Bachelor Thesis [International Bachelor of Economics and Business Economics]

Impact of locational characteristics on the clustering of ICT startups: an empirical study in the Netherlands

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Abstract:

This thesis studies the effect of location factors on the creation of new ICT firms in the Netherlands. The focus of the location factors is on agglomeration economies present in the region. The paper links early theories of agglomeration and clusters with an analysis in the Netherlands. As The Netherlands has recently become the go-to location for a lot of technology startups according to some influential trend watchers, it makes this a timely and relevant study for policymakers. The paper uses 4 indicators of agglomeration economies. As a result, this paper finds that the establishment of a new ICT firm is affected by the macroeconomic factors of the region, its specialization in the manufacturing sector and the level of competition present in the region. By analyzing these factors, the result can be useful for policymakers when managing the regulation on new startups.

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I. Introduction

One of the most acknowledged ICT clusters in the world is Silicon Valley in Southern San Francisco, where high tech companies ranging from Google to Zapier reside. It started as a major hub for the aerospace industry, which lead to the founding of several top technology companies, in the 1990s it became the center of computer industries in the US (Business Insider, 2017). As the cluster development continues, it is now the prime location for tech entrepreneurs to locate their new established business. Donkin (2017) explains that the ICT cluster in Silicon Valley has paved the way for great innovations mainly due to its working culture. As Donkin (2017) points out, the creative atmosphere and the freedom for employees to start their own projects have lead to innovations such as Gmail, which marks one of the many achievements from the Silicon Valley cluster. Moreover, the relationships generated from the cluster can enhance the quality of innovation even more. Following this, Silicon Valley has seen a large scale of growth in entrepreneurship, specifically in the technology industry, creating a cluster of high tech startups. As a result, many research and books have been written on the development of the Silicon Valley. One of the most well-known book on Silicon Valley, 'The Man Behind the Microchip', by Leslie Berlin tells the story of lives behind the high-tech industries in Silicon Valley. Moreover, researchers such as Steven Klepper (2010) have studied the origin of the cluster and what actually impacts the advancement of the cluster. Nevertheless, regions in Europe have also recently seen an advanced development of clustering. London has grown to be the major cluster for the financial technology industries, followed by Berlin which is the second biggest city for technology startups in Europe (BBC, 2017).

Furthermore, the 2017 Global Startup Ecosystem Report has shown a growth in the European entrepreneurship activities. However, the report also shows the quality of startup hubs in Europe is still behind compared to those in the US. The European Commission has increasingly established more importance into prospering the entrepreneurial scene in Europe. The European Commission (n.d.) stated in their website that, currently, the most important source of employment in Europe are Small and Medium-sized Enterprises (SMEs). According to Startup Genome's Global Startup Ecosystem Report (2017), the biggest startup clusters in Europe are London, Berlin, Paris, and Amsterdam. Amsterdam has seen a significant growth of entrepreneurial activities, most importantly, in the Internet and Technology industry (Karabell, 2016). In 2016, the European Commission awarded the Netherlands as the European Capital of Innovation 2016/2017 (Karabell, 2016). In addition, the Netherlands is the go-to location for well known international internet companies. As an example, Netflix, the biggest internet TV company at the moment, has a European HQ in Amsterdam and has created over 400 new jobs (Ryan, 2017). A couple of the most successful Dutch technology companies in the past decades are booking.com and TomTom, which are now in M&A and IPO stage of funding. Following this, both Amsterdam and Rotterdam has seen a launch of many other tech companies. For instance, WeTransfer founded in Amsterdam, a cloud data based service which allows for an easier transfer of files, have played a significant role in the Dutch technology industry by reaching a profit of 1 billion euro in 2015 (Konrad, 2016). WeTransfer is an example of a Dutch ICT innovation which has developed into a tool which can be used by businesses from other sectors as part of their workflow. Overall, the growth of the ICT sector in the Netherlands can be said to originate from newly established businesses and growing presence of large international companies.

When observing ICT clusters, a question remains, ***what location factors impact the establishment of these geographical concentrations of ICT companies***. The subject of geographical concentration of an industry has always been a well-known topic in economics. Alfred Marshall's (1920) influential work, Principles of Economics, originally published in 1890, has touched on this subject, specifically on the location of industrial firms. Marshall (1920) explains the existence of geographical concentration of industrial firms, and why industrial companies feel the need to be located close to each other. His work can be seen as one of the early theories of agglomeration economies, which will be explained in the next section of this paper.

The location of a firm can substantially affect the development of the firm as it determines their local market. From the economic situation of the region to the culture of the population, these locational factors are taken into account when locating a firm. In addition, these locational determinants are also of interest to policymakers. As mentioned before, the European Commission has pointed out a major role of SMEs on the employment rate in the EU (European Commission, n.d.). The European 2020 Action Plan is one of the many strategies from the European Commission that aims to advance entrepreneurship in Europe. The program includes training of the creation and development of a new business, helping to remove barriers such as fundraising and expanding the European entrepreneurship culture (European Commission, n.d.). Furthermore, the European Commission has also taken smaller steps such as alleviating the process of registering a new business, educating the youth on entrepreneurship and connecting entrepreneurs with investors. In turn, by examining the Global Startup Ecosystem report and prominent ICT startups such as WeTransfer, it can be seen that the ICT industry itself in the Netherlands seems to be growing in terms of both startups and incumbent firms. Thus, this paper provides societal relevance in the European economy as it assesses the location factors on the development of the ICT sector in the Netherlands.

This paper will examine the impact of locational factors based on early theories of clusters and past researches on the development of ICT clusters, with a focus in the Netherlands. Many scholars have studied the relation between locational characteristics and ICT clusters, especially in regards to Silicon Valley. Although there is a substantial amount of studies on this topic, there is still limited application on Europe, specifically in Amsterdam as the ICT clusters have just recently developed. This paper aims to understand the location factors which results in the advancement of the information technology industry in the Netherlands.

As the paper continues into the relationship between location factors and the growth of the ICT industry in the Netherlands, it is important to briefly review the theory behind clustering. Michael Porter and Alfred Marshall have explained theories on clusters and agglomeration in many of their economic works. Their theory discusses the origin of clusters and also how it benefits the economy. The second part of the section will provide a comprehensive discussion on past works of literatures on locational characteristics. Following the discussion of past literatures and theory on clusters, this paper will develop 3 hypotheses, which will be analysed using econometric models. The result of the empirical analysis will be shown in the section following the hypotheses alongside a discussion regarding the findings and the hypotheses.

II. Literature review

Theories on agglomeration and clustering

Economist, Michael Porter (1998) explains clusters as a concentration of companies and institutions in the same location, affiliated in the same field. These inputs then determine what location characteristics impact the clusters. Porter (1998) addresses the theory of locational characteristics on cluster areas, mentioning the importance of inputs that firms require in order to achieve high productivity. Most importantly, the quality of the business environment will significantly affect the level of competition in the region (Porter, 1998). In addition, Porter (1998) indicates the need for the presence of institutions, threats from rivals, customers and human capital with specialized skills and knowledge for the competitive advantage of a location. Furthermore, Porter (1998) point out the importance of the close proximity of the factors mentioned above to allow for easy access, relationships and knowledge transfers which then can lead to productivity growth.

According to Porter (1998) clusters are significant to competition in three ways. Firstly, clusters increase the productivity of incumbent firms as the relationship between firms can be highly complementary for their production process. This is because clusters allow better access to inputs and high-quality employees which are a significant factor in productivity boost. Second, a cluster can escalate the rate of innovation as well as employment in the area as it helps fasten the pace of knowledge and information transfer. This point is central to this paper, as the paper assesses the growth of newly developed business which also can represent new innovation in the region. As customers are a significant part of a cluster, it opens up vast windows in the market for companies to innovate. Moreover, Porter (1998) pointed out that clusters generally advance the creation of new businesses due to the solid customer base present in the region, making it easier for the development of newly established businesses. In addition, he mentions that in an advanced cluster, there are a vast amount of companies from different sectors, who can provide knowledge and input for new businesses. Both these reasons reduce the potential failure of starting a new business. Porter (2000) also published another work which focus on location and competition. Porter (2000) states that clusters tend to amplify the level of competition, however it also amplifies the level of cooperation between firms which results in a coexistence of competition and cooperation. As competition drives up the intensity of rivals, cooperation on the part of suppliers benefit firms by reducing cost. Subsequently, Porter (2000) emphasizes the importance of competition in the development of a cluster itself. Porter (2000) discusses how competition can increase the establishment of new firms. As the second part of this section continues with discussion of past works of literature, it assesses past research which have taken into account the effect of competition on the advancement of clusters overtime.

In turn, economist Alfred Marshall (1920) explains three sources for economies of scale in agglomeration; **knowledge spillovers, local non-traded inputs, and a local skilled labor pool.** Agglomeration economies are generally defined as location-specific economies of scale (McCann, 2013). Theory on clusters and agglomeration commonly goes together as the economies of scale that agglomeration economies generate, leads to a broader beneficial relationship between businesses, which then can be identified as a cluster. This theory is essential to this paper, as the locational determinants that the analysis will focus on is agglomeration in the region.

Firstly, <u>knowledge spillover</u> is explained by the ability of employees to develop a relationship with employees from other firms in an agglomeration economy. This is followed by a share of information and knowledge between firms, benefiting all in the region. McCann (2013) elaborates on this by providing an explanation for "Tacit Knowledge", which is an important point in knowledge spillover. He described tacit knowledge as unfinished information which in a cluster, is spread on a "non-market basis" (McCann, 2013). Subsequently, the informal exchange of this information in a cluster allows for mutual benefits between parties in the market. The second factor mentioned, local non-traded input, indicates the possibility of firms in a region to gain access to specialized inputs and reduce the cost of transportation due to the close proximity of suppliers. McCann (2013) explained this factor by using Wall Street as an example, known for its cluster in financial institutions. He mentions that the abundant presence of business services in Wall Street, has a main role of providing assistance to the financial sector. Hence, providing the financial institutions in the region with an advantage. Due to the fact that business services such as legal or software service are usually associated with high costs, the existence of a large pool of these services provides the financial sector with a cost advantage. The third and final source stated by Marshall (1920) is the presence of local skilled labor pool. Marshall (1920) explain that firms in an agglomerated economy have the advantage of having access to a large labor pool with specialized skills. The cost of training employees is generally a substantial part of a firm's expenditure as it may occur for a long period of time, thus it is a considerable advantage for firms to have as it can save them a significant amount of expenditure. This labor pool can be generated from a cluster as the geographical concentration of firms in the same industry brings about employees with industry-specific skills. Therefore, Marshall (1920) stated that access to local skilled labor pool reduces the search and training cost for labor.

Furthermore, Duranton and Puga (2004) elaborate on these sources of agglomeration by reformulating these 3 sources into sharing, learning and matching (Duranton and Puga, 2004. As cited in McCann, 2013). McCann (2013) explains that the sources stated by Duranton and Puga (2004), helps to view agglomeration as a "dynamic phenomenon" of interactions between firms in a cluster. In addition, they mention that the main aspect of theses sources is the advantage on reducing the costs for knowledge and information transfer. This shows that there are several discussions that can be found regarding theories of clusters and agglomeration. Many economists have extended the agglomeration and cluster theory which was earlier introduced by Alfred Marshall.

Additionally, there are three well-known types of agglomeration economies introduced by Marshall (1920); ***internal returns to scale, localization and urbanization economies.*** Firstly, internal returns to scale can be described as when firms achieve economies of scale simply due to their size. However, this particular type of agglomeration is not in line with Marshall's (1920) sources of agglomeration as it does originate from external factors. This paper will not focus on this type of agglomeration as it does not relate to locational characteristics. In turn, localization economies focus specifically on the close proximity of firms in the same sector. This type of agglomeration focuses on the presence of suppliers for a particular sector in the region. McCann (2013) elaborate on localization economies by using the automobile clusters in Detroit and Michigan as an example. The presence of large automobile firms in those regions leads to a vast amount of local suppliers. Thus, as the automobile firms benefit from internal return to scale, the suppliers also benefit from transfer of knowledge between other suppliers. All three of the sources of agglomeration mentioned by Marshall are factors that can result in localization economies. However, another point which needs to be stated is that as technology improves, firms need to be able to adapt in order to avoid adverse growth. Lastly, the third type of agglomeration is the economies of urbanization. It explains agglomeration of firms in different sectors (Jacobs, 1960. As cited in McCann, 2013). Therefore, rather than simply having localization economies for a specific sector, urbanization economies explain the benefits it generates for various sectors present in the region. Urbanization economies can also be demonstrated by the Wall Street example, where different sectors compliment each other in a region and allow for mutually beneficial exchanges (McCann, 2013). The next section discusses past works of literature on the topic of locational determinants, it can be seen that many scholars have gone in depth into studying the effect of agglomeration on clustering of new businesses.

Past research on locational determinants

The second part of this literature review examines several past researches on the topic of locational determinants of newly established businesses. As geographical characteristics and the definition of new business is very broad, different methodologies and results can be found regarding this topic. Arauzo-Carod et al. (2010) assess the methods and results of empirical studies in an industrial location. Their paper looks at a considerable amount of research by scholars on a similar topic and aims to show how the methods have developed over time and how results have differed. Arauzo-Carod et al. (2010) state that recent empirical studies have shifted to making use of Count Data Models (CDM) instead of Discrete Choice Models (DCM). DCM refers to data when the unit of analysis are the firms and the primary involvement is its characteristics on the location decisions. Whereas CDM focus more on the geographical characteristics of the location decision, thus the unit of analysis is geographical. Moreover, Arauzo-Carod et al. (2010) discuss the key location determinants that are generally present in past works of literatures. For literature making use of DCM, explanatory variables showing positive effects are agglomeration economies, unemployment and higher quality public transport (Arauzo-Carod et al., 2010). Moreover, when using a geographical factors as unit of analysis (CDM), they found that generally, the key explanatory variables with positive effect are agglomeration economies and market size (not captured by DCM). Arauzo-Carod et al. (2010) stated that these findings are essentials for policymakers as it points them out to key factors such as education, infrastructures and, taxes. As this section continues with discussions regarding past literatures, a more in depth explanation on how these key determinants affect the location decision of new businesses will be presented.

Egeln et al. (2004) study the location decisions of new businesses, explicitly in Germany. Their paper is one of the many literatures used in Arauzo-Carod et al. (2010) overview. They focus on public research spin-off startups, which are businesses established by researchers originating from a parent research institution as these are the primary businesses that spawn new innovations. As mentioned before, new business is a very broad category, and it can be defined in a number of ways. Egeln et al. (2004) explain that Silicon Valley is an example of a cluster involving these businesses, as a significant number of the early days' companies located in Silicon Valley stem from public research institutions. Their paper made use of a count data model, specifically the negative binomial regression. As mentioned by Arauzo-Carod et al. (2010), researchers have increasingly made use of the count model. Their result find that public research spin off tends to be located in agglomerated region. They indicate localization economies by the level of startups in the region that are also in the same sector as the spin-off firm. Whereas urbanization economies are indicated by the population in the region and purchasing power.

Most importantly, Egeln et al. (2004) discuss how the locational determinants of startups in knowledge intensive industries differs with those of public research spin-offs. They used three categories to explain the location determinants of these startups. These three categories are agglomeration indicators, knowledge and research base and socio-economic structure. The agglomeration indicators are measured by the logarithmic expression of the population, employment density and travel distance to nearest airport. Their result shows a significant positive effect of population of age 15 - 65 years for locational determinants of spin-off startups and general startups. Egeln et al. (2004) explains that this is mainly due to the fact that this population age range represents potential founders of new businesses. Egeln et al. (2004) also mention the importance of purchasing power for both startups and public research spin-offs location determinants, as it represents the overall demand of the region. Another important point from their paper is the significance of research intensive activities in the region as a location determinant for startups. Egeln et al. (2004) results show that the more research intensive the manufacturing industry in the region, the more likely the region would see a growth in the number of startups. However, this is not the same with public research spin-offs, instead they are affected by the degree of technology and knowledge intensive activities in the region. Their paper states that location determinants for startups lies in the "pull" factor, thus emphasizing the region's demand. Whereas for new established public research spin-offs, the "push" factors such as human capital and science are more emphasized.

Another literature which focuses on location decision in Germany is a study by Bade and Nerlinger (2000), their study looks at the spatial distribution of new technology based firms (NTBF). Bade and Nerlinger (2000) aimed to show significant factors which can explain why the number of technology startups are substantially different amongst German districts ("Kreise"). Their result shows that most NTBF are located in densely populated and economically developed regions, which is consistent with the findings of Egeln et al. (2010). However, the effect of population density that they find shows an inverted u-shaped effect. Thus, at some point the advantage of being in a densely populated region turn into a disadvantage. Population density can also explain the effect of urbanization economies. Moreover, Bade and Nerlinger (2000) shows a significant relationship between the number of NTBF and research & development facilities. In their paper, research & development facilities include universities, privately held research facilities and technological universities. This is somewhat in line with Egeln et al's. (2010) result which indicates that research facilities affect the development of startups in a region. However, unlike Egeln et al's. (2010) result, Bade and Nerlinger (2000) finds that the effect of agglomeration economies is ambiguous. They find that this effect is limited to top technology industries only and the relationship is shown to be non-linear. Meaning, after a certain degree of specialization in the economy, the effect on the number of new businesses turns into an adverse effect.

Subsequently, Arauzo-Carod and Viladecans-Marsal (2009) study in depth the effect of agglomeration economies of the location decision of startups in the metropolitan areas of Spain. As Bade and Nerlinger (2000), they also separated startups into three degree of technology categories (low, intermediate and high). Furthermore, Arauzo-Carod and Viladecans-Marsal (2009) indicate two types of agglomeration in their research; urbanization and localization economies (discussed in previous section). They measure agglomeration using several explanatory variables which indicates urbanization and localization. These explanatory variables are population density, distance from the city center, human capital (university & education in intermediate level) and previous entry in own sector. Urbanization economies are generally indicated by the population density and human capital, whereas localization economies are identified by the entries of businesses in the sector. Arauzo-Carod and Viladecans-Marsal (2009) also made use of count data models in their analysis, same as other researchers when studying this topic. Their paper has scientific relevance as it focuses specifically on metropolitan areas, thus concentrating on the effect of the close proximity to agglomeration economies. In line with Egeln et al's. (2010) result, their result shows a significant effect of agglomeration economies on location of new businesses. Furthermore, this relationship is shown to be different across industries. Firstly, their result shows a significant positive effect of urbanization economies only on new high and low tech firms (Arauzo-Carod & Viladecans-Marsal, 2009). However, they find that localization economy has a significant positive effect on all categories of tech firms. In addition, Arauzo-Carod and Viladecans-Marsal (2009) results shows a significant negative effect of distance from the city center. An interesting point in their outcome is that this effect is higher as the startups is more technology intensive (Arauzo-Carod & Viladecans-Marsal, 2009). They explain that the more technologically advanced the startup, the more desire they have to be close to the city center in order to benefit from the advantages of agglomeration. Arauzo-Carod & Viladecans-Marsal (2009) also stated the importance for policymakers to take into account these locational determinants when trying to promote the growth of new businesses.

Arauzo-Carod and Viladecans-Marsal (2009) also cited the work of Rosenthal and Strange (2003), which study the locational determinants of startups in several metropolitan areas. Rosenthal and Strange (2003) too focus on the effect of agglomeration as a location determinant for new firms in various industries. Their research does not only look at the count of new established business in the metropolitan areas, in addition, they also examine the employment of newly established firms. Their results show the importance of competition in the industry on the establishment of new firms. This particular outcome is seen to be significant in all but 1 industry in their research. Regarding agglomeration, Rosenthal and Strange (2003) measure localization economies using the employment magnitude of the particular industry, whereas urbanization economies is measured by the employment magnitude in other industries in the region. These agglomeration variable are calculated using Herfindahl-Hirschman Index, which is frequently used as a measure for market concentration (Rosenthal & Strange, 2003). The result shows that localization agglomeration affects the rate of new businesses more than urbanization economies. In addition, Rosenthal and Strange (2003) paper also took into account the distance from the agglomeration economies - they find that the effect of localization economies decreases as distance increases from the spatial concentration. Another interesting outcome by Rosenthal and Strange (2003) research is that the presence of geographical concentration of small firms has a greater effect on the birth of new firms than the concentration of medium or large incumbent firms. Thus, they conclude that the existence of the entrepreneurship community is a considerable factor for the location of new businesses.

Another approach into studying the locational determinants of businesses, is by examining the investment decisions. Lall and Chakravorty (2005) study the theory behind industrial location and spatial inequality, through an empirical study in India. Their paper examined the location decision of private sector investments, which is argued to be driven by “efficiency-related” factors (Lall & Chakravorty, 2005). Lall and Chakravorty (2005) hypothesis states that private sector investments would gravitate towards industrial clustering and metropolitan areas, which is also consistent with the arguments from previous literatures in this section. Lall and Chakravorty (2005) confirm their assumption that private sector investments tend to move towards profit maximizing regions where there is a hospitable local governments present. In other words, firms prefer to locate in regions where regulations are more at ease. Lall and Chakravoty's (2005) work differs from other past works of literatures as they focus on the investment location decisions. Their paper is relevant as part of this literature review as it shows that there are many ways of researching the locational determinants of a cluster. An investment into the region will indicate either a development in an incumbent firm, growth of a newly established company or a foreign firm locating in the region.

Another research that studies the location determinant of new investment is a paper by Guimarães et al. (2000). Their paper examines the effect of agglomeration of location of new investments in Portugal. Guimarães et al. (2000) research made use of four variables for agglomeration, which are service agglomeration, localization agglomeration, total manufacturing agglomeration and foreign specific agglomeration. Their paper measured localization economies through the employment in a specific industry. Hence, service agglomeration is measured by the share of employment in the service sector and foreign specific agglomeration is measured by the proportion of employment in foreign plants. Their result shows that service agglomeration has the strongest effect on the location of new investments. Guimarães et al. (2000) indicate service agglomeration and total manufacturing activity as urbanization economies. Hence, their findings show that urbanization agglomeration has a stronger effect than localization agglomeration which is measured by the share of employment in the specific industry. They state that the significant effect of service agglomeration, points to the importance of urban regions for investments. Guimarães et al. (2000) explain that this is because the high level of service present in the region which helps overcome barriers faced by foreign firms. This is an important conclusion for policymakers if they look to increase the FDI rate in the region. Moreover, their conclusion is particularly interesting for this paper as it will also compare the effect of localisation and agglomeration economies on the establishment rate of businesses.

As this paper aim to better understand the effect of agglomeration on the establishment of ICT businesses in the Netherlands, this section also discusses recent theories of agglomeration. Following earlier studies of agglomeration, Rosenthal and Strange (2004) use recent data to study the scope of agglomeration economies. They pointed out a distinction between three scopes of agglomeration that can exists, these scopes are industrial, temporal and geographic. These scopes represent how effects from agglomeration can expand over time. Firstly, the industrial scope describes the extent to which increasing returns to scale from agglomeration can spread across industries in a region. In other words, this scope explains the potential returns to scale that extends beyond localisation economies, which represents geographical concentration of an industry. The second scope mentioned in their paper is the geographic scope. This point puts an emphasis on distance in an agglomerated region. It examines how close market agents are in the region, as the closer the proximity of market agents, the more possibility for cooperation. Rosenthal and Strange (2004) third scope is temporal, which explains the time factor in increasing returns to scale. With the temporal scope, Rosenthal and Strange (2004) states that an interaction between market agents will benefits the market even after some time. This scope is particularly important for explaining the knowledge spillovers in agglomeration. It explains the importance of knowledge as it benefits future development of the region. Especially for those knowledge and learning that do not have an immediate effect, the welfare it brings will be seen in the future expansion of the region. Moreover, Rosenthal and Strange (2004) conclude that evidence from recent data supports the theory of Marshall (1920) which states that the three source of agglomerations are: input sharing, labor market pooling, and knowledge spillovers. Overall, their paper provided a more extensive perception of agglomeration based on recent economic events. Most importantly, for policymakers, these scopes of agglomeration can guide them with expanding agglomeration in a region.

Following the discussion of past works of literature, it can be seen that the topic of agglomeration and establishment of technology firm is a prominent subject for scholars. In addition, measuring agglomeration and new firms can be done in various ways. Early theories of agglomeration indicated 3 types of agglomeration, however, scholars use different interpretations to illustrate these agglomeration economies. Localization economies can be measured through the share of employment in specific sectors or the Herfindahl-Hirschman Index to measure an industry concentration as used by Rosenthal and Strange (2003). Moreover, urbanization economies seem to be generally measured through population density and total manufacturing activity in the region. In turn, establishment of new technology businesses can also be measured in numerous ways. Scholars have focused on different indicators of technology startups, such as research spin-offs or by looking at the location decision of private sector investments. Therefore, this section shows how broad the topic of locational decision of startups is and there are different ways on how it can be approached.

III. Hypotheses

Following previous sections which have discussed the theory of clustering and past works of literature, this paper develops 3 hypotheses which will be analysed using various econometric model. The hypotheses are used to evaluate the key locational factors for the establishment of new technology startups in the Netherlands. As earlier theories have focused on the interaction of agglomeration and clusters, this paper will analyse the location determinants of ICT startups in the Netherlands with a focal point of agglomeration economies. In addition, many scholars have shown a significant effect of agglomeration economies on the creation of new firms. Hence, using a different measurement of agglomeration economies, this paper aim to analyse the effect of agglomeration as a location characteristic on the establishment of ICT startups.

As the theory suggest, the economies of scale generated from agglomeration economies will lead to a development of clusters. The benefits brought by these, in turn, will attract new businesses to locate in the region and upsurge the development of firms in the cluster. Moreover, as examined from previous studies, both urbanization and localization economies seems to have a significant positive impact on the location decision of startups. Urbanization economies is said to have a significant impact on the development of clusters as Marshall's (1920) theory on agglomeration states that the geographical concentration of different business sectors leads to beneficial relationship between diverse sectors. In addition, the presence of localization economies brings about industry specific benefits (knowledge transfer, relations with suppliers) which theory and past research have shown to have a significant effect on the growth of clusters. Thus, this paper will formulate the following first 2 hypotheses:

H1: The presence of localization economies will exhibit a positive impact on the number of newly established ICT startups

H2: The presence of urbanization economies will exhibit a positive impact on the number of newly established ICT startups

As Porter emphasized the relationship between clusters and the level of competition in the economy, the last hypothesis will further assess this theory. Competition can be described in numerous ways. This paper will use the presence of monopoly power to analyse the relationship between competition and new firms. Following past researches and theories, if a region has very few competition, which can indicate the presence of a monopoly power, the development of a cluster will tend to be very limited. This is because as new businesses come in, the firm with the monopoly power will still have a greater advantage in the market from its pool of customers and low cost benefits. In turn, regions with high competition can result in a further development of clusters as businesses are pushed to innovate further and startups would have higher potential to survive.

H3: The presence of monopoly power will exhibit a negative impact on the number of newly established ICT startups

IV. Data

This section will give a description of the data that will be used in the analysis. In addition, the variables needed in the regression analysis will be explained. Firstly, the data consists of employment figures and number of firm, both of which were gathered from LISA-database. Furthermore, data on population density was collected from Statistics Netherlands. However, since LISA-database and Statistics Netherlands does not provide GDP as a time series for the years 1997 - 2015, this paper uses added value as a proxy for GDP. All of the data collected are for the 40 NUTS 3 region in the Netherlands, for the year 1997-2015. The employment and number of firms figures, contains all sectors indicated by the Dutch Standaard Bedrijfsindeling (SBI). SBI is based on the economic activities classification of the United Nations (International Standard Industrial Classification of all Economic Activities, ISIC).

By using the data collected from LISA, the location quotient of employment in Business Services, Manufacturing and ICT sector is calculated using the equation that will be discussed in the next section (summary of averages shown in Appendix 1). The classification of business services based on SBI[1] can be described as activities which contains consultancy, research and specialised business services (e.g legal, architects, designs, etc). In turn, the manufacturing category contains all types of manufacturing activities ranging from food production to machinery and equipment. For the location quotient variable, a value of 1 or higher, is considered to be a high concentrated service and manufacturing region. Thus, the higher the location quotient, the more specialized the region is in business service, manufacturing or ICT. Both the location quotient is calculated for all the region and all the years 1997 - 2015.

[1] Central Bureau for Statistics. (n.d.). Retrieved 23 July, 2018, from https://www.kvk.nl/download/SBI_code_%20ENG_2018_dec2017_tcm109-451911.pdf

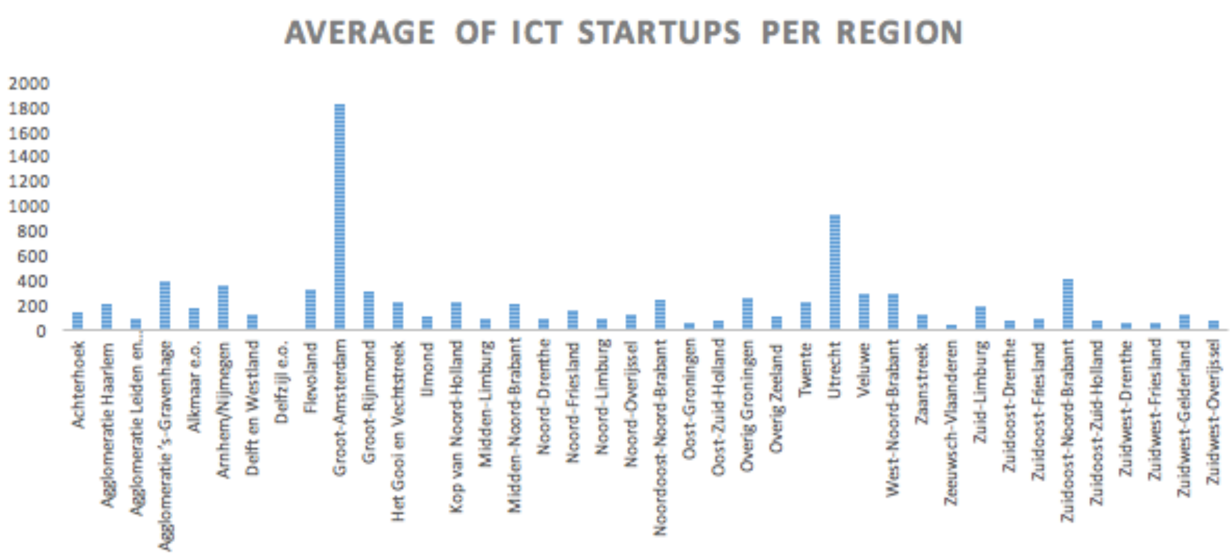
Firstly, examining the data on added value, the top 3 regions with the highest added value are Amsterdam, Rijnmond and Utrecht. This is not unexpected as those are the biggest regions in the Netherlands. Except for The Hague (incorporated in Groot-Rijnmond), as it specializes in national government services, hence it does not accurately indicate productivity. However, it is important to take into the account the population in the region in order to use a measure for productivity in the analysis. More precisely, the productivity is measured by added value divided by the population in the region. By examining the distribution of productivity in the country (mean summary shown in appendix 2), most regions have an average of around 20,000 EUR added value per capita. The region with the highest productivity rate is Amsterdam, then followed by Utrecht. The discrepancy is also very visible as Amsterdam has an average added value per capita of approximately 50,000 EUR and Utrecht has an average of approximately 36,000 EUR, whereas the average for others are around 20,000 EUR.

Evaluating the 20 years average of ICT firms for every region, it is not surprising that Amsterdam has the highest average (mean summary shown in appendix 3). The data indicates Amsterdam with an average of 8000 firms and the lowest is Delfzijl with an average of 79 firms. The second region with the highest average of ICT firm is Utrecht with an average of 5000. The third largest region for ICT sector in the Netherlands is Zuidoost, which composed of Eindhoven. This is also not unexpected as Eindhoven is known to be the center for technology and design firms in the Netherlands. By examining the histogram of ICT firms in the region, it can be seen that there is a big discrepancy in the distribution of ICT firms in the Netherlands. Most of the regions have less than 5000 ICT firms, with some outliers beyond 5000. Moreover, looking at the average for the ICT employment, it follows somewhat the same distribution as the data on firms. Surprisingly however, Utrecht has a higher ICT employment on average than Amsterdam. Utrecht has an average of 40,000 whereas Amsterdam has an average of 37,000. This gives an indication of the level of competition for the ICT sectors in the two regions.

The ICT Competition variable indicates the presence of monopoly power in the region as it is measured by the average size of ICT firms in the region. Hence, it is calculated by the number of ICT employment over the number of ICT firms in the region. The higher the proportion, the higher the presence of a monopoly power in the region. Thus, when analyzing the top three regions for ICT sector (Amsterdam, Utrecht and Noord Brabant) the competition variable indicates Amsterdam with the highest presence of monopoly power in the ICT sector (mean summary shown in appendix 4).

Moreover, examining the data of employment in the business service sector and manufacturing sector will give a moderate idea on the extent of the sectors specialization in the regions (mean summary shown in appendix 5). Firstly, the average employment in the manufacturing sector is highest in Groot-Rijnmond. This is not surprising as the region contains Rotterdam, which is known as the location of the biggest port in Europe. Rotterdam, the second biggest city in the Netherlands is also known for the presence of factories in the region whereas Amsterdam is known for its tertiary sector. Thus, the data extracted from LISA seems to be a reliable indicator for the macroeconomic variables in the Netherlands. Rotterdam has an average of 50,000 which indicates the region with the highest manufacturing employment and the region with the least manufacturing employment is Noord-Drenthe.

The most important variable to observe, however, is the number of ICT startups per region (summary shown in appendix 6). The data derived from LISA shows the number of new ICT startups for each region for the year 1997 - 2015. Firstly, examining the mean for the number of startups per year will indicate the top regions with the highest presence of entrepreneurship. Amsterdam seems to be the region with the highest average of startups, with around 1800 startups a year. This is then followed again by Utrecht with an average of 900 per year. Graph 1 shows the distribution of the average of ICT startups registered per year for each region. From the graph it can be seen that Amsterdam and Utrecht is an outlier in the data, with over 900 startups created per year.



Graph 1: Average of ICT startups per region

V. Methodology

As the focus of the paper is on the number of ICT startups in the Netherlands, a count data model is used. This is because the number of ICT startups each year is not a continuous variable, thus an OLS regression is not suitable for such analysis. Hence, in order to analyse the hypothesis formulated in the previous section, this paper will make use of a Negative Binomial Model (NBM). There is a wide variety of count model data, most research on similar topic uses either Poisson model or a Negative Binomial Model (NBM). Thus, it is important to first identify which model will be most plausible for the analysis. Firstly, a test on the assumptions of Poisson model needs to be carried out to see if a Poisson model would be a suited count data model to use. One of the main assumption for Poisson model is that the mean of the data equals the variance. After summarizing the Number of ICT startups data (see appendix 7), it can be seen that the mean and the variance differs. As the data has a much higher variance compared to the mean, it shows an over-dispersed data which suggest the use of a negative binomial model instead of Poisson model. The negative binomial regression relaxes the mean equal to variance assumption that holds for a Poisson model. In addition, the likelihood ratio test indicates a better fit when using a negative binomial regression than a Poisson model. As mentioned in the previous section, this paper will use data on new established ICT firms per region in the Netherlands for the years 1997 - 2015.

This paper analyses the establishment of new ICT startups using the data extracted from LISA-database, which shows the count of ICT startups that have registered per year. The explanatory variables, which will be used to analyse the hypothesis, is localisation economies, urbanization economies and the size of competition. The hypothesis state that agglomeration economies will have a significant positive effect on startup location. As discussed previously, both past works of literatures and theory have examined this relationship. In order to measure localisation economies, this paper will make use of the location quotient based on employment in business services, manufacturing industries and the ICT sector. The analysis focuses on the concentration of business service and manufacturing sectors, because they are generally the largest sector in the region thus would have the biggest impact in the region's economy. Moreover, examining a region's specialization in ICT is also an important factor to consider. This research aims to show how substantial is a region's concentration in the own sector effects the establishment of the sector's startups. As the establishment of new ICT firms may not necessarily come from localisation economies of the ICT sector, this paper will analyse to what extent does ICT, business services or manufacturing sector influences the new formation rate of ICT firms.

Moreover, urbanization economies will be measured by the population density of the region, thus the denser the population in the region, the higher the level of urbanization economies. Population density indicates urbanization economies as it helps illustrate the geographical concentration of goods and services using population as the unit of measurement. In addition, the level of ICT competition will be measured by the average size of firms in the region. The higher the average size of firm, the more likely the region would see a presence of a monopoly firm. Thus, this paper would expect a negative relation between the competition variable and the number of ICT startups.

Moreover, the analysis will take into account of several macroeconomic variables which effects the economic development of the region. These variables are added value per capita and total employment in the region. The added value per capita measures productivity in the region which proxies for GDP per capita. The expected sign of these two variables are positive on the number of new startups. As it represents demand and the economic prosperity in the region.

This paper also examines the distribution of each explanatory variables in order to determine if a transformation will be necessary. Histogram on total employment, population density and productivity can be seen in the appendix 8. Hence, after examining the histograms, in order to compose a more normally distributed statistics of the data, the analysis will use the logarithmic expression of the three variables. The histograms of the logarithmic expression are also presented in the appendix 8.

Presented below are the equation and formula which will be used for the analysis. The first equation shows the equation of the negative binomial regression and the second formula shows how the location quotient for the three different sectors are calculated.

$$\begin{aligned} \text{Number of ICT Startups} \\ &= \beta 0 + \beta 1 LocationQuotientM + \beta 2 LocationQuotientBS \\ &+ \beta 3 LocationQuotientICT + \beta 5 logPopulationDensity + \beta 6 CompetitionICT \\ &+ \beta 6 logProductivity + \beta 7 LogTotalEmploymentRegion + \varepsilon \end{aligned}$$

$$\text{Location quotient of employment in Business Services, Manufacturing and ICT} = \frac{\frac{\text{Jobs in BS / M/ICT sectors in a given region}}{\text{Total jobs in the given region}}}{\frac{\text{Jobs in BS / M/ICT sectors in the Netherlands}}{\text{Total jobs in the Netherlands}}}$$

The table provided below shows the expected signs of the main explanatory variables which will be used to analyze the 3 hypothesis. The expected sign is supported by the argument for the hypothesis provided in the previous section.

Explanatory Variables	**Expected Sign**
Location Quotient Business Services (Localisation Economies)	+
Location Quotient Manufacturing (Localisation Economies)	+
Population Density (Urbanization Economies)	+
Competition ICT (Employment over nr of firms)	-
Productivity (Added value per capita)	+
Total Employment in the region	+

Table 1: Expected signs of main explanatory variables

Before starting the analysis, this paper also checks the collinearity between variables. Correlation figures between variables is shown in the appendix 9. When analysing the magnitude and direction of the figures, it looks as expected. However, in order to check if multicollinearity is a problem, the VIF test is used. The result of the VIF test is shown in Table 2. Even though the rule of thumb for VIF have to be treated with caution, this paper will use the moderate rule of 4 as a benchmark for the VIF. In general, there are several rule of thumb for VIF, starting with a 10 which indicates severe multicollinearity or some researchers uses a strict 4 (O'Brien, 2007). Table 1 shows all VIF figures less than four.

Variable	VIF
Location Quotient BS	3.23
Location Quotient ICT	2.38
Location Quotient M	2.30
Log Productivity	1.94
Log Total Employment	2.06
Competition ICT	2.00
Log Population Density	2.01
Mean VIF	**2.27**

Table 2: VIF Results

VI. Empirical Result

Before analysing the NBM result, it is important to examine the likelihood-ratio test. This test can be seen in table 3 along with the results of the analysis. Hence, as shown in table 3, the significant chi-square test indicates that the mean equal to variance hypothesis can be rejected. This justifies the use of a negative binomial regression instead of the Poisson model. The main analysis, however, will use a fixed effect model of NBM to control for time-invariant differences.

The negative binomial regression result shows a similar finding to that of Bade and Nerlinger (2000). The result shows a positive effect of specialization in manufacturing firms on the number of ICT startups. In addition, it also exhibits a positive impact of macroeconomic elements on the formation of ICT startups. This paper uses productivity (added value per capita) and total employment in the given region as variables to indicate macroeconomic factors. Table 3 provides the analysis of 8 NBM regressions to show how adding a variable to the regression effects the coefficients of each variable. The coefficient of the NBM regression is interpreted as the effect of the difference in the log in the expected count of the dependent variable.

Firstly, a regression on each of the location quotient is executed to show the direction of the effect on the number of ICT startups. Without adding control variables, these regressions show an unexpected result. Specialization in business services and ICT sector displayed a negative effect on the number of ICT startups, although the coefficient for business service seems to be insignificant. When regressing the three of them together on the dependent variable, it shows a significant effect of all three location quotient on the dependent variable, with only the ICT location quotient showing a negative effect. However, these variables do not provide a compelling explanation for this paper's analysis as control variables are needed for a statistically significant study. As the second hypothesis focuses on the effect of urbanization economies on the number of startups, the next regression included the logarithmic expression of population density. The regression with all 3 location quotient and the log of population density shows a significant coefficient for all but business service. The location quotient for manufacturing and log of population density shows a positive effect on the difference in log of the expected count of ICT startups. Subsequently, the level of competition in the ICT sector is incorporated in the regression. The result shows a significant negative effect of competition in the ICT sector, which correspond with the third hypothesis. Surprisingly, including this variable lead to a significant coefficient of the location quotient for business services and reduce the significance of population density.

As more control variables are introduced, the coefficients become more significant and stronger. Interestingly, the ICT location quotient seems to not be statistically significant in the full model (8). However, by examining other variables, the majority of them have expected signs of effects. Specialization in the manufacturing sector in a region is shown to increase the differences in logs of the expected counts of startups by 0.475 units. Although the specialization in manufacturing sector seems to have a significant positive effect, the result does not show a significant effect of specialization in business service on the count of ICT startups. In addition, the coefficient for the location quotient of business services seems to also be very small (0.014). This counters the result of Guimarães et al. (2000) which emphasizes the effect of service agglomeration. One possible explanation for the insignificant effect shown in the full model (8) is the correlation between business services and the manufacturing sector. As firms may have both a business service and manufacturing base, the ICT service provided to them may be difficult to track, thus the effect for it may be ambiguous. This result is consistent with that of Bade and Nerlinger (2000), where they show a positive significant coefficient of the share of manufacturing employees but not that of services. Focusing on the location quotient of the manufacturing sector, it explains that as more manufacturing firms are presence relative of other sectors in the region, the higher the likelihood that the number of ICT startups would increase. Thus, it indicates the importance of a region's specialization in their manufacturing sector on the formation of new ICT firms.

Subsequently, the specialization in ICT sector in a region shows an insignificant positive effect on the expected count of the number of ICT startups. This result is unexpected, as an insignificant coefficient would indicate that the variable does not show economic connotations on the establishment of ICT startups in the region. As the location quotient illustrate the extent to which a labor pool in the region specializes in ICT, this paper expected a significant positive result. One possible explanation for why this variable may not show a significant coefficient may be because founders of ICT startups do not necessarily have previous employment in the ICT sector. As an example, the founder of WeTransfer, Bastian Beerens has an experience as the printing manager in Nike before creating WeTransfer. Hence, specialization in ICT sector may not have a direct effect on the formation of new ICT businesses. Founders may have experiences in other sectors and develop this knowledge into an ICT firm or may have just graduated from university. Even though it seems straightforward to have a significant effect on the concentration of the ICT sector on the establishment of ICT startups, there are several factors that may influence this.

Furthermore, when analysing the full model, it can also be seen that the effect of the logarithmic expression of the population density is negative and statistically significant. This result contradicts this paper's hypothesis concerning the effect of urbanization economies on the establishment of ICT startups. Previously, this paper expected that the population density, which indicates urbanization economies, will have a significant positive effect on the number of ICT startups. This assumption was based on past literature and economic theory which discussed the effect of agglomeration on the establishment of new businesses. Egeln et al. (2004) findings show a contradictory result, where the logarithmic expression of the population in the region shows a significant positive effect on the establishment of startups. Another research that shows a contradictory result is the research of Arauzo-Carod and Viladecans-Marsal (2009) which exhibit a positive effect of urbanization economies (measured by population density) on the number of technology startups. However, their result only shows a significant effect for high and low tech startups. Arauzo-Carod and Viladecans-Marsal (2009) reasoning for this is because higher technology intensive startups have more motive to be close to the center of the city. Moreover, Bade and Nerlinger (2000) findings show an inverted u-shaped relationship between population density and technology startups. Their result shows that once a critical point is reached, the higher the degree of population density leads to a negative effect on the expected count of technology startups. This can somewhat help explain the result of the full model (8), where a 1 percent increase in the population density show a negative effect on the difference in the log of the expected counts of the number of ICT startups. Bade and Nerlinger (2000) reasoning for the negative effect is because, at a certain point, there are fewer resources as the region gets more crowded. In addition, their result also mentions that startups in the higher technology level have a higher preference in locating at a more densely populated region. By examining the discussion from past researches (Bade & Nerlinger 2000; Arauzo-Carod & Viladecans-Marsal 2009) a possible explanation for this negative effect of population density is because the desire to locate in a crowded market may only significantly exist for high technology startups. Thus, as this paper takes the overall count of ICT startups, the findings show that the denser the region, the less number of overall ICT startups are registered per year. Furthermore, the saturated market that may be present in a crowded region can restraint a substantial amount of founders to locate in those regions. Moreover, extending Bade and Nerlinger's (2000) limited resources explanation, most of the overly populated regions have much higher prices for goods & services due to the high demand and limited resources available. Therefore, may also present a barrier for founders to establish a new firm.

As the competition variable is measured by the average size of firms in the region, this variable is expected to have a negative effect on the dependent variable. By analysing the full model (8) present in table 3, it shows that the variable Competition ICT has a significant negative effect on the number of ICT startups. This result can be interpreted as, a one-unit increase in the average size of firms leads to a decrease in the difference in logs of the expected count of ICT startups by -0.08. Although the coefficient seems to be very small, it is still important to take this variable into account as it shows an economically significant effect on the establishment of new ICT businesses. This is in line with the findings of Arauzo-Carod and Viladecans-Marsal (2009) and Rosenthal and Strange (2003) result which also shows that competition in the sector encourages the creation of new firms. In addition, it is also in line with Porter (2000) theory which emphasize the existence of competition in intensifying the productivity and innovation in the market. Moreover, large firms with monopoly power possess greater cost advantage from internal economies of scale as their production process is much bigger. The existence of large firms in the region can make it harder to establish new businesses as most of the consumer demand is already satisfied by the large incumbent firm. Founders may be discouraged to establish a business as competition in the market may seem too high. In other words, there is more barrier to entry when large firms are present in the market.

As mentioned before, the NBM regression also shows a significant positive effect of macroeconomic variables on the dependent variable. This is not unexpected, as most past works of literature have shown the importance of macroeconomic variables on the new formation rate of businesses. As shown in the results presented in Table 3, both regional total employment and productivity have a significant positive effect on the number of new ICT firms. Productivity proxies for GDP per capita as it is measured by the added value over population in the region. It can also somewhat identify the demand present in the region as it represents the well-being of the region's economy. Moreover, the positive effect of productivity on the number of ICT startups indicates that ICT startups are more likely to be located in regions with higher purchasing power. This can be explained by the large market size of the region, creating a suitable environment for newly established business. In addition, the log of total employment in the region also shows a positive significant effect on the expected count of ICT startups. The total employment in the region can illustrates the overall skills and knowledge of the population which explains why it positively affect the development of new ICT firms. In addition, total employment represents the size of the labor pool in the region, which is an important factor for new businesses as founders need to find the right team to develop their venture.

Furthermore, as mentioned in the data section, there is a large discrepancy between the regions in the Netherlands. Thus, as part of a robustness check, this paper also did the same NBM regression without Amsterdam and Utrecht. As Amsterdam and Utrecht is the region with the biggest outliers and has an average of ICT startups of over 900, it is important to see how much it affects the analysis for the rest of the 38 regions. The result of this analysis is provided in Table 4. From the results, it can be seen that the coefficient and statistical significance does not differ much than from the analysis which includes Amsterdam and Utrecht. Hence, it shows that the NBM regression model result shows a robust analysis of the location determinants of ICT startups in the Netherlands.

Negative Binomial Regression								
Dependent Variable: Nr of ICT Startups								
Coefficients (Standard Errors)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Location Quotient M	0.260** (0.129)			0.354** (0.147)	0.413*** (0.147)	0.617*** (0.137)	0.711*** (0.145)	0.475*** (0.151)
Location Quotient BS		-0.021 (0.174)		0.352* (0.210)	0.160 (0.219)	0.455** (0.217)	0.0894 (0.215)	0.002 (0.217)
Location Quotient ICT			-0.095* (0.057)	-0.118* (0.062)	-0.111* (0.062)	0.186*** (0.059)	0.221*** (0.061)	0.075 (0.070)
Log of Population Density					0.654*** (0.219)	-0.030 (0.229)	-1.000*** (0.206)	-1.496*** (0.278)
Competition ICT						-0.110*** (0.010)	-0.116*** (0.008)	-0.073*** (0.012)
Log Regional Total Employment							0.967*** (0.0824)	0.744*** (0.096)
Log of Productivity								0.680*** (0.126)
Number of Observation (40 regions x 19 time periods)	760	760	760	760	760	760	760	760
Log-Likelihood	-3852.88	-3854.86	-3852.350	-3850.422	-3846.199	-3779.883	-3714.2655	-3702.017
Conditional Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wald chi2(7) = 420.40 Prob > Chi1 = 0.0000								
All panel data negative binomial regression, intercept included. Significant coefficients indicated by *** (at 1% level), ** (at 5% level) and * (at 10% level)								

Table 3: Result of Negative Binomial Regression

Negative Binomial Regression WITHOUT AMSTERDAM AND UTRECHT								
Dependent Variable: Nr of ICT Startups								
Coefficients (Standard Errors)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Location Quotient M	0.397*** (0.134)			0.413** (0.149)	0.464*** (0.147)	0.691*** (0.139)	0.715*** (0.144)	0.469*** (0.150)
Location Quotient BS		-0.279 (0.198)		0.147 (0.231)	-0.026 (0.241)	0.194 (0.245)	0.366 (0.246)	0.289 (0.073)
Location Quotient ICT			-0.129** (0.060)	-0.128** (0.065)	-0.123* (0.065)	0.190*** (0.062)	0.194*** (0.063)	0.0317 (0.070)
Log of Population Density					0.574*** (1.921)	-0.066 (0.235)	-0.910*** (0.258)	-1.454*** (0.279)
Competition ICT						-0.124*** (0.010)	-0.117*** (0.008)	-0.071*** (0.012)
Log Regional Total Employment							1.010*** (0.087)	0.766*** (0.101)
Log of Productivity								0.724*** (0.1388)
Number of Observation (40 regions x 19 time periods)	760	760	760	760	760	760	760	760
Log-Likelihood	-3582.71	-3586.00	-3584.52	-3580.613	-3577.542	-3514.501	-3455.0205	-3441.684
Conditional Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wald chi2(7) = 420.40 Prob > Chi1 = 0.0000								
All panel data negative binomial regression, intercept included. Significant coefficients indicated by *** (at 1% level), ** (at 5% level) and * (at 10% level)								

Table 4: Negative Binomial Regression WITHOUT AMSTERDAM AND UTRECHT

VII. Discussion

This section will present a discussion of the hypotheses using the result shown in table 3. The first two hypotheses state that both localisation and urbanization economies (agglomeration) have a positive effect on the formulation of new ICT startups. These hypotheses are then tested using 4 variables in the NBM regression model. From the result obtained, it can be seen that there is a vague effect of agglomeration on the establishment of ICT startups. A similar result is obtained by Bade and Nerlinger (2000), which also points out an ambiguous effect of agglomeration. Their research, however, focuses on different levels of technology startups, which shows a stronger significant effect for those startups with a higher technology level. In addition, Bade and Nerlinger (2000) point out that there is a critical point where the effect of agglomeration leads to a disadvantage. As this paper's empirical analysis uses the overall count of the number of ICT startups, it shows the effect of agglomeration to be inconclusive. The negative effect of population density on the expected count of the number of startups can be explained by the deficit of resources as the regions get more crowded (Bade & Nerlinger, 2000). Moreover, an important point that is acquired from the empirical result is the specialisation of the manufacturing sector for the creation of new ICT ventures. This indicates a significant advantage of localisation economies on the formation of ICT startups. Hence, this point supports the earlier hypothesis regarding localisation economies which was derived from theories and past researches. A research by Rosenthal and Strange (2003), however, points out the importance of localisation economies of the own sector on the establishment of startups in a certain sector. Thus, their conclusion differs as they find that the most important factor is the concentration of the specific sector on the formation of new startups in that particular sector. Instead, this paper pinpoints the importance of localisation economies in the manufacturing sector on the development of ICT startups.

Furthermore, the final hypothesis can be analysed by examining the Competition ICT variable. The hypothesis states that the existence of a monopoly firm will negatively impact the establishment of new ICT startups. As the Competition ICT variable measures the average size of firms in the region (employment over number of firms), the higher the unit of the variable the more likely there is a presence of a monopoly firm. Hence, the initial expectation is that if a region has a monopoly firm instead of a large number of small firms, the barriers of entry will be larger, thus fewer startup formations in the region. The result from Table 3 is consistent with this expectation. Although it does not show a large coefficient for a unit increase in the average size of firms, it points out the importance of competition for the new formation rate. This is compatible with Rosenthal and Strange (2003) result which concluded that competition in the sector encourages the creation of new firms.

VIII. Conclusion

As the result shows, the effect of agglomeration economies still seems inconclusive. One possible explanation for this is because the analysis still has its limitations. Firstly, as not all the location quotient seems to have a significant effect, it is important to understand where the ICT service is allocated to and how different sectors interact with each other. Hence, an input-output analysis is a possible approach to this, to see where the ICT service is distributed amongst other sectors in the region. There are several other analyses that could also be used to examine how the ICT sector relate to other sectors in a region. Another approach is through transaction data which measures transaction on who purchases ICT service most. Another useful concept for further studies is to look at co-agglomeration. Jacobs et al. (2014) study the co-location of business services and multinational enterprises, a similar study could also be done in regards to startups and how it links to both urbanization and localization agglomeration. Moreover, this paper did not take into account the level of education in the region as there was limited data available. Measuring the location quotient of employment in the education sector is possible, however, as it is highly correlated with employment in Business Services, this paper did not include this variable in the final analysis. One potential recommendation for further research is to include the number of research facilities and universities in the area as other past researchers have seen a significant effect of this in the creation of new businesses.

Overall, this paper makes a contribution by using a different measurement of agglomeration (location quotients) and focusing on the Netherlands. As there is a very limited amount of research which have focused on the Netherlands, this paper also makes societal contributions as the Netherlands have received a lot of attention as the destination for startups in Europe (Forbes, 2017). Hence, analysing the locational determinants of these startups are of interest to policymakers in order to sustain or boost the economic environment in the region. From the discussion, it can be concluded that when policymakers wish to focus on new firms, it is best to look at regions with a specialization in the manufacturing sector. Moreover, as a region gets overpopulated, policymakers have to take into account that it can harm the establishment of new firms. The analysis also points out the importance of controlling the level of competition in a region for policymakers, as the result shows it significantly affects the creation of ICT startups. More precisely, it means controlling for the presence of monopoly power. As shown in the result, the existence of a monopoly firm in the region can restrict the establishment of new firms.

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Appendix

Appendix 1.A

Region	**Mean of Location Quotient M**
Achterhoek	1.627997
Agglomeratie Haarlem	0.61772734
Agglomeratie Leiden en Bollenst..	0.90117629
Agglomeratie 's-Gravenhage	0.33549619
Alkmaar e.o.	0.69437934
Arnhem/Nijmegen	0.92609158
Delft en Westland	0.70750453
Delfzijl e.o.	1.8062577
Flevoland	0.91160315
Groot-Amsterdam	0.37610098 .
Groot-Rijnmond	0.77555479
Het Gooi en Vechtstreek	0.75778865
IJmond	1.744715
Kop van Noord-Holland	0.78454825
Midden-Limburg	1.526706
Midden-Noord-Brabant	1.3737784
Noord-Drenthe	0.71680438
Noord-Friesland	0.99255238
Noord-Limburg	1.6819772
Noord-Overijssel	1.2019995
Noordoost-Noord-Brabant	1.3650554
Oost-Groningen	1.5725106
Oost-Zuid-Holland	0.92973164
Overig Groningen	0.84963448
Overig Zeeland	1.0783736
Twente	1.4968228
Utrecht	0.57554758
Veluwe	0.99968222
West-Noord-Brabant	1.3813988
Zaanstreek	1.3779959
Zeeuwsch-Vlaanderen	1.5948621
Zuid-Limburg	1.348799
Zuidoost-Drenthe	1.5318547
Zuidoost-Friesland	1.3841914
Zuidoost-Noord-Brabant	1.5305312
Zuidoost-Zuid-Holland	1.3054691
Zuidwest-Drenthe	1.2463402
Zuidwest-Friesland	1.395389
Zuidwest-Gelderland	1.1765266
Zuidwest-Overijssel	1.35004
Total	**1.1487879**

Appendix 1.B

Region	Mean of Location Quotient BS
Achterhoek	0.58173254
Agglomeratie Haarlem	1.0800386
Agglomeratie Leiden en Bollenstreek	0.86125371
Agglomeratie 's-Gravenhage	1.2788418
Alkmaar e.o.	0.99647579
Arnhem/Nijmegen	0.96370298
Delft en Westland	0.98041713
Delfzijl e.o.	0.63506237
Flevoland	1.0927559
Groot-Amsterdam	1.727261
Groot-Rijnmond	1.0731935
Het Gooi en Vechtstreek	1.1009312
IJmond	0.73717683
Kop van Noord-Holland	0.74456806
Midden-Limburg	0.5663088
Midden-Noord-Brabant	0.80423852
Noord-Drenthe	0.77844118
Noord-Friesland	0.89543948
Noord-Limburg	0.44961578
Noord-Overijssel	0.65451643
Noordoost-Noord-Brabant	0.85763485
Oost-Groningen	0.47839541
Oost-Zuid-Holland	0.86452042
Overig Groningen	0.74540458
Overig Zeeland	0.65144872
Twente	0.65803528
Utrecht	1.4000962
Veluwe	1.0355675
West-Noord-Brabant	0.77482682
Zaanstreek	1.101267
Zeeuwsch-Vlaanderen	0.56235013
Zuid-Limburg	0.79105465
Zuidoost-Drenthe	0.51931134
Zuidoost-Friesland	0.68677652
Zuidoost-Noord-Brabant	1.0471533
Zuidoost-Zuid-Holland	0.65716239
Zuidwest-Drenthe	0.68689615
Zuidwest-Friesland	0.65119467
Zuidwest-Gelderland	0.79318383
Zuidwest-Overijssel	0.8856429
Total	**0.84624736**

Appendix 1.C

Regions	Mean Location Quotient ICT
Achterhoek	0.50807313
Agglomeratie Haarlem	0.88507304
Agglomeratie Leiden en Bollenst	0.52762336
Agglomeratie 's-Gravenhage	1.7965045
Alkmaar e.o. .	0.66387126
Arnhem/Nijmegen	1.1103968
Delft en Westland	1.0721896
Delfzijl e.o. .34139248	.34139248
Flevoland 1.1181344	1.1181344
Groot-Amsterdam 1.4579046	1.4579046
Groot-Rijnmond .68082247	0.68082247
Het Gooi en Vechtstreek	3.708858
IJmond	0.39046517
Kop van Noord-Holland	0.39002546
Midden-Limburg	0.64530873
Midden-Noord-Brabant	0.63061797
Noord-Drenthe	0.53970687
Noord-Friesland	0.48631337
Noord-Limburg	0.47284295
Noord-Overijssel	0.57243251
Noordoost-Noord-Brabant	0.75678606
Oost-Groningen	0.61332347
Oost-Zuid-Holland	0.88233813
Overig Groningen	1.0752686
Overig Zeeland	0.45243107
Twente	0.61997947
Utrecht	1.8758177
Veluwe	0.76316659
West-Noord-Brabant	0.53545005
Zaanstreek	0.62008007
Zeeuwsch-Vlaanderen	0.19447405
Zuid-Limburg	0.91024841
Zuidoost-Drenthe	0.69696446
Zuidoost-Friesland	0.40717936
Zuidoost-Noord-Brabant	1.4103973
Zuidoost-Zuid-Hollan	0.58365864
Zuidwest-Drenthe	0.35099994
Zuidwest-Friesland	0.32606885
Zuidwest-Gelderland	0..87091137
Zuidwest-Overijssel	0.39507207
Total	**0.80847931**

Appendix 2

Region	**Mean of Productivity**
Achterhoek	20902.915
Agglomeratie Haarlem	26309.214
Agglomeratie Leiden en Bollenst.	34671.548
Agglomeratie 's-Gravenhage	24769.873
Alkmaar e.o.	23440.169
Arnhem/Nijmegen	26974.055
Delft en Westland	33311.545
Delfzijl e.o.	23464.405
Flevoland	23670.049
Groot-Amsterdam	52161.52
Groot-Rijnmond	32689.418
Het Gooi en Vechtstreek	33667.352
IJmond	26660.747
Kop van Noord-Holland	20405.993
Midden-Limburg	22900.947
Midden-Noord-Brabant	25432.144
Noord-Drenthe	21874.466
Noord-Friesland	22610.094
Noord-Limburg	25784.965
Noord-Overijssel	30348.453
Noordoost-Noord-Brabant	26837.054
Oost-Groningen	15348.888
Oost-Zuid-Holland	25339.187
Overig Groningen	47121.259
Overig Zeeland	21217.795
Twente	23364.769
Utrecht	36685.349
Veluwe	26621.232
West-Noord-Brabant	31505.656
Zaanstreek	22493.701
Zeeuwsch-Vlaanderen	26655.662
Zuid-Limburg	25129.818
Zuidoost-Drenthe	21668.866
Zuidoost-Friesland	21352.807
Zuidoost-Noord-Brabant	32959.243
Zuidoost-Zuid-Holland	26910.957
Zuidwest-Drenthe	22648.033
Zuidwest-Friesland	18376.572
Zuidwest-Gelderland	24811.682
Zuidwest-Overijssel	24295.881
Total	**26834.857**

Appendix 3

Region	Mean of ICT Firms
Achterhoek	859.89474
Agglomeratie Haarlem	901.05263
Agglomeratie Leiden en Bollenst..	562.05263
Agglomeratie 's-Gravenhage	2253.2105
Alkmaar e.o.	820.68421
Arnhem/Nijmegen	2209.8947
Delft en Westland	667.94737
Delfzijl e.o.	80.631579
Flevoland	1668.4211
Groot-Amsterdam	8402.6316
Groot-Rijnmond	2128.5263
Het Gooi en Vechtstreek	1646.2632
IJmond	450.84211
Kop van Noord-Holland	961.57895
Midden-Limburg	560.26316
Midden-Noord-Brabant	1209.9474
Noord-Drenthe	474.68421
Noord-Friesland	667.10526
Noord-Limburg	566.10526
Noord-Overijssel	672.15789
Noordoost-Noord-Brabant	1588.5789
Oost-Groningen	278.94737
Oost-Zuid-Holland	537.31579
Overig Groningen	1269.4737
Overig Zeeland	588.68421
Twente	1331.2105
Utrecht	5367.5789
Veluwe	1842
West-Noord-Brabant	1586.7368
Zaanstreek	482.36842
Zeeuwsch-Vlaanderen	165.78947
Zuid-Limburg	1358
Zuidoost-Drenthe	362
Zuidoost-Friesland	370.26316
Zuidoost-Noord-Brabant	2545.4737
Zuidoost-Zuid-Holland	547.73684
Zuidwest-Drenthe	285.21053
Zuidwest-Friesland	283.63158
Zuidwest-Gelderland	750.31579
Zuidwest-Overijssel	330.26316
Total	1240.8868

Appendix 4

Region	Mean of Competition ICT
Achterhoek	3.9326626
Agglomeratie Haarlem	3.0591573
Agglomeratie Leiden en Bollenst..	5.1545138
Agglomeratie 's-Gravenhage	12.565699
Alkmaar e.o.	2.7522842
Arnhem/Nijmegen	6.4852354
Delft en Westland	7.1077453
Delfzijl e.o.	2.6034089
Flevoland	3.6463415
Groot-Amsterdam	5.0384742
Groot-Rijnmond	6.4734597
Het Gooi en Vechtstreek	8.5410723
IJmond	2.2597532
Kop van Noord-Holland	2.1394669
Midden-Limburg	5.2624369
Midden-Noord-Brabant	4.5169105
Noord-Drenthe	3.2372643
Noord-Friesland	4.1417487
Noord-Limburg	4.3191182
Noord-Overijssel	5.9461619
Noordoost-Noord-Brabant	5.3938044
Oost-Groningen	5.2701441
Oost-Zuid-Holland	6.7891079
Overig Groningen	6.5464228
Overig Zeeland	3.4302953
Twente	5.1705644
Utrecht	8.6563335
Veluwe	4.9416517
West-Noord-Brabant	3.732555
Zaanstreek	3.2672702
Zeeuwsch-Vlaanderen	2.2131505
Zuid-Limburg	7.1420952
Zuidoost-Drenthe	5.5397632
Zuidoost-Friesland	3.2365169
Zuidoost-Noord-Brabant	8.0846168
Zuidoost-Zuid-Holland	6.0244227
Zuidwest-Drenthe	2.6979906
Zuidwest-Friesland	2.3163646
Zuidwest-Gelderland	4.2101108
Zuidwest-Overijssel	2.8896874
Total	**4.9183946**

Appendix 5.A

Region	Mean of Employment Manufacturing
Achterhoek	33478.053
Agglomeratie Haarlem	6398.9474
Agglomeratie Leiden en Bollenst..	15966.053
Agglomeratie 's-Gravenhage	14867.105
Alkmaar e.o.	7793.1579
Arnhem/Nijmegen	35685.895
Delft en Westland	9074.7368
Delfzijl e.o.	3971.8421
Flevoland	15570.053
Groot-Amsterdam	33005.842
Groot-Rijnmond	50880.579
Het Gooi en Vechtstreek	9740.1053
IJmond	15067.579
Kop van Noord-Holland	13124.316
Midden-Limburg	18980.526
Midden-Noord-Brabant	32511.474
Noord-Drenthe	6268.6842
Noord-Friesland	15948.105
Noord-Limburg	26794.105
Noord-Overijssel	23408.263
Noordoost-Noord-Brabant	49527.947
Oost-Groningen	9780.1053
Oost-Zuid-Holland	12630.579
Overig Groningen	18532.105
Overig Zeeland	14980.421
Twente	48021.842
Utrecht	42423.632
Veluwe	36678
West-Noord-Brabant	46406.158
Zaanstreek	10199.579
Zeeuwsch-Vlaanderen	9128.6842
Zuid-Limburg	43445.947
Zuidoost-Drenthe	12282.211
Zuidoost-Friesland	12678.105
Zuidoost-Noord-Brabant	67124.579
Zuidoost-Zuid-Holland	24318.895
Zuidwest-Drenthe	8579.1053
Zuidwest-Friesland	8900.0526
Zuidwest-Gelderland	13951.316
Zuidwest-Overijssel	10194.421
Total	**22207.978**

Appendix 5.B

Region	**Mean of employment Business Services**
Achterhoek	11372.579
Agglomeratie Haarlem	10568.526
Agglomeratie Leiden en Bollenst..	14598.737
Agglomeratie 's-Gravenhage	53344.105
Alkmaar e.o.	10840.105
Arnhem/Nijmegen	35174.579
Delft en Westland	12028.947
Delfzijl e.o.	1342.7895
Flevoland	17908.737
Groot-Amsterdam	146112.63
Groot-Rijnmond	67010.684
Het Gooi en Vechtstreek	13164
IJmond	6072.3158
Kop van Noord-Holland	12039
Midden-Limburg	6660.9474
Midden-Noord-Brabant	18243.737
Noord-Drenthe	6539.7368
Noord-Friesland	13694.368
Noord-Limburg	6831.3158
Noord-Overijssel	12236.526
Noordoost-Noord-Brabant	29606.947
Oost-Groningen	2823.6316
Oost-Zuid-Holland	11138.895
Overig Groningen	15520.579
Overig Zeeland	8608.2632
Twente	20216.105
Utrecht	98575.053
Veluwe	36409.737
West-Noord-Brabant	24804.263
Zaanstreek	7702.1579
Zeeuwsch-Vlaanderen	3073.9474
Zuid-Limburg	23947.632
Zuidoost-Drenthe	3965.6316
Zuidoost-Friesland	6023.3158
Zuidoost-Noord-Brabant	43873.947
Zuidoost-Zuid-Holland	11718.211
Zuidwest-Drenthe	4579.4737
Zuidwest-Friesland	4033.7895
Zuidwest-Gelderland	9048.5789
Zuidwest-Overijssel	6400.2632
Total	**21196.37**

Appendix 6

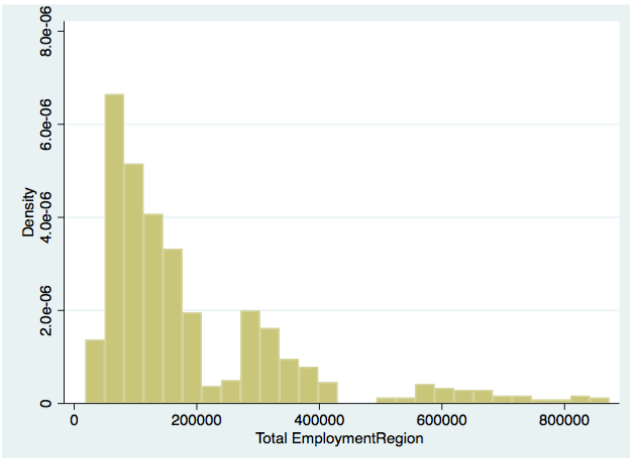
Region	Mean of Nr ICT Startups
Achterhoek	120.36842
Agglomeratie Haarlem	196.68421
Agglomeratie Leiden en Bollenst..	72
Agglomeratie 's-Gravenhage	376.26316
Alkmaar e.o.	167.47368
Arnhem/Nijmegen	338.78947
Delft en Westland	102.73684
Delfzijl e.o.	11.052632
Flevoland	315.31579
Groot-Amsterdam	1816.4211
Groot-Rijnmond	286.57895
Het Gooi en Vechtstreek	203.47368
IJmond	86.368421
Kop van Noord-Holland	205.21053
Midden-Limburg	71.157895
Midden-Noord-Brabant	195.84211
Noord-Drenthe	69.368421
Noord-Friesland	138.42105
Noord-Limburg	76.578947
Noord-Overijssel	110.36842
Noordoost-Noord-Brabant	220.36842
Oost-Groningen	40.526316
Oost-Zuid-Holland	63.368421
Overig Groningen	249
Overig Zeeland	85.578947
Twente	216.31579
Utrecht	924.05263
Veluwe	274.15789
West-Noord-Brabant	270.36842
Zaanstreek	110.42105
Zeeuwsch-Vlaanderen	26.368421
Zuid-Limburg	180.15789
Zuidoost-Drenthe	52.526316
Zuidoost-Friesland	79.052632
Zuidoost-Noord-Brabant	387.57895
Zuidoost-Zuid-Holland	64
Zuidwest-Drenthe	41.736842
Zuidwest-Friesland	44.947368
Zuidwest-Gelderland	102.68421
Zuidwest-Overijssel	54.210526
Total	**211.19737**

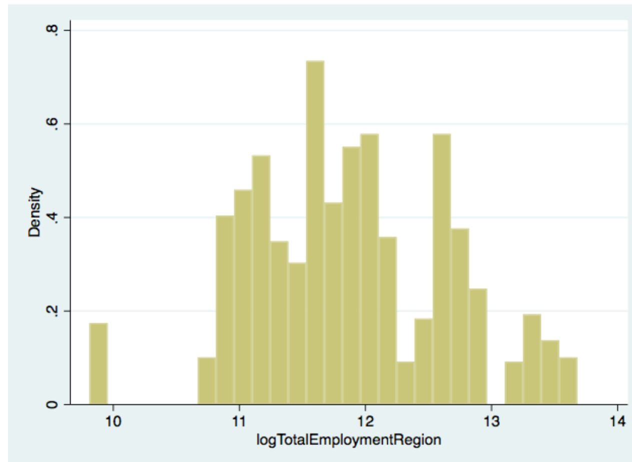
Appendix 7

Variable	Observation	Mean	Std. Dev
Nr of ICT Startups	760	211.1974	332.5231

Appendix 8.A

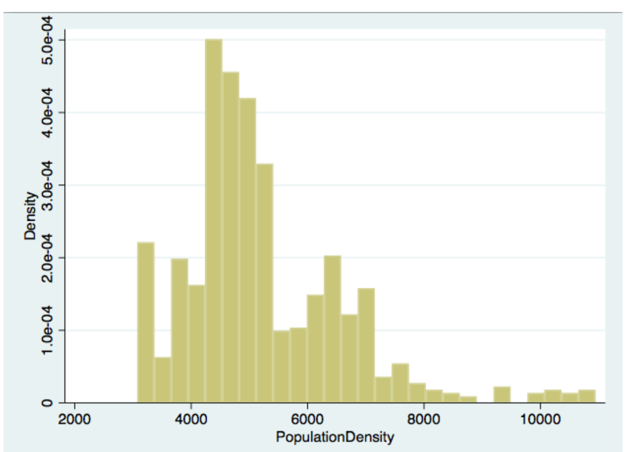
Histogram Total Employment and Log of Total Employment

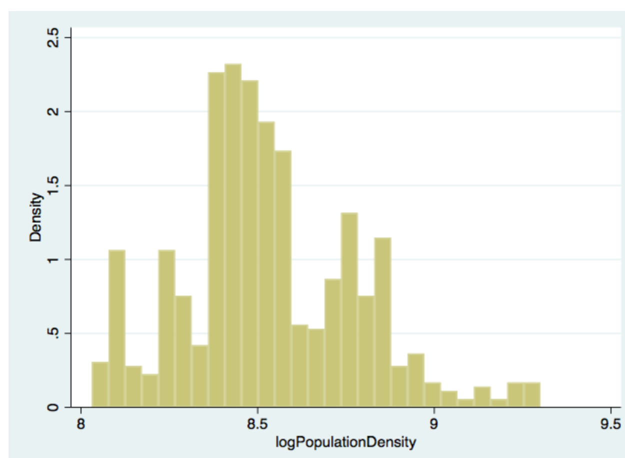




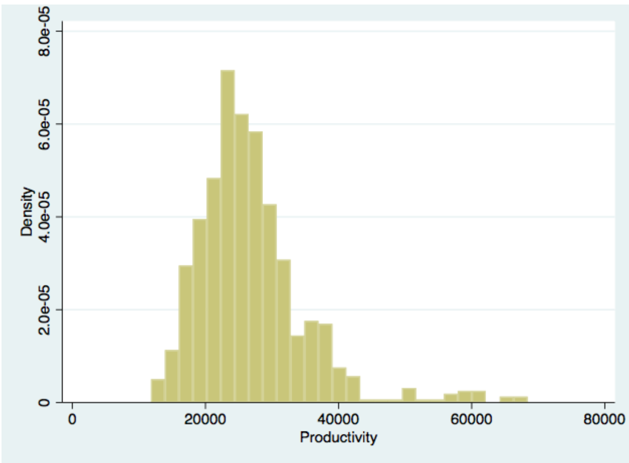
Appendix 8.B

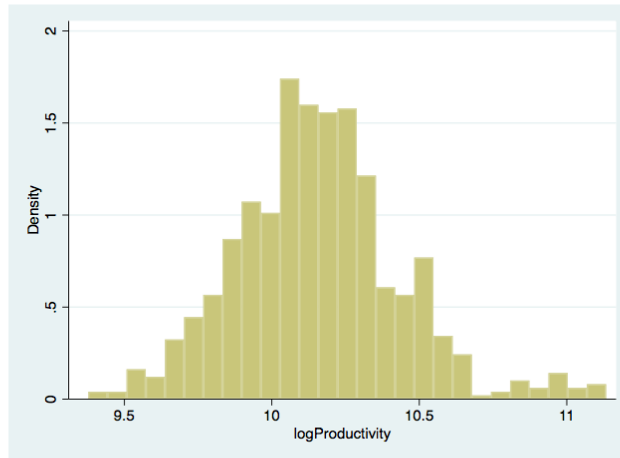
Histogram of Population Density and log of Population Density





Appendix 8.C Histogram of Productivity and log of Productivity





Appendix 9

	Nr ICT Startup	LQ BS	LQ ICT	LQ M	Log Productivity	Log Total Employment Region	Competition ICT	Log Population Density
Nr ICT Startup	1.0000							
LQ BS	0.6926	1.0000						
LQ ICT	0.3637	0.5701	1.0000					
LQ M	-0.4543	-0.7213	-0.4706	1.0000				
Log Productivity	0.5225	0.4727	0.3918	-0.3313	1.0000			
Log Total Employment Region	0.6035	0.5669	0.3702	-0.4445	0.5064	1.0000		
Competition ICT	0.1114	0.3268	0.5635	-0.2890	0.0188	0.4214	1.0000	
Log Population Density	0.3668	0.6417	0.2875	-0.5945	0.4457	0.4304	0.1847	1.0000