COLLABORATING FOR INVESTMENT ATTRACTION IN THE TORONTO REGION

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EXECUTIVE SUMMARY

Established in February 2017, Toronto Global is a leading investment attraction agency in Canada, and one which is designed to act on behalf of all of the municipalities that comprise the Toronto Region. The underlying rationale for the establishment of this regional agency is two-fold: a belief that foreign direct investment (FDI) in any one part of the Toronto Region stands to benefit all sub-regional municipalities, and an understanding that a collective regional value proposition is stronger than the sum of its parts.

This research paper provides both quantitative and qualitative analysis of the economic impact of FDI into the Toronto Region, providing data-driven support for this rationale. It also contributes to knowledge of how the regional economy operates, as well as an understanding of how both foreign and domestic firms weigh location decisions. These insights highlight how firms at home and abroad view the Toronto Region's strategic assets, which strengthens Toronto Global's ability to describe the region's value proposition to potential investors.

Quantitative Insights

A multi-regional input-output (MRIO) model was used to understand the regional distribution of economic impacts – value added (GDP), gross output, employment, wages, taxes and imports – associated with recent FDI projects in the Toronto Region. The MRIO used in this analysis was specifically designed to consider the unique industrial bases of the regional municipalities that make up the Toronto Region, as well as the inter-industrial interdependencies that exist between them.

The report analyzes seven FDI projects across the Toronto Region, spanning several high value-added industry sectors. These included three investments made in York Region (GM's Automotive Software and Research Centre, IBM's Soft-Layer Data Centre and Huawei's expanded Canadian headquarters focusing on telecommunications infrastructure and networks), two in the City of Toronto (Cisco's ICT research and development facility and startup incubator and Thomson Reuters' new Toronto Technology Centre), one in Durham Region (Hans Steel manufacturing facility) and one in Mississauga (Roche's Global Pharmaceutical Development site). Because large firms rarely announce a specific investment figure as part of a new expansion, the model imputed a value to the investment, based on the number and type of jobs announced by the companies.

The results generated by the MRIO model offer several important insights:

- The model showcases that FDI, regardless of location, benefits the region as a whole. While the host jurisdiction sees the greatest share of economic benefits associated with any investment project, all regional jurisdictions ultimately benefit in terms of employment creation, taxes, the purchase of supplies and services as well as other benefits, to varying degrees.

- The City of Toronto is typically the second largest beneficiary (after the host jurisdiction) of economic impacts in the examples of investment projects undertaken in other parts of the GTA, reflecting its anchoring role within the region. The magnitude of benefits accrued outside the host jurisdiction is generally proportional to the size of the jurisdiction and diversity of its economy. Being well connected to the host jurisdiction also helps to increase the level of economic benefits other jurisdictions receive from an investment project. For example, Peel Region receives the third largest impact for investment undertaken outside its borders, which can be attributed to its diverse industrial base and high degree of connectivity between the City of Toronto and York Region.

- The magnitude of the economic return on investment for a project does not depend on the size or location of the initial investment. Investment projects generating more than a 100% return in value added span all jurisdictions and all investment levels.

- Between 78 and 98% of the economic impacts of an FDI project (i.e. value-added, gross output, employment, wages, and imports) fall within the borders of the Toronto Region, giving some indication that the region truly does operate as an economic entity. Importantly, the modelling results suggest that over 83% of the jobs generated by the investment projects remained in the Toronto Region.

- The federal and provincial governments receive a far greater proportion of the tax revenue generated by an FDI project than do local municipal governments. The tax revenue collected by the province is roughly three times that of municipal governments (makes sense since the Province and Federal governments derive their revenue from a wider tax base, including income and other taxes not available to the municipalities)

Qualitative Insights

While the Multi-Regional Input-Output (MRIO) modelling is useful for analyzing and comparing the distribution of economic impacts of various FDI projects across the Toronto Region, the approach is static and therefore unable to capture the dynamic impacts that accrue to the region from the establishment of these new operations. The model results do not illustrate, for example, the linkages between industries and jurisdictions and how greenfield investment may affect them over time. These structural changes to the regional economy may represent more meaningful effects than changes in income at an aggregate level can demonstrate.

To address this concern, the quantitative findings were supplemented with a qualitative analysis that included: (1) a review of scholarly literature regarding global outsourcing, the formation of global production networks and regional economic development and (2) in-depth firm-level interviews with many of the multinational enterprises (MNEs) examined in the quantitative analysis, as well as a few others to include investments in additional locations and industries.

The purpose of the literature review and the interviews was to explore the factors that may have led these companies to locate specific operations in the Toronto Region and to examine the extent to which these firms are articulating with local domestic firms and ultimately contributing to the functional upgrading of the Toronto regional economy (and, conversely, the integration of the regional economy into the broader global economic system). The scholarly literature on global production networks (GPNs) and strategic coupling offer a conceptual scaffolding on which to develop these ideas.

GPNs are defined as a means of economic organization through which firms coordinate the production of goods and services across multiple geographic locations. GPNs are comprised of many actors and activities that transform tangible materials and intangible inputs into manufactured products and/or services for customers. Controlled by “lead” or “focal” firms which often take the form of large multinational corporations (MNCs), GPNs are international in scope, and the activities contained within them can range from resource extraction and materials processing to conceptual design and high-end fabrication and services.

Lead firms heading GPNs make decisions to “land” particular functions in particular locations based on the potential of said locations to generate profitability and flexibility for the lead firms and their GPNs overall. This “landing” process is referred to in the scholarly literature as “strategic coupling” as it depicts a process whereby economic functions are distributed in space to those locations which offer the lead firms various strategic advantages (e.g., lower costs, faster time to market, quality levels, access to experienced labour etc.). Regional institutions (such as agencies like Toronto Global) play a critical role in aligning the region’s assets to the strategic needs of lead firms and their associated partners and suppliers.

Viewed from the perspective of GPNs, regional prosperity becomes far more than simply optimizing the economic mix of activities within the region itself, and instead involves a given regional economy’s ability to occupy a position in given GPNs that convey to the region the highest possible levels of value creation and value capture. This involves matching the assets of the regional scale with the strategic needs of the GPN. The most favourable GPN value positions are typically those involving highly complex activities such as research and development and investments in data analytics, cloud computing and other forms of advanced information technology, which cannot easily replicated by other regions.

For strategic coupling to succeed, the local subsidiary must become embedded into the local supplier and innovation networks to continually add value to the production process. This relationship benefits the local economy by allowing domestic firms to access markets, capital, technology, knowledge and capabilities beyond their home economies. By tapping into a GPN, firms reap economies of scale by focusing on particular tasks/functions for an entire GPN as opposed to only those for regional firms. Through the upgrading of skills and production processes or the introduction of new technological capabilities or organizational innovations, a region can improve its position within the value network (i.e., functional upgrading) allowing it to attract even more investment. The MNEs interviewed for this study – IBM, Cisco, General Motors, Huawei, Thomson Reuters, Siemens, Festo – have each located valuable research and development activities in the Toronto Region, embedding a critical component of their Global Production Network (GPN), and in particular high-value-added aspects of their supply chain, in the region.

Viewed through a strategic coupling lens, the region boasts numerous advantages enabling it to attract R&D investment from top global firms. With four universities and five colleges, the Toronto Region has a steady enrollment of more than a quarter of a million postsecondary students annually. A recent report by PwC report ranks Toronto fifth out of 30 cities in intellectual capital and innovation and tenth in technology readiness, just behind San Francisco, Tokyo and Paris.

> **Global firms such as IBM, Cisco, General Motors, Siemens or Huawei are looking for an ecosystem of businesses and talent on which they can build to help strengthen their product offerings. Multinational enterprises that choose to locate within the GTA inevitably develop connections across the entire region through university partnerships, talent recruitment and business operations. This makes a regional approach to investment attraction all the more pertinent.**

The strength and breadth of the Toronto Region's universities in particular are key strategic assets for firms looking to invest in R&D. Cisco, GM and IBM all describe the value of building relationships with university researchers and startup firms that can feed into and help grow a local innovation ecosystem. Huawei has committed to investing $10 million annually in university research funding in Canada, with $3 million earmarked for the University of Toronto to collaborate on a diverse range of projects, from cloud computing, biomedical engineering, materials science and theoretical physics.

Developing a world-class research centre is an effective way for a region to boost its cost-capability ratio advantage. The knowledge and capability that comes with a leading university and a community of innovative startups cannot easily be matched elsewhere, giving the region a unique edge in attracting R&D mandates from multinational corporations. Lead firms must be able to tap into many sources of innovation to develop ideas and products that can compete in the global marketplace. By building a world-renowned research and startup community, the Toronto Region has given itself a winning value proposition for multinational corporations looking for top research talent.

Cross-industry partnerships are another big draw for lead firms. In the case of Huawei, the Toronto Region offers the advantage of having both a well-established automotive sector and a strong tech sector. As the company seeks to expand into the field of autonomous and smart vehicle technology, this combination offers significant opportunities for growth. Few regions around the world are as well-positioned to enable a lead firm to develop and roll out new technologies in this field. Cisco also chose the Toronto Region to leverage its stronghold in financial information systems and computing, partnering with IBM and TD Bank to grow its fintech capabilities. And, with a focus on machine automation, Toronto Region's diverse economy provides Festo with a diverse set of customers for its Industry 4.0 solutions while augmenting the region's attractiveness to firms who see value in increased productivity through sophisticated automation of production.

Many of the firms interviewed highlighted the GTA's large technical talent pool as a motivator to locate in the region. Lead firms often examine a region's ability to quickly and effectively fulfill skill and labour requirements when making location decisions. As IBM notes, Canada has the largest (software) developer population outside of the US, making it a strategic location in which to invest and carry out research. Ontario in particular, it says, boasts a stock of 200,000 highly skilled tech workers, and graduates about 4,500 tech students from its universities each year. Thomson Reuters points to this as the main factor behind its decision to open the Technology Centre in Toronto. The company has a goal of building a 1,500 person research team, which it says few locations in the world could accommodate.

The case studies often show how firms will build on their initial investment to broaden their presence across the region and further afield. Huawei's early success with its R&D program in Kanata led it to expand its research footprint all across Ontario, taking advantage of the specialized skillsets found in both the Ottawa and Toronto Regions. Siemens Canada located its head office in Oakville, yet it has set up operations, subsidiaries and a distribution network throughout the GTA. The diversity and range of the company's operations means that an investment in any one municipality is likely to have multiple spillover effects across the region.

The case studies in this report illustrate that lead firms base their location decisions on much more than what any one jurisdiction alone can offer. Global firms such as IBM, Cisco, General Motors, Siemens or Huawei are looking for an ecosystem of businesses and talent on which they can build to help strengthen their product offerings. MNEs that choose to locate within the GTA inevitably develop connections across the entire region through university partnerships, talent recruitment and business operations. This makes a regional approach to investment attraction all the more pertinent.

Conclusion

The quantitative and qualitative insights provided in this report offer strong support for having a collaborative regional approach to investment attraction in the Toronto Region from the point of view of both foreign firms and (sub)regional municipalities. Foreign firms consider the value proposition of the region overall when making a location decision and in turn not only inject jobs, value added and taxes, but more importantly, can transform and upgrade the entire regional economy through the investments they make and the local (and global) connections they form.

The MNEs interviewed for this report provide evidence that this transformation is underway in the Toronto Region. The decision by leading global multinationals to locate part of their advanced research and development activities in the GTA will offer tremendous economic benefits to the Toronto Region for years to come. While all jurisdictions across the region see a substantial rise in income and jobs as a result of these FDI projects, the most significant outcome of these investments is the transformation that comes with being part of a global production network. These investments signal an intent by these firms to embed critical elements of their business – and the market access, talent and intellectual capital that goes with them – into the fabric of the region. In turn, these projects offer much greater benefits than the sum of their parts.

This report shows that to attract investment from MNEs, city regions must think globally. The leading firms of today weigh location decisions on the basis of what strategic assets regions as a whole – not just particular jurisdictions – can offer them in the context of a highly competitive international marketplace. Working together to strengthen and promote the region's business and talent ecosystem will allow each jurisdiction to prosper while creating a winning value proposition to attract global firms.

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About Toronto Global:

Toronto Global is a not-for-profit investment attraction group that supports the expansion of foreign-owned businesses to the Toronto Region. Representing the Cities of Toronto, Mississauga and Brampton, as well as the Regions of Durham, Halton and York, Toronto Global works with the Government of Canada, the Province of Ontario, and municipal partners to offer complimentary and customized services to growing international companies. Services range from sharing market research and intelligence that support decision-making, to facilitating local connections to support the establishment of operations. Toronto Global actively promotes the competitive advantages of the Toronto Region as an ideal location for corporate expansion.

TABLE OF CONTENTS

1.0 INTRODUCTION

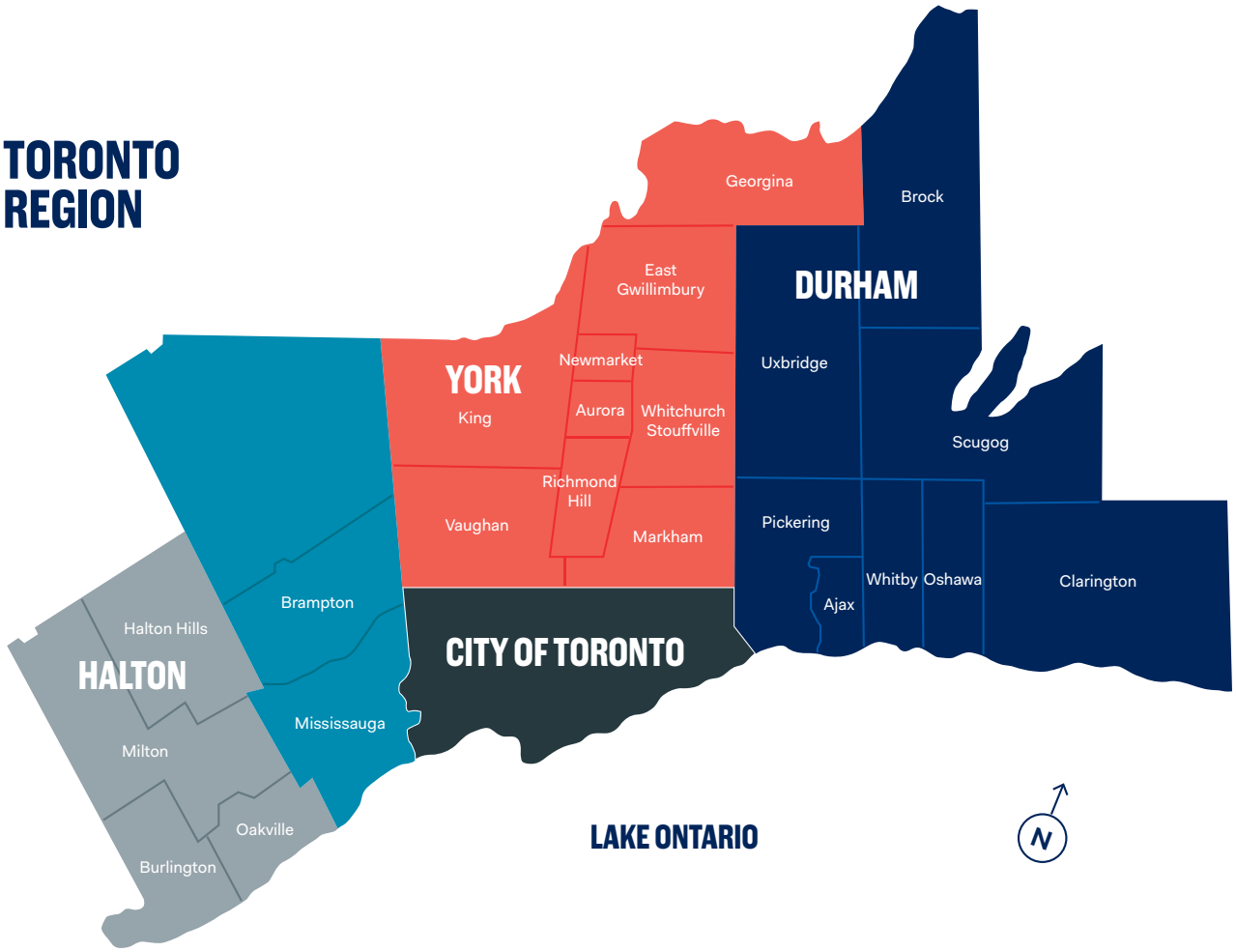
The Greater Toronto Area (GTA), like most large urban centres, is not one homogeneous city, but rather an amalgamation of many different municipalities. This heterogeneity is clearly mirrored in the highly variegated economic structure of the GTA. Some of the constituent regions of the GTA derive the bulk of their livelihoods from knowledge-intensive service work, while others derive it from highly technical manufacturing and assembly operations, and others still are heavily dependent on agricultural and other basic forms of production and related services. Such a high degree of variability in economic structures naturally gives rise to a high degree of spatial variation across the Toronto Region in terms of economic welfare, occupational characteristics, demographics, and most importantly, beliefs regarding what is, and what is not, important. This complexity has yielded myriad approaches by governing bodies active in the GTA to attract economic development to their jurisdictions. As noted by PwC in its *Roadmap to Revitalization* report for the Greater Toronto Marketing Alliance (GTMA)[1] a key element in many of these approaches lies in the attraction of inward foreign direct investment (FDI).

In the *Roadmap to Revitalization* report, PwC recommends the creation of a new regional agency to take the lead on attracting FDI to the GTA, and that this agency should not only take the lead on specific industrial sectors and/or markets agreed to by the other member FDI organizations in the GTA, it should also connect with and coordinate the activities of the various FDI organizations throughout the GTA. The success of this agency, Toronto Global, clearly requires an understanding by the constituent municipalities of the GTA that a regional agency will serve the best interests of all municipalities in the region. If it is to succeed in fulfilling its mandate, this ultimately requires acceptance of the notion that inward FDI to one part of the region is beneficial for all municipalities in the GTA, not just the particular one in which the new investment is located.[2] That is to say, there is more to be gained by taking a region-wide approach to attracting FDI as opposed to the more piece-meal approach that is used presently.

1 PwC (2013). "Greater Toronto Marketing Alliance: Roadmap to Revitalization – see http://www.greatertoronto.org/wp-content/uploads/2014/02/Roadmap-to-Revitalization-Final- Report-Summer- 2013.pdf.

2 It is important to note that the actual regional distribution of economic benefits associated with inward FDI in a given region is a function of each region's economic structure, the occupational and educational composition of each region's resident labour force, and interregional commuting patterns.

Figure 1: The Greater Toronto Area



Providing a data-driven justification for the role of the new regional investment and marketing agency is clearly essential to the success of Toronto Global. This report provides Toronto Global with both a quantitative and qualitative analysis of the economic impact of inward FDI into the broader regional economy constituted by the individual municipalities that comprise the GTA (see Figure 1).

In the first section of the report (after this introduction), a Multi-Regional Input-Output (MRIO) model is used to quantify the economic impacts of alternative FDI packages and their distribution over the five sub-regions (i.e., the City of Toronto and the regions of Durham, Halton, Peel and York) that comprise the GTA. The MRIO model has been developed and implemented by Econometric Research Ltd. (ERL).

While the MRIO-based modeling exercise is useful for comparing various FDI scenarios in terms of the spatial distribution of impacts within the GTA, the approach does rely on, among other things, the assumption of invariant production relationships between industries within the model. In other words, the approach is static and unable (as would be any quantitative approach) to capture the internal spatial and temporal economic dynamics stemming from inward FDI in the GTA. If contemporary Economic Geographic theory and practice tells us anything, it is that these interindustry relations are subject to rapid and unpredictable change (both in terms of intensity and spatial distribution). No one could have predicted, for example, the changing importance of RIM (now Blackberry) in the Regional Municipality of Kitchener-Waterloo – and indeed the Province of Ontario – or the changing dynamics of the automotive sector that runs across the United States mid-west and Southwestern Ontario. Indeed, these changes are driven by changes in other countries (and in transnational spaces which are governed by global lead firms which head Global Production Networks (GPNs)), and by the pervasive pattern of disintegrating value chains and outsourcing that we are witnessing at the global scale. For example, in a relatively short period of time (less than two decades), firms as iconic as IBM and Apple have ceased all manufacturing activities and outsourced all such activities to contract manufacturers located overseas, focusing their attentions on R&D and downstream services. Similar changes have taken place in automotive, information technology, appliance and even high value-added service sectors (e.g., software development).

To address this concern and to buttress our quantitative analysis, we conducted an analysis and interpretation of contemporary scholarly literature dealing with the relationship between this trend toward global outsourcing, and the formation of GPNs and regional economic development. Our objective in this section of the report is to conceptualize the ways in which these pervasive trends toward the vertical disintegration of value chains and the subsequent formation of GPNs could lead to dramatic changes in the nature of the GTA economy. This occurs largely through inward FDI associated with GPNs "landing" in the GTA, which not only engage with existing economic actors, but also contribute new knowledge and information with the potential to generate new firms in new industries, and new economic connections within the regional economy itself. The regional economy in turn "strategically couples" with hitherto absent aspects of various GPNs.

In other words, this part of the report aims to augment the quantitative analysis with a conceptual framework that Toronto Global, and its constituent municipalities, can utilize to better appreciate the extent to which the regional economy is integrated into the broader global economic system. Indeed, it is our belief that the extent to which this integration occurs (as well as the qualitative nature of this integration) will have a far more pervasive effect on how the various regions of the GTA fare economically in the future than will the direct economic impact of new Greenfield investments in the short term. The trend toward global outsourcing is accelerating and the evidence suggests that it is having a rapid and indelible effect on the contemporary economic geography of the Toronto Region.

The report will progress as follows. Immediately following this introduction, we present our quantitative analysis of various inward investment scenarios in the GTA. These scenarios are based on primary field research conducted by the authors with various actors in both public and private sectors regarding what sorts of inward FDI have taken place in the GTA in recent years. This primary research provided us with some basic descriptive parameters vis-à-vis several recent FDI-related projects in various parts of the GTA which were then used to drive an MRIO model of the GTA economy and to determine the extent and spatial distribution of the associated economic impacts within the GTA region. The third section of the report moves on to examine the concept of GPNs and in particular the relationship between GPN formation and evolution and regional economic development in the GTA. This section will define GPNs in more detail and focus specifically on the economic imperatives which have led to

their expansion. It will also discuss the problems and challenges associated with planning for regional economic development in this globalizing context, as well as some of the specific implications for regional economic development in the GTA. The fourth section of this report consists of a detailed examination of a series of firm-level case studies, based on the aforementioned primary research with multi-national enterprises (MNEs) that have located within the GTA in recent years. These case studies will be used to illuminate the extent to which these new firms are interconnected with the global economic system, in myriad industries, and the degree to which these connections are benefiting the GTA regional economy.

Our presumption, based on a detailed reading of the relevant literature, is that in regions like the GTA, where high-value-added activities are the norm and becoming more so, this integration into various GPNs through foreign direct investment stands to create unforeseen qualitative change in the nature of this regional economy, for the better. We utilize these case studies to marry the insights from the qualitative analysis along with the powerful results of the quantitative analysis, to make a compelling case for a strong, well-funded investment attraction strategy for the Toronto Region.

2.0 QUANTITATIVE ASSESSMENT OF THE SPATIAL-ECONOMIC IMPACTS OF FDI IN THE TORONTO REGION

The basis of the argument that a well-honed and well-resourced regionally-focussed investment attraction strategy for the entire GTA stands to benefit all constituent municipalities rests on quantitative evidence of such positive impacts. To that end, this section discusses and interprets the results of a state-of-the-art regional economic impact analysis of different FDI scenarios involving real foreign-owned firms in the GTA. The economic impacts discussed below have been produced using a custom-built "Multi-regional Input-Output" (MRIO) model of the GTA economy.[3]

In an effort to gather information regarding FDI into the GTA which has generated, or which stands to generate, new economic activity within the GTA, the authors consulted with principals of Toronto Global and existing industry contacts, in addition to reviewing business media coverage. The result was a listing of firm-level projects as shown in Table 1. Table 1 includes a selection of investment projects that are being undertaken in various parts of the GTA by multi-national enterprises (e.g., IBM, Cisco, Huawei, General Motors, Thomson Reuters, Roche Pharmaceuticals, and Hans Steel). The purpose of this section of the report will be to present a high-level summary of a quantitative economic impact analysis of each of the investment scenarios described in Table 1. That is, for each of the firm-level projects identified in Table 1, the MRIO model was used to assess the spatial distribution of economic impacts associated with each project within the GTA.

Total FDI in the Toronto Region is not a readily available figure. Even the highly visible announcements of some of these investments by major international players are not matched by disaggregated data and specific information on the amount of investment and/or its allocation over meaningful components. Investing corporations are satisfied with announcing plans and the new jobs they are expected to generate.

The majority of the investment projects and plans are in the high-tech and information technology sectors of the economy. They have come to the GTA because of a number of attractive factors, including a vibrant and growing information technology sector capitalizing on a rich supply of highly skilled workers, a solid base of research and world ranked universities and colleges, attractive and safe cities and towns, a well-functioning urban transit system, proximity to major international airports, and a determined effort by municipalities to woo these dynamic industries.

3 The MRIO model was developed and implemented by Econometric Research Ltd. (ERL).

In Table 1 we present information on a selected number of investments made recently or to be made in the GTA by major MNEs. The data includes location of the investment, (where available) the total magnitude of the investment, the declared number of potential jobs and the nature of the investment (sector or activity). For example, General Motors has recently (in 2016) announced the development of a greenfield Automotive Software and Research Centre in Markham Ontario. IBM has revealed plans to construct a $32.5 million Soft-Layer Data Centre also in Markham that would spend around $24.5 million on engineers and professionals working at the Centre. Huawei is expanding its Canadian Headquarters, focusing on telecommunication infrastructure and networks. As well, Cisco has developed an ICT Research and Development Facility as part of its promotion of its start-up incubator in Toronto. Thomson Reuters has just announced its plans to develop a Toronto Technology Centre that could provide as many as 1,500 jobs in Toronto (though starting off with 200 high-skilled, largely engineering, jobs). As well, Roche Pharmaceuticals is proposing to develop a major pharmaceutical development/Head Office facility in Mississauga. Finally, Hans Steel is planning to develop a large warehouse and manufacturing facility (to manufacture steel towers) in the Township of Uxbridge in Durham Region on a 5.2 ha parcel of land.

Table 1: Inward FDI in the Toronto Region

FDI Case No.	City/Region	Name of Company	Amount Invested	Type of Investment	Nature of Investment	Field(s)	Date
1	Markham	General Motors	100,000,000	Greenfield Development and Hiring	Automotive software research and development facility. Research areas include autonomous vehicle software and controls, safety and vehicle dynamics technology, and infotainment and connected vehicle technology	Engineering	2016
2	Markham	IBM	32,500,000	Construction	Construction of SoftLayer Data Centre		2017
3	Markham	IBM	24,500,000	Hiring	SoftLayer Data Centre		2017
4	Markham	Huawei	36,500,000	Greenfield Development	New Canadian Headquarters	Administration; Sales; Engineering	2011
5	Markham	Huawei	28,000,000	Hiring	Upgrading and Expansion	Administration; Sales; Engineering	2014
6	Toronto	Cisco	$100,000,000	Leasing and Hiring	ICT Research and development facility and start-up incubator. Focused on smart technologies and the internet of things		2014
7	Toronto	Thomson Reuters	$63,000,000	Leasing and Hiring	Toronto Technology Centre		2016
8	Uxbridge/ Durham	Hans Steel	$20,000,000	Steel Facility	Steel Towers	Manufacturing	2017
9	Mississauga/ Peel	Roche Pharmaceuticals	$190,000,000	Diagnostic Centre	Pharmaceuticals	Research	2013-2017

Source: Interviews with stakeholders and general press releases
Note: For the GM project in Markham, the company did not provide this investment figure as it is against their corporate policy to do so. They did, however, provide estimates of the numbers of jobs to be created and their type (i.e., high-education such as engineers). ERL used this information, in addition to information regarding reasonable salary ranges for these positions, to estimate the amount of investment required to create this number of high-tech jobs. In other words, we worked back from the stated employment expectation and imputed the required investment. In the case of the Thompson Reuters Toronto Technology Centre (TR-TTC) we ran the model using the 200 high-skill jobs estimate.

2.1 Scenario I: General Motors Investment in Markham

GM embarked on a Greenfield Automotive Software Research and Development Facility in Markham in 2016. This development is expected to involve over $100 million in investment which will generate significant impacts in Markham, York and the GTA.[4] A summary of the economic impact analysis of GM's investment in Markham is shown in **Table 2** below. Table 2 indicates that this project in Markham is generating significant economic impacts for Ontario, the GTA as a whole, York Region (which contains the City of Markham), and all of the other sub-regional constituents of the GTA. Table 2 and **Figure 2** show that the $100 million investment by GM is estimated to generate total output, total value-added and total wages and salaries impacts in York Region of $148,990,000, $80,748,000, and $56,685,000 respectively. These wages and salary impacts represent the creation of 1,389 person-years of employment in York Region. The following table summarizes this information in a format which allows for easy comparison of those impacts which accrue to York Region and those which accrue to the broader provincial economy. Clearly, the GM investment in Markham is having a very substantial economic impact on the region and on the province.

Table 2: Economic Impacts of GM Investment in Markham

Thousands of 2016 Dollars

	Ontario	York
Initial Expenditure	$100,000	$100,000
Value Added		
Direct	$53,214	$53,214
Indirect & Induced	$69,275	$27,534
Total	$122,489	$80,748
Multiplier	1.22	0.81
Gross Output		
Direct	$100,000	$100,000
Indirect & Induced	$135,408	$48,990
Total	$235,408	$148,990
Multiplier	2.35	1.49
Wages & Salaries		
Direct	$38,062	$38,062
Indirect & Induced	$47,834	$18,623
Total	$85,896	$56,685
Employment (P.Y.)		
Direct	643	643
Indirect & Induced	1,490	747
Total	2,132	1,389
Multiplier	3.32	2.16

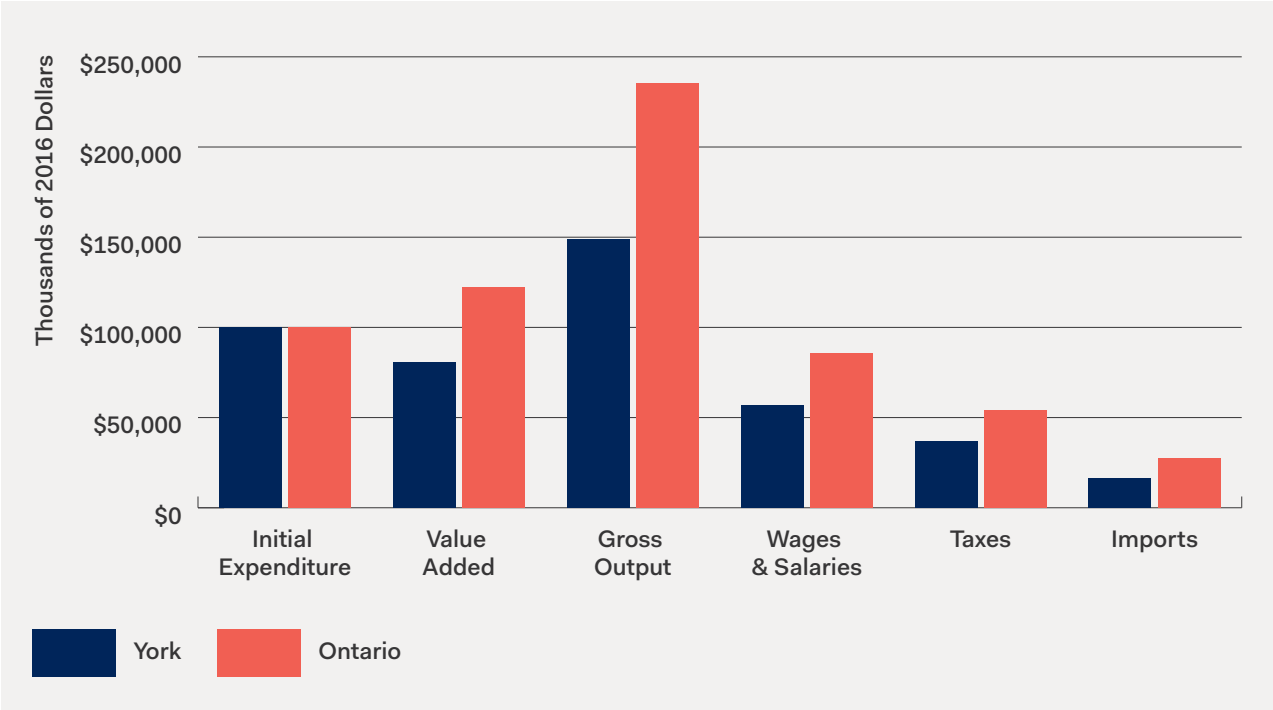
Continued...

4 As shown in Figure 1 above, Markham is one jurisdiction inside York Region. The MRIO model operates at the regional and sub-regional level (i.e., economic impacts are computed for the entirety of York Region and not specifically for the City of Markham).

		...Continued
Taxes		
Federal	$25,217	$16,583
Provincial	$21,749	$15,283
Local	$6,844	$4,809
Total	$53,810	$36,675
Imports		
From Other Provinces	$10,421	$6,369
From Other Countries	$16,997	$9,935
Total	$27,418	$16,304

Source: Econometric Research Limited, GTA MRIO Model

Figure 2: Economic Impacts of GM Investment in Markham



Noteworthy is the fact that this $100 Million investment by GM in Markham stands to have significant economic impacts on all other regions of the GTA (with York Region capturing the majority), and Ontario as a whole. Indeed, as shown **Figure 3**, all regions experience value-added (i.e., income), gross industrial output and labour income impacts as a result of GM's investment in Markham.

Of the employment impacts associated with GM's investment in Markham, **Figure 4** shows these impacts will be distributed across a number of industrial categories, with business and professional services, trade, education and health services, and finance, insurance and real estate accounting for the majority of the employment impacts accruing off-site (i.e., the off-site employment impact in Markham stemming from GM's $100 Million investment project account for nearly two-thirds of the total employment impact in the region).

Figure 3: Inter-Regional Economic Impacts of GM Investment in Markham

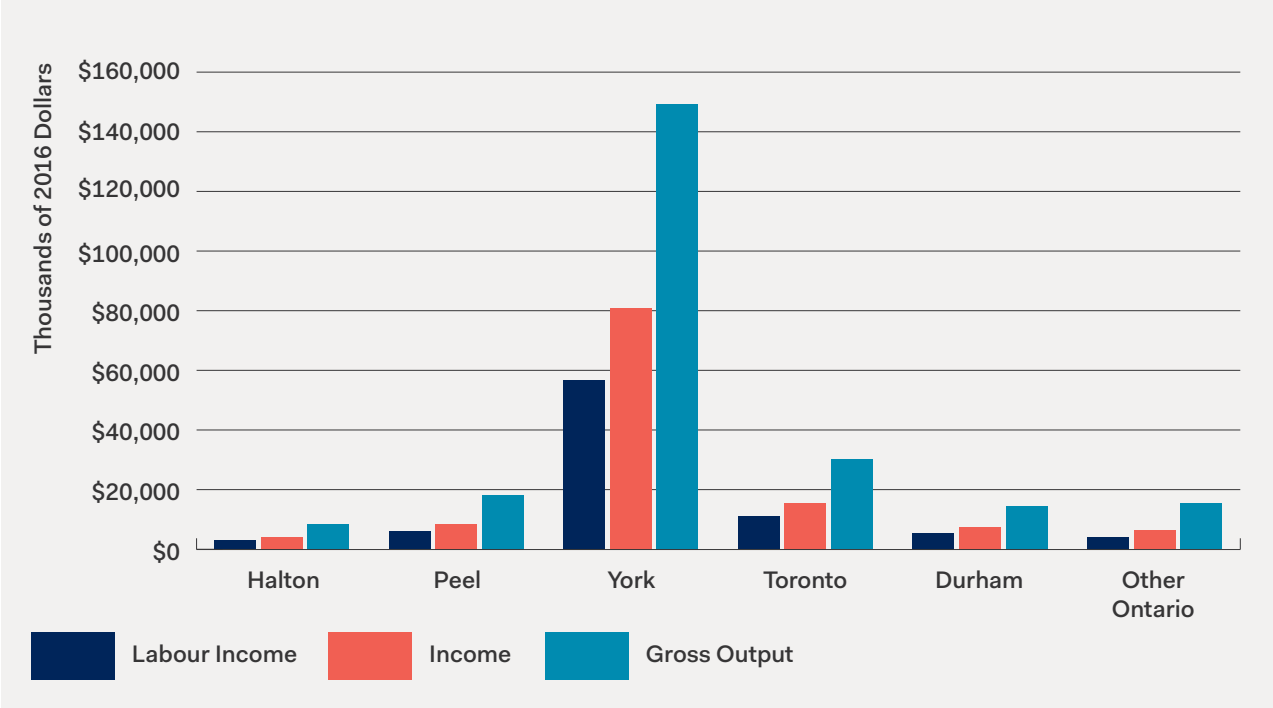
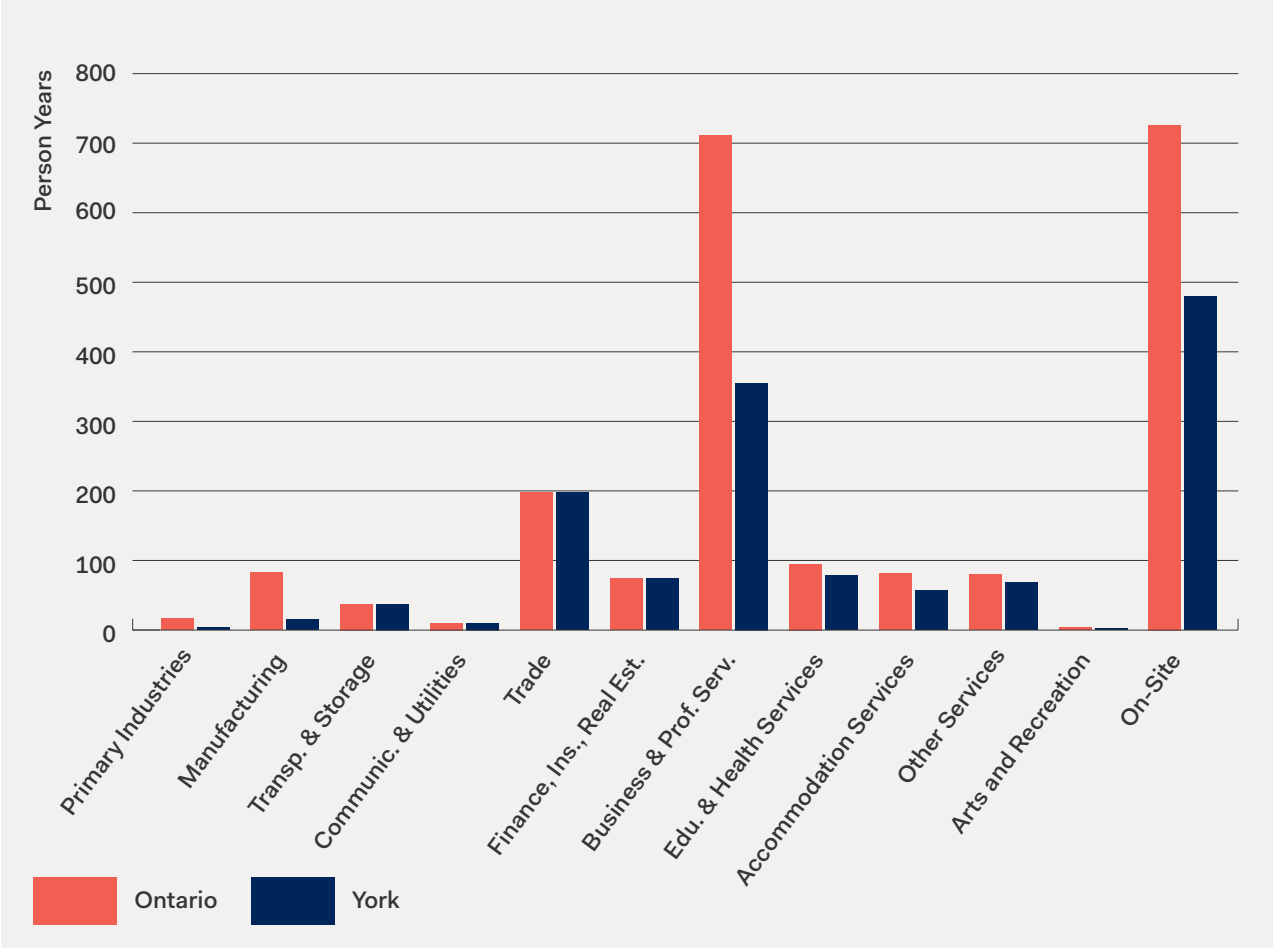


Figure 4: Employment Impacts of GM Investment in Markham



2.2 Scenario 2: IBM Data Centre in Markham

IBM Canada is investing $32.5 million in the construction of a "SoftLayer Data Centre" in Markham Ontario, and plans to spend another $24.5 million annually in labour costs to operate the facility. In what follows, the economic impacts associated with the construction of the data centre will be evaluated, while the next case (Investment Case 3) will explore the impacts associated with operations.

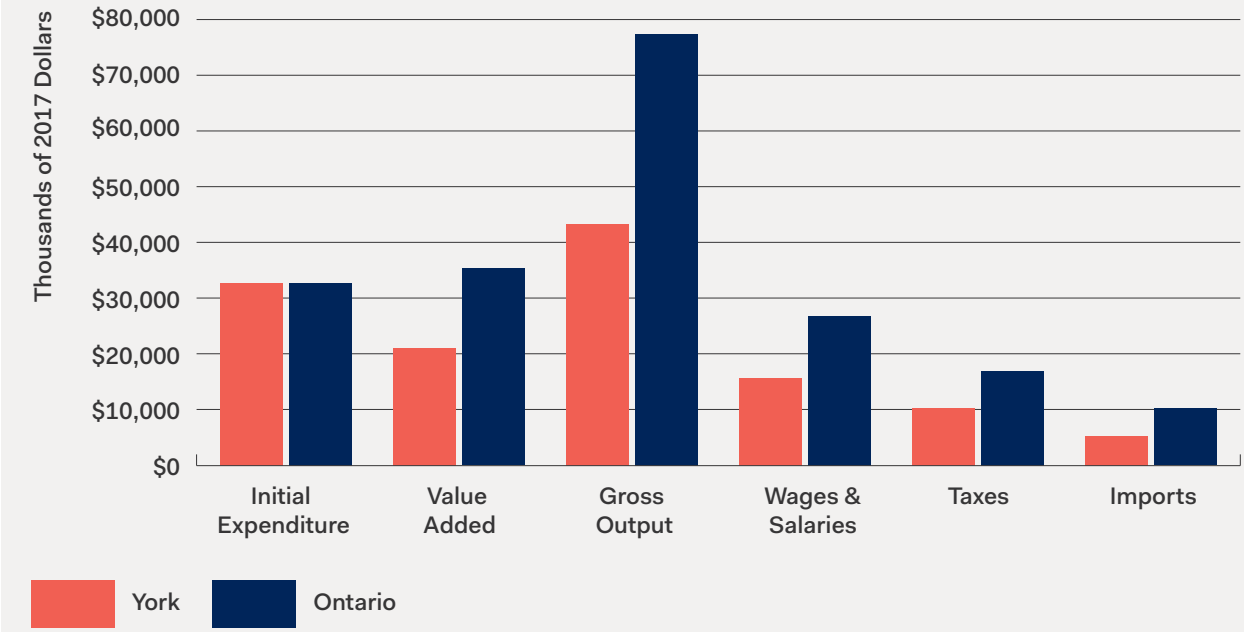
Table 3: Economic Impacts of IBM Capital Investment in Markham

Thousands of 2017 Dollars

	Ontario	York
Initial Expenditure	$32,500	$32,500
Value Added		
Direct	$13,669	$13,669
Indirect & Induced	$21,364	$7,213
Total	$35,033	$20,882
Multiplier	1.08	0.64
Gross Output		
Direct	$32,500	$32,500
Indirect & Induced	$44,172	$10,514
Total	$76,672	$43,014
Multiplier	2.36	1.32
Wages & Salaries		
Direct	$11,904	$11,904
Indirect & Induced	$14,727	$3,615
Total	$26,631	$15,519
Employment (P.Y.)		
Direct	132	132
Indirect & Induced	464	225
Total	596	357
Multiplier	4.51	2.70
Taxes		
Federal	$7,135	$4,254
Provincial	$7,397	$4,502
Local	$2,328	$1,417
Total	$16,860	$10,173
Imports		
From Other Provinces	$3,583	$1,926
From Other Countries	$6,545	$3,362
Total	$10,128	$5,288

Table 3 and Figure 5 reveal that $32.5 million investment by IBM in Markham is estimated to generate total output, total value-added and total wages and salaries impacts in York Region of $43,014,000, $20,882,000 and $15,519,000 respectively. The wages and salaries impacts reflect the creation of 357 person-years of employment in the region.

Figure 5: Economic Impacts of IBM Capital Investment in Markham



This $32.5 million investment by IBM in Markham stands to have significant economic impacts on the other regional municipalities which comprise the GTA, with York Region capturing the largest share, but with Toronto, Peel, Durham and Halton each capturing significant portions of the activity, as shown in **Figure 6**.

Figure 6: Inter-Regional Economic Impacts of IBM Capital Investment in Markham

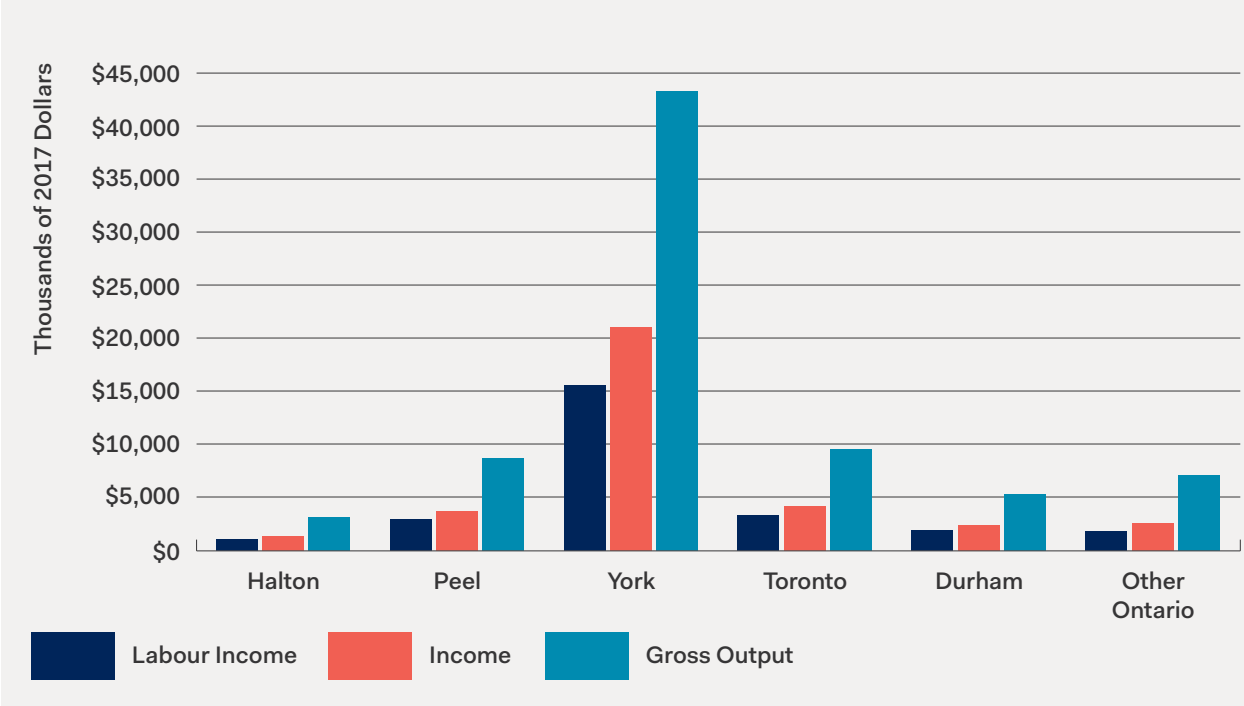
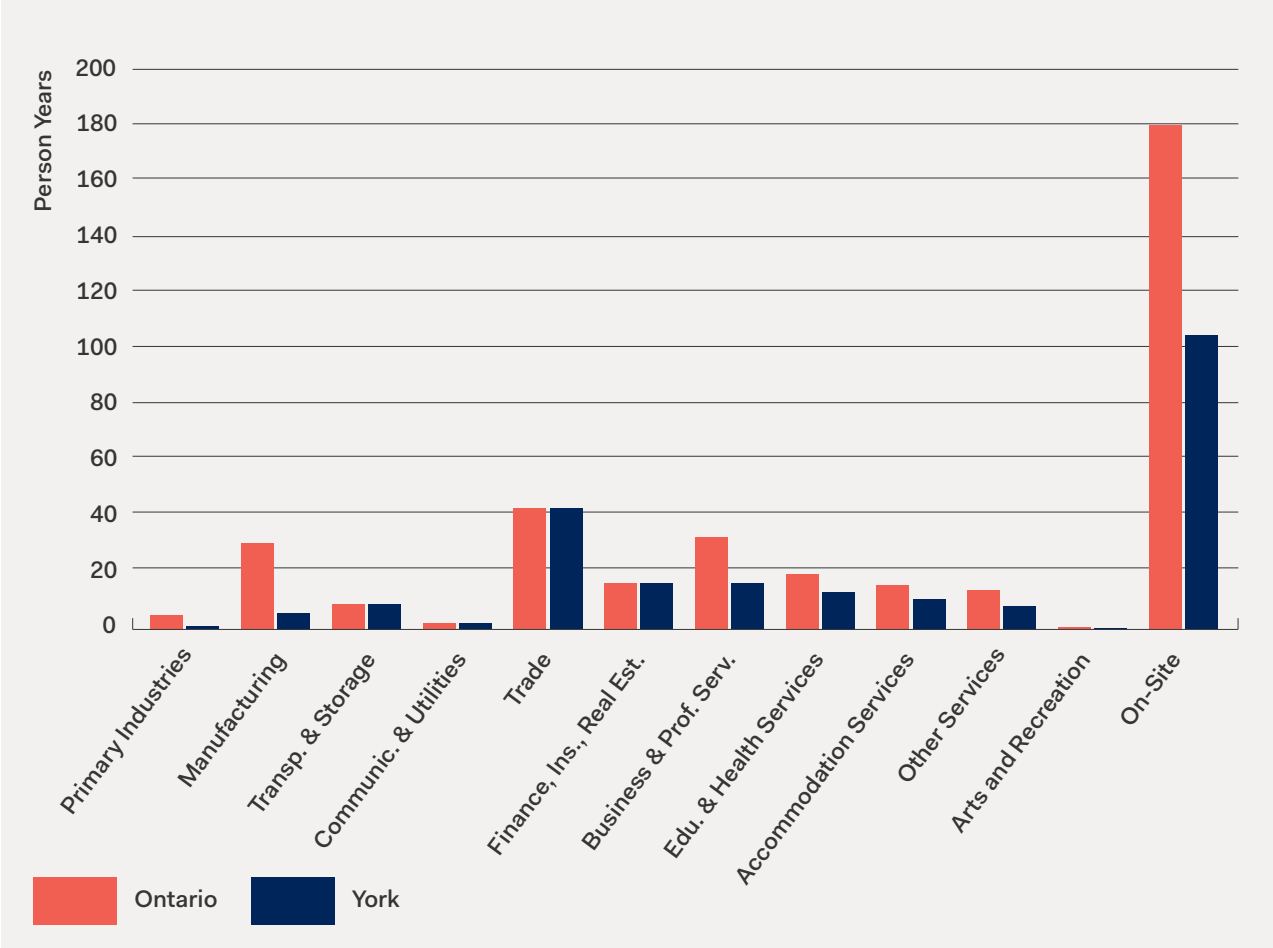


Figure 7 shows that the employment impacts associated with this construction project in Markham are distributed across most industrial categories (i.e., it has a broad-spectrum economic impact) in York Region and in Ontario as a whole.

Figure 7: Employment Impacts of IBM Capital Investment in Markham



2.3 Scenario 3: IBM Operation of the SoftLayer Data Centre

IBM Canada's SoftLayer Data Centre in Markham Ontario will involve a yearly wage-bill of $24.5 million. The following table presents a summary of the economic impacts, in York and Ontario as a whole, associated with ongoing operations.

Table 4 and Figure 8 show that annual operating expenditures (largely for highly skilled labour) of $24.5 million in Markham are estimated to generate annual total output, total value-added and total wages and salaries impacts in York Region of $36,503,000, $19,783,000 and $13,888,000 respectively, with significant economic impacts spilling over to the rest of Ontario. The wages and salaries impact in York Region reflects the creation of some 333 person-years of employment.

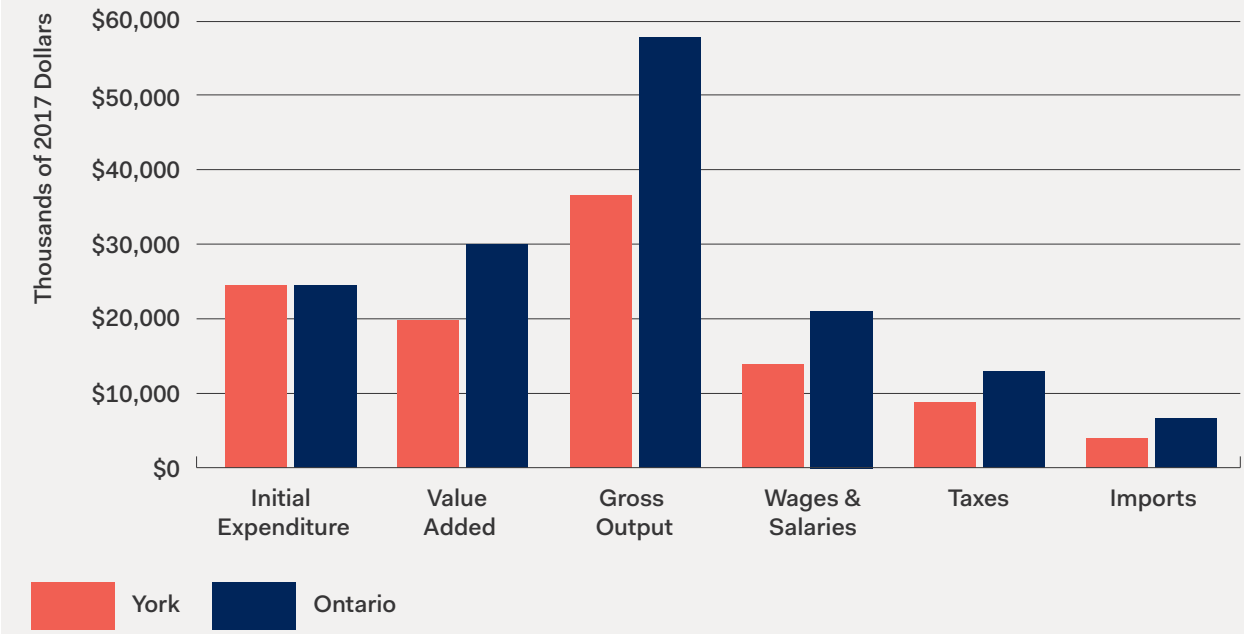
Table 4: Economic Impacts of IBM Operational Expenditures in Markham

Thousands of 2017 Dollars

	Ontario	York
Initial Expenditure	$24,500	$24,500
Value Added		
Direct	$12,782	$12,782
Indirect & Induced	$17,227	$7,001
Total	$30,009	$19,783
Multiplier	1.22	0.81
Gross Output		
Direct	$24,500	$24,500
Indirect & Induced	$33,174	$12,003
Total	$57,674	$36,503
Multiplier	2.35	1.49
Wages & Salaries		
Direct	$9,142	$9,142
Indirect & Induced	$11,904	$4,746
Total	$21,046	$13,888
Employment (P.Y.)		
Direct	154	154
Indirect & Induced	357	178
Total	511	333
Multiplier	3.31	2.16
Taxes		
Federal	$6,055	$3,982
Provincial	$5,208	$3,664
Local	$1,639	$1,153
Total	$12,902	$8,799
Imports		
From Other Provinces	$2,543	$1,554
From Other Countries	$4,148	$2,423
Total	$6,691	$3,977

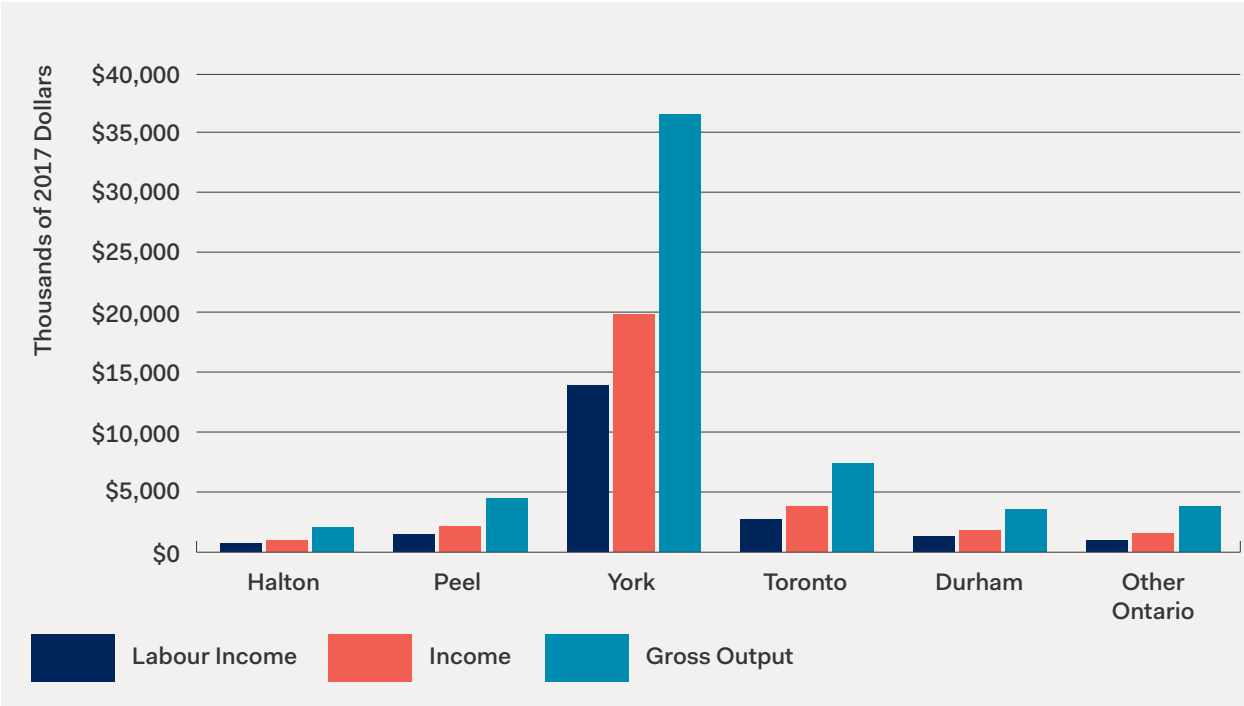
Source: Econometric Research Limited, GTA MRIO Model

Figure 8: Economic Impacts of IBM Operational Expenditures in Markham



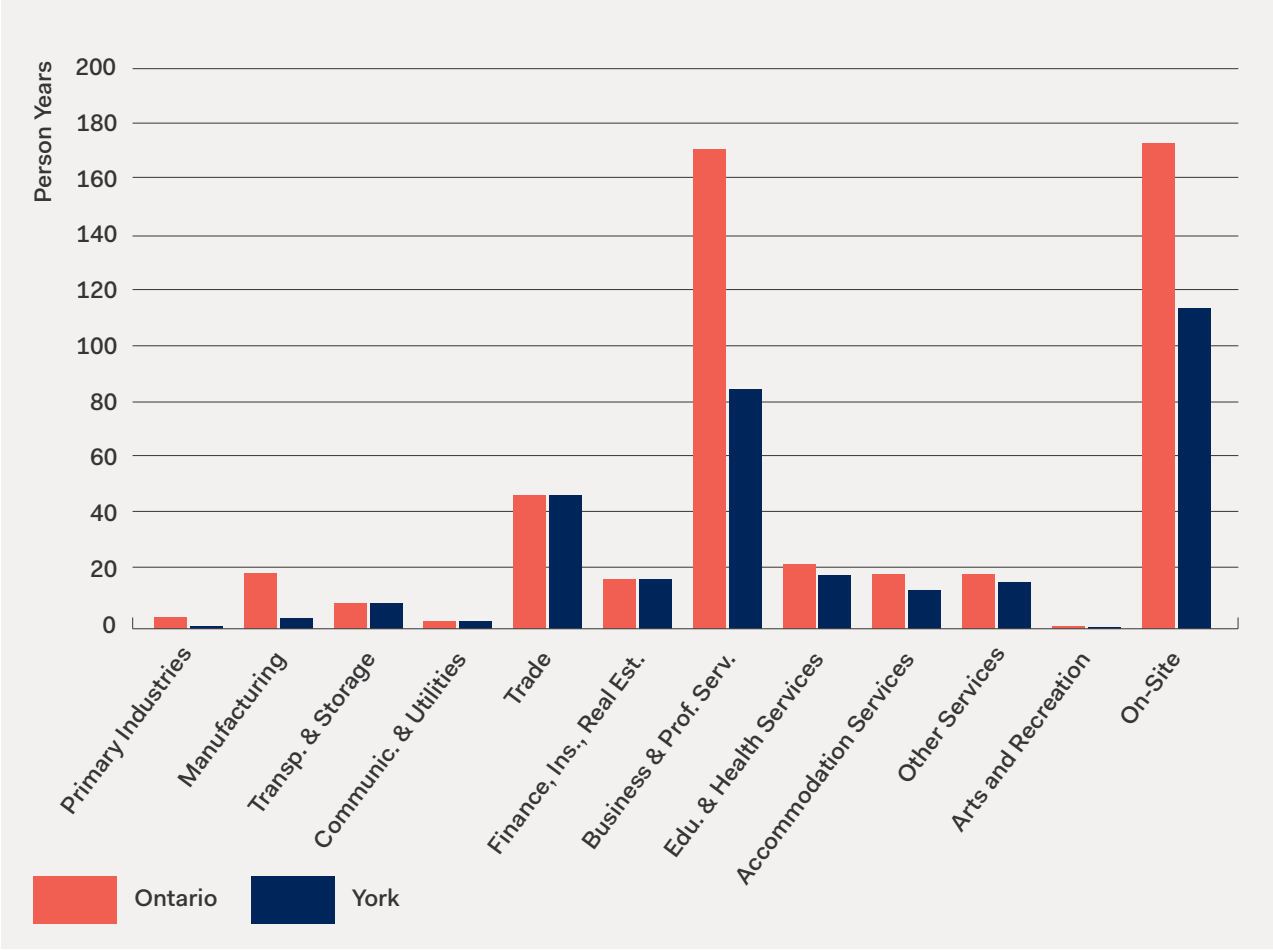
While Figure 8 makes the point that both York Region and Ontario as a whole benefit from the ongoing operation of IBM's SoftLayer data centre in Markham, **Figure 9** shows that this $24.5 million in annual expenditures stands to have a significant impact on the other constituent municipalities of the GTA.

Figure 9: Inter-Regional Economic Impacts of IBM Operational Expenditures in Markham



The employment impacts associated with the operation of the data centre in Markham accrue in many industrial sectors within the region and beyond, in addition to that which occurs on site. **Figure 10** presents the total employment impact associated with yearly operations of the facility in Markham broken down by the industries in which they accrue. Interestingly, and in stark contrast to the profile associated with the construction phase shown earlier (see Figure 6), the employment impacts associated with operations are concentrated overwhelmingly in the "Business and Professional Services" industry (which includes everything from scientific consulting, to legal services, to engineering and laboratory analysis services).

Figure 10: Employment Impacts of IBM Operational Expenditures in Markham



2.4 Scenario 4: Huawei Capital Investment in Markham

Huawei has invested $36.5 million in Markham for the creation of a new headquarters for the Canadian operations. This is planned to be a greenfield development (i.e., to involve construction on formerly unused land). Table 5 and Figure 11 show that this planned $36.5 million investment in Markham is estimated to generate total output, total value-added and total wages and salaries impacts in York Region of $48,308,000, $23,452,000 and $17,430,000 respectively. The wages and salaries impact reflects the creation of some 394 person-years of employment within York Region as a result of Huawei's investment and hiring activities.

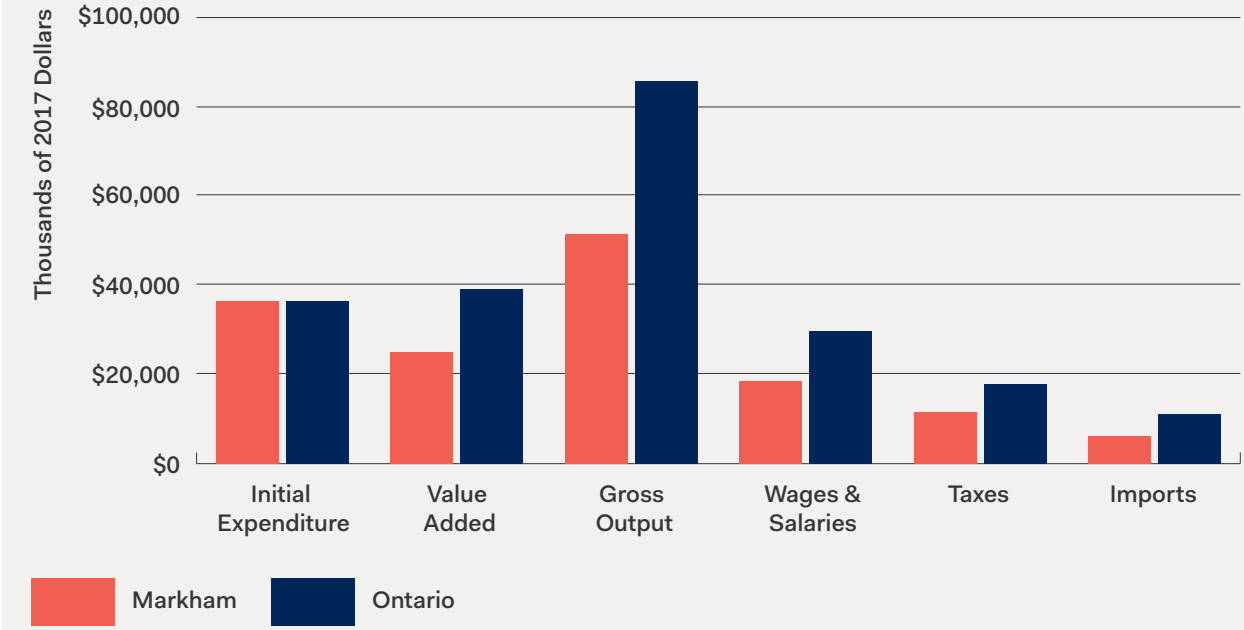
Table 5: Economic Impacts Huawei Capital Investment in Markham

Thousands of 2017 Dollars

	Ontario	Markham
Initial Expenditure	$36,500	$36,500
Value Added		
Direct	$15,351	$15,351
Indirect & Induced	$23,993	$9,786
Total	$39,344	$25,137
Multiplier	1.08	0.69
Gross Output		
Direct	$36,500	$36,500
Indirect & Induced	$49,608	$15,160
Total	$86,108	$51,660
Multiplier	2.36	1.42
Wages & Salaries		
Direct	$13,369	$13,369
Indirect & Induced	$16,539	$5,263
Total	$29,908	$18,632
Employment (P.Y.)		
Direct	148	148
Indirect & Induced	509	276
Total	657	424
Multiplier	4.43	2.86
Taxes		
Federal	$7,580	$4,855
Provincial	$7,876	$5,057
Local	$2,478	$1,591
Total	$17,934	$11,503
Imports		
From Other Provinces	$3,945	$2,272
From Other Countries	$7,227	$3,960
Total	$11,172	$6,232

Source: Econometric Research Limited, GTA MRIO Model

Figure 11: Economic Impacts of Huawei Capital Investment in Markham



Noteworthy is the fact that $36.5 million in investment and hiring activity in Markham stands to have significant economic impacts across all regions of the GTA, and the rest of Ontario (see **Figure 12**).

Figure 12: Inter-Regional Economic Impacts of Huawei Capital Investment in Markham

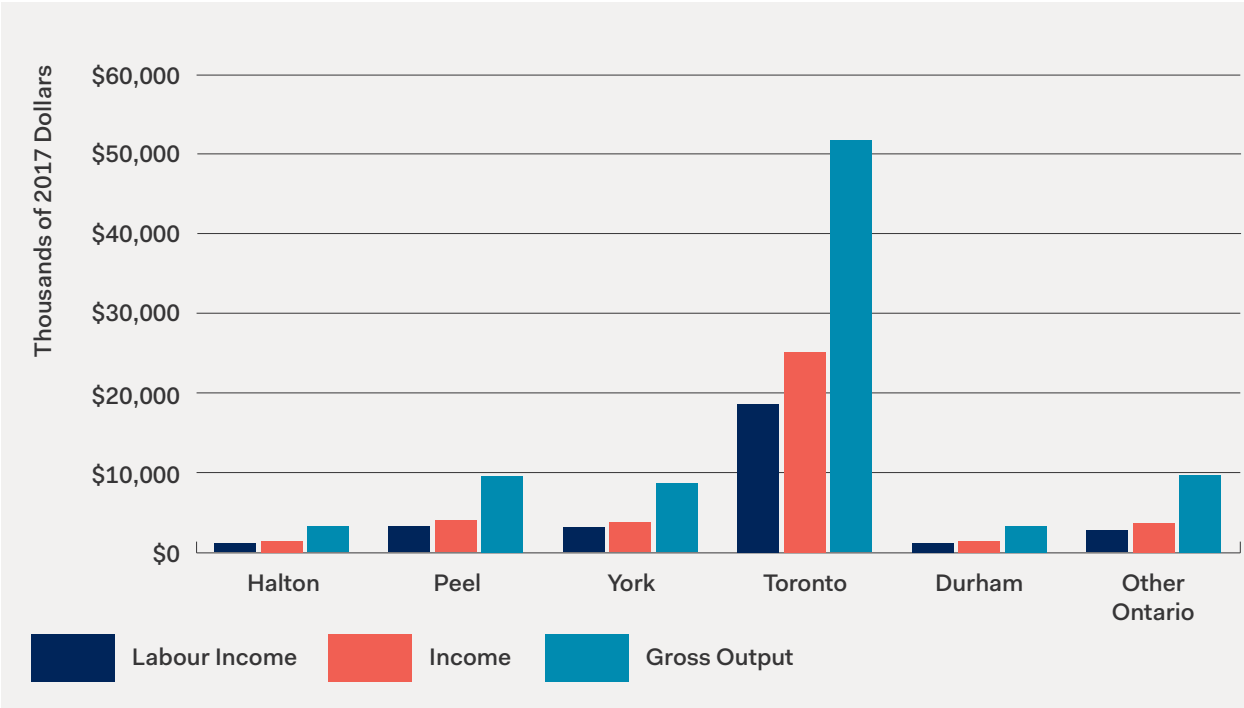
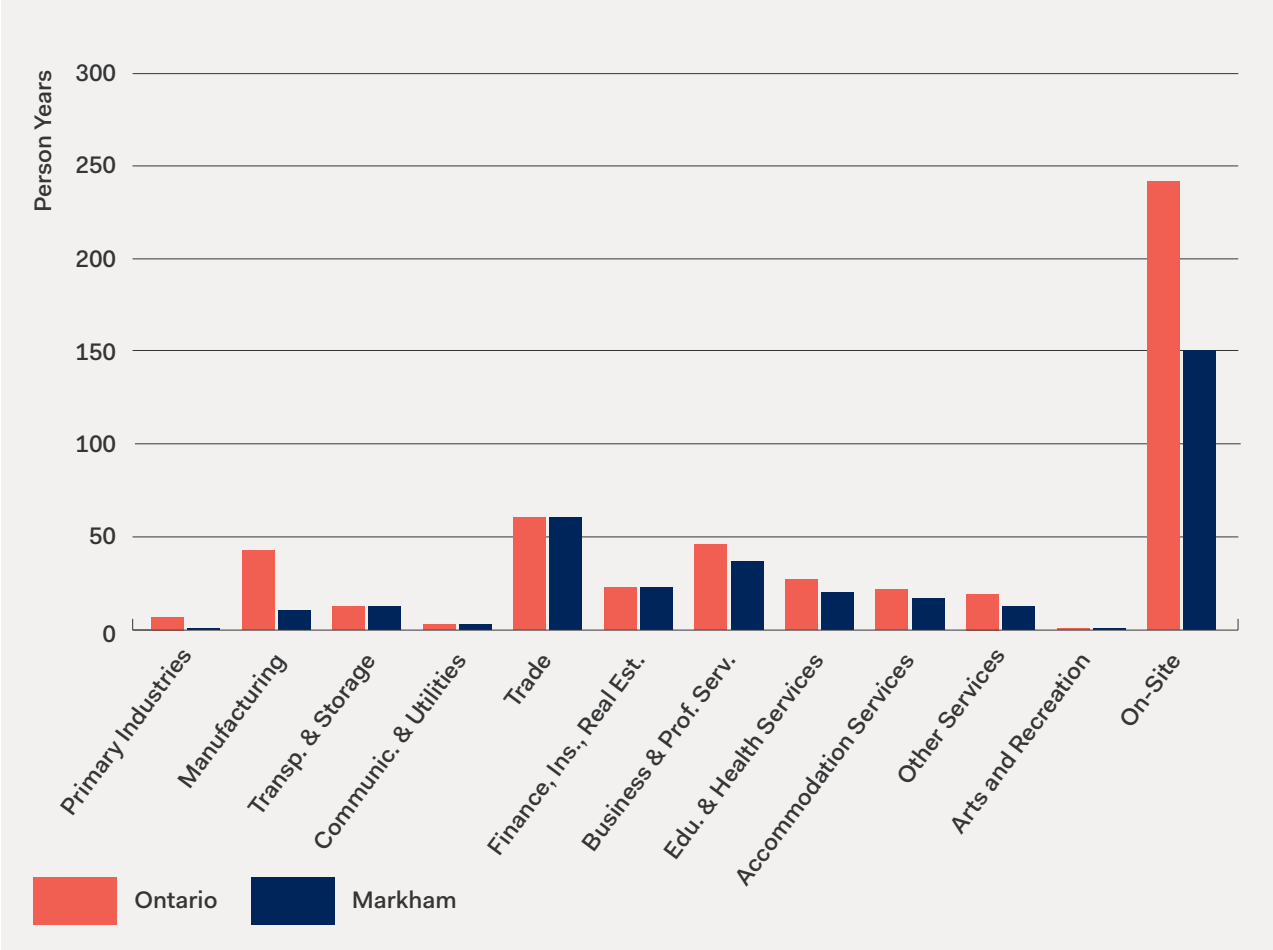


Figure 13 shows that the employment impacts in Markham are spread across many industrial sectors, largely in trade industries.

Figure 13: Employment Impacts of Huawei Capital Investment in Markham



2.5 Scenario 5: Huawei Operations in Markham

Huawei Canada upgraded their capacity in Markham by hiring additional administrative, engineering and sales employees representing $28 million in annual expenditures. Table 6 and Figure 14 provide a summary of the associated economic impacts. By hiring administrative, R&D and sales employees (at a cost of $28 million annually) in Markham, we calculate that Huawei stimulates additional total industrial output, total value-added and total wages and salaries impacts in York Region of $41,717,000, $22,610,000 and $15,872,000 respectively. The wages and salaries impacts reflect the creation of some 383 person-years of employment in York Region.

Table 6: Economic Impacts of Huawei Operational Expenditures in Markham

Thousands of 2017 Dollars

	Ontario	York
Initial Expenditure	$28,000	$28,000
Value Added		
Direct	$14,900	$14,900
Indirect & Induced	$19,397	$7,710
Total	$34,297	$22,610
Multiplier	1.22	0.81
Gross Output		
Direct	$28,000	$28,000
Indirect & Induced	$37,914	$13,717
Total	$65,914	$41,717
Multiplier	2.35	1.49
Wages & Salaries		
Direct	$10,657	$10,657
Indirect & Induced	$13,395	$5,215
Total	$24,052	$15,872
Employment (P.Y.)		
Direct	180	180
Indirect & Induced	407	203
Total	587	383
Multiplier	3.26	2.13
Taxes		
Federal	$6,712	$4,413
Provincial	$5,743	$4,050
Local	$1,807	$1,274
Total	$14,262	$9,737
Imports		
From Other Provinces	$2,855	$1,742
From Other Countries	$4,659	$2,716
Total	$7,514	$4,458

Source: Econometric Research Limited, GTA MRIO Model

Figure 14: Economic Impacts of Huawei Operational Expenditures in Markham

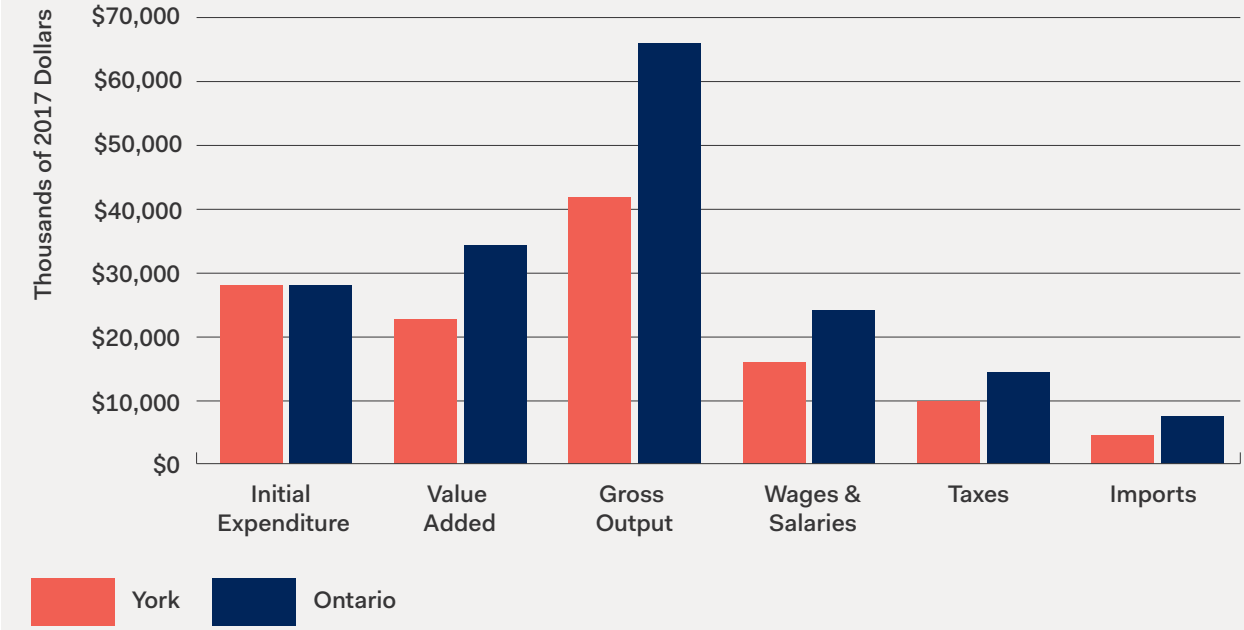


Figure 15 shows that Huawei's $28 million in operational expenditures on administrative, engineering and sales employees in Markham has a measurable impact on all other regions within the GTA, as well as in Ontario as a whole (though most of the impact is concentrated within Markham as would be expected given the service and technical employment nature of these expenditures).

Figure 15: Inter-Regional Economic Impacts of Huawei Operational Expenditures in Markham

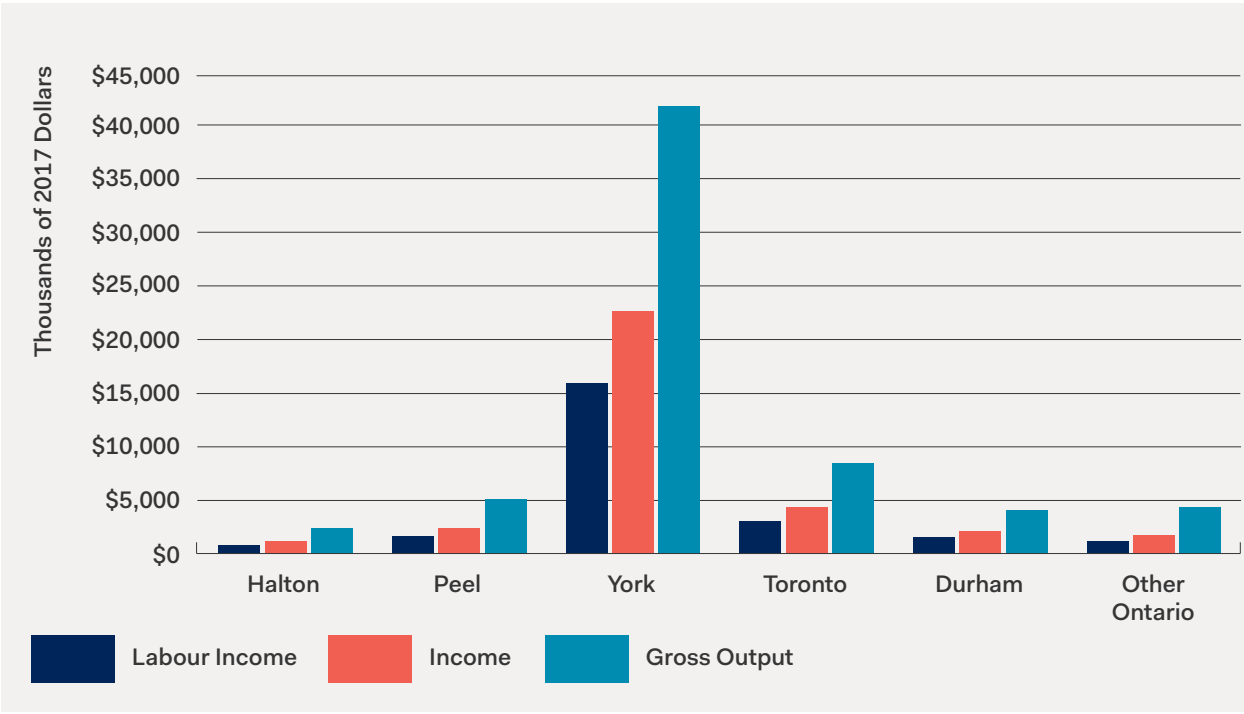
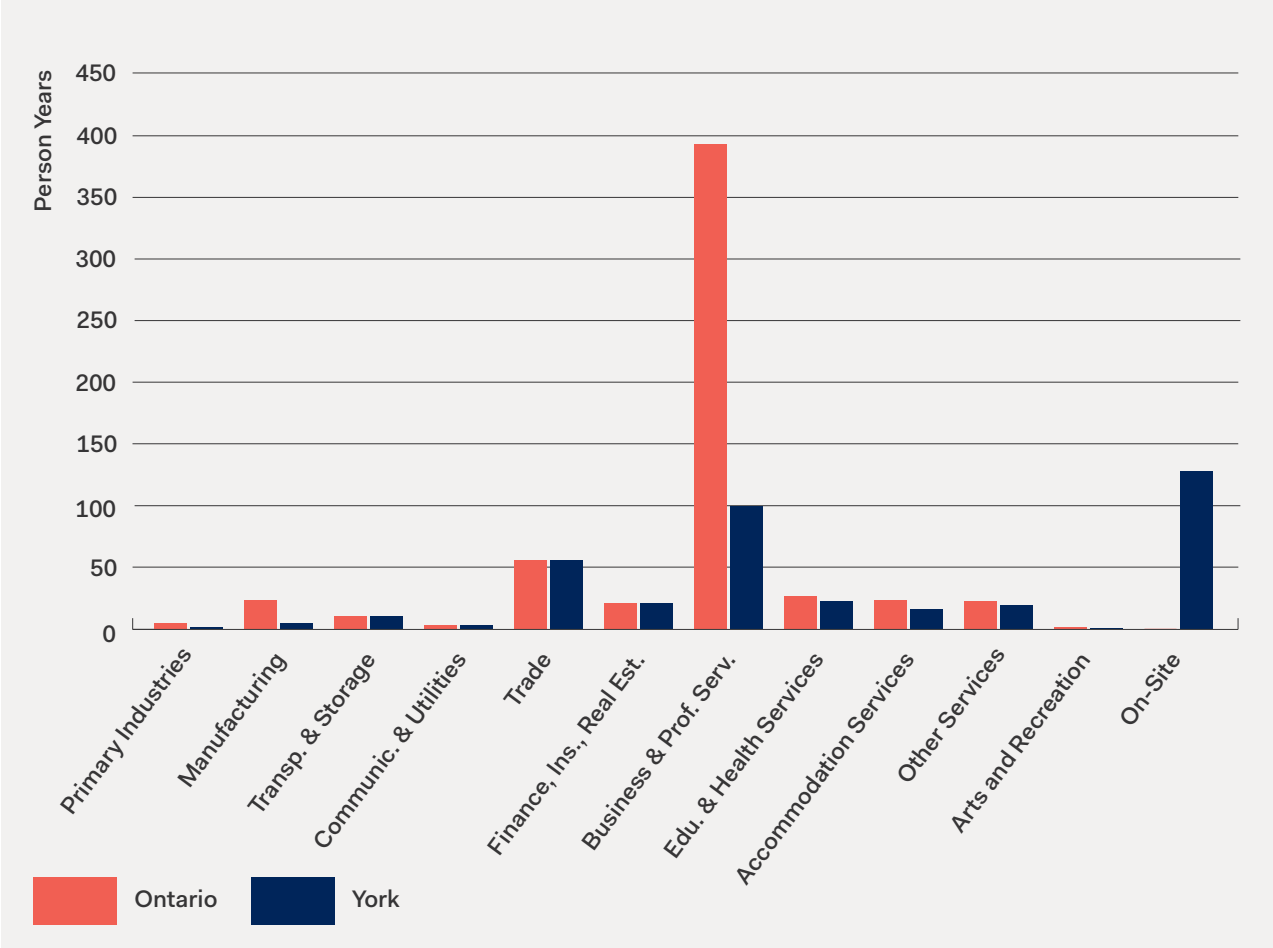


Figure 16 shows that the employment impact in Markham associated with these operational expenditures is spread across most other sectors, but with a very clear concentration in the "Business and Professional Services" industry.

Figure 16: Employment Impacts of Huawei Operational Expenditures in Markham



2.6 Scenario 6: Cisco Systems in Toronto

In 2014 Cisco Systems Canada invested $100 million to establish an ICT R&D facility and start-up incubator in the City of Toronto. Cisco did not build its own facility, but rather leased existing space. Table 7 and Figure 17 provide a summary of the associated economic impacts.

Table 7: Economic Impacts of Cisco Operational Expenditures in Toronto

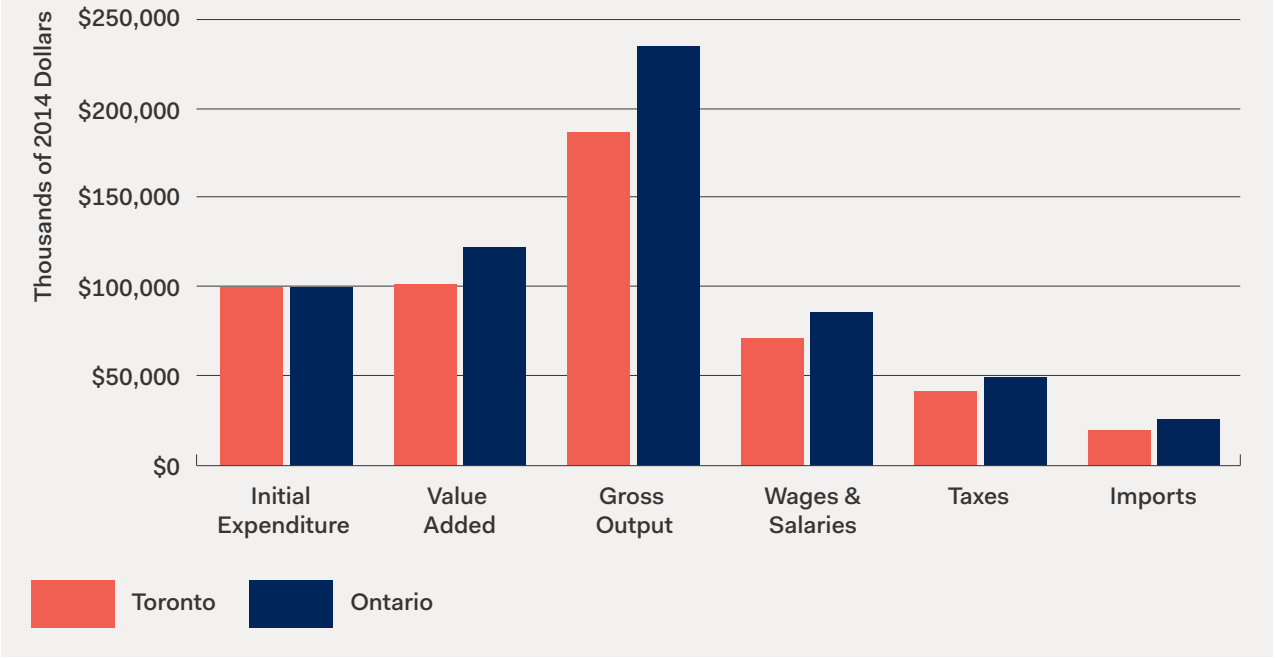
Thousands of 2014 Dollars

	Ontario	Toronto
Initial Expenditure	$100,000	$100,000
Value Added		
Direct	$55,861	$55,861
Indirect & Induced	$66,628	$45,764
Total	$122,489	$101,625
Multiplier	1.22	1.02
Gross Output		
Direct	$100,000	$100,000
Indirect & Induced	$135,409	$86,933
Total	$235,409	$186,933
Multiplier	2.35	1.87
Wages & Salaries		
Direct	$39,955	$39,955
Indirect & Induced	$45,941	$31,694
Total	$85,896	$71,649
Employment (P.Y.)		
Direct	675	675
Indirect & Induced	1,493	1,123
Total	2,168	1,798
Multiplier	3.21	2.67
Taxes		
Federal	$23,399	$19,402
Provincial	$19,934	$16,961
Local	$6,273	$5,337
Total	$49,606	$41,700
Imports		
From Other Provinces	$9,988	$7,741
From Other Countries	$16,297	$12,109
Total	$26,285	$19,850

Source: Econometric Research Limited, GTA MRIO Model

By hiring employees to allow Cisco to further its presence in smart technologies and the "Internet of Things", and by conducting operations at the City of Toronto facility, we calculate that Cisco stimulated total output, total value-added and total wages and salaries impacts of $186,933,000, $101,625,000 and $71,649,000 respectively within the City of Toronto. The wages and salaries impact reflects the creation of some 1,798 person-years of employment in the City of Toronto.

Figure 17: Economic Impacts of Cisco Operational Expenditures in Toronto



Noteworthy is that that this $100 million in expenditure by Cisco in the City of Toronto has a substantial impact on employment in all other regions of the GTA, with Toronto clearly capturing the majority (as would be expected given the very specialized nature of the required employees and associated services). That said, even this very high-technology-oriented venture results in spillover to the other constituent municipalities of the GTA (see **Figure 18**).

Figure 18: Inter-Regional Economic Impacts of Cisco Operational Expenditures in Toronto

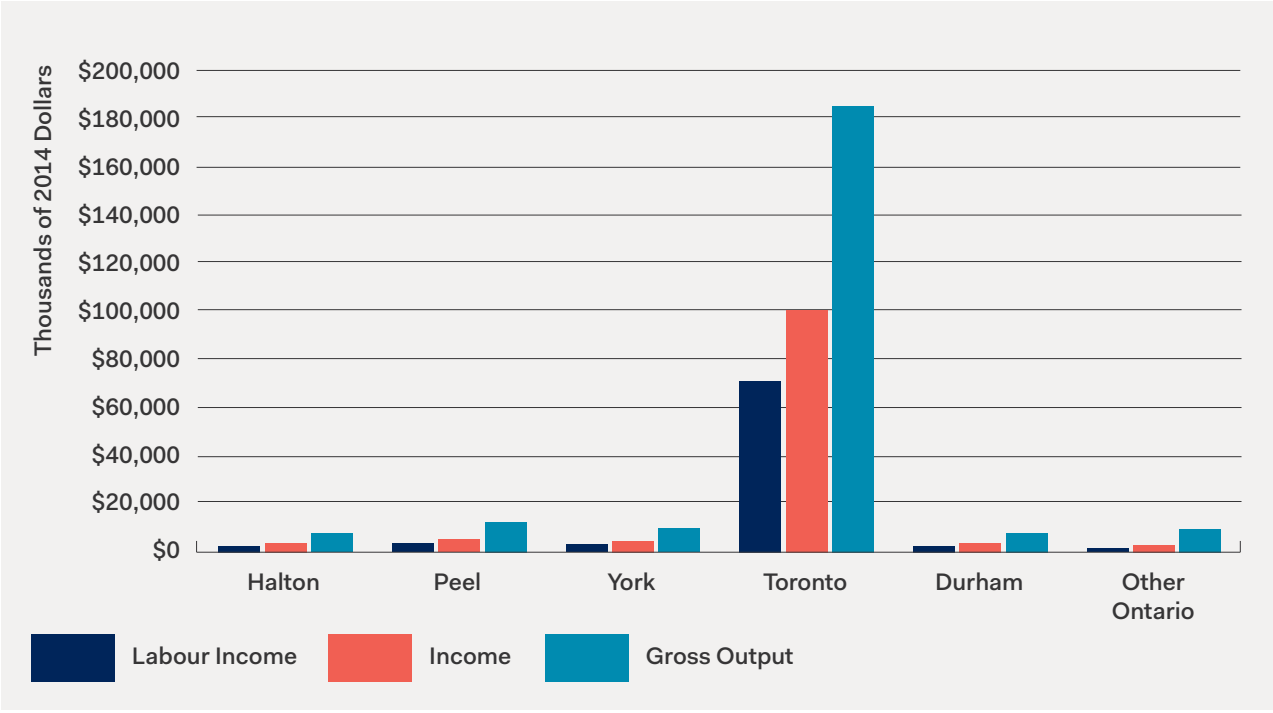
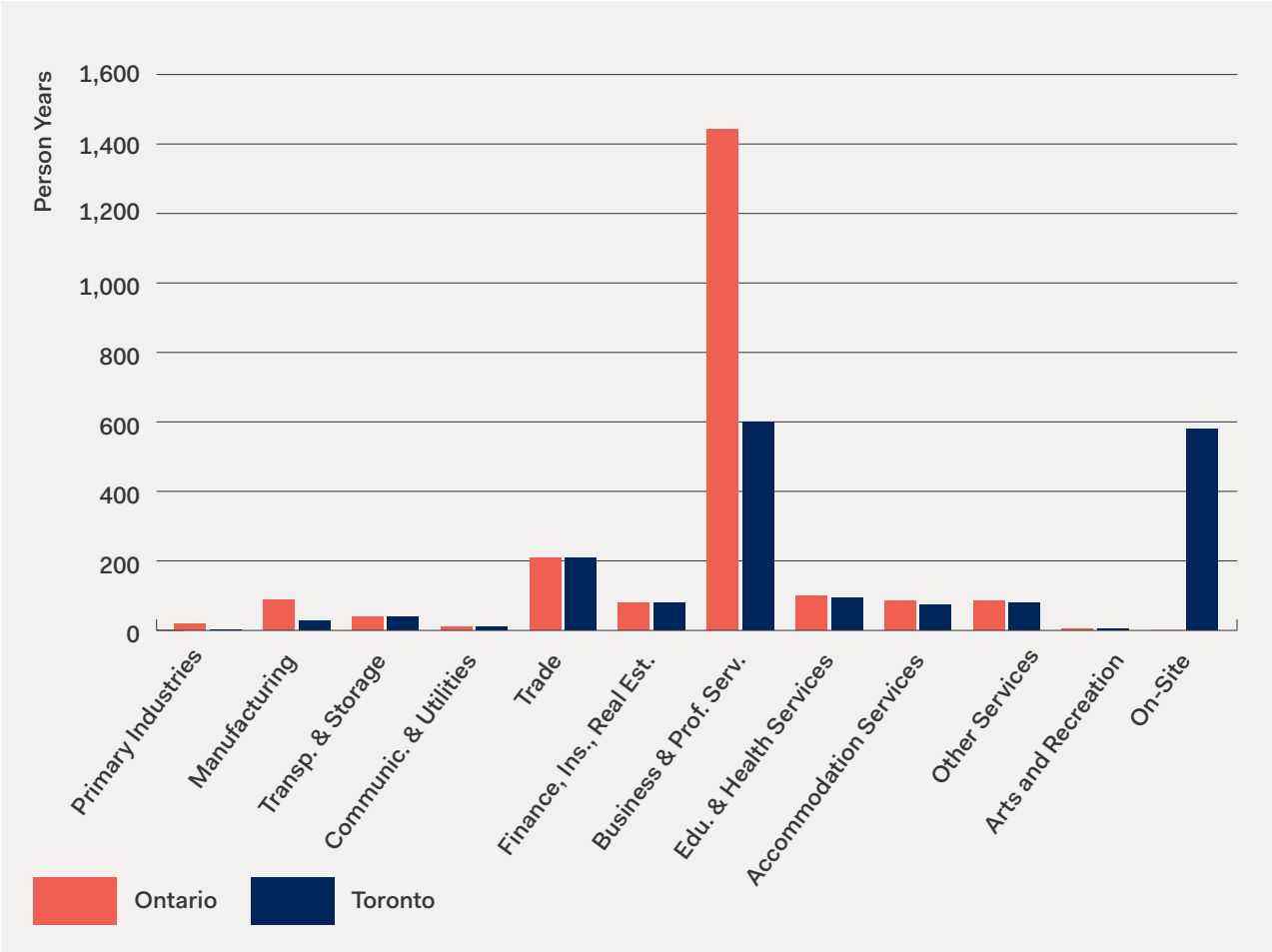


Figure 19 shows that the employment impact associated with Cisco's operations in the City of Toronto are spread over most industrial sectors, with the majority being captured by the "Business and Profession Services" sector. Interestingly though, employment impacts within this industrial category are most pronounced for the province overall, perhaps reflecting strong connections to other key technology hubs in Ontario such as Waterloo and Kanata.

Figure 19: Employment Impacts of Cisco Operational Expenditures in Toronto



2.7 Scenario 7: Thomson Reuters Toronto Technology Centre

Thomson Reuters Canada has recently announced plans to create a new Toronto Technology Centre (TR-TTC), starting with 200 highly skilled employees and quickly ramping up to 400 and then 1,500 new employees (in highly skilled occupations) in the City of Toronto. Thomson Reuters will accomplish this by leasing existing space and hiring specialized labour. In what follows, we estimate the interregional economic impacts associated with 200 highly skilled jobs earning on average $120,000 per year. Table 8 presents a summary of the associated economic impacts.

Table 8: Economic Impacts of Thomson Reuters Operational Expenditures in Toronto

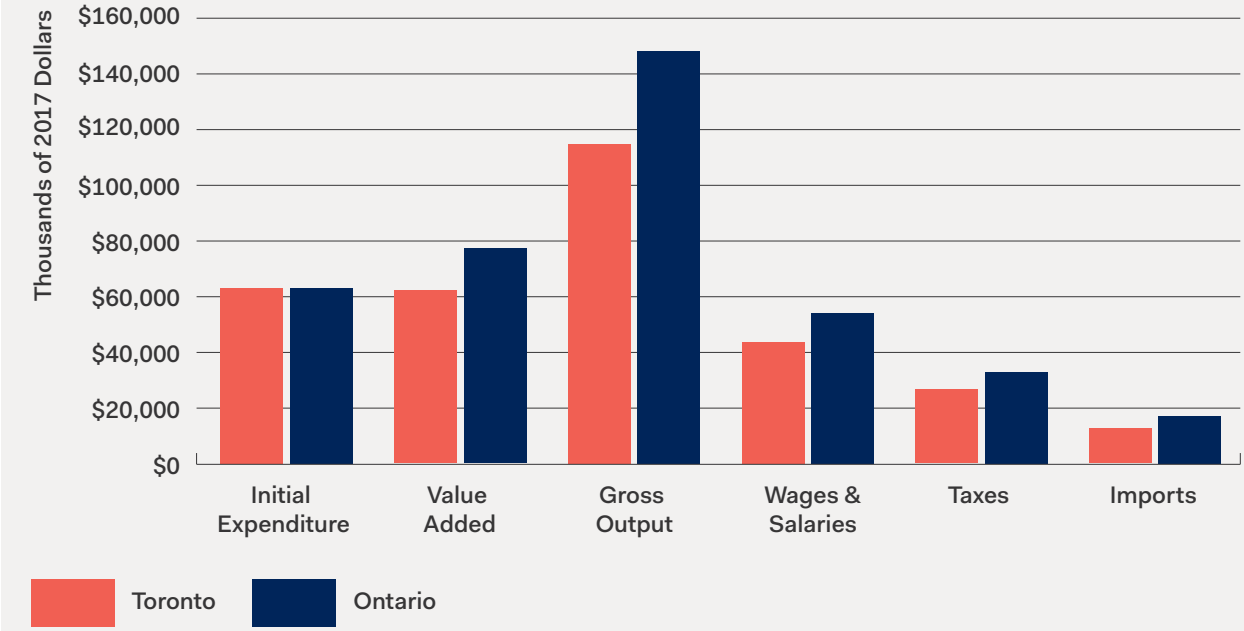
Thousands of 2017 Dollars

	Ontario	Toronto
Initial Expenditure	$63,000	$63,000
Value Added		
Direct	$33,525	$33,525
Indirect & Induced	$43,644	$28,656
Total	$77,169	$62,181
Multiplier	1.22	0.99
Gross Output		
Direct	$63,000	$63,000
Indirect & Induced	$85,307	$51,765
Total	$148,307	$114,765
Multiplier	2.35	1.82
Wages & Salaries		
Direct	$23,979	$23,979
Indirect & Induced	$30,135	$19,652
Total	$54,114	$43,631
Employment (P.Y.)		
Direct	200	200
Indirect & Induced	917	649
Total	1,117	849
Multiplier	3.27	2.60
Taxes		
Federal	$15,473	$12,498
Provincial	$13,171	$10,670
Local	$4,144	$3,357
Total	$32,788	$26,525
Imports		
From Other Provinces	$10,484	$7,614
From Other Countries	$6,425	$4,866
Total	$16,909	$12,480

Source: Econometric Research Limited, GTA MRIO Model

The economic impacts associated with the establishment and operation of Thomson Reuter's new Toronto Technology Centre (employment of 200) is expected to generate total output, total value-added and total wages and salaries impacts of $114,765,000, $62,181,000, and $43,631,000 respectively within the City of Toronto. The wages and salaries impact in the City of Toronto reflects the stimulation of 849 person-years of employment in the city. Interestingly, the operation of the TR-TTC in the City of Toronto leads to province-wide total output, total value-added and total wages and salaries impacts of $148,307,000, $77,169,000 and $54,114,000 respectively. Clearly the City of Toronto is capturing the lion's share of these provincial impacts, as indicated in the **Figure 20**.

Figure 20: Economic Impacts of Thomson Reuters Operational Expenditures in Toronto



Noteworthy is the fact that this expenditure by Thomson Reuters in the City of Toronto has a measurable impact on employment in the other municipalities which comprise the GTA (while Toronto's dominance is not surprising given the nature of these expenditures – see **Figure 21**).

Figure 21: Inter-Regional Economic Impacts of Thomson Reuters Operational Expenditures in Toronto

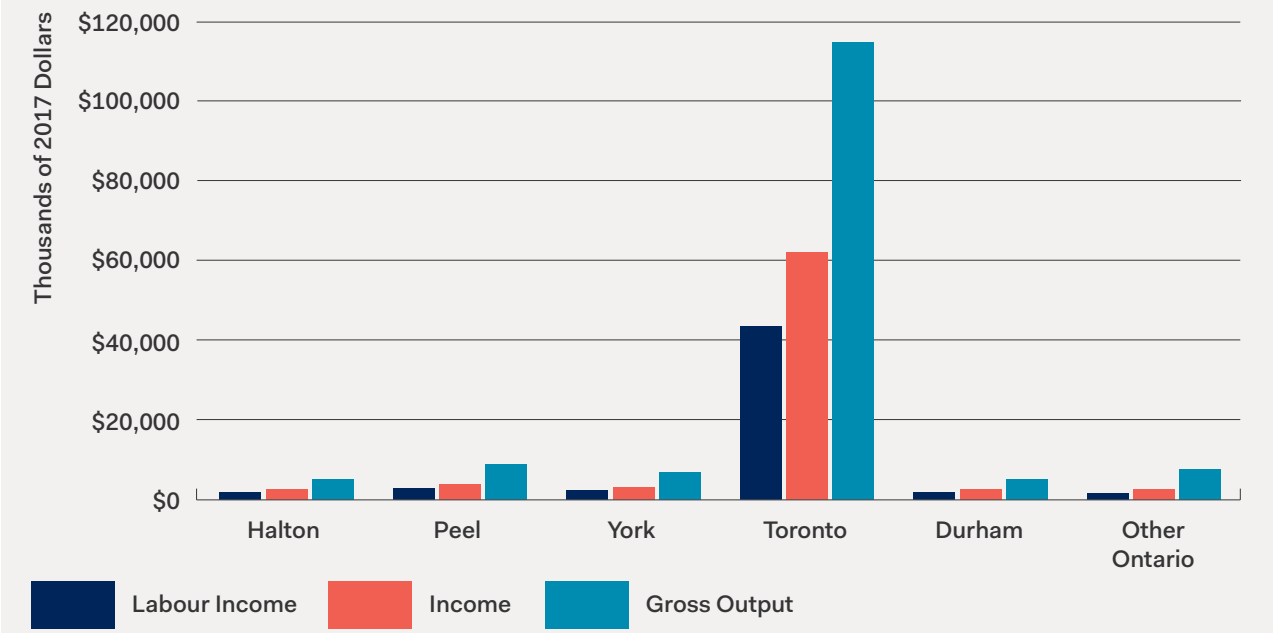
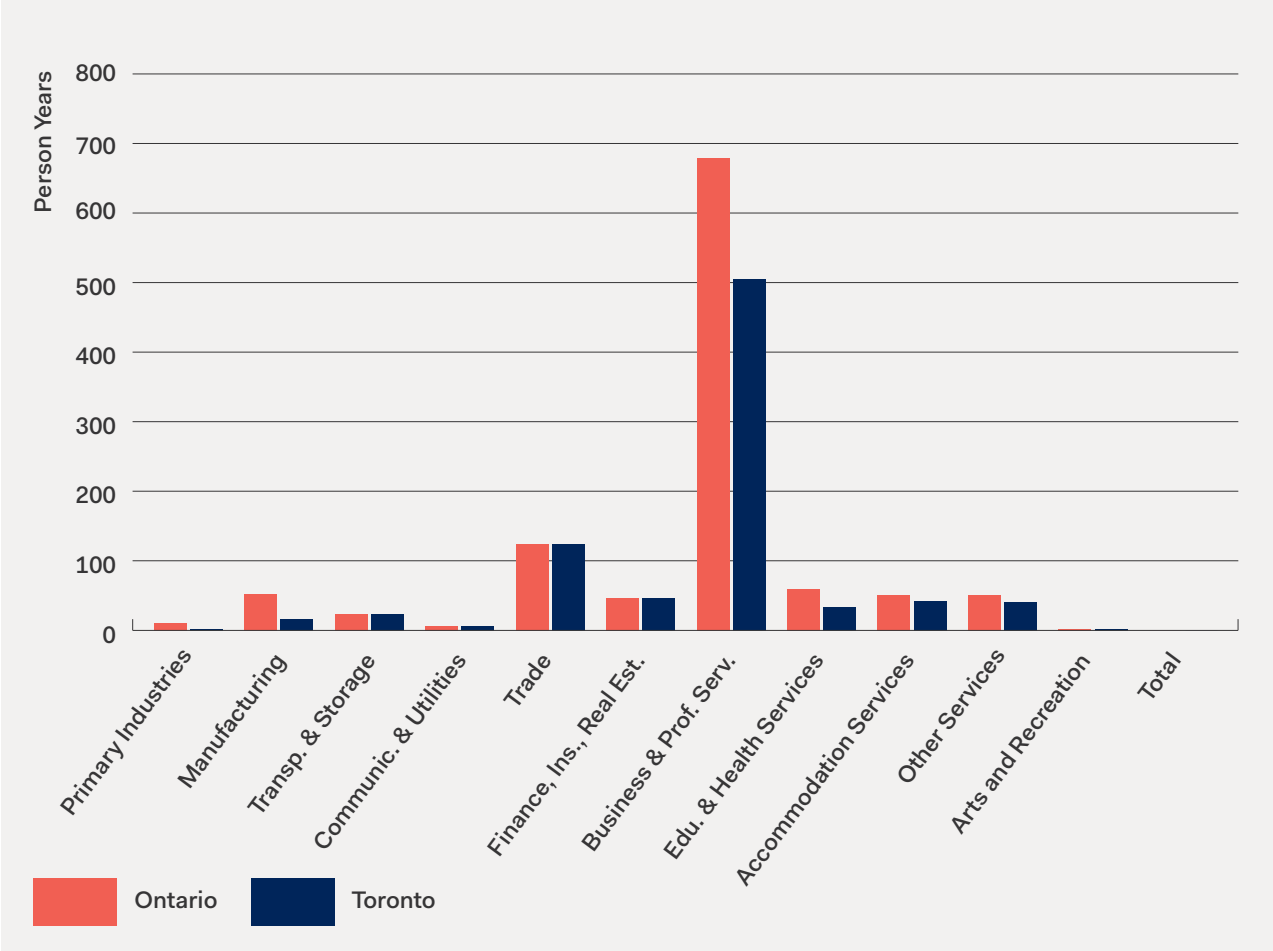


Figure 22 shows that the employment impact associated with Thomson Reuter's Toronto Technology Centre are spread over most industrial sectors in the City of Toronto, with the "Business and Personal Services" industry accounting for the majority.

Figure 22: Employment Impacts of Thomson Reuters Operational Expenditures in Toronto



2.8 Scenario 8: Hans Steel Facility in Uxbridge/Durham

Hans Steel is planning the development of a large warehouse and a steel manufacturing facility in the Township of Uxbridge in Durham Region. The subject parcel is 5.2 ha in size and supports a 7,505m^2 warehouse and office building. Hans Steel is currently proposing a 3,705m^2 addition to house the steel manufacturing company. The lands surrounding the subject property are industrial. The new development involves the investment of $20 million in Durham, of which land cost is approximately $5.2 million. Table 9 presents a summary of the associated economic impacts.

Table 9: Economic Impacts of Hans Steel Capital Expenditures in Uxbridge

Thousands of 2017 Dollars

	Ontario	Durham
Initial Expenditure	$20,000	$20,000
Value Added		
Direct	$5,647	$5,647
Indirect & Induced	$9,115	$4,180
Total	$14,762	$9,827
Multiplier	0.74	0.49
Gross Output		
Direct	$15,000	$15,000
Indirect & Induced	$19,595	$4,550
Total	$34,595	$19,550
Multiplier	1.73	0.98
Wages & Salaries		
Direct	$4,407	$4,407
Indirect & Induced	$6,241	$1,510
Total	$10,648	$5,917
Employment (P.Y.)		
Direct	62	62
Indirect & Induced	188	50
Total	250	113
Multiplier	4.01	1.81
Taxes		
Federal	$2,958	$1,347
Provincial	$2,521	$1,155
Local	$793	$363
Total	$6,272	$2,865
Imports		
From Other Provinces	$3,229	$1,085
From Other Countries	$1,485	$592
Total	$4,714	$1,677

Source: Econometric Research Limited, GTA MRIO Model

The economic impacts associated with the establishment of the Hans Steel facility in Uxbridge is expected to generate total output, total value-added and total wages and salaries impacts of $19,550,000, $9,827,000 and $5,917,000 respectively within Durham Region. The wages and salaries impact in Durham Region reflects the stimulation of some 113 person-years of employment. Interestingly, the $20 million investment by Hans Steel in Durham Region leads to province-wide total output, total value-added and total wages and salaries impacts of $34,595,000, $14,672,000 and $10,648,000 respectively. Table 9 shows that even though Durham Region's economic base is relatively concentrated in rural activities, it still manages to capture more than half of all spin-off effects associated with this investment as shown in **Figure 23**.

Figure 23: Economic Impacts of Hans Steel Capital Expenditures in Uxbridge

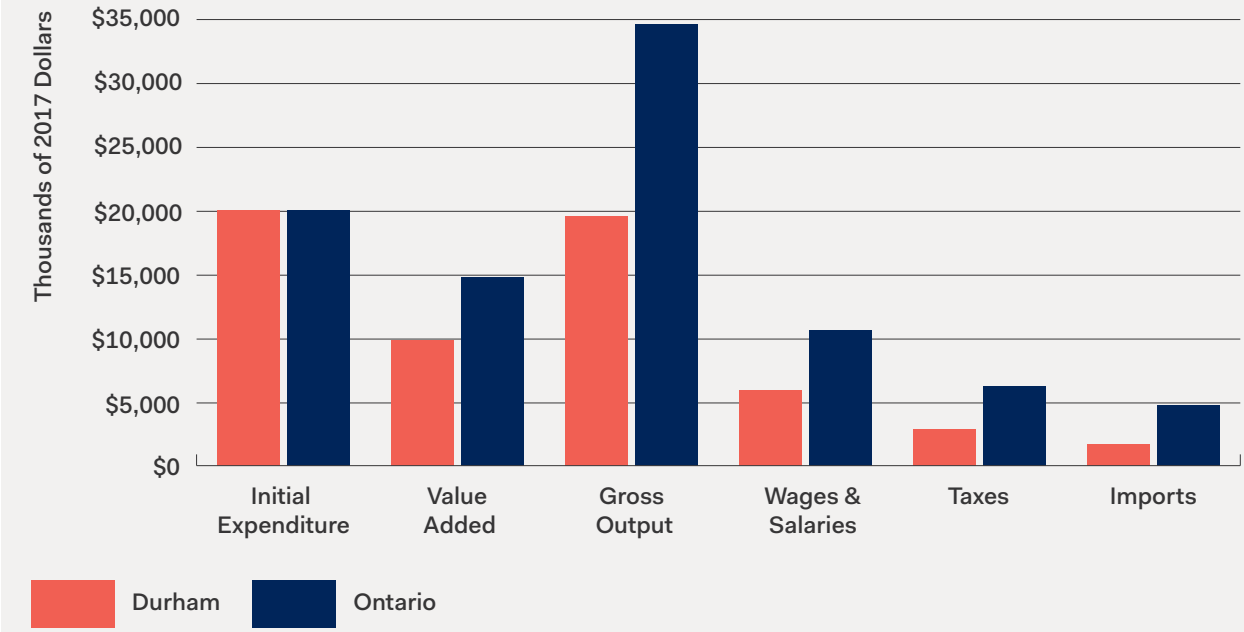
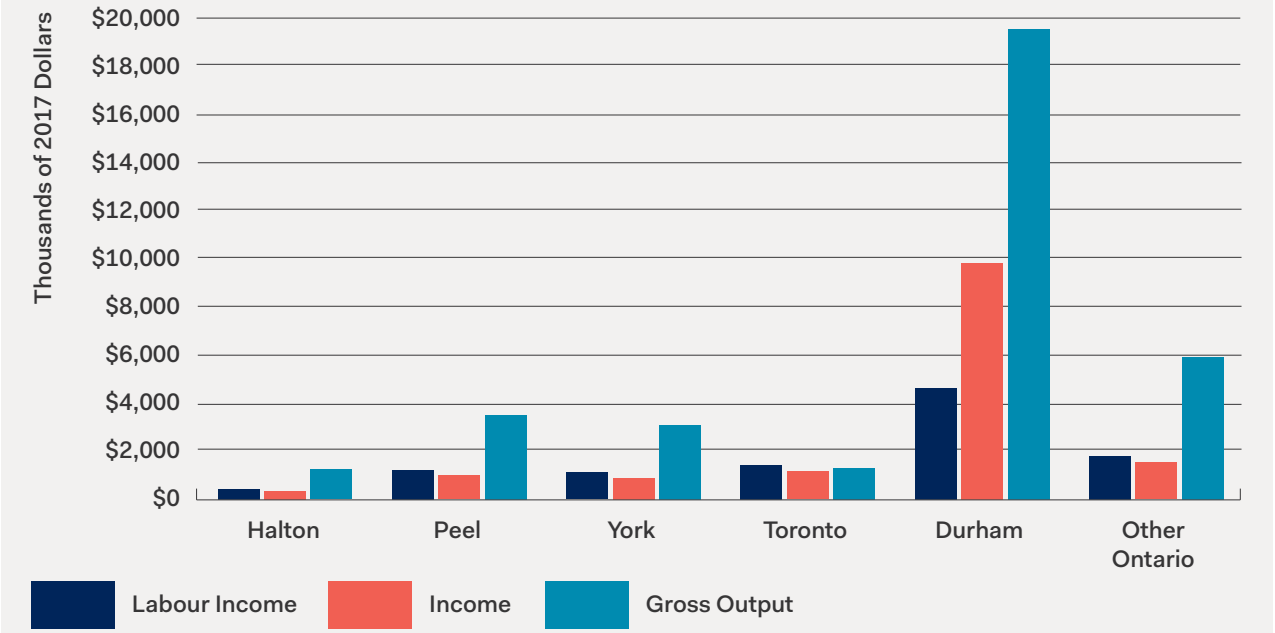


Figure 24 shows that this investment in Uxbridge/Durham, while having its largest impacts in Durham itself, also stimulates considerable output, value-added and employment impacts (not to mention tax revenues of myriad sorts) in the other constituent regions of the GTA and indeed Ontario.[5]

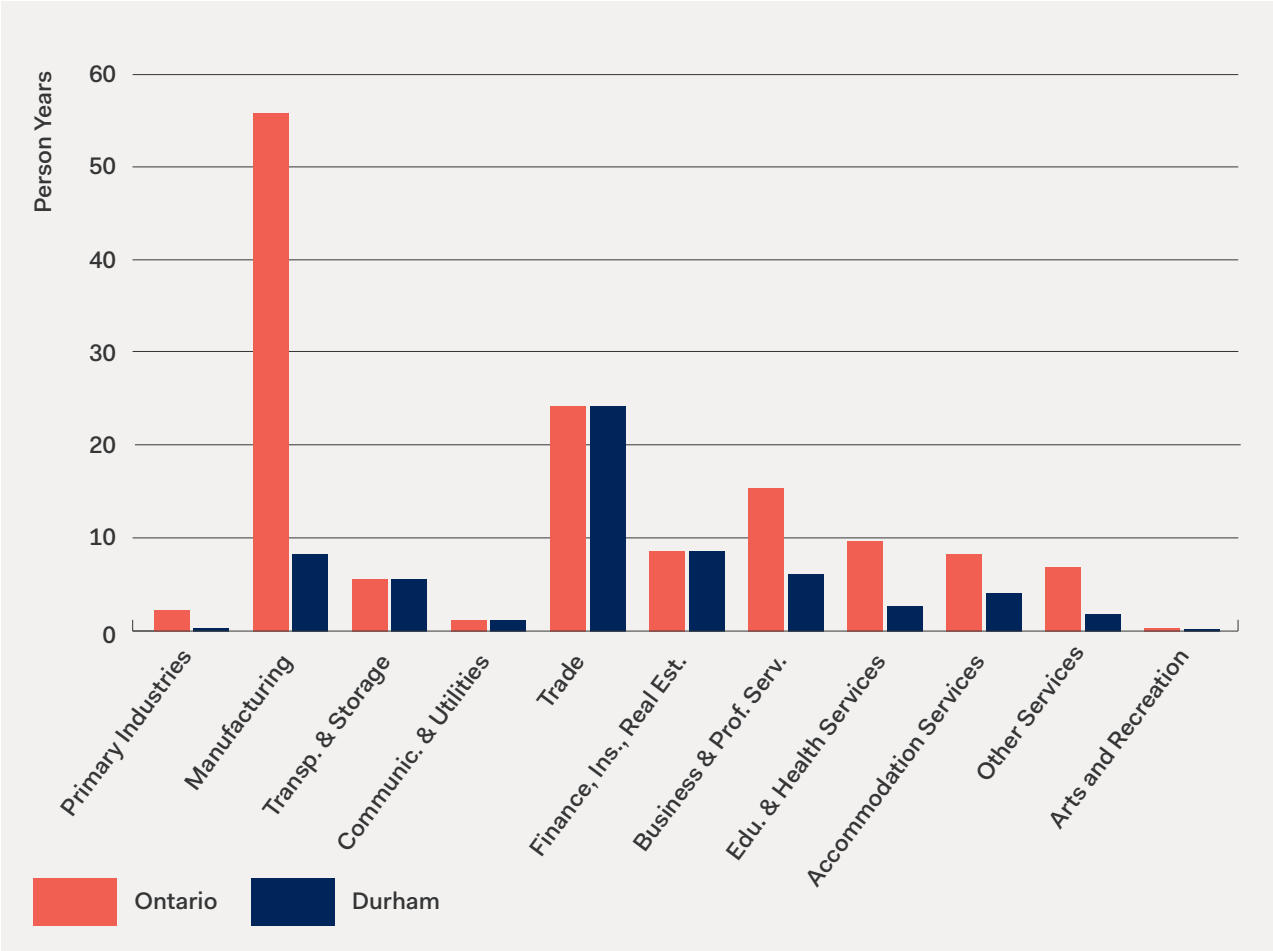
Figure 24: Inter-Regional Economic Impacts of Hans Steel Capital Expenditures in Uxbridge



5 As shown in Figure 1 above, Markham is one jurisdiction inside York Region. The MRIO model operates at the regional and sub-regional level (i.e., economic impacts are computed for the entirety of York Region and not specifically for the City of Markham).

Figure 25 shows while the provincial employment impacts associated with Hans Steel's investment in this new facility are concentrated in the manufacturing industry, the impacts captured by Durham Region specifically were concentrated in wholesale and retail trade sectors, with a very small manufacturing sector impact (i.e., indicative of the region's economic structure). Even with this primary focus, Hans Steel's investment stimulates substantial economic impacts in Durham Region itself.

Figure 25: Employment Impacts in Durham of Hans Steel Capital Expenditures in Uxbridge



2.9 Scenario 9: Hans Steel Operations in Uxbridge/Durham

Hans Steel's new facility will produce electrical towers and will employ approximately 80 workers on a consistent basis. Table 10 presents a summary of the economic impacts associated with the yearly operation of this facility. Table 10 and Figure 26 shows that the operations of the new facility stand to have total output, total value-added and total wages and salaries impacts in Durham Region of $27,630,000, $13,251,000 and $9,441,000 annually (in addition to local and provincial tax revenues in all jurisdictions including all regions in the GTA and the Province). Figure 27 shows how these impacts are distributed across the regions of the GTA. While Durham clearly captures the majority of the impacts, due in large part to the fact that the expenditures are made there, all of the other regions of the GTA experience substantial impacts as a result.

Table 10: Economic Impacts of Hans Steel Operational Expenditures in Uxbridge

Thousands of 2017 Dollars

	Ontario	Durham
Initial Expenditure	$16,200	$16,200
Value Added		
Direct	$5,631	$5,631
Indirect & Induced	$9,197	$7,620
Total	$14,828	$13,251
Multiplier	0.92	0.82
Gross Output		
Direct	$16,200	$16,200
Indirect & Induced	$21,228	$11,430
Total	$37,428	$27,630
Multiplier	2.31	1.71
Wages & Salaries		
Direct	$4,107	$4,107
Indirect & Induced	$6,230	$5,334
Total	$10,337	$9,441
Employment (P.Y.)		
Direct	80	80
Indirect & Induced	189	155
Total	269	235
Multiplier	3.36	2.94
Taxes		
Federal	$3,131	$1,273
Provincial	$2,626	$1,077
Local	$826	$339
Total	$6,583	$2,689
Imports		
From Other Provinces	$3,714	$1,011
From Other Countries	$1,649	$545
Total	$5,363	$1,556

Source: Econometric Research Limited, GTA MRIO Model

Figure 26: Economic Impacts of Hans Steel Operational Expenditures in Uxbridge

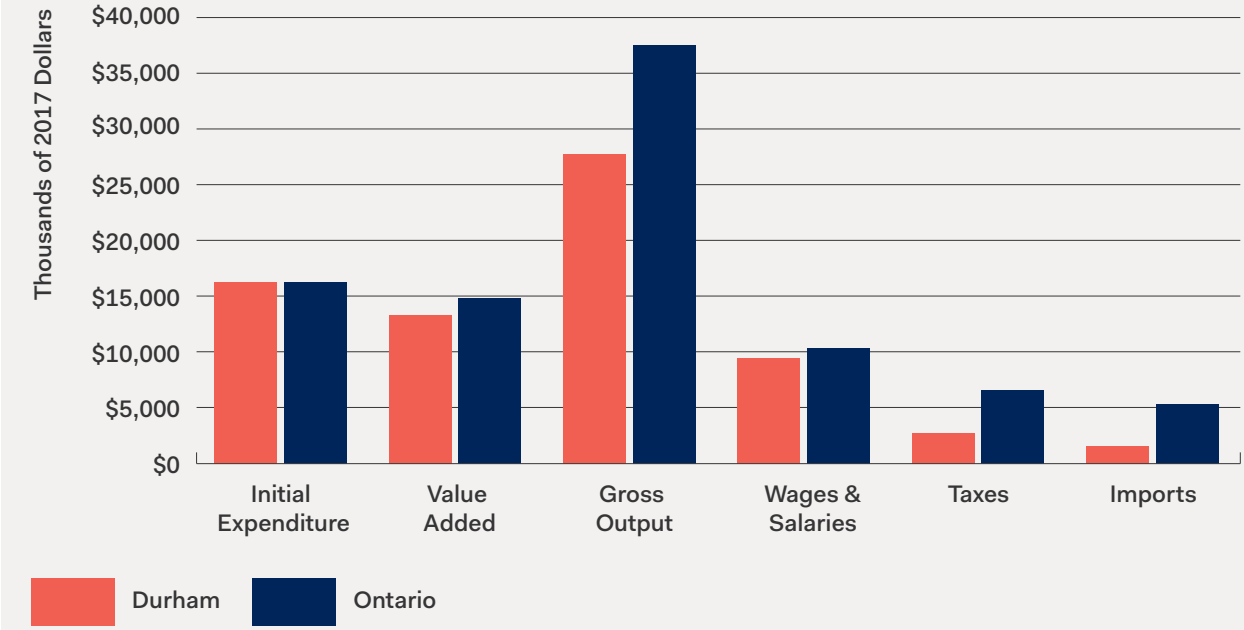


Figure 27: Inter-Regional Economic Impacts of Hans Steel Operational Expenditures in Uxbridge

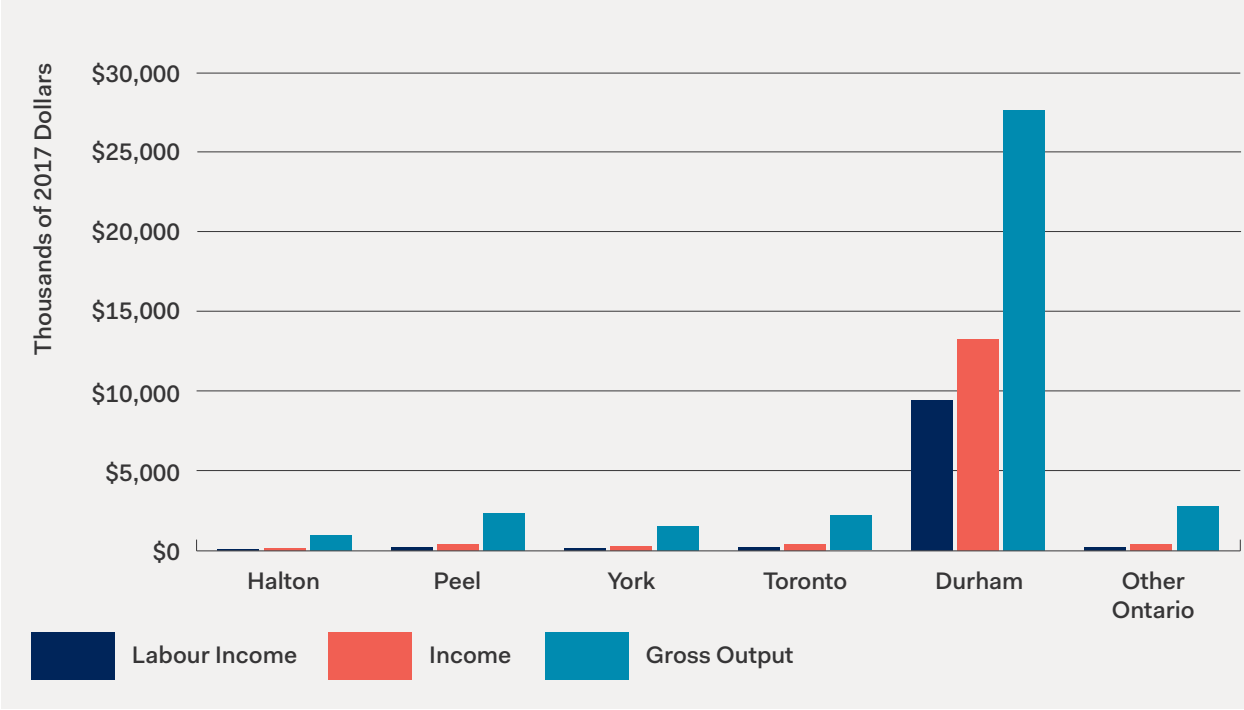
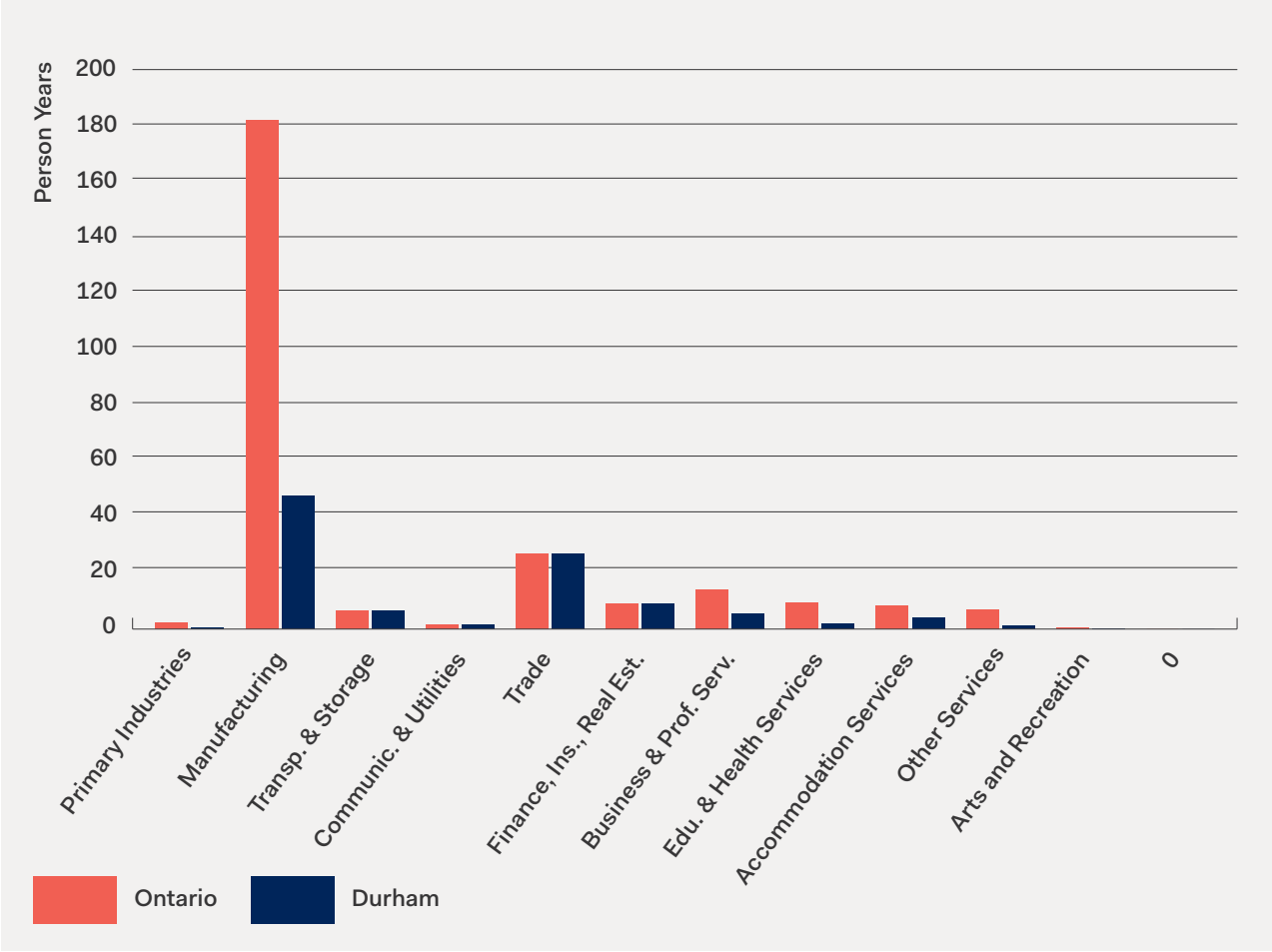


Figure 28 shows that the operational expenditures will translate into a mixture of manufacturing and service-related employment in Durham Region and that Ontario will capture a more than proportional manufacturing impact as a result (i.e., annual operational expenditures in Durham stimulate demand for other manufactured products that are produced in the rest of the Province, largely in the remainder of the GTA).

Figure 28: Economic Impacts in Durham of Hans Steel Operational Expenditures in Uxbridge



2.10 Scenario 10: Roche Pharmaceutical Capital Investment in Mississauga

On October 2, 2016 Roche Canada's Pharmaceutical division opened a new facility at 7070 Mississauga Road in Mississauga. The new facility represents a capital investment of $190 million (see Table 11). Table 11 shows that the investment will translate into gross industry output, total value-added and total wages and salaries impacts in Peel Region of $219,590,000, $92,345,000 and $78,375,000 respectively. The wages and salaries impact in Peel Region reflects the creation of some 1,583 person years of employment in Peel in response to this capital investment. Not surprisingly, the figure corresponding to the Province as a whole are similarly impressive (see also Figure 29).

Table 11: Economic Impacts of Roche Capital Expenditures in Mississauga

Thousands of 2017 Dollars

	Ontario	Peel
Initial Expenditure	$190,000	$190,000
Value Added		
Direct	$71,209	$71,209
Indirect & Induced	$111,807	$21,136
Total	$183,016	$92,345
Multiplier	0.96	0.49
Gross Output		
Direct	$190,000	$190,000
Indirect & Induced	$236,682	$29,590
Total	$426,682	$219,590
Multiplier	2.25	1.16
Wages & Salaries		
Direct	$56,114	$56,114
Indirect & Induced	$76,789	$22,261
Total	$132,903	$78,375
Employment (P.Y.)		
Direct	870	870
Indirect & Induced	2,323	713
Total	3,194	1,583
Multiplier	3.67	1.82
Taxes		
Federal	$36,649	$18,573
Provincial	$31,254	$15,914
Local	$9,834	$5,008
Total	$77,737	$39,495
Imports		
From Other Provinces	$39,377	$15,848
From Other Countries	$17,725	$8,153
Total	$57,102	$24,001

Source: Econometric Research Limited, GTA MRIO Model

Figure 29: Economic Impacts of Roche Capital Expenditures in Mississauga

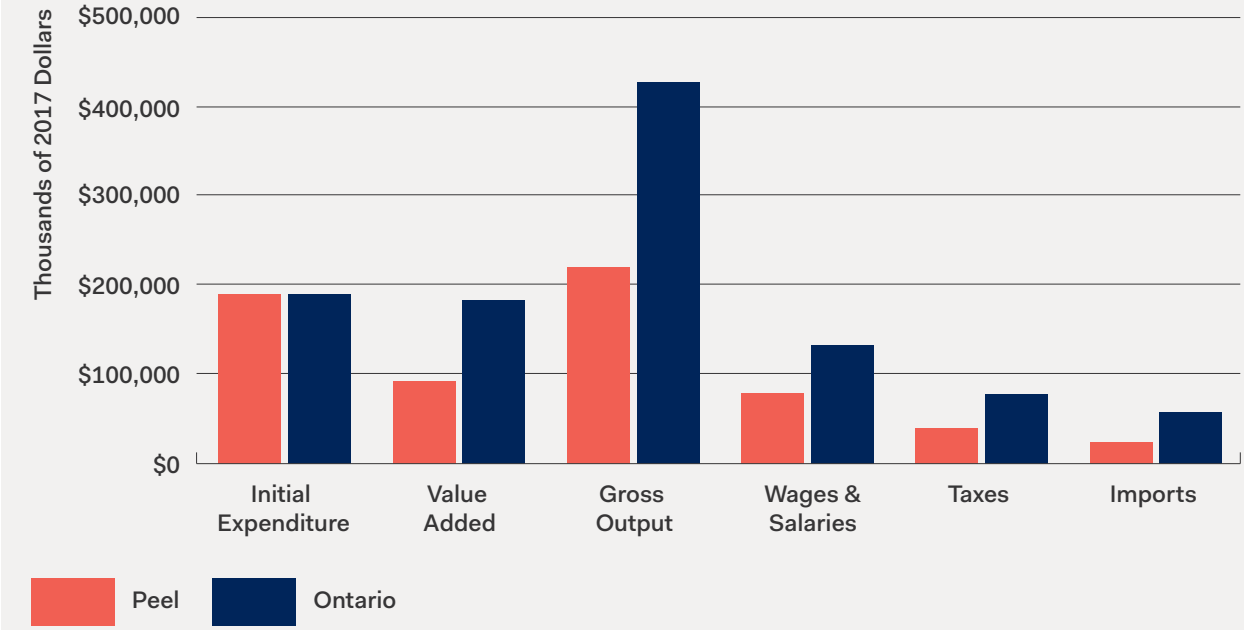


Figure 30 shows that this investment in Mississauga of $190 million stimulates very substantial impacts in the other municipalities of the GTA.

Figure 30: Inter-Regional Economic Impacts of Roche Capital Expenditures in Mississauga

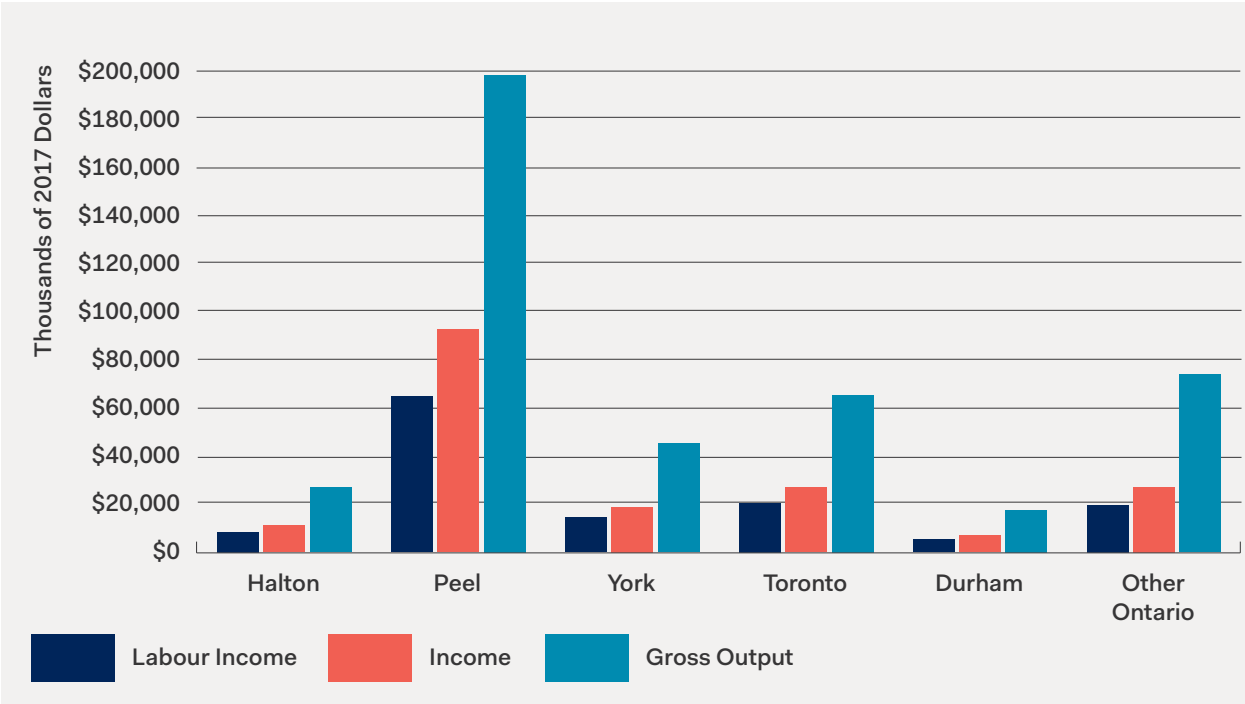
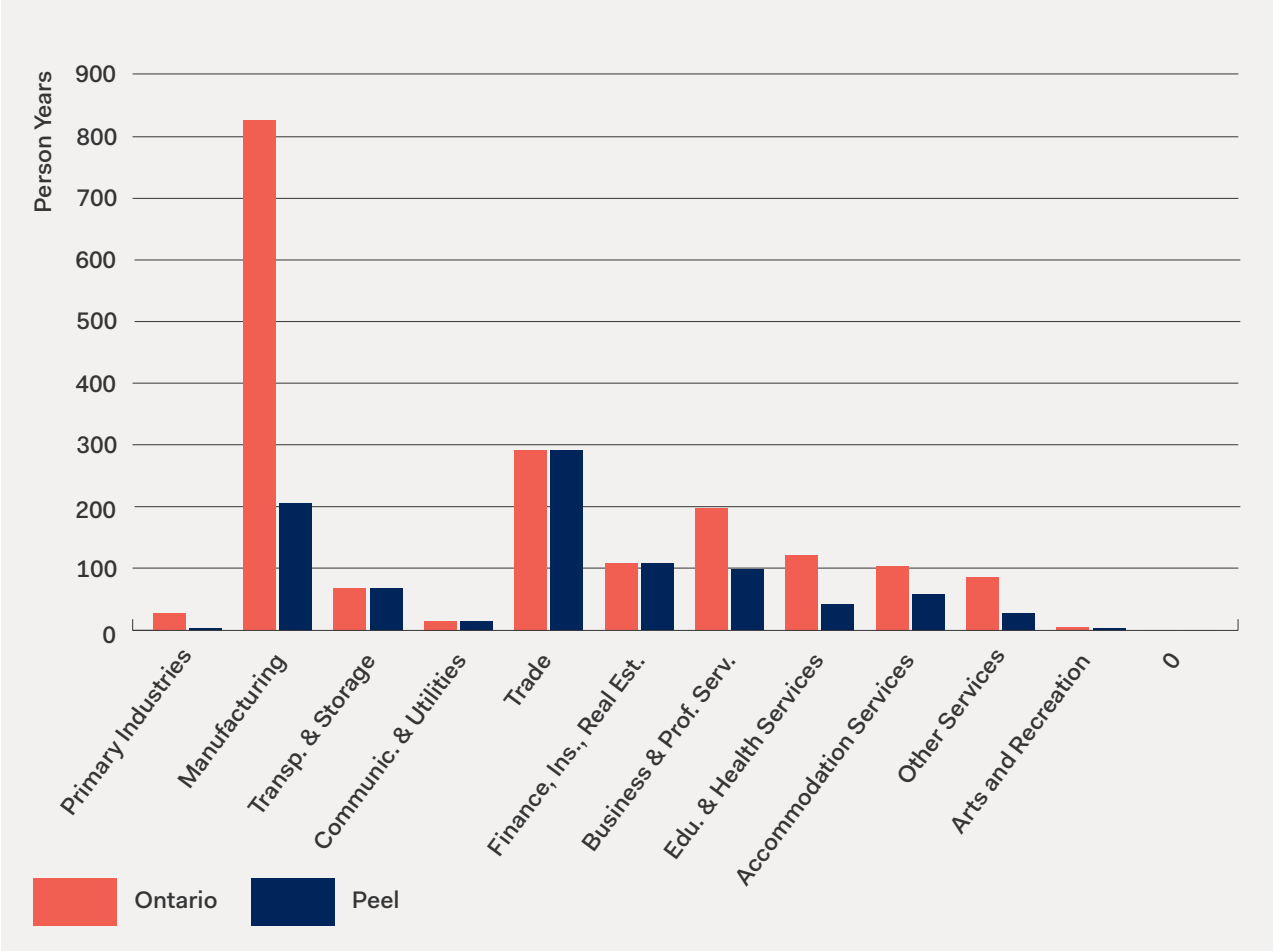


Figure 30 shows that Peel Region, Toronto and the rest of Ontario capture the largest impacts, but all regions experience considerable economic stimulus as a result of Roche's capital investment project.

Figure 31 shows how the impacts presented in Figure 31 translate into employment impacts across various industrial sectors in Peel Region and in Ontario overall. The province-wide impact is overwhelmingly concentrated in manufacturing sectors, though Peel captures a significant share of this manufacturing employment itself. Both Peel and Ontario also experience considerable impacts in the wholesale and retail trade sectors. Again, the key take-away here is that capital investment in Mississauga stands to have substantial impacts on all regions of the GTA, not to mention the province.

Figure 31: Province-Wide Employment Impacts of Roche Capital Expenditures in Mississauga



2.11 Scenario II: Roche Pharmaceutical Operational Expenditures

Table 12 and Figure 32 present a summary of the economic impacts (in Peel and for Ontario as a whole) associated with the yearly operations of the Mississauga facility. Annual gross output, total value-added and total wages and salaries impacts will accrue to the Region of Peel of $105,221,000, $39,710,000, and $18,316,000 respectively. In addition, all levels of government will experience substantial tax revenue impacts on an annual basis as a result of Roche's operations in Peel.

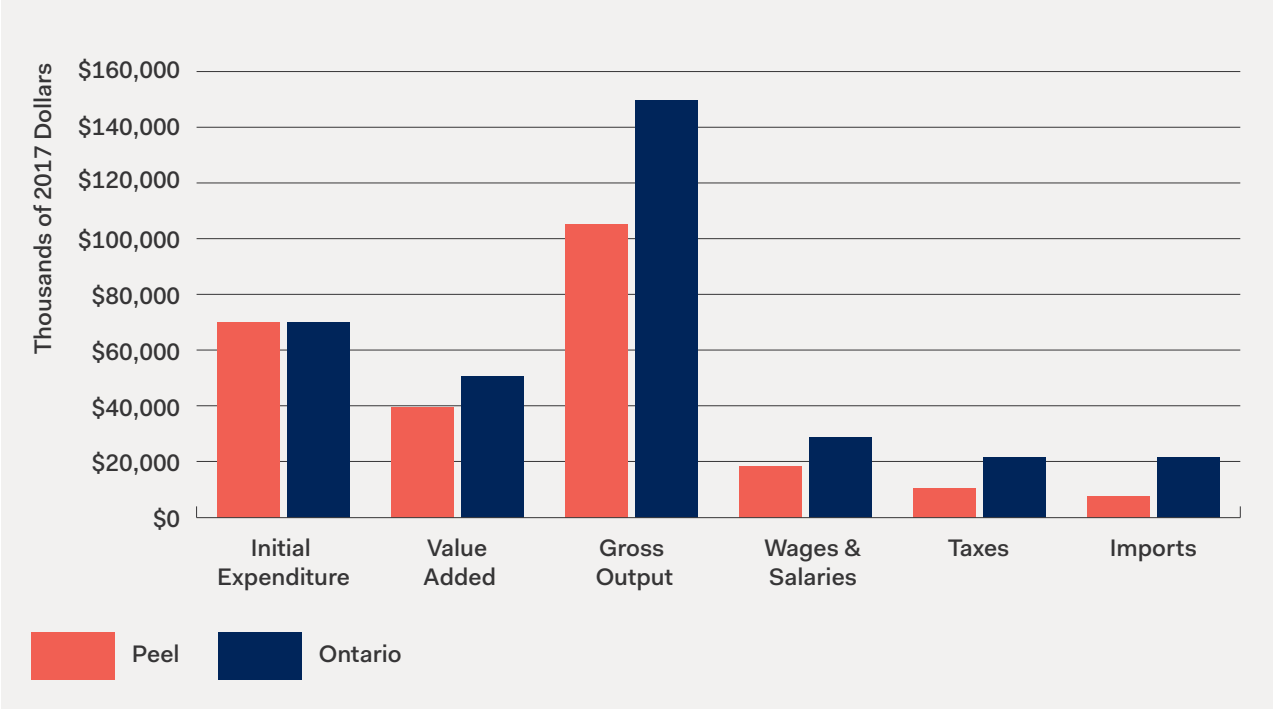
Table 12: Economic Impacts of Roche Operational Expenditures in Mississauga

Thousands of 2017 Dollars

	Ontario	Peel
Initial Expenditure	$70,000	$70,000
Value Added		
Direct	$16,229	$16,229
Indirect & Induced	$34,376	$23,481
Total	$50,605	$39,710
Multiplier	0.72	0.57
Gross Output		
Direct	$70,000	$70,000
Indirect & Induced	$79,510	$35,221
Total	$149,510	$105,221
Multiplier	2.14	1.50
Wages & Salaries		
Direct	$7,295	$7,295
Indirect & Induced	$21,639	$11,021
Total	$28,934	$18,316
Employment (P.Y.)		
Direct	128	128
Indirect & Induced	590	248
Total	717	375
Multiplier	5.63	2.94
Taxes		
Federal	$10,258	$4,995
Provincial	$8,801	$4,298
Local	$2,769	$1,352
Total	$21,828	$10,645
Imports		
From Other Provinces	$15,152	$5,340
From Other Countries	$6,643	$2,516
Total	$21,795	$7,856

Source: Econometric Research Limited, GTA MRIO Model

Figure 32: Economic Impacts of Roche Operational Expenditures in Mississauga



As with the capital investment impacts discussed earlier, both Peel and Ontario see the lion's share of the total impact accruing to the manufacturing sectors of their respective economies.

Figure 33 shows once again that operational expenditures by Roche at their Mississauga facility stand to have substantial and ongoing economic impacts across all regions of the GTA (see also Table 12).

Figure 33: Inter-Regional Economic Impacts of Roche Operational Expenditures in Mississauga

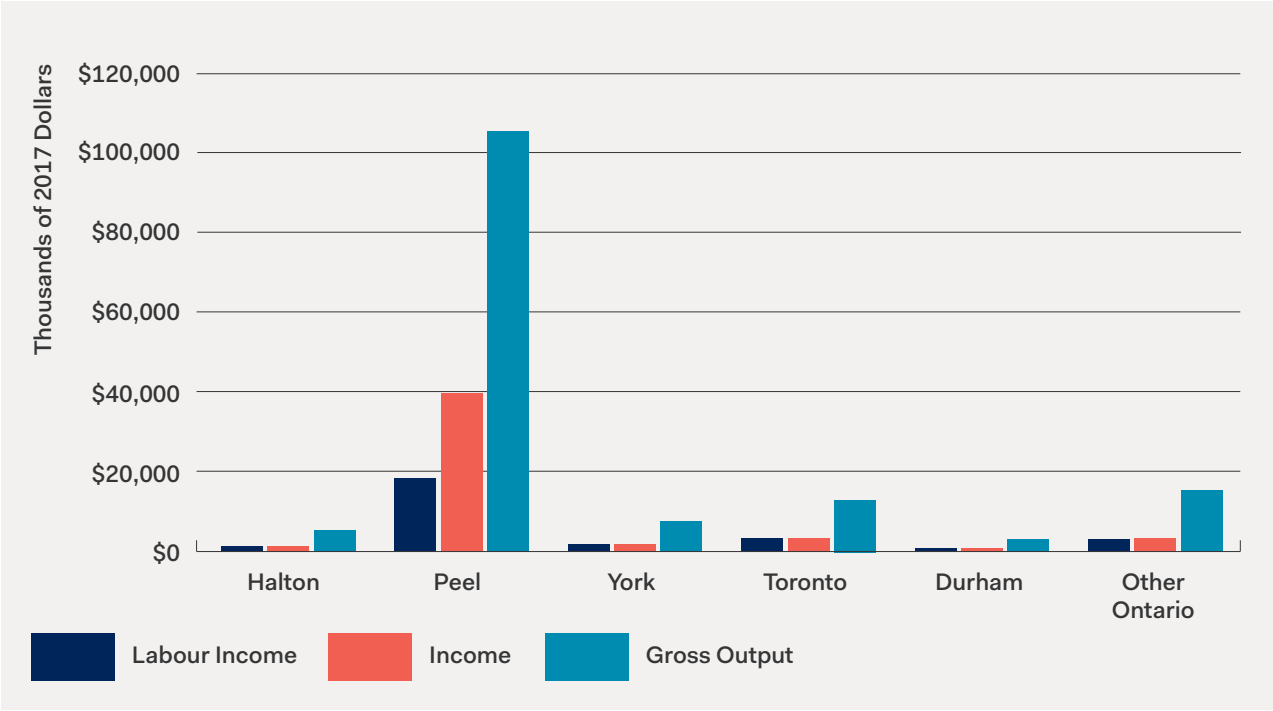
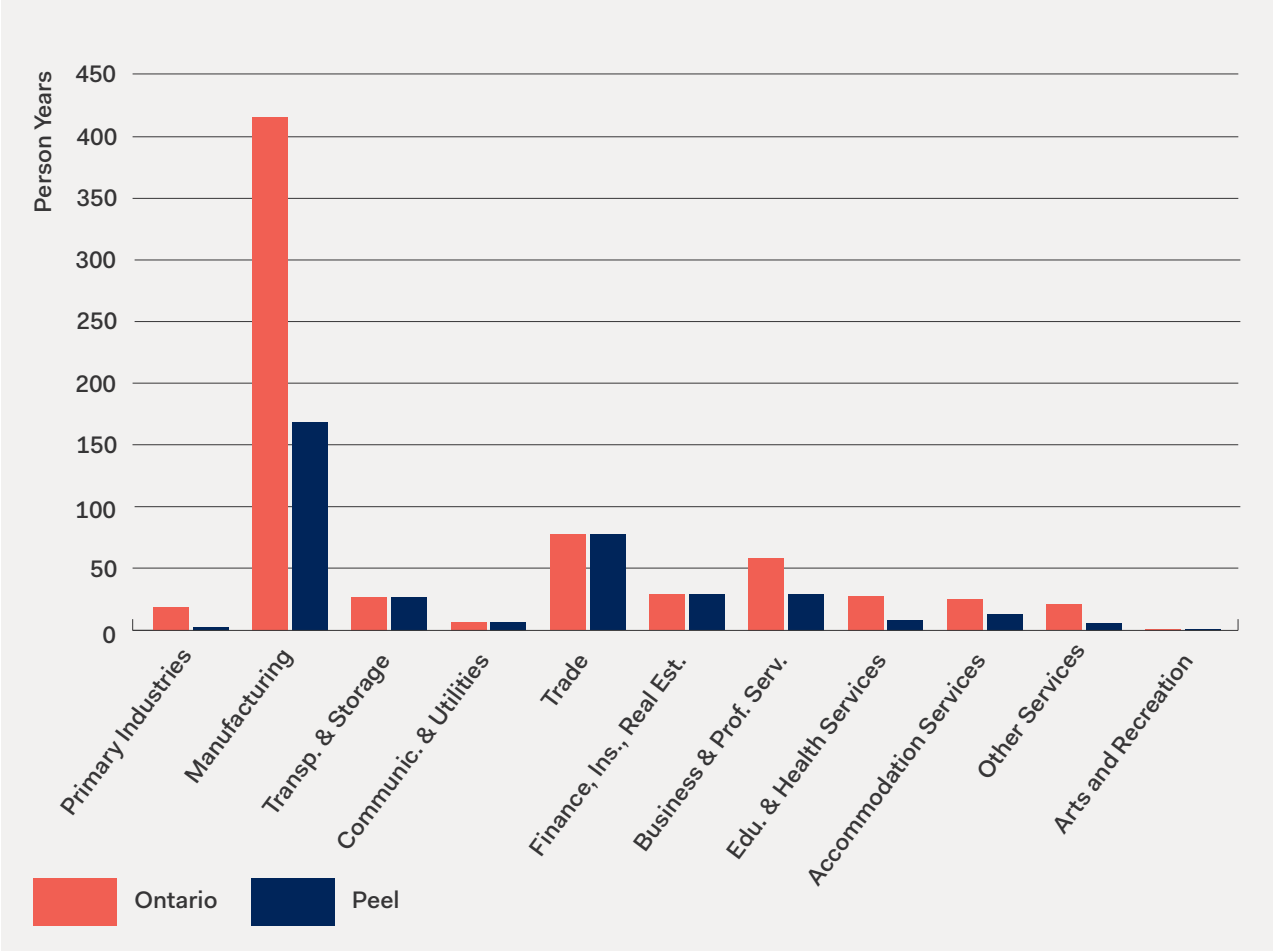


Figure 34, like Figure 31 above shows that Roche's operational expenditures stimulate economic impacts across most of the industrial sectors of Peel Region and Ontario, with manufacturing sector impacts accounting for the majority in both cases.

Figure 34: Province-Wide Employment Impacts of Roche Operational Expenditures in Mississauga



3.0 A QUALITATIVE INTERPRETATION OF THE EFFECTS OF INWARD FDI IN THE TORONTO REGION

The economic performance of the GTA going forward will increasingly be determined by the ability of this regional economy to connect with, and take on high-value-added positions within, GPNs of all sorts. The decision by leading global multinationals, such as IBM, Cisco, General Motors, Siemens or Huawei to locate a critical part of their advanced research and development activities in the GTA will embed critical components of their respective GPNs in this region. The extent to which those firms incorporate a broader range of domestic or foreign small and medium-sized enterprises (SMEs), dispersed across the GTA, in their innovation ecosystems will, in turn, determine the extent to which the benefits of those investments are distributed more widely.[6] Understanding these dynamics, and, to the extent possible, anticipating their effects requires that we conceptualize the changes occurring within this regional economy as part of a broader set of structural dynamics in the myriad GPNs that constitute the global economy, to which the firms in this region, in nearly every conceivable industrial sector are, or will become, embedded.

> ...production is no longer organized in vertically integrated companies focused solely on home locations. The manufacturing of products has increasingly been fragmented, or decomposed, into discrete phases in complex global production networks (GPN). Today, many products are being built and assembled from more pieces in more places than ever before. Increasingly, each component becomes a point of competition between firms dispersed throughout the world.[7]

The above quotation makes the point that the distribution of various aspects of the productive process across far flung GPNs has become the new normal when conceptualizing economic development. The GPNs, formed by virtue of key underlying dynamics (e.g., reducing cost, increasing flexibility and increasing speed to market) have undermined a narrowly nationalist organization of production, and transformed it into one characterized by a high degree of global integration. Gone are the days when a national economy (or a regional economy for that matter) would house all aspects of productive activity within its borders and indeed enact policies to ensure this insularity. The new age of globalization is one characterized by trade in value-added (i.e., in highly modular intermediate goods) and where the production of the goods we consume is best thought of as being an "elaborately choreographed transnational odyssey" characterized by the rapid rise of multinational corporations (MNCs), global outsourcing of production, national and regional specialization in specific ranges of production,

6 Cantwell and Mudambi (2005) and Cantwell (2013: 2014: 2015) distinguish between "competence-creating" subsidiaries and "competence-exploiting" subsidiaries, with the former being more likely to engage in knowledge exchange and development with local actors, and the latter typically associated with the exploitation of lower input costs. These authors posit that competence-creating subsidiaries are critical in the development and augmentation of local capabilities and, hence, upgrading. Competence-creating subsidiaries are more likely to locate in those contexts whereby strong potential exists for the establishment of on-going and productive business network relations (i.e., the establishment of an innovation system). See: Cantwell, J. and Mudambi, R. (2005). "MNE Competence-Creating Subsidiary Mandates." Strategic Management Journal, Vol. 26, p.1109-1128; Cantwell, J. (2013). "Blurred Boundaries between Firms, and New Boundaries within (Large Multinational) Firms: The Impact of Decentralized Networks for Innovation." Seoul Journal of Economics, Vol. 26, No. 1., p. 1-32; Cantwell, J. (2014). "Introduction" in J. Cantwell (2014) (ed.) "Location of International Business Activities: Integrating Ideas from Research in Multinational Business, Strategic Management and Economic Geography.", Palgrave-Macmillan, UK; Cantwell, J. (2015). "An Introduction to the Eclectic Paradigm as a Meta-Framework for the Cross-Disciplinary Analysis of International Business." In J. Cantwell (2015) (ed.) "The Eclectic Paradigm: A Framework for Synthesizing and Comparing Theories of International Business from Different Disciplines or Perspectives." Palgrave-Macmillan, UK.

7 Breznitz, D. (2013). "The problem of decomposition: industrial policy and growth in a world of phased production." in 21st Century manufacturing, UNIDO. P.53.

and an evolving pattern of winners and losers in the wake of this newly established spatial division of labour.[8] This evolution of the global economic system has real implications for all regions which comprise it, including national, sub-national and metropolitan regions alike. In what follows, we examine the implications of these broad economic changes for regional economic development in general and the GTA economy in particular.

GPNs are defined as a means of economic organization through which firms mobilize a combination of regional assets such as low input costs or a concentration of skilled labour by searching for, creating, maintaining, and detaching from relationships with regions that fit their particular production needs. Controlled by "lead" or "focal" firms which often take the form of large multinational corporations (MNCs), GPNs are international in scope, and the activities contained within them can range from resource extraction and materials processing to conceptual design and high-end fabrication and services.[9]

As nations and regions compete for FDI in this highly globalized environment, their success is increasingly determined by their ability to articulate into these GPNs, and hence "to land" part of the economic activity (and hence value) associated with this global odyssey that is modern goods and service production. While spatial variability in economic prosperity is nothing new, this new era of national and regional development in an increasingly globalized context, means that the prospects for many regional economies are becoming ever more linked to the decisions taken by actors beyond a given nation's or region's borders. Understanding the dynamics that influence the behaviour of these GPNs and the basis on which decisions are made with respect to local and regional economies, is therefore becoming imperative for the successful formulation of investment marketing and attraction strategies at the regional level.

3.1 GPNs: Characteristics, Determinants and Change

A GPN is a multi-actor, multi-scalar transnational production system. Coe and Yeung (2015) add to this by noting that:

> [f]rom a development perspective, under the right conditions the emergence of global production networks can provide an unprecedented opportunity for domestic firms and producers to acquire market access, capital, technology, knowledge and capabilities from beyond their home economies. Their learning may now no longer be limited to domestic economic and institutional endowments, but rather is increasingly grounded in trans-local networks of economic activity.... In this process, domestic firms are progressively dis-embedded from their home economies and become gradually re-embedded in global production networks of various kinds.[10]

8 Kenney, M. (2004). "Introduction", in Kenney, M. and Florida, R. (Eds.), "Locating Global Advantage: Industry Dynamics in the International Economy.", Stanford, CA; Stanford University Press.

9 Coe, N., Hess, M., Yeung, H-WC., Dicken, P., and Henderson, J. (2004). "'Globalizing regional development: a global production networks perspective". Transactions of the Institute of British Geographers 29: 468-484; Yeung,H. (2009). "Transnational corporations, global production networks, urban and regional development: A geographer's perspective on Multinational Enterprises and the Global Economy". Growth and Change 40(2): 197- 226; MacKinnon, D. (2012). "Beyond strategic coupling: reassessing the firm-region nexus in global production networks". Journal of Economic Geography 12: 227-245; Coe, N. and Yeung, H. W-C. (2015). Global Production Networks: theorizing economic development in an interconnected world. Oxford University Press, New York.

10 Coe, N. M. and Yeung, H. W-C. (2015). "Global Production Networks: theorizing economic development in an interconnected world." Oxford University Press, UK. 33.

GPN theory posits that economic development trajectories for particular regions stem from the dynamic processes by which regional firms are strategically coupled with, or become lead firms in, GPNs. Research suggests that uneven developmental outcomes at all spatial scales are driven, more and more, by organizationally fragmented and spatially dispersed production networks (i.e., GPNs). GPNs constitute a new form of economic organization characterized by the complex intertwining of economic and non-economic actors, typically coordinated by a lead firm and producing a range of goods and services across multiple geographic locations for global markets.[11]

GPNs are comprised of "actors" – firms, extra-firm actors (e.g, unions, interest groups, governments etc.), and intermediaries (e.g., financial intermediaries, logistics providers, standards setting bodies etc.). All of these actors are involved in the processes of value creation, value enhancement and value capture. The GPN therefore is best viewed as an "...amalgamation of value activities that transform tangible materials and intangible inputs into manufactured products and/or services for industrial customers or final consumers.".[12] This makes clear the point that value capture becomes the most important strategic imperative in any GPN and that the ability of any individual node (i.e., region or location) in the network to capture value depends critically on the nature of the activities which have landed at that particular node within the GPN. This is determined largely by the relative ability of the different nodes within the network to offer the lead firm terms and conditions which are conducive to its profit motive.

3.2 Genesis of GPNs

Twentieth century economies were nationally bounded, by and large. Firms invested in-situ to capture activities associated with the satisfaction of domestic demand (e.g., early Fordist production in the automobile manufacturing industry). While these early firms participated in international production systems, they tended to do so within the confines of a transnational subsidiary where the subsidiary focused on replicating what was done in its home market in some other locale (e.g., American automobile operations in Europe or South America). These have been referred to by scholars of international business as market-seeking subsidiaries.[13]

By the 1970s however, this approach to production (be it in goods or services production) began to experience significant stresses. As developing economies started to reap the benefits of massive state interventions (e.g., Japan's Keiretsu or Taiwan's Chaebol) in the form of large industrial firms in key industries (e.g., automobiles and electronics), manufacturers in developed economies came under severe price competition. The most effective way to deal with this competition was for firms in developed economies to reduce costs and/or increase productivity. This resulted in a spatial reorganization of economic activities that entailed the vertical disintegration of production and increasing specialization whereby firms focused their resources on those tasks for which they were most ideally suited and the outsourcing of other tasks (for which they are not ideally suited) to other firms, often in other (low cost) countries. This transition led to the "offshoring" of those aspects of production which could be accomplished more cost-effectively in other jurisdictions. Indeed, scholars suggest that the proliferation of GPNs since the 1980s is the result of this increasing international specialization in the context of the imperatives to

11 Coe and Yeung (2015). 34

12 Coe and Yeung (2015); 36

13 See Cantwell, J. (2009). "Location and the Multinational Enterprise." Journal of International Business Studies, Vol. 40, No. 1, pp. 35-47." (see also Cantwell 2013: 2014: and 2015).

reduce costs, increase flexibility, reduce time to market, the increasing constraints of financial discipline, and the need to sustain markets.[14]

While early thinking on GPNs emphasized the central importance of cost reduction as a driving factor, it was soon noted that cost considerations alone were not sufficient to explain the behaviour of firms leading to the creation of GPNs. Of equal, if not greater importance, are the capabilities of potential suppliers of necessary inputs. As such, Coe and Yeung note that the key dynamic in the spatial configuration of production is the "cost-capability ratio".[15] From the perspective of a lead firm, the combination of high capability and low cost is indicative of a potential supplier that is ideally positioned to allow the lead firm to extract maximum value from its productive activities. From the perspective of the lead firm therefore, supplier firms which have attained a particularly low cost-capability ratio (CCR) are especially attractive as potential additions to the lead firm's GPN. Such suppliers are well poised to evolve from being a generic supplier to a strategic partner (i.e., capturing even more value).[16] Another example of a type of lead firm supplier would be that of the platform leader.[17] In this instance, the supplier has high capabilities and high costs; as long as the supplier's goods or services are not easily substituted by other sources then they can remain at a privileged position within a GPN.

The process of optimizing CCRs by lead firms and suppliers is a recursive one. Lead firms optimize their CCRs by internationalizing aspects of production and/or through outsourcing. Through this process of continually optimizing CCRs, lead firms and suppliers are continually reorganizing their value chains, finding newer and better configurations that allow them to attain even lower CCRs. This recursive process clearly has the potential to continually redistribute different aspects of production to different locations globally. Those places which are successful at maintaining very attractive CCRs are more likely to remain part of prevailing GPNs. This emphasis on the CCR shows very clearly that developed nations need to continually innovate and improve their capabilities in the face of their increasing costs in order to retain coveted positions within GPNs. Even stagnant capability growth will lead to increasing CCRs, and a relative decline in attractiveness vis-à-vis lead firms and their suppliers.

While CCRs are a primary driver of the process of vertical specialization and the creation of GPNs, the need for increasing flexibility is another. Increased competition also means that firms must be able to respond to market changes faster than previously, lest they risk losing out to their competitors. In response to this imperative, lead firms have begun to look for and partner with suppliers that possess highly flexible and specialized production technologies and processes in the hopes that this will improve the adaptability of the GPN as a whole. Given the highly integrated nature of production, the window of time during which a lead firm may reap maximum value from a given product or service is that period during which they face little or no competition (i.e., when they enjoy first-mover advantages). As such, the sooner a given lead firm is able to bring a particular innovation to market (i.e., adapt to market demands), the more time it has to enjoy maximum returns. Strategies to enable this tend to include the retention of accomplished contract manufacturers with proven track records in getting design and prototyping stages completed quickly thereby allowing quick market entry – far more quickly than if the lead firm had to invest in the production capacity itself.

14 Coe and Yeung (2015)

15 Coe and Yeung (2015)

16 Intel is a classic example of strategic partner in the ICT GPNs. Any firm that produces any sort of information processing equipment must purchase processors and other semiconductors from Intel - hence Intel is a strategic partner in many GPNs.

17 Microsoft is a platform leader. Its software is necessary for all PCs (non-macOS) and its products are largely non- substitutable. Hence, this firm maintains its position in the GPN for computer manufacturers despite high costs.

3.3 GPNs and Regional Economic Development

Thinking on regional economic development has come full circle over the past half-century. From an initial focus on export-driven growth to an unwavering emphasis on internal social and institutional conditions within regions, to the current emphasis on GPNs which see regional dynamics being largely determined by forces originating outside of the regions themselves and largely disconnected from them. Much has been learned about regional economic development along the way. A key contribution of GPN research has been the realization that regional economic development must be considered in a globalizing context. This has given rise to the conception of the region as a porous territory whose boundaries are transcended by a broad range of socially embedded relations between firm and non-firm actors operating at multiple scales.[18]

In 2013, the United Nations Commission on Trade and Development estimated that roughly 80 percent of all global trade was encompassed within GPNs.[19] From reshaping power structures and reallocating resources to prompting the construction of industrial districts and production platforms, GPNs have had an immense impact on regional developmental trajectories across multiple scales.[20] In particular, Breznitz (2013) notes that since phases of production tend to favour particular locations over others, the relevant questions relate to how these phases of production take on specific locations and, what are the relative advantages and limitations of excelling in specific phases of production?

On the first of these questions, Cantwell (2009) is helpful. Cantwell notes that "[w]hen considered as a whole, the diversified structure of location-specific assets becomes a source of competitive advantages where the particular combination that has been found is synergistic...."[21] On this topic, Cantwell also notes that "[t]he increasingly more important ... motive for international diversification [of locationally distinct productive assets] is the creation of new value through the development of internationally interdependent structures that connect together a range of complementary activities."[22] In other words, Cantwell sees a particular international assemblage of productive activities as being a portfolio of locational assets (albeit, in the context of an MNE). Indeed, the locational specificity of GPNs was seen to be the result of firms attempting to reach an optimal level of return from their locational assets, where the return is optimized by allocating productive activities to those locations which offered the greatest net-benefit for the firm (or for the lead firm and its associated GPN) as a whole. Breznitz notes something similar in saying that the locational choices made by various actors in a GPN are not random, but rather "[t]hese windows of opportunity arise amid the numerous uncontrollable externalities of an increasingly international economy."[23]

18 MacKinnon (2012), p.230.

19 Coe and Yeung (2015)

20 Coe, N., Hess, M., Yeung, H-W., C., Dicken, P., and Henderson, J. (2004). "'Globalizing regional development: a global production networks perspective." Transactions of the Institute of British Geographers 29: 468-484; Yeung, H-W., C. (2009). "Transnational corporations, global production networks, urban and regional development: A geographer's perspective on Multinational Enterprises and the Global Economy." Growth and Change 40(2): 197- 226; MacKinnon, D. (2012). "Beyond strategic coupling: reassessing the firm-region nexus in global production networks". Journal of Economic Geography 12: 227-245; Breznitz, D. (2013). "The problem of decomposition: industrial policy and growth in a world of phased production." in 21st Century manufacturing, UNIDO; Yeung and Coe (2016).

21 Cantwell, J. (2009). "Location and the Multinational Enterprise." Journal of International Business Studies, Vol. 40, No. 1, pp. 35-47. (p. 37).

22 Cantwell, J. (2009), p.38

23 Breznitz, D. (2013), p. 59.

Cantwell underscores the fact that increasing globalization and fragmentation of value-added activities has very specific locational implications in noting that: "[t]he new paradigm is one of continual experimentation over the right mix of activities at the firm-level, seeking out the most productive combinations of business areas and technologies. Since individual locations are inevitably specialized in their activity, and indeed increasingly specialized in part owing to greater subsidiary-level specialization within MNEs..., the most suitable and potentially innovative combinations of activity now commonly require international connections."[24]

With regard to the second question, Breznitz suggests that "[i]n a world of commodities, the challenge is to find the sweet spot in the value network. It is not a matter of which sector you are in, but where you are located in the value network."[25] In other words, regional prosperity depends greatly on 'where' in a given GPN (or series of GPNs) a particular regional economy is located. Is a specific region attempting to compete with developing nations to retain labour intensive activities (i.e., engaged in a race to the bottom), or is it competing with other high-tech regions to house advanced R&D activities associated with advanced information technologies associated with, for example, the development of autonomous vehicles? The former would be indicative of a less than favourable 'position' within a given GPN, while the latter would be indicative of a region which offers lead firms the potential for low CCRs, high flexibility, and minimal time to market. So, an important related question would be, what is the role of regional economic development authorities in inserting their respective regions into more advantageous positions within GPNs?

It has been proposed that regional development is the dynamically produced outcome of the interaction between region-specific relational networks (e.g., social networks, networks of tech CEOs etc.) and GPNs within the context of changing regional governance structures.[26]In other words, regional development, is the outcome of a set of relational processes with other regions/actors in the same national territory and increasingly at the international scale. For regional development to occur in any location at a particular moment, a number of interrelated sets of conditions must be present: first, economics of scale and scope must be present within the region.

The possibility of localization economies within the GPN must exist (i.e., the region must have the potential to become an economically efficient node in the GPN for a specific state of production or for a range of products); and, the appropriate configurations of regional institutions required to 'hold down' GPNs and unleash the region's potential must exist (e.g., the high degree of networking, the overwhelming entrepreneurial ethos, and the established venture capital tradition that exists in Silicon Valley).

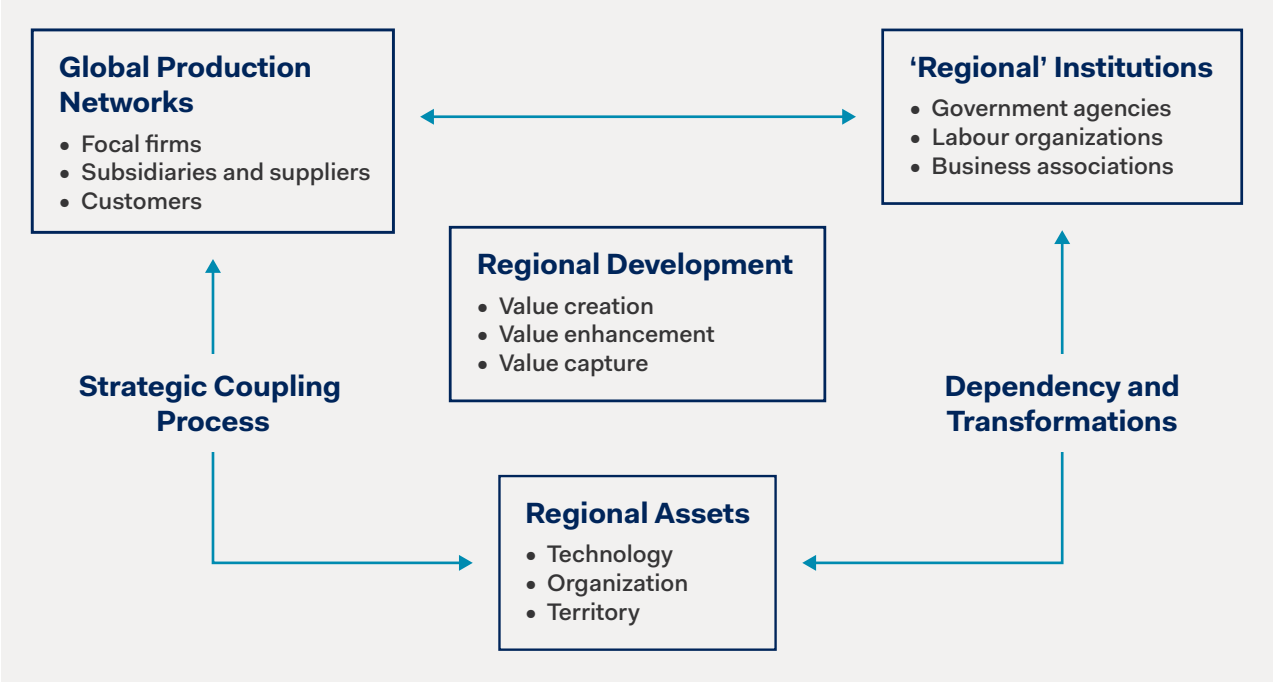
24 Cantwell, J. (2009), p. 38.

25 Breznitz' reference to 'where' in this quote is not actually a reference to a particular physical location but rather a 'position' within the value-added hierarchy of a given GPN.

26 Coe et al. (2004).

This interactive process yielding regional development is depicted in Figure 23 below.[27]

Figure 23: A framework for analyzing regional development and global production networks



The box labeled "Regional Assets" at the bottom of the graphic in Figure 23 represents all of the region-specific factors that are necessary (but not sufficient) for regional development to take place. These are the regional assets that produce the vitally important economies of scale and scope. These region-specific assets combine with regional institutions such as government agencies, labour organizations and business associations, as well as extra-regional institutions such as international standard setting bodies, or international labour unions, or international environmental lobbies, etc. to determine the extent to which the region-specific assets can assist/encourage regional economic development.

One factor that scholars have identified as salient in linking regional economies to global networks is the presence of 'global pipelines'. Global pipelines consist of relationships between individuals or communities (i.e., actors) that allow for sophisticated cooperation and information transfer between actors in distant regions.[28] The presence of these global pipelines can help regions to incorporate new technologies and processes. Moreover, these connections can also be useful for advertising regional assets and attracting powerful lead firms to supplier regions.

Further light can usefully be shed on this dynamic by looking at recent research on the changing relationship between MNEs and their host locations in the context of the knowledge-based economy. A significant body of research dating back to the 1980s documents the fact that the relations between subsidiaries in host locations and their parent MNEs shifted as the subsidiaries have increasingly been given the mandate to pursue "asset-

27 Figure 23 is taken from Coe et al. (2004), p. 470

28 Bathelt, H., Malmberg, A., and Maskell, P. (2004). "Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation." Progress in Human Geography, Vol. 28, No. 1, pp. 31-56

seeking" or "asset-augmenting" strategies.[29] In this approach, subsidiaries have been awarded increasing scope to pursue competence-creating investment strategies, with the view that the host location is not just a market for the home country's products, but a potential source of competitive advantage for the MNE (and, by extension the GPN). According to Cantwell, this stream of research depicts "the MNE as an international network for geographically dispersed innovation" which stresses "the dynamic connectedness between local knowledge creation and exchange in each node of the network."[30] For this strategy to succeed, the local subsidiaries (or subcontractors) must become embedded in their own local networks of research activity and competence building (i.e., form their own business network relationships), and become a node of knowledge creation and innovation which is synergistic with the overall GPN. From the perspective of the MNE as a whole, the goal is to disperse a range of value-creating activity across a number of different nodes or centres of excellence that collectively form the international network of the MNE, which results in the construction of an integrated portfolio of locational assets across a range of host countries or regions in which the MNE is effectively embedded. This changing strategic rationale for MNE investments in host countries suggests a new rationale for corporate diversification in which the MNE can create new value by linking a series of interdependent subsidiaries and research centres into an evolving range of complementary activity.[31] This lies in stark contrast to the mode of development characteristic of the 1960s and 1970s which saw these MNE subsidiaries replicating what was being done in the home country, but for a new host. MNEs therefore are now seen as being "...evolutionary learning organizations which create (and draw upon) a regular and cumulative flow of knowledge and capabilities from locationally differentiated sources.[32]

In those regional economies that are able to leverage their research assets and competence building capabilities, there is a potential to attract new investments by MNEs (as lead firms in GPNs perhaps) to leverage local capabilities as a core element of the MNE's global innovation strategies. Regions that prove successful in pursuing this route may be able to leverage new corporate investment to help move onto a trajectory of upgrading or modernizing their economic development potential.

The aforementioned notion of synergies between host regions and the needs and capabilities of GPN lead firms and associated suppliers has been expressed more formally in the concept of "strategic coupling." Strategic coupling is a concept developed in a recent analysis of the growth and evolution of the Asian Tiger economies of South Korea, Taiwan and Singapore, by Henry Yeung.[33] Strategic coupling involves the dynamic processes by which relational assets are matched to the strategic needs of the lead firms in GPNs; regional institutions play a critical role in aligning these regional relational assets to the strategic needs of the lead firms and associated

29 Cantwell, J. (2009); Cantwell, J. and Mudambi, R. (2005). "MNE Competence-Creating Subsidiary Mandates." Strategic Management Journal, Vol. 26, p.1109-1128; Cantwell, J. (2013). "Blurred Boundaries between Firms, and New Boundaries within (Large Multinational) Firms: The Impact of Decentralized Networks for Innovation." Seoul Journal of Economics, Vol. 26, No. 1., p. 1-32; Cantwell, J. (2013). "Blurred Boundaries between Firms, and New Boundaries within (Large Multinational) Firms: The Impact of Decentralized Networks for Innovation." Seoul Journal of Economics, Vol. 26, No. 1., p. 1-32; Cantwell, J. (2014). "Introduction" in J. Cantwell (2014) (ed.) "Location of International Business Activities: Integrating Ideas from Research in Multinational Business, Strategic Management and Economic Geography.", Palgrave-Macmillan, UK; Cantwell, J. (2015). "An Introduction to the Eclectic Paradigm as a Meta-Framework for the Cross-Disciplinary Analysis of International Business." In J. Cantwell (2015) (ed.) "The Eclectic Paradigm: A Framework for Synthesizing and Comparing Theories of International Business from Different Disciplines or Perspectives." Palgrave-Macmillan, UK.

30 Cantwell, J. (2009). p. 36.

31 Cantwell, J. (2009).

32 Cantwell, J. (2009). p. 38

33 Yeung, H. (2016). "Strategic Coupling: East Asian Industrial Transformation in the New Global Economy." Cornell,University Press, New York.

partners and suppliers.[34] Strategic coupling involves finding the synergies and complementarities referred to above in distant partners (often facilitated through global pipelines of various sorts). Simply, a lead firm (e.g., Samsung or Hyundai), in optimizing their value chains, find specific suppliers in particular geographic locations which offer them attractive characteristics (embodied in attractively low CCRs, for example), and which offer the lead firm and the GPN as a whole a boost in efficiency relative to the status quo. In this process of constantly searching for better suppliers and partners, these lead firms and the associated GPNs continually adjust to a changing global economic geography.

More specifically, strategic coupling occurs when region-specific assets interact profitably with extra-regional institutions and assets to enable a process of co-production. Strategic coupling refers to the process wherein actors in cities and regions converge with GPN actors in the interest of forming a mutually beneficial arrangement based on the degree to which regional 'bundles' of assets line up with the strategic needs of the lead firm and/or the GPN more generally.[35] The harnessing of regional assets (such as skills, expertise, knowledge etc.) must be accomplished by regional institutions and positioned to complement the strategic needs of trans-local actors situated within various GPNs.[36] Looked at in this manner, regional development is the product of strategic coupling of GPN elements and region-specific assets.[37] More specifically, in an urban/regional development context, strategic coupling is a dynamic process through which particular actors, be they trans-local members of GPNs or regional actors, negotiate and coordinate local assets and trans-local requirements via some configuration of relational connections.[38]

The literature identifies three basic forms of strategic coupling:

- *International interfirm partnerships:* These partnerships involve arrangements made between lead firms and local partners/suppliers who possess a particular set of regional assets that have been deemed as valuable by the lead firm;

- *Indigenous innovation and the creation of 'national champions':* Based on the developmental state model, indigenous innovation refers to the state-led fostering of powerful lead firms over time and allowing them to then form their own GPNs; and,

- *Production platform provision:* Largely based around providing a large supply of low-cost inputs, cheap labour, and lax regulations, production platforms can be produced by public or private actors in the interest of linking them with the needs of lead firms through the provision of low-skill, low-cost production.[39] [40]

34 MacKinnon (2012), p. 241.

35 Henderson, J., Dicken, P., Hess, M., Coe, N., Yeung, H. W.-C. (2002). "Global production networks and economic development". Review of International Political Economy 9: 436–464; Coe, N. and Yeung, H. (2015); Yeung, H. (2016); MacKinnon, D. (2012). "Beyond strategic coupling: reassessing the firm-region nexus in global production networks". Journal of Economic Geography 12: 227-245.

36 Coe et al. (2004), p. 470.

37 MacKinnon (2012). p. 230.

38 Yeung (2009), p. 213; MacKinnon (2012), p. 230.

39 Examples of production/assembly platforms include Greater Bangkok (Thailand), Yangtze and Pearl River Deltas (China), Bangalore (India), Sofia (Bulgaria), Manila (Philippines) etc. (Coe and Yeung, 2015; 186).

40 MacKinnon (2012); Yeung (2009).

Several general strategies for achieving strategic coupling have been identified in the literature including the following:

- *Layering:* layering involves the changing of institutions through repeated waves of investment being directed at a coupled region by a lead firm with the aim of improving the organizational capacities of suppliers;

- *Conversion:* Described as a reorientation of the relationship between regional assets and lead firms, a conversion strategy involves the adaptation of regions to new market demands or technological regimes; and,

- *Recombination:* Similar to layering and conversion, recombination involves the combination of existing regional assets with new rounds of investment from lead firms. Unlike layering or conversion, recombination involves the decoupling of GPNs from one region and their re-coupling with the target region.[41]

Based on the above, it is clear that the way regional actors and assets articulate with GPNs through strategic coupling can play a critical and varied role in shaping their developmental trajectories. Moreover, by conceptualizing regional development in this way, it is also clear that regional developmental trajectories can be enhanced, altered, or upset if any of these considerations were to change either abruptly or over time.

This way of thinking of regional development in a globalizing context offers a direct conceptual link between GPNs, strategic coupling, and regional development. It shows how the dynamics of lead firm investment/divestment can interact with and alter the assets, institutions, and 'path dependency' of target regions. In this regard, recent work on regional economic development has added two new modes of path development which are highly relevant for this case study: path upgrading and path modernization.[42] Path upgrading involves a major change to a path related to the enhancement of a position within a GPN – moving up the value chain based on the upgrading of skills and production capabilities – while path modernization involves a major change of a path into a new direction based on the introduction new technological capabilities or organizational innovations into a regional economy. The critical issue in analyzing recent developments in the GTA is to determine whether the current changes underway reflect a more limited trajectory of path upgrading by the MNEs with respect to their localization strategies for this region or whether it in fact has the potential to open up a new direction based on the exploitation of emerging technologies in which the GTA has some comparative advantages in terms of its underlying research capacity, institutional configuration and mix of labour market skills.

One aspect of strategic coupling upon which the entire process of regional development pivots is the bargaining and cooperation relationships between regional institutions and lead firms/key actors in GPNs. Broadly construed as the power relations of GPNs, these relationships play an important role in determining the ability of supplier firms to engage in upgrading through their participation in a GPN. Because of this, one area where policy makers can help to encourage positive regional development is through the strengthening of bargaining power in their respective regions. One way of doing this is for regions to establish a single organization or body responsible for handling the coordination of investment attraction and international trade partnerships, as this would allow firms to consolidate their individual bargaining power.[43]

41 Martin, R. (2010). "Rethinking path dependence: beyond lock-in to evolution". Economic Geography 86: 1–27.

42 Isaksen, A. and Trippl, M. (2016). "Exogenously Led and Policy-Supported New Path Development in Peripheral Regions: Analytical and Synthetic Routes." Economic Geography DOI: 10.1080/00130095.2016.1154443.

43 MacKinnon (2012).

As previously noted, the key regional development challenge facing regional authorities is targeting and hitting that "sweet spot" in the value chain – one which is synergistic with both the assets and capabilities of the region and the lead firm and associated GPN.[44] Another related challenge involves regional authorities being able to discern the dynamic trajectory of GPNs, and to constantly compare their assets and capabilities with the likely future needs of the GPNs and attempt to ensure that local assets are amenable to potential upgrading over time. Only by doing so can regions continue to capture more value, and continue to increase prosperity levels for regional populations. A forward-looking investment attraction strategy would provide regional development agencies in particular locations with real-time telemetry regarding trends, needs, wants, and items on the drawing board for existing and emerging lead firms and GPNs. In this way, the likelihood of particular regions being able to maintain some degree of parity between regions and the GPNs on which they depend will be greatly enhanced.

In order to address this concern about maintaining coherence between regional assets and the needs of various GPNs, government agencies, trade unions, employer associations, and other similar bodies must work together to promote a select suite of optimally beneficial regional assets. It is further argued that these policies, if crafted to attract the right sort of lead firms, could induce key actors to bring their core technologies and expertise into the target region.

3.4 Implications of the GPN Perspective for the GTA

As noted above, regional development as seen from the GPN perspective hangs on the process of strategic coupling whereby regional assets including physical assets in addition to knowledge, skills, and innovatory predilections, are mated with the strategic needs of lead firms in GPNs, and their various partners and suppliers. This process therefore promotes development of those regions that are capable of 'coupling' with GPNs through the creation, enhancement and capture of surplus economic value. It is the role of regional institutions to ensure that strategic coupling occurs; to know what a particular region's assets happen to be; what GPNs exist and what their strategic requirements are; and to make a compelling case to the MNEs that typically lead these GPNs regarding the suitability of a given region to the profit motives of the GPN overall, while simultaneously safeguarding the long-term social and economic well-being of their constituents. This is the task which has befallen all regional governments (be they supra-national, national, or intra-national regional, and indeed metropolitan jurisdictions). The Greater Toronto Area is a case in point. It is one metropolitan area that is in direct competition with all other global city regions the world-over for the investment dollars associated with existing and emerging GPNs, and the GPN literature tells us that these global cities are indeed in direct competition for many parts of a great many GPNs. The GTA's ability to continue to grow and to provide a high standard of living to all of its residents going forward is fundamentally dependent on its ability to strategically couple with portions of existing and emerging GPNs and thereby attract the type of investment that satisfies regional standards vis-à-vis risk and potential reward.

44 Breznitz (2013).

Strategic coupling is about the matching of regional assets to the strategic needs of a GPN. The extent to which a given bundle of regional assets is synergistic to a given GPN, the more likely it is that such a region will be able to "land" some portion of that GPN within its jurisdiction. Research into strategic coupling and the conditions under which it can yield differential regional outcomes has identified a series of dimensions of strategic coupling between GPNs and regions that can help regional authorities in discerning those opportunities which are truly desirable (or likely to be so) in the longer term, from those which are opportunistic and unlikely to yield long-term regional benefits.[45] This research indicates that those regions which possess highly unique and non-substitutable forms of assets, especially knowledge assets, are least likely to be in a position of attracting an opportunistic branch-plant type MNE. As a region's knowledge assets move along the continuum toward the more generic end, the more likely it is to be in such a position. Similarly, a particular region's status as the source (i.e., the home region) or the host (i.e., the receiving region) also matters. It is often the case that MNEs are more deeply embedded, and hence more likely to engage in high-value-added activities, in their home country/region. The type of strategic coupling also matters; organic strategic coupling, that which forms in a co-evolutionary manner between the lead MNE and the regional assets is also more likely to yield a high degree of embeddedness than are the more superficial forms of structural coupling which are based on political-economic relations between regions and GPNs. In addition, those relations between a lead firm and a particular set of regional assets which are asymmetrical (typically in favour of the lead firm heading the GPN) are likely to yield less than desirable forms of strategic coupling from the region's perspective.

The Greater Toronto Area, by all accounts, is on the end of the continuum which would point toward its ability to engage in highly advantageous forms of strategic coupling with GPNs. The region is home to five universities and six colleges with a steady enrollment of more than one quarter of one million students annually. Toronto also ranked third among world cities in the PwC (2016) Cities of Opportunity report.[46] Indeed, the PwC report notes that "Toronto is impressive not only in that it does so well in so many areas, but in the company it keeps in doing so. ... Toronto finishes in the top 10 in the demographics and livability indicator, ranking #7, but what is more important is to take a look at the cities that are part of this elite group. Just above it lie New York, Paris, London, Los Angeles, San Francisco, and Amsterdam (in that order) and just below it sit Berlin, Chicago and Stockholm. All of the other cities here are, each in its own way, a global icon of urban culture. But Toronto not only competes with them, it outdoes them in critical areas of urban life."[47]

45 See MacKinnon (2012) Table 1 on p. 240.

46 PwC (2016). Cities of Opportunity.

47 PwC (2014). Cities of Opportunity 7. https://www.pwc.com/us/en/cities-of-opportunity/2016/cities-of- opportunity-7-report.pdf , p. 10

For present purposes more specifically, Toronto ranks eighth in terms of relocation attractiveness out of 30 cities, and first out of 30 cities in terms of quality of life. Importantly, Toronto also ranks fifth out of 30 cities behind London, San Francisco, Paris and Amsterdam on the indicator for intellectual capital and innovation, and tenth out of 30 in terms of technology readiness, just behind San Francisco, Tokyo and Paris.[48] The GTA is, by all measures, ripe for attracting the sort of investment that is likely to yield competence-building and innovating subsidiaries in the region – subsidiaries and activities that are poised to bring new knowledge and innovative potential into this regional economy, and generate truly synergistic economic opportunities.

This notion of competence-creation by subsidiaries in regions which host FDI is apropos. While the GTA does rank highly as a knowledge-intensive regional economy, increasing productivity and hence economic well-being for the region's present and future populations will require that this region not only maintain but increase its ability to partake in these highly choreographed global production networks which dominate – or soon will – every conceivable segment of economic activity. With this in mind, planning for the continued growth and development of this regional economy in a globalizing context will require that the region continues to not only attract inward FDI, but that it continuously increase the share of all value created that it captures. This increased value capture requires that the GTA continually engage in value chain upgrading, moving up the value-added spectrum in all GPNs. This will require continuous learning and innovation, both by regional institutions and by firms through the exchange of knowledge through both formal and informal means.

48 PwC (2016), p. 34 and 40.

4.0 FIRM-LEVEL CASE STUDIES OF INWARD FDI IN THE TORONTO REGION

This section of the report will present firm-level case studies. These firm-level case studies are based on primary data acquired through face-to-face interviews with company executives in addition to secondary data taken from contemporary media sources, trade publications, and academic sources. The objective of this section is to highlight the extent to which these particular examples of inward FDI in the GTA are contributing to qualitative change in the nature of the regional economy by linking it with global production (i.e., innovation) networks.

4.1 IBM Canada

IBM Canada is one of the top sector employers and industry leaders in the sector. Founded in 1917, IBM Canada is a technology development company and a provider of technology services and business consulting. With $1.45 billion worth of exports in 2015, IBM Canada is one of the largest technology companies in Canada, providing a range of products and services including business analytics software, cloud-based computing services, industry-specific business solutions, IT infrastructure, mobile application development, and IT security solutions. The company also operates seven software development labs (known collectively as the IBM Canada Lab) in Markham, London, Ottawa, Montreal, Edmonton, Vancouver and Victoria.

In the analysis which follows, we provide a qualitative case study of the changing nature of IBM's investments in research and development across the GTA and southern Ontario more broadly, as well as an account of the development of two new highly innovative models of research collaboration and commercialization that IBM has formulated in cooperation with several leading universities in the GTA and Southern Ontario.

4.1.1 Software Development, Research and Innovation

IBM is the largest software company in Canada and one of the top five R&D investors in Canada. Canada is the second most important software development market in the world for IBM, which is currently focused on a strategy of aligning the company around the provision of solutions which integrate across the more traditional distinctions of hardware, software and services. These solutions can take a variety of different forms, such as cognitive computing. Canada has the largest developer population outside of the US, which is part of what makes it such a strategic and significant location for IBM to invest and carry out research. While Canada is important to IBM as a company, IBM is also very important to Canada more broadly.

IBM has long sponsored a series of research projects in Canada through organizations like the Centre for Advanced Studies at the IBM Software Solutions Lab in Markham. IBM Canada's "Canada Lab" constitutes the heart of the company's software research and development operations. First established with the founding of IBM's Toronto lab – now the Markham lab – in 1967, the Canada lab has grown to become part of IBM's largest team of software engineers located outside the United States. Although the research conducted at the Canada lab is not widely published, IBM Canada president John Lutz stated in an interview in 2012 that IBM viewed Canada as the 'home' of the company's analytics. IBM Canada also states that the company spent $477 million on R&D spending in 2015, though this information is not disaggregated.

4.1.2 Service Provision

In addition to research and development, IBM Canada also provides technology services such as cloud-based computing, business solutions, IT infrastructure and security, training, and financing. With two Data Centres located in Drummondville, QC and Toronto launched in 2015, IBM Canada now provides high-speed cloud computing to Canadian consumers. Representing an investment of $75 million, these Data Centres have been constructed in order to satisfy growing business demand for high-speed cloud computing, as well as to allow Canadian customers to connect to IBM's network of 30 Data Centres located all over the world. In addition, IBM Canada has established an IBM Canada Leadership Data Centre in Barrie, while announcing the creation of a second "Western" Leadership Data Centre in Acheson, AB. These centres provide IT infrastructure and business support to Canadian businesses. Business solutions are also provided by IBM Canada's three e-business innovation centres located in Toronto, Edmonton, and Vancouver. These services include customer-facing solutions for various forms of marketing and information dissemination (Toronto), inbound solutions for software development challenges, and business strategy.

4.1.3 IBM Research Collaboration and Innovation Incubator Initiative

IBM's research collaborations with university and other researchers primarily took the form of one-off collaborations on individual R&D projects until the late 1990s. At that point a new approach started to emerge through the creation of the Centre for Advanced Studies (part of the Markham Lab) which became the dominant form to undertake and manage research collaborations. Part of the collaboration between CASS and researchers at a number of universities involves making significant investments of technology or in-kind investments to support the work being done by university-based researchers. But it became progressively more difficult for IBM to manage the collaborations on a one-off basis, as the number and scope of them increased progressively over the next decade and a half.

This challenge is what led IBM to develop a new model for collaboration in order to deal with the scope and scale of their research collaborations. The fact that the process of generating and managing research collaborations for IBM was becoming inefficient led the company to begin thinking about the development of a new and very different model. The new model emerged out of discussions with several university presidents in Ontario and senior officials at the provincial Ministry of Research and Innovation, as well as Industry Canada. The discussions focused around the idea of how to stimulate investments and manage research activity for an anchor company of the size of IBM. The challenge for the Ontario government and the federal government was how to create a better commercial return on its investments in research funding – particularly in the academic system.

The result was the establishment of the Southern Ontario Smart Computing and Innovation Platform (SOSCIP) and the creation of the SOSCIP Research Consortium – a collaborative initiative launched in April 2012 in cooperation with the Governments of Canada and Ontario, as well as seven Ontario universities. These universities include McMaster, Waterloo, Western, U of T, Ottawa, Queen's, and the University of Ontario Institute of Technology. Representing a total investment of $210 million dollars (of which IBM has contributed $175 million as of December 2014), this project is designed to create a new focal point for IBM Canada's big data and analytics research focused on issues such as urbanization, health care, water and energy conservation and management, and software innovation. The SOSCIP high performance computing platform has a number of key distinguishing features or characteristics. It runs off the faster supercomputer (IBM BGQ) in Canada, it provides the premier agile (FPGA) research environment, it incorporates an advanced cloud/analytics platform and it provides an Extreme Large Memory research platform.

More significant than its hardware and software features is the fact that SOSCIP represents a new model for delivering collaboration between an anchor company, such as IBM, and its university-based research partners. The focus of the research consortium is not just on investments in infrastructure or technology, but on how to put the right combination of people together and how to develop a new way of managing the intellectual property (IP) that emerges out of the research collaboration. A key part of the SOSCIP approach is a new concept of open IP. Under this approach all parties to the research collaboration have full rights to the intellectual property that emerges or results from the collaboration. There is no separate accounting of the IP, but any of the parties involved, whether from IBM, the universities or small firms that emerge has an equal right to take advantage of the research and go register a patent that emerged from the research collaboration.

The governance model for SOSCIP is the unique piece of the new approach. What IBM has brought to the table in this initiative is an industry based model of governance. Projects funded by SOSCIP have to come forth with a path to commercialization right from the outset and some degree of involvement by SMEs. For IBM this is a much better way of doing things than the traditional method of research collaboration. With the initial launch of the platform and research consortium, there was a commitment to generate or fund 30 projects under the initiative over a five-year period. However they have vastly exceeded that target and within the first three years of the consortium they had funded more than 50 projects. Roughly 40 of those projects had resulted in an SME being created or they had helped an entrepreneur to grow their initiative. So far to date SOSCIP has created more than 900 skilled personnel often with technical capabilities and big data or data analytics. They have generated a run revenue rate of $2 billion over 10 years and the initiative has also generated $2 billion of savings for the Ontario health care system.

Since its establishment in 2012, SOSCIP and the IBM Canada Research and Development Centre have generated at least 200 highly skilled research jobs in Ontario. Furthermore, in 2015, IBM Canada announced that it would be investing another $65 million dollars into the SOSCIP initiative, and that it intended to double the number of universities involved in the consortium. Since April 2015, IBM Canada has managed to achieve this by including Wilfred Laurier University, OCAD, Seneca College, the University of Windsor, Carlton University, Ryerson, and York University. IBM's involvement with virtually all of the universities and a number of the leading community colleges in the Toronto Region, indicates its deep level of involvement across the broader region. The success of the original SOSCIP Research Consortium led a number of key policy makers in the Ontario Ministry of Research and Innovation to consider how they could build on its initial success. They offered to help IBM Canada design a new project and out of this round of discussions the policy design for the more recent IBM Innovation Incubator Initiative emerged. This was the first new project funded under the Strategic Partnerships Stream of the province's Jobs and Prosperity Fund. And in effect Innovation Incubator Initiative became an extension of what SOSCIP was all about. The Innovation Incubator Initiative focuses on the total life cycle for research and innovation, with an emphasis on collaboration and innovation at the front end leading to commercialization as the eventual outcome.

The primary goal of the Initiative is to take the discrete elements of SOSCIP and adapt them to generate a higher level of commercialization results in the GTA and Ontario. In so doing, IBM and its various partners in the Initiative are trying to overcome the traditional barriers that get in the way of successful commercialization activity, including access to capital, access to technology and infrastructure, access to talent and support for the necessary curriculum to provide the skills needed.

IBM describes the new Innovation Incubator Initiative as being based on four underlying goals that drive the overall strategy:

1. Bolster skills and economic development through a ground-breaking collaborative research models focused on important aspects of Canadian society/economics;

2. Provide collaborators with support and access to a unique and globally leading computing infrastructure to expand and accelerate research scope and outcomes;

3. Accelerate commercialization of "Made in Canada" new products and services, leveraging small to medium-sized businesses in industry partnerships;

4. Attract investment to Canada from IBM and others for Research and Development in cognitive, cloud, analytics, mobile, security and social.

The primary goal of the Innovation Incubator Initiative is to support up to 500 startups across the innovation ecosystem in Ontario. A key assumption underlying the Initiative is that entrepreneurs in Ontario are effective at creating new technology and new software but not necessarily as great at solving commercial problems with a potential market in business. Studies of the key reasons why startups fail usually focus on either the inability to find a first customer or the inability to deliver their product or software on a broad-enough scale to the range of customers who want to purchase it. The Innovation Incubator Initiative is designed to overcome these critical barriers for startups. IBM felt that they could create spaces where startup firms would be able to hear about the challenges faced by large industry and provide more effective guidance to the startup firms in designing and marketing their products to those potential customers. The overall goal is to create a demand-based innovation ecosystem in Ontario.

The Innovation Incubator Initiative will take space in five of the existing incubators and accelerators in the Toronto Region and across Ontario: the MaRs Discovery District in downtown Toronto, the Digital Media Zone at Ryerson University, Invest Ottawa, Communitech in Kitchener Waterloo, and the Venture Lab in Markham, which moved into IBM space at 3600 Steeles Avenue East in Markham in February 2017. Furthermore, the Innovation Incubator Initiative has its own space at 185 Spadina Avenue. Called IBM's Bluemix Garage, the second Toronto Innovation Space will be located at Ryerson University, and will be designed to help business ventures of varying sizes accelerate the development of cloud-based applications through the use of IBM's analytics software. IBM's contribution to the Innovation Hubs includes physical space in some instances, access to the cloud and cognitive platforms and other computing technologies, design thinking support in the development of products, as well as the strategy for bringing them to market, embedded executives and marketing, sales and export support.

Although the Initiative is still in its very early stages, a leading financial institution already has 10 to 20 employees working in the IBM space on Spadina Avenue; IBM has 10 employees providing support to the company in the space and there are several smaller companies in the space working with the financial institution and IBM. All of these parts of the overall initiative contain elements of the same approach. They are far more productive and capable ways of undertaking collaborative research with an eye to commercial development of the results, all within a three-year timeframe. The Incubator Innovation Initiative operates on what IBM refers to as a hub-and-spoke type model. The incubators located in the GTA and the SOSCIP high performance computing platform are linked to all of the IBM laboratories and incubators across the country and even globally. What underlies the program is a consistent model of innovation to bring a more effective strategy for commercialization and bootstrapping startup companies to the broader region and the rest of country.

The Initiative encompasses far more than a single incubator or laboratory, whether it is in Markham, at Ryerson, MaRS or 185 Spadina Avenue. The Innovation Incubator Initiative has already begun linking the physical spaces described above to IBM cloud and cognitive technologies in order to be able to provide the researchers and the SMEs with access to the IBM services described above. SOSCIP is a world-class technology project; it is the fastest and most agile computer platform in Canada, which has made it so attractive for partners to work with. The Initiative makes available an additional and complementary suite of IBM technology and services, including Watson artificial intelligence program, BlueMix, which provides a suite of very fast web app development capabilities and controlled access. IBM is also making available up to 25 PhD's to support technology development in the SMEs that will be working with the Initiative. The initiative involves a larger innovation incubation strategy. IBM executives managing the program believe they have the ingredients to accelerate the commercialization process in a consistent manner across all the Centres of Excellence and incubators and accelerators they operate across the country. If the model is successful, the ultimate objective is to distribute a wide range of economic benefits in the form of increased jobs in rapidly growing firms across the entire region and the rest of the country.

The key to the success of the strategy is to allow new companies to scale up at a much more rapid rate than they would be able to do on their own and to tap into a dense network of potential customers for their products in the form of IBM's existing partners. The strategy to scale is based on several things, including the capabilities afforded to a small startup company by cloud and cognitive-based technologies. IBM offers the ability to grow a new company in the cloud here in Canada, because they have the computer servers in Canada to do this, and to instantaneously bring them to a server in another market.

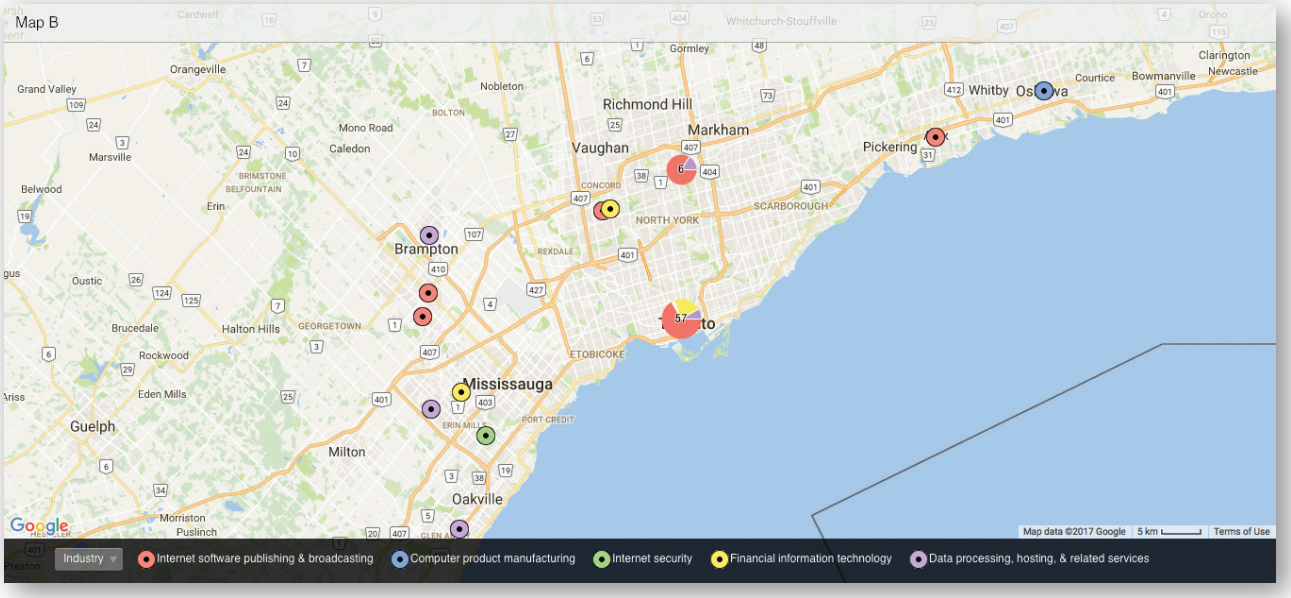
IBM provided us with the example of a medical device company to illustrate how the process can work. The company in question is developing a new product in the form of a heart measuring device. The company started at Queen's University in Kingston, moved to Toronto to work on IBM's cloud platform, and is now carrying out a clinical trial in North Carolina in order to get FDA approval. They need to be able to work with a hospital in North Carolina on the clinical trial for their device. The value added proposition of the Innovation Incubator Initiative is the ability to allow them to instantaneously move data from Toronto to North Carolina and be on a secure scalable cloud service, because IBM operates servers all over the world and can subsequently assist a company to enter new markets in the U.K., Japan, or Brazil bringing their solution into that country. The concept of scalability is crucial for the whole initiative. From IBM's perspective, there are two dimensions of scale: one is global – the ability to be able to go to other jurisdictions and replicate what they're doing in one jurisdiction very quickly in another one; the second is size – helping a startup company grow from a prototype that has 1,000 customers into production for 25 million customers.

The other advantage that IBM provides to the startup companies is access to large firms who can be potential customers and partners for the new company. In this context, IBM also refers to the Initiative as creating "collisions" between the startups and potential customers and partners. They can provide access to the new firms to backend operations of their customers. Normally this would be a difficult obstacle for a startup company to surmount. IBM is able to provide the opportunity for the young startup to introduce its innovative algorithm or software product into the backend or back office operations of the established company. As a 100-year old information technology company in Canada, IBM provides hardware, software and services to most of the large financial institutions and many other large companies in the country. This gives them the capability to take a small start-up company with a software or technology solution, bundle it together with a suite of IBM products, and put it on their production enterprise level system, and generate production and revenue opportunities for the startup company. From IBM's perspective, it also helps them grow their relationship with those companies and we grow their markets for their own products as well.

The underlying commercialization model that lies behind the Incubator Initiative is the idea of supporting and developing the innovation ecosystem in different regions of the country. The objective of the initiative is to reach into the ecosystem whether through its partnership with a network of university and college researchers or the startups working in the various incubators and then to connect those companies with potential customers and help grow them to scale. To the extent they are successful in building this model, the companies will expand their employment and growth opportunities across the region.

Through a collaboration agreement that we reached with the IBM Innovation Incubator at 185 Spadina Avenue, we obtained a list of 89 startup companies that they are currently working within the various incubators that are part of the overall initiative. We were able to geocode the individual companies and determine the segment of the ICT sector in which they are working (Figure 24). Of the 89 companies in total that we identified, 74 are based in the GTA. While the majority of them are found in the central business district of the City of Toronto, it is interesting to see that the rest are distributed across the entire GTA. Based on past research in this as well as other industrial sectors, we would anticipate that as some of these companies successfully scale up, they will need to relocate from the CBD in Toronto to other parts of the region for different economic regions. Thus, not only are the direct economic benefits of the original investment in Markham distributed across the entire region, as the MRIO input-output analysis reveals, more importantly, the longer time benefits of IBM's investment in the initiative will be reflected in the ongoing growth and development of the innovation ecosystem that it is building across the GTA.

Figure 24: Start-ups Involved in the IBM Innovation Incubators Initiative



The IBM case study provides strong confirmation of the way in which the strategies of MNE's with respect to their host regions is changing to focus more on the development of what we have called "asset augmenting" strategies. These strategies focus on developing an innovation ecosystem with deep links into the region's knowledge capabilities through the post-secondary research sector, followed by the development of a network of enhanced firm capabilities that is created by linking a new cohort of startups and scale up firms with the company's own products and corporate strategy to grow their markets with existing and new customers, both in Canada and globally. It is this element of the strategy that has the potential to have the most lasting and beneficial impact on the future growth and prosperity of the entire region.

4.2 General Motors Canada

General Motors Canada is an automotive company and 'dealer-network' that produces and distributes Chevrolet, Buick, Cadillac, and GMC brand vehicles throughout Canada. In addition to the production of vehicles, GM Canada produces vehicle parts such as transmissions and V-6 and V-8 engines. More recently the company has announced it will significantly increase its Canadian base of automotive R&D, engineering and software development related to active safety, infotainment, autonomous vehicle systems and controls. The company directly employs 8,700 people in its manufacturing, engineering and sales administration business in Canada, plus more than 15,000 related jobs in the company's OnStar customer service centre and through approximately 450 GM brand dealerships across Canada. The company's activities also generate numerous other related jobs in supplier and other support industries.

The presence of the GTA's automotive cluster dates to the founding of Colonel Sam McLaughlin's Motor Car Company in Oshawa in 1908 which transformed the British Empire's largest horseless carriage company into an automotive company (purchased by General Motors in 1918). Southern Ontario, and the GTA in particular, has been the site of a significant proportion of North America's auto assembly since the negotiation of the Auto Pact with the U.S. in 1965.

Historically the auto sector was most striking in that the predominance of the 'Big Three' OEMs had very little domestic engineering or R&D performed in Ontario, despite its significant weight in the provincial economy and the substantial proportion of North American production accounted for by the province. In the words of the current President of GM Canada, Steven Carlisle, Ontario's automotive sector was completely reliant on technology developed elsewhere for the cars we assembled – not a recipe for success in a knowledge-based and innovation-intensive economy. As this case study indicates, GM Canada is in the process of actively altering its R&D trajectory, with profound implications for a broad cross-section of key players in the automotive ecosystem spread across the GTA.

4.2.1 Vehicle and Parts Production

Presently, GM Canada operates two vehicle assembly plants located in Ingersoll and Oshawa, ON. The Ingersoll plant, known as the CAMI assembly plant, is the smaller of the two factories, and currently produces the new model Chevrolet Equinox. GM Canada's Oshawa assembly plant – which adjoins the company's parts sequencing Supplier Park – operates two assembly lines. One of these lines, (known as the flexible manufacturing line), produces the Chevrolet Impala, the Buick Regal, and the Cadillac XTS, whilst the other line will be retooled to accommodate the production of light duty trucks – making Oshawa GM's only plant in North America able to manufacture both cars and trucks in the same plant.

In addition to its vehicle assembly GM Canada operates the St. Catharines Propulsion Plant, which manufactures vehicle transmissions and V6 and V8 engines used in GM vehicles produced across North America.

4.2.2 Research, Design and Development

Since the 2008-2009 financial crisis and the ensuing bailout of the automotive sector in both Canada and the U.S., the automotive sector has experienced a fundamental restructuring, during which several OEM plants and parts supplier plants have been closed leading to a decline in employment and vehicle output. The increased attention to local and regional R&D capacity by the US OEMs such as GM (in a manner consistent with Cantwell's concept

of asset augmenting strategies) is part of a broader response by the MNEs to the growing integration of digital capabilities in automobiles – the emergence of the automobile as a new digital platform– as well as the pressure exerted by tighter emissions regulations at both the national and supra-national level that is driving greater research on light weighting materials and alternative energy sources. This pressure is resulting in increased R&D activities by OEMs and a move toward higher value added segments of the industry (electrical and electronics parts) by automotive parts suppliers.

This transformation of the OEM's R&D strategy is also occurring in the context of a steady shift of innovation from the single firm (usually the OEM) to a broader network of firms along the supply chain and to startup firms outside the automotive supply chain. The shift is driven by the increased reliance of automotive R&D on "combinatorial knowledge" which combines formerly discrete knowledge bases, rather than "cumulative knowledge" which builds on existing knowledge stocks. The creation of combinatorial knowledge requires more integrated networks and partnerships among the various actors along the supply chain, including among OEMs, parts suppliers, universities/colleges, research centres and startup companies. In the wake of this transition, GM Canada is fundamentally expanding its R&D strategies in Canada, increasing its partnerships with Ontario universities and colleges, especially in the GTA. GM Canada is building new partnerships with startup firms through its fast-expanding engineering & R&D capabilities in Oshawa and Markham and through its new "2908 at Communitech" innovation lab in Waterloo and through the introduction of new GM ride sharing operations known as Maven.

In a speech to the J.D. Power 2016 TalkAUTO Canada, Steve Carlisle, the President and Managing Director of General Motors of Canada outlined the basic contours of the strategy that the company is currently pursuing both in the U.S. and in Canada. Essentially, the company plans to disrupt itself before it is disrupted by a wide range of new startup companies. The company's vision for its future rests on four pillars: it is one that is electric, connected, autonomous and part of the sharing economy. With an industry leading position in vehicle connectivity through more than 20 years of "OnStar" service, GM sees mobile digital technology doing to the automobile what the smart phone has done to communications over the past decade. They believe that most new car buyers expect the automobile to be a mobile device and are moving rapidly to offering "mobility as a service". GM also sees vehicle connectivity and the move to autonomous vehicles as having the potential to significantly improve customer safety given that over 95% of automotive fatalities result from driver error. With an accelerated range of new automotive technologies under development, GM can serve as a vital customer for Canadian partners and research capabilities that can accelerate their introduction of safe and highly connected electric autonomous vehicles. Finally, they believe that they will ultimately become a company that is in the business of providing urban mobility solutions, rather than just an automobile production company, and the introduction of their new subsidiary, Maven, to Canada, is one step towards this transition. In words that echo those of John Cantwell, he said that, "our industry will be drawn to those jurisdictions with leading talent and capabilities in these areas of needs and opportunities, such as lightweight materials, mobile connectivity, data analytics, advanced battery technology, cyber security, software development, sensors and artificial intelligence" and GM Canada has found many of these strengths right in their own backyard.

GM Canada currently conducts research at three R&D centres in Canada (Markham, Oshawa and Kapuskasing) as well as in partnership with universities across Canada and the Corporate Innovation Lab at Communitech. The first of these is the Canadian Technical Centre - Oshawa, which employs about 350 people. For the past decade it has focused on vehicle engineering and development (particularly on chassis and sub-systems), research regarding product quality and manufacturing, and has now taken on mandates of work in the areas of 'connected car' and green technology research. The CTC - Oshawa and the Company's new 700-person R&D facility in Markham Ontario, officially known as the Canadian Technical Centre - Markham, are benefitting from an increase in funding from the company as part of GM's new push towards the development of autonomous vehicle technologies. This

new technology mandate – which is projected to generate between 700 and 1,000 new engineering jobs across the province – includes research into autonomous vehicle software and controls, active vehicle safety dynamics, infotainment, connected cars, and environmentally friendly technology. Due to the capacity limitations of the original Technical Centre in Oshawa to house the entirety of GM Canada's planned expansion, the company opened the new Automotive Software Development Centre in Markham, ON, to accommodate its new engineering hires. This will allow the Markham research centre to focus specifically on autonomous vehicle technologies, vehicle safety, infotainment, and connected car technologies. The CTC - Markham opened in the fall of 2016 and already has 120 engineers working in it. Recruitment for the Centre has taken place largely from within the GTA. One of the benefits of locating in the GTA from GM's perspective is the deep talent pool of highly qualified software engineers.

In addition to opening the CTC in Markham, GM has also announced that it will open a new research centre at 721 Eastern Avenue in downtown Toronto as part of its 'Toronto GM Mobility Campus'. Though the exact research that will be conducted has not yet been announced (aside from research on autonomous vehicle technology), the site is also expected to host a separate headquarters for GM Canada's Cadillac division, a new sales outlet for select GM brands, the Canadian head office for its "Maven" car sharing service, and a specialized sales and service centre focused on electric vehicles and e-bikes, which was developed at its Technology Centre in Oshawa. GM Canada expects the new campus to generate between 130 and 150 new jobs. The potential for the new centre to be designated as a site for experimenting with 'urban mobility solutions', part of GM's announced strategy, or to collaborate with Waterfront Toronto on a test bed for autonomous vehicles has also been raised in public forums, but has not been confirmed by the company. From GM's perspective, a key advantage of locating these various research centres in the GTA is the dense and complex transportation systems found in the region provide an ideal testing ground for the wide array of mobility and transportation solutions that the company is working on.

Finally, GM also participates in two major collaborative research endeavours: the Automotive Partnership of Canada, which researches design-to-commercialization of electric vehicles, and the Partners for the Advancement of Collaborative Engineering Education (PACE), which provides computer-based engineering tools to universities. Furthermore, GM Canada has also established two research 'outposts' in Waterloo, ON. These include a $1 million research chair in advanced materials engineering at the University of Waterloo, and the Communitech Innovation Lab in Kitchener dedicated to research in urban mobility and connected vehicle innovations. In addition to the creation of the research chair position, GM Canada has provided funding to sponsor engineering student capstone design projects involving software development in the interest of supporting 'connected car' innovations. Research at the Communitech Innovation Lab is expected to include the development of advanced smartphone applications for connected vehicles, autonomous driving technology, and new approaches to sharing electric and autonomous vehicles. The centre will also conduct research into new ways for customers to navigate their way through cities, with particular attention to ways cities can help integrate new modes of transportation such as e-bikes.

Over the course of 2016, senior executives of the company spent several weeks travelling to ten different universities in Canada visiting the engineering faculties to get a sense of the cutting-edge research being done in those universities. Through this process the company is trying to develop its own inventory of the respective bench strength that the universities in the GTA and southern Ontario currently have. They are interested in some of the work being done at the University of Toronto in research areas involving the use of artificial intelligence for autonomous vehicles, enhanced engineering control systems and robotics.

One event that GM Canada has taken advantage of to build its relationships with startups and SMEs in the emerging IT-automotive sector of the economy is the "Collision Day" held at 2908@Communitech in Waterloo in October. General Motors Canada joined the Communitech Corporate Innovation Lab in February 2016 with the opening of its "2908 Innovation Lab". The purpose of the "Collision Day was to enable Canadian startups and SMEs to explore potential growth opportunities with GM as it develops new technologies and partnerships to enable its future in the emerging environment for automobiles that it defines as increasingly electric, connected, autonomous and part of the sharing economy.

The event held in October was intended to link key GM decision makers with innovative Canadian startups and SMEs who have the potential to become partners of the OEM with capabilities that can fit into the auto company's future vision. The goal for the collision day was to explore mobility solutions for urban centres in cold climates, such as the Greater Toronto Area, with a focus on:

- Autonomous driving technology – sensing, perception, mapping, and diagnostics
- Car sharing – business models, design concepts, and connectivity enablement
- Multi-modal alternative transportation methods

GM Canada President and Managing Director Steve Carlisle said, "At GM Canada we see an important opportunity to expand our Canadian ecosystem and R&D relationships in an exciting time of disruption and transformation for our industry. Innovation is today's critical economic driver and this event with Communitech explores how a range of very capable Canadian startups may fit well with GM's partnering and investment interests."

Finally, GM Canada has also announced a $10 million investment in its second existing research centre – the Kapuskasing Cold Weather Development Centre – in 2016. Currently, the facility is used by GM Canada to test its vehicles under extreme weather conditions. With this new round of investment, however, the Kapuskasing facility will be upgraded for the purpose of improving the cold weather testing capacity of the research facility, including the ability to test the performance of autonomous vehicle technology in winter driving conditions.

The new GM Canada engineering mandate that is being developed in the GTA is highly significant both for Canada and for the Toronto Region. Engineering and R&D for infotainment, active safety systems, connected cars and software development for autonomous vehicle systems and controls are all closely aligned with the most significant areas of transformation in the global auto sector today. Both the leading automotive companies and a host of new startups believe that these technologies will redefine our concepts of mobility. The Canadian innovation ecosystem that GM Canada is developing in the Toronto Region with new university and supplier partners is a key to the sweet spot for the future of auto innovation. Growing these research capabilities will solidify the company's footprint in the Toronto Region and connect Canada to the most important automotive technologies of the future. Canadian partners – both universities and startups that align with GM Canada strategic direction – have the opening to participate in this coming transformation through a commercialization opportunity with an MNE that one of the handful of globally capable developers of these new technologies.

4.2.3 Administration and Logistics

With five administrative and logistics centres located throughout Canada, GM Canada maintains a substantial administrative staff as part of its operations. The largest of these operations – the GM Canada headquarters located in Oshawa, ON – houses several of the company's administrative departments including vehicle sales, service, and marketing, purchasing, finance, product engineering and planning, personnel, legal, customer care and aftersales, and corporate affairs.

4.3 Cisco Systems Canada

Established in 1992, Cisco Systems Canada Co. is a provider of commercial IT solutions and a manufacturer of network technologies. Products and services offered by Cisco Canada include blade switches, cloud and systems management, collaboration endpoints, conferencing, customer collaboration, data centre management and automation, data centre switches, interfaces and modules, networking software, optical networking, physical security, routers, IT security, servers, service exchange, storage networking, unified communications, video, and wireless. With more than 1,700 employees located in offices in Toronto, Ottawa, Halifax, Montreal, Quebec City, Winnipeg, Calgary, Edmonton, and Vancouver, as of 2017, Cisco Canada has been consistently recognized as one of Canada's top employers.

4.3.1 Investment

4.3.1.1 Research and Development

In 2013, Cisco Canada announced it would invest up to $4 billion in the Ontario economy over the next decade. As of 2014, $150 million had already been committed to the province, with the company announcing the development of its new Cisco Toronto Innovation Centre, as well as the establishment of a number of research chairs at Canadian universities. Citing Ontario's high-quality STEM graduates as an important factor influencing the decision, the company's aim is to take advantage of this pool of skilled labour by developing its R&D infrastructure and capacity in the province. Specifically, the company intends to use its new Ontario facilities to conduct research into the Internet of Things (IoT)/the Internet of Everything (IoE).

In addition to the investment announcement, Cisco Canada also works in cooperation with Cisco Investments, a subsidiary of Cisco Systems, Inc. focused on providing seed funding to tech start-ups. Established in 1993, Cisco Investments currently maintains an active portfolio that is valued at approximately $2 billion and is spread over 100+ investments. With investment decisions intimately tied to the needs of its parent company, Cisco Investments is currently focused on funding projects related to big data, Software as a Service (SaaS) and mobile application development, IT infrastructure, the Internet of Things/Internet of Everything, IT security, and semiconductor development.

4.3.1.2 Ottawa Development Centre

First acquired as Skystone Systems in 1997, Cisco Canada's Ottawa Development Centre (ODC) is a research and development hub located in Kanata, ON. Shortly after it was established, the ODC began to focus its research on core routing technologies, resulting in a number of commercial breakthroughs which established the centre as an important aspect of Cisco Canada's growing R&D activities. Annually, Cisco spends more than $100M on R&D in

Canada through its engineers in Kanata as well as throughout the rest of the country. There are approximately 400 employees located at the Kanata Centre, with 300 employees directly involved in R&D projects. The Kanata Centre has been instrumental in developing many successful products for Cisco and is crucial in the current production of essential products and equipment for major service providers not only in Canada but throughout the world.

4.3.1.3 University Partnerships

Since 2013, Cisco Canada has invested more than $15 million, establishing 12 research chairs and partnerships at Canadian universities. Like the case studies described above for GM and IBM, these investments represent a significant shift in Cisco's strategy for investment in Canada. The company has shifted its strategy from one focused on tailoring its product offerings from the home market for sale in the host market to what we described as an "asset augmenting" strategy designed to tap into the local research and knowledge enhancement capabilities of the Canadian post-secondary research sector.

While the research chairs are located at a number of universities across the country (listed below), the key feature from a Toronto Region perspective is that Cisco Canada staff at the Cisco Toronto Innovation Centre manage its relationships with the researchers across the country. It is worth noting as well that part of Cisco Canada's objective is to use its relationships with research chairs to build out its local innovation ecosystem in Toronto and across the country. The research chairs they have invested in include the following:

Carleton University:

- $1.8 million to establish the Carleton Sensor Technology for the Internet of Things Research Chair.

Laval University:

- $325,000 over five years to establish the Cisco Research Chair in Educational Leadership focused on exploring leading-edge technology that will allow faculty to offer high-calibre online courses in computer science and software engineering.

McMaster University (2):

- $2.1 million over eight years to establish a Professorship in Integrated Health Biosystems ($1.6 million) and the Cisco Research Chair in Bioinformatics. These two positions will be well integrated to allow for a bridging of the gap that exists between data-intensive areas of biomedical research and healthcare.

University of Alberta:

- $2 million over ten years to establish the Cisco Research Chair in Healthcare Solutions, focused on the use of technology for improving surgical procedures.

University of British Columbia:

- $1 million over five years for the joint establishment of UBC's campus as a 'living lab' for the development, demonstration, and commercialization of new technologies and solutions for greenhouse gas reduction, Smart+Connected Communities, Smart+Connected Real Estate, and energy management.

University of New Brunswick:

- $2 million over ten years to establish the Cisco Research Chair in Data Analytics.

University of Regina:

- $2 million over ten years to establish the Cisco Research Chair in E-Governance focused on how governments can more effectively communicate with citizens, businesses, and other governments through video, information sharing, and online collaboration.

University of Saskatchewan:

- $2 million over ten years to establish the Cisco Research Chair in Mining Solutions focused on the promotion, support, and leading of mining research, development, and innovation at the university through industry-linked projects.

University of Waterloo:

- $1 million over five years to establish the Cisco Smart Grid Research Chair.

University of Western Ontario:

- $750,000 over five years to establish the Cisco Research Chair in Banking and Insurance Analytics.

University of Winnipeg:

- $2 million over ten years and a two-endpoint Cisco TelePresence virtual meeting system to establish the Cisco Research Chair for Collaborative Technologies. The position will be focused on commercializing innovative environmental technologies through UWin CREATE's demonstration and technology transfer capabilities.

4.3.2 Operations

4.3.2.1 Cisco Connect Toronto/Montreal

Established as a set of trade shows for internet and communications technologies and solutions, Cisco Canada's Connect Toronto and Connect Montreal are annual events hosted by the company as a way of facilitating the creation of business relationships. In addition to vendor displays, the events also host workshops and information sessions designed to help participants learn about the latest research taking place within the organization.

4.3.2.2 Cisco Canada Headquarters

Located at 88 Queen's Quay West, Cisco Canada's new headquarters can be found within the RBC WaterPark Place III building. While the building itself is considered to be high-tech, Cisco Canada worked together with the architect on the design to make it the first truly smart building in North America. Designed with room for 900 employees, the headquarters follows a ratio of 2.6 workspaces for every employee so as to encourage the productive use of space and optimize the potential for innovation.

4.3.2.3 Cisco Toronto Innovation Centre

Officially opened in January 2016, Cisco Canada's Toronto Innovation Centre is a 100-thousand square foot facility located on the 29th floor of the company's Toronto headquarters. Reflecting the beginning of a $100 million investment over the next ten years, the Innovation Centre is designed to facilitate the development and demonstration of digital innovation and solutions, and is one of nine global innovation centres. According to Cisco Canada, the innovation centre brings together customers, industry collaborators, start-ups, application developers, accelerators, government organizations, and universities/colleges to work on real world problems focused on the Internet of Things, healthcare transformation, FinTech, and urban innovation (smart cities, smart buildings, urban mobility, and environmental transformation). It also contains a dynamic classroom space used for Cisco solutions training, a TelePresence room with which the other innovation centres can be contacted, a series of flexible rooms, and access to the new customer experience centre.

"The Cisco Toronto Innovation Centre is designed to break the status quo by bringing together customers, partners, startups, universities, and open communities to..." inspire, innovate, and invest.[49] Cisco Innovation Centres (CICs) are located in key cities around the world, and serve as a hub to showcase the possibilities associated with the digital world and the Internet of Things. In each, Cisco works to collaboratively develop solutions (and rapid prototypes) with partners, and to invest and partner with startups, accelerators, and universities. "The Cisco Innovation Grand Challenge searches for the most disruptive digital ideas or solutions that transform industries and governments."[50]

At the time of our site visit, there were six full-time employees (part of a global innovation team of more than 70 employees) working in the Innovation Centre. Their primary mandate is to grow the innovation ecosystem, both locally and throughout Canada, by tapping into Cisco's research connections with universities, colleges, and incubators/accelerators in the Toronto Region and across the country. Cisco uses the same language to describe the purpose of its investments in the Innovation Centre as do GM and IBM – namely, the value of building on its relationships with university researchers to develop partnerships with startup firms that can feed into and help grow a local innovation ecosystem.

While many companies in the Information and Communications Technology (ICT) industry are locating their R&D facilities in countries like India and China, the interviewees from the Cisco Toronto Innovation Centre cited several critical factors that influenced the company's decision to locate one of its innovation centres in the city:

- the region's relative proximity to San Jose, California (their corporate HQ's - only a four-hour flight away);
- the highly educated labour force in the Toronto Region, and Ontario more broadly, that it can recruit from;
- the diversity of the Canadian population;
- the relatively stable political system and sound governments;
- and finally, the perception by Cisco executives that there was a great opportunity for Cisco to grow its business in Canada. Cisco does a substantial amount of business in this country and its senior management felt they had a wealth of opportunities to continue to grow.

49 http://www.cisco.com/c/m/en_ca/innovationcenter/toronto.html as of February 6, 2017.

50 http://www.cisco.com/c/en/us/solutions/innovation-centers.html as of February 6, 2017.

Another factor that contributed to the decision was the fact that Cisco has several strong relationships with other firms and actors in the region (e.g., Toronto Dominion Bank, Waterfront Toronto, and 12 Cisco Research Chairs at universities across Canada). Cisco is also working very closely with the Chief Technology Officer for the City of Mississauga, Shawn Slack, on a range of issues related to urban innovation. They currently have an active link with the city, and have worked to tie together all the different systems that are at work as part of the city's operations.

Additionally, Cisco is developing relationships with firms in the financial services sector of Toronto. On January 11, 2016, the TD Bank Group (TD) and Cisco Canada announced an agreement to collaborate on technology solutions for both improved customer and employee experiences. This agreement resulted in the creation of a dedicated TD-Cisco team that works collaboratively in a designated space in the Cisco Toronto Innovation Centre. TD was the first customer project to be housed in the Innovation Ventre with initial areas of focus including employee mobility, the Internet of Things (IoT), contact centre operations, and corporate energy conservation.

Other corporate innovation partnerships (to-date) include London Hydro, Metrolinx (UP Express), MLSE (Air Canada Centre), and Barrick Gold.

With respect to the lab at the innovation centre in Toronto, Cisco does not require a large physical space because the lab is mostly virtual and has direct connections to other innovation centres (e.g., London Hydro), accelerators (e.g., MaRS, Communitech), and numerous other academic partners. The lab is also not an incubator nor an accelerator in its own right; it has an ongoing relationship with the OMERS incubator at 111 Richmond Street (OneEleven), which has recently moved to Front Street, as well as other accelerators and incubators across the country. Partnering with OMERS on the incubator provides Cisco with a front row seat in the incubation space.

The staff in the Cisco Toronto Innovation Centre are also working on a video infrastructure to connect the networks and create a virtual innovation ecosystem. The Cisco website and the website for the innovation centre will have a list of nodes in the network that are connected. Cisco also works closely with IBM in Canada, the company's largest reseller for Cisco products and its largest strategic partner. Some of the go-to-market partners for Cisco and the Innovation Centre besides IBM include Dimension Data, Ellis Don, and McKesson.

4.3.2.4 Cisco Ventures

Another important piece of Cisco's Canadian strategy is the $150 million venture-capital program they launched in conjunction with OMERS, Georgian Capital Partners, and McRock Capital. There is currently $60 million of Cisco money invested in the VC fund. Through the fund, Cisco is actively investing in a number of startup firms in the Toronto Region. Their VC partners come to them with possible investments with a goal of bringing these possible investments into the Cisco Toronto Innovation Centre to work with them more closely. One of the companies they have invested in through the venture fund is Invixium, located in Markham. Another company that they are working with is Aisle Labs, which provides data analytics for high density shopping centres. The company uses the Cisco Toronto Innovation Centre as a testing site before they go to market with potential customers such as Cadillac Fairview, the Greater Toronto Airports Authority (GTAA), and Oxford Properties.

4.3.3 Global Innovation

From the perspective of its developmental impact on the GTA economy, the Cisco Toronto Innovation Centre plays many roles, and offers many advantages in terms of positioning the GTA for the potentially disruptive advent of Industry 4.0. First, the Cisco Toronto Innovation Centre is one of 9 CICs located around the globe (Perth/Sydney, Barcelona, Berlin, London, Paris, Rio de Janeiro, Songdo, and Tokyo). Each engages with local/domestic partners and customers to build products and develop solutions. The Cisco Toronto Innovation Centre connects the innovation ecosystem in Toronto, and the surrounding region, into the global innovation system for STEM-related industries. Cisco, as a key partner with many global lead firms (e.g., IBM), is well positioned to instantly share innovations from any one of its key innovation centres and/or global partners to other partners, connecting local economies to the global marketplace and innovation system. The Cisco openBerlin Innovation Centre, for example, offers partner companies the ability to go from collaborative brainstorming, to design and rapid prototyping, all under one roof. One example promoted on the main Cisco website is an alliance between Cisco and Azeti Networks, which involves the development of digital control systems for all aspects of a facility's physical plant – from HVAC to door opening and closing, to network status – from an individual handheld device (e.g., iPad). One of the benefits of this potential synergistic collaboration is the ability to reduce the use of energy in large corporations, with direct and rapid impacts on retained earnings.

By locating in Toronto, the Cisco Toronto Innovation Centre moves this region in the direction of 'global city' status, and makes it an attractive location for the landing of high-value activities by global lead firms (e.g., strategic coupling). If, for example, through the links between the Cisco Toronto Innovation Centre, the MaRS Discovery Centre, the University of Toronto, and corporate partners like IBM and TD, new synergistic advances occur within the realm of financial information systems and computing, then the region as a whole stands to benefit as it becomes a global hub for this activity. Likewise, the potential for horizontal, as well as vertical, knowledge spillovers will attract lead firms across a very broad range of industries to this region.

Like the previous case studies covered in this report, the Cisco model is strongly based on building out an innovation ecosystem. The company links its research capabilities through investments in university research chairs to its network of startup firms working in the lab at the Cisco Toronto Innovation Centre. These are then connected to potential investments through its venture fund and Cisco go-to-market partners, such as IBM, TD, EllisDon, and other corporate partners.

While the Cisco Toronto Innovation Centre is physically housed in the new Cisco headquarters on the Toronto waterfront, through its networking capabilities and virtual working style, Cisco is actively engaged with a wide range of government, education, and corporate partners located throughout the GTA. These long-range investments in growing the innovation ecosystem in the region will likely have a deep-seated and more lasting effecting on the economic prosperity of the region than its initial investment in the physical facilities of its headquarters.

4.4 Huawei Canada

First established in 2008, Huawei Canada is a provider of internet and communication technology (ICT) solutions and services. Huawei Canada's focus is on the provision of telecommunications network infrastructure, professional services, and enterprise solutions, as well as the development of applications, software, and mobile devices. In 2017 Huawei Canada had 700 employees in Ontario alone, of whom 400 worked in their R&D facilities and the remaining 300 in operations.

4.4.1 Markham Headquarters

After spending three years at their original headquarters established in 2008, in 2011 Huawei Canada moved to a new, purpose-built headquarters in Markham, Ontario. The headquarters is listed as employing a staff of between 100 to 500, all working in sales, marketing, administration, and support.

The new Markham office is the locus for all of Huawei's operations across Ontario and Canada, both on the business and the research fronts. The Canadian headquarters was located in Markham for several different reasons – largely because of the proximity to their major customers who are the large telecom network providers like Bell and Telus, the presence of a large Chinese population in Markham, and the fact that the cost of rent was cheaper than it was in downtown Toronto. As Huawei continues to expand both its sales and its research footprint in Canada, they expect that a considerable proportion of their future employment will be based at the Markham headquarters, especially in light of its capacity to accommodate up to 500 employees at the site.

4.4.2 Applied Research

Huawei Canada's largest operation is its Ottawa Research and Development Centre located in Kanata, ON. Opened in 2010 with a $67.5 million/5 year investment from Huawei and a $6.5 million in provincial support, the centre employs 130 researchers working in the areas of wireline, wireless, optical, and IP networking. The presence of the research facility in Ottawa grew out of an initial collaboration between the company and several ex-Nortel engineers. Beginning in 2010, Huawei assigned the small research group the task of developing a new chip that could transmit signals over 2G, 3G and 4G wireless networks simultaneously. The Single RAN (radio access network) chip, which was designed by the small initial research team in Ottawa, allowed the company to put a 2G/3G and a 4G blade all in one box that could be placed on the cell tower for the wireless network. It provided a much more efficient way for the company to transmit signals for both older and newer generation wireless networks through the same equipment. The challenge in designing the chip is that the three blades all have to communicate with each other. Huawei initially thought that it would take the chip design team up to five years to develop the chip that would allow that communication to take place; yet the Ottawa research team developed the CHIP in just 18 months. This accomplishment caught the attention of the senior management of the company and gained a wider recognition of the quality of the research talent located in Ottawa and in Canada more generally. From that initial start, Huawei then laid its expansion plans that involved the initial grant from the Province of Ontario in 2010 for $6.5 million with its commitment to invest $67 million over a five-year period

In 2014, Huawei Canada announced it would be expanding its research and development activities in Ontario – a project they called "Ontario 5G" – with an additional investment of $212 million. Alongside an additional $16 million in provincial support (announced in 2016), these funds are being used to hire an additional 500 research and development positions by 2020, and 75 sales, marketing, and support staff, and to establish new research centres in Waterloo and Markham.

Located in the David Johnson Research and Technology Park adjunct to the University of Waterloo campus, Huawei Canada's Waterloo research centre employees 50 engineers and computer scientists focused in the areas of applications and mobile security. Huawei Canada's VP of Corporate Affairs Scott Bradley stated that in 2017 the company has 100 researchers in their Markham facility with a focus on big data, 'cloud computing' and hardware acceleration technologies.

As part of its longstanding relationship with Telus (which began in 2008 when the company began to provide parts and servicing for Telus), Huawei Canada and the mobile network provider have established the "Living Lab" in downtown Vancouver. Focused on research into 5G wireless network technology, the purpose of the Living Lab is to provide a test space for various technologies related to the provision of fibre-wireless internet in the city. The lab was established in 2015 after Telus announced its plans to invest $1 billion into the expansion of its fibre optic network into Vancouver's downtown. In 2016, the Living Lab announced that it has achieved wireless network speeds of 29.3 gigabits per second.

4.4.3 University/College Partnerships

In addition to its applied research, Huawei Canada also works in partnership with a number of Canadian universities and colleges. As of 2016, Huawei Canada had announced that it has invested $6 million dollars in developing university research partnerships. Going forward, however, Huawei Canada has announced that it intends to invest $10 million annually in university research funding. A portion of these funds will be directed to three universities directly, while another portion is available through two additional research and training programs.

4.4.3.1 Polytechnique Montreal: NSERC-Huawei Industrial Research Chair in Future Wireless Technologies (FuWiC)

On February 10, 2017, Huawei Canada announced the creation of the FuWiC Chair at the Polytechnique Montreal in Quebec. Hosted in the university's Poly-Grames research centre, the FuWiC research chair is co-funded by Huawei Canada and NSERC, each of whom have provided $2.45 million in funding for the project. In addition, Huawei Canada has provided in kind contributions, although the value of these contributions has not been qualified. The FuWiC research chair is to be awarded to individuals researching in the areas of wireless technologies, smart connectivity, 5G networks, and the internet of things.

4.4.3.2 The University of Toronto

In April 2016, Huawei Canada and the University of Toronto announced a new research partnership that will be based out of the Edward S. Rogers Faculty of Electrical and Computer Engineering. This partnership will see Huawei invest $3 million in research projects with the University over the next three years. The collaboration will support a diverse range of projects, from designing optimized cloud computing to engineering next-generation Internet architectures, and aims to expand the relationship between the company and the university into fields such as biomedical engineering, materials science and theoretical physics.

The Edward S. Rogers Sr. Department of Electrical & Computer Engineering (ECE) has a strong history of successful collaborations with Huawei in many different areas. ECE Professor Wei Yu has had a fruitful partnership with the company since 2013 and his lab is currently working toward designing 5G cellular networks, the next generation wireless standard targeted for 2020. Yu is quoted on the University's web site: "We're thinking ahead about ways to enhance broadband user experience through massive connectivity and cloud computing. Future wireless networks will also be about connecting your car, monitoring and sensing the environment, and widespread home and office automation. That means millions of connected devices and an explosion of new applications."

4.4.3.3 The University of Waterloo

In addition to the creation of the new Waterloo research centre, Huawei Canada announced in 2016 that it would be investing $3 million over three years into a research partnership with the University of Waterloo. The partnership will be focused on cloud computing, next generation communications, data management, and data analytics.

4.4.3.4 Huawei Innovation Research Program (HIRP)

Huawei Canada's Innovation Research Program was established in order to provide research funding to Canadian universities pursuing work in the areas of big data, future networks, media technology, computing technology, compression technology, and wireless communication technology, such as the forthcoming 5G network standard. In addition to facilitating access to $60,000 worth of potential government-sponsored research grants, the HIRP program also offers up to $90,000 per person to successful applicants.

The growing research investment by Huawei across the province in a relatively short period of time is a direct offshoot of the success of its initial research investment in Kanata. The company recognized that Ottawa has unique skill-sets in chip design and in wireless, but the Toronto Region has expertise in different areas that are crucial for its long-term research and development projects. The skill-sets that they have identified in the Toronto Region involves areas of hardware acceleration, computing, cloud computing, and all that falls under cloud computing. The company is committed to employing 500 people in the province of Ontario by 2020, but corporate executives expect that they will reach that number at the latest by 2018. While they are continuing to expand in Ottawa, they are expanding "like crazy" in the Toronto Region. As in the other case studies described above, the key catalyst for their expanding investment in the region has been the partnerships with the universities and colleges (or post-secondary educational institutions). The research partnerships with the universities serve as a broader signaling device within the global company for the quality of the talent that exists in the region, and it often serves as the first step in developing a recruiting strategy for new hires to work on research with the company. Their approach is now shifting towards the idea of building a broader innovation ecosystem in the Toronto Region and Ontario more generally.

One sector of the provincial economy that is of particular interest to Huawei is the automotive ecosystem, largely because of the presence of GM and the fact that GM is partnering with several universities and colleges in southern Ontario. Huawei is also currently working with BMW and Audi in Europe and China, reflecting interest from automotive companies globally in partnering with telecom leaders in the areas of automated vehicles and infotainment systems. One of the opportunities that the company sees in terms of their investment in Ontario is the strength of the provincial automotive sector and rapidly evolving shift in the sector away from only lower-value added automotive assembly operations to an increasing range of high-value-added R&D activities linked to next generation automobiles. Huawei views it as a huge opportunity for the company to be located in Ontario given its strong leadership position in automotive and technology sectors. In our interview, a company executive described this combination of the auto and IT sectors as "a unique, unique ecosystem that California doesn't have this. It's a very, very unique – in Ontario. Ontario should be stacking way up there and we're going to be the first jurisdiction to have a fully automated highway."

4.4.3.5 Huawei Seeds of the Future Program

Huawei Canada's Seeds of the Future program provides funding for students to first visit the company's Ottawa Research Centre, before then spending two weeks learning from Huawei engineers in Beijing and Shenzhen, China. The program is currently in its 3rd year. In an effort to encourage engineering students to pursue work in the field of ICT technologies, as well as to help improve their understanding of ICT systems and research, the Seeds of the Future has accepted 20 students from Canadian universities who will be travelling to China this spring.

4.4.4 Huawei's Future Investment and Growth in the Toronto Region

The company sees the strategic importance of its Ontario research facilities as increasing dramatically within the global corporation over the next five years. The executive who was previously the head of their R&D facility at the Canada Research Centre has returned to China to become head of Wireline Research for Huawei globally. The head of Wireline Research globally for Huawei is now the head not only of the global operation, but he retains his official title as President of the Canada Research Centre and he is also the President of North American Research Institute. So effectively he oversees all North American research out of the company's Ottawa research centre. In his public statement at the launch of the company's new partnership with the University of Toronto in November 2016, he suggested that given the growing strategic importance of its research activities in the region, the Toronto Region could become the eventual headquarters for Huawei's North American research.

This development will not occur overnight, but could happen gradually over a five to ten year period. One of the critical advantages contributing to the attractiveness of the Toronto Region as a site for global research is the ability to recruit people to work in this area. The company is finding that it is much easier to convince highly qualified research talent to move to work in Vancouver or Toronto than to other locations. So strategically for Huawei if they expand research activities in the Toronto Region, it is easier to assemble the people they need to make up that team. The company also suggested that one of the advantages it has found to working in the Toronto Region is that it is easier to assemble a multicultural team from different parts of the world and get them to work effectively than is the case in other potential research centres in which it could be located. The company is finding that Canadian research teams are more open-minded and collaborative in their approach to research which enables their ability to get the research teams up and running relatively quickly in this region. So, from Huawei's perspective there is an interesting dynamic emerging of why it is an advantage to be located in Canada. Canada's diversity and openness is becoming a distinct advantage in helping it become much more competitive when it comes to attracting talent from around the world. They think that this should be a key message that the Toronto Region promotes in talking about the corporate benefit of building global research teams in this region. "You want to recruit from around the world, you want to put 10 people from around the world together, that's a stoplight in Toronto. You can't walk anywhere without a team being a global team. That's how we function, that's what Toronto is all about. I think that's a potentially huge selling point."

4.5 Festo Canada

Festo Canada is the Canadian subsidiary of a German-based manufacturer of products and solutions for factory and process automation. Parts distributed by Festo Canada include pneumatic/hydraulic drivers, electrical control mechanisms, valves, sensors, and electronic motors. In addition, Festo also provides technical education and workforce development programs, component servicing and maintenance services, and regional sales and administrative services. Headquartered in Mississauga, with two additional facilities in Montreal and Quebec City, Festo Canada currently employs approximately 150 people in their Automation business (described above) and another 250 in the Education and Training business which is headquartered in Quebec City. Festo Canada also works in cooperation with numerous distribution partners throughout the country. Festo Canada is an independent subsidiary of a German-owned firm, Festo. Festo Canada has been operating in Canada for more than four decades, and the parent company has been active for more than nine decades internationally. Festo Canada employs about 150 people and has annual revenues of approximately $47 million CAD.

Festo Canada, as well as the parent company, are positioned to supply state-of-the-art components and sub-systems designed to automate machines with an eye toward increasing productivity. Festo's customers include OEMs in a wide range of industries including automotive, packaging, biotechnology and cosmetics, food and beverage, electronics and assembly, food processing, stocking and lifting technology, medical devices and laboratory automation, and water and wastewater treatment (source: interview with CEO). Festo's focus is on facilitating the automation of machines in all industries.

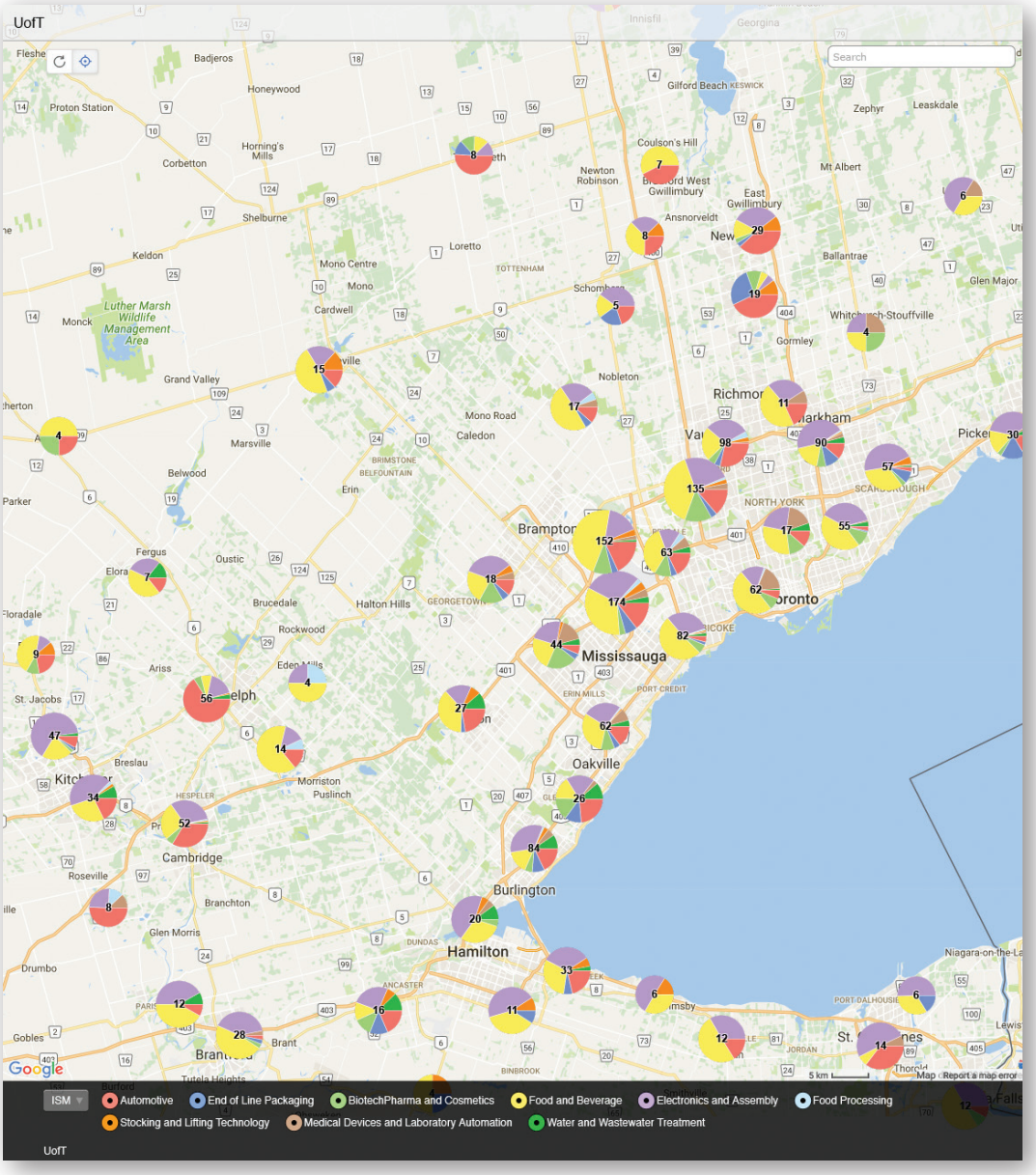
Festo Canada's operation has recently changed as it opened a large logistics centre in Mason, Ohio and, as a result, ceased using their Mississauga facility as a logistics and distribution centre. Instead, the Mississauga facility is now used as a space where Festo's engineers, and those of their customers, can collaborate and co-develop technical solutions for its customers. Indeed, during our site visit, we saw several instances of Festo engineers working together with engineering teams from their client firms, to get automated systems programmed properly. Split between the company's operations in Mississauga, Quebec City, and Montreal, Festo Canada's technical solutions – rather than falling into the category of original equipment manufacturing – constitute the provision of assistance/troubleshooting for customers attempting to integrate Festo components into their automated manufacturing process(es), particularly in the field of automated process solutions and automated handling. Specifically, in our interview, a senior executive noted that Festo Canada "works with customers, engineer to engineer, to turn the right components into handling solutions it then assembles at its facility in Mississauga". Festo Canada also provides technical solutions to customers by proposing new and innovative ways in which Festo components could be integrated within their production processes.

As part of a push towards the development of sustainable technologies and 'internet of things' technologies compatible with the 'Industry 4.0' paradigm, Festo (the parent company) has launched of number of research initiatives including Optimized Resource Efficiency in Production through the Energy-Autonomous Sensors and Interactions with Mobile Users project (ENSIMA), the Eco Manufactured Transportation Means from Clean and Competitive Factory project (EMC2), the Green Carbody project, and the Energy Efficiency in Production in the Drive and Handling Technology Field (EnEffAH). As part of this push, the company has also released its CPX automation platform, which includes IT services, integrated programmable logic control (PLC), safety modules, motion control, high-speed counting, proportional regulatory controls, pressure and temperature sensing, pneumatic valve control, and diagnostic capabilities. Festo has also begun to engage in R&D in the field of biomimicry. Though unable to confirm whether any research will be undertaken by Festo Canada beyond the automated process solutions and automated handling, Roger Hallett stated in 2016 that he expected the company

to grow as a result of these initiatives and that Festo is supporting new collaboration between industry and academia to facilitate the uptake by Canadian manufacturers of advanced manufacturing concepts from Industry 4.0, the industrial internet of things and other initiatives.

The company is clearly eyeing 'Industy 4.0' and their role in this new era of mechanized production. Industry 4.0 is often referred to as the "Internet of Things" and refers to a system whereby production is not only automated but where the various mechanized components of the system are digitally aware of other components in the system and able to accept input, send output, and adapt to input from users as well as from other components. Festo, as a major actor in the mechatronics industry currently, undoubtedly intends to play a central role in this next transformative phase of industrial structural change. To do so, they realize that they will require an abundance of appropriately skilled workers.

Figure 25: Map Showing Festo Customer Accounts in the GTA



Festo Canada is an example of inward FDI which landed in the GTA and which has tremendous potential to convey considerable productivity, knowledge and technology spillovers to other firms within this regional economy. In assisting in the development of a suitable workforce, the firm is contributing to the diffusion of knowledge which can flow to all firms within the GTA which make use of these technologies. There is also considerable potential for horizontal spillovers (i.e., to other potential vendors of these goods and services) through the mobility of labour within the region, the general circulation of ideas through relevant communities of practice, and through mimicry. By 'landing' a key firm in the provision of mechatronics goods and services, the GTA has become more attractive to those lead firms and other OEMs who rely on these goods and services. This augments the GTA's attractiveness to any and all firms who see value in increased productivity through sophisticated automation of production.

4.6 Thomson Reuters

Thomson Reuters is a Canadian company that provides data, technology and information to customers in over 100 countries. Working with both governments and private businesses, Thomson Reuters provides services in the areas of finance, news media, risk management, law, and tax and accounting. As of 2017, Thomson Reuters maintained seven offices between employing over 1,200 people across Canada.

4.6.1 Operations

4.6.1.1 Finance

Thomson Reuters offers a suite of finance-related products to its customers including both software packages and data sets. Regarding software packages, Thomson Reuters has developed the Eikon software, a package designed to provide easy access to news, data, and analytics sorted by preference, and the Elektron software, a customizable workflow optimization and data management application that puts out high-speed, machine readable information. The company also offers products in the areas of company data, economic data, market data, pricing data, and trading and investing data.

4.6.1.2 Government Solutions

Thomson Reuters provides a number of services under the banner of 'government solutions.' Broken down into the categories of national security and tax and legal solutions, the company's focus on government solutions revolves around information provision rather than software development. Under the banner of national security, Thomson Reuters offers secure personnel screening, due diligence, and investigative solutions that can be customized to fit the different workflows of individual governments and corporations. Thomson Reuters also offers supply chain risk management services, including the detection, monitoring, and minimization of potential risks associated with corporate and government suppliers, distributers, and partners. Additionally, the company provides insider threat analyses through the Thomson Reuters Special Services division, which has developed a robust, customizable system for evaluation solutions related to insider threats. Finally, the company has also combined a suite of private-sector developed tools related to the monitoring illicit finance for use by both corporate and government customers.

For tax and legal solutions products, Thomson Reuters provides software and analysis designed to help governments and their tax agencies operate more efficiently. Broken down into tax and accounting services (constituted by resource and revenue optimization services), corporate and government practice (which provides tools and solutions for corporate and government legal professionals), and corporate and government management (which provides solutions to manage legal department workflows), Thomson Reuters tax and legal services are both widespread and flexible.

4.6.1.3 Risk Management

As part of its risk management portfolio, Thomson Reuters offers three distinct services. These include World-Check, Compliance Learning, and Regulatory Intelligence. With respect to World-Check, Thomson Reuters offers screening services for 'heightened risk' individuals and entities globally, and allows business to identify risks within their various business and 'human' networks. Additionally, Thomson Reuters Compliance Learning services are designed to provide practical, interactive, customizable, and cost-effective compliance training for employees. Finally, the company also provides Regulatory Intelligence services, which includes supplying companies and governments with datasets related to regulations and regulatory bodies across the world.

4.6.1.4 Law

With 23 individual products listed on their website alone, Thomson Reuters provides a wide-array of legal products and services. While the majority of these products constitute reference texts and training manuals, the company also provides legal assistance software and language classes. The list of available products is quite extensive and includes a number of different products marketed under the Carswell name as well as news publications such as Canadian Lawyer and the Law Times.

4.6.1.5 Tax and Accounting

Aside from its tax and accounting services listed under it's 'government solutions' section, Thomson Reuters also provides additional tax and accounting services. These include:

Taxnet Pro: An online tax research service providing information and analytics about tax-related data and regulations;

Onvio & DT Professional Suite: A suite of compliance software combined with state-of-the-art productivity tools designed to improve efficiency and profitability of tax and accounting firms;

Checkpoint: "The leading provider of US and international ax information for tax and accounting professionals." Provides expert research, guidance, technology, learning, and news about tax and compliance issues;

ONESOURCE: "The most comprehensive global tax solution for corporate tax and accounting professionals." Provides solutions for tax compliance challenges as well as an automated process for US organization making transactions across NA, or for multinationals making transactions across the world;

Thomson Reuters Pro View: A professional grade software platform that allows interaction with eBook versions of tax-related information sources; and,

Print Solutions: Printed analyses, news reports, guidance tips, and productivity tools in the areas of corporate tax, international tax, estate tax, and wealth planning.

In addition, the Tax & Accounting business, working in tandem with Thomson Reuters Labs announced an agreement in May 2017 with Ottawa based startup MindBridge Analytics Inc. to deliver data analytics capabilities as part of the Thomson Reuters Tax & Accounting Audit Suite. MindBridge offers an artificial intelligence (AI) solution to help auditors detect fraud and other accounting anomalies.

4.6.1.6 Administration

Although founded in Toronto in 2008 as a result of the Thomson Corporation's purchase of Reuters Group and registered in Ontario, the company had been headquartered in New York City until the past year. The success of its initial research investments in Ontario and a growing interest in the rapidly expanding research capabilities of the Toronto Region have led to a desire on the part of the company to embed its corporate research initiatives more solidly in the region. This desire to build on the success of its recent investments led the company to announce in 2016 that it would be relocating the company's CEO and CFO to its corporate offices in the Bay-Adelaide Centre in downtown Toronto that includes the Reuters News bureau in Canada. This is part of a larger corporate move to expand its R&D footprint in the Toronto Region.

4.6.2 Research and Development Investments

4.6.2.1 Toronto Tech Hub

In October 2016, Thomson Reuters announced that it would be expanding its Canadian operations through the creation of a new "Toronto Technology Centre". The Technology Centre located at 120 Bremner Blvd near the Toronto waterfront is now open and at the time of our site visit had already staffed up to the level of 80 people. The company expects to employ 200 people at this site by the end of 2017 and reach a level of 400 jobs by the end of 2018. However, the long-term goal of the company, as indicated in the office announcement of its move to Toronto, is to expand the Technology Centre to a total of 1,500 software engineering and data science jobs. Research at the Toronto Technology Centre will be focused on expanding the company's capabilities in cognitive computing, visualization, user experience and cloud development. The Toronto Technology Centre has a corporate mandate to adapt the latest research insights in big data/data analytics, artificial intelligence and cognitive computing into its wide array of corporate products across all of the companies lines of business indicated above. The new Technology Centre will also house the company's Centre for Cognitive Computing, which is headed by Khalid Al-Kofahi, who has recently moved from Egan, Minnesota to Toronto. Al-Kofahi is the key leader for Thomson Reuters in the area of cognitive computing and artificial intelligence. The Centre for Cognitive Computing partners with other outside technologies, such as IBM's Watson. The Technology Centre itself is headed by Shawn Malhotra.

The corporate decision to open the Technology Centre in Toronto and house their cognitive computing activities in Toronto is driven by the emerging technology strengths in the region in data visualization and artificial intelligence, which the company views as undeniable forces in the Canadian economic landscape. According to Thomson Reuters CEO Jim Smith, this decision is "all about talent", citing Ontario's stock of 200,000 high-skilled tech workers, and the 4,500 tech workers graduated by Ontario universities per year. The company regards the southern Ontario technology corridor focused around Toronto as containing one of the densest concentrations of technology skills in the world. Thomson Reuters Labs VP Mona Vernon said the company's new Toronto-based technology centre is part of its broader innovation strategy. Vernon acknowledges that Thomson Reuters is rather Ontario-focused at the moment due to the nature of its current footprint – "Toronto is great location for us," she acknowledges. The city provides both a talent and customer base from a legal services perspective, including the corporate counsel segment, and financial services. Vernon said Thomson Reuters' investment in Toronto was driven in part by available talent, and that the company will be looking to hire people with core software development skills, technical engineers and product managers. Skill sets around data science, cloud and automation will also be high on the list, she said. When the company undertook an assessment of the skills they needed to staff the Technology Centre in fields like machine learning, cloud computing, big data and data analytics, this region was one of the few in the world that could meet their needs. The decision to locate the new Technology Centre here is partly based on the belief that there are very few locations in the world that could accommodate their goal of building a 1,500-person strong research team.

The new Technology Centre is designed as a traditional corporate research centre, but is intended to be an applied R&D centre that works closely with the company's existing product lines to take advantage of emerging technologies in fields like data analytics, visualization and cognitive computing in expanding the capabilities of their product offerings to better meet the needs of their clients. The research team being assembled is expected to deliver new enhanced versions of their offerings for the product lines that have been assigned to them.

The decision to open the Technology Centre in Toronto and to expand the company's overall footprint in the region is part of a broader shift in corporate strategy to consolidate their research capabilities in this region. The decision to move the head of their Centre for Cognitive Computing to the new Technology Centre is one part of this strategy of consolidating their research capabilities, but also reflects a growing recognition in the corporate world that Toronto is one of the leading centres globally for research and development in machine learning and deep learning technologies. Thomson Reuters strongly supported the recent opening of the Vector Institute in Toronto and has signed on as one of the lead corporate partners for the Institute. The establishment of the Institute with strong support from both the federal and provincial governments is seen as an important indication of Toronto's emergence as a global centre of excellence in machine learning, which Thomson Reuters views as a critical technology for the product development going forward.

The company is particularly interested in exploiting synergies that deploy the capabilities of the new computing technologies mentioned above across their distinctive lines of activity in their news business, legal, tax and accounting and financial risks sectors. Part of the rationale for wanting to concentrate their research activities around the different product offerings in a central corporate location is to promote more effective collaboration among the technologists working on developing the various product offerings.

Thomson Reuters is also developing an open platform that is designed to allow third party developers and vendors to access the company's data and content in order to create specialized products that can add value for their customers on top of Thomson Reuters' own products. In order to do that, the outside developers in the broader ecosystem need access to the company's products and data in order to develop the application, authenticate its effectiveness in working with the Thomson Reuters product and finalize it. The open platform that they are developing provides this mechanism to support the ability of outside developers to work with the Thomson Reuters products. At the same time, the ability to develop new applications on top of Thomson Reuters products allows access for the third parties to the company's existing client base, which helps to grow the market for their new products. One example of the kind of collaboration they envision is the announcement made in November 2016 with UofT startup, Blue J Legal, a University of Toronto startup, of an exclusive joint initiative to bring Tax Foresight, a new suite of artificial intelligence-based tax case outcome predictors, to Canadian corporate tax professionals, tax preparers, accountants and tax lawyers.

To further facilitate this kind of engagement with the third party developer community, the Technology Centre has already held two engagements at MaRS to meet with local FinTech startups in order to explore ways to collaborate together and help them understand what the company's long-term strategy is in the Toronto Region. Going forward, the company envisions itself as a key part of the expanding FinTech ecosystem in this region. The relationship that Thomson Reuters is trying to build with the broader startup community and innovation ecosystem in the Toronto Region follows a similar path to that of several of the other companies discussed in this report.

Going forward, the Technology Centre is also interested in expanding its relationship with the Toronto Region universities and postsecondary educational institutions by creating internship and recruiting opportunities for the students and graduates of those institutions. They are interested in expanding the range of internship and co-op opportunities for students in the Centre. The fact that the head of the Centre has an undergraduate degree from Waterloo and a Master's degree from the University of Toronto helps to solidify those connections.

4.6.2.2 Thomson Reuters Labs – Waterloo Region

Focused on prototyping innovative solutions for customers using data science and optimization techniques, the Thomson Reuters Lab at the Corporate Innovation Hub in Kitchener, ON (established in 2015) is located in the region's Communitech incubator. Hoping to benefit from the region's culture of collaboration and innovation – as well as its proximity to the University of Waterloo – Thomson Reuters also established the lab as a means of pursuing partnerships with local companies and start-ups. The Lab is housed in a different part of the company from the Toronto Technology Centre and is part of the TR Lab program. They have now established similar Labs in other technology centres around the globe, including Singapore, Zurich, London, Cape Town and Boston, although an interviewee at the company noted that the Lab in Waterloo region was the first one in what he termed the "bubble network of labs" that the company has now established. The role played by the labs in the company's overall strategy is quite different from the role envisioned for the corporate Technology Centre. The labs are focused on rapid innovation, creating a prototype and figuring out how to solve a customer's problem in a relatively short time. The intention is to keep the labs small, focused and agile, in order to allow them to operate at a relatively rapid pace.

Having said that, the company sees a lot of synergy to having the Lab located in one part of the broader region and the Technology Centre anchored in Toronto. The value of having the Technology Centre located close by is that it will be able to take an innovative idea developed in the Lab that works for a particular customer and expand it into an enterprise level product. In this way, the company perceives the role of the Labs and the Centre to be distinctive, yet complementary, within the context of their broader corporate innovation strategy.

4.6.3 Conclusion

The establishment of the new Thomson Reuters Toronto Technology Centre, combined with the transfer of their Centre for Cognitive Computing from Minnesota to Toronto, their partnership with the Vector Institute and the relocation of their CEO and CFO from New York City to Toronto, represents a significant reorientation of their overall corporate innovation strategy toward their Canadian home base. Thomson Reuters is different than some of the other companies reviewed for this report in that it is a Canadian-based company, rather than an MNE. However, the fact that key corporate functions have been located outside of Canada and Toronto since the acquisition of Reuters indicates that it shares some features in common with the other cases discussed. The significant expansion of its R&D footprint in the Toronto Region that is underway signifies a major corporate shift in strategy towards grounding the company's innovative activities in the region and in this respect shares strong similarities with some of the other cases discussed and further confirmation of the changing way in which large global companies are anchored in the regional economy.

4.7 Siemens Canada

Siemens is a leading global multinational enterprise (MNE) whose long-term growth fields focus on electrification, automation and digitalization. In order to take full advantage of the market potential in these various fields, Siemens' business lines are organized into eight divisions (Power & Gas, Power Generation & Services, Energy Management, Building Technologies, Mobility, Digital Factory, Process Industries & Drives, and Financial Services). In addition, two other business lines, Siemens Healthineers and Siemens Wind Power, operate as separately managed businesses.

In Canada, Siemens employs over 4,800 people across the country, operates 46 offices, and 15 production facilities. In 2015, Siemens reported sales of $3 billion, and the company has been repeatedly recognized as one of the country's top employers by Mediacorp.

4.7.1 Operations

Production:

Siemens Canada provides a diverse line of products largely tailored to all levels of government as well as to large businesses. The company offers products and services in the following business lines: Power & Gas, Power Generation & Services, Energy Management, Building Technologies, Mobility, Digital Factory, Process Industries & Drives, and Financial Services, in addition to Siemens Healthineers and Siemens Wind Power that are operating as a separately managed businesses.

Power and Gas

The Power and Gas Division is the trusted partner for world class Power Generation products and solutions for the oil and gas, power and industrial markets. The Division focuses on delivering reliable, efficient, clean and safe products and solutions.

Power Generation Services

Siemens offers a broad spectrum of innovative products and services for ensuring high reliability and optimal performance of rotating power equipment within the utility, oil and gas, and industrial processing industries worldwide.

Energy Management

The Energy Management Division is one of the leading global suppliers of products, systems, solutions, and services for the economical, reliable, and intelligent transmission and distribution of electrical power. The portfolio includes facilities and systems for the low-voltage and medium voltage distribution power grid level, smart grid solutions and high-voltage transmission equipment, systems and services.

Building Technologies

Building Technologies is a world leader for safe, energy efficient and environmentally friendly buildings and infrastructure. As a technology partner, consultant, service provider, system integrator and product supplier, Building Technologies offers fire protection, security, building automation, heating, ventilation and air conditioning (HVAC) and energy management products and services. The digitalization and integration of these technologies and services is considered as part of the Siemens Smart Cities initiative.

Mobility

The Mobility Division is responsible for delivering efficient and integrated transportation of people and goods by rail and road – all products, solutions and services regarding mobility including Transport Systems Electrification, Automation, Smart Parking Technologies, E- Buses and Highway Traffic Automation; these are also considered as part of the Siemens Smart cities initiative.

Digital Factory

The Digital Factory Division offers a comprehensive portfolio of seamlessly integrated hardware, software and technology-based services to support manufacturing companies worldwide in enhancing the flexibility and efficiency of their manufacturing processes and reducing the time to market of their products leading to the implementation of Industry 4.0 Technologies.

Process Industries and Drives

Siemens' Process Technologies and Services aim to measurably increase productivity and improve time to market, with innovative, integrated technology designed to continuously improve the reliability, safety, and efficiency of products, processes and plants.

Financial Services

The Financial Services Division (SFS) provides business-to-business financial solutions. Siemens supports customer investments with project and structured financing as well as leasing and equipment finance.

Healthcare

The separately managed business "Siemens Healthineers "is one of the world's largest suppliers of medical infrastructure and is a leader in medical imaging, laboratory diagnostics, and clinical IT."

Wind Power

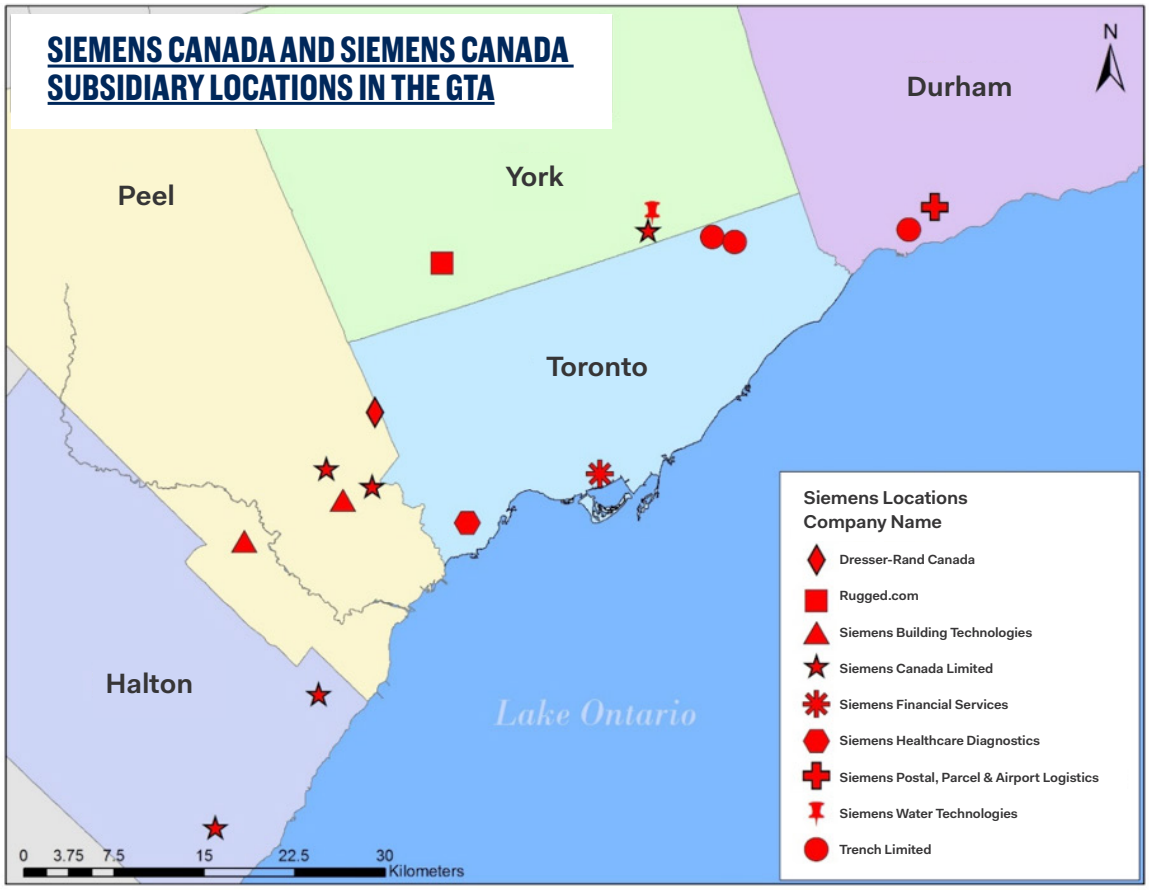
The separately managed business Siemens Wind Power is a leading supplier of reliable, environmentally-friendly and cost-efficient renewable energy solutions. Driving down the cost of wind power is the key target of this division, as Siemens aims to make renewable energy fully competitive with conventional energy sources.

In April 2017, Siemens Canada announced a new collaboration with Kensington Capital to promote CleanTech innovation in Canada. The two companies have signed a memorandum of understanding with the goal of accelerating the commercialization of CleanTech energy solutions in Canada. The MOU identifies a number of areas where the companies will focus their joint efforts, including energy storage, transmission and distribution, combined heat and power plants, power generation, smart grid, micro grid and biomass. The agreement also includes the potential to pursue joint infrastructure projects at the municipal, provincial and federal levels with the aim to pursue cross jurisdictional opportunities and strengthen the position of both firms in the Canadian and North American markets.

4.7.2 Locations

While Siemens' head office is located at a recently leased facility at 1577 North Service Road in Oakville, it operates out of numerous locations within the Greater Toronto Area and in addition has a number of locations across Canada. The data in Figure 4.6 provides a graphical representation of where the company's various operations are located.

Figure 4.6



In addition to their own facilities within the Toronto Region, Siemens Canada has an extensive network of distributors in the GTA and across the country that both distribute Siemens products and act as value-added resellers of their products. The distribution network provides supplies to electrical contractors, as well as system integration; undertakes services, repairs, and modernization of equipment; and provides training and warranties on Siemens products. Among the leading distributors for Siemens are Sonepar, Franklin Empire and Gerrie Electric. Our interviewees estimated that the distribution network generates $200 million of business in these various business lines with Siemens products. Some of the distributors, such as Franklin Empire, work closely with Siemens, serving as value-added resellers who work closely with the company to customize and enhance their products by providing feedback from their customer base.

Siemens also operates a more specialized program with select partners to provide a higher level of integration between the Siemens and the offerings of the partner firms. This undertaking is called the Siemens Solution Partner Program; it sets out the framework for strategic alliances with system integrators and engineering companies, which sets global standards for the special capabilities of the companies involved, and establishes a network of available partners across Canada. Each Siemens Solution Partner is considered to be have expertise in creating industrial automation and controls solutions based on Siemens Industry Automation & Drive Technologies products.

The term **Siemens Solution Partner** identifies companies which offer:

- individual solutions based on Siemens products;
- engineering services to integrate industrial automation and controls solutions into existing or new systems; or
- consultancy services and procure product for the development of such industrial solutions.

4.7.3 Research and Development

University/College Partnerships:

Over the past three years, Siemens Canada has entered into partnerships with several Canadian universities and colleges aimed at improving training and education in STEM subjects – particularly in mechatronics. Partnership relations with postsecondary institutions include the University of Toronto, Ryerson University, Sheridan College and Seneca College in the Toronto Region, as well as McMaster University, Western University, Windsor University, Mohawk College, Fanshaw College, Fleming College, and Algonquin College in Ontario, along with the University of Alberta and NAIT in Edmonton, Alberta as well as Simon Fraser University, the British Colombia Institute of Technology, and Kwantlen Polytechnic University in BC, in addition to NB University.

Siemens also launched its own educational initiative in 2014 entitled the Siemens Canada Engineering and Technology Academy, a project aimed at complementing the post-Secondary Engineering Education's Curricula and tailoring advanced engineering education to the Practical Industry needs, which is discussed in more detail below.

University of Toronto

Siemens has been an active partner and investor in the World Council on City Data, which is a member based organization that is affiliated with the Global Cities Institute housed in the Daniels Faculty of Architecture, Landscape and Design at UofT. The President of Siemens Canada has served on the Advisory Board of the WCCD and the Vice President for Cities and Infrastructure Projects at Siemens Canada is closely involved with the work of the WCCD and the GCI.

Sheridan College

In 2015, Siemens Canada announced that it had signed a memorandum of understanding with Sheridan College mainly for Partnership on Siemens Mechatronics systems certification program that would also see Siemens expertise provided in the form of guest lectures, technical workshops, and the provision of recommendations for curriculum development, as well as internship and co-op placements at Siemens.

Sheridan College has also been a beneficiary of the multi-million Siemens Granted NX software packages (used for the purposes of undertaking computer-aided-design, manufacturing, and engineering), as well as its Product Lifecycle Management Capabilities.

Seneca College

Again in 2015, Siemens Canada opened the Mechatronics Simulation and Demonstration Centre alongside Seneca College as part of Siemens Canada Engineering and Technology academy Portfolio. The purpose of the lab is to act as a training ground for students to enter into the Siemens Mechatronics Systems certification program. Included in the agreement between Siemens Canada and Seneca College is the co-development of the educational curriculum, training programs, and applied research initiatives, as well as the establishment of internships, apprenticeships, and co-op placements at Siemens.

Fanshaw College

Fanshaw College has been the beneficiary of two distinct partnerships formed between itself and Siemens Canada. In January, 2017, the company announced it would be providing Fanshaw College's Schools of Applied Science and Technology with a $248-million in-kind grant in the form of Siemens' NX software package (used for the purposes of undertaking computer-aided-design, manufacturing and engineering), as well as its Product Lifecycle Management software.

In April of 2017, the company announced that it would again be partnering with Fanshaw College – this time through the provision of a $28 million in-kind donation to the school's ergonomics program. Intended to drive research and innovation in the field of workplace design, the donation includes a design and modelling software called Jack that is widely considered to be an industry-standard software.

McMaster University

Similar to its arrangement with Fanshaw College, Siemens Canada's partnership with McMaster University involves a $458 million in-kind donation in the form of sophisticated engineering software announced in 2015. Composed of Siemens Canada's Product Lifecycle Management software, NXTM software, teamcenter portfolio software, Tecnomatix portfolio software, LMSTM solutions software, Fiberim portfolio software, and Syncrofit portfolio software, this donation constitutes a comprehensive suite of software packages designed to aid in computer-aided design and manufacturing, finite element analysis, lifecycle data management, digital manufacturing, systems engineering, simulation/ test, and multi-material/composites design optimization.

Western University

After entering into a partnership with Siemens Canada in 2015, Western University's Faculty of Engineering received a $522 million in-kind grant of the company's Product Lifecycle Management software package. The software is used by Western University's Faculty of Engineering to teach students computer aided design, manufacturing, and engineering skills.

Fleming College

In 2015, Siemens Canada announced that it would be providing $100,000 worth of equipment, software, and training to Fleming College in order to improve students' access to industry grade educational products. The bulk of the donation came in the form of 36 programmable logic controllers, as well as training on how to operate and program the consoles.

Algonquin College

Also in 2016, Siemens Canada and Algonquin College announced that they would be collaborating on two projects designed to improve robotics, mechanical engineering, and electrical engineering education at the school. The first will have Siemens Canada collaborating with Algonquin College on the development of educational programming for energy generation. The second, which is included as part of Siemens Mechatronics Systems Certification Program, will allow Algonquin to establish supplementary mechatronics courses as part of its curriculum in order to help its students pursue an education in the field.

British Colombia Institute of Technology

In 2016, Siemens Canada and the British Columbia Institute of Technology announced the signing of a memorandum of understanding establishing a partnership between the two parties. Focused on undertaking and commercializing collaborative Smart Grid Cyber Security and microgrid research outputs. Although the commitments of each party are unclear, both have stated that they intend for the relationship to be long-standing.

4.7.4 Siemens Canada Engineering and Technology Academy

Siemens Canada Engineering & Technology Academy (SCETA), established by Siemens Canada on Oct. 1st 2014, is a unique initiative designed to equip engineering and engineering technology students in Canada, as well as existing Siemens engineers, with the educational and professional foundation required for successful careers. SCETA's portfolio include five different programs:

1. Dual Education Program

In March 2015, Siemens Canada launched the first-ever Work Integrated Learning Program called Dual Education Program, designed by utilizing the best features of the Siemens AG's Dual Education System developed in Germany.

The SCETA actively recruits students for this program, starting one year before they graduate, from seven partnering post-secondary educational institutes (universities and colleges) in Ontario and Alberta, including Ryerson University, the University of Waterloo, McMaster University, the University of Alberta, Algonquin College, Mohawk College, and the Northern Alberta Institute of Technology. These students complement their various engineering and technology degree programs and curriculum with the Siemens expertise and methodology-based program that provides "hands on" technical skills and strategic business competencies relevant to the North American market. Throughout their 16-month enrollment with SCETA, students are paid a full-time salary, tuition during their university/college program and, upon graduation, selected graduates are offered full-time engineering positions at Siemens Canada operational divisions. SCETA opened its inaugural class with 30 students, and is currently in its third cohort with the some of the graduates of the first cohort, having already been hired to work full-time within various Siemens Canada divisions.

The SCETA program has been recognized widely by the related association bodies with various Awards including:

- **The 2016 Ontario Business Achievement Award (OBAA) in Skills and Training**, which is awarded to a business whose skills and training initiatives best harness the talent of its people, embrace diversity, and support employee success.

- **The 2017 Award for Engineering Project of the Year – Innovative Category** by the Ontario Society of Professional Engineers (OSPE) Hamilton / Halton Engineering Committee.

- **The 2017 Ontario Professional Engineers Awards (OPEA) - Award for Engineering Project/ Achievement**. This award pays tribute to an endeavor that has made a significant, positive impact on society, industry, and/or engineering, and that was conceived, designed and executed with significant input by Ontario engineers. (Award Ceremony in Nov. 2017)

2. Siemens Mechatronics Program

Industrial manufacturing is becoming more advanced and complex as we move towards an integrated and digitalized model. Sophisticated Mechatronics systems are at the centre of this new model and is creating a growing need for qualified people with up to date knowledge of integrated mechatronic systems.

The lack of availability of a suitable college program offering the type of curriculum and graduates in the holistic methodology that industry requires has led to the introduction of Siemens Mechatronics Systems Certification Program (SMSCP). The program provides a globally recognized, Siemens proprietary technical certification. It is an alternative global educational/industrial certification with a new "hands on" and diagnostic teaching methodology, to enhance the skills and capabilities of industry experts and technical service staff working in the field and improve their employment opportunities in the Industry.

This certification is now available to Canadian students via Siemens' partnership with Canadian universities and colleges. Partner schools, like Sheridan College, Seneca College, Mohawk College, Algonquin College, the University of Windsor University, KPU University, and Simon Fraser University – which have been qualified and certified by Siemens – integrate one or more of the three levels of mechatronic certification into their curricula and conduct this program in their own classrooms.

3. The Siemens Portfolio: Continuous Education Related Engineering and Technology Topics

SCETA designs and conducts engineering knowledge-based courses related to the Siemens portfolio that enhance the professional engineering and technology knowledge of all Siemens full-time employees. Tailored to the role/responsibilities of its attendees, these in-house courses help employees support Siemens growth and success from all positions in the company.

4. Professional Association Relationship Management

Siemens is representing the needs of its engineering workforce through "SCETA" as one voice with professional engineering associations. SCETA provides governance, and guidance on professional engineering practice within Siemens Canada and also offers mentorship and training of best engineering practices required for its engineer employees to comply with applicable rules of conduct.

5. Apprentice Programs

In 2018 to 2020, Siemens plans to consolidate its many relationships with academic partners to ensure a unified and corporate-wide apprenticeship plan.

4.7.5 Conclusion

Siemens Canada is a large and diversified technology-based firm that operates across many different industrial sectors. Although the company's head office is located in Oakville, its different operations, subsidiaries and its distributor network is spread throughout the Greater Toronto Region. The diversity and range of the company's operations means that an investment in any one municipality of the region is likely to have multiple spillover effects across the region.

Like many of the other cases reviewed in this report, Siemens has been intensifying its linkages with universities and community colleges across the GTA and throughout southern Ontario. While some of these linkages involve research agreements, Siemens places significantly greater emphasis on training and education initiatives, with a wide range of partners at the post-secondary level, as well as national professional and business organizations. They have also donated a significant amount of Siemens technology to these institutions to ensure that engineering and technology students and technicians receive training on some of the most up to date and technologically sophisticated systems available. Their emphasis on the mechatronics training program reflects a similar concern that students' education in Ontario and across Canada is well versed in the more holistic and integrated approaches to manufacturing and industrial processes that are increasingly being referred to in Europe as Industry 4.0. In this way, the evidence presented in this case study supports the broader analysis of this report that key investments by MNEs within the GTA promotes the growth and development of the regional economy, both by way of the associated direct impacts of the investments (buildings, workers, procurements etc.), but also indirectly by improving the technological capabilities of linked companies (distributors and customers) and upgrading the skills and technological capabilities of the workforce more generally.

5.0 DISCUSSION & CONCLUSIONS

Our objective in writing this report has been to review the evidence regarding the scale, nature and interregional distribution of the economic impacts of inward FDI into the Toronto Region. The report makes the case that globalization is a process that is well under way and that particularistic tendencies can only act to isolate jurisdictions, be they municipalities or nations. To this end, the task of understanding how the globalization of production of all goods and services, and the task of reading the determinants of this process with the aim of making certain regions are more capable of participating in it to their benefit, requires a knowledgeable and effective strategy on behalf of the entire region. It is important to understand how the regional economy is integrated into myriad Global Production Networks (GPNs), and where the potential exists for firms in all parts of this regional economy to move up the value-added spectrum within these GPNs and thereby create and retain more value, thus improving the economic well-being of the GTA overall, its constituent municipalities individually, and their residents. In what follows, we highlight some of our important findings that relate to these objectives and discuss their meaning in the context of promoting regional economic development within the GTA.

As noted at the outset, our approach to this project has been multidisciplinary. When we initially proposed this work to Toronto Global, we noted that the best way of illustrating the potential of inward FDI to benefit all regions of the GTA, regardless of where in the GTA the investment occurred, would utilize both quantitative and qualitative methods. The quantitative methods, we noted, could be used to show how inward FDI into any of the municipalities of the GTA would affect all of the other municipalities of the GTA (e.g., in terms of firm level income, employment, personal income through wages and salaries, municipal tax revenues etc.). We also noted that while this sort of information is very useful (and indeed critical in many instances), it is by definition static. That is to say, the knowledge regarding the nature of the inter-industrial interregional interdependencies in the GTA which act to transmit exogenous shocks in one region (e.g., inward FDI) into endogenous activity in others remain as specified in the data on which the MRIO model is based. What the quantitative approach therefore does not tell us is how such investment shocks could actually affect the fundamental economic structures of the regions and thereby contribute to the evolution of said regional economies from their current states, to other forms which may allow for a more profitable engagement with FDI going forward. For this, we turned to a qualitative analysis. Specifically, we used a relatively deep reading of the academic literature on the spatial dynamics of GPNs and the implications of this for regional economic development to fashion a series of empirical case studies through which we could attempt to test for the presence of some of the benefits of the vertical disintegration and globalization of production in the GTA (e.g., the integration of the GTA into GPNs, the ability of firms in the GTA through this integration to access new knowledge and technologies and thereby move up in the value-added hierarchies of the GPNs. In what follows, we underline the key results from both the quantitative and qualitative analyses that relate to these objectives and highlight the benefits of inward FDI in the GTA, both in the present and in the future, and the importance of maintaining a state-of-the-art and well-resourced FDI Strategy for the Region.

The results of the quantitative analysis (conducted by Econometric Research Limited) shows very clearly, using current data on industry-level interregional connections within the GTA and on the structure of production in each of the industrial sectors which comprise this regional economy, that FDI in one municipality of the GTA has very tangible implications (i.e., benefits) for all of the others, to varying degrees. Specifically, the quantitative impact analysis was executed on the basis of data on real inward FDI cases in the GTA. The three largest case studies involve a $190 million diagnostic centre development by Roche Pharmaceuticals in Mississauga, a $100 million investment in an autonomous vehicle/software/infotainment/R&D facility by GM in Markham and a $100 million

investment by Cisco Canada in its Toronto Technology Centre (an ICT R&D facility) in Toronto. In each case, these inward FDI scenarios are reflective of what are commonly referred to as 'knowledge economy' endeavours. Figure 21 above shows that Thomson Reuters' investment of $190 million (amounting to 200 engineering jobs at outset, and ramping up quickly to 400 and ultimately 1,500 engineering jobs) stands to have very substantial economic impacts in the City of Toronto, as well as in the surrounding municipalities of the GTA. At the base level of activity – 200 jobs – Thomson Reuters' Toronto Technology Centre stands to generate annual labour income impacts of $2.82 million, $2.32 million, $1.81 million, and $1.80 million in the counties of Peel, York, Durham, and Halton respectively. Likewise for Cisco Canada's investment of $100 million in a high-technology hub in the City of Toronto, Figure 18 above shows that all municipalities in the GTA experience significant impacts in terms of firm income, output, value-added, and employment. Indeed, the Regional Municipality of Durham, which is largely a rural region within the GTA, is calculated to experience an additional $7.98 million worth of industrial output, and $2.79 million in labour income (annually) as a result of the direct, indirect and induced impacts associated with the operation of Cisco's Toronto Technology Centre.

Figure 3 shows the interregional economic impact pattern associated with GM's new Markham facility. For reasons that have to do with the location of the investment (Markham as opposed to Toronto) and the different type of investment expenditures involved (greenfield construction versus mostly endowing research capacity at universities and hiring researchers in the case of Cisco), the GM Markham facility is calculated to have far more extensive impacts on all other municipalities within the GTA than the Cisco Toronto Technology Centre. While the majority of the impacts are still captured in the municipality which hosts the FDI project, all other regions experience very tangible economic impacts as a result. Again, substantial government revenues add to the ability of this activity to have far-reaching benefits within the GTA and beyond.

The quantitative economic impact analysis, by measuring the interregional economic impacts of several different inward FDI scenarios in the GTA, does provide evidence to suggest that all regions of the GTA stand to benefit from inward FDI. What this analysis cannot do however is provide any evidence on the likelihood of any of the more peripheral regions of the GTA economy experiencing upgrading in their capabilities and hence their ability to capture economic spin-offs from inward FDI in any part of the GTA (i.e., the evolution in the structure of GTA municipal economies). How/why would such economic evolution occur? It is well known that the real estate market in the GTA is very active and that this makes land (and other goods) relatively more expensive. As the market gets increasingly expensive, both firms and workers are moving further into the periphery. This is causing former residential suburbs to become urban centres in their own right and this is contributing to the creation of a polynuclear urban region in the GTA, as opposed to one massive periphery centred on Toronto. This means, of course, that these more peripheral regions are acquiring the human capital, and the firm presence, to bring about higher value-added production in the periphery. This, in time, will cause some higher value-added activities which currently only occur in the City of Toronto or in Peel Region, to migrate out to Halton, and Durham. All this is to say that the regional economic system that we know as the GTA is evolving (see Figure 23 above), and this evolution cannot be captured in the quantitative analysis. For this we turn to the qualitative analysis.

To preface the qualitative case studies of the firms at the centre of the aforementioned inward FDI scenarios, we spent considerable time synthesizing the literature relating to the formation and evolution of GPNs and the relevance of this for regional economic development. This literature review shows that GPNs are forming as a natural extension of current economic imperatives. At the same time, the analysis illustrates that technological advances (especially in the ICT realm) have interacted with these economic incentives to facilitate the process of vertical disintegration and ultimately global outsourcing. Firms can now outsource certain aspects of production to other actors located in parts of the world which have far lower costs for certain critical inputs (e.g., relatively inexpensive computer programming and engineering in Bangalore, India; extremely efficient and cost-effective semiconductor foundries in Taiwan etc.), and curtail those activities in the higher-cost home environment.

Central to the literature surrounding globalization and the vertical disintegration of production is the notion of the GPN and specifically the processes of strategic coupling which allow them to form and evolve. Simply put, strategic coupling takes place when a particular regional economy offers a given MNE (usually a lead firm or a large OEM) a strategic advantage in one or several aspects of its production process (e.g., millions of relatively skilled workers willing to work for low wages to assemble by hand electronic products for export). In such a case, the MNE will move those activities capable of exploiting the advantage to the new location (and likewise shutter higher cost alternatives that are currently in use). This process has led to the concentration of high-value-added activities (e.g., R&D, marketing, HQ etc.) in the more expensive urban centres of the developed world, and the lower-value- added production in the less-developed world. The strategic coupling literature is full of examples where, by improving domestic absorptive capacity and market conditions and facilitating local learning from foreign-owned subsidiaries, a regional economy can experience value-chain upgrading and hence move up the value-added hierarchy and thereby capture and retain more value from production.

The GTA represents a very attractive mix of production inputs for all manner of GPNs (from high-tech ICT to lower-tech food processing), and as a result, the GTA is “on the radar” for most lead firms (i.e., the heads of GPNs). The IBM case study makes clear that Markham was chosen as the site for the company’s SoftLayer data centre for reasons which include easy access to highly trained labour and world-class research universities and faculty. Likewise, for GM, our interview with senior executives revealed that GM sees the talent and R&D capacity of this regional economy as playing a key role in GM’s attempt to develop key disruptive technologies in the automotive sector (e.g., autonomous cars, infotainment etc.) before these are thrust upon GM by the competition. Indeed, across all case studies, the potential of the highly skilled workforce in the GTA, its status as a global leader in terms of scientific research and technological innovation, figured prominently in the firms’ investment decisions.

The GPN literature alluded to above, and specifically the concept of strategic coupling, ties this prominence of the GTA in the locational decisions of global technology lead firms like IBM, GM, Cisco, Huawei and others to the prospects for future growth and development of the GTA and its constituent municipalities. In particular, these lead firms (as the orchestrators of many massive GPNs) have the power to further integrate the GTA into their Global Innovation Systems. Once this happens, and the local subsidiaries in the GTA begin seeking knowledge, and not just seeking resources to exploit (e.g., cheap labour or cheap energy or lax environmental regulations etc.), a process of two-way knowledge exchange can occur – from the GPN to the GTA and from the GTA back to the GPN. Once this begins to happen – and our case studies give some indication that this process of path modernization is underway – the absorptive capacity of GTA firms (local as well as foreign-owned) will increase, thereby increasing the region’s ability to both generate and retain value, well-being and economic growth for its inhabitants across all the constituent municipalities.

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