Bachelor thesis

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T t e:
Utilizing “The diamond of national advantage” for technology start-ups:
A comparison of location advantages of the Silicon Valley and the technology cluster in the Toronto-Ottawa region.

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Abstract

The Silicon Valley is the best-known business around the world and when it comes to technology also the most successful one. Furthermore, it is especially famous for its environment for technology start-ups, of which some have grown to multi-billion-dollar businesses such as Apple.

However, recently the supremacy of the Silicon Valley as the dream location for technology start-ups started to decrease, for example, due to increasing rent prices and more restricting immigration regulations. Hence, the attention has shifted to other technology clusters including the Toronto-Ottawa region, which has been growing for the last years and has also already been the origin for world-wide successful technology start-ups including Blackberry.

Therefore, this paper will concentrate on comparing the location advantages of the Silicon Valley and the Toronto-Ottawa region with the help of Porter´s “Diamond of national advantage” in order to identify which cluster has the potential to become the favoured location for technology start-ups.

The different factors of the diamond are analysed, and the results are ranked and compared through a model developed within the thesis.

It was found that the Silicon Valley is still the most advantageous location for technology start-ups, however the Toronto-Ottawa region and hereby especially the Toronto-Waterloo corridor has the potential to surpass the American cluster in the future. However, the region still needs to increase its capital volume and increase the quality of their university.

Keywords: Silicon Valley, Toronto, Ottawa, Waterloo, cluster, Michael E. Porter, Diamond of national advantage, technology, start-up, location advantage

JEL classifications: J2, C38, O15, G2, H54, R31, M31

I. Outline

II. List of figures and tables

III. List of abbreviations

CD	Census division
CMA	Census metropolitan area
DRB	Defence Research Board
GTA	Greater Toronto Area
ICT	Information and communications technology
MIL	Microsystems International Limited
NRC	National Research Council
RIM	Research in Motion
R&D	Research and development
STEM	Science, technology, engineering and mathematics
THE	Times Higher Education
VC	Venture capital

1. Introduction

1.1 Research problem

The Silicon Valley is acknowledged around the world as one of the most innovative technology clusters in the world and a lot of different governments have tried to copy and implement similar circumstances in their countries. Hence, many technology clusters have arisen such as Israel´s “Silicon Wadi” or the UK´s “Silicon Fendi”, whose names already reflect the enormous impact the Silicon Valley has had on the development of other technology clusters.

Similarly, in the 1990s a technology cluster in the Ottawa region emerged, which is also sometimes called the “Silicon Valley North”. Especially in its first years, the cluster grew exponentially and even at a higher rate than its sister in the south. Furthermore, in 2017 the technology cluster in Toronto had the highest growth rate in North America and created more jobs than the big technology clusters such as the Bay Area, Seattle and Washington combined. Nevertheless, this Canadian clusters as well as all other technology clusters in the world have not been able to surpass the Silicon Valley in its attractiveness for start-ups in this field yet.

However, recently the supremacy of the Silicon Valley as the dream location for technology start-ups started to decrease. For example, access to talent has become the highest concern for start-ups in the region, especially due to changing immigration laws. On the contrary, lately Canada liberated its immigration policies making it comparably easy for highly educated workers to permanently immigrate into the country.

Therefore, a re-examination of the Silicon Valley as the most attractive technology cluster for start-ups seems advisable, especially because the Toronto-Ottawa region, combining the clusters in Toronto, Ottawa and Waterloo, seems to gain in attractiveness. As Porter´s “Diamond of national advantage” analyses the competitive advantage of a nation or region, the model will be used as a basis to compare both clusters.

Hence, the aim of this paper is to compare the technology cluster in the Toronto-Ottawa region and the Silicon Valley in order to identify which cluster has the potential to become the favoured location for technology start-ups utilizing “The diamond of national advantage” model by Michael E. Porter.

1.2 Research method

This thesis compares the Silicon Valley and the Toronto-Ottawa region as locations for technology start-ups using a literature-based approach. The basis of it is Michael E. Porter´s “Diamond of national advantage” and the majority of the research will explain how the regions perform within the model. In order to present comparable criteria mainly research of the country´s statistical institutions as well as reports from independent research companies were used.

1.3 Course of investigation

In order to sufficiently answer the research question raised in 1.1, chapter 2 will supply the reader with the theoretical background of this paper and will define relevant concepts.

Therefore, in the second chapter agglomeration and its connection to the theory of cluster will be described, before the importance of location advantages and their nature are explained. Further, the nature of technology start-ups will be defined. Lastly, Michael E. Porter´s “Diamond of national advantage” will be portrayed focusing on the relevant elements for this thesis which are the external factors of the model.

The third chapter will give an introduction to the locations that are compared. Firstly, the Silicon Valley will be presented by illustrating its history, focusing on the creation of the cluster and its beginning. Then the geographical area will be shown in the location profile and some key facts about the region will be given. Lastly, Apple will be presented as a representative example for a successful technology start-up, which was able to utilize the advantages of the Silicon Valley in order to grow into an international company. This section will again focus on the beginnings of the company and its start-up phase highlighting important steps in its history where the usage of resources of the region becomes apparent. This usage will later be referred back to at relevant points within the analysis.

The same structure will be applied when introducing the Toronto-Ottawa region, while introducing Blackberry as the example.

In the fourth chapter, Porter´s model will be applied in order to compare the location advantages of the Silicon Valley and the Toronto-Ottawa region. Every comparison of the resources will be done by analysing the used criteria, which are directly derived from Porter´s work. Additionally, influential factors of the criteria will be examined.

The chapter is structured according to the model and hence begins with analysing the factor conditions of the regions. Here, the paper will investigate the human resources, material resources, knowledge resources, capital resources as well as the infrastructure of the regions. In the subchapter dedicated to knowledge resources only the best rated universities within each cluster will be analysed as origins of these resources.

Furthermore, the demand conditions of the regions will be highlighted by focusing on the demand conditions for the smartphone industry in the different countries. Hence, in this chapter, the thesis will broaden its perspective and compare nation-wide conditions, while centring on smartphones, as an example of technology products. More specifically, the concept of sophisticated customers, the transferability of needs to other, foreign markets, as well as the size of the demand will be analysed.

Moreover, the paper will examine the related and supporting industries of the regions concentrating on the relationship between them and start-ups.

Lastly, the results of the comparison will be interpreted by supplying a comparative model developed by the researcher. The methodology of the model will be explained briefly and an overview of the outcome of the comparison will be given. Additionally, criteria with deviating performances of the regions will be looked at again and further information will be provided to classify the deviation and its relevance.

In chapter 5, a summary of the acquired knowledge will be provided and an answer to the research question will be given. In addition, the limitations and restrictions of the research will be shown. The thesis will be concluded with an outlook of the future of both regions as locations for technology start-ups.

2. Theoretical background

2.1 Agglomeration and cluster

An agglomeration is a spatial concentration of elements such as a spatial concentration of companies, which occurs due to location advantages and a consequent accumulation of businesses (Brich, Hasenbalg, & Winter, 2014, p. 56). Hence, examples of agglomerations are business clusters (ibid).

Furthermore, it is important to note that agglomerations go hand in hand with economic growth and are seen as parallel processes (Martin & Ottaviano, 2008, p. 292). By reaping the benefits of the concentration of businesses, such as technology spill-over

effects or lower costs, companies become more specialized and competitive (Brich, Hasenbalg, & Winter, 2014, p. 56; Wang, Madhok, & Li, 2013, p. 995).

Moreover, clusters are an agglomeration and more specifically a “geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities” and can vary in size (Porter, 2008, p. 215). Such associated institutions are universities, research laboratories or standard agencies and companies, which do not necessarily need to be operating in the same segment but can be connected vertically as well (Brich, Hasenbalg, & Winter, 2014, p. 627). Hence, most businesses located in a cluster do not compete with each other, enabling an effective way of dialogue between different institutions as they do not fear competitive disadvantage such as technology spill-overs (Porter, 2008, p. 221). Other reasons for the formation of clusters include a specialized labour market, the availability of suppliers as well as an exchange of information and technology, meaning that the diamond´s factors have a stronger influence on companies located in a cluster (Birkinshaw, 2000, p. 98; Porter, 1991, p. 179). Thus, there are strong incentives for companies to locate their business in clusters (Birkinshaw, 2000, p. 98).

However, a geographical proximity of companies is only relevant, if a value-creation proximity between the institutions and companies exists as well (Ketels, 2011, pp. 176-177). Thus, only if the relationships of companies and corporations affect the value creation of the products, a cluster is of importance (ibid, p. 177).
Additionally, the existence of clusters can give an indication that part of a company´s competitive advantage completely or at least partially stems from its business location (Porter, 2008, p. 214).

2.2 Location advantages

The term “location advantage” was coined by Dunning, who developed the eclectic paradigm, which determines the success of foreign direct investment and multinational enterprise activities through analysing ownership, location and internationalization advantages (Dunning & Lundan, Multinational Enterprises and the Global Economy, Second Edition, 2008, p. 95). Hence, this thesis will follow a definition by Dunning, who describes location advantages as all location specific tangible and intangible assets, including natural resources and technological skills, that are available to all firms within the location. (ibid, p. 96).

Examples for these assets are labour and capital endowment as well as technology and managerial skills and favoured access to markets (ibid). Solely, due to a company´s residence in a specific location, they have access to those resources, which might not be available elsewhere or not in the same quantity and quality (Cuervo-Cazurra, de Holan, & Sanz, 2014, p. 509). Generally, those resources and advantages are accessible for every firm if there are legally allowed to do so, however firms should concentrate on the availability of location factors that fit their needs (Narula & Santangelo, 2012, pp. 6-7). Thus, the concept explains why it is economically beneficial for companies to reside in specific locations with particular location factors, such as cheap labours of production and the availability of natural resources (Wang, Madhok, & Li, 2013, p. 998).

Even though multiple models that try to identify and classify a country´s location advantages exist, this paper will be using “The diamond of competitive advantage” by Michael E. Porter, which claims that location advantages define competitive advantages (Dunning, Location and the Multinational Enterprise: A Neglected Factor?, 1998, p. 60).

Lastly, it is important to note that location advantages do not only relate to a whole country but also to different regions, leading to competition of areas even within countries (Narula & Santangelo, 2012, p. 6).

2.4 The diamond of national advantage

“The diamond of national advantage” was developed by Michael E. Porter and firstly published in his book “The competitive advantage of nations” (Huggins & Izushi, 2015, p. 458). It explains reasons for a nation´s international success and states that the competitiveness of a country depends on the capacity of its industries to innovate and upgrade (Porter, 1991, p. 93).

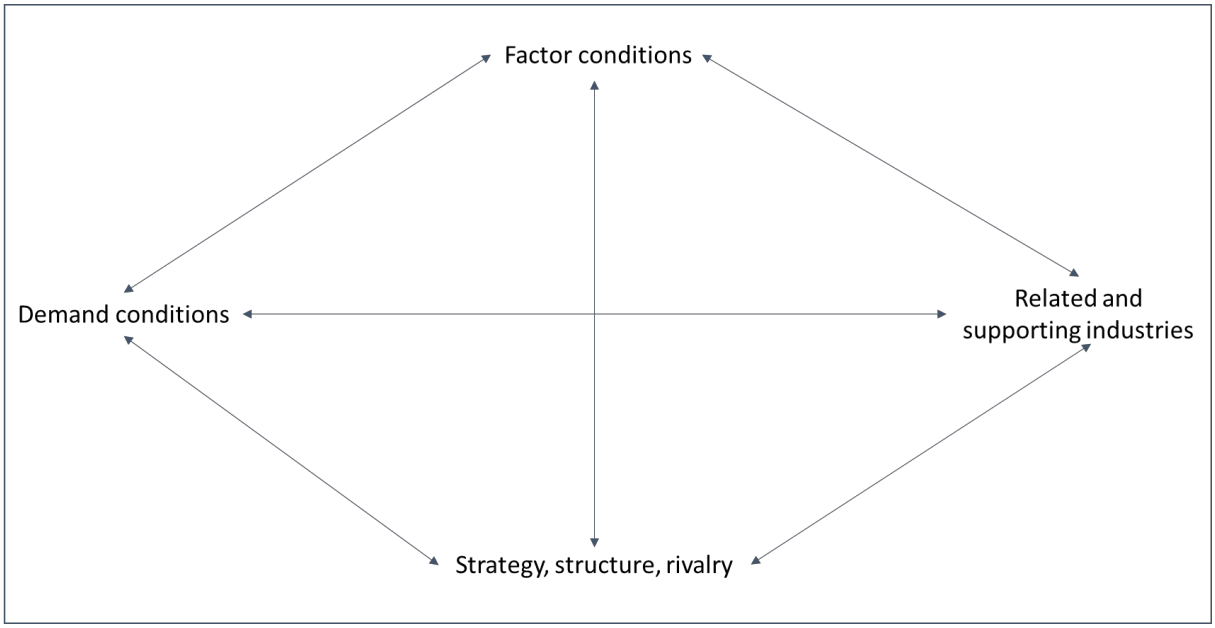
However, a competitive advantage can also exist within a cluster (ibid, pp. 175.-176). As Porter points out, competitive advantage is not a clear principle, as according to the theory of comparative advantage all nations are competitive in the production of at least one product (ibid, pp. 22, 27). Whereas in a short perspective a competitive advantage is often measured by the level of the real exchange rate, Porter´s model takes on a long-term perspective concentrating on the productivity of a nation (ibid pp. 23, 25-26). In order to gain a competitive advantage, a company needs to innovate

and hence a national competitive advantage exists if national conditions force an industry to innovate (ibid, pp. 67, 90).

Generally, the model identifies and evaluates four factors influencing a company´s productivity and competitiveness in a specific country and location and thus the firm´s ability to create and maintain a competitive advantage (Ketels, 2011, pp. 173-174; Grant , 2011, pp. 112-113).

Moreover, as it can be observed in figure 1, the influencing factors of a competitive advantage are factor conditions, demand conditions, related and supporting industries as well as a firm´s strategy, structure and rivalry (Porter, 1991, pp. 95-96). Additionally, these variables are influenced by the government and change as well as influence each other (ibid, p. 97).

Figure 1: The diamond of national advantage



Source: Own source, based on Porter, 1991, p. 95

Firstly, factor conditions are often the only or most analysed variable of traditional competitive theories (Grant , 2011, p. 114). However, Porter puts an emphasis on the fact that the availability of factor conditions does not automatically lead to a competitive advantage, as a need to overcome not available factor conditions forces a company to innovate. (Porter, 1991, p. 98). Thereby, a non-availability of resources can be a source of a competitive advantage as well (ibid).

Generally, Porter defines five groups of factor conditions including human resources, material resources, knowledge resources, capital resources and the infrastructure of a region (ibid, pp. 98-99). When analysing human resources, the quantity, qualifications,

costs of personnel are of importance, whereas the quantity, quality, accessibility and costs of land as well as the location of a country are included in material resources (ibid). Additionally, knowledge resources encompass all scientific, technical, industry related knowledge and the existence of universities, governmental and private research facilities within a region (ibid). The quantity, costs and types of available capital, quality and costs of the infrastructure, such as housing, are analysed in the capital and infrastructure resources (ibid).

Additionally, these factor conditions can also be ranked and grouped into basic and advanced factors (ibid, p. 100). The former includes natural resources, the climate, geographical location and unskilled workers of a country, whereas the latter comprises sophisticated skills and new technology (ibid). Nowadays, advanced factors are more important when it comes to the choice of location of a company and creating a competitive advantage, however they are also more scarce as they require investments (ibid, p. 101). Nevertheless, the basic factors are still important as they are the basis on which advanced factors develop (ibid). For example, basic factors can be transformed into advanced factors like educating unskilled workers (ibid, p. 102).

Additionally, Porter categorises factor conditions into generalised and specific factors (ibid). Generalised factors, such as capital, can be utilized in many industries whereas specialised features, for example, specially educated workers are only of usage by some industries and are important when creating and sustaining a competitive advantage (ibid).

Therefore, it can be concluded that competitive advantages are the most durable if they are based on advanced and specialised factors (ibid, pp. 102-103). However, if a lot of these factors are internationally mobile and hence only are of usage to a country and company if they stay within the country or region (ibid, p. 103).

Secondly, demand conditions, are influencing a competitive advantage of a nation (Grant , 2011, p. 115). When analysing the demand of the home country, the characteristics of the consumer needs, its scope and growth pattern and mechanisms of how preferences are transferred to foreign markets are looked at (ibid).

Generally, demanding customers in the home market of a company can lead to a competitive advantage, as sophisticated customers with high expectations and standards can pressure firms to innovate faster (Ketels, 2011, pp. 175-176). Especially, due to the cultural nearness of domestic customers it is also easier for companies to identify customers' needs and to stay in contact with them during the

development of their products (Porter, 1991, p. 110). Additionally, companies often have a specific sense of pride when it comes to their domestic markets which makes it especially important for companies to be successful in their home market (ibid).

Similarly, it is an advantage of a company if consumers in their domestic market anticipate global needs and act as a signal for future international demand (ibid, p. 115). This way new products can be developed early, or existing products can be improved continuously through innovation resulting in an early presence of the company in the market, which can be utilized to build factories and gain experience (ibid, p. 119). Those anticipatory consumer needs develop due to the culture or values of the home country, for example Sweden´s consciousness of disabled people pressured Swedish companies to develop products for those as well (ibid, p. 115). Additionally, it is also beneficial if national needs impact international needs through emigration, tourism or culture-based exports such as films (ibid, pp. 122-123).

Moreover, if a market is big in a country, domestic companies are able to use economies of scales faster and invest more in research and development (R&D) (ibid, pp. 116-117). This dependency between size and R&D expenses also continues to exist after the company decides to internationalise as it is easier for firms to predict the demand of their domestic market and hence, they make decisions on R&D expenses according to it (ibid). Usually, a big market also comprises more customers which may have slightly different needs, leading to a higher need for companies to innovate to satisfy the desires of all their customers (ibid, p. 118).

However, an early saturation of the home market is not necessarily a disadvantage as it often means higher competition, decreasing prices and thereby increasing the urgency to innovate (ibid, p. 120). A saturated market is also often a starting point of companies to internationalise (ibid).

This also leads to the fact that the quality of domestic demand is more important than the quantity of it (ibid, p. 123). Nevertheless, the segment structure of the demand needs to be considered as well (ibid, p. 117). Companies are more likely to have a competitive advantage in industries where their national demand is a high segment of the global demand, as this increases their priority and attention given to this segment (ibid). Hence, even companies in relatively small countries with a high part of global demand are able to develop a competitive advantage by focusing more intensely on the particular need (ibid).

In conclusion, it can be said that all of the above factors influence each other, and that one beneficial demand condition does not automatically lead to a competitive advantage (ibid, p. 123). To take it even further, the presence of demand in the home country is not sufficient as domestic customers must have demanding and anticipatory needs as well (ibid).

Thirdly, the existence of related and supporting industries in the home country that are international competitive is beneficial for companies (Porter, 1991, p. 124).

Through the domestic supporting industries firms have fast and often more cost-efficient access to required products due geographical and cultural nearness (ibid, p. 127). Therefore, closer working relationships with national suppliers can develop and fast communication and exchange of ideas and innovations can influence the innovativeness of a company (ibid). Additionally, transaction costs associated with sourcing the products for production from abroad such as customs can be circumvented when being able to use national suppliers. (Ketels, 2011, p. 176).

Moreover, related industries can accelerate the development of a supporting industry and increase the probability that new opportunities are recognised within the industry (Porter, 1991, p. 130). Generally, industries are related if companies can coordinate activities of their value chain or produce products that are complementary (ibid, p. 129). Again, due to the cultural and geographical proximity, domestic related industries are often more influential to a company (ibid). Further, if successful they can lead to positive spill-over effects beyond the boundaries of the industry (Grant , 2011, p. 116). Hence, there is a tendency for successful industries within a country to be grouped into clusters of related and supporting industries, forming an essential part of a competitive dynamism within a nation (Snowden, 2011, S. 159).

Fourthly, the firm´s strategy, structure and rivalry need to be considered when analysing the national competitive advantage (Porter, 1991, p. 131). However, this thesis will not apply this part of Porter´s diamond in the later analysis as only the external environment of companies within a location will be analysed. Hence, there will be no further explanation concerning this issue.

In addition, the government of a nation also influences the competitive environment of a country through its ability to shape and influence all four variables (Porter, 1991, pp. 150-151). For instance, through policies and investments in education the quality of human capital can be increased, or special competition laws and subventions can be

issued affecting the competitive environment (ibid, pp. 151-152). Further, governmental interference can also be negative, because companies do not see the necessity to invest themselves to create a sustainable competitive advantage and governmental support cannot generically create it (ibid, p. 699).

Therefore, Porter recommends the government to be a “pusher and challenger” by actively interacting with conditions of all variables (ibid). Further, the government should ensure a competitive environment and provide stability (Snowden, 2011, S. 159).

Finally, the variables of the diamond are also influenced by change and occurrences outside the range of action of companies and often of nations, such as unexpected inventions or wars (Porter, 1991, p. 148). However, the effect of change depends not only on the variables but also on the nation´s characteristics of how to utilize and adapt to it (ibid, p. 149).

2.3 Technology start-ups

Start-ups are not consistently defined in literature. For example, Kiehl argues that being a start-up is only a development phase in which it is decided to start a company “within a particular industry with a particular strategy” (Kiehl, 1998, p. 5) However, according to Brich et al, start-ups are young companies with an innovative business idea, often in the areas of business, communication technologies or life science, founded with little capital and hence they are often dependent on venture capital (VC) or seed capital (Brich, Hasenbalg, & Winter, 2014, p. 2971). Therefore, technology is often associated with start-ups.

Thus, referencing Bürgel, who uses Little´s definition of a “new-technology-based firm” for his denotation, technology start-ups are companies that have been established for up to ten years, by at least one person and are not a subsidiary of another company with the main purpose of exploiting “an invention or a technological innovation” (Bürgel, 2000, p. 80). This definition will be applied throughout the thesis.

3. Silicon Valley and the technology cluster in the Toronto-Ottawa region

3.1 Silicon Valley

3.1.1 History

The following table describes the beginning of the Silicon Valley and how the region was able to become the best-known technology cluster in today´s world. It focuses on

the main institutions, companies and people who influenced the region through the formation of the cluster.

Table 1: The beginnings of the Silicon Valley

1890s	Stanford University is founded with the goal of encouraging the applicability of science and knowledge in the business world as well as a constant interaction with firms (Herger, 2016, p. 53).
1900s	Professors of Stanford invest in a radio station and thereby attract engineers to the region (ibid).
1930s	The military enters the area by locating an Air Force defence base in the Bay Area (ibid, p. 54).
1940s	Frederick Terman, dean of the School of Engineering and later president at Stanford starts collaborations with military institutions (Wright, 2017, p. 6).
	Terman encourages students, such as Bill Hewlett and Dave Packard to start their companies and animates electronic companies to settle in the Bay Area (Hambrecht, 1984, p. 75; Herger, 2016, pp. 55-56)
	The Stanford Research Institute is founded with the mission of the discovery and application of technology (Herger, 2016, p. 56).
1950s	With the Stanford Research Park, the first industrial zone is created by a university and today for example houses Tesla (ibid).
	William Schockely who founded Schockley Laps, a semiconductor company in Santa Clara, wins a Nobel prize and hence many engineers are moving to the area (Hambrecht, 1984, p. 75).
	Former employees of Schockely Laps start Fairchild Semiconductor becoming the market leader in the industry, and the origin of a cluster, enabling technology spill-over and the growth of a supplier industry (Klepper, 2010, p. 15; Herger, 2016, p. 57).
1970s	The region starts to gain national attention and is named “Silicon Valley” by the reporter Dan Hoefler (Kenney, 2000, pp. 3-4)
1980s	Semiconductor manufacturers move to lower-cost locations leading to a crisis within the Silicon Valley (Huggings & Izushi, 2007, p. 68). However, this initiates the formation of more information and communications technology (ICT) starting the region´s dominance within this industry (ibid).

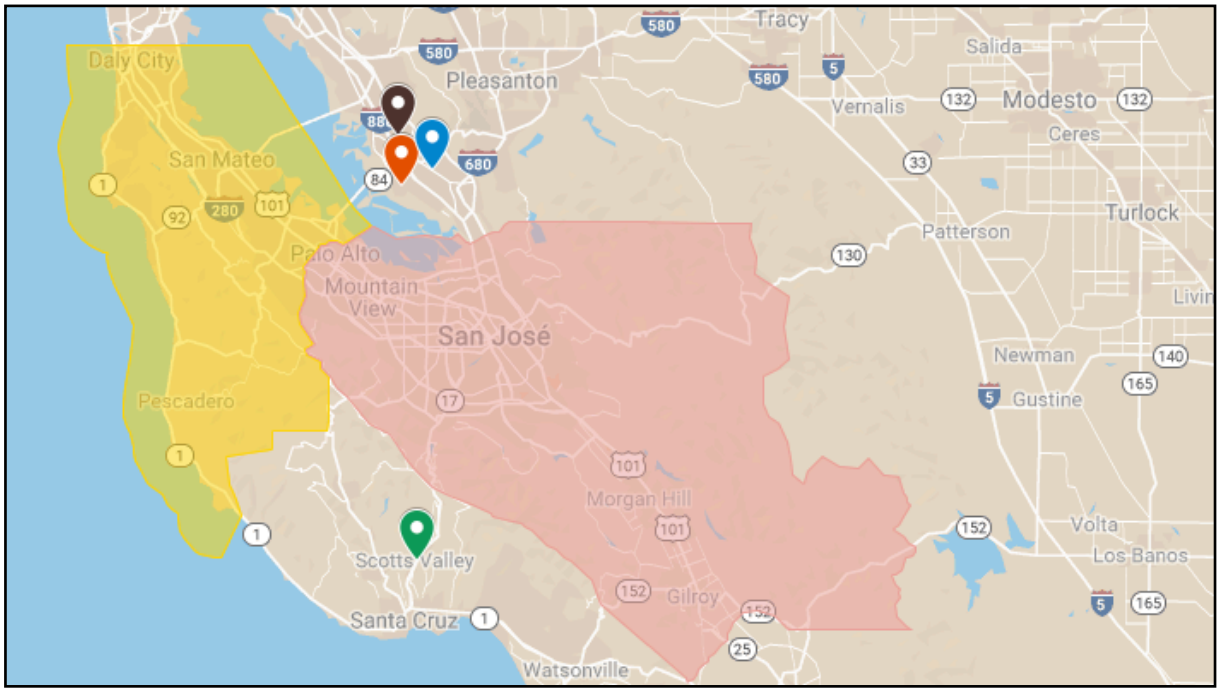
Source: Own source based on Herger, Wright, Hambrecht, Klepper, Kenney, Huggins & Izushi

3.1.2 Location profile

Nowadays the Silicon Valley is described as one of the most impressive industry clusters in the history of the United States and has transformed itself into a high-tech cluster (Klepper, 2010, p. 15; Hulsink, 2007, p. 3).

Further, due to its ongoing growth, there is no clear geographical definition of the Silicon Valley (Herger, 2016, p. 65). Whereas in the beginning the core of the cluster was located between Redford City and San José, today sometimes the whole area between Marin County the East Bay and Santa Cruz is being referred to as the Silicon Valley or the Bay Area (ibid). However, this thesis will use the definition of the "Institute for Regional Studies", which regularly publishes data about the area and defines it as the whole of the San Mateo County, which is highlighted in yellow in figure 2 below, the Santa Clara County marked in red, Fremont, Newark, Union City of the Alameda County and Scotts Valley of the Santa Cruz County, which are the cities individually evidenced on the map (Massaro, 2018 Silicon Valley Index, 2018, p. 6).

Figure 2: The Silicon Valley



Source: Google, 2019

This region comprises 1,854 square miles or 4,801.84 square km and has had a population of 2.7 million in 2016 (ibid). Between 2015 and 2016, the Silicon Valley contained the highest growth rate of employment in innovation industries such as Internet & Innovation or Software in the US and experienced the highest growth of STEM degrees conferred by capita ranking at 16% (Melville & Kaiser, 2018).

3.1.3 Example: Apple

Apple was founded in 1976 by Steve Jobs and Steve Wozniak (Gatz, 2005, p. 41). Already as a child, Steve Jobs expressed an interest in electronics and due to his family living in the Silicon Valley, he had access to the networks of the companies (O´Grady, 2009, p. 19). Hence, he became part of the Hewlett Packard Explorer-Club, a group of young technicians working at HP (ibid, p 20).

In 1971, Steve Jobs and Steve Wozniak were introduced to each other by a mutual friend (Gatz, 2005, p. 25). Four years later, both started Apple in Jobs´ garage and through contacts like Mel Schwarz, a professor at Stanford the company received its first credit of $20.000 to produce their first computer (ibid, pp. 42, 44). More than 45 years later, Apple did not only revolutionize the computer industry with the Apple II but also changed the music and cell phone industry with their iPod and iPhone (O´Grady, 2009, pp. 67, 135).

3.2 Toronto-Ottawa

3.2.1 History

The table below illustrates the beginning of the technology cluster in the Toronto-Ottawa region and describes the impact universities, federal programmes and facilities as well as selected companies had on the development and formation of the region.

Table 2: The beginnings of the Toronto-Ottawa region

1850	The University of Toronto is founded out of King´s College in Toronto (Friedland, 2002, pp. 31-32).
1940s	The Defence Department establishes the Defence Research Board (DRB) and founds the Electronic Advisory Committee (Creutzberg, 2005, p. 14).
	The University of Toronto establishes Canada´s first training centre for computers with the help and funding of the DRB and National Research Council (NRC) (ibid, p. 15)
1950s	The University of Waterloo is founded due to a high demand of technical educated labour force (Nelles, Bramwell, & Wolfe, 2005, p. 20).
	Northern Electronics opens two research subsidiaries in Ottawa including Microsystems International Limited (MIL), which initiates the research and telecom proficiency in the area and attracts highly skilled engineers to Ottawa (Lucas et al, 2009, p. 194).
1960s	The University of Toronto receives a donation of $2.3 million to develop the graduate engineering programme resulting in higher graduate student numbers, more scientific personnel and additional research (Friedland, 2002, p. 501).
1970s	First ICT companies are established in Waterloo of which a fair amount are spinoffs from the University of Waterloo (Lucas et al, 2009, p. 195).
	Leading technology companies such as Fairchild Semiconductor choose Toronto as their Canadian location (Creutzberg, 2005, p. 17).
	MIL is sold leading to a high supply of highly skilled workers, of whom some found their own companies or start to work for other companies in the area (Lucas et al, 2009, p. 194).
	Governmental programmes encourage R&D in computer technology, to increase the technology knowledge of private companies (ibid, p. 195).
1980s	Federal programmes are established to support university research programmes (ibid).
	The Ottawa-Carleton Research Institute is founded, which encourages collaborations of universities and businesses, and contributes to the development of the technology cluster (Brouard et al, 2004, p. 61).

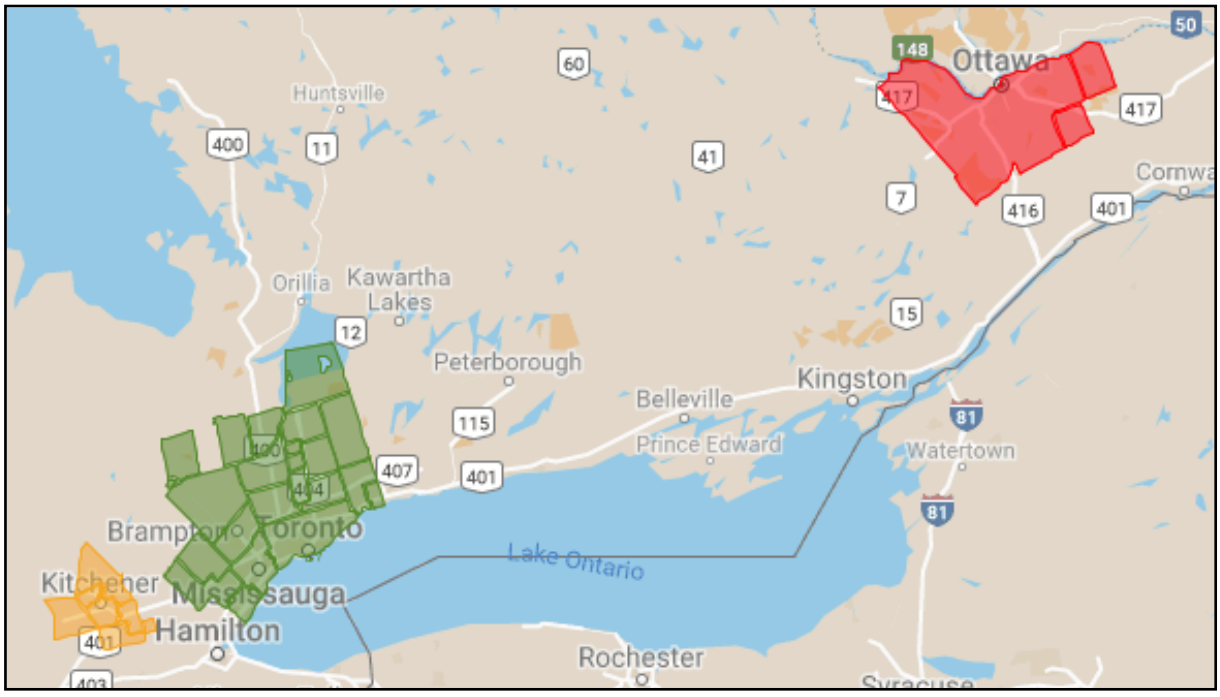
Source: Own source, based on Friedland, Creutzberg, Nelles, Bramwell, & Wolfe, Lucas, Sands, & Wolfe, Brouard, Chamberlin, Doutriaux, & de la Mothe

3.2.2 Location profile

In this paper the Toronto-Ottawa region will be defined as the ICT clusters in Toronto, Ottawa and Waterloo, which are the largest, second largest and fifth largest ICT clusters in Canada (Lucas et al, 2009, pp. 191, 193). Whereas in Ottawa especially "telecommunications and photonics" companies are located, the cluster in Waterloo centres around "software, wireless technology and advanced manufacturing" and the Toronto cluster includes a range of companies in the ICT industry (ibid).

Generally, the Toronto cluster is defined as the Greater Toronto Area (GTA) but to be able to use relevant statistics, this paper will use the definition of the census metropolitan area (CMA) of Toronto, which is almost identical to the GTA and is illustrated in green in the map below (Statistics Canada, 2019; City of Toronto, 2016). For the same reason, the Ottawa part of Ottawa-Gatineau will be used, which can be seen in red. Lastly, the Kitchener-Cambridge-Waterloo CMA will be utilized, illustrated in orange in figure 3 below.

Figure 3: The Toronto-Ottawa region



Source: Google, 2019

This region consists of 10.597,30 square km and had a population of 7.4 million in 2016 (Statistics Canada, 2019). When only looking at Toronto, it is already the third largest technology cluster in North America after the Silicon Valley and New York and it is furthermore the Canadian location of leading technology companies such as IBM Canada and Microsoft Canada (Lucas et al, 2009, p. 191). Additionally, Ottawa is

historically the origin of the ICT industry in the country and during the 1990s the region grew at a higher rate than the Silicon Valley, but it was hit by the dot-com crisis harder than other clusters such as Waterloo (Ghent Mallett, 2004, p. 22; Nelles, Bramwell, & Wolfe, 2005, p. 18). Additionally, Waterloo is still growing rapidly (Flanagan, 2017). Between 2011 and 2016, it had the second highest employment growth rate of technology jobs in North America, just behind Charlotte, North Carolina (ibid). Therefore, the Toronto-Ottawa region including all three major hubs is the largest technology cluster in Canada (Lucas et al, 2009, pp. 191-193)

3.2.3 Example: Blackberry

BlackBerry was founded in 1984 as Research in Motion or RIM by Mike Lazaridis and Douglas Fregin, who were engineering graduates from the University of Waterloo and the University of Windsor (Moon, 2013). The beginnings of the company were characterized by cooperation with other companies (Friend, 2013). For example, RIM provided LED signs to General Motors and in the 1990s a pager by RIM used the Mobitex wireless network (ibid). As a consequence, RIM attracted private investors, such as Jim Balsille, who invested $250,000 (ibid).

After the first successful launches of pagers that were also able to use the Internet and email, the company went public in 1997, raising $115 million and witch the name of the devices changing to “BlackBerry” sales skyrocketed (ibid). In 2007, Blackberry became the most valuable company in Canada, however only three years later it was overtaken as the worldwide leader of smartphone sales by Android and Apple (Moon, 2013).

4. Comparing the location advantages

4.1 Factor conditions

4.1.1 Human resources

As already stated, Porter defines the human resources of a nation as the quantity, quality and costs of employees (Porter, 1991, p. 98).

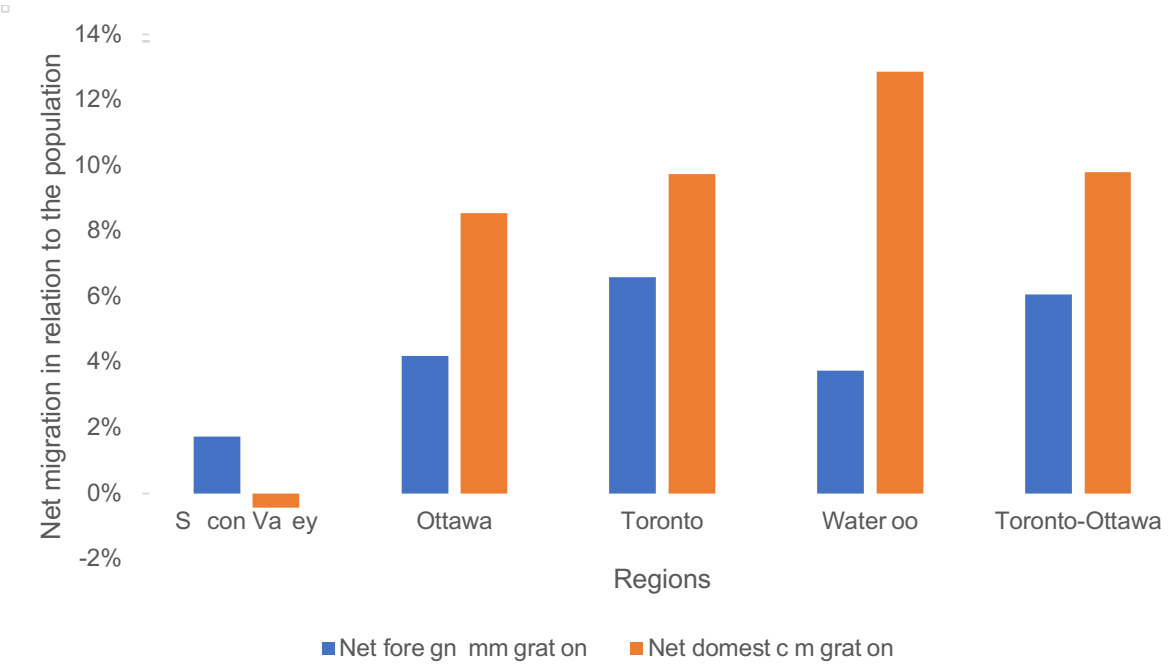
Whereas during the years after the dot-com-crisis the population in the Silicon Valley remained relatively stable, since 2005 the region has started to grow again, until in 2016 2.7 million people lived in the region (Massaro, 2018 Silicon Valley Index, 2018, p. 10). Compared to that in the same year 991.726 people were living in Ottawa, 5.93 million in Toronto and 523,894 in Waterloo totalling to 7.44 million people in the

Toronto-Ottawa region (Statistics Canada, 2019). Between 2011 to 2016, the population changes in the Silicon Valley and in the Toronto-Ottawa were very similar, increasing by 6.2% and 6.1% respectively (Silicon Valley Indicators, 2019; Statistics Canada, 2019). These changes in population sizes can both be attributed to natural change, as well as immigration (Massaro, 2018 Silicon Valley Index, 2018, p. 10).

In the observed period, there was a foreign net migration of 46,862, meaning that more foreigners moved to the Silicon Valley than people migrated abroad from it (State of California Department of Finance, 2018). However, it is also worth noticing that there was a negative domestic migration of 11,901 people (ibid). This trend of domestic migration to other parts of the United States from the Silicon Valley has been going on since 2015 (ibid). However, the Silicon Valley has always had a negative net domestic migration since the 1991 with the exception of 2012 to 2014 (ibid).

On the contrary, between 2011 and 2016 there has been a large positive net migration in the Toronto-Ottawa region, accumulating to a 451,900 net foreign immigration and 729,535 net domestic immigration (Statistics Canada, 2019). Even when considering these numbers in relation with the population size, a difference in net migration patterns in the two regions can be observed, shown in figure 4.

Figure 4: Net migration between 2011 and 2016 in relation to the population size in 2016 in the Silicon Valley and the Toronto-Ottawa region



Source: Own source, based on Statistics Canada, 2019, State of California Department of Finance, 2018

On average, 10% of the population in the Toronto-Ottawa region in 2016 has moved from other parts of Canada into the area between the years 2011 and 2016 and 6% from other countries (ibid). Hereby, Waterloo experienced the highest relative inflow of domestic immigrants and Toronto the highest inflow of foreign immigrants (ibid). Compared to that only 2% of the population in the Silicon Valley in 2016 has moved to the area in the five years prior and as already said, the net domestic migration has even been negative (State of California Department of Finance, 2018).

The difference in the net domestic migration between the regions can be explained by the high living and housing costs in the Silicon Valley, which is a common reason for people leaving the area (Kotkin & Cox, 2018). This outflow of talent to other parts of the United States is also an important reason why the Silicon Valley relies heavily on foreign immigration as a source of employees (ibid).

Nevertheless, there is also a discrepancy between the foreign immigration numbers of the Silicon Valley and the Toronto-Ottawa region, which is influenced by current legislation changes as well as the policies of the current national administrations (Pender, 2018; Kotkin & Cox, 2018). Whereas the Canadian government has launched new programs increasing the speed of the immigration process and raising the number of immigrants allowed into the country per year, the United States is going in the opposite direction (ibid).

In June 2017, the “Global Talent Stream” program was introduced by the Canadian government, which is a pilot agenda initially set up for two years with the intent to increase the access to foreign high-skilled workers for local companies and is especially directed at foreign technology workers (Pender, 2018; Government of Canada, 2019). Therefore, the process of receiving a visa through this program is relatively fast and easy (Pender, 2018). Companies can apply for such a visa for a foreign employee through two categories: category A and category B (Government of Canada, 2019). The former is directed at innovative companies looking to fill “unique and specialized positions”, which are defined as positions, where “advanced knowledge of the industry”, an “advanced degree of interest to the employer”, a “minimum of five years’ experience” is necessary and, or it is highly paid (ibid). The latter aims at Canadian companies looking to hire foreign highly skilled workers in defined careers, which includes computer and software engineers as well as computer programmers and interactive media developers (Government of Canada, 2019). If these requirements are fulfilled, the company needs to be referred by designated

referral partners including local governments and economic development corporations as well (ibid).

One of the main benefits of the program are its fast procedures (Pender, 2018). Before the pilot was initiated, it took around ten weeks until permanent resident visas and work permits got accepted, while now it only takes as little as two weeks (ibid). In December the Ministry of Immigration, Refugees and Citizenship reported that through the "Global Talent Stream" 3,100 new positions have been filed, which led to 38,000 new jobs being created for Canadians or permanent residents and an investment of $59 million in domestic trainings (Morgan, 2018). Therefore, according to Navdeep Bains, the federal minister of innovation, science and economic development, every issued visa leads to ten new Canadian jobs (Pender, 2018).

Another recent Canadian immigration program directed at highly skilled workers for example working in the technology industry, is the "Federal Skilled Worker (Express Entry)" program, which was established in 2015 (Smith, Turner, & Katem, 2018). In order to be eligible to apply, one needs to have skilled work experience in a managerial, professional or technical jobs and skilled trades, certain language abilities and a certain level of education as well as enough funds to live in Canada or a valid job offer (Government of Canada, 2019). Whereas in 2016 most of the applications took six months or less in order to be finalized, in 2017 already 80% of the applications were processed in four months or less (Smith, Turner, & Katem, 2018). Furthermore, the number of issued invitations increased tremendously by almost 500% from 2016 to 2017 to 41,364, which can be explained by changes in the calculation system (ibid). Additionally, the government plans to increase these numbers further in 2019 and 2020 (ibid). Moreover, the three biggest shares of occupations of the people using this program in 2016 as well as 2017 were in the technic sector, namely Information System Analysts and Consultants, Software Engineers and Computer Programmers and Interactive Media Developers (ibid).

On the contrary, in the last years the regulations concerning immigration have been tightened in the United States and according to President Trump, they will become even more restrictive in the future (Pierce & Gelatt, 2018, p. 2). This is especially a concern for the Silicon Valley and technology start-ups because 71% of tech workers in the area were immigrants in 2016 and many of them are working in the United States through a H-1B visa (Baron, 2018). It is also worth noticing that in 2013 17.7% of all

approved applications for this visa were issued for employers in California, which was the highest share nation-wide (Ruiz, 2017).

The process of applying for the visa is relatively complicated and expensive to sponsor for companies as it costs between $10,000 and $11,000 per employee (ibid). General requirements for the “H-1B Specialty Occupations” visa include that the job must qualify as a specialty occupation and that the applicant has the qualification to accept the offer (U.S. Citizenship and Immigration Services, 2017). More specifically, the job needs to require at least a bachelor´s degree, which also needs to be common for the industry or is a constant requirement of employer (ibid). If the job does not require a bachelor´s degree, it needs to be very specialized, resulting in the need for a degree (ibid). Additionally, the applicant´s degree must at least equivalent to a US bachelor´s and have a certification authorizing him to the practice of the job or have an education or training equivalent to a degree (ibid).

Initially, the future employer needs to submit an application, then needs to fill out different paperwork, until in the last step the possible new worker can apply for the visa (ibid). Currently, each fiscal year there is a cap of 65,000 visas plus additional 20,000 visas issued for applicants with a US master´s degree or higher (ibid). However, compared to the years between 1998 and 2004 when 195,000 visa were available (Pierce & Gelatt, 2018, p. 5, Mayda, 2018, p. 106). Hence, in 2018 as well as in the last 15 years prior the cap was met and exhausted, as for the 20,000 master´s degree visas there have been 96,000 applications alone (Anderson, 2018). Furthermore, when one is awarded with the visa, it has a duration of three years and can be extended to another three years (Mayda, 2018, p. 118)

Additionally, of the 85,000 visas issued in 2016 Google used 2,500 and Apple 2,000, which again shows the high need of technology companies in the Silicon Valley for foreign workers (Baron, 2018).

Since the election of President Trump, the visa has been undergoing changes again, starting with him signing the “Buy American, Hire American” executive order in April 2017, which requires the agencies to only give out visas to the “most-skilled foreigners or highest-paid beneficiaries” (Semotiuk, 2019). In order to ensure that, all applications will firstly fill up the 65,000 cap, even those of people who would normally fall under the 20,000 advanced degree exemption (O´Brien, 2018). This order has already let to the U.S. Citizenship and Immigration Services increasing denials and asking for more evidence (Semotiuk, 2019).

Next, in August 2018, the premium processing of applications, which is an option the employer can choose to speed up the processing time from around six months to 15 days when paying $1,410, was put on hold (Maurer, 2018). This initiative has already slowed down the handling of the process and will be in effect until February 2019 (ibid). Finally, on 19th November, a new application form was introduced by the Department of Labour, which has been criticised for asking for more internal information of the employing companies leading to a higher possibility of negative press for them and an indirect pressure to conform to President Trump´s “Hire American” line (Semotiuk, 2019). However, the effect of this change cannot be evaluated yet (ibid).

All these measures have seemingly already have had another effect. After five years the number of applications for the H1-B visas has fallen from 236,000 in the 2017 fiscal year to 199,000 in 2018 (Jan, 2018).

Hence, even though the population change within the compared regions was almost the same between 2011 and 2016, there was a much higher level of foreign migration in the Toronto-Ottawa region. This deviation is most probably going to increase even more in the future due to the changing immigration regulations analysed above. Hence, due to the higher population in the Toronto-Ottawa region and higher growth prospect, there is a greater availability of human capital within the Canadian region than in the Silicon Valley.

Therefore, after the quantity of human capital has been compared, the quality will be analysed by comparing the education of the people living in the regions. Education is important to consider as it can help to gain economic growth and to achieve a competitive advantage (Saiz-Àlvarez, 2013, p. 312).

In 2016, 45% of the population between 25 and 64 living in Ottawa had a bachelor´s degree or higher, compared to 41% of the people living in Toronto and 29% living in Waterloo (Statistics Canada, 2019). However, the education level in the Silicon Valley is generally higher, as 51,6% of the population above 25 in Santa Clara and San Mateo had at least a bachelor´s degree (Silicon Valley Indicators, 2019).

Additionally, in table 3 one can see how many people had a science, technology, engineering and mathematics (STEM) degree in 2016 in the areas. However, as only the share of the population with a bachelor´s degree or higher who has a STEM degree is measured by the Canadian Federal Statistical Office, it is assumed that this percentage can be transferred to the population with only a bachelor´s degree. Further,

in this chart the census division (CD) of Ottawa is used as the basis of the analysis, which is a bit smaller that the CMA.

Table 3: The number of people with STEM degrees in the different clusters

	STEM degrees in 2016
Silicon Valley	534,071
Toronto-Ottawa region	300,067
Ottawa (CD)	39,616
Toronto	243,659
Waterloo	16,792

Source: Own source, based on United States Census Bureau, 2019; Statistics Canada, 2019

There are almost two times more people with a STEM degree living in the Silicon Valley than in the Toronto-Ottawa region leading to a higher availability of qualified personnel in the American cluster (United States Census Bureau, 2019; Statistics Canada, 2019). This difference is especially surprising when considering that the population of the Toronto-Ottawa region is almost three times larger than the population in the Silicon Valley (Statistics Canada, 2019; State of California Department of Finance, 2018).

Further, there is a high imbalance of the distribution of the STEM educated workers in the Toronto-Ottawa region, as 81% of all people within the Canadian region with this educational background are living in Toronto (Statistics Canada, 2019).

Moreover, the costs of human capital need to be considered according to Porter (Porter, 1991, p. 98). In table 4, one can observe the different wages per year in the different regions of a Senior Software Engineer and a Data Scientist, which are jobs belonging to the “Top 5 jobs in Silicon Valley” (Mangalindan, 2013). The numbers are taken from Indeed, which analyses job advertisements published on the website in the last 36 months (Indeed Canada, 2018; Indeed USA, 2018). In order to compare the wages, the Canadian Dollar to US Dollar exchange rate from the 4th January 2019 was applied, which was 0.7457 (Daily Exchange Rates Lookup, 2019).

Table 4: Wages per year in the Silicon Valley and the Toronto-Ottawa region in USD

	Senior Software Engineer	Data Scientist
Silicon Valley (Palo Alto)	$160,884	$137,566
Toronto-Ottawa region	$67,629.52	$78,462.55
Ottawa	$70,860.14	$67,125.68
Toronto	$79,323.09	$89,799.43
Waterloo	$52,705.33	No data available

Source: Own source, based on Indeed, 2018; Indeed, 2019

Hence, the average wages of technology employees in the two different areas differ by around $93,000 to $59,000 per year on average, increasing the attractiveness of the Silicon Valley for workers. (Indeed Canada, 2018; Indeed USA, 2018)., the wage level within the Toronto-Ottawa region is diverse as well, resulting in a yearly difference of around $26,600 when comparing Toronto and Waterloo.

Therefore, the cost of qualified human capital is higher in the Silicon Valley than in the Toronto-Ottawa region, even though the salaries within the Canadian region also differ considerably.

4.1.2 Material resources

Generally, material resources utilized in an economy are defined as resources originating from a country´s raw materials and natural resources or imported semi-finished and raw materials (OECD, 2015, p. 25). However, Porter focuses the quantity, quality and costs of commodities as well as the climate and geographic location of it when analysing a country´s material resources (Porter, 1991, p. 98).

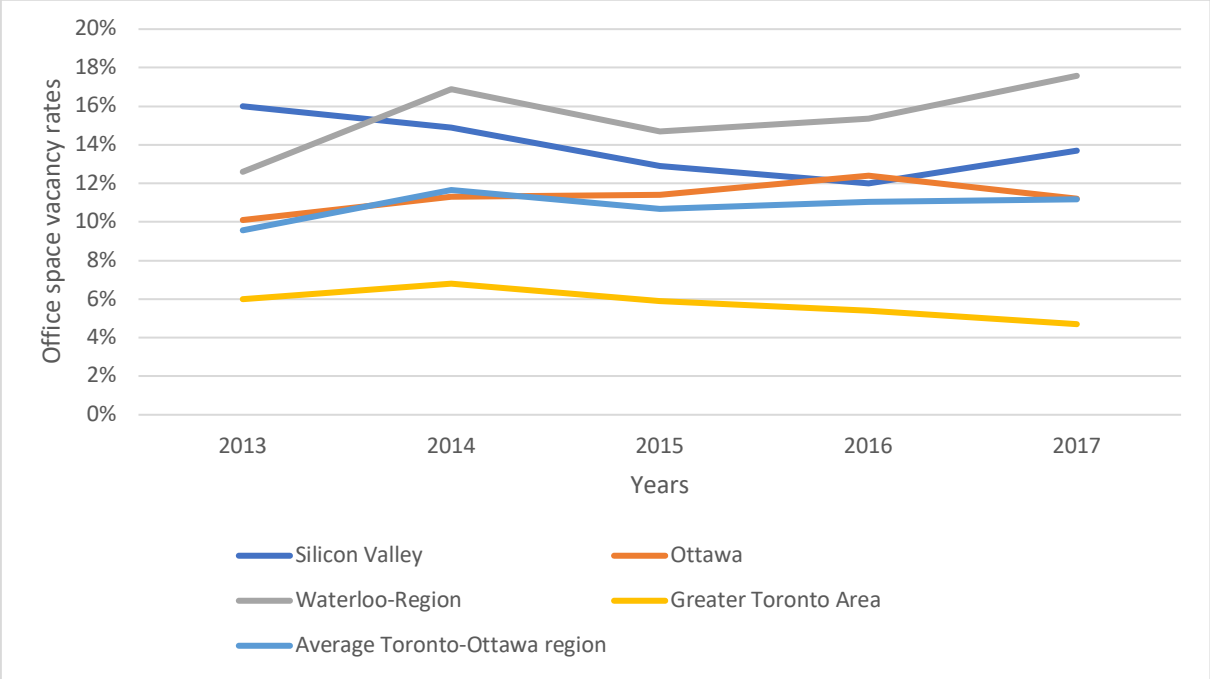
According to a research of Tesfaye, only access to “suitable locations” are of importance to start-ups when it comes to material resources as defined by Porter (Tesfaye, 1997, p. 93). Hence, this chapter will be focused on the criteria of the availability and price of office locations.

A company with 500 workers searching for an office location with 7,000 square feet needed to calculate $1.84 million in Ottawa, $ 2 million in Toronto and $ 4.7 million in the Silicon Valley, which is defined as the San Francisco Bay Area, per year for an office in July 2017 (CBRE Research, 2018, p. 29).

When it comes to the availability of office space apart from indicating how hard or easy it is to find an office, the vacancy rate is also an indicator of the development of

economic activities of a region and “measures the amount of space that is not physical occupied” (Massaro, 2018 Silicon Valley Index, 2018, p. 40). Below, figure 5 depicts the average vacancy rate of the different regions in the fourth quarter of the years 2013 to 2017. However, the Canadian data in 2017, as well as the vacancy rate in the Waterloo-region in 2013 and 2014 depict the vacancy rate in the third quarter of the respective year.

Figure 5: Office space vacancy rates in the Silicon Valley and the Toronto-Ottawa region



Source: Own source, based on Colliers Canda, 2019; Silicon Valley Indicators, 2019

As it becomes apparent, the vacancy rate in the Silicon Valley has always been higher than the average vacancy rate in the Toronto-Ottawa region. However, not all areas in the Canadian region have a small availability of office space, as the vacancy rate in the Waterloo-region has consistently been higher than the one of the Silicon Valley. Nevertheless, especially the shortage of office spaces in the GTA significantly impacts the average vacancy rate.

The graph also shows, that the vacancy rate in the Silicon Valley has been increasing again after a dip in 2016 and in the third quarter of 2018 it already amounted to 18.4% (Massaro & Manago, Quarterly Report SILICON VALLEY COMMERCIAL SPACE Q3 2018, 2018, p. 6). This can be explained by ongoing mergers and acquisitions and consolidation activities especially in the hardware sector as well as “occupation losses in the airline and finance industries” in the area (ibid). However, when only looking at

some cities in the heart of the Silicon Valley, such as Palo Alto, Redwood City, Melo Park, Mountain View and Sunnyval, the vacancy rate remains relatively low at 3% to 6% (ibid).

Hence, even though the average office space vacancy rate in the Silicon Valley is higher than in the Toronto-Ottawa region, this is not the case when solely comparing the Silicon Valley and Waterloo.

4.1.3 Knowledge resources

Knowledge resources of a country encompass the national scientific, technical and industry-related knowledge, which can be found in universities and research facilities and which is utilized by companies (Porter, 1991, p. 99).

Whereas historically, the University of Stanford has been an important source of knowledge to the Silicon Valley, especially in Ottawa, knowledge resources are also held by federal and private research facilities (Herger, 2016, p. 53; Brouard et al, 2004, p. 61). These facilities include the NRC and the Communication Research Center (ibid). However, this thesis will only focus on comparing the knowledge resources laying within the universities. Even though in 2004, the two research universities in Ottawa, namely the Carleton University and the University of Ottawa were only the third largest researchers in the city behind Nortel, which has since become insolvent, and the federal research laboratories (Armit, 2004, pp. 207, 217).

Nevertheless, the universities acknowledge their importance when it comes to research and both have established research programmes close to the relevant industries and started incubation programmes in order to help spin-off companies to develop (ibid). However, the research funding available to the University of Ottawa has been decreasing between 2011 and 2016 (University of Ottawa, 2019).

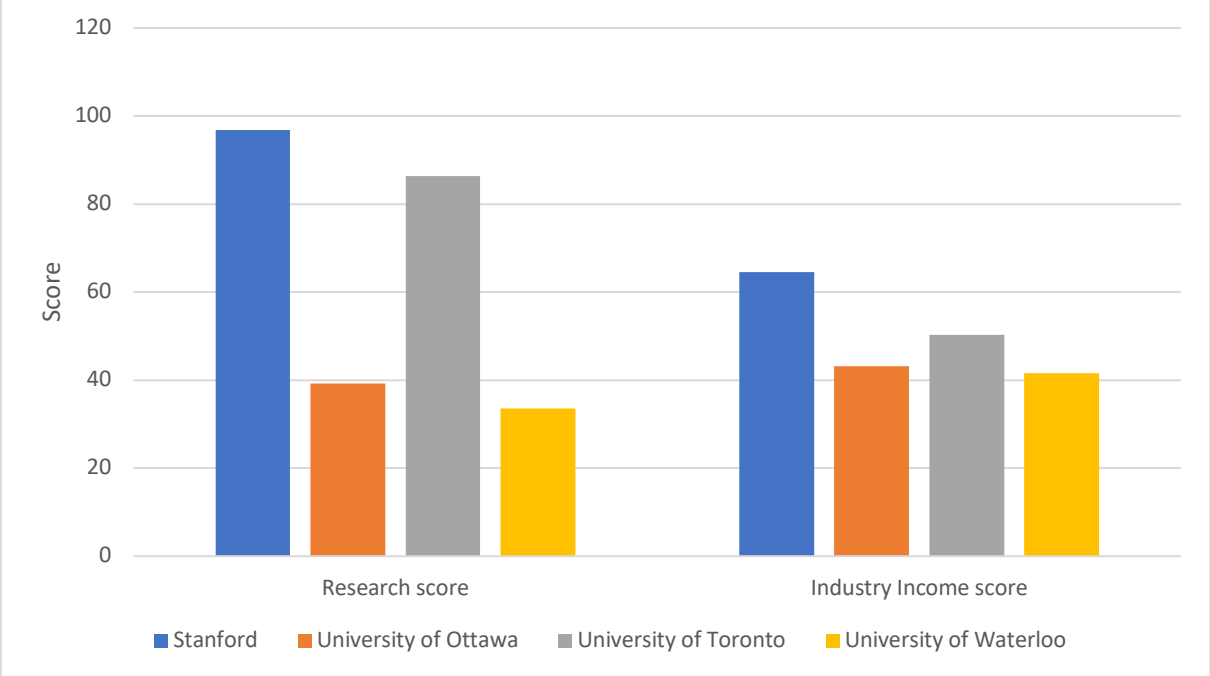
In comparison, the University of Stanford is often recognised and seen as the “core” or the heart of the Silicon Valley, since scholars suggest that without it the cluster would not exist in its extent (Herger, 2016, p. 94). For example, one reason for this is that for example, Stanford alumni and employees have founded almost 40,000 companies since the 1930s, (Stanford University, 2018).

Additionally, according to “Times Higher Education” (THE), which describes itself as “the leading provider of higher education data for the world´s research-led institutions”, the highest ranked universities in the compared regions in 2019 are Stanford Universities at number three the University of Toronto at rank 21, the University of

Ottawa at number 176 and the University of Waterloo, which ranks 201 to 250 with other universities. (Times higher education, 2019). However, when only looking at the field of “Engineering and technology”, Waterloo ranks higher than Ottawa, at rank 91-100 and 301-400 respectively, whereas Stanford is the second best and Toronto the 31st best university in this field (ibid).

Furthermore, when just analysing the level of research of the universities, which is one of the ways universities can interact with companies, Stanford is still the leading of the four universities as it can be seen below in figure 6 (Haour & Miévelle, 2011, p. 6; Times higher education, 2019). However, the University of Toronto follows close with just 10.5 points less (Times higher education, 2019).

Figure 6: Scores of the research and industry income by THE of the main universities of the Silicon Valley and the Toronto-Ottawa region



Source: Own source, based on Times higher education, 2019

Furthermore, the industry income indicator shows the level of knowledge transfer of a university, which is again an important way of how a university interacts with companies (Haour & Miévelle, 2011, p. 6; Times higher education, 2019). Concerning this indicator, the universities are closer together, but Stanford still takes the lead.

The third way of engaging with companies is education, as educating the future employees of a firm, is seen as the “most powerful way to transfer knowledge and technology” (Haour & Miévelle, 2011, p. 6). In 2016 Stanford University alumni were the second most hired employees by the 25 largest Silicon Valley employers and the

alumni from the University of Waterloo the 16th most hired (Staley, 2017). Moreover, no other Canadian university makes the list of the 25 most hired from universities (ibid).

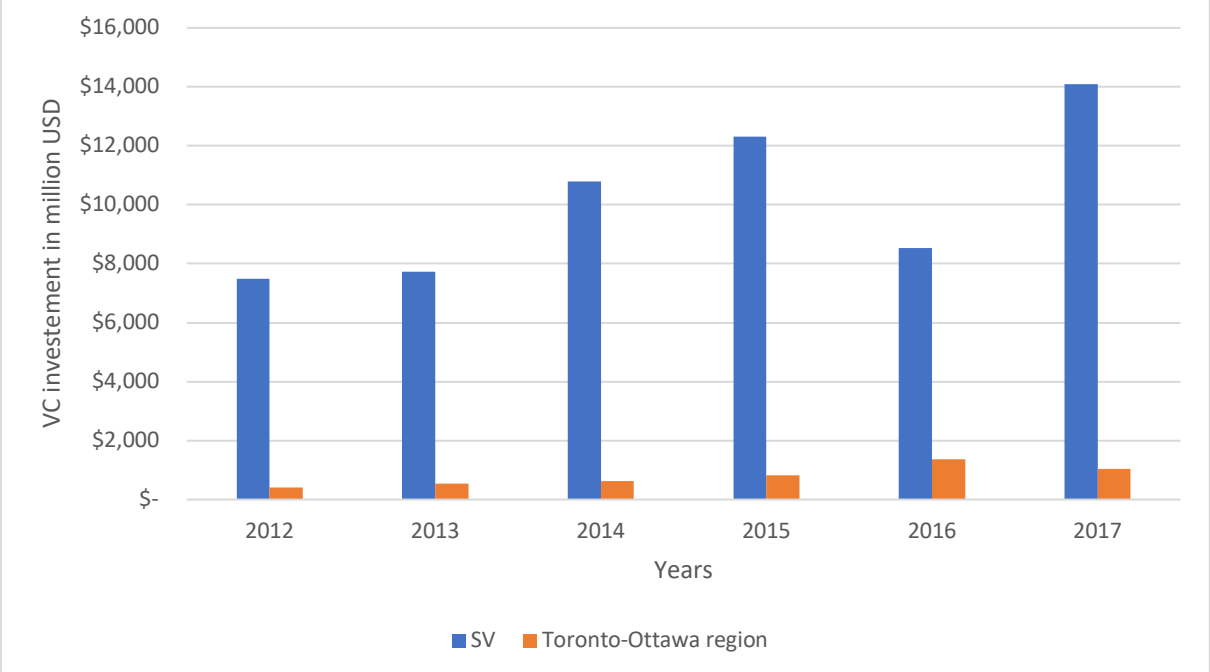
Hence, the Silicon Valley enjoys a higher level of knowledge resources found in and enabled by universities than the Toronto-Ottawa region.

4.1.4 Capital resources

Another factor that is part of Porter´s analysis are capital resources and more specifically the amount available of the different sources as well as their costs (Porter, 1991, p. 99). This subchapter will concentrate on VC and angel investment as these have been the primary sources of funding for start-ups in the United States (SIlicon Valley Bank, 2017, p. 6).

As it becomes apparent in figure 7 below, the value of VC invested in the Toronto-Ottawa region is very small compared to the investment value in the Silicon Valley. In 2017, $14.101 million was invested in the Silicon Valley and $1.039 million in the Toronto-Ottawa region (PwC Canada, CB Insights, 2017, pp. 14, 31; Silicon Valley Indicators, 2019). The difference between investment values becomes even more apparent when looking at the biggest VC deal in 2017 in the Silicon Valley. $914 million were invested in Grail Inc., which is almost 90% of the amount invested in the entire Canadian cluster (ibid)

Figure 7: VC investment in the Silicon Valley and the Toronto-Ottawa region



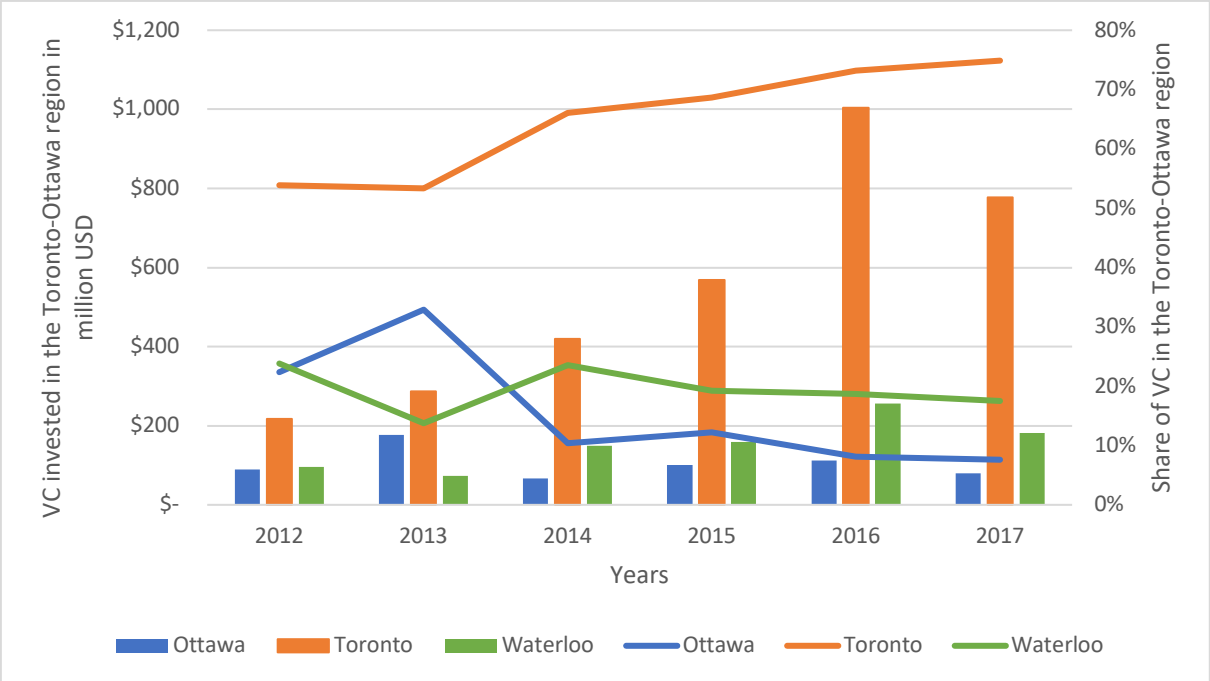
Source: Own source, based on PwC Canada, CB Insights, 2017, p. 31; Silicon Valley Indicators, 2019

Further, when analysing the sectors receiving the most funding, the internet industry takes the lead followed by healthcare and mobile and telecom both in the Silicon Valley as well as in Canada (ibid). However, whereas in Canada computer hardware and services are third with receiving 20% of the investment volume, only 4.4% is invested in this sector in the Silicon Valley (ibid).

In addition, whereas in average the VC investment in the American cluster increased by 18% in the years of 2013 to 2017, the Toronto-Ottawa area experienced an average growth of 25% (ibid, pp. 32, 38, 40; ibid). It is noticeable, while the investment decreased in the Silicon Valley by 31% in 2016, due to a fear of overvalued start-ups, the Canadian cluster experienced an increase in investment by 66% (Silicon Valley Indicators, 2019; Kendall, 2017; PwC Canada, CB Insights, 2017, pp. 32, 38, 40). A year later, the situation reversed, the American investment increased by 65% and the Canadian decreased by 24% (ibid).

Additionally, the share of investment value in the Toronto-Ottawa region is also diverse, which can be seen in figure 8.

Figure 8: VC invested in the Toronto-Ottawa region



Source: Own source, based on (PwC Canada, CB Insights, 2017, pp. 32 ,38, 40)

Even though Toronto has had the biggest share throughout the years it has also increased from 54% in 2012 to 75% in 2017 (PwC Canada, CB Insights, 2017, pp. 32, 38, 40). Additionally, whereas in 2013 the share of VC investment in Ottawa has been higher than in Waterloo, since then Waterloo´s share has been higher by 10% to 15%

(ibid). In 2017, 18% of VC in the region was invested in Waterloo and 8% in Ottawa (ibid).

One reason for the comparatively low amount of VC invested in the Toronto-Ottawa region is that historically there have been “excessive government support programmes” that were not run sufficiently (Cumming, Johan, & MacIntosh, 2017, p. 104). Even though the federal and local government have withdrawn from different programmes, which had crowded out a lot of private investment in the late 90s and 2000s, these programmes have thrown back the VC industry for years (ibid, p. 105). Additionally, the new government support agendas still do not create the best environment for private investors, as they support the larger, established companies (ibid, p. 113). Hence, access to capital is one of the greatest worries for Canadian entrepreneurs (ibid).

Secondly, angel investment is the second largest source of capital for entrepreneurs (SIlicon Valley Bank, 2017, p. 6).

In 2017, angel investment amounted to $140 million in the Silicon Valley, whereas in Central Canada, including Ontario and Quebec only $109.13 million were invested, when using the same exchange rate as above (NACO, 2017, p. 36; Silicon Valley Indicators, 2019). However, it also needs to be considered that the Silicon Valley is only 0.21% of the size of Central Canada (Massaro, 2018 Silicon Valley Index, 2018, p. 6; Statistics Canada, 2019). Furthermore, from the top three angel investment groups that invested the most in Canada in 2017, all are based in Ontario (NACO, 2017, p. 18). This indicates that from the amount invested in Ontario and Quebec, a big share was invested in Ontario as only less than 10% of investments happened interprovincial (ibid, p. 37).

Therefore, it can be concluded that there is more angel investment available in the Silicon Valley than in the Toronto-Ottawa region, however the difference between the investment volume is not as high between the investment volume of VC.

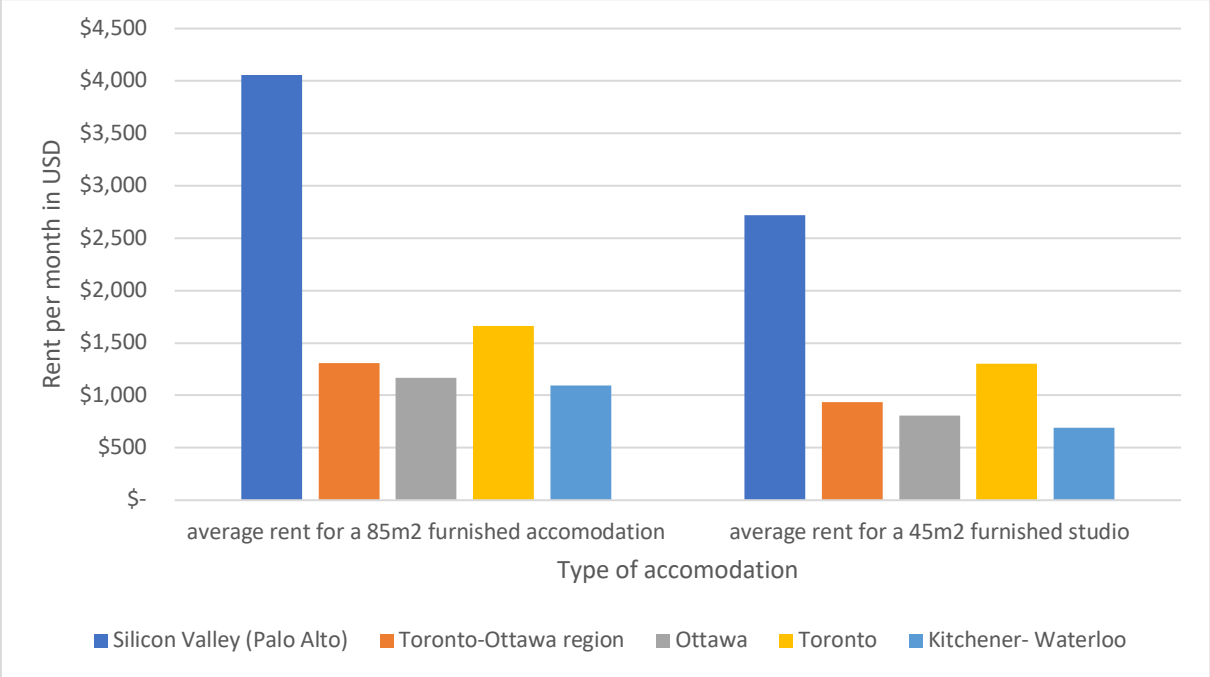
4.1.5 Infrastructure

When it comes to the infrastructure of a nation, one needs to look at the kind of infrastructure, quality and costs of it, which influences the competition (Porter, 1991, p. 99). This also includes housing, of which there is a lack in the Silicon Valley (Massaro, 2018 Silicon Valley Index, 2018, p. 56; ibid). In the last ten years a housing

shortage of around 31,253 accommodations has been observed leading to higher rents and growing house prices (ibid, p. 59).

Below in figure 9, one can see the average monthly rents for an 85 square meters furnished accommodation as well as for a 45 square meters furnished studio, which were taken from the website “expatistan”, which bases its analysis on data entered by users (Expatistan, 2019). Again, in order to be able to compare the prices, the exchange rate from 4th January was applied.

Figure 9: Average rent in the Silicon Valley and the Toronto-Ottawa region



Source: own source, based on Expatistan, 2019

When looking at figure 9, it becomes apparent that living in the Silicon Valley is three times more expensive than living in the Toronto-Ottawa area. More specifically, it is more than two times cheaper to live in Toronto, more than three times cheaper to live in Ottawa and almost four times cheaper to live in the Kitchener-Waterloo area than in the Silicon Valley (Expatistan, 2019).

However, as already established the wages are higher in the Silicon Valley as well (Indeed Canada, 2018; Indeed USA, 2018). Nevertheless, when adjusting the average rent for a furnished accommodation to the wages of a Senior Software Engineer, one still needs to pay 3.7% more of one´s salary in the Toronto-Ottawa region than in the Silicon Valley and in Waterloo even 4,5% and in Ottawa 6,6% (Indeed Canada, 2018; Indeed USA, 2019; Expatistan, 2019).

Additionally, according to Czernich et al a high-speed internet infrastructure influences economic growth, even at a higher level than other public and telecommunication infrastructure, as it also increases the diffusion of knowledge and information and also increases competition and innovation (Czernich, Falck, Kretschmer, & Woessmann, 2011, pp. 505, 530) Hence, the internet access and speed in the regions will be considered as well.

In 2016, 81.9% of the Canadian population had access to the internet but at the same time 91% of the households in the Silicon Valley did (Massaro, 2018 Silicon Valley Index, 2018, p. 45; Statista, 2019). When it comes to the speed of the internet and especially of fixed broadband, in November 2018 the United States ranked 7th and Canada 16th of 126 analysed countries (Speedtest Global Index, 2018).

However, the upload and download speed is higher in the Silicon Valley compared to the speed in Ottawa and Toronto, as it can be seen in table 5 (ibid).

Table 5: Download and upload speed in the Silicon Valley and the Toronto-Ottawa region

	Download (Mbps)	Upload (Mbps)
Silicon Valley (San Jose)	116.56	29.23
Toronto-Ottawa region	100,26	27,19
Ottawa	95.8	20.56
Toronto	104.72	33.83

Source: own source, based on Speedtest Global Index, 2018

On average the download speed is 16.3 mbps and the upload speed 2.04 mbps faster in the Silicon Valley than in the Toronto-Ottawa region. Hence, the internet infrastructure is better developed in the Silicon Valley than in the Toronto-Ottawa region leading to a higher transmission of information, greater level of competition and innovation as well as an overall larger influence on economic growth.

4.2 Demand conditions

As already described in the chapter 2.4, Porter notes that the demand of a country influences its national companies through the characteristics of the consumer´s needs, the demand´s scope and pattern of growth as well as how the national preferences are transferred to foreign markets (Grant , 2011, p. 115).

Generally, when it comes to the characteristics of the consumer needs, it is the most beneficial for the country if the national customers are very sophisticated and thus are

very demanding due to national preferences and conditions, which is indicated by a high demand (Porter, 1991, p. 113).

When comparing the demand for technology products in the two regions, this thesis will limit its view by only analysing the demand for smartphones on the national level. Generally, both Canada and the United States are characterised by a high demand for these devices (Hardy, 2018). In 2018, 86% of all Canadians owned a smartphone, whereas in 2017 82% of Americans owned one (ibid). Further, the highest smartphone penetration rate in Canada is in Ontario, where even 89% of the population has a smartphone (United States Census Bureau, 2019; Hardy, 2018).
Hence, the high demand for technology products in both regions indicates a high level of sophistication of the local customers.

Additionally, when analysing the national preferences of the customers, one firstly needs to have a look at which importance convenience plays in the local culture, as this is the core need and driving force for the progress and innovation in technology (Wu, 2018). It is also sometimes called “convenience technology”, which are technological innovations that are fast, easy and safe to use and offer convenience and additional benefits to the user (Sundström & Radon, 2015, p. 15). However, this convenience through technology comes with a higher price as one needs to “pay a premium for convenience” (Wu, 2018). For example, even though users can still get music for free via the internet, they are willing to pay extra to access it more conveniently, for example via the Apple Store and iTunes (ibid).
Furthermore, Americans are well known for the importance they put on convenience, which for example manifests itself in the early development of a large number of convenience food stores and chains (Kohleisen, 2001, pp. 85-87). However, convenience has been present as a value in the Canadian culture for a long time as well (Agriculture and Agri-Food Canada, 2010, pp. 13-14). This can be attributed to a lack of time that especially higher educated people experience due to an increasingly demanding work environment as well as a higher importance of other activities such as sports as well as family time (ibid).
Thus, convenience has stronger roots in the American culture, but is valued in Canada as well.

Another important value necessary for a demanding culture in the technology sector is the emphasis it puts on innovation (Ahmed, 1998, p. 33). Zhang argues that the

mainstream American culture is shaped by different elements of which one is innovation (Zhang, 2013, p. 37). In combination with change, it is the “American philosophy of life” and acts as a facilitator of social progress and the evolution of society (ibid, 41). Additionally, especially disruptive innovation is at the heart of the entrepreneurial culture of the US, with the Silicon Valley as one of the centres (Kenney & Urs, Industrial and Corporate Change, 1999, p. 72; Shapiro, 2012). This culture encourages entrepreneurship and is one of the most important reasons to the United States´ success in innovative industries (Shapiro, 2012).

On the contrary, innovation is not yet part of the Canadian’s culture, which becomes evident when looking at recent publications of the Canadian government, that in June 2016 issued a report calling to action different sectors of society to “participate fully in an innovation economy” (Government of Canada, June 2016, p. 2). Similarly, it acknowledges that Canada needs “to take bold actions” (ibid, p.3).

Furthermore, the gap between the emphasis the United States puts on innovation and the emphasis of Canada becomes apparent when looking at the current Global Innovation Index 2018, where the United States ranks sixth and Canada 18th (Global Innovation Index, 2018, pp. 239, 338). The index does not consider the demand side of a country, however, it is still a relevant indicator when trying to measure the importance a culture puts on innovation, as national preferences and therefore the demand of the customers, pressure the companies to innovate (Porter, 1991, p. 115).

In conclusion, even though compared to the rest of the world, both Canada and the United States are in the top 20 of innovative economies, innovation is more integrated into the American culture and thus has a higher influence on the demand in the United States.

Except from the quality of the demand, the size of it, and its growth opportunities need to be considered as well when analysing a region´s demand (Porter, 1991, p. 116).

As already determined when analysing the factor conditions, the population of the Toronto-Ottawa region is 2.8 times larger than the population of the Silicon Valley, but the populations´ growth rates are almost at the same level, indicating that the Silicon Valley will not be able to surpass the Canadian region in the nearest future when it comes to the population size (Statistics Canada, 2019; United States Census Bureau, 2019).

Additionally, when looking more closely at technology products, as analysed in the beginning, currently, Canada has a higher demand for smartphones, as there are more

users there than in the US (ibid). Assuming that there is the same percentage of users within the regions and considering the higher population size in the Toronto-Ottawa region, it can be concluded that the demand for smartphones is higher in the Toronto-Ottawa region than in the Silicon Valley.

Lastly, Porter argues that it is beneficial for a nation or region if its demand preferences are transferred to the global market, as companies then can anticipate global consumer needs (Porter, 1991, p. 115). Already during his research, Porter realised that the above-mentioned wish for convenience of American customers is spreading around the world and thus increases the international success of American consumption goods (ibid). Even though, no Canadian company is in list of the top five of smartphone brands in the worlds, Blackberry has shown that a Canadian technology company from the Toronto-Ottawa area can successfully transfer a need detected in their national market, in this case of having access to e-mails on a phone, to the international market (Oxborrow, 2018; Seth, 2015).

Hence, one can argue that there are very similar demand conditions in the United States and Canada. However, when it comes to the values behind the demand for smartphones, they are more embedded in the United States. Therefore, in the past companies in the United States were able to transfer their domestic consumer´s needs to the world market more successfully than Canadian firms.

4.3 Related and supporting industries

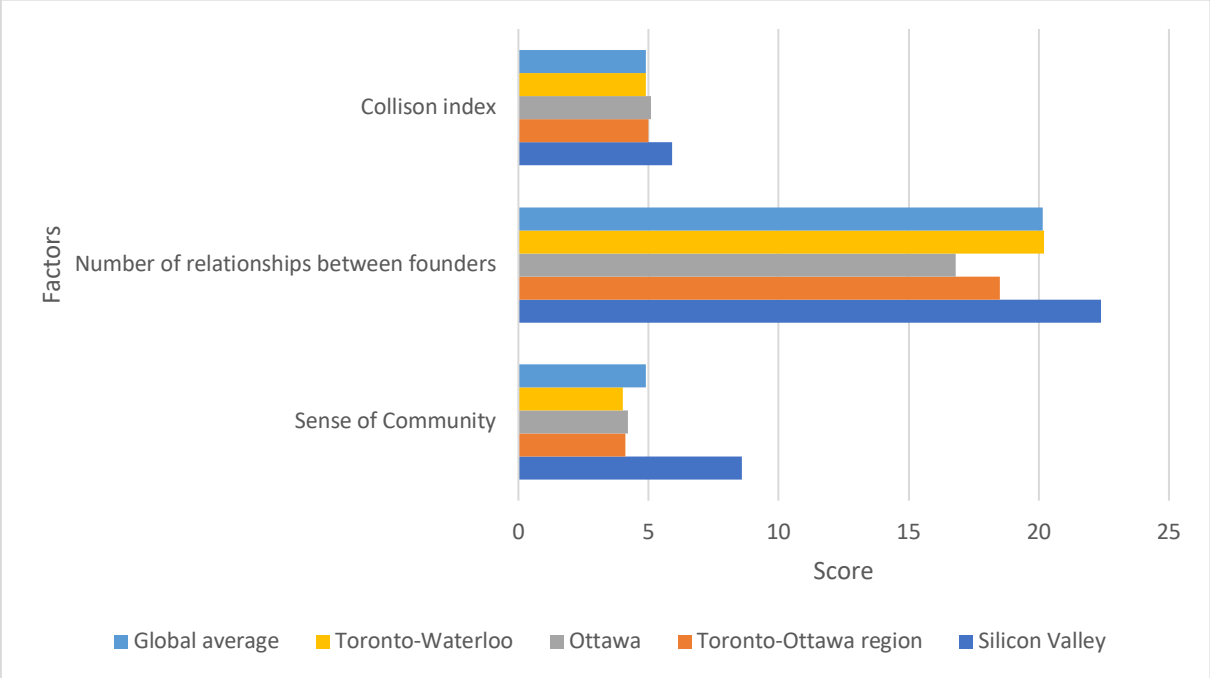
The last factor that will be analysed is the existence of international competitive related and supporting industries. Through supporting industries, companies have early, fast and cheap access to qualitative high means of production as already described in chapter 2.4 (Porter, 1991, p. 127). It is also of advantage for companies to be located in an area with a number of related industries as this for example creates positive spill-over effects (ibid, pp. 130-131).

In general, domestic related and supporting industries create a competitive advantage if they are working together with the observed sector (ibid, p. 125). This connection can manifest itself in different ways of collaboration and it can also be transferred to private and public institutions (Brouard et al, 2004, p. 82). For example, multi-firm networks, which are especially in knowledge-intensive industries often complex in its tasks and functions and subject to change, can be used in order to exchange information and interact witch each other (O´Sullivan, 2004, S. 144-145).

As part of their “Global Startup Ecosystem Report 2018” Startup Genome published the “Top 10 Ecosystems for Local Connectedness” out of nearly 100 ecosystems considered, measuring the “sense of community”, “local relationships”and “collisions” of an area (Startup Genome; Global Entrepreneurship Network, 2018, p. 37). Thus, local connectedness can act as an indicator for the level on which start-ups cooperate with each other as well as with supporting and related industries. Generally, only the Silicon Valley of the analysed regions is in the top ten list of local connectedness and ranks second overall (ibid).

Below in figure 10, one can see how the analysed regions compare to each other in the different factors as well as how they compare to the global average.

Figure 10: Local connectedness score of the Silicon Valley and the Toronto-Ottawa region



Source: Own source, based on (Startup Genome; Global Entrepreneurship Network, 2018, pp. 145, 153,157)

Overall, it can be seen that the Silicon Valley ranks highest in all three categories (ibid). However, the least discrepancy between the regions is evident in the factor “collision”, where all rank very closely to the global average (ibid).

Yet when looking at the number of relationships between founders, it can be observed that the Toronto-Ottawa region and especially Ottawa perform low compared to the other areas as well as the global average as the Toronto-Ottawa region has 3.9 points less than the Silicon Valley and also 1.65 points less than the global average (ibid). Additionally, the sense of community in the whole Canadian region is worse than the

global average whereas it is almost two times better in the Silicon Valley compared to the global average (ibid).

Thus, related and supporting industries work more closely together in the Silicon Valley than in the Toronto-Ottawa region contributing to the competitive advantage of the American Cluster.

4.4 Interpretation of results

Figure 11 and figure 12 illustrate how the regions are performing compared to each other in the previously analysed categories. Hereby, figure 11 shows a comparison of the Silicon Valley and the Toronto-Ottawa region, whereas figure 12 highlights the performance of Ottawa, Toronto and Waterloo compared to each other and the Silicon Valley. Figure 12 was added to the results because different performance levels within the three different areas in the Toronto-Ottawa region are evident. However, in case data was not available on the level of the areas, the cells were left blank and were not considered for the comparison. Furthermore, due to the nature of the data, sometimes areas were combined, which is reflected by merged cells. Even though both comparisons were conducted, the following interpretation will focus on the evaluation of the Silicon Valley and the Toronto-Ottawa region, as this is the main topic of the thesis. However, in case there are major differences between the areas, those will be named as well.

Additionally, for every indicator the best result of the regions was used as the basis against which the performances of the other regions were measured. Then the results were split between three different performance levels illustrated in green, yellow and red in the figures.

The performance levels and colours were attributed according to the following rules:

$$Performance \geq \frac{2}{3} * Best\ performance = green$$

$$\frac{1}{3} * Best\ performance\ \leq Performance\ > \frac{2}{3} * Best\ performance = yellow$$

$$Performance\ < \frac{1}{3} * Best\ performance = red$$

However, as two indicators, namely how much convenience is valued as well as the transferability of the demand conditions, were not measured by numbers, the best performance received 1 and the other region or areas 0 as a measurement. The

relative performance levels can be found in more extensive versions of figure 11 and 12 in the annex.

Figure 11: Comparison of the Silicon Valley and the Toronto-Ottawa region

			Silicon Valley	Toronto-Ottawa region
Factor conditions	Human resources	Change in population		
		STEM degrees		
		Wages		
	Material resources	Office prices		
		Vacancy rate		
	Knowledge resources	University ranking		
		Research		
		Knowledge transfer		
	Capital resources	Venture capital		
		Angel investment		
	Infrastructure	Rent 85m2		
		Rent 45m2		
		Download speed		
		Upload speed		
Demand conditions		Ownership smartphone		
		Convenience		
		Innovation		
		Population size		
		Transferability		
Related & supporting industries	Local connectedness	Collison		
		Relationships between founders		
		Sense of community		

Source: Own source based on the author´s analysis

Figure 12: Comparison of the Silicon Valley and the areas within the Toronto-Ottawa region

			Silicon Valley	Ottawa	Toronto	Waterloo
Factor conditions	Human resources	Change in population				
		STEM degrees				
		Wages				
	Material resources	Office prices				
		Vacancy rate				
	Knowledge resources	University ranking				
		Research				
		Knowledge transfer				
	Capital resources	Venture capital				
		Angel investment				
	Infrastructure	Rent 85m2				
		Rent 45m2				
		Download speed				
		Upload speed				
Demand conditions		Ownership smartphone				
		Convenience				
		Innovation				
		Population size				
		Transferability				
Related & supporting industries	Local connectedness	Collison				
		Relationships between founders				
		Sense of community				

Source: Own source based on the author´s analysis

As it can be observed in figure 11, out of the 22 criteria applied, the Silicon Valley lands in the top third with 17 criteria, in the middle third with two criteria and in the

bottom third with three criteria. Compared to this, the Toronto-Ottawa region ranks in the top third with 13 criteria, in the middle third with four criteria and in the bottom third with five criteria. This result would indicate that the Silicon Valley is still the leading technology cluster in the two regions. However, Porter also points out in his model that a lack of resources can lead to a competitive advantage as well as this exerts pressure on the companies in the region to overcome this disadvantage through innovation (Porter, 1991, p. 98). Hence, one must look at the diverging performances of the regions and their implications more closely in order to make a well-founded judgement.

When looking at the criterion “change of population”, which considers the change of population in the regions between 2011 and 2016, it appears as if there is no great difference between the regions. However, this does not reflect the current change of the migration developments in the regions, which is an important contribution to the growth of the population and workforce as almost half, i.e. 45.8%, of all employees aged 25 to 44 in the Silicon Valley were not born in the United States and even 71% of tech employees in the region (Massaro, 2018 Silicon Valley Index, 2018, p. 15; Baron, 2018) .

Furthermore, as already determined, the net foreign migration in the Silicon Valley is relatively low and one of the destinations people are currently migrating to is Canada and especially the Toronto-Ottawa region, which is reflected by the fact that 82% of the applicants for the “Express Entry programme” in Canada are from the United States (Murphy, 2018). However, in contrast the majority of software engineering students from the University of Toronto is leaving the region as well and are moving to the Bay Area (ibid). Hence, currently there is an exchange of qualified workers between the regions. Nevertheless, the development of the immigration regulations as well as the political and social environments in the US will determine the future of the large amount of qualified foreign workers coming to the Silicon Valley. Thus, one of the biggest profiteers from those anticipated changes will be Canada and the Toronto-Ottawa region, which can offer fast permanent residency, public healthcare and an attractive technology cluster (Weise & Rai, 2018).

This is further evidenced by a research conducted by CBRE, which shows that Toronto has the highest net migration of qualified workers with a technology degree when comparing the 50 technology hubs within Canada and the United States,

leaving the Silicon Valley at the second place with an almost ten thousand lower net migration (CBRE Research, 2018, p. 20).

Even though the changes in population in the Silicon Valley and the Toronto-Ottawa region are almost the same, the factor immigration, which influences the growth, is currently developing in favour of Toronto-Ottawa.

The criteria “STEM degrees” in figure 11 shows that there is a significantly higher number of people with a scientific and engineering degree living in the Silicon Valley than in the Toronto-Ottawa region. Nonetheless, the Silicon Valley faces a shortage of technology workers, which will amount to over one million by 2024 and as argued above, the region will be relying on immigration to fill this shortage and to stay at the innovation level (Najoo, 2017; Sheng, 2018).

Similarly, a study found out that Canada has a lack of technology experts too, assuming that in 2020 more than 220,000 workers will be missing to fill existing job opportunities (Murphy, 2018). This shortage of tech workers is also due to the growths of certain areas, as for example in 2017 there were more technology jobs created in Toronto than in the Silicon Valley (CBRE Research, 2018, p. 20)

Hence, even though there is a higher availability of STEM educated workers in the Silicon Valley than in the Toronto-Ottawa region, the shortage of qualified employees will be higher in the American region in the future.

Other criteria which have an influence on the comparison and in which the regions perform differently, are the wages of the employees in the regions as well as the office rent companies need to pay. The figures illustrate in green that employees in the Silicon Valley earn over one third more than employees that are doing the same job in the Toronto-Ottawa region indicating an advantage for the region in the United States. However, this can be a weakness as well because this means that the costs of doing business are significantly higher in the Silicon Valley than in Toronto-Ottawa. That is also supported by the office costs, which are even more than two thirds higher in the Silicon Valley. These expenses are especially problematic for start-ups who often do not have a lot of capital in the beginning to spend on an office and even if they can afford it, the office vacancy rate is relatively low as well, especially compared to Waterloo, where it is 20% higher than in the Silicon Valley.

However, as already explained above disadvantages of locations can be turned into advantages. For example, in the Silicon Valley now very successful technology

companies that are still role models for young start-ups, such as Apple, started their company in their own garage (Gatz, 2005, p. 42). This arrangement does not only mean that the founders need to work together in a very limited space and but also need to be innovative to make it work (Turner, Qvarfordt, Jacob, Golovchinsky, & Back, 2010, p. 849). Further, there are also more opportunities for them to communicate to each other than in an office space with separate rooms (ibid, pp. 847-848). If founders are passionate enough about their projects to work through problems such as a provisional setting or initial failures, there is a high probability that they are able to get through other highs and lows of being an entrepreneur (Moroni, Arruda, & Araujo, 2015, p. 2201).

Additionally, this lack of space is a contributing factor of why incubators and accelerators grew at a high rate in the Silicon Valley and are now able to assist and guide start-ups in their early stages (Isabelle, 2013, pp. 17, 20). Especially incubators are also offering office spaces for start-ups to use which makes communicating within the programme very easy and increases the amount of knowledge the start-ups will be able to obtain (ibid, p. 21).

Furthermore, high wages do not only lead to high personnel costs but also attract highly educated people, which are able to earn more money in the Silicon Valley than in the Toronto-Ottawa region (Kesselmann, 2001, p. 81). Nevertheless, when making this argument one also needs to consider the higher living costs in the Silicon Valley. When analysing the rents for studios and apartments the rent in the Silicon Valley is in average 300% higher than in the Toronto-Ottawa region. This problem has very tangible consequence as the Bay Area Council found out in March 2017 that 40% of current residents of the Silicon Valley are considering moving somewhere else especially due to high housing and living costs (Bay Area Council, 2017, p. 1).

However, it is worth noticing that Toronto suffers from high rents as well compared to the other areas within the Toronto-Ottawa region, but the rates are still almost 60% lower than in the Silicon Valley.

Thus, the advantages of high wages and disadvantages of high rents in the Silicon Valley offset the hindrances of comparably lower wages and the benefit of lower rents in the Toronto-Ottawa region, leaving no region at an advantage.

In the representative university ranking of THE, Stanford University ranks a lot higher than the best performing universities in the Toronto-Ottawa region and hence the Silicon Valley performs best in the criteria in the context of knowledge resources.

However, it needs to be considered that the University of Toronto is still ranked 21st out of the best 1,250 universities in the world, which is also significantly higher than the University of Ottawa and the University of Waterloo. Hence, both Stanford, ranked 3rd and the University of Toronto are one of the top universities in the world. Nevertheless, when it comes to the knowledge creation in the universities in the Silicon Valley, especially through research, the universities in the Toronto-Ottawa region still lack behind.

In addition, the next criterion that shows huge differences between the Toronto-Ottawa region and the Silicon Valley, is the availability of capital and especially VC. Whereas the Silicon Valley is overflown by capital, in the last year only 5,5% of the investment volume in the Silicon Valley was invested in the Toronto-Ottawa region.

However, a large supply of capital does not only have advantages as for example the probability to fail as a start-up increases from 50% to 75% when a VC fund has invested in it (Levitt, 2018).

Additionally, even though there has been more VC available than ever in the Silicon Valley since the dot-com era, the share of money invested during seed investment rounds has been declining, as the VC firms have reached a size where they cannot afford this high risk investment anymore (Chaddha, 2018). This leads to less capital available for new start-ups, which can result in less start-ups surviving (ibid). But even if start-ups are able to receive early funding, the guidance and mentoring VC firms are also supposed to provide, might not be as effective anymore as the VC firms now have a much larger portfolio in order to spread risk more effectively (Surowiecki, 2010).

Furthermore, there is a risk of inefficiently operating start-ups, which are not incentivized anymore to keep on innovating and further developing their strategy due to the large amount of capital available to them (Chaddha, 2018). An example for this is Uber, which has not been not able to present profits even or possibly due to their high valuation of $76 billion resulting from former financing rounds (Somerville, 2018). This overvaluation, especially of unicorns, also shows when one of them goes public. For example, Square which went public in 2016 was only valued at two-thirds of their initial valuation by their investing VC firms at the end of their initial public offering (Govindarajan, Govindarajan, & Stepinski, 2016).

Hence, the oversupply of capital in the Silicon Valley results in an inefficient allocation of capital and less capital being invested in early funding rounds, as well as less

advise being given to start-ups. Therefore, a large pool of capital available at one location should not be the only reason for a start-up to choose a location and does not automatically determine a competitive advantage of the region.

Additionally, even though the amount of VC available in the Toronto-Ottawa region is very small compared to the Silicon Valley, recently between 2013 and 2017 the investment value of VC has been growing at a higher level in the Canadian region than in the Silicon Valley, indicating that the Canadian cluster also gains attraction by more investors who have also realised the potential of the region.

As explained in chapter 2.4, a long-term and effective competitive advantage is created if it is based on advanced and specific factors. In the conducted analysis, STEM educated workers fulfil both criteria, whereas universities are the institutions responsible for forming this factor condition and are advanced factors themselves. As it can be observed in figure 11, the Silicon Valley ranks highest in both criteria, indicating that the competitive advantage of this cluster is more long-term oriented than the one of the Toronto-Ottawa region.

When it comes to the demand, the overall population of the Silicon Valley is a lot smaller than the population in the Toronto-Waterloo area, which is also due to the geographical size difference between the regions. However, this means that there is a larger local market for start-ups in the Canadian region, considering that the smartphone usage is also higher there than in the United States. Hence, they are, for example, able to increase their production capacity faster.

Especially in research intensive industries like the technology industry having a large local market is of importance as investment decisions are often taken based on the local demand structure (Porter, 1991, p. 117). However, Porter further notes that if the product is also in demand internationally, a large local market is not an advantage (ibid). This effect is further amplified by the fact that this analysis only considers small areas of two countries, meaning that not only an international demand but also a national demand of the rest of the country effects the companies in the industry as well.

Hence, although the population in the Toronto-Ottawa region is more than twice as large as the population in the Silicon Valley, this is not of a competitive advantage for the region. Another factor supporting this argument, is that the smartphone market is beginning to be oversaturated in Western countries including Canada and the United States, indicated by slowing and stagnating sales number (Fenner, 2018).

Moreover, as already touched upon, the cultural values behind the development of the smartphone and other technologies are more embedded in the culture of the United Stated than in Canada. Nevertheless, both convenience and innovation are integrating within the Canadian culture.

Furthermore, as the example of Blackberry shows, Canadian companies are also able to detect relevant needs of their customers related to technology and successfully transfer their product to foreign markets, even though when it comes to global Smartphone brands, no Canadian company is under the top five. Hence, the prerequisites are present in the Toronto-Ottawa region.

Concluding, the larger population, demand and market in Canada is not an important source for a competitive advantage of the Toronto-Ottawa region. Similarly, the American and Canadian cultures are very similar when it comes to the values of innovation and convenience and hence start-ups from both regions enjoy a transferability of needs of their domestic customers to other countries. However, currently American start-ups still enjoy a slight lead due to the more embedded relevant values in their domestic consumers.

Lastly, differences between the local connectedness in the different regions are highlighted in the figures. This is especially a concern as Startup Genome found out that relationships and a sense of community correlate the most with the overall performance of a start-up, thus making it the most important indicators of the three influences of the local connectedness score (ibid, p. 37). Therefore, founders with a high level of local relationships and a high sense of community enjoyed higher sales than low connected companies (ibid). This is an aspect where the Toronto-Ottawa area still lacks behind. One reason for that might be the geographical size, as the region is a lot larger than the Silicon Valley, making it harder for a community to form. Therefore, it might be of interest to narrow down the analysed Canadian region to Toronto-Waterloo, especially because they are in such close proximity to each other, specifically when comparing this with the distance to Ottawa.

In fact, there are only 114 kilometres between Waterloo and Toronto, which is almost the same distance as between top performing technology hubs such as Tel Aviv and Haifa and San Francisco and the Silicon Valley (Fraser, 2016). Thus, although Porter argues that clusters can also be geographically large and, for example, encompass multiple countries, seemingly a certain, limited geographical size is of advantage when successful clusters are forming (Porter, 2008, p. 215).

Furthermore, when looking at figure 12, one can observe that in three cases where Toronto performs 2/3 times worse than the best area, namely when it comes to office and private rent and vacancy rates, Waterloo performs the best out of the observed regions. Additionally, this also works the other way around. Whereas the ranking of the research and knowledge transfer abilities of the University of Waterloo performs the lowest out of the area, the University of Toronto is the second best after Stanford. Moreover, Waterloo has a very limited population, but Toronto is the largest city in Canada and hence can offer a huge local market, additional employees and attractive wages. Further, in the comparison, illustrated in figure 12, Toronto and Waterloo perform best after the Silicon Valley, leaving Ottawa in the last place. Additionally, whereas the focus of the technology cluster in Ottawa is telecommunications and photonics, both Toronto and Waterloo focus on ICT (Lucas et al, 2009, p. 191). Hence, they also fit together very well thematically.

5. Conclusion

5.1 Summary

In the economic context, a cluster is an accumulation of companies and institutions in a specific geographical area. They are connected with each other through a closeness in value creation and they work together vertically or horizontally, for example leading to knowledge spill-over effects. Hence, a cluster can be a location advantage, which includes all advantages a location has, making it attractive for companies.

Furthermore, this paper concentrated on technology start-ups, which are characterized by being fairly young, independent companies, whose business model circles around a technological invention or innovation.

Additionally, the “Diamond of national advantage” analyses the factor conditions, demand conditions, the related and supporting industries and a firm´s structure, strategy and rivalry of a region. However, this paper concentrates on only the first three aspects. Generally, it is utilized to determine the competitive advantage of a nation but can also be applied to regions and clusters.

Both, the Silicon Valley and the Toronto-Ottawa region have historically been influenced by universities with an engineering and science focus and some key companies that provided the base for other companies within the technology industry

to form. Additionally, governmental investments, for example by the defence departments helped the regions to grow.

Today, the Silicon Valley is located in the California and centres around San Mateo and Santa Clara, whereas the Toronto-Ottawa region is larger, a bit more geographically diverse and includes Toronto and Waterloo, which are located in close proximity to each other as well as Ottawa.

Further, two examples of the creation of former technology start-ups, which successfully transformed at least for a certain period of time into a major international company were given, namely Apple and Blackberry.

When evaluating the criteria relating to the factor conditions of the Toronto-Ottawa region and the Silicon Valley, the results indicate that the Silicon Valley has a higher quality of human resources. There are more people with a STEM degree in the Silicon Valley than in the Canadian area and the wages are higher. The population is increasing at a similar pace in the regions but when looking at the future the countries´ changing regulations concerning immigration needs to be considered. Here, Canada uses a more open and inclusive approach than the United States.

When looking at the examined material resources important for a technology start-up, Toronto-Ottawa takes the lead, with lower office prices and especially in Waterloo with a much higher vacancy rate.

Nevertheless, concerning the knowledge resources, the Silicon Valley with the Stanford University has one of the best universities in the world. No university in the Toronto-Ottawa region can compare with their level of research and knowledge transfer. Moreover, the level of especially VC invested is much higher in the Silicon Valley than in the Canadian region, but this is not necessarily an advantage due to a possible oversupply.

Overall the Toronto-Ottawa region performs much better in the category infrastructure, due to its more affordable housing prices, which are three times lower than the ones in the Silicon Valley. When it comes to the internet speed, both areas are at a similar level.

Analysing the demand conditions, this paper concludes that the Silicon Valley takes a lead due to its embedded values of innovation and convenience and the high transferability of the demand conditions of the area to other parts of the world. However, it is worth noticing that the Toronto-Waterloo region has a higher demand for smartphones and a higher population than the Silicon Valley, resulting in a larger

market for local start-ups there. However, as these devices are also demanded in the rest of the nations and abroad, this is not a particularly big advantage for the region.
Lastly, the criteria touched upon concerning related and supporting industries where the collision, the relationship between founders and the sense of community or generally the local connectedness within the regions. Here, both areas have comparable results, only the sense of community is rated higher in the Silicon Valley than in the Toronto-Ottawa region, which might be due to the larger size of the Canadian region.

In conclusion, the comparison shows that currently the Silicon Valley still is the most attractive location for technology start-ups out of the two analysed, due to its superiority in most of the considered areas and criteria. However, after a closer analysis and interpretation of the findings, it becomes obvious that especially in the areas where the Silicon Valley seems to be miles ahead of the Toronto-Ottawa region, their dominance might not be long lasting anymore. For example, even though there is a higher abundance of highly-qualified labour in the Silicon Valley than in its Canadian competitor, due to changes in immigration regulations and the high living costs in the area, this advantage might shift in favour of the Toronto-Ottawa region. Additionally, an effective use of capital is more advantageous to start-ups than a huge amount available in the industry.
This effect becomes even more clear when Ottawa is left out of the analysis for the Canadian region as the advantages and disadvantages Toronto and Waterloo have as locations negate themselves. Additionally, when comparing the Silicon Valley and the Canadian areas on its own, Ottawa never has the highest performance level in any of the analysed criteria, leading to the proposition that the Toronto-Waterloo corridor might be a closer competitor to the Silicon Valley than the whole of the Toronto-Ottawa region. Hence, even though currently the Silicon Valley still takes the lead, the Toronto-Ottawa region and especially the Toronto-Waterloo corridor has the potential to become the most favoured location for technology start-ups.

5.2 Critical acclaim

Due to the external view this paper concentrates on, it does not cover the complete diamond model of Porter and hence, it cannot be claimed that the results of this paper originated from the whole model as aspects concerning the strategy, structure and rivalry in the regions were not considered. For example, the culture of networking and

low hierarchy used and lived within the cluster is considered as a huge asset of the regions.

Additionally, the criteria applied are only some aspects Porter mentioned within the influencing factors of his diamond. For example, this thesis only compares the knowledge resources within some universities of the regions, neglecting national and private facilities and other universities, which are also a source of these resources.

Moreover, except from Porter´s diamond, other factors need to be considered as well as for example the Silicon Valley also vastly attracts new technology start-ups due to its number of success stories in this area such as Apple, Google or Microsoft. The "myth" that has been created around the Bay Area due to these stories has not been part of this evaluation but play an important factor in the competitive advantage of the location.

Furthermore, even though the technology industry encompasses a lot of different products and services, but concerning the demand, the paper only concentrated on smartphones. However, these products do not represent the whole industry and the demand conditions towards other products and services, especially in the business-to-business sector might be different.

In addition, even though the regions were geographically clearly defined in chapters 3.1.2 and 3.2.2, the source of some of the data might apply a different definition.

Similarly, data from different sources where compared. Hence, the methodology of how the data was investigated as well as definitions of the same concept might not be aligned completely leading to results that are not completely comparable.

5.3 Outlook

Some of the major factors that are contributing to the attractiveness of Toronto-Ottawa as a location for technology start-ups do not only apply to this location but also to others within Canada. For example, the relative relaxed immigration regulations compared to the United States is something that other technology hubs within Canada also enjoy. One of these clusters is Vancouver, which is not only much closer in location to the Silicon Valley than the Toronto-Ottawa region but further just across the border to Seattle, where for example Amazon also has a huge office. Furthermore, Vancouver has already proven through technology start-ups like Shopify that it can produce internationally scalable companies. Hence, it will be interesting to see if Vancouver

might even be able to overtake the Toronto-Ottawa region as the new “Silicon Valley North”.

When it comes to the Silicon Valley, possible current and future major policy decisions on the federal level including but not limited to increasing trade barriers will also continue to influence to attractiveness of the region. Additionally, the hype around successful former technology start-ups and founders, such as Facebook and Mark Zuckerberg as well as Tesla and Elon Musk, is currently decreasing, influencing the image and perception of a Silicon Valley entrepreneur. Coupled with the high living costs in the Bay Area and restrictive immigration laws, highly educated people around the world might choose a different location for their technology start-up in the future. Hereby, the Toronto-Ottawa region is certainly ranking high as an attractive alternative.

IV. Glossary

Angel investment	The investment is often directly provided by an individual and also includes the investor offering contacts and advice. Additionally, angel investment is often the source of seed financing. As angel investors are often or have been previous entrepreneurs as well, they are more willing to invest in high-risk start-ups because they are not only motivated by financial considerations but also by being able to transfer and provide their knowledge.
Collision	Collision stands for the "engagement [of founders] with others in the community and their attendance at events" (Startup Genome; Global Entrepreneurship Network, 2018, p. 37).
Industry income score	The score is derived from "how much research income an institution earns from industry (adjusted for PPP), scaled against the number of academic staff it employs" (Times higher education, 2019).
Local relationships	Local relationships describe how many local relationships founders have with other executives, investors, experts and founders (Startup Genome; Global Entrepreneurship Network, 2018, p. 37).
Research score	It is derived from a reputation survey done by THE, the research income, which is "scaled against academic staff numbers and adjusted for purchasing-power parity (PPP)", as well as the research productivity, which shows the "university's ability to get papers published in quality peer-reviewed journals" (Times higher education, 2019).
Sense of community	Sense of community considers how easy it is to ask and receive help and introduction as a start-up founder from investors and other entrepreneurs (Startup Genome; Global Entrepreneurship Network, 2018, p. 37).

Venture capital	VC is typically invested by a company which raised funds from investors and invest in what is classified as high-risk. Hence, they often provide capital to start-ups who have difficulties with raising it from traditional sources such as banks as they often have hardly any to no collateral and operate in a new industry and environment which is thus seen as uncertain. Apart from capital, VC firms also provide advice as well as knowledge and contacts to the start-ups.

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VI. Annex

VI.I Comparison of the Silicon Valley and the Toronto-Ottawa region

			Silicon Valley	Toronto-Ottawa region	Silicon Valley	Toronto-Ottawa region
Factor conditions	Human resources	Change in population	6,2%	6,1%	100,0%	97,6%
		STEM degrees	534.071,00	300.067	100,0%	56,2%
		Wages	160.884,00	67.629,52	100,0%	42,0%
	Material resources	Office prices	4.704.639,00	1.917.214,50	245%	100%
		Vacancy rate	13,7%	17,6%	78%	100%
	Knowledge resources	University ranking	3,00	132,67	100,0%	4422,2%
		Research	96,80	53,03	100,0%	54,8%
		Knowledge transfer	64,60	45,03	100,0%	69,7%
	Capital resources	Venture capital	14.101,00	1.039,00	100,0%	7,4%
		Angel investment	140,00	109,13	100,0%	77,9%
	Infrastructure	Rent 85m2	4.059,00	1.310,19	309,8%	100,0%
		Rent 45m2	2.719,00	933,99	291,1%	100,0%
		Download speed	116,56	100,26	100,0%	86,0%
		Upload speed	29,23	27,19	100,0%	93,0%
Demand conditions		Ownership smartphone	81,8%	86%	95,1%	100,0%
		Convenience	1,00	0,00	100,0%	0,0%
		Innovation	6,00	18,00	100,0%	300,0%
		Population size	2.702.348,00	7.443.660,00	36,3%	100,0%
		Transferability	1,00	0,00	100,0%	0,0%
Related & supporting industries	Local connectedness	Collison	5,90	5,00	100,0%	84,7%
		Relationships between founders	22,40	18,50	100,0%	82,6%
		Sense of community	8,60	4,10	100,0%	47,7%

VI.II Comparison of the Silicon Valley and the areas within the Toronto-Ottawa region

			Silicon Valley	Ottawa	Toronto	Waterloo	Silicon Valley	Ottawa	Toronto	Waterloo
Factor conditions	Human resources	Change in population	6,2%	5,9%	6,2%	5,5%	100,0%	93,8%	99,0%	88,8%
		STEM degrees	534.071,00	39.616,05	243.658,66	16.792,24	100,0%	7,4%	45,6%	3,1%
		Wages	160.884,00	70.860,14	79.323,09	52.705,33	100,0%	44,0%	49,3%	32,8%
	Material resources	Office prices	4.704.639,00	1.839.315,00	1.995.114,00		236%	92%	100%	
		Vacancy rate	13,7%	11,2%	11,2%	17,6%	78%	64%	63%	100%
	Knowledge resources	University ranking	3,00	176,00	21,00	201,00	100,0%	5866,7%	700,0%	6700,0%
		Research	96,80	39,30	86,30	33,50	100,0%	40,6%	89,2%	34,6%
		Knowledge transfer	64,60	43,2	50,30	41,60	100,0%	66,9%	77,9%	64,4%
	Capital resources	Venture capital	14.101,00	79,00	778,00	182,00	100,0%	0,6%	5,5%	1,3%
		Angel investment	140,00				100%			
	Infrastructure	Rent 85m2	4.059,00	1.169,26	1.664,40	1.096,92	370%	107%	152%	100%
		Rent 45m2	2.719,00	807,97	1.299,76	694,25	392%	116%	187%	100%
		Download speed	116,56	95,80	104,72		100%	82,2%	89,8%	
		Upload speed	29,23	20,56	33,82		86%	61%	100%	
Demand conditions		Ownership smartphone	81,8%							
		Convenience	1,00							
		Innovation	6,00							
		Population size	2.702.348,00	991.726,00	5.928.040,00	523.894,00	45,6%	16,7%	100,0%	8,8%
		Transferability	1,00							
Related & supporting industries	Local connectedness	Collison	5,90	5,10	4,90		100%	86,4%	83,1%	
		Relationships between founders	22,40	16,80	20,20		100%	75,0%	90,2%	
		Sense of community	8,60	4,20	4,00		100%	48,8%	46,5%	

VII. Declaration of originality

I hereby declare that this exposé and the work reported herein was composed by and originated entirely by me. Information derived from published and unpublished work of others has been acknowledged in this text and references are given in the list of references.

Hamburg, 08.02.2019 [redacted]

VIII. Declaration of consent to publication

I hereby express my consent to one version of my bachelor´s thesis being published in the library of the relevant department.

Hamburg, 08.02.2019 [redacted]