COVID-19 and the economy:
Exploring potential vulnerabilities in the Waterloo region

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Abstract

The global COVID-19 pandemic has raised questions about the vulnerability of regional economies. Chief among concerns for economic development and planning are questions about how regional economies can contend with recovery in this rapidly changing environment and build a more resilient and pandemic-ready economy. Drawing upon an extensive review of academic literature, a scan of industry and policy reports, an analysis of socio-economic data and local case studies, we consider how broad economic trends may have an impact on the Region of Waterloo. We use Canadian census data to provide a pre-pandemic snapshot of employment by cluster in the Kitchener-Waterloo-Cambridge Census Metropolitan Area (CMA), and we consider how shifts towards remote work and commuting decisions may shape the region. Overall, our analysis paints a nuanced picture of economic change and possibilities. It highlights the key role that local institutions, strategic planning and policy can play in shaping those outcomes.

Keywords: COVID-19; economic vulnerability; remote work; work from home; commuting; clusters;

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1 Introduction

As the global pandemic related to COVID-19 began to unfold across Canadian cities and around the world, it has had unprecedented impacts on every facet of economic and social life. Amongst the many dimensions of urban life that have been affected, there are pressing questions about how local firms and regional economies will rebound or recover from the substantial shock caused by widespread lockdowns, shifts in consumer and business spending, and political and policy decisions that influence the structure and function of global supply chains.

Prior to the global pandemic, there was consensus that city-regions play a key role in anchoring and coordinating the global economy. Cities – especially larger ones, but also their mid-sized counterparts – are important sites for the generation of new ideas, products, and firms. Moreover, firms in newer tech-based industries favour urban locations to access talent, knowledge infrastructure, and other critical amenities and resources.[1] Indeed, the Waterloo region has been widely cited and studied for its noteworthy performance in producing world-class innovation, high levels of entrepreneurial tech start-ups, and cadres of well-educated, highly skilled talent.[2]

The advent of the pandemic has led to debate over the future of cities as the primary engines of economic growth, innovation and development.[3] Driving this point home, several prominent tech companies, including Shopify and Facebook, announced very early in the pandemic that they would shift a high proportion of their workforce to remote work. Rather than viewing this as short-term measure, both firms emphasized these decisions as more permanent shifts in their respective organizations. For example, Facebook anticipates that more than half of its workforce will work remotely within the decade. [4] This raises the spectre of whether these tech giants are the canaries in the coalmine, anticipating the locational decision of other firms in our post-pandemic future.

Yet, we would caution that the death knells of the city are most likely overstated. Indeed, even the aforementioned trends in the tech sector are far more complex and nuanced than the original headlines suggest. When Facebook announced its shift to remote work, it simultaneously extended its office footprint in New York. Similarly, Amazon, Google and other large tech companies announced that they were seeking larger amounts of real estate in large, global cities to accommodate their workforce.[5]

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[1] Storper, M. 2013. *Keys to the city: How economics, institutions, social interaction, and politics shape development*. Princeton: Princeton University Press; Zukin, S. 2020. Seeing like a city: How tech became urban. *Theory and Society*. https://doi.org/10.1007/s11186-020-09410-4

[2] Compass. 2015. *Waterloo start-up ecosystem report*. https://startupgenome.com/reports/waterloo-startup-ecosystem-report; Spigel, B. and Vinodrai, T. 2020. Meeting its Waterloo? Recycling in entrepreneurial ecosystems after anchor firm collapse. *Entrepreneurship and Regional Development*. https://doi.org/10.1080/08985626.2020.1734262

[3] Nathan, M. 2020. Will coronavirus cause a big city exodus? *Economics Observatory*. https://www.coronavirusandtheeconomy.com/question/will-coronavirus-cause-big-city-exodus; Florida, R., Rodriguez-Pose, A. and Storper, M. 2020. Cities in a post-COVID world. *Papers in Evolutionary Economic Geography*. http://econ.geo.uu.nl/peeg/peeg2041.pdf

[4] Murphy, H. 2020. Facebook to shift more permanently to a more remote workforce. *Financial Times*, May 21, 2020; Davis, B. 2020. Shopify offices remaining closed until 2021, with most staff shifting to permanent remote work. *The Record*, May 21.

[5] Weise, K. and Haag, M. 2020. Amazon sticks with office expansion plans in New York and elsewhere. *New York Times*, August 18.

The implications of this nuanced calculus are far-reaching, raising questions about the demand for office space and the locational choices of highly skilled talent and firms alike. Certainly, these broader locational trends and global debates about the future of cities and the future location of tech-based work are of direct relevance to the Waterloo region. The implications are particularly profound for *mid-sized* new economy cities and regions, like the Waterloo region, where the tech economy has been a central pillar of economic development plans and strategies.[6] The region has been a beneficiary of the past investment by large tech companies such as Google and, more recently, by Canada's largest tech company, Shopify; both companies have made investments leading to expanded operations along the region's central transit corridor, in downtown Kitchener and Uptown Waterloo. In addition, public agencies and private organizations have channeled resources into creating the ideal conditions for this type of activity to thrive. These local investments have included interventions to create downtown vibrancy, walkable and transit-friendly environments, and denser forms of urban living.

The aforementioned activities meant to attract outside investments to the region's tech economy have also delivered the conditions for homegrown success. The pandemic has also generated opportunities for companies to create new product lines and enter new markets. InkSmith, a local tech start-up, offers a particularly poignant example. The firm's success in pivoting from being educational technology firm to a medical equipment manufacturer is now well storied in the Canadian media, highlighting the firm's agility and speed in scaling up production and generating mid-skill manufacturing employment opportunities, which notably – for the most part – cannot be executed remotely. This is a story where the Waterloo region's strong industrial past come to bear on its post-pandemic urban future.

Overall, firm-level decisions affecting key sectors of the regional economy, such as how and where they locate, and how they structure work and their innovation processes, have the potential to shift the economic base of the region in a number of ways. These shifts in firm location decisions and their re-organization of work raise important questions about the future of the region's economy. What economic vulnerabilities does the regional economy face? And, how can the Region plan to be more resilient?

2 Analytical approach

To understand economic vulnerabilities associated with the onset of the global pandemic, we conducted an extensive scan of relevant academic literature, as well as of current industry and policy reports. To ground our analysis in a place-specific understanding of the region, we provide a pre-pandemic snapshot of the existing industrial structure of the region to identify particular industries experiencing employment growth or decline. To do so, we draw upon custom tabulations from the 2016 Canadian Census of Population to identify both cluster strengths and weaknesses. We also tabulate employment growth and specialization at the 3-digit level of the North American Industrial Classification System (NAICS). We extend our analysis to examine some of the underlying dynamics associated with particular sectors of the regional economy. Specifically, we examine existing work-from-home and commuting patterns, as well as the capacity of particular sectors to shift to remote work or telework. Finally, we draw upon case study analysis to highlight the importance of key public institutions in enabling the region to respond to the local, regional and national contours of the pandemic.

[6] Waterloo Economic Development Corporation. 2020. https://www.waterlooedc.ca/en/industries/industries.aspx; City of Kitchener. 2016. *Make It Kitchener*. https://www.makeitkitchener.ca/about/makeitkitchener_aoda-compliant-pdf_final-july-2016.pdf

Overall, this analytical approach allows us to address the question of economic vulnerability in a place-specific manner. We provide a rich, detailed and nuanced account of Waterloo's regional economy. Our analysis includes the key sectors promoted within local and regional economic development strategies due to their contributions to growth, productivity and prosperity, but also the remainder of the economy, which provides for employment across the spectrum.

Unless otherwise specified, data presented are for the Kitchener-Waterloo-Cambridge Census Metropolitan Area (CMA) as defined by Statistics Canada. Throughout the report, we refer to this CMA as the Waterloo Region and refer to the regional government as the Region of Waterloo, or the Region.

3 Sources of economic vulnerability in the Waterloo region

To frame our understanding of economic vulnerability, we conducted an extensive review of the academic and policy literature. Overall, we identified three key areas in which a regional economy may be vulnerable due to the global pandemic.

First, the literature on regional economic resilience and economic change emphasizes the importance of the industrial structure of the region.[7] In particular, a region's pre-existing **cluster strengths or sector specialization(s)** may make it more or less pre-disposed to a particular shock, depending on the nature of the economic activity. It may expose the region to global supply chain vulnerabilities or to particular labour or skills shortages. However, regional industrial expertise may also present opportunities as particular sectors take on greater strategic importance at the national or global scale. In the case of the global pandemic, manufacturing capacity – especially related to medical equipment – is one such example.[8]

Second, and related to this first point, understanding the nature of work and the skills requirements associated with the composition of the regional economy is of utmost importance. In the context of the COVID-19 global pandemic, lockdowns followed by gradual re-openings have prompted **shifts in work practices**, including the extensive use of remote work/work-from-home (WFH). The COVID-19 global pandemic has resulted in many businesses, especially those involving more traditional office work, shifting to remote operations involving various forms of telework and WFH arrangements. Firms have used this opportunity to evaluate these arrangements and assess the extent to which telework may become a more permanent organizational structure. Indeed, a recent Statistics Canada report concluded that roughly four out of ten Canadian jobs could be conducted remotely.[9]

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[7] Martin, R.L. 2018. Shocking aspects of regional development: Towards an economic geography of resilience. In G. Clark, M. Gertler, M. P. Feldman & D. Wójcik, eds., *The New Oxford Handbook of Economic Geography*, pp. 839– 864. Oxford: Oxford University Press; Bristow, G. and Healy, A., eds. 2020. *Handbook on Regional Economic Resilience*. Cheltenham: Edward Elgar; Christopherson, S., Michie, J. and Tyler, P. 2010. Regional resilience: Theoretical and empirical perspectives. *Cambridge Journal of Regions, Economy and Society* 3: 3– 10; Hassink, R. 2010. Regional resilience: A promising concept to explain differences in regional economic adaptability? *Cambridge Journal of Regions, Economy and Society* 3: 45– 58.

[8] Lowe, N and Vinodrai, T. 2020. Reflections on Retooling for the Covid-19 Pandemic, *Metropolitics*, 19 June 2020. URL: https://www.metropolitiques.eu/Reflections-on-Retooling-for-the-Covid-19-Pandemic.html

[9] Deng, Z., Morissette, R., and Messacar, D. 2020. *Running the economy remotely: Potential for working from home during and after COVID-19.* StatCan COVID-19: Data to Insights for a Better Canada. https://www150.statcan.gc.ca/n1/pub/45-28-0001/2020001/article/00026-eng.htm

The shift to WFH has raised longer-term questions about the future demand for office space, public transit use, commuting patterns and modal choices, as well as questions about the longer-term implications for innovation and knowledge exchange, processes that often rely on face-to-face interactions and networks.

However, it is important to underscore that not all work can be conducted remotely. Work in some knowledge-intensive sectors (e.g. scientific laboratories), trades (e.g. repairs, maintenance, construction), transportation and warehousing, or in public-facing service work (e.g. personal services, manufacturing, restaurants and retail work) often requires workers to be on site. Statistics Canada estimates that telework capacity is uneven, and the sectors where telework capacity is less than 30 percent include jobs in essential services, resource industries, and the transportation sector. Younger people and those that have lower levels of formal education are also disproportionately less likely to hold jobs that can be performed remotely. [10]

We also know little about the long-term implications of remote work and the unintended vulnerabilities it presents. Innovation scholars have long pointed to the key role that face-to-face interaction plays in fostering knowledge exchange and entrepreneurship. A shift to remote work could undermine these processes and present serious challenges to the local entrepreneurial ecosystem.[11] Other potential issues include those related to mental health and well-being, greater exposure to domestic abuse, and inequitable arrangements related to the household division of labour.[12] There are also issues related to organizational culture and the social dynamics of networks that may magnify existing challenges related to equity and inclusion in the labour market and the workplace.

Finally, the literature on regional resilience points to the critical role that **local institutions** play in facilitating and supporting economic transitions for firms and workers.[13] Local institutions can be instrumental in directing investment, coordinating development efforts, and building partnerships, as well as providing strategic guidance and regional stewardship. Moreover, local institutions can help shape a region's culture and thus the approach or attitude towards change.

We investigate each of these three broad themes with respect to the Waterloo Region below.

3.1 Cluster strengths and sector specializations

To identify existing specializations and relative strengths, we examine the industrial structure of the Waterloo regional economy. We use a cluster analysis to identify regional strengths. Clusters are typically viewed as a source of regional competitive advantage, where there is a strong concentration (or agglomeration) of firms and institutions related by skills, knowledge, inputs, demand, and other linkages.[14] We measure clusters using a set of widely accepted definitions created by the Harvard

[10] Deng, et al. 2020.

[11] Nathan, 2020; Florida et al. 2020.

[12] Vu, V. 2020. Home is where the work is: COVID-19s impact on working remotely across occupations. June 11. Toronto: Brookfield Institute, https://brookfieldinstitute.ca/home-is-where-the-work-is-covid-19s-impact-on-working-remotely-across-occupations-2/; Montpetit, D., and Munn-Rivard, L. 2020. *The COVID-19 Pandemic and Gender: Selected Considerations.* Library of Parliament: HillNotes.

[13] Bristow and Healy, 2020; Hassink, 2010; Martin, 2018.

[14] Porter, M. 1998. Clusters and the new economics of competition. *Harvard Business Review* Dec: 77-90; Wolfe, D.A. and Gertler, M.S. 2004. Clusters from the inside and out: local dynamics and global linkages, *Urban Studies* 41, 1071–1093.

Business School's Institute for Strategy and Competitiveness in partnership with the U.S. Department of Commerce and U.S. Economic Development Administration, adapted for the Canadian context and data availability.[15]

Figure 1 shows the relative economic performance of selected clusters in the Kitchener-Waterloo-Cambridge CMA by measuring specialization (location quotient, or LQ, on the x-axis), 10-year compound annual employment growth rates (y-axis), and employment (the size of each point).[16] The clusters located in the top right quadrant have high levels of specialization (LQs greater than 1) and positive compound annual employment growth rates between 2006 and 2016. Clusters that are growing include those related to the IT and analytical services, food processing, medical devices, automotive manufacturing and insurance. Figure 1 emphasizes the importance of activities related to high-order business services and technology-oriented activities, as well as the region's more traditional and historical base in manufacturing.

In contrast, clusters located in the bottom right quadrant, while demonstrating regional specialization (LQs greater than 1), have negative growth rates, meaning that employment declined between 2006 and 2016. These include clusters related to the plastics, metals, machinery and livestock processing. These industries reflect the legacy industries that have historically been an important part of the region's economic base.

In addition to the analysis presented here, we also calculate these metrics for every 3-digit NAICS industry in the Kitchener-Waterloo-Cambridge CMA (Appendix A1 to A7) to provide additional detail around the dynamics of the regional economy. We group the results for these 101 industries according to the following major industrial categories:

- Primary industries
- Manufacturing
- Wholesale trade
- Retail trade
- Transportation and warehousing
- Professional services
- Hospitality, government and public services

Overall, our analysis emphasizes that while Waterloo's regional economy demonstrates clear areas of specialization, there is also a very high level of industrial diversity within it. This observation echoes several previous studies.[17] We argue that it is critical to recognize this industrial diversity in planning for a post-pandemic economy.

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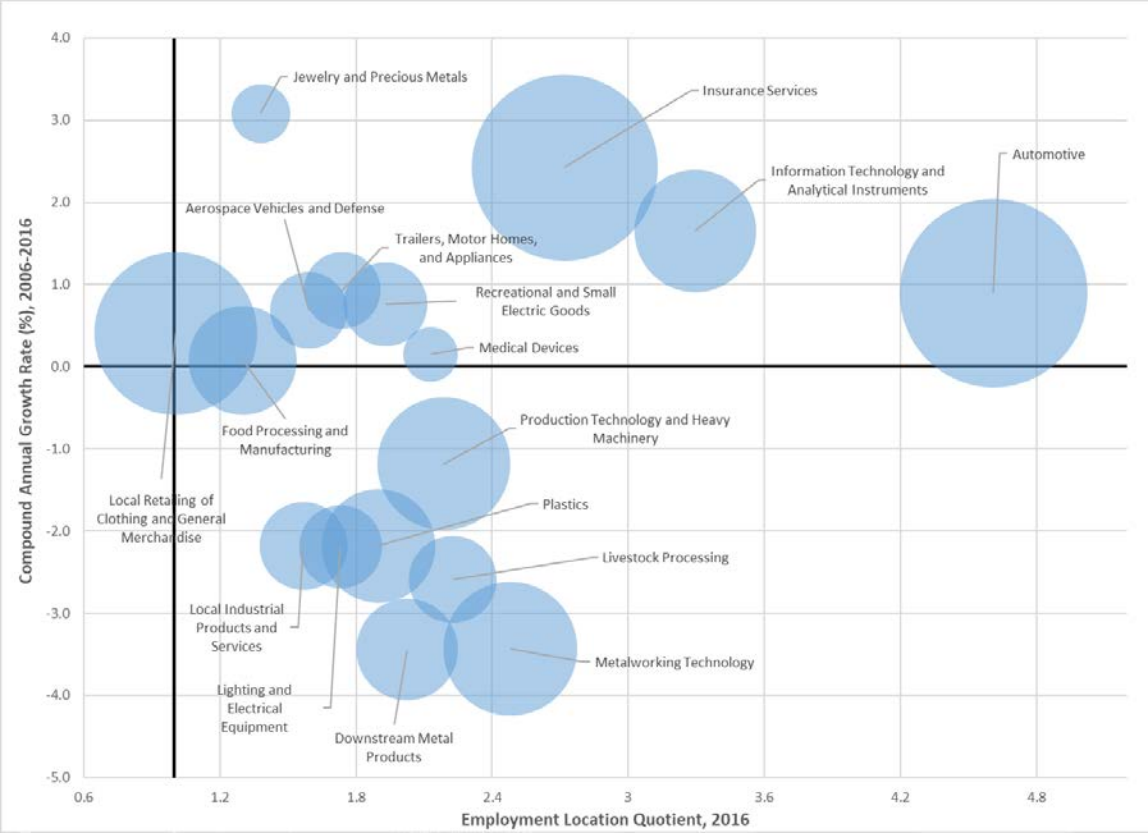
[15] Delgado, M., Porter, M.E. and Stern, S. 2014. Defining clusters of related industries. *NBER Working Paper Series*. Working Paper 20375. Cambridge, MA: National Bureau of Economic Research. http://www.nber.org/papers/w20375

[16] We limit our analysis to those clusters where there is sufficient specialization (LQ greater than 1 overall), scope (LQ greater than 1 in all of the constituent industries), and size (overall employment greater than 1000). See Spencer, G., Vinodrai, T., Gertler, M.S., and Wolfe, D. 2010. Do clusters make a difference? Defining and assessing their economic performance. *Regional Studies* 44(6): 697-715.

[17] Vinodrai, T. 2016. A city of two tales: Innovation, talent attraction and governance in Canada's Technology Triangle. In *Growing Urban Economies: Innovation, Creativity, and Governance in 21st Century Canadian City-Regions*, ed. D.A. Wolfe and M.S. Gertler. Toronto: University of Toronto Press.

Figure 1: Cluster growth and specialization in the Waterloo region, 2006-2016



Source: Statistics Canada, *Census of Population, 2006 and 2016* [Authors' calculations]

3.2 Shifting work practices: Remote work and commuting patterns

To assess the vulnerability of Waterloo region's economy to trends specifically associated with the COVID-19 pandemic, we amass a series of indicators capturing a pre-pandemic baseline across sectors, including

- Proportion of the labour force regularly working from home;
- Proportion of the labour force using active modes of transportation (e.g. walking, cycling) to commute;
- Proportion of the labour force using public transit to commute;
- Telework capacity[18]

Taking these indicators together allows planners and economic developers to consider how the pandemic might have an impact on land use, the location of work, and future investments in transportation infrastructure.

[18] These variables are calculated for the Kitchener-Waterloo-Cambridge CMA, with the exception of telework capacity, which relies on national-level estimates.

Table 1 captures these indicators across industrial sectors; it shows sectors in order of their relative contribution to employment in the Waterloo region. We discuss each of these indicators in turn to understand pre-pandemic conditions that inform the baseline for changes brought on by COVID-19.

First, we examine modes of commuting. There are high proportions of workers in service industries that use active transportation in their journey to work (i.e., walking or cycling). This includes both workers in lower order services (e.g., accommodation and food), as well as more knowledge-intensive services (e.g., education). This reinforces the potential widespread benefits of local interventions made to promote cycling and other active means of transportation during the pandemic. In addition to health and environmental benefits, cycling infrastructure can be a strategic asset for attracting highly skilled workers to the Region.

Similarly, when we examine public transit use, we find high proportions of public transit use amongst workers in accommodations and food services (16.6%), retail trade (10.0%), and arts, entertainment and recreation (8.3%), where levels are much higher than the regional average (6.0%). With the exception of the latter category, workers in these industries also have low telework capacity, and are generally in lower income and wage earning brackets. Thus, we would emphasize the continued importance of maintaining and developing public transit, even as ridership may have declined during the pandemic.

Table 1: Commuting, work at home and telework capacity by industry in Waterloo Region

Industry (2-digit NAICS) [1]	Employment (%)[2]	Active Transport (%) [3]	Public transit (%) [3]	Work at home (%) [2]	Telework capacity (%)[4]
Manufacturing	16.1	2.6	3.5	1.8	19.1
Retail trade	11.0	7.7	10.0	3.3	22
Health care, social assistance	9.7	5.0	5.1	7.0	28.8
Educational services	8.6	8.7	6.9	3.8	84.6
Professional, scientific and technical services	7.6	6.1	5.7	19.0	83.9
Construction	6.6	1.4	1.0	1.0	11.1
Accommodation, food services	6.5	13.3	16.6	1.3	5.6
Finance, insurance	6.2	4.3	5.1	7.8	85.3
Transportation, warehousing	4.2	1.9	3.0	3.3	24.5
Admin. support, waste mgt, remediation	4.2	3.7	8.9	8.0	35.1
Wholesale trade	4.2	2.4	3.2	7.6	57.3
Other services (except public admin)	3.8	7.0	5.5	9.4	31.4
Public administration	3.5	5.3	3.7	1.2	58.2
Information, cultural industries	2.8	6.2	7.0	6.8	68.5
Real estate, rental and leasing	1.7	7.0	2.3	22.2	47.8
Arts, entertainment, recreation	1.6	7.6	8.3	14.6	40.1
All industries	**98.2%**	**5.3**	**6.0**	**6.4**	**38.9**

[1] Data not shown for the following sectors, accounting for 1.8% of employment: Agriculture, forestry, fishing and hunting; Utilities; Management of companies and enterprises; and Mining, quarrying, oil and gas extraction.
[2] Statistics Canada. 2016. *Census of Population*, custom tabulations [Authors' calculations]
[3] Statistics Canada. 2016. *Census of Population*, Catalogue no. 98-400-X2016333. [Authors' calculations]
[4] Statistics Canada. 2020. *Running the economy remotely: Potential for working from home during and after COVID* https://www150.statcan.gc.ca/n1/pub/45-28-0001/2020001/article/00026-eng.htm

Next, we examine the proportion of workers by industry who already identified home as their regular place of work. As Table 1 shows, this was only 6.4% of the labour force and there is substantial variation across sectors. Workers in professional services (19.0%), real estate (22.2%), arts, entertainment and recreation (14.6%) are much more likely to work from home. This is likely due to the prevalence of freelance and consulting activities, as well as the project based nature of work in many of these industries.

Finally, we present data on telework capacity from a Canadian study estimating the extent to which telework is possible across different sectors and demographics.[19] This national study adapts and applies a method developed by US researchers to understand remote working potential in the US economy.[20] According to this approach, occupations that meet any of the following criteria are categorized as incompatible with remote work, such as the need to:

- perform for, or work directly with, the public;
- work outdoors;
- operate or repair machinery and equipment;
- inspect equipment, structures or materials;
- wear common or specialized protective or safety equipment;
- handle or move objects; or
- perform general physical activities.

The Canadian study shows that most work in sectors such as education, professional services and finance can be conducted remotely.[21] Thus, places that skew towards these knowledge-intensive activities may have to contend more directly with the influence of organizational decisions related to remote work, rather than other efforts that might shape work such as the introduction or extended application of robotics, artificial intelligence or machine learning that might be labour saving instead.

It is important to note that three of the top four sectors (measured by employment) in the Waterloo Region have relatively low telework capacity. Put differently, high telework capacity sectors account for only about one-quarter of all jobs.

3.3 Institutional supports

Previous studies have highlighted the presence of strong civic actors and institutions in the Waterloo region. [22] These existing local institutions can be critical supports for firms as they contend with the ongoing pandemic and recovery. We illustrate this point by way of a case study by returning to the example of the Kitchener-based start-up company, InkSmith.

[19] Deng, Z., Morissette, R., and Messacar, D. 2020. *Running the economy remotely: Potential for working from home during and after COVID-19.* StatCan COVID-19: Data to Insights for a Better Canada. https://www150.statcan.gc.ca/n1/pub/45-28-0001/2020001/article/00026-eng.htm

[20] Dingel, J.I., and B. Neiman. 2020. *How many jobs can be done at home?* NBER Working Paper, no. 26948. Cambridge, MA: National Bureau of Economic Research.

[21] Deng et al. 2020.

[22] Spigel and Vinodrai, 2020. See also Wolfe, D.A. 2010. Strategic management of core cities: Path dependence and economic adjustment in resilient regions. *Cambridge Journal of Regions, Economy and Society* 3: 139-152.

Early in the pandemic, a local physician approached InkSmith about using their 3D and laser printing technology to make face shields in light of personal protective equipment (PPE) shortages.[23] The firm developed a prototype, with manufacturing of this initial prototype facilitated through the help of Kwartzlab, a local makerspace, as well as other community organizations, including public libraries.

While InkSmith's original design did not have federal approval and the original design made it slow to produce and assemble, redesign efforts led to an improved product. Local support organizations assisted in fast-tracking approval from Health Canada, ensuring its use in the Canadian healthcare system. With regulatory approval in hand, InkSmith was able to create a new spin-off firm: Canadian Shield. By the end of April 2020, Canadian Shield had reached 150 employees and – at time of writing – the firm exceeds 300 employees. Production scaled from five units daily at the start to 200,000 per day.[24] The firm's early ability to scale up production was secured through public-procurement contracts from provincial and national governments.

Local institutional networks within the region were also important in aiding the rapid scaling of Canadian Shield. The firm was able to leverage existing manufacturing expertise in the region, relationships with Communitech, the local industry association (which has long played an important facilitative role in supporting entrepreneurship and start-ups in the local innovation ecosystem), as well as local and regional government grants and economic development supports. This institutional redirection is an important element of regional rebound and recovery efforts.[25]

Overall, this case highlights that there are key local public institutions and public procurement programs that provided some of the conditions that allow firms to pivot more quickly. Moreover, we would emphasize the role of local institutions that are often not considered in economic development and planning, such as makerspaces and public libraries, alongside institutions that are normally associated with economic development such as industry associations, government programs, and public universities.

4 Implications for economic development and planning

The COVID-19 pandemic is amplifying and accelerating existing trends. In some cases, the pandemic has created new opportunities for firms and governments. In other cases, the pandemic has challenged certain types of economic activities. This process of creative destruction has not been experienced equally across the regional economy. This is no surprise given that baseline conditions are highly uneven across different demographics and sectors of the economy revealing potential economic vulnerabilities. This diversity and nuance must be taken into account in developing forward-looking plans for the Region.

Overall, we advocate for an **evidence-based, strategic approach to planning Waterloo region's post-pandemic future,** with an eye towards a **resilient, equitable and inclusive recovery**. The evidence we present here offers some of the important puzzle pieces to better understand the impacts that the pandemic may have on land use, locational decisions of firms and workers, the commuting modal decisions and

[23] Sharkey, J. 2020. Health Canada certifies made-in-Kitchener face shields to protect against COVID-19. *CBC News*, March 24. https://www.cbc.ca/news/canada/kitchener-waterloo/inksmith-covid-19-face-shield-mask-health-1.5507989.

[24] Accounts of the InkSmith story are available here: https://www.canadianshieldppe.ca/blogs/news; see also Lowe and Vinodrai, 2020.

[25] Lowe and Vinodrai, 2020.

patterns of workers, and where potential opportunities and vulnerabilities may exist. Our data highlight diverse and uneven pre-pandemic baseline conditions related to WFH and commuting that will inform how the pandemic will influence the future of the regional economy.

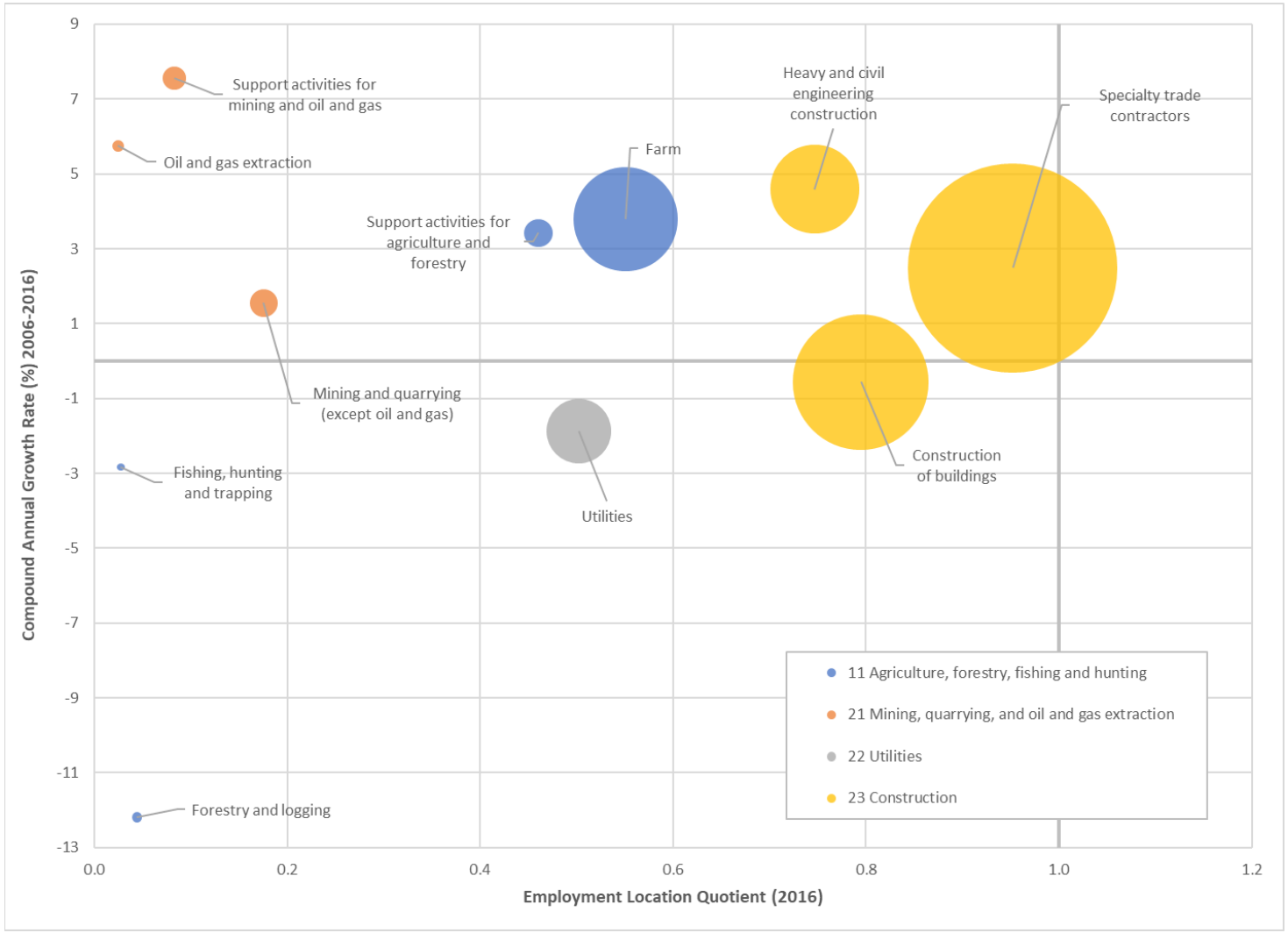
Our report also highlights the critical role of public infrastructure and support, primarily at the local level, but also senior levels of government. Such supports, financial and otherwise, were important for firm retooling efforts, and lessons learned here could be applied elsewhere.

Based on our review of the existing academic and policy literature, as well as our analysis of the quantitative and case study evidence presented here, we conclude by offering the following insights and guidance to support the Region in its strategic planning processes.

- **Recognize and build upon diverse sector strengths** – Our data show that the Waterloo region has a diverse array of industrial strengths that reflect the region's industrial history and strategic interventions that support new economy activity;
- **Capitalize on opportunities related to manufacturing expertise** – The Waterloo region's dual strengths in technology and manufacturing offer important opportunities for retooling and reshoring manufacturing, with the potential to generate both high- and mid-skilled jobs.
- **Invest in cycling infrastructure and public transit** – Investments in strategic areas such as public and active transportation infrastructure work to attract highly skilled workers, provide important amenities that can anchor talent and firms, and support broader equity goals by providing safe and reliable commuting options for more vulnerable workers in the service sector that rely more heavily on transit. Such infrastructure also contributes to reducing emissions and contributes to the Waterloo region's environmental sustainability.
- **Invest in social infrastructure and high quality municipal public services** – As opportunities for WFH increase, local governments will also play a key role in attracting and retaining more location-flexible workers in the Waterloo region. The Region can provide, or facilitate the provision of, high quality municipal services, such as parks and other recreational amenities; social services, in particular childcare; and other quality of life enhancing amenities.
- **Recognize the importance of local institutions and latent regional assets** – Studies of the Waterloo region consistently identify local institutions as important partners in guiding and supporting economic transitions. Our research also identified that local institutions such as maker spaces and public libraries – often not considered local assets for regional competitive advantage – can confer unexpected advantages that contribute to resiliency; and
- **Recognize the importance of public institutions and investments** - Public supports and infrastructure have played a critical role in creating enabling conditions for firms to pivot to new markets and expand production. Ongoing efforts could identify additional new production opportunities, particularly related to medical supplies and high value-added equipment.

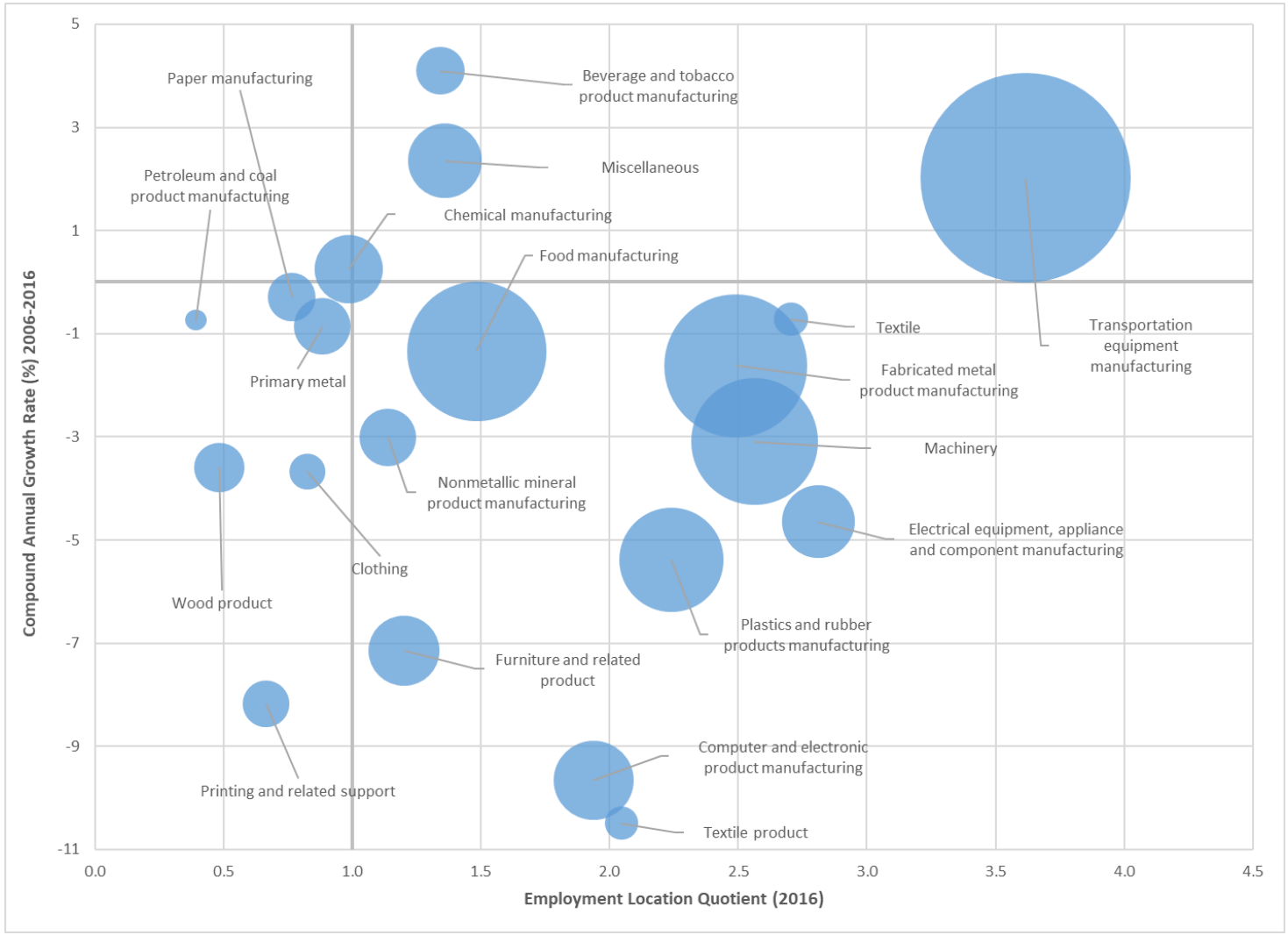
The strategic actions outlined here begin to address the economic vulnerabilities identified in this report and offer steps towards a resilient, post-pandemic future for the Waterloo region.

Appendix A-1: Employment growth and specialization in the primary industries - Waterloo region, 2006-2016



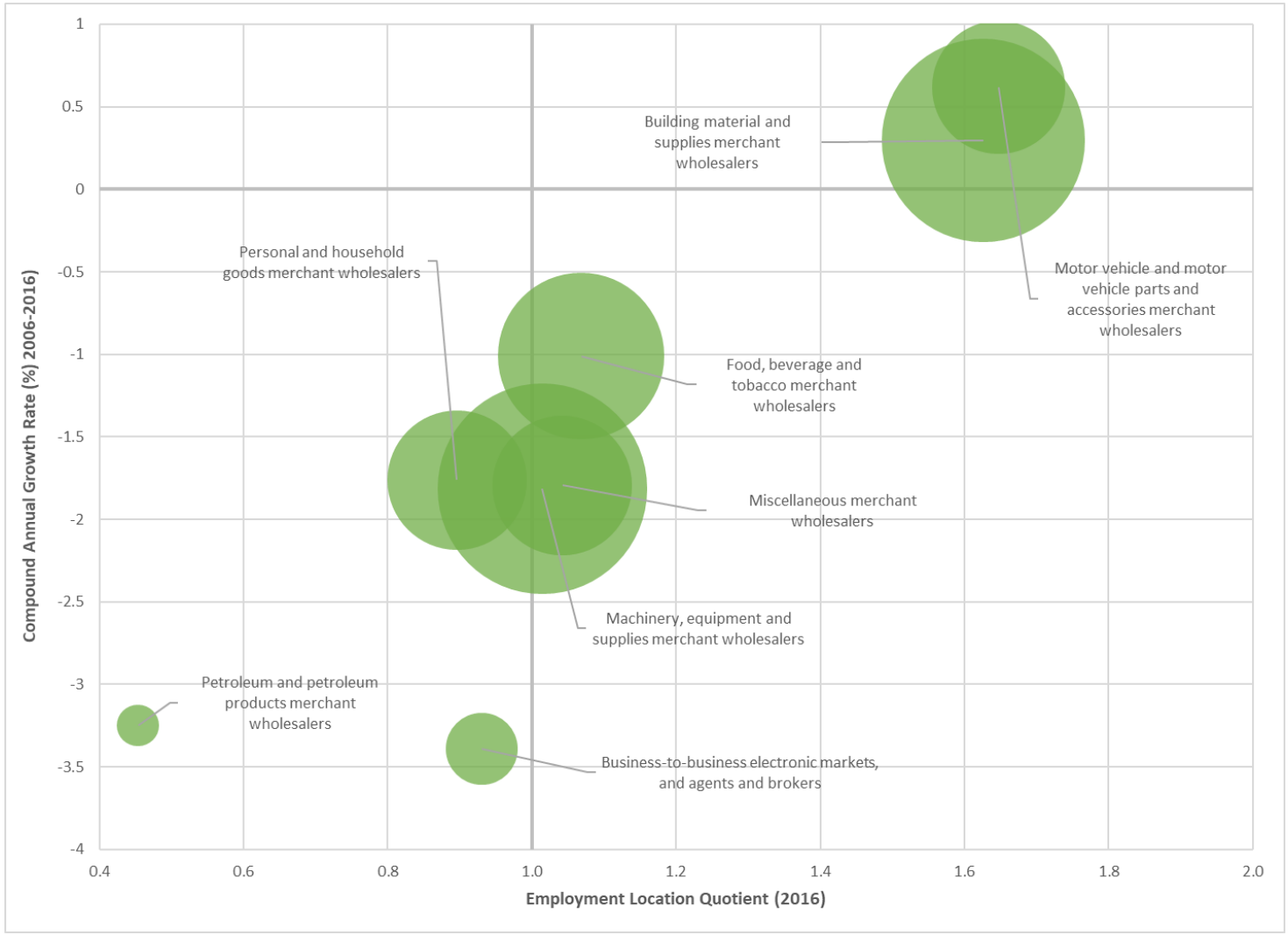
Source: Statistics Canada. 2016. *Census of Population – 25% Sample Data*; Statistics Canada. 2006. *Census of Population.* [Authors' calculations]

Appendix A-2: Employment growth and specialization in the manufacturing industries - Waterloo region, 2006-2016



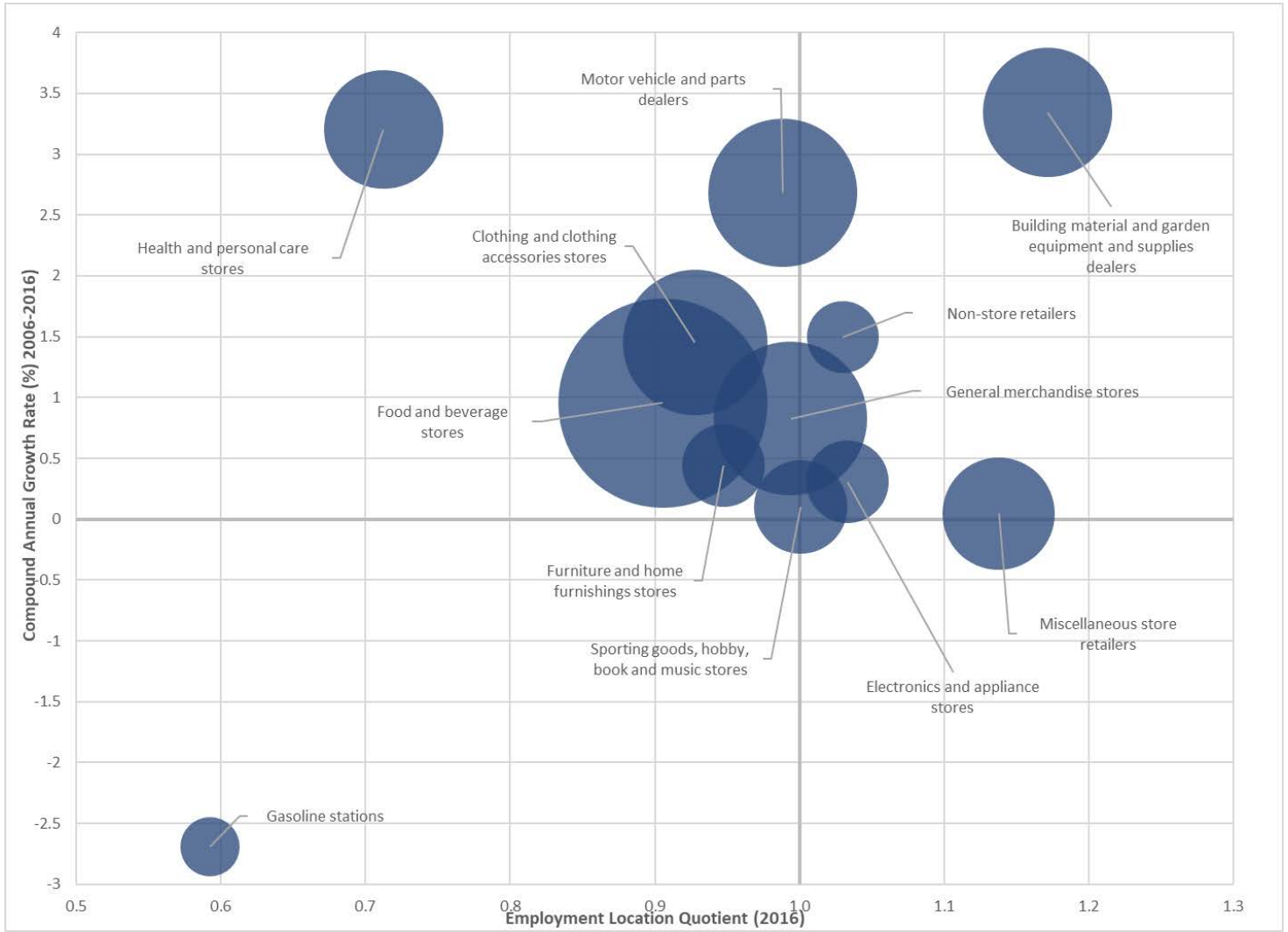
Source: Statistics Canada. 2016. *Census of Population – 25% Sample Data*; Statistics Canada. 2006. *Census of Population.* [Authors' calculations]

Appendix A-3: Employment growth and specialization in the wholesale trade industries - Waterloo region, 2006-2016



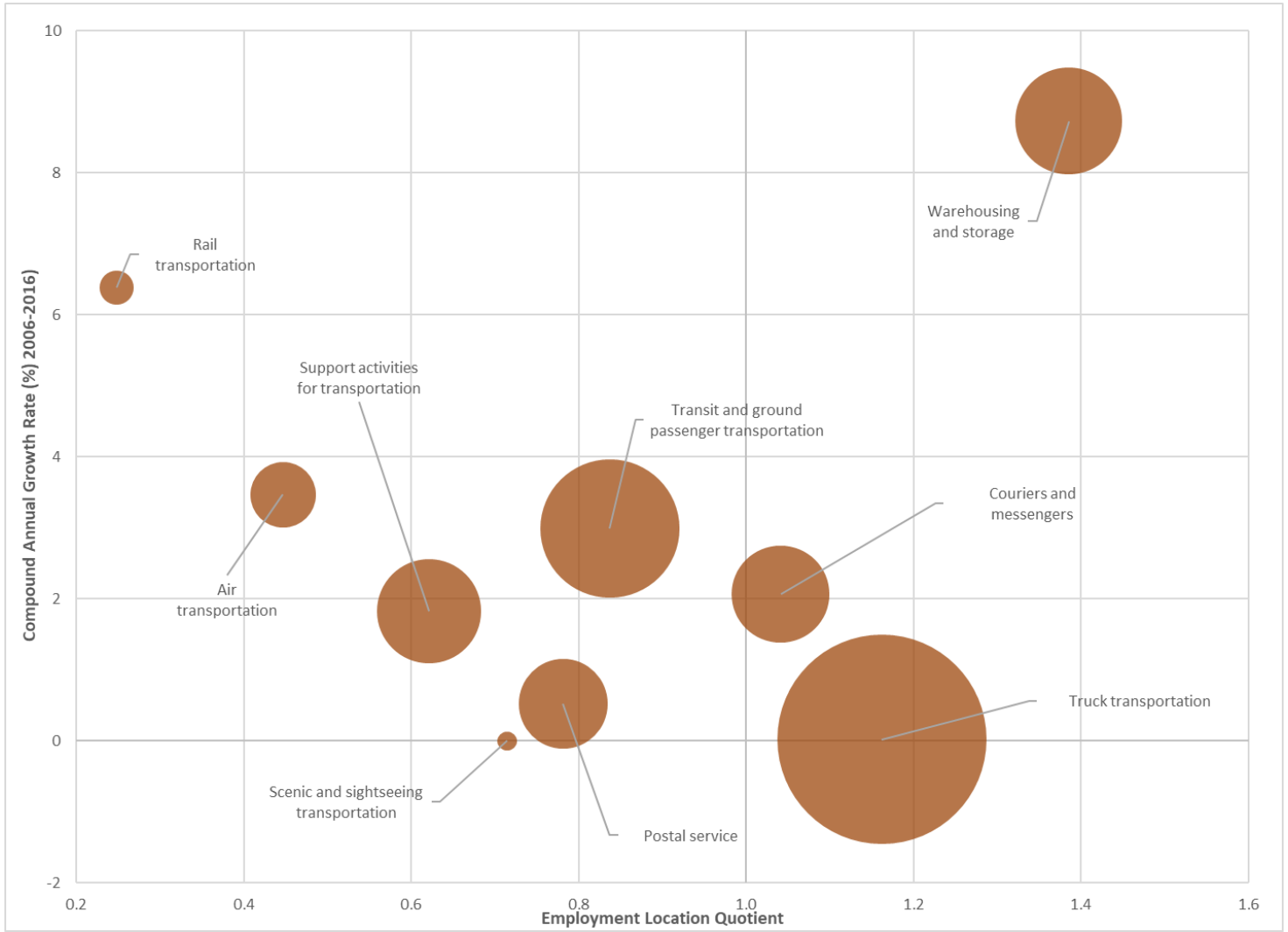
Source: Statistics Canada. 2016. *Census of Population – 25% Sample Data*; Statistics Canada. 2006. *Census of Population.* [Authors' calculations]

Appendix A-4: Employment growth and specialization in the retail trade industries - Waterloo region, 2006-2016



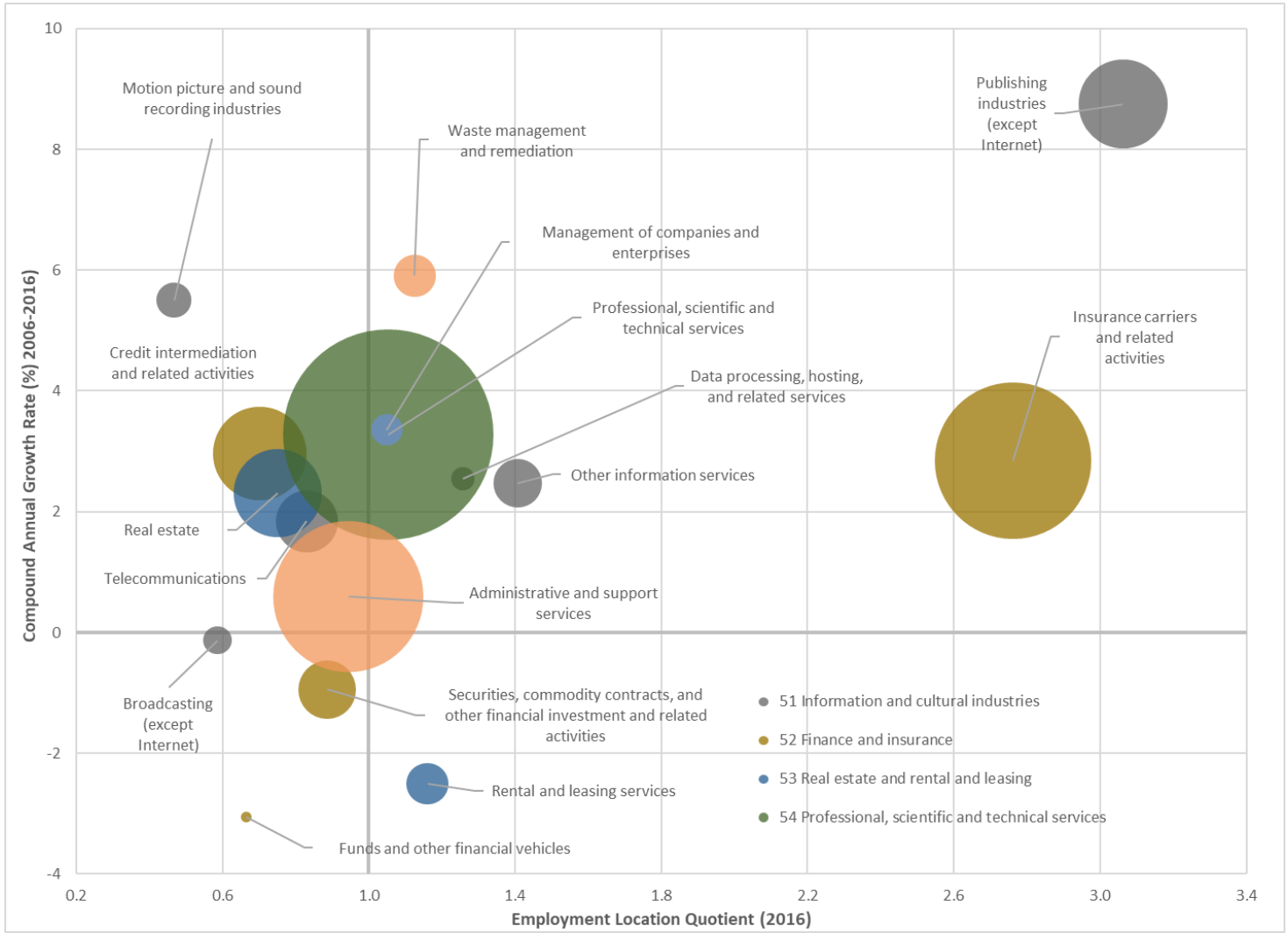
Source: Statistics Canada. 2016. *Census of Population – 25% Sample Data*; Statistics Canada. 2006. *Census of Population.* [Authors' calculations]

Appendix A-5: Employment growth and specialization in the transportation and warehousing industries, Waterloo region, 2006-2016



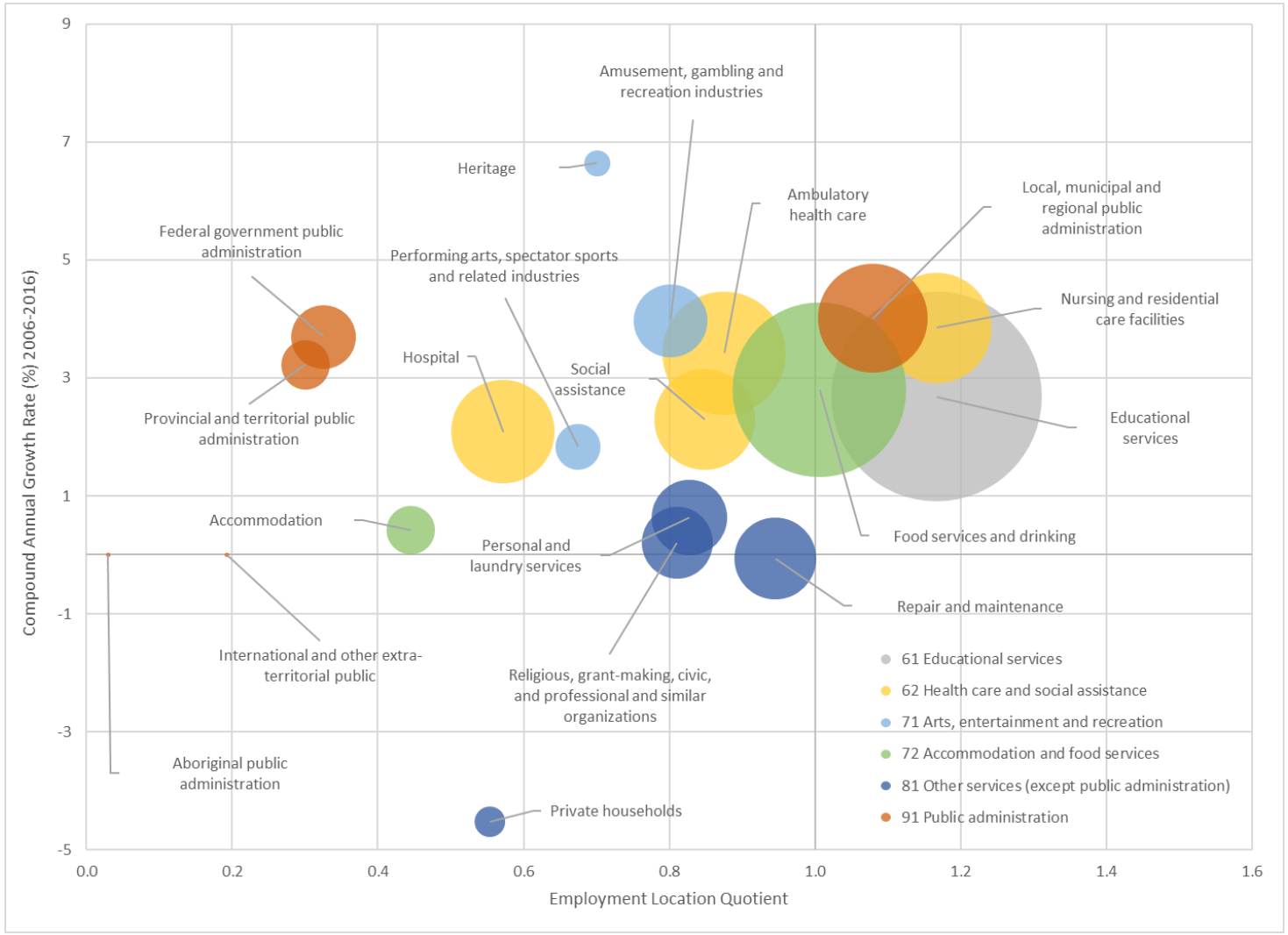
Source: Statistics Canada. 2016. *Census of Population – 25% Sample Data*; Statistics Canada. 2006. *Census of Population.* [Authors' calculations]

Appendix A-6: Employment growth and specialization in the professional services industries - Waterloo region, 2006-2016



Source: Statistics Canada. 2016. *Census of Population – 25% Sample Data*; Statistics Canada. 2006. *Census of Population.* [Authors' calculations]

Appendix A-7: Employment growth and specialization in hospitality and public services industries - Waterloo region, 2006-2016



Source: Statistics Canada. 2016. *Census of Population – 25% Sample Data*; Statistics Canada. 2006. *Census of Population.* [Authors' calculations]

Appendix B: Regular place of work by industry in the Waterloo region, 2016

Industry (2-Digit NAICS, 2012)	Regular Workplace (Number; %)							
	Worked at home		Worked Outside Canada		No Fixed Address		Usual place of work	
Agriculture, forestry, fishing and hunting	1,185	40.2%	0	0.0%	215	7.3%	1,550	52.5%
Mining, quarrying, and oil and gas extraction	20	5.7%	10	2.9%	75	21.4%	245	70.0%
Utilities	10	1.0%	0	0.0%	120	11.5%	910	87.5%
Construction	735	4.1%	10	0.1%	8,610	48.1%	8,565	47.8%
Manufacturing	775	1.8%	95	0.2%	1,125	2.6%	42,045	95.5%
Wholesale trade	870	7.6%	75	0.7%	790	6.9%	9,680	84.8%
Retail trade	970	3.3%	30	0.1%	1,010	3.4%	27,455	93.2%
Transportation and warehousing	375	3.3%	275	2.4%	2,755	24.1%	8,045	70.3%
Information and cultural industries	525	6.8%	35	0.5%	310	4.0%	6,835	88.7%
Finance and insurance	1,335	7.8%	20	0.1%	425	2.5%	15,405	89.7%
Real estate and rental and leasing	1,015	22.2%	0	0.0%	525	11.5%	3,030	66.3%
Professional, scientific and technical services	3,945	19.0%	185	0.9%	945	4.5%	15,720	75.6%
Management of companies and enterprises	45	10.0%	0	0.0%	10	2.2%	390	86.7%
Administrative and support, waste management and remediation services	875	8.0%	15	0.1%	3,485	31.7%	6,610	60.2%
Educational services	895	3.8%	200	0.9%	1,335	5.7%	21,065	89.7%
Health care and social assistance	1,875	7.0%	65	0.2%	1,835	6.8%	23,185	86.0%
Arts, entertainment and recreation	600	14.6%	20	0.5%	415	10.1%	3,090	75.1%
Accommodation and food services	215	1.3%	30	0.2%	520	3.0%	16,390	95.6%
Other services (except public administration)	960	9.4%	45	0.4%	780	7.7%	8,395	82.5%
Public administration	115	1.2%	0	0.0%	570	5.9%	8,970	92.9%
All Industries	**17,320**	**6.4%**	**1,110**	**0.4%**	**25,860**	**9.5%**	**227,580**	**83.7%**

Source: Statistics Canada. 2016. *Census of Population. Catalogue Number 98-400-X2016319*. [Authors' Calculations].

Appendix C: Commuting mode by industry in the Waterloo region, 2016

Industry (2-Digit NAICS, 2012)	Commuting Mode (Number; %)							
	Private Vehicle		Public Transport		Active Transport		Other	
Agriculture, forestry, fishing and hunting	1,765	83.9%	50	2.8%	195	11.0%	35	2.0%
Mining, quarrying, and oil and gas extraction	320	90.6%	10	3.1%	-	0.0%	25	7.8%
Utilities	1,035	94.7%	25	2.4%	30	2.9%	-	0.0%
Construction	17,175	96.7%	180	1.0%	245	1.4%	145	0.8%
Manufacturing	43,170	93.5%	1,510	3.5%	1,110	2.6%	195	0.5%
Wholesale trade	10,470	93.9%	335	3.2%	255	2.4%	50	0.5%
Retail trade	28,460	81.7%	2,835	10.0%	2,205	7.7%	180	0.6%
Transportation and warehousing	10,800	93.8%	320	3.0%	205	1.9%	145	1.3%
Information and cultural industries	7,150	86.3%	500	7.0%	445	6.2%	30	0.4%
Finance and insurance	15,830	90.2%	800	5.1%	675	4.3%	70	0.4%
Real estate and rental and leasing	3,555	89.3%	80	2.3%	250	7.0%	50	1.4%
Professional, scientific and technical services	16,670	87.3%	950	5.7%	1,010	6.1%	160	1.0%
Management of companies and enterprises	405	88.9%	10	2.5%	35	8.6%	-	0.0%
Administrative and support, waste management and remediation services	10,095	86.5%	900	8.9%	375	3.7%	90	0.9%
Educational services	22,400	84.0%	1,550	6.9%	1,945	8.7%	85	0.4%
Health care and social assistance	25,025	88.6%	1,265	5.1%	1,250	5.0%	350	1.4%
Arts, entertainment and recreation	3,505	82.9%	290	8.3%	265	7.6%	35	1.0%
Accommodation and food services	16,910	69.3%	2,815	16.6%	2,255	13.3%	110	0.7%
Other services (except public administration)	9,170	85.8%	505	5.5%	645	7.0%	160	1.7%
Public administration	9,540	90.3%	350	3.7%	505	5.3%	70	0.7%
All Industries	**222,255**	**87.7%**	**15,280**	**6.0%**	**13,925**	**5.5%**	**1,985**	**0.8%**

Source: Statistics Canada. 2016. *Census of Population. Catalogue Number 98-400-X2016333*. [Authors' Calculations].