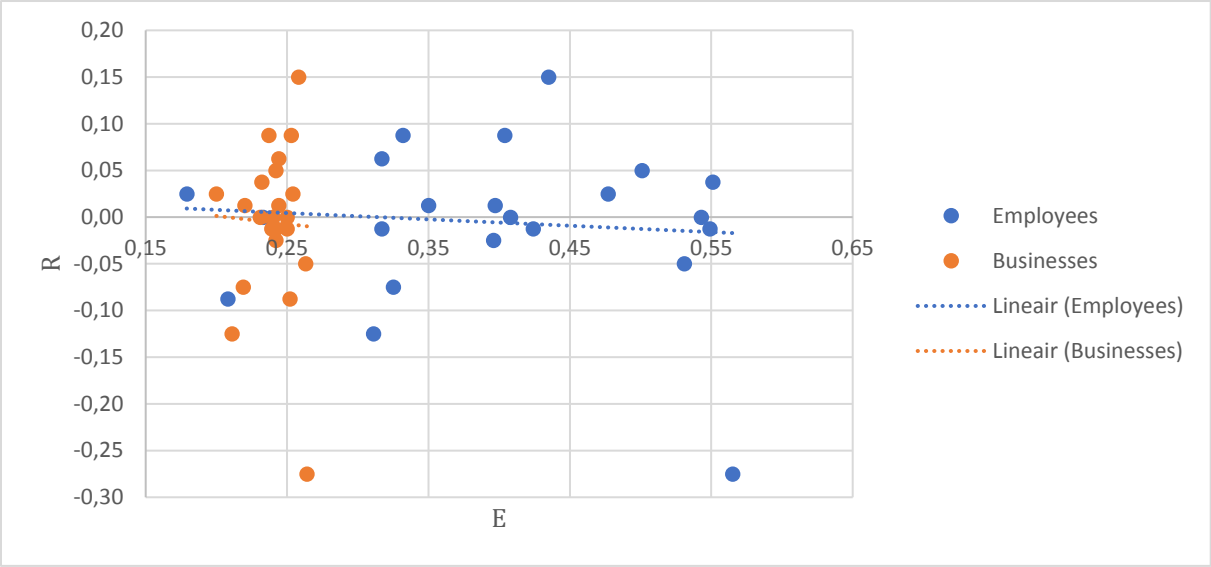

Figure 32. Relation between E and R, metropolitan

4.4.2 Conurbation

On conurbation level, there is one significant relation between diversity of economic activities and economic resilience (Table 6). This is the case for the E index of businesses. The E index (Figure 35), of employees is the only other regression that shows a positive relation, though not significant. The other indices show a negative relation between economic diversity and economic resilience.

What can be observed is that for the S (Figure 33) and H index (Figure 34), there is a negative relation between diversity and resilience, which means that the less diverse a region is, the more resilient it is, although not significant. On the contrary, for the E index, there is a positive relation between diversity and resilience. For businesses, this relation is significant, which means that a conurbation with a higher diversity of businesses is more resilient.

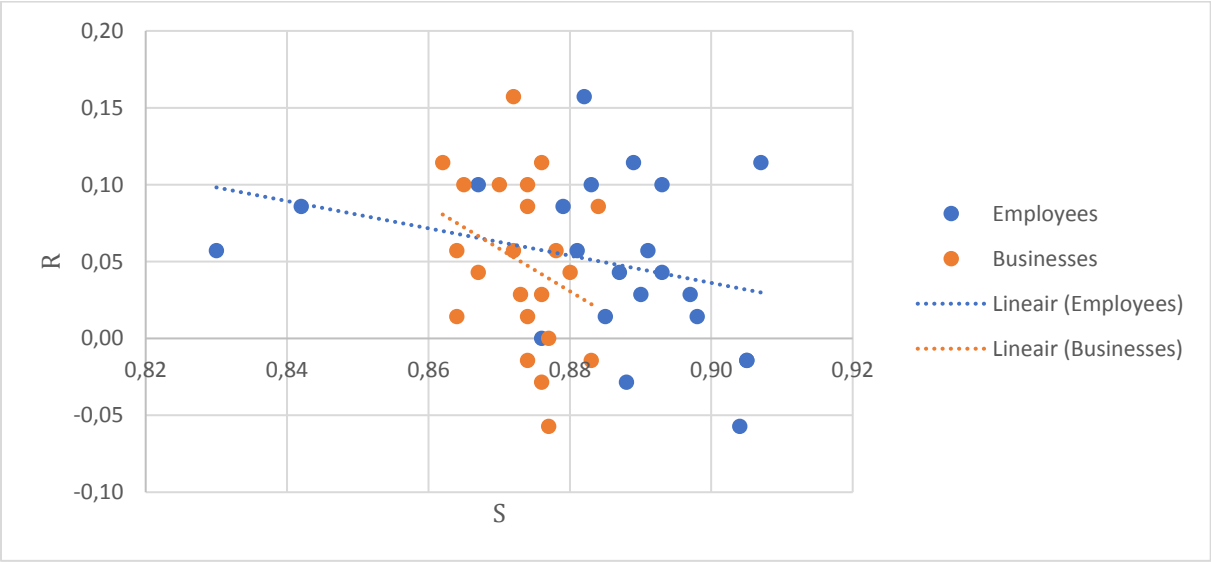

Figure 33. Relation between S and R, conurbation

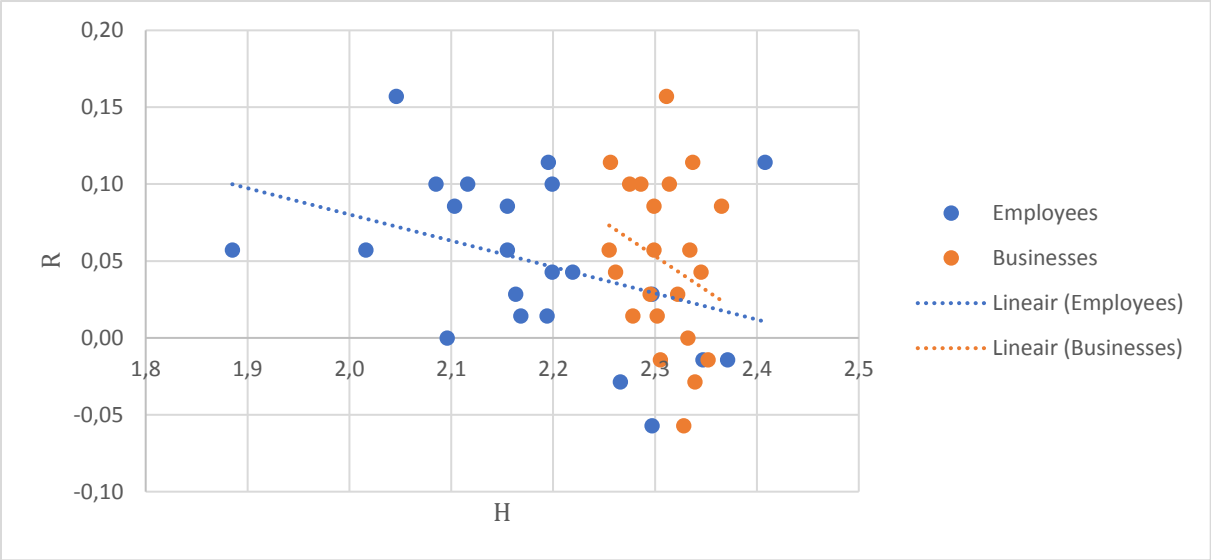

Figure 34. Relation between H and R, conurbation

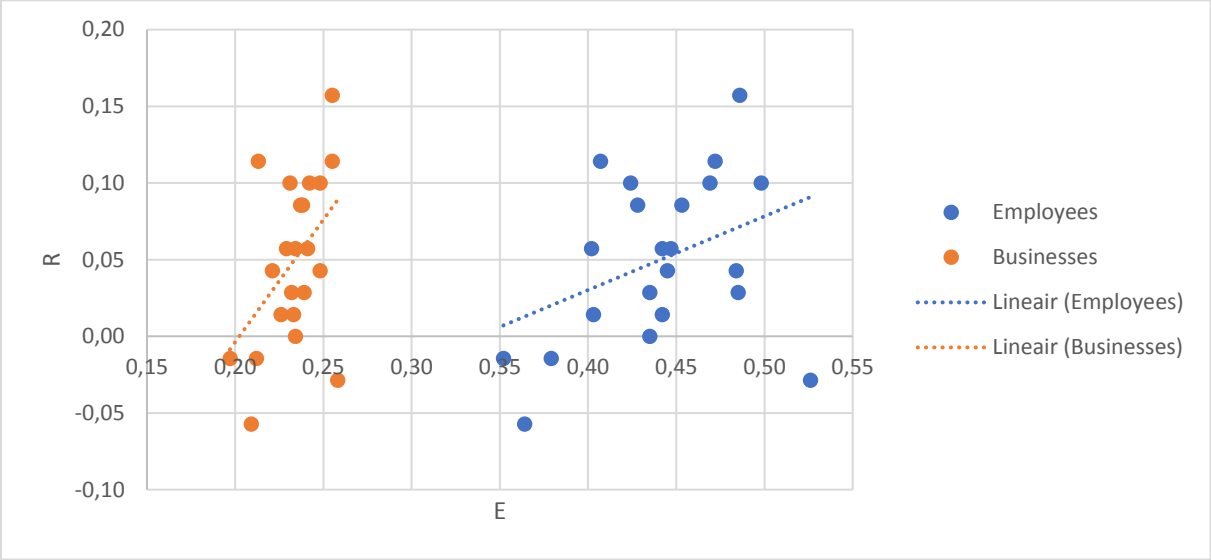

Figure 35. Relation between E and R, conurbation

4.4.3 COROP

On COROP level, there are no significant relations found between diversity of economic activities and economic resilience (Table 6). What can be observed is that for the S index (Figure 36), the employees show a negative relation with resilience, whilst businesses show a positive relation with resilience. The H index (Figure 37) shows for both employees and businesses a negative relation with resilience. The E index (Figure 38) is the only index on COROP levels which shows for both employees and businesses a positive relation between diversity and resilience.

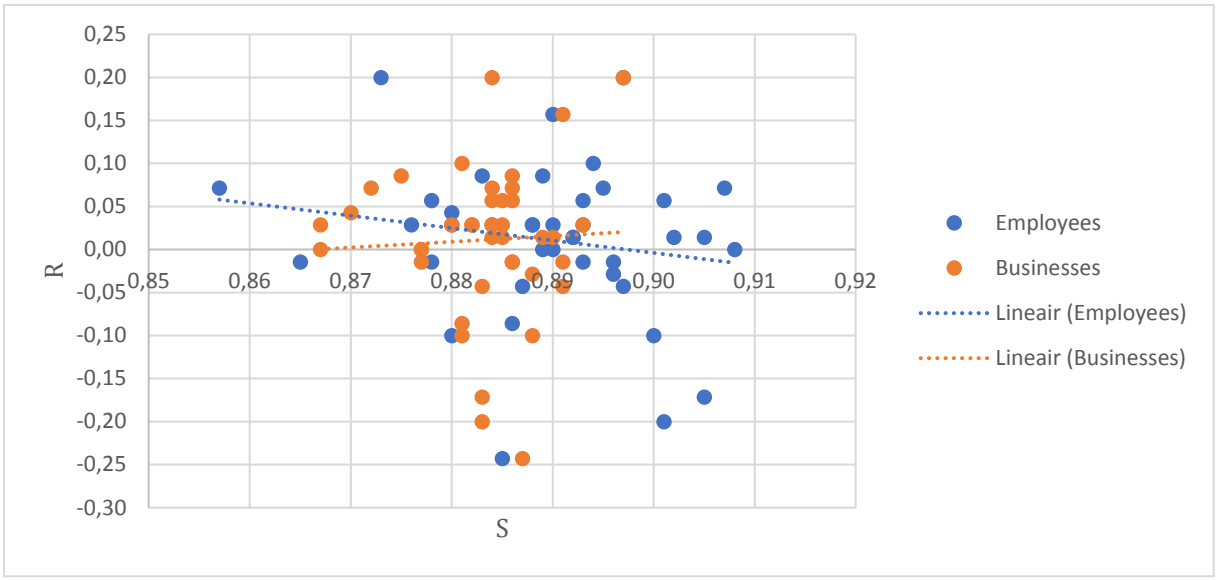

Figure 36. Relation between S and R, COROP

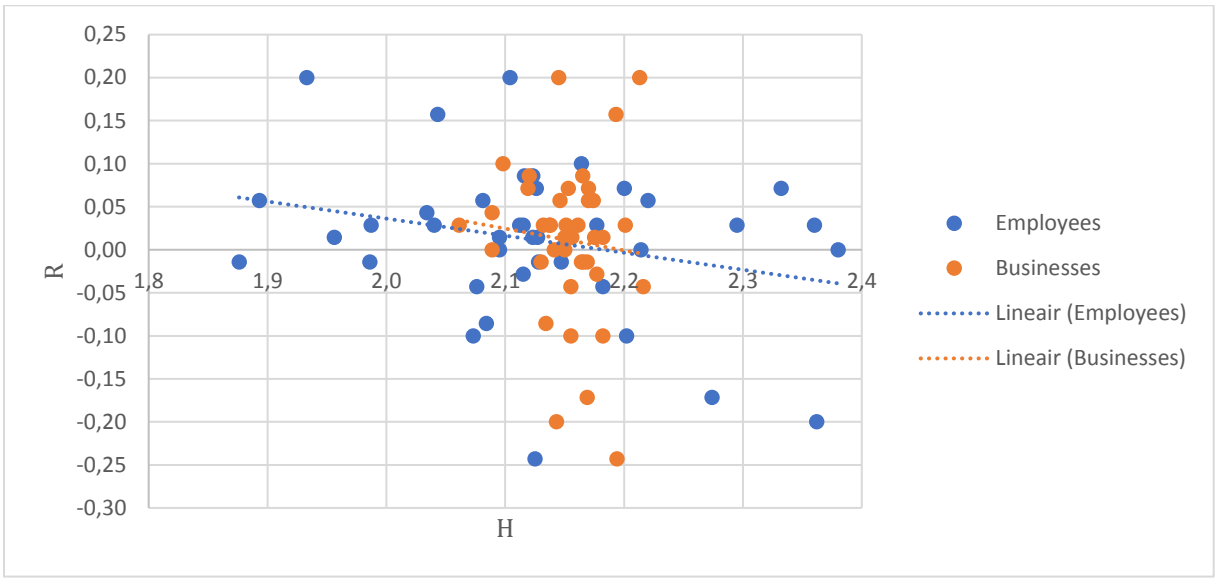

Figure 37. Relation between H and R, COROP

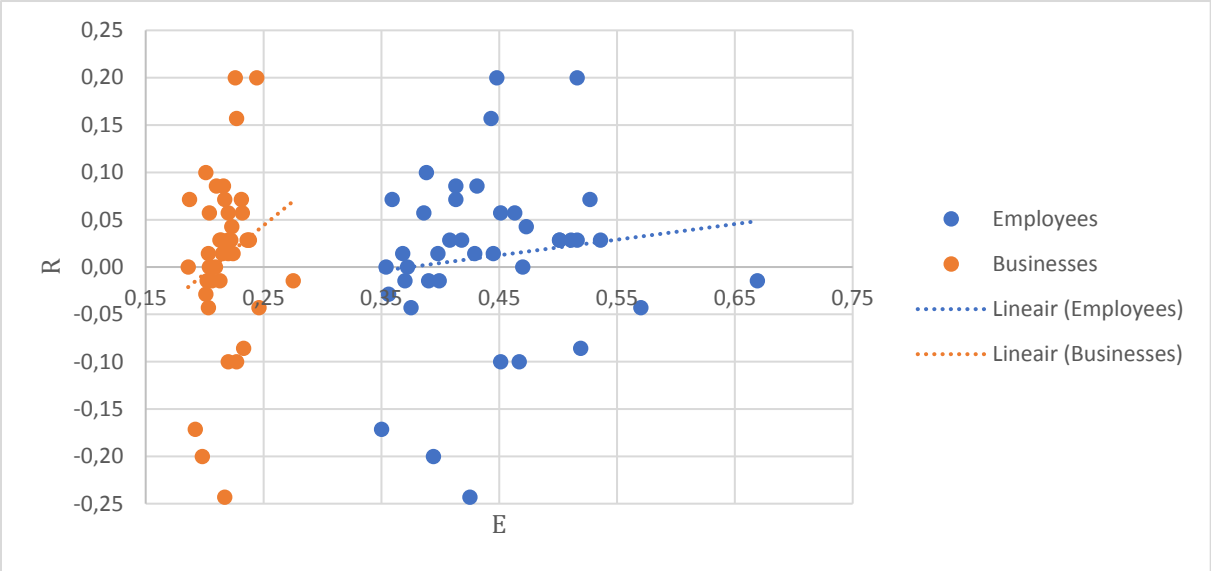

Figure 38. Relation between E and R, COROP

4.4.4 NUTS-2

On NUTS-2 level, there is one significant relation found between diversity of economic activities and economic resilience (Table 6). This counts for the E index of employees. What can be observed is that for the diversity indices of employees, the E index of employees (Figure 41) is the only one with a positive relation with economic resilience, whilst the S (Figure 39) and H index of employees (Figure 40) show a negative relation with economic resilience. All diversity indices of businesses show a positive relation with economic resilience, though not significantly.

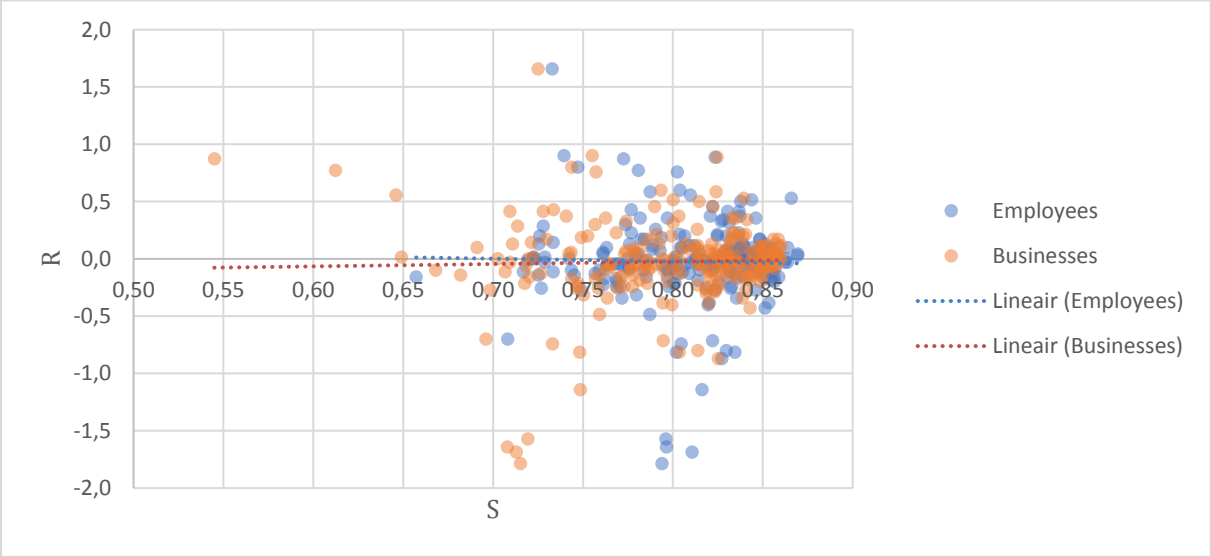

Figure 39. Relation between S and R, NUTS-2

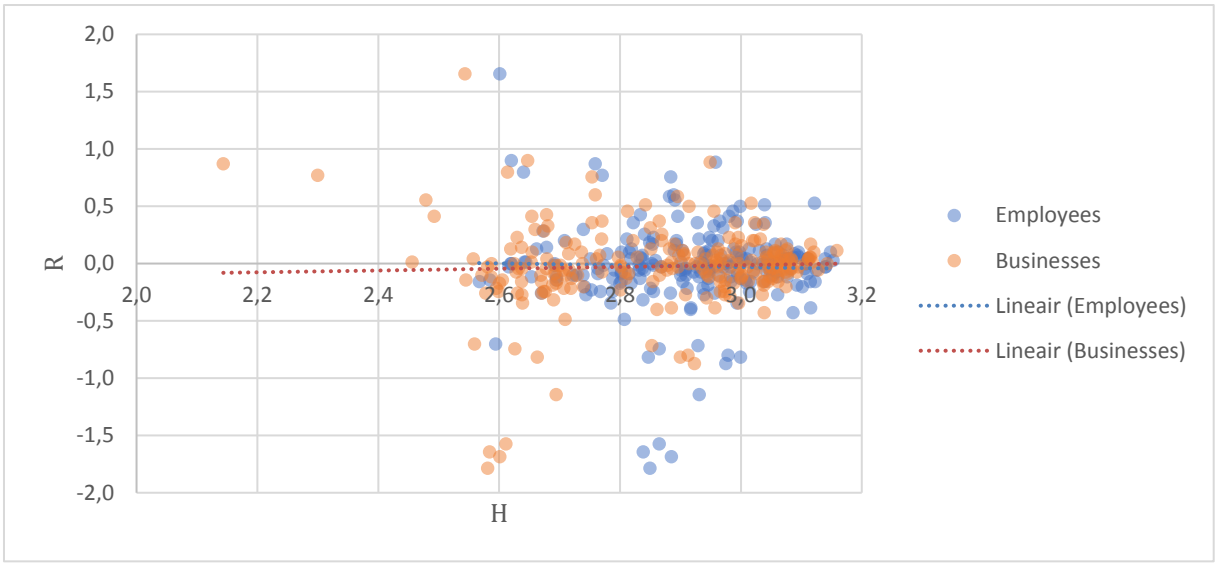

Figure 40. Relation between H and R, NUTS-2

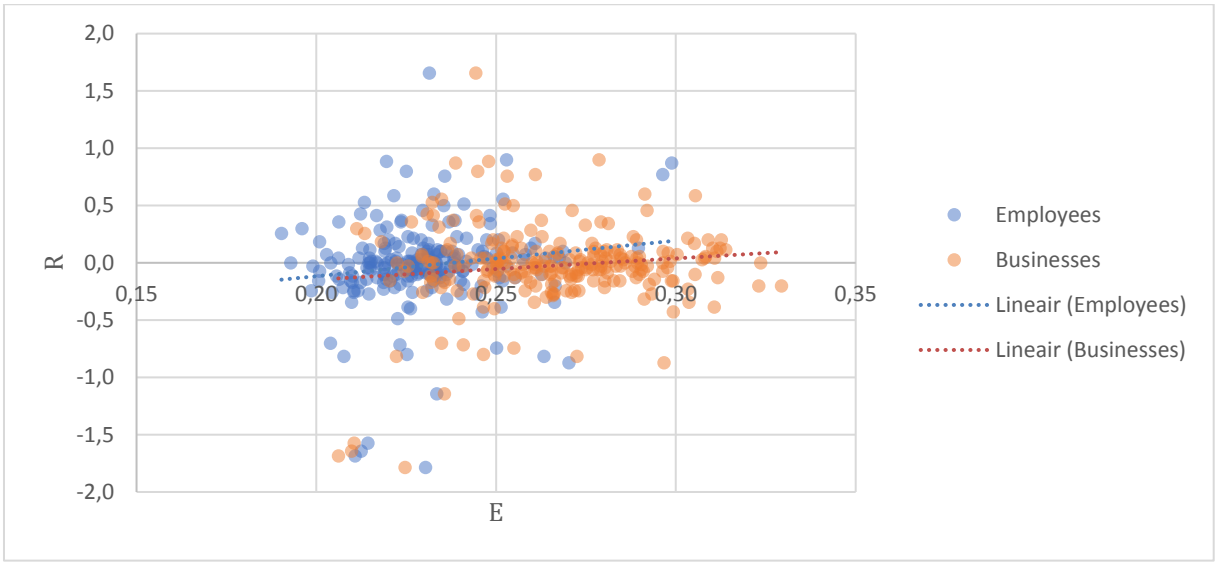

Figure 41. Relation between E and R, NUTS-2

4.5 Deviation

4.5.1 Metropolitan

In Figure 42, deviation (d) values of the metropolitan regions are shown, based on the diversity indices of both employees and businesses. As can be observed, it is difficult to identify a spatial pattern in terms of geographical location of regions that confirm or do not confirm the hypothesis. It depends on the diversity index used whether a geographical region confirms or does not confirm to the hypothesis.

For the diversity indices of employees, respectively eleven (S), ten (H) and twelve (E) regions confirm the hypothesis. Five metropolitan regions (Arnhem, Nijmegen, Amersfoort, Haarlem and Amersfoort) confirm the hypothesis for all three diversity indices. For the diversity indices of businesses, respectively twelve (S) and ten (H and E) regions confirm the hypothesis. Five metropolitan regions

(Groningen, Apeldoorn, Dordrecht, Tilburg and Geleen/Sittard) confirm the hypothesis for all three diversity indices

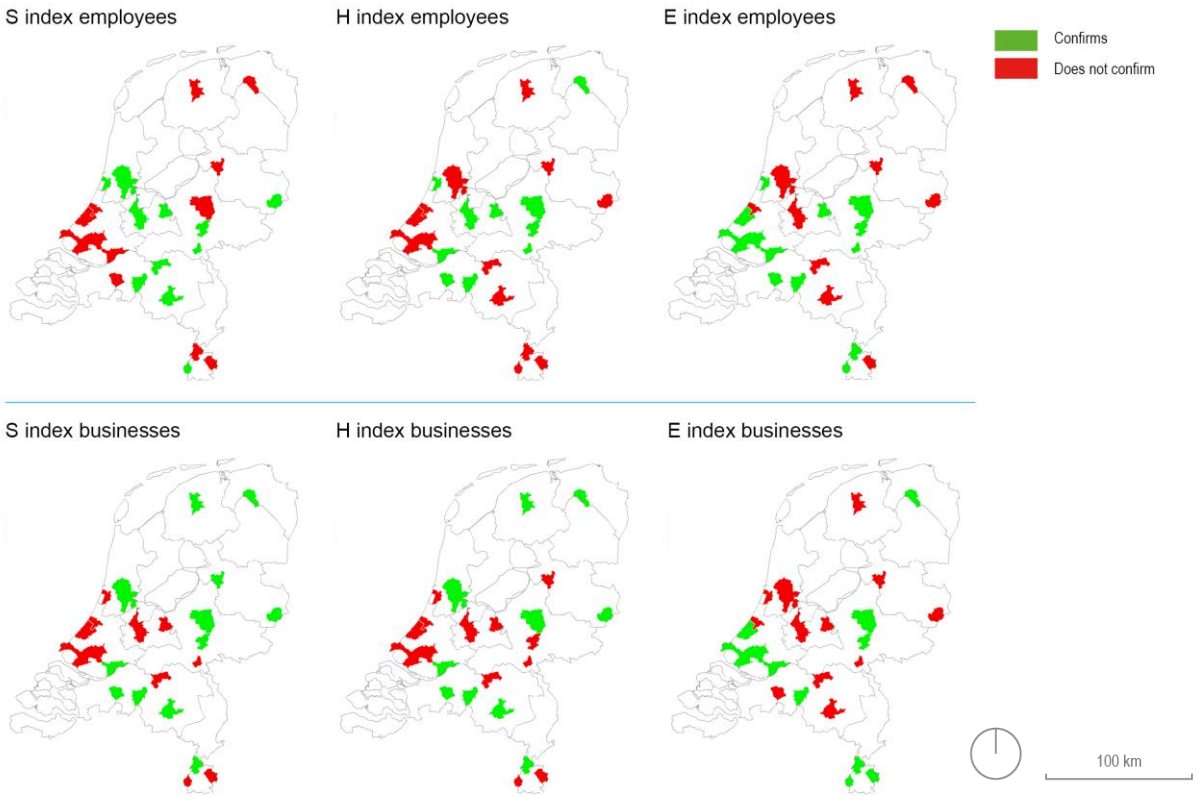

Figure 42. Deviation analysis, metropolitan

4.5.2 Conurbation

In Figure 43, one can find the deviation values of the conurbation regions, based on the diversity indices of both employees and businesses. As can be observed, it is difficult to identify a certain spatial pattern.

For the diversity indices of employees, respectively six (S and H) and thirteen (E) regions confirm the hypothesis. Three conurbation regions (Zwolle, Nijmegen and Maastricht) confirm the hypothesis for all three diversity indices. For the diversity indices of businesses, respectively eight (S), ten (H) and fifteen (E) regions confirm the hypothesis. Six conurbation regions (Groningen, Zwolle, Enschede, Apeldoorn, Haarlem and Maastricht) confirm the hypothesis for all three diversity indices.

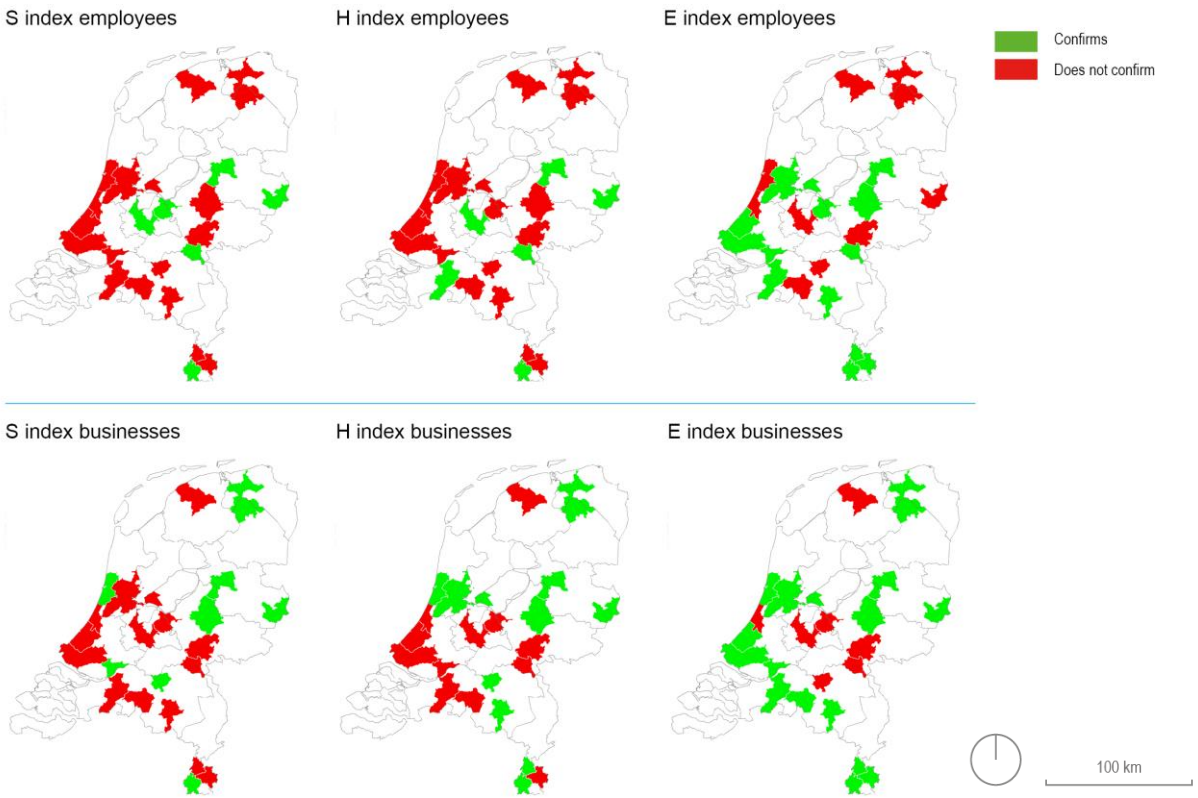

Figure 43. Deviation analysis, conurbation

Based on the regression analysis, there is a significant relation between the E index of businesses and economic resilience of these regions. Therefore, an additional analysis is executed to analyse which sector positively or negatively influences this relation. For the majority of regions applied that 'Wholesale and retail trade' (sector G) was largest (18), and for the rest 'Consultancy, research and other specialised business services' (sector M) (4) was dominant. Regions where G is the largest sector positively contribute to the hypothesis, whilst regions where M is the largest sector, negatively contribute to the hypothesis (Figure 44). However, this is not a significant influence ($p = 0{,}08$). This is due to the low number of observations (n=22).

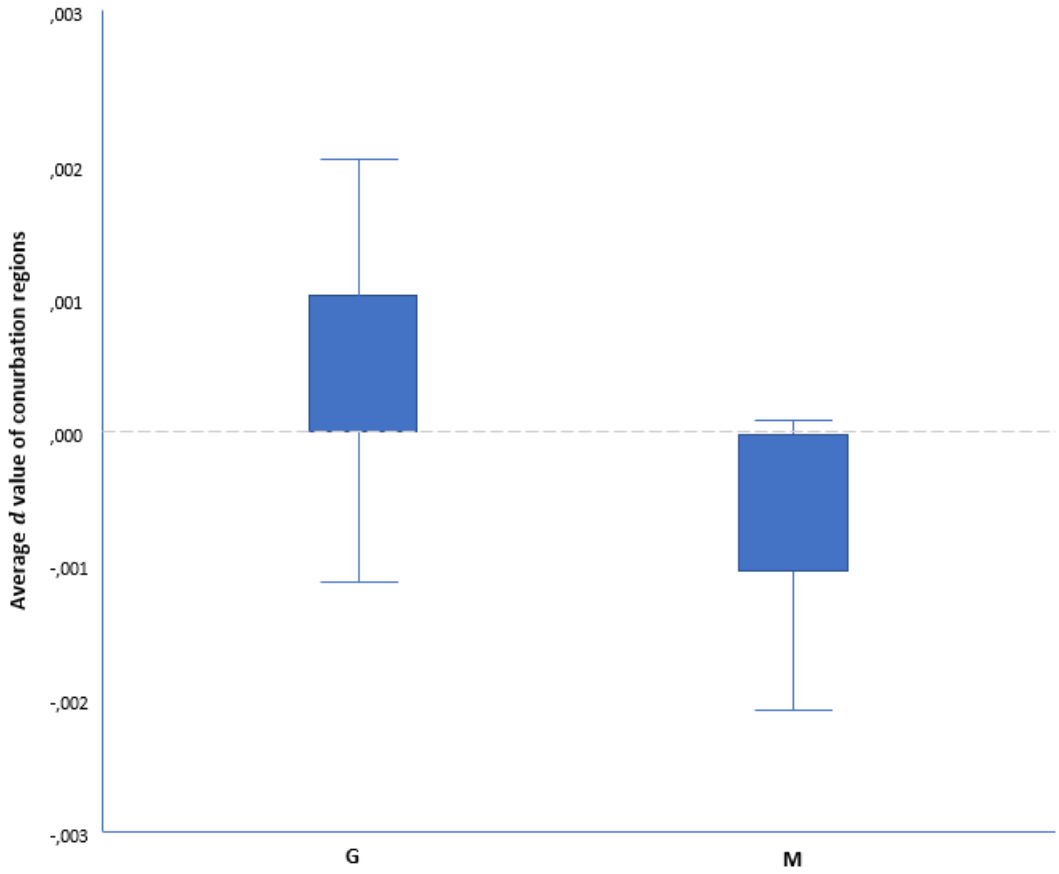

Figure 44. Sector analysis of deviation E index of businesses

4.5.3 COROP

In Figure 45, one can find the deviation values of the COROP regions, based on the diversity indices of both employees and businesses. As can be observed, it is difficult to identify spatial pattern.

For the diversity indices of employees, respectively twenty (S), sixteen (H) and 23 (E) regions confirm the hypothesis. Two (CR14 and CR40) COROP regions confirm the hypothesis for all three diversity indices. For the diversity indices of businesses, respectively 25 (S and E) and sixteen (H) regions confirm the hypothesis. Ten (CR03, CR12, CR16, CR23, CR24, CR26, CR27, CR32, CR34 and CR38) COROP regions confirm the hypothesis for all three diversity indices.

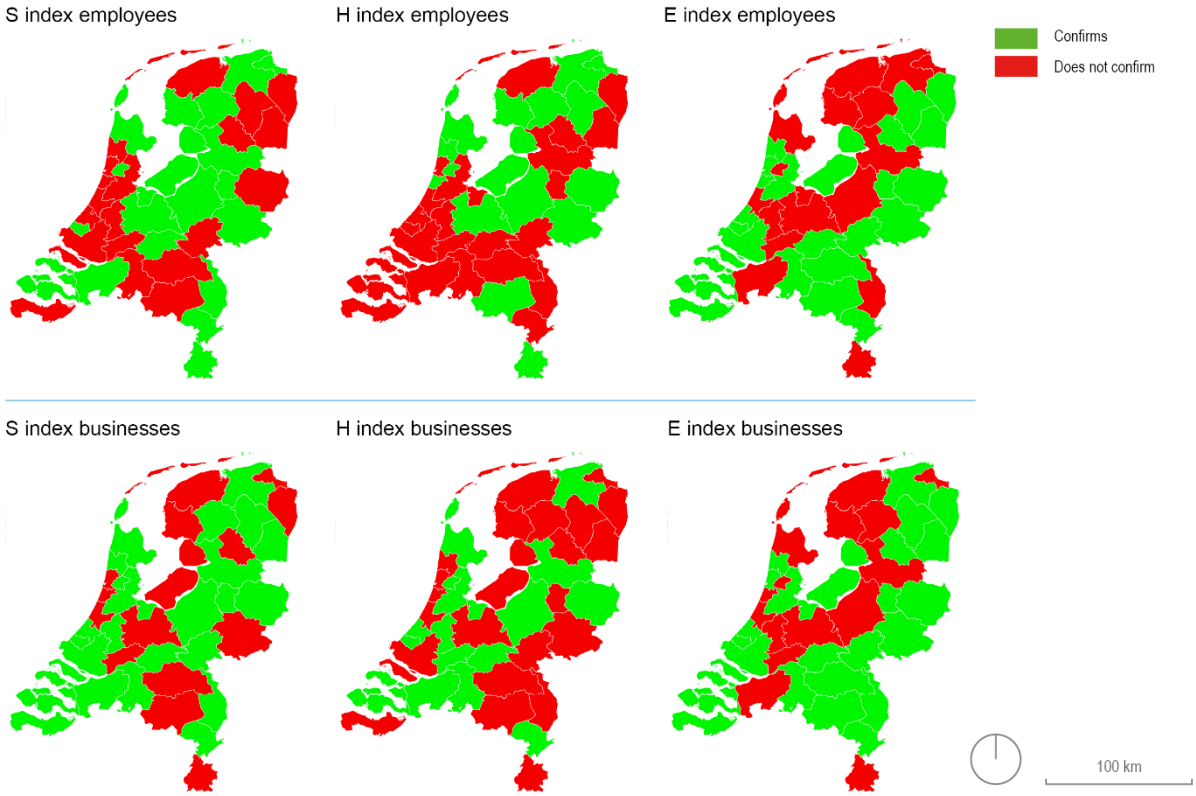

Figure 45. Deviation analysis, COROP

4.5.4 NUTS2

In Figure 46, one can find the deviation values of the COROP regions, based on the diversity indices of both employees and businesses. As can be observed, it is difficult to identify a certain spatial pattern.

For all three diversity indices of employees, there are 127 regions (54%) which confirm the hypothesis, though not in all three cases the same regions. For the diversity indices of businesses, respectively 129 (55%) (S and H) and 117 (50%) (E) regions confirm the hypothesis. This means that, on average, more than half of the regions confirm the hypothesis.

Figure 46. Deviation analysis, NUTS-2

Based on the regression analysis, there is a significant relationship between the E index of employees and economic resilience of these regions. Therefore, a sector analysis is executed to analyse which sector positively or negatively influences this relation. For the majority of the regions 'wholesale and retail trade' (sector G, n=126) was the largest, followed by 'manufacturing (sector C, n=87). In one region, most employees are active in 'transportation and storage' (sector H, n=1). The average deviation values of these three sectors are all positive, which implies that they positively contribute to the hypothesis. However, their influence on the average deviation value is not significant ($p = 0{,}80$).

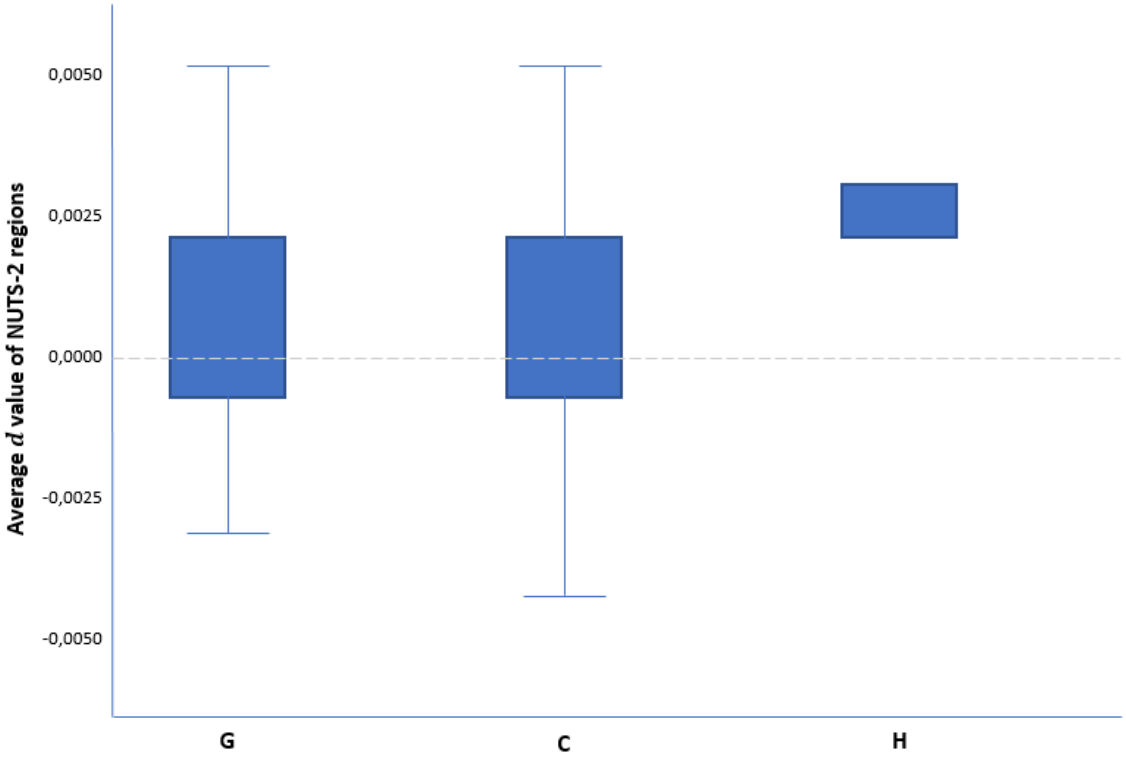

Figure 47. Sector analysis of deviation E index of employees

5 Discussion

5.1 On which scale level is the relationship between diversity and resilience the strongest?

Based on the results presented in Table 6, I conclude that the diversity indices on conurbation level show the strongest relation with economic resilience. The R square value on conurbation level is on average the highest, which indicates that 12,8% of the variance in economic resilience is predictable from the diversity indices. The E index of businesses on conurbation level has a R square value of 0,213, which means that 21,3% of the variance in economic resilience is predictable with this index. This is the highest r square value measured in this analysis. The E index of employees has a high R square value too, resulting in 0,151.

However, where the E indices show a positive relation between diversity and economic resilience, the other two indices show a negative relation between diversity and economic resilience. This means that the higher the S or H index, the less resilient a conurbation is (although not statistical significant). This is not in line with the hypothesis, because I expected a positive relation: the more diverse the economic activities in a region, the more resilient it should be.

I argue that the reason why the diversity indices of the conurbation level shows the strongest relation with economic resilience is due to the determination of the borders of the conurbation regions by the CBS. As said, I had to overcome the 'source-destination' issue of the employee and its employer, since I made use of unemployment data of the municipality of the source of the employee, whilst on the other hand I made use of data on diversity of economic activities of the destination of the employee. The conurbation level is the only level which considers this aspect of an employee specifically. As introduced, the metropolitan level is based on morphological characteristics of a region. The COROP regions in the Netherlands (NUTS-3 on European level) and the NUTS-2 levels on European level are based on already existing administrative borders.

To determine the borders of the conurbation regions, the regional labour market and housing market are analysed by the CBS. This means that the boundaries of the conurbation regions are therefore based on where employees live and work, which is an important factor in the regression analyses I did. When there is a mismatch in the data (i.e. unemployment data which does not correspond with data on diversity of economic activities), the outcomes of the regression analyses might be influenced by this. Therefore, I conclude that the conurbation level is the level which show the strongest relation between diversity of economic activities and economic resilience, because it considers the regional labour and housing market.

5.2 Which diversity index shows the strongest relationship with resilience?

Based on the results presented in Table 6, I conclude that the E index shows the strongest relationship with economic resilience. It is the only diversity index which has on average (for all four levels of economic regions) a positive relation with economic resilience, which means that the higher the E index, the more resilient an economic region is. The other two indices show on average a negative relation with economic resilience, which means that the more diverse the region, the less resilient it is. Besides the average values, there are only two diversity indices found with a significant relation with economic resilience: the E index of businesses on conurbation level and the E index of employees on NUTS-2 level.

A reason why the E index shows the strongest relation with economic resilience might be that it considers both the richness of employees or businesses and the relative abundance (dominance or evenness) of them. The S index only considers the first aspect, which is not enough to cover the whole range of diversity, whilst the H index considers also both aspects, but which gives an absolute outcome. The E index takes an extra aspect into account in comparison the H index, on which it is based, because it represents the H index as a relative measure in terms of what the maximum possible H index can be. This maximum value is based on the total number of employees or businesses in a region.

I argue that this latter step is crucial to identify the diversity of a region, because although the H index considers both aspects of diversity, it gives a distorted representation. Consequently, a high H index does not automatically lead to a high E index. Therefore, I conclude that the equitability index gives the best representation of the actual diversity of economic activities. This, I argue, is also the reason why the E index shows the strongest relation with economic resilience.

Next to which diversity index is used, it matters whether the diversity of employees or the diversity of businesses is used. In general, there are more employees than businesses in a certain region. This might cause for example that a region has a high diversity index in terms of businesses, but not in terms of employees, or vice-versa. The size of businesses might influence this difference between the two indices, because a low number of businesses does not automatically imply a low number of employees in a specific sector. Based on the outcomes of this research, I argue that both the diversity of employees as well as the diversity of businesses – at least for the E index - show a positive relationship with economic resilience.

5.3 What type of regions in terms of geographical location show a relationship between diversity and resilience?

Based on the spatial analysis, I argue that from this research I cannot identify a geographical region that consistently confirms or does not confirm the hypothesis. From the analysis maps in paragraph 4.5, there is not a general recognizable pattern for the three different levels of economic regions in the Netherlands. Also on European level there is no general recognizable pattern to observe. To conclude, there is not a geographical region where an increase in diversity of economic activities consistently leads to an increase in economic resilience.

5.4 Which dominant economic sector in a region influences the relationship between economic diversity and resilience?

Based on the sector analysis, which is only done for the two indices which have a significant regression (E index of employees on NUTS-2 level and E index of businesses on conurbation level), no dominant sectors are found that significantly influence the outcomes of the regression analysis (i.e. the deviation values). Although the extend of the analysis to answer this sub-research question is limited, I argue that, due to the minor differences in the average deviation per regions with a dominating sector, the influences of a specific sector are only minor to none. To conclude, no specific sector influences the relationship between economic diversity and economic resilience.

5.5 What is the relationship between regional economic diversity and regional economic resilience?

Based on the outcomes of this research, I conclude that it depends on which level and type of economic region is used and which diversity index is used. The diversity indices of the conurbation level of

economic regions, which is used in the Netherlands, shows on average the strongest relation with economic resilience. Next to that, the diversity index which shows on average the strongest relation with economic resilience is the Equitability (E) index.

When only the E index on conurbation level is analysed, I can conclude that there is a relation between the diversity of economic activities and economic resilience. The correlation coefficient of the (E) index of employees with economic resilience is 0,479 and the correlation coefficient of the (E) index of businesses is 1,591 (Table 6. The latter relation is significant, whilst the first is not significant. Based on these outcomes, I might conclude that the hypothesis can be confirmed, at least for the relation between the economic diversity of businesses and economic resilience on conurbation level.

The only other statistical significant relation found between the diversity of economic activities and economic resilience is for the (E) index of employees on NUTS-2 level. However, the correlation coefficient is 0,007, which means that there is only a minor, almost neglectable increase in resilience when the diversity of a region increases.

The two other diversity indices (S and H) show for both employees and businesses on average a negative correlation coefficient, which means that the more diverse a region is, the less resilient it is. This relation is however not statistically significant, but it at least does not confirm the hypothesis. Even more, it shows the total opposite as expected. This is, I argue, due to which aspects a diversity index considers.

5.6 Limitations of this research

5.6.1 Quality of the data

The outcomes of this study are largely dependent on the quality of the secondary data. All the data used for this research is extracted from two agencies: the CBS (Netherlands) and EUROSTAT (Europe). These are professional agencies which are funded by governmental organisations and their data is widely used for other research purposes. However, I was not able to check and improve the quality of this data and since they are the only agencies which provide the necessary data for free, I was bounded to work with their data.

Although these are professional agencies, there are some limitations in the data. For example, for data on economic activities on municipal level in the Netherlands, there seems to be a mismatch between number of businesses and number of employees. There are some regions in which there are no businesses in a specific sector, but there are employees in that sector. This might be the case due to administrative issues or restrictions making the data publicly available. On European level, there are many NUTS-2 regions which do not have data on the number of employees and businesses per sector, which might be causes by the still developing statistical agencies in several countries. I decided that, although some shortcomings in the data exist, that I would made use of the data clearly communicate these limitations for this research.

Another limitation in the quality of the data is not related to the data itself, but to the processing step itself to derive at the input data for the indices. For the metropolitan and conurbation level, there was no data available of unemployment levels. Therefore, I aggregated the unemployment levels of the municipalities of a specific region and divided it through number of municipalities, which gives an average unemployment rate for a metropolitan or conurbation region. This, however, is not a weighted

average, which also considers the population size of a municipality. Therefore, a recommendation for future research is to analyse whether the weighted average of unemployment rates per metropolitan and conurbation region differ and influence the resilience index and related outcomes of this research.

5.6.2 Indices

One strategy to improve the validity of my research is that I used three different diversity indices. As discussed, the outcomes of the regression analysis are very dependent on how the index is constructed. Therefore, I decided to use three diversity indices which all consider different aspects of diversity. This, in the end, turned out to be crucial, because they all present different outcomes which should be interpreted in a differently (i.e. which influence the outcome and conclusions of this study).

On the other hand, I only used one index to measure the economic resilience of a region. According to Martin and Sunley (2015), there are yet no agreed metrics, methods or indices for assessing the resistance and recovery of regional economies to financial shocks. Therefore, it is still in the pioneering phase and it can only be improved when more research is being undertaken that considers the basic principles of resilience of regional economics. The development of the R index in this research should therefore be seen in the light of the developments in the literature on regional economic resilience.

Another aspect that influences the outcomes of this research is the timeframe that I used. Due to the availability of data, I was forced to use the period 2008-2014 for the analysis, which is a period in which I only observed an increase in unemployment rates (at least in the Netherlands). This means that the outcomes of the regression analysis can only be interpreted in the light of an increase in unemployment rates, whilst the resilience index is developed in such a way that it should also be able to cover the aspects of times of economic growth and a decline in unemployment rates. Therefore, additional research in the future is needed to assess the full ability of the resilience index and to analyse whether more diverse economic regions recover faster than less diverse economic regions.

Besides that, on European level I used the development in unemployment rates on national levels as reference situation and not the development in unemployment rates on European level on average. Therefore, I recommend for future research that the it might be interesting to analyse what the outcomes will be when the average unemployment rates on European level are used as a reference situation for the regional economic resilience and the relationship with economic diversity.

6 Conclusion

6.1 Relationship between diversity and resilience

The aim of this research was to explore and assess if the diversity of economic activities contributes and relates to economic resilience of regions. The hypothesis for this research was that there is a positive relation between diversity and the resilience of a system. In this study, I used the economic system to explore and assess this relation. Therefore, the hypothesis was that a region that has a greater diversity in economic activities would be more resilient.

The findings of this research show that there is an argument for those who argue that diversification is beneficial for a region, because the only statistically significant relation our found for those regions that show a positive relation between diversity and resilience. This implies that an increase in the diversity of economic activities in terms of employees and businesses is positively related to an increase in economic resilience. An increase in diversity of economic activities means that an economic region is not dependent on one or a few sectors, which implies that there are more sectors that are not evenly impacted by a recession. Therefore, I argue that an increase in diversity of economic activities, at least in conurbation regions, is related to an increase economic resilience.

However, based on these findings, I also must conclude that there is only minor evidence that an increase in diversity also leads to an increase in resilience, at least in economic systems. This conclusion is fragile and highly dependent on how the indices are constructed and chosen. Therefore, more research on the relation between diversity and resilience should be done to further establish solid arguments that can inform spatial economic policies. Next to that, I only analysed the correlation between two variables, which does not allow me to say that there is a causal relationship between diversity and resilience. It requires more research to analyse whether regions who explicitly increased the diversity of economic activities also increase their economic resilience to say whether there is a causal relationship or not.

6.2 Planning for resilience

Due to the increasing popularity of resilience in planning policies has made resilience thinking has made the term itself “incontestable, portraying a desirable, aspirational goal relevant to practically any given issue” (White & Hare, 2014, p. 934). However, taking the notion of resilience for granted might lead to using the term without a clear conception what resilience is and what contributes to resilience. The concept of resilience “has evolved as a pragmatic tool to deliver endogenous responses to exogenous risks. Resilience strategies promise risks can be ameliorated, and where shocks are experienced society can return to ‘normality’ with rapidity and efficiency” (White & Hare, 2014, p. 940). Resilience is used in different forms and types of policy documents and is becoming a ‘buzzword’ in the field of planning practices (Davoudi & Porter, 2012), but without any critical reflection on how the term is used and what resilience is, the term might lose its original meaning and its applicability. Although the focus of resilience was traditionally on environmental issues, there has been an increase in the policy fields where it is used nowadays. Consequently, Doyle (2017) argues that “there remains debate around how ‘resilience’ can be best operationalised within planning.”

In this research, I specifically focused on economic resilience, which is just one field in which the term can be used. The results of this research show that promoting a diversity of economic activities can be a way to enhance the economic resilience of a region (Wilkinson, 2011). This diversity can me promoted via a variety of planning instruments, such as spatial economic development strategies,

regional policies and the development of attractive locations for businesses. A diversity of employees can be promoted via, amongst others, investing in different forms of education.

In the end, whether resilience is desirable or not remains subject of political debates and considerations. As a researcher (and future planning professional), I can only aim to inform policy makers in the best possible ways, based on empirical research and findings on what contributes to resilience. This research is a step forward in operationalizing the buzzword 'resilience' in economic sense and what contributes to economic resilience. I hope that more research will be done on resilience, which will increase our understanding of resilience and what contributes to it. In the end, this would enable us to really develop resilient regions.

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Appendix 1. List of metropolitan, conurbation and COROP regions in the Netherlands

Table 11. List of metropolitan and conurbation regions in the Netherlands

01 – Groningen	12 – Leiden
02 – Leeuwarden	13 – ‘s-Gravenhage
03 – Zwolle	14 – Rotterdam
04 – Enschede	15 – Dordrecht
05 – Apeldoorn	16 – Breda
06 – Arnhem	17 – Tilburg
07 – Nijmegen	18 – ‘s-Hertogenbosch
08 – Amersfoort	19 – Eindhoven
09 – Utrecht	20 – Geleen/Sittard
10 – Amsterdam	21 – Heerlen
11 - Haarlem	22 – Maastricht

Table 12. List of COROP regions in the Netherlands

CR01 – Oost-Groningen	CR21 – Agglomeratie Haarlem
CR02 – Delfzijl en omgeving	CR22 – Zaanstreek
CR03 – Overig Groningen	CR23 – Groot-Amsterdam
CR04 – Noord-Friesland	CR24 – Het Gooi en Vechtstreek
CR05 – Zuidwest-Friesland	CR25 – Agglomeratie Leiden en Bollenstreek
CR06 – Zuidoost-Friesland	CR26 – Agglomeratie ‘s-Gravenhave
CR07 – Noord-Drenthe	CR27 – Delft en Westland
CR08 – Zuidoost-Drenthe	CR28 – Oost-Zuid-Holland
CR09 – Zuidwest-Drenthe	CR29 – Groot-Rijnmond
CR10 – Noord-Overijssel	CR30 – Zuidoost-Zuid-Holland
CR11 – Zuidwest-Overijssel	CR31 – Zeeuwsch-Vlaanderen
CR12 – Twente	CR32 – Overig Zeeland
CR13 – Veluwe	CR33 – West-Noord-Brabant
CR14 – Achterhoek	CR34 – Midden-Noord-Brabant
CR15 – Arnhem/Nijmegen	CR35 – Noordoost-Noord-Brabant
CR16 – Zuidwest-Gelderland	CR36 – Zuidoost-Noord-Brabant
CR17 – Utrecht	CR37 – Noord-Limburg
CR18 – Kop van Noord-Holland	CR38 – Midden-Limburg
CR19 – Alkmaar en omgeving	CR39 – Zuid-Limburg
CR20 – IJmond	CR40 - Flevoland

Appendix 2. Classification of Economic Activities

Overview of classification of economic activities

1-digit	CBS 1-digit classification	Economic sections, NACE Rev. 2,
A	Agriculture, forestry and fishing	Agriculture, forestry and fishing
B	Mining and quarrying	Mining and quarrying
C	Manufacturing	Manufacturing
D	Electricity, gas, steam and air conditioning supply	Electricity, gas, steam and air conditioning supply
E		Water supply, sewerage, waste management and remediation activities
F	Construction	Construction
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	Wholesale and retail trade; repair of motor vehicles and motorcycles
H	Transportation and storage	Transportation and storage
I	Accomodaton and food service activities	Accomodaton and food service activities
J	Information and communication	Information and communication
K	Financial institutions	Financial and insurrance activities
L	Renting, buying and selling of real estate	Real estate activities
M	Consultancy, research and other specialised business services	Professional, scientific and technical activities
N	Renting and leasing of tangible goods and other business support services	Administrative support service activities
O	Public administration, public services and compulsory social security	Public administration and defence; compulsory social security
P	Education	Education
Q	Human health and social work activities	Human health and social work activities
R	Culture, sports and recreation	Arts, entertainment and recreation
S	Other service activities	Other service activities
T		Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
U		Activities of extraterritorial organisations and bodies

Appendix 3. NUTS-2 variables

NUTS-2	*S(emp)*	*H(emp)*	*E(emp)*	*S(bus)*	*H(bus)*	*E(bus)*	R
AT11	0,826	2,978	0,269	0,824	2,997	0,324	0,000
AT12	0,819	2,946	0,227	0,826	3,021	0,275	-0,057
AT13	0,864	3,139	0,237	0,832	2,998	0,265	-0,029
AT21	0,836	3,016	0,252	0,832	3,012	0,299	-0,157
AT22	0,820	2,971	0,232	0,837	3,050	0,283	-0,029
AT31	0,802	2,901	0,222	0,831	3,036	0,280	0,014
AT32	0,837	2,998	0,246	0,839	3,041	0,296	0,100
AT33	0,834	2,966	0,239	0,829	2,993	0,285	0,071
AT34	0,806	2,893	0,247	0,839	3,022	0,313	0,200
BE10	0,835	2,926	0,233	0,816	2,868	0,265	-0,029
BE21	0,817	2,855	0,223	0,795	2,801	0,250	-0,014
BE22	0,804	2,802	0,238	0,782	2,736	0,265	0,100
BE23	0,804	2,811	0,227	0,791	2,769	0,252	0,214
BE24	0,800	2,815	0,228	0,802	2,814	0,265	-0,086
BE25	0,810	2,869	0,228	0,814	2,896	0,263	-0,029
BE31	0,802	2,833	0,255	0,804	2,809	0,289	-0,129
BE32	0,796	2,802	0,233	0,763	2,692	0,257	-0,086
BE33	0,802	2,791	0,234	0,777	2,716	0,261	-0,057
BE34	0,784	2,727	0,263	0,786	2,709	0,305	-0,100
BE35	0,789	2,778	0,255	0,778	2,715	0,283	0,086
BG31	0,743	2,738	0,228	0,668	2,571	0,255	-0,100
BG32	0,728	2,673	0,218	0,714	2,674	0,260	0,286
BG33	0,821	2,965	0,239	0,741	2,770	0,263	0,371
BG34	0,809	2,946	0,234	0,727	2,719	0,255	-0,129
BG41	0,851	3,125	0,230	0,784	2,877	0,251	-0,057
BG42	0,749	2,743	0,215	0,698	2,637	0,244	-0,271
CZ01	0,864	3,148	0,234	0,848	3,054	0,252	0,100
CZ02	0,757	2,788	0,217	0,839	3,000	0,258	-0,129
CZ03	0,762	2,818	0,219	0,837	2,988	0,260	-0,171
CZ04	0,777	2,855	0,225	0,833	2,980	0,263	0,229
CZ05	0,717	2,695	0,206	0,833	2,966	0,252	-0,114
CZ06	0,775	2,853	0,215	0,834	2,967	0,250	0,000
CZ07	0,719	2,691	0,209	0,831	2,958	0,257	-0,014
CZ08	0,763	2,815	0,219	0,831	2,961	0,261	0,100
DE11	0,771	2,787	0,199	0,747	2,599	0,239	-0,243
DE12	0,798	2,855	0,210	0,777	2,674	0,258	-0,243
DE13	0,772	2,784	0,210	0,763	2,639	0,261	-0,343
DE14	0,727	2,670	0,204	0,769	2,670	0,271	-0,257
DE21	0,832	2,956	0,210	0,746	2,578	0,230	-0,257
DE22	0,761	2,753	0,219	0,814	2,800	0,303	-0,229
DE23	0,785	2,802	0,221	0,770	2,670	0,284	-0,157
DE24	0,742	2,692	0,215	0,794	2,737	0,296	0,000
DE25	0,785	2,773	0,219	0,786	2,701	0,277	-0,014
DE26	0,759	2,722	0,222	0,795	2,730	0,290	-0,100
DE27	0,769	2,767	0,212	0,773	2,676	0,273	-0,243
DE30	0,830	2,895	0,217	0,709	2,492	0,232	0,414
DE50	0,837	2,948	0,239	0,768	2,629	0,288	0,229
DE60	0,815	2,837	0,215	0,742	2,557	0,247	0,043
DE71	0,852	3,007	0,214	0,759	2,605	0,237	-0,143
DE72	0,745	2,694	0,220	0,778	2,696	0,294	-0,143
DE73	0,800	2,831	0,224	0,784	2,694	0,290	-0,014
DE80	0,804	2,889	0,233	0,793	2,759	0,291	0,600
DE91	0,768	2,763	0,215	0,763	2,638	0,275	-0,043
DE92	0,823	2,922	0,223	0,765	2,628	0,258	-0,071
DE93	0,823	2,947	0,233	0,765	2,632	0,268	-0,043
DE94	0,815	2,909	0,219	0,776	2,669	0,263	-0,100
DEA1	0,826	2,937	0,207	0,747	2,595	0,235	-0,214
DEA2	0,851	3,009	0,212	0,757	2,600	0,236	-0,171
DEA3	0,814	2,945	0,223	0,782	2,688	0,265	-0,186
DEA4	0,775	2,763	0,209	0,784	2,690	0,268	-0,086
DEA5	0,781	2,817	0,206	0,779	2,679	0,254	0,043
DEB1	0,801	2,850	0,232	0,786	2,707	0,280	-0,214
DEB2	0,769	2,741	0,246	0,797	2,739	0,329	-0,200
DEB3	0,818	2,883	0,227	0,758	2,630	0,265	-0,257
DEC0	0,780	2,838	0,236	0,750	2,690	0,291	-0,314
DED2	0,827	2,955	0,232	0,774	2,680	0,275	0,329
DEE0	0,822	2,986	0,230	0,790	2,812	0,292	0,457
DEF0	0,814	2,908	0,219	0,781	2,678	0,261	-0,043
DEG0	0,787	2,882	0,222	0,824	2,895	0,305	0,586
DK01	0,863	3,108	0,233	0,860	3,107	0,276	0,000
DK02	0,813	2,932	0,242	0,855	3,118	0,298	0,014
DK03	0,806	2,901	0,226	0,855	3,128	0,290	-0,057
DK04	0,813	2,938	0,228	0,859	3,142	0,289	0,000
DK05	0,812	2,947	0,245	0,860	3,159	0,314	0,114
EL30	0,774	2,739	0,196	0,757	2,659	0,211	0,300
EL41	0,739	2,620	0,253	0,755	2,647	0,279	0,900
EL42	0,733	2,601	0,231	0,725	2,543	0,244	1,657
EL43	0,747	2,640	0,225	0,744	2,614	0,245	0,800

ES11	0,831	2,970	0,220	0,800	2,850	0,234	0,314
ES12	0,844	3,039	0,241	0,800	2,842	0,252	0,514
ES13	0,837	2,980	0,248	0,728	2,654	0,245	0,414
ES21	0,824	2,958	0,219	0,824	2,949	0,248	0,886
ES22	0,802	2,884	0,236	0,757	2,753	0,253	0,757
ES23	0,810	2,890	0,252	0,646	2,478	0,235	0,557
ES24	0,830	2,962	0,229	0,799	2,868	0,249	0,200
ES30	0,866	3,122	0,213	0,839	3,017	0,232	0,529
ES41	0,837	2,994	0,224	0,803	2,865	0,238	0,371
ES42	0,822	2,929	0,223	0,795	2,852	0,241	-0,714
ES43	0,822	2,948	0,241	0,777	2,770	0,247	-0,071
ES51	0,846	3,040	0,206	0,833	2,990	0,226	0,357
ES52	0,832	2,983	0,210	0,820	2,947	0,232	-0,114
ES53	0,838	2,999	0,235	0,814	2,914	0,255	0,500
ES61	0,834	2,999	0,208	0,803	2,900	0,222	-0,814
ES62	0,819	2,917	0,226	0,799	2,861	0,249	-0,400
ES63	0,781	2,771	0,296	0,612	2,299	0,261	0,771
ES64	0,773	2,759	0,299	0,545	2,144	0,239	0,871
ES70	0,830	2,979	0,225	0,814	2,912	0,246	-0,800
FI19	0,794	2,908	0,227	0,849	3,081	0,273	-0,057
FR10	*	*	*	0,854	3,115	0,229	0,057
FR21	*	*	*	0,820	2,966	0,277	-0,157
FR22	*	*	*	0,825	2,973	0,272	0,086
FR23	*	*	*	0,824	2,974	0,271	-0,143
FR24	*	*	*	0,826	2,973	0,261	-0,200
FR25	*	*	*	0,814	2,936	0,269	-0,043
FR26	*	*	*	0,825	2,973	0,269	-0,243
FR30	*	*	*	0,785	2,801	0,241	-0,029
FR41	*	*	*	0,823	2,982	0,266	-0,286
FR42	*	*	*	0,818	2,973	0,266	-0,271
FR43	*	*	*	0,828	2,979	0,280	-0,043
FR51	*	*	*	0,830	2,994	0,254	-0,057
FR52	*	*	*	0,834	2,996	0,256	0,229
FR53	*	*	*	0,818	2,943	0,264	-0,300
FR61	*	*	*	0,828	2,981	0,250	0,029
FR62	*	*	*	0,832	3,001	0,254	0,157
FR63	*	*	*	0,824	2,959	0,289	-0,029
FR71	*	*	*	0,836	3,011	0,239	-0,029
FR72	*	*	*	0,822	2,955	0,271	0,457
FR81	*	*	*	0,823	2,959	0,250	0,014
FR82	*	*	*	0,832	2,991	0,237	0,171
HU10	0,859	3,123	0,225	0,850	3,061	0,247	-0,157
HU21	0,763	2,840	0,225	0,850	3,065	0,278	-0,057
HU22	0,789	2,903	0,231	0,850	3,074	0,281	0,114
HU23	0,828	3,025	0,248	0,841	3,037	0,281	0,343
HU31	0,797	2,928	0,237	0,835	3,022	0,279	0,357
HU32	0,805	2,930	0,233	0,827	3,000	0,270	-0,114
HU33	0,797	2,900	0,231	0,829	3,002	0,271	-0,100
IE01	0,822	2,963	0,236	0,800	2,865	0,265	-0,100
IE02	0,844	3,045	0,221	0,829	2,958	0,251	0,029
ITC1	0,775	2,802	0,201	0,788	2,808	0,224	-0,071
ITC2	0,835	2,988	0,290	0,808	2,851	0,312	0,129
ITC3	0,829	2,943	0,229	0,774	2,766	0,239	0,071
ITC4	0,790	2,840	0,190	0,813	2,869	0,213	0,257
ITF1	0,787	2,807	0,223	0,759	2,709	0,240	-0,486
ITF2	0,802	2,847	0,263	0,748	2,663	0,272	-0,814
ITF3	0,811	2,885	0,211	0,713	2,601	0,206	-1,686
ITF4	0,796	2,838	0,212	0,708	2,584	0,210	-1,643
ITF5	0,805	2,865	0,250	0,733	2,626	0,255	-0,743
ITF6	0,794	2,849	0,230	0,715	2,581	0,225	-1,786
ITG1	0,796	2,865	0,214	0,719	2,611	0,211	-1,571
ITG2	0,816	2,931	0,233	0,748	2,694	0,236	-1,143
NL11	0,853	3,094	0,258	0,819	2,954	0,300	0,071
NL12	0,840	3,020	0,250	0,817	2,941	0,291	-0,071
NL13	0,831	2,939	0,250	0,805	2,906	0,298	0,086
NL21	0,838	2,992	0,233	0,801	2,885	0,273	0,014
NL22	0,842	3,028	0,227	0,815	2,924	0,260	0,000
NL23	0,820	2,917	0,251	0,820	2,957	0,311	-0,386
NL31	0,850	3,043	0,233	0,810	2,897	0,267	0,071
NL32	0,853	3,076	0,222	0,821	2,942	0,251	0,043
NL33	0,847	3,052	0,219	0,821	2,944	0,249	-0,100
NL34	0,839	3,014	0,260	0,821	2,962	0,310	0,129
NL41	0,836	2,972	0,217	0,814	2,914	0,252	0,000
NL42	0,839	2,992	0,235	0,813	2,929	0,277	0,100
NO01	0,854	3,105	0,239	0,858	3,084	0,274	-0,043
NO02	0,831	3,009	0,264	0,852	3,083	0,308	0,043
NO03	0,826	2,982	0,240	0,849	3,062	0,279	-0,029
NO04	0,862	3,140	0,253	0,855	3,095	0,292	-0,029
NO05	0,844	3,072	0,247	0,858	3,111	0,289	0,043
NO06	0,853	3,110	0,268	0,858	3,112	0,311	0,043
NO07	0,847	3,087	0,266	0,857	3,114	0,308	0,057

PL11	0,729	2,616	0,199	0,709	2,581	0,226	-0,029
PL12	0,794	2,849	0,201	0,749	2,710	0,218	0,186
PL21	0,768	2,800	0,210	0,744	2,694	0,232	-0,171
PL22	0,797	2,904	0,209	0,720	2,637	0,220	-0,157
PL31	0,725	2,585	0,206	0,682	2,545	0,232	-0,143
PL32	0,708	2,594	0,204	0,696	2,559	0,235	-0,700
PL33	0,729	2,644	0,216	0,649	2,456	0,231	0,014
PL34	0,733	2,653	0,221	0,707	2,587	0,250	-0,114
PL41	0,722	2,619	0,193	0,720	2,625	0,222	0,000
PL42	0,782	2,822	0,224	0,763	2,754	0,245	0,357
PL43	0,725	2,662	0,219	0,711	2,619	0,251	0,129
PL51	0,777	2,834	0,212	0,733	2,678	0,231	0,429
PL52	0,733	2,678	0,223	0,721	2,637	0,254	0,143
PL61	0,723	2,620	0,204	0,703	2,587	0,232	0,000
PL62	0,722	2,642	0,215	0,722	2,653	0,252	0,014
PL63	0,761	2,751	0,212	0,773	2,761	0,243	0,043
PT11	0,793	2,837	0,203	0,815	2,905	0,229	0,071
PT15	0,823	2,939	0,244	0,824	2,908	0,266	-0,271
PT16	0,809	2,890	0,215	0,814	2,903	0,236	0,114
PT17	0,850	3,057	0,220	0,825	2,933	0,233	0,000
PT18	0,822	2,946	0,243	0,804	2,878	0,261	-0,014
PT20	0,827	2,975	0,270	0,825	2,923	0,297	-0,871
PT30	0,835	2,993	0,266	0,838	2,996	0,304	-0,343
RO11	0,776	2,819	0,213	0,792	2,882	0,257	0,129
RO12	0,770	2,836	0,214	0,791	2,886	0,261	-0,043
RO21	0,784	2,853	0,219	0,730	2,725	0,249	0,171
RO22	0,800	2,911	0,222	0,717	2,718	0,247	-0,214
RO31	0,772	2,831	0,215	0,718	2,706	0,248	-0,057
RO32	0,853	3,115	0,225	0,794	2,885	0,246	-0,386
RO41	0,805	2,940	0,231	0,691	2,655	0,252	0,100
RO42	0,782	2,893	0,222	0,786	2,890	0,268	0,171
SE11	0,869	3,139	0,231	0,823	2,966	0,246	0,043
SE12	0,825	3,004	0,232	0,850	3,066	0,270	0,029
SE21	0,779	2,858	0,229	0,851	3,070	0,285	0,029
SE22	0,839	3,039	0,235	0,843	3,036	0,266	-0,157
SE23	0,832	3,016	0,226	0,849	3,061	0,261	0,014
SE31	0,799	2,933	0,237	0,853	3,092	0,288	-0,071
SE32	0,854	3,095	0,269	0,859	3,120	0,311	0,100
SE33	0,848	3,076	0,261	0,859	3,115	0,305	0,171
SK01	0,854	3,095	0,247	0,779	2,828	0,277	0,057
SK02	0,657	2,567	0,201	0,771	2,854	0,283	-0,157
SK03	0,726	2,708	0,220	0,753	2,821	0,289	0,200
SK04	0,761	2,833	0,231	0,743	2,797	0,288	0,057
UKC1	0,851	3,086	0,246	0,843	3,039	0,299	-0,429
UKC2	0,855	3,092	0,241	0,843	3,038	0,293	-0,186
UKD1	0,834	2,999	0,251	0,847	3,052	0,312	-0,129
UKD3	0,855	3,077	0,226	0,849	3,061	0,272	-0,114
UKD4	0,829	2,953	0,229	0,843	3,042	0,285	-0,029
UKE1	0,830	2,983	0,240	0,842	3,038	0,299	-0,157
UKE2	0,851	3,082	0,249	0,847	3,054	0,298	-0,043
UKE3	0,846	3,061	0,240	0,840	3,035	0,293	-0,271
UKE4	0,840	3,041	0,226	0,845	3,048	0,277	-0,057
UKF1	0,846	3,069	0,231	0,850	3,067	0,279	0,071
UKF2	0,837	2,980	0,226	0,855	3,080	0,282	0,014
UKF3	0,825	2,931	0,242	0,840	3,032	0,303	0,214
UKG1	0,851	3,078	0,238	0,855	3,079	0,285	0,043
UKG2	0,839	3,030	0,234	0,848	3,056	0,284	0,114
UKG3	0,847	3,060	0,225	0,845	3,048	0,273	-0,114
UKH1	0,848	3,063	0,228	0,855	3,084	0,273	0,029
UKH2	0,848	3,056	0,231	0,856	3,066	0,277	0,171
UKH3	0,844	3,049	0,234	0,854	3,069	0,279	-0,057
UKJ1	0,855	3,088	0,227	0,854	3,055	0,267	0,086
UKJ2	0,852	3,053	0,225	0,853	3,053	0,263	0,014
UKJ3	0,851	3,042	0,230	0,857	3,076	0,278	0,129
UKJ4	0,844	3,062	0,236	0,851	3,058	0,280	0,100
UKK1	0,857	3,109	0,230	0,856	3,077	0,272	-0,086
UKK2	0,838	3,037	0,238	0,852	3,064	0,286	0,000
UKK3	0,825	2,952	0,251	0,836	3,020	0,309	0,200
UKK4	0,838	3,001	0,238	0,844	3,042	0,290	0,057
UKL1	0,831	2,994	0,231	0,837	3,024	0,281	-0,086
UKL2	0,847	3,058	0,241	0,851	3,074	0,296	-0,071
UKM2	0,857	3,109	0,235	0,846	3,045	0,280	0,043
UKM3	0,856	3,115	0,233	0,841	3,045	0,280	-0,157
UKM5	0,869	3,152	0,257	0,834	3,017	0,307	0,029
UKM6	0,856	3,102	0,266	0,849	3,074	0,323	-0,200
UKN0	0,833	3,014	0,231	0,820	2,966	0,272	-0,243

* No data available