DECEMBER 2021

Into the Scale-up-verse

EXPLORING THE LANDSCAPE OF CANADA'S HIGH-PERFORMING FIRMS

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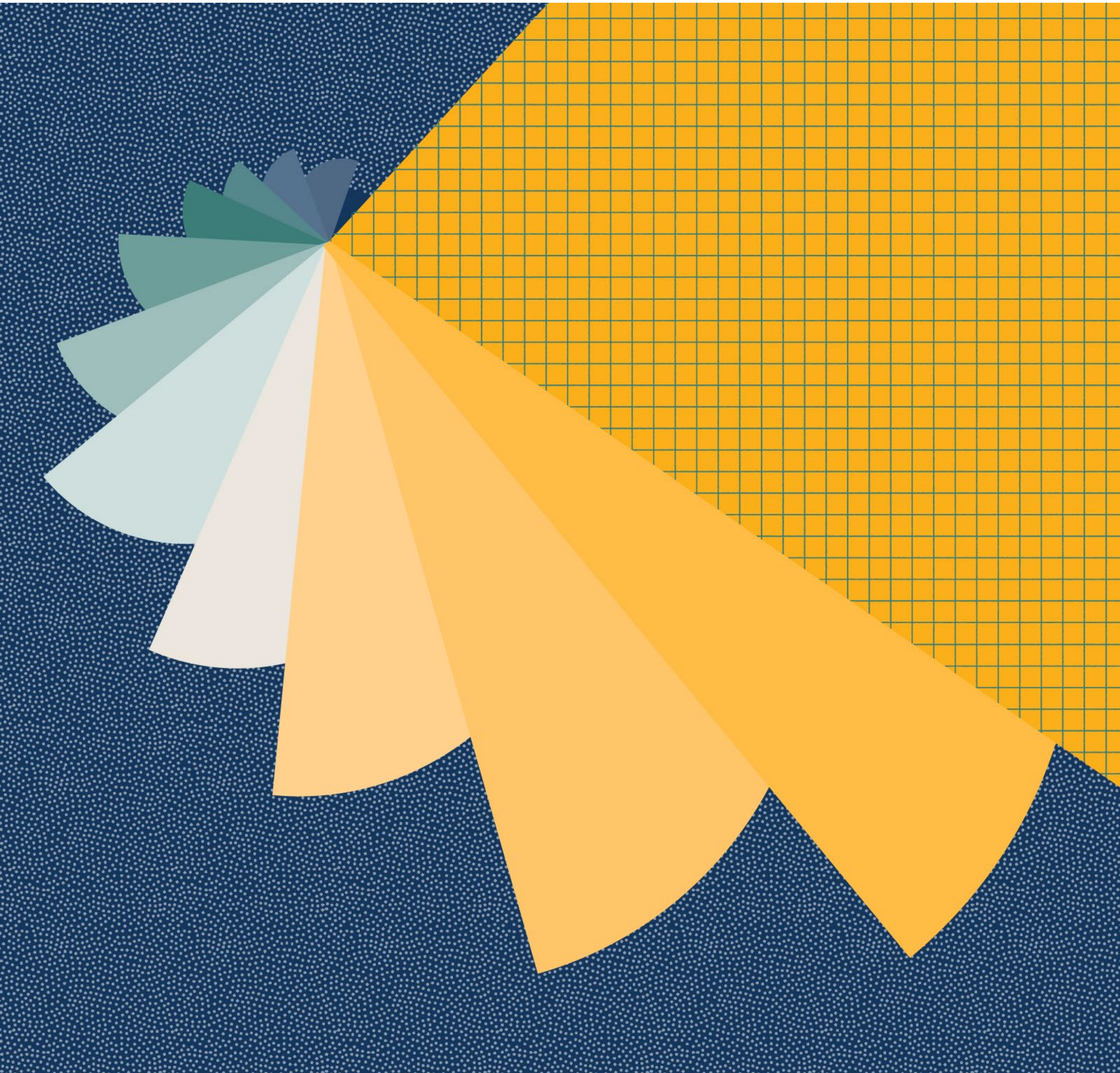

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Foreword

How do Canadian technology scale-up firms fit into the larger discussion of Canada's immediate and long-term economic prospects? What can the government do to support home-grown firms to scale and beyond?

Historically, to foster economic growth, Canada has relied on investment in its resource and traditional manufacturing industries, often by foreign multinational enterprises (MNEs), to the omission of its homegrown technology firms. Government policy too often assumed that our prosperity would come from the expansion of these sectors and the technology and ideas imported by foreign firms into the sectors.

This lack of attention to the domestic technology sector, and the potential contribution of scale-up firms, has ignored the nature of competition, innovation, and growth in an ideas-based and data-driven economy, where the benefits of innovation accrue to firms that can capitalize on the expanding markets derived from the introduction of novel products and services. This failure also overlooks the fact that trade surpluses in high-technology goods and services increasingly accrue to those countries with strong inducements for home-grown firms to scale up and expand into global markets. The result, which was entirely predictable, is growing surpluses and prosperity for those countries that have sustained the growth and expansion of their domestic scale-up firms and deficits for those that have failed to do so.

The implications of Canada's current innovation policy mix are potentially dire for the country's long-term prosperity. The easy entry by foreign MNEs and subsidiaries to Canada's innovation corridors (especially Toronto-Waterloo) gives them ready access to our intellectual property (IP) and domestic talent base. Scale-up CEOs were mostly left to manage their growth without adequate recognition and policy support. Homegrown and scale-up firms have only recently joined the conversation on Canada's innovation policy, with the founding of the Council of Canadian Innovators in 2015.

Part of the problem facing scale-up entrepreneurs, government, and policymakers is a lack of detailed information on both the extent and characteristics of scale-up firms. By conducting systematic interviews with executive-level personnel at Canadian scale-ups, and augmenting this data with empirical research of the impact and importance of scale-ups on Canada's economy, we can achieve several things: 1) properly define a scale-up and what it takes to scale a technology firm in Canada; 2) validate the nature and extent of the scale-up problem; 3) determine what government programs might be effective in supporting growth and where the policy gaps or mismatches are located; and 4) consider the impact of scale-ups on Canada's economic prosperity.

This report is the first of its kind in Canada and a direct result of almost four years of industry-academic-government collaboration between Delvinia, the University of Toronto' Innovation Policy Lab, Mitacs, and the Brookfield Institute for Innovation + Entrepreneurship to capture the data to help frame future economic policy that will support the growth of Canadian scale-up firms. This research was inspired by the five-year SSHRC-funded research partnership conducted within the Innovation Policy Lab, entitled Creating Digital Opportunity for Canada.

The data and insights in this paper will provide the context and timely information that scale-up CEOs, the academic research community, and government policymakers need to affect policy change and to ensure the long-term economic prosperity of Canada.

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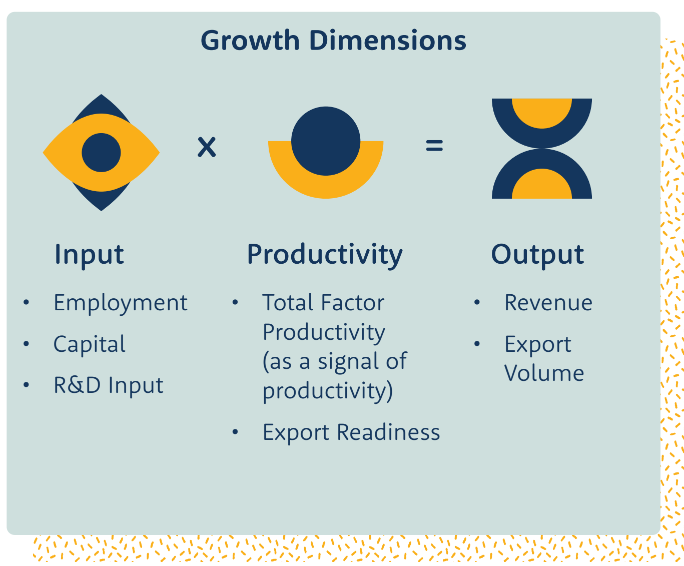
Executive Summary

Canada's scale-ups, or companies that experienced sustained periods of high growth, are multi-faceted, not just in their geographic distribution or industry composition, but in the many different ways they contribute to the Canadian economy. As a group, scale-ups in Canada contribute significantly to Canada's employment growth, export values, innovation, and productivity growth. Such contributions meant that policymakers have, in recent years, focused greatly on how to encourage the creation of more scale-ups. Yet, we know little about what scale-ups are and how they behave in Canada. Importantly, many conversations surrounding scale-ups too often treat the category as a monolithic entity, where each individual scale-up company creates significant employment impact, foster innovation, and export Canadian goods at the same time.

In this report, we leverage the most detailed dataset in Canada concerning business dynamics, covering all registered companies in Canada, to analyze scale-up behaviour.

We focus not only on the different ways that companies' growth can be measured, but also on the varied ways in which they engage in business, from export to innovation. This is the most comprehensive look at scale-ups in Canada thus far. This executive summary highlights the report's major findings and themes.

A framework for understanding business growth



- **Companies grow in multiple different ways, and whether they grow their employment, their output, or their productivity matters greatly in how they behave.** In this report, we examine six definitions of firm growth, and show that conversations concerning scale-ups need to distinguish between these vastly different types of companies for a more informed approach to policy design.
- **In understanding business growth, firm size is one variable. How quickly firms grow and how consistently they grow are also important factors.** Discussions regarding impactful firms often focus on the absolute size of the business. However, scale-ups that satisfy the definition with lower growth thresholds behave largely in the same way as firms that satisfy the definition with a higher growth threshold (where the growth magnitude and consistency are both similar).

Table A

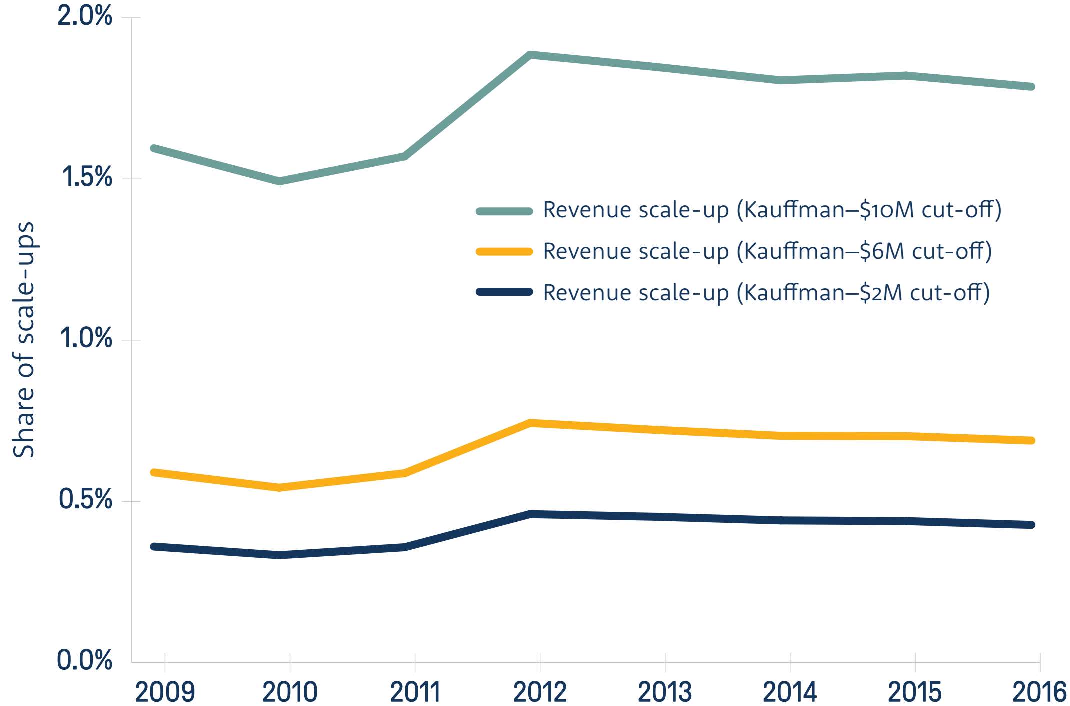
Scale-up definitions used in this report

Dimension of growth	Shorthand definition	Firm population	Scale-up definition
Employment	OECD Employment	Firms with at least 10 employees at the beginning of the growth period (four years prior to measurement)	Average of at least 20 percent year-over-year growth in employment for three consecutive years
	Kauffman Employment	Firms 10 years or younger that started with at most 49 employees	Grow to at least 50 employees by the tenth year of operation or at the year of measurement, whichever is less
Revenue	OECD Revenue	Firms with at least 10 employees at the beginning of the growth period (four years prior to measurement)	Average of at least 20 percent year-over-year growth in real total revenue for three consecutive years
	Kauffman Revenue	All firms	Average of at least 20 percent year-over-year growth in real total revenue for three consecutive years with $2 million in revenue at the end of measurement year
	Kauffman Revenue-6	All firms	Average of at least 20 percent year-over-year growth in real total revenue for three consecutive years with $6 million in revenue at the end of measurement year
	Kauffman Revenue-10	All firms	Average of at least 20 percent year-over-year growth in real total revenue for three consecutive years with $10 million in revenue at the end of measurement year

Scale-ups are rare, but impactful economically

Figure A

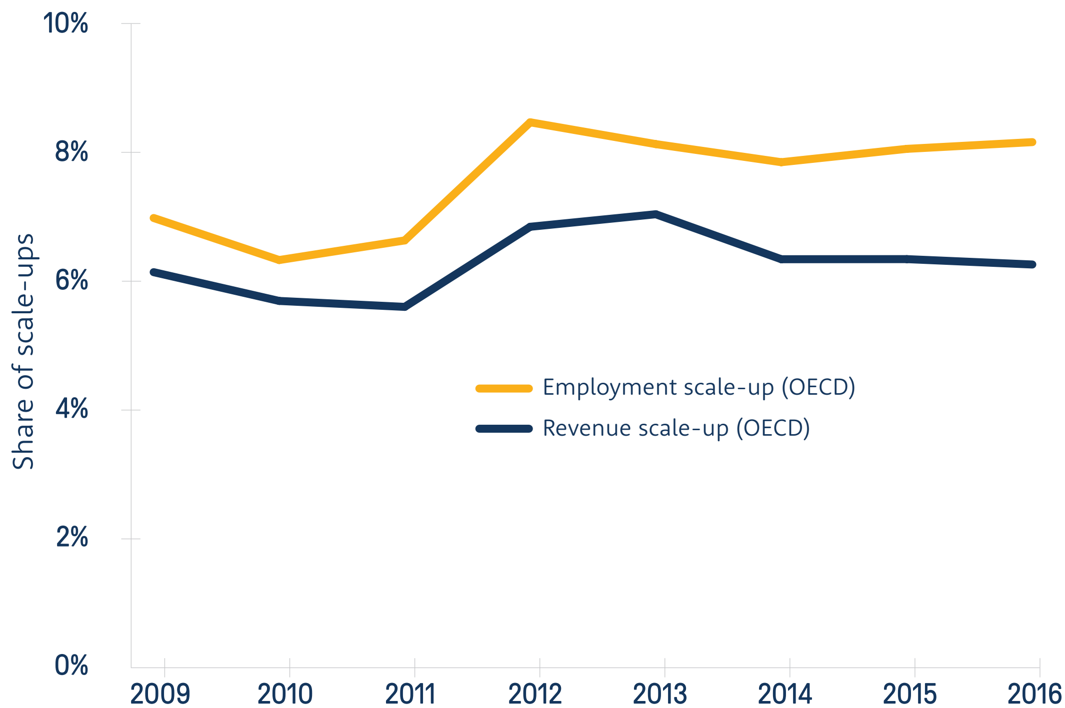
Share of Scale-ups, Kauffman Revenue Definitions



Source: NALMF, Authors' calculations

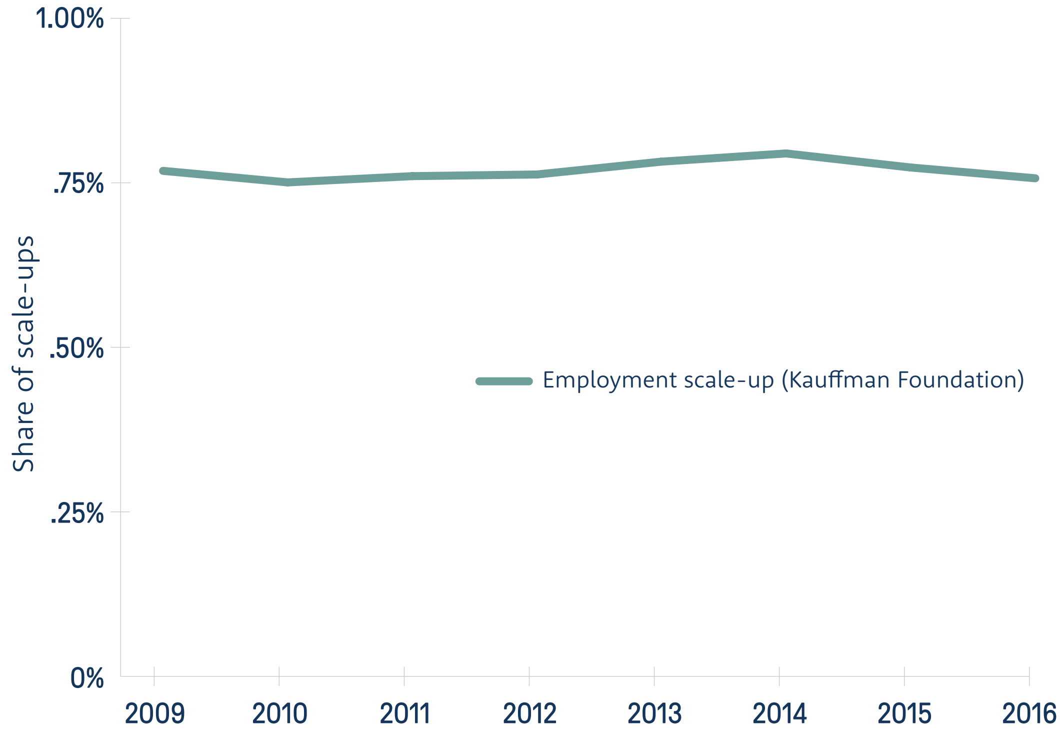
Figure B

Share of Scale-ups, OECD Definitions



Source: NALMF, Authors' calculations

Figure C
Share of Scale-ups, Kauffman Employment Definitions



Source: NALMF, Authors' calculations

- **Only around 1 in 100 companies meet the definition of a scale-up in Canada.** However, despite their rarity, revenue scale-ups attain revenue levels of at least 20 times those achieved by non-scale-ups, and employment scale-ups attain employment levels of at least five to ten times that of non-scale-up companies. While these companies are defined by their growth in their respective metrics, the scale at which these firms differ from non-scale-ups is notable.

- **The share of companies qualifying as scale-ups has recovered since the 2008 financial crisis. This share has remained stable between 2012 and 2016.** While scale-ups also felt the economic disruption brought on by the 2008 financial crisis, the largest of these firms were the most likely to persevere, and the subsequent recovery in the share of scale-ups in the economy means they continue to be an important part of the economy.

- **Scale-up companies are highly productive, but once confounding factors are controlled for, some of these differences disappear.** On average, scale-up firms show productivity growth levels that are significantly higher than non-scale-ups. However, after controlling for confounding effects, such as the industry composition as well as geographic composition of these companies, the initial positive differences in productivity disappear for all but scale-ups defined under the revenue definition. In particular, those that qualify as scale-ups under the Kauffman Employment definition (firms that grow while they are still young) see a statistically significant negative productivity growth association.

- **Average pay at scale-ups is not always higher than average pay at non-scale-ups, but is highly industry-dependent.** While scale-ups contribute significantly to the economy, pay differences between scale-ups and non-scale-ups are not always present, and we only observe significant differences between scale-ups and non-scale-ups defined under the revenue-based definition. However, in some specific industries (such as technology), we see higher pay reflected in technology scale-ups defined by all three definitions.

Scale-ups reflect the regional and industrial diversity of Canada, and results at the sub-national and sub-provincial levels need to be considered carefully

- **While significant geographical heterogeneity in scale-up activities exists, the relative rarity of scale-ups makes sub-provincial analysis difficult**. This is the first analysis that we know of that disaggregates scale-up behaviour by a sub-provincial geography, and we see some surprising results in terms of locations where scale-ups tended to be concentrated. Notably, there were specific non-urban geographies, such as northern Ontario, that recorded a relatively high share of scale-ups. However, due to the still-small numbers of firms implicated, deeper analysis in examining such geographical heterogeneity is difficult.

- **Geographical differences extend across time, where we see different trends in different regions across Canada.** Despite the relative stability in the share of scale-ups nationally, when scale-up activities are disaggregated at the regional level, we saw considerable variation in how the share of scale-ups changed over time. While some regions in the country, such as British Columbia, saw consistent increases in the share of scale-up companies over time, others, such as the Prairies (comprising Alberta, Saskatchewan, and Manitoba) saw a brief rise in the share, followed by a steep drop in the share by 2016.

- **Such differences extend to the industry sectors in which scale-ups originate.** Here we see few industries perform well under all three of the scale-up definitions examined in detail. Often, we see industries with high levels of activity under one scale-up definition do not have such levels of activity under another scale-up definition.

- **While the location where scale-ups are headquartered is important, they may not fully reflect the geographies where scale-ups actually record their impact.** Importantly, metropolitan areas with higher scale-up concentration did not exhibit different levels of productivity growth that can be attributed to resource reallocation compared to metropolitan areas with lower scale-up concentration. This may be due to the fact that a scale-up's impact does not fully correspond with the legal jurisdiction where it is headquartered.

Scale-ups are important drivers of both innovation and exports in Canada

- **The rate at which scale-ups export are 10 times that of non-scale-ups under both the Kauffman Employment definition and the Kauffman Revenue definition.** However, differences between scale-ups and non-scale-ups in export behaviour may reflect the average size of companies. This is also seen in the higher revenue and employment levels associated with higher volumes of export in a company. We see differences in the rate at which scale-ups export under the OECD Employment definition, and the relevant firm sub-population (those with at least 10 employees). This implies the importance of accessing international markets in attaining a certain size for Canadian companies. However, even in these instances, higher export volume is associated with a higher likelihood of a firm qualifying under the OECD Employment definition.

- **Scale-ups are also associated with higher likelihood and volume of research and development (R&D) spending; however, while further research is needed, larger firms saw increased benefits from higher R&D spending.** Across all three scale-up definitions, we observe significantly higher levels of R&D spending compared to non-scale-ups. These impacts remain when we controlled for confounding factors. However, when we analyze the impact of R&D separately for companies of different sizes, we observe that the larger the company, the higher the employment and revenue impact it experienced for additional increases in R&D spending. However, we note the potential difficulty in further scaling already-high R&D spending at these large firms.

- **There is a decline over time in the share of scale-ups investing in R&D.** While scale-ups are more likely than non-scale-ups to invest in R&D, we observe a general decline over time in the share of scale-ups that invest in R&D. This finding is consistent with other works that analyze the innovation economy in Canada and should be noted.

- **While general investment in R&D activity was associated with growth, receiving a patent was less likely to be associated with an immediate impact on revenue.** While patent grants are positively associated with the higher likelihood that the company is an employment scale-up, we see no statistically significant association with the likelihood of a firm being a revenue-based scale-up. This likely reflects the fact that the revenue and commercialization impact of a patent is not immediately realized. However, we still see patents are positively associated with business size, likely implying an increased ability for larger firms to engage in patenting.

Overall, we find that while scale-ups in Canada contribute to the economy in ways expected of them, different types of scale-ups contribute differently. No single scale-up definition satisfied and supported all policy objectives cited in the interests of scale-ups. We argue, therefore, for a shift away from a sweeping focus on specific industries or a particular set of firms without considering and identifying clear policy objectives that scale-ups originating from those contexts need to achieve. Instead, we advocate for a discourse that, as a first step, clearly defines the policy objectives desired before identifying the set of firms that are most likely to achieve such objectives once they scale up. We also recommend designing policies specifically in aid of such policy objectives.

Table B

Summary table of effects of specific business activities on firm growth

Business Activity	Impact on Revenue Levels	Impact on Employment Levels	Impact on Probability of scaling-up		
			Kauffman Revenue	OECD Employment	Kauffman Employment
Exporting	Positive	Positive	Positive	Positive	N/A
Patent	Positive	Positive	None	N/A	Positive
R&D	Positive	Positive	Positive	Positive	Positive

Introduction

Research in entrepreneurship receives much scholarly and public policy attention, as businesses form an integral part of our economy. In the last two decades, research in entrepreneurship has focused on the role of young and/or high-growth firms—what some, including the researchers here, call "scale-ups." The interest in scale-ups stems from the promise such firms hold in fulfilling several key government policy objectives, including employment gains, technological innovation, and economic competitiveness. It is often understood, in Canada and elsewhere, that with the right mix of policy support and a dash of serendipity, governments can spur the creation of companies that contribute to the country's employment growth, innovation, and global competitiveness. For many, scale-ups are seen as the guarantors of national prosperity.

The main goal of this report is to guide researchers, industry actors, and policy-makers towards a deeper understanding of the known facts, but also of the complexity and uncertainty surrounding Canada's scale-ups.

Despite governmental and research interest in scale-ups, discourse on the subject often lacks even definitional clarity. What is a scale-up, and how do we define it? As we will show, one can measure scale-up status by employment and revenue growth. Does it matter which growth metric is used, and does it change how we identify and describe scale-up activity? The literature on the subject is not without answers to these questions, but those answers often are scattered across studies rather than brought together for purposes of comparison. Without a clearer understanding of basic questions like these, it is difficult to know how, or even whether, scale-ups of different types can achieve the key policy objectives identified above. The problem, in Canada at least, is the lack of a comprehensive framework for understanding these firms.

This report constitutes one such attempt at creating a framework. Here, we provide a thorough overview of both the concept of scale-ups, including different ways of measuring them, and the impact that scale-ups have on Canada's economic landscape across various definitions and conceptions of growth. The main goal of this report is to guide researchers, industry actors, and policymakers towards a deeper understanding of the known facts, but also of the complexity and uncertainty surrounding Canada's scale-ups.

In exploring this topic, we acknowledge the varied lenses through which different individuals and groups look at and understand business growth. There are, indeed, different lenses through which one can examine scale-up activity. We invite readers to think of this report as a scientific instrument that they can use for studying scale-ups. Much like a kaleidoscope, a small change in how one orients the tool reveals an entirely new landscape of high-growth firms. For example, whether one focuses on employment or revenue as the growth metric of choice will impact the answers one finds.

We apply our tool to a rich dataset that covers the universe of all registered companies in Canada, inclusive of more than a decade of economic activity and tax filings. This data is made richer still by linking it to a comprehensive database on goods exporting from Canada and a patent database which includes intellectual property data on nearly all major countries. We address the benefits and challenges of our data choices throughout the report, which we hope will add further nuance to the discussion.

Our investigation yields a number of higher-level findings. First, scale-ups in Canada are relatively rare. The proportion of firms that qualify depends on the (growth) measurement one chooses to use, comprising anywhere from seven percent of firms with a proven business model to less than one percent of young firms (those at most 10 years old).

The growth metric chosen also determines scale-up performance. For instance, there is no clear link between employment and output or

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other performance metrics (e.g., R&D spending). Scale-ups that contribute disproportionately to employment growth (such as those in the hospitality industry) generate relatively less revenue, are significantly less productive, and support part-time positions that offer lower average pay. By contrast, those firms in the technology (or "tech") industry, a class of firms that generate a lot of policy interest, pay higher salaries than the national average, register high productivity gains, and spend the most on R&D, but they also create fewer jobs.

Scale-ups can be found all over Canada, although there is a concentration of activity in major population regions, especially for younger scale-ups and those in the tech industry. We also identify a disproportionate share of scale-up activity in other regions of the country. A high concentration of scale-ups can be found in the oil fields of Alberta, the tree-lands of Vancouver Island, and the less populous northwestern Ontario. Understanding scale-ups in these regions is not only critical to addressing widening urban-rural divides in Canada, but in advancing difficult but necessary conversations around equitable growth, environment sustainability, social relations, and other important values, alongside purely financial concerns.

Additionally, we find that conventional markers of business success, such as filing a patent grant, spending on R&D, or exporting products to overseas markets, are predictive of a company's scale-up status, even if such activities are not essential for company growth. The association between these business activities and firm performance (i.e., growth in revenue or employment) is complicated. We present various ways to think about and conceptualize these activities.

For example, while the performance benefit realized the first time a company exports or receives a patent is considerable, such benefits diminish over time, and depend on the volume of exports, or the total number of patents that company holds. Not unlike the different scale-up definitions, how one measures “exporting” and its relationship to growth (and the kind of growth) matters. Furthermore, we find that the benefits from certain activities, such as R&D, are not evenly distributed. Large firms, for example, enjoy significantly greater revenue and employment benefits from R&D spending. Smaller firms have a harder time reaping the benefits of R&D.

Despite the richness of the data, we find important limitations in answering our questions. One example is capturing certain business activities. Measuring the export of digital services, for example, is challenging. It is also difficult to adequately measure research and development spending given the way R&D is captured and measured in tax filings. The increased tendency to rely on trade secrets and standards as opposed to patents (or other types of formal intellectual property) presents additional challenges.

Notably, this project was conceptualized and executed before the COVID-19 pandemic’s economic disruption. And while we are probably still some years away from having robust economic indicators to assess the full impact of this economic crisis, we hope that some of the insights regarding the observed resiliency of scale-ups in the wake of the 2007/2008 global financial crisis will offer some signs of how different companies fare.

Our analysis shows that scale-ups suffered through the financial crisis like most firms the world over, affecting relatively smaller firms most intensely. Larger scale-ups managed to weather the financial crisis relatively better. Despite the high levels of disruption, we observe little impact in the dynamics of early-firm growth. This should be welcome news and provide hope for a robust recovery from the current crisis.

Overall, the discourse on scale-ups tends to coalesce around supporting the growth of a select few “superstar” firms (or even a single firm) that satisfy all policy objectives. Anchor firms, such as Ottawa’s Nortel before its collapse, are no doubt important (Calof et al., 2014). But we do not find this discourse to be particularly helpful, nor do we view it as reflective of the Canadian scale-up landscape in any meaningful way. It is a daunting task for any company to satisfy even one of the main policy objectives, such as job creation, innovation, productivity growth, or export promotion, much less multiple priorities.

The overarching conclusion of our research is that while scale-ups in Canada broadly contribute in ways expected of them, no single type of scale-up satisfies all policy objectives in all places and across all industries.

We argue for a shift away from a sweeping focus on a specific industry or particular set of firms without consideration of the varying performance of these industries and firms. Scale-ups are not a monolith. Instead, we advocate for a discourse that more clearly defines the policy objective(s) firms can achieve, and then encourages policymakers, researchers, and industry

The overarching conclusion of our research is that while scale-ups in Canada broadly contribute in ways expected of them, no single type of scale-up satisfies all policy objectives in all places and across all industries.

collaborators to seek to create (through policy) a business environment that incentivizes and supports growth of companies in that direction.

Before we proceed to the main body of the work and our empirical findings, we present a short summary of the current thinking that exists on scale-ups. Following that, we discuss both our theoretical construction of scale-up activity and how we empirically measure and analyze such companies, focusing especially on what the data can (and cannot) tell us. The remainder of the report profiles the various lenses through which scale-ups can be examined, drawing relevant insights and conclusions that should generate further lines of inquiry and new grounds for conversation on scale-ups and firm growth.

Scale-ups: A Short Review

It is common today to read that scale-ups are important, but it is not always clear why this is the case. In this section, we briefly review the literature on the subject, focusing on why scale-ups are considered so important to employment gains, innovation, economic competition, and other desirable impacts.

Some of the early works in business economics focus on identifying firms that contributed disproportionately to net jobs created (Birch, 1979), pointing to one of the most commonly cited reasons we should care about scale-ups firms (or high-growth firms[1]): they are responsible for the vast majority of net jobs created (Moreno, Fabiana, and Coad, 2016). While such growth can come from firms of many sizes, they tend to be concentrated in a small number of (typically) young firms (Haltiwanger, Jarmin, and Miranda, 2013; Haltiwanger, Jarmin, Kulick, and Miranda, 2016; Coad and Daunfeldt, 2014).

Scale-ups appear in many different jurisdictions around the world, from the United Kingdom (Storey, 1994; NESTA, 2009), Sweden (Daunfeldt, Lang, Macuchova, Rudholm, 2013), Brazil, Côte d'Ivoire, and Indonesia (Goswami, Medvedev, Olafsen, 2018). This story is no different in Canada, where high-growth firms account for the bulk of new jobs created (Birch, Haggerty, and Parsons, 1995; Picot and Dupuy, 1998; Schreyer, 2000; Halabisky, Dreessen, and Parsley, 2008; Dixon and Rollin, 2014; Vu and Huynh, 2019).

However, given that scale-ups are often defined as firms with high growth rates in employment change, the fact that they have greater job impact than other types of firms can be read as a function of the definition and not necessarily a stylized fact.[2] When we go beyond mere employment impact measures, research finds that scale-ups have notable economic impacts across other metrics. They contribute significantly more to productivity gains (Du and Temouri, 2015; Haltiwanger, Jarmin, Kulick, and Miranda, 2017), innovation and learning (Coad and Roal, 2008; Hölzl and Klaus, 2010), exporting and research and development (Huang, 2019). Governments do and indeed should, look towards these firms not just for their employment impact, but as sources of innovation-based entrepreneurship (Botelho, Fehder, Hochberg, 2021). And while empirical studies on scale-ups have been numerous, correspondingly few focus on the theoretical underpinnings of what makes these "threshold firms" special.

The idea of a threshold firm, introduced by Steed (1982), holds that companies passing a certain growth threshold are established, market-proven companies that are organizationally and managerially more sophisticated than start-ups and early-growth firms. Fast-growing firms with export and innovation potential require greater managerial sophistication in a way that start-ups and other firms do not. These are businesses which survived the early-growth phase of the firm lifecycle, and, as a consequence of meeting growth requirements, are organizationally much less dependent on the whims of any one individual (such as a CEO) or changes in the business environment.

Theoretically, Steed's perspective finds support in Penrose (1995), who addresses the question of firm size and organizational capacity in her seminal work on the theory of the firm. In The Theory of the Growth of the Firm, Penrose argues that firms with sound overall managerial capacity are capable of theoretically limitless growth. She focuses not on the individual manager or entrepreneur in the firm, but the firm's overall managerial capability—that is, the culture and the administrative structure by which a firm makes decisions. She argues that if managerial capability is sound and adapts to changing environments, there is no limit to how large a firm can grow. Empirically, research on growth dynamics of Canadian firms finds growth kink points (thresholds separating growth firms from others) at the 20 and 50 employee counts, suggesting that these may be some of the initial growth points that distinguish scale-ups from other firms (Song and Bérubé, 2021).

We know the main reason "the firm" exists in the first place is to overcome transaction costs (Coase, 1937). Firms provide the crucial service of coordinating across different resources (labour, capital, technology, etc.) more efficiently than other actors and are thus understood as drivers of growth, innovation, and productivity gains. As noted, the literature shows that scale-ups account for most of these gains. Relatively few scale-ups, if any, will break through towards large and/or multinational firm status, and creating policy mixes to support the growth of such champions requires careful design and monitoring. Scale-up firms are undoubtedly the cohort of firms from which such national champions will emerge (Denney, Southin, and Wolfe, 2021).

Research on scale-ups also recognizes potential spillover and externalities scale-ups have on the broader economic environment in which they operate. The Organization for Economic Co-operation and Development (OECD)'s 2013 cross-national study of high-growth firms, for instance, finds evidence of positive externalities, in the form of increased employment and consumer demand (OECD, 2013). Indirect effects are also created by scale-up firm activities (de Nicola, Muraközy, and Tan, 2019).[3] Evidence suggests that scale-ups are also most likely to benefit from spillover effects from foreign-direct investment (Békés, Kleinert, and Toubal, 2009). In some instances, these spillover effects might be negative, such as the erosion of business dynamism due to the monopolistic behaviour of larger and more established firms, some of which will likely be scale-ups(Breznitz and Taylor, 2014).

While we have yet to gain a full understanding of how to stimulate the creation of scale-ups, we know that once a company experiences a growth event, they tend to not fail afterwards (Dvorkin and Gascon, 2017; OECD, 2018). Repeating and sustaining growth, however, is difficult.[4]

The question of whether we want all firms growing notwithstanding,[5] there is a strong empirical and theoretical case for why we ought to care about scale-ups. But how, exactly, do we define and measure a scale-up? Research finds that the number of high-growth firms identified in a firm population depends in part on which specific definition and growth metrics are used (Côté and Rosa, 2017; Daunfeldt, Elert, and Johansson, 2014). Which definition should we use, and why? We explore these questions and related concerns in the next section.

Analytical Framework

In this section, we lay out the analytical framework used for this report. First, we critically review competing definitions and conceptualizations of scale-up (or high-growth) firms and describe the definitions used in this report, the implications of using any given definition, and the justification for their use. Then we provide an overview of the data used in this report and explain some of our key metrics and measurements. We conclude with a brief explanation of the empirical strategy used for our analysis.

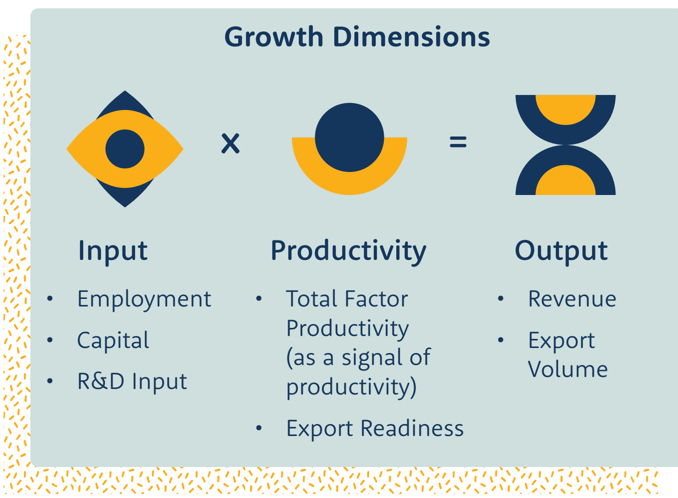
Definitions

For the purpose of this research, we focus on a particular concept of a firm, termed "enterprise" in the Business Register (BR) and directly adapted from Statistics Canada.[6] Choosing our analytical unit to be at the enterprise level poses specific rewards and challenges. Conceptually, the enterprise level is what a firm is intuitively understood to be, where a set of individuals maintain control of the operation and direction of a specific business activity. For this research, data is aggregated at the enterprise level (even enterprises that have multiple business numbers associated with them).

However, focusing on the enterprise level also means that economic activity by enterprise cannot be disaggregated at different geographies. This implies that the firm is tied to its legal address, which may not be where the majority of business activity or economic impact occurs, which is especially problematic for larger firms that could, in theory, operate offices or locations in multiple geographical locations.[7] We address this concern to some extent with our choice of geographical definition, the economic region, which is explained below.

In addition to establishing a clear conceptualization of the firm, we also seek to provide greater definitional and conceptual clarity regarding scale-ups. Not all scale-up enterprises are the same. This is typically a function of the definition. The existing literature on scale-ups uses measurements based on employment and revenue metrics that are fundamentally different from each other. Unsurprisingly, when metrics by which scale-ups are measured change, so too do their impact. If we use revenue, for instance, employment impacts are considerably lower (Daunfeldt, Olov, Elert, and Johansson, 2014). Employment, for instance, is an input, while revenue is a proxy for output. These definitions are likely to capture very different firms, and the use of the various definitions can potentially create significant confusion in policy discussions of scale-up activities. This underscores the need for policy analysts to be clear about which definitions they are using and the cohort of firms being targeted with the policy intervention. A review of the firm growth process (Figure 1) can bring clarity to an otherwise conceptually confusing discourse.

Figure 1
Model of firm growth



Within the standard economic literature, firm growth occurs when firm output grows. Taking firm growth in isolation, without considering other market mechanisms, a firm grows its output by increasing inputs (using the current production technology) and/or improving the production technology (given the same input). A firm's production technology[8] (or their total factor productivity) is a particularly important growth factor that is sometimes missed by the literature on high growth firms. Taken together, these three components (input, productivity, output) complete the picture of our model of firm growth.

Existing evidence demonstrates that scale-ups measured by one growth metric differ substantially from others (Daunfeldt, Elert, and Johansson, 2014). In this sense, we can understand the literature on scale-ups by classifying the metric chosen from the firm growth process.

Furthermore, growth on any of these three sets of metrics can be understood as focusing on one of three properties of growth:

- **Growth trajectories:** This property of growth focuses on the size of the growth itself (e.g., 20 percent growth in revenue or employment), and aims to characterize the change in size of an enterprise.
- **Growth thresholds:** This property of growth focuses on the size of the enterprise after a growth period (e.g., $2 million in revenue), and is often included to reduce small-firm bias or to capture a firm's administrative capacity.
- **Growth consistency:** This property of growth focuses on whether growth experienced by a firm is a one-off event, or sign of consistent growth (e.g., minimum of 20 percent average annualized growth over a three-year period).

Then, how exactly do we define a scale-up? Existing definitions use both output- and input-based definitions, and typically include additional metrics such as firm age, initial size, and average annual growth. Employment-based measures focus on either threshold levels of employment growth (Ahmad, 2006; Halabisky, Dreessen, and Parsley, 2006; Deschryvere, 2008) or absolute employment gains (Birch 1987; Schreyer 2000). These definitions, however, are limited to input-only measures. Other metrics are not part of the definition.

In 2007, the Organization for Economic Cooperation and Development (OECD), in an effort to standardize measurement across member states, expanded the definition to include additional growth properties, namely growth magnitude and consistency, identifying these as "all enterprises with average annualized growth greater than 20 percent per annum over a three-year period with at least 10 employees at the beginning of the growth period." Growth is measured by employee change or turnover (revenue) change. For their Index of Growth Entrepreneurship, the Kauffman Foundation introduced a revenue/output-based definition, in addition to a revised employment-based definition (Morelix, Reedy, and Russell, 2016). Both definitions are widely used today, and the OECD definition has been validated through cross-national sensitivity analysis as a relevant measure (Peterson and Ahmad, 2007).[9]

In this research, we focus on both input (namely, employment) and output (revenue) dimensions of growth. We do not directly focus on productivity as a measure of growth or as a metric for defining scale-ups, as productivity is often calculated as a residual using input and output measures (Andrews, Criscuolo, and Gal, 2015). Accordingly, we use productivity as a characteristic of firm performance. For specific definitions, we use a combination of OECD-Eurostat and Kauffman Foundation definitions, with additional modifications (especially on the revenue threshold) informed by industry consultations.[10] We focus on commonly-used definitions to add meaningfully to the literature on this subject.

Table 1

Overview of scale-up definitions used

Dimension of growth	Shorthand definition	Firm population	Scale-up definition
Employment	OECD Employment	Firms with at least 10 employees at the beginning of the growth period (four years prior to measurement)	Average of at least 20 percent year-over-year growth in employment for three consecutive years
	Kauffman Employment	Firms 10 years or younger that started with at most 49 employees	Grow to at least 50 employees by the tenth year of operation or at the year of measurement, whichever is less
Revenue	OECD Revenue	Firms with at least 10 employees at the beginning of the growth period (four years prior to measurement)	Average of at least 20 percent year-over-year growth in real total revenue for three consecutive years
	Kauffman Revenue	All firms	Average of at least 20 percent year-over-year growth in real total revenue for three consecutive years with $2 million in revenue at the end of measurement year
	Kauffman Revenue-6	All firms	Average of at least 20 percent year-over-year growth in real total revenue for three consecutive years with $6 million in revenue at the end of measurement year
	Kauffman Revenue-10	All firms	Average of at least 20 percent year-over-year growth in real total revenue for three consecutive years with $10 million in revenue at the end of measurement year

We are aware of other definitions, such as the U.S. Bureau of Labor Statistics' "kink point" approach and the "top decile" approach, among several others.[11] Furthermore, we recognize the limited portability of the Kauffman Foundation's definitions of scale-ups, as the data sources they employ in measuring scale-up activity are substantially different in nature and design and acknowledge our industry-informed custom definitions cannot be used for international comparison. There is less concern for OECD scale-up/high-growth definitions, as they were developed with cross-country comparison in mind, with the OECD working with national statistical agencies to ensure the highest level of cross-country comparability. Table 1 identifies the definitions used, including type and the target population.

Data and measurement

In measuring scale-ups and their behaviour in Canada, we employ data from the National Accounts Longitudinal Microdata File (NALMF). NALMF is a database maintained by the Canadian Centre for Data Development and Economic Research (CDER) that combines information submitted by businesses to the Business Register (BR) with various tax filings that enterprises submit to present a more complete picture of the economic landscape in Canada. As this is an administrative data source, coverage is near universal for all registered businesses that file taxes in Canada.

For additional analysis, data derived from NALMF is linked to the Exporter Registry, a database that tracks businesses that export goods (not services) with values of at least $30,000 and compiled from Canada Border Services Agency (CBSA) records, as well as United States import statistics for exports from Canada to the U.S. Although NALMF coverage extends from 2000 to 2016, linked export data is only available from 2011 onwards. We discuss the implications of this data set when we analyze export behaviour.

Finally, we link NALMF to PATSTAT, the European Patent Office's Worldwide Patent Statistics Database, to understand firm patent behaviour for the full range of years from 2000 to 2016. We primarily match the BR records to patent records by understanding the primary assignee of the patent. Given the rare event that patenting is for Canadian businesses and concerns regarding data suppression, we do not report summary statistics for this metric. We use patent grants as a measure of innovation (or capacity to innovate) and analyze it accordingly in the econometric section of this research.

Growth metrics

As explained above, we use three growth metrics: employment (input), revenue (output), and productivity. Within NALMF, there are competing employment definitions: T4 and PD7. We use the latter (PD7) in our analysis. Employers submit PD7 forms for each employee at the business, to remit part of the employees' paycheque to mandatory contributions (primarily Canada Pension Plan and Employment Insurance). This is somewhat different from employment numbers derived from T4 submissions, which is a statement of remuneration businesses provide to employees and used primarily for the employee's tax filing purposes. T4s tend to be more accurate as employees have incentives to pressure the employer to issue T4 forms, but T4s might not track employment particularly well when the firm goes out of business, as there is no legal expectation for the firm to file T4 slips for employees at the year they exit the market. In addition, T4s are submitted for every employee of the business each year, and thus may not provide for an accurate level of employment at any given point (a business that employs one employee for the first six months and another for the last six months of the year will still submit two T4 slips). PD7 forms, on the other hand, are submitted monthly, and when an average is taken over 12 months, provide a more accurate average employment levels for that firm in that year.

One shortcoming of both employment measures in NALMF is that PD7s and T4s are only submitted for employees of the business and not any self-employed personnel or individuals who provide consulting (or similar) services to firms. This distinction is particularly important in cases where companies use self-employed individuals as de-facto employees, as they will not be counted in either employment metrics.

For the output metric, we use a firm's total revenue (as reported in the T2), deflated using inflation numbers obtained from the Bank of Canada (2000 as base year). We use revenue as opposed to a profit metric as there is no tax implication in reporting high levels of revenue, compared with reporting high levels of profit. Firms have been shown to engage in (legal, semi-legal, and illegal) accounting strategies to minimize recorded profit, and therefore tax liabilities, making any metrics with high implications for tax unreliable in measuring firm performance.

Finally, to measure firm productivity, we test five different methods in estimating firm-level total factor productivity (TFP), employing data on firm revenue, firm payroll, employment, assets, and cost of sales. The five methods include Pooled Ordinary Least Squares, Within Estimator, First Differences, Second Differences, and an Internal Instrument Approach. The approaches are characterized and described in Levinsohn, James, and Petrin (2003), Wooldrige (2009), and Petrin and Levinsohn (2012). Production functions were estimated separately for each four-digit NAICS (North American Industry Classification System), which were then used to estimate TFP growth for each firm in the sample. Productivity growth metrics derived using the five different methods were then evaluated, resulting in the selection of estimates derived from Second Differences and the Internal Instrument Approach.

Geographies and industries

A significant contribution of this report will be in assessing the economic footprint of scale-ups across sub-national geographies and by these same geographies across selected industries. For geographies, we use all 13 provinces and territories and Canadian economic regions (ERs). Economic regions are a combination of census divisions (CDs) defined in consultation with provincial and territorial governments to assess regional economic activity. Conceptually, ERs approximate the priority policy regions in the province. As a result, economic regions do not have consistent population sizes the way other statistical areas do.

There are a total of 76 ERs, providing comprehensive coverage of regional economic activity across Canada. Analysis at the sub-provincial level often uses census metropolitan area (CMA) and census agglomeration (CA), which are defined by population thresholds and commuting flows between census subdivisions, and act as a local labour market. However, a firm headquartered in a particular CMA may not conduct most of its economic activity in that CMA. Using the ER as a unit of analysis allows us to focus on the policy environment that impacts regions differently, as opposed to focusing on the local economic impact of these firms, which could be misleading.

In choosing the industry-level classification, we note that the standard high-level industry groups in the North American Industry Classification System (NAICS) do not adequately capture firms in specific industries of interest, particularly the tech sector. Previous research has explored the relative prominence of scale-ups (and fast-growing firms) in the tech industry compared to other industries (Henrekson and Johansson, 2010; Vu and Huynh, 2018). There is an expectation, particularly among policymakers, that the tech industry is where most scale-ups and high-growth firms will be found (Mason and Brown, 2013; Coad, Daunfeldt, Hölzl, Johansson, and Nightingale, 2014). However, the industry classification available does not isolate the tech sector particularly well, especially at the sub-provincial level.

To account for these limitations regarding industry definitions and focus, we developed a custom grouping of industry sectors using the method established by Lamb and Seddon (2016),[12] extending it for the most recent measure of occupational technological intensity to identify tech industries, as established in Vu, Zafar, and Lamb (2019).[13] For the remaining four-digit NAICS level, we aggregate them loosely at the two-digit NAICS level, guided by Vu and Huynh (2018), which examines scale-up activity in Ontario in order to capture industries highlighted as being scale-up intensive. We validated our approach with a group of economic and policy experts, making minor modifications to our definitions. Appendix B outlines the logic employed in defining tech, and Table 2 provides a complete breakdown of custom industry groupings.

Table 2
Custom industry groupings by NAICS codes

Custom industry category	Coding logic
Accommodation and food services	NAICS 72
Administrative support	NAICS 56
Construction	NAICS 23
Finance	NAICS 52
Non-tech manufacturing	NAICS 31-33 (not otherwise in tech)
Non-tech professional	NAICS 54 (not otherwise in tech)
Other products	NAICS 11, 21, 22
Other services	NAICS 48-49, 51, 53, 55, 61-62, 71, 81, 91
Retail	NAICS 44-45
Technology	As defined in Appendix B
Wholesale	NAICS 41

between firm performance and economic activities and growth events.

The descriptive analysis presents the "economic footprint" of scale-ups in Canada across various definitions. In addition to identifying the total number and proportion of scale-ups and high-level employment and revenue contributions, we explore the economic characteristics of scale-ups across other relevant indicators, including average pay, firm-level productivity, exporting behavior, and R&D spending. For select indicators, we examine the economic impact of scale-ups across geographies (provinces and economic regions) and industries (with a focus on tech, for the reasons stated above).

Empirical strategy

Our empirical strategy for analysis relies on two straightforward methodological approaches. The first method is a descriptive overview of scale-up activity and economic impact overall and across industries and geographies by relevant economic metrics. The second method uses various econometric approaches (i.e., different types of regression models) to examine the association

For analysis that goes beyond the proportion of firms within a population and overall employment and revenue contributions, we use only three of the original six definitions: those based on the Kauffman Employment and Revenue and the OECD Employment criteria. The reason for this decision is twofold. First, we want to capture at least one employment and revenue definition. The revenue definitions are similar, so we chose the definition that includes a revenue threshold, a decision informed by theory (revenues serve as a “threshold”) as well as consultations with industry actors and experts in the field. Second, for employment-based definitions, we determined that Kauffman Employment and OECD Employment definitions capture two sufficiently different populations, so we decided to use both.

In addition to descriptive analysis, we use various econometric approaches that measure the association (or correlation) between innovation activities (patenting, R&D spending), growth events (specifically, exporting), and productivity changes with growth trajectories (i.e., employment and revenue changes) and scale-up status. Using regression models for Kauffman Employment and Revenue and the OECD Employment definitions, we can include adjustments for variation across industries, geographies, and other relevant variables. Depending on the structure of the specific outcome variable (e.g., continuous, dichotomous), we specify different regression models (e.g., OLS, logit, quantile) to examine how some variables of interest are associated (or not) with the growth and performance of Canadian firms. More information about model specifications and additional explanations are provided below.

The next two sections present our empirical findings and analysis. First, we provide our descriptive analysis of scale-ups in Canada by various definitions and across different geographies and industries. This is followed by our econometric findings. We then conclude the report and discuss the implications of our findings.

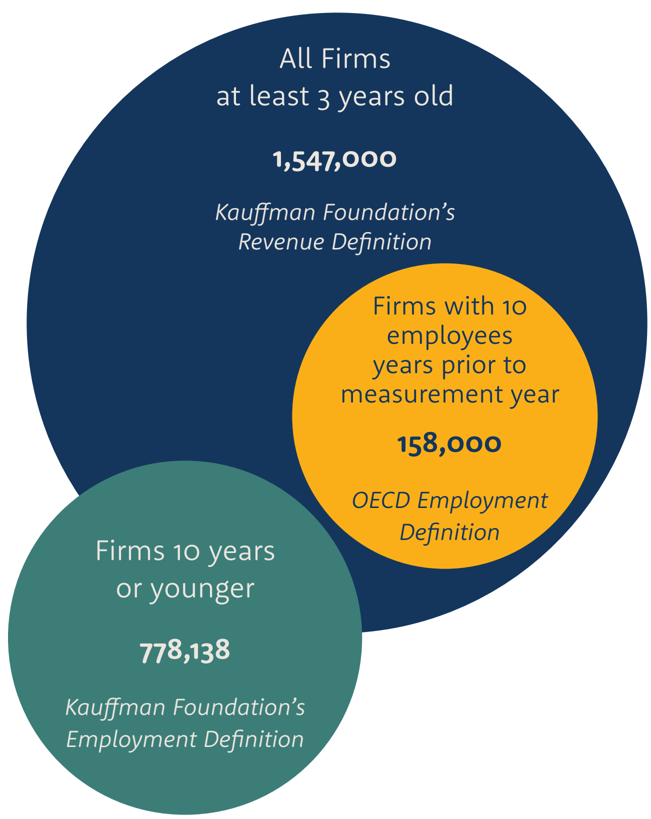
Scale-ups' Economic Footprint

We begin our analysis with the descriptive characteristics of scale-ups in Canada. We especially focus on understanding the differences in firms that are captured by different scale-up definitions, initially focusing on all six of our definitions. After that, we closely examine the three select definitions for revenue- and employment-based definitions we identified above. We cover a wide range of topics, from change over time as well as geographic and industrial distribution. We also focus on characterizing and contrasting scale-ups and non-scale-ups in their productivity growth, and their export and R&D behaviour.

Scale-up shares by definitions

In understanding scale-up activity across various definitions, we need to be conscious of the firm (sub)populations under consideration, especially when comparing between definitions. For example, one should exercise caution when comparing scale-up companies defined using the Kauffman Foundation's criteria for defining employment scale-ups, meant to specifically capture growth experiences of young firms, to older and more established companies, such as those identified by the Kauffman Foundation's criteria for defining revenue scale-ups.[14] In total, there are three distinct groups, as shown in Figure 2.

Figure 2
Firm (sub)populations by definitions



- **Kauffman Revenue group (various revenue cut-offs)**: This group of scale-ups, defined by the Kauffman Foundation's criteria for revenue scale-ups, is the most inclusive and consists of all companies in the population of firms at least three years old (necessary to calculate three years of firm growth).

- **OECD group (OECD Revenue and OECD Employment)**: This group of scale-ups, defined by the OECD's definitions for revenue and employment scale-ups, consists of all firms with at least 10 employees at the beginning of the measurement period. Conceptually, this group takes into account only those companies that have a proven business model.[15]

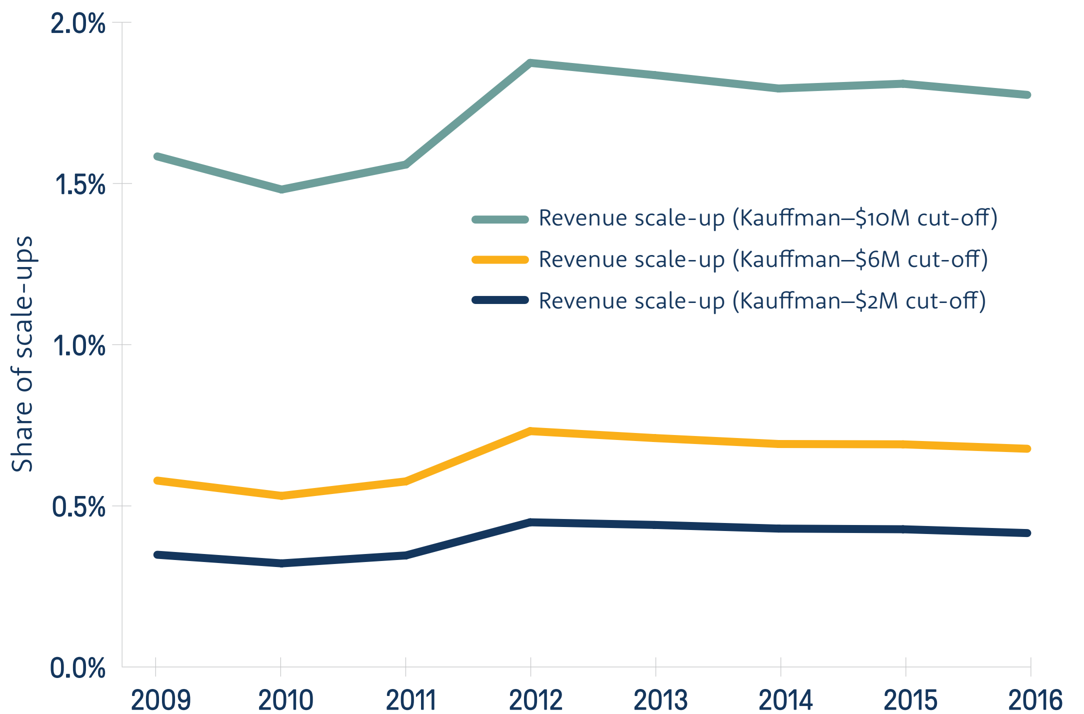
- **Kauffman Employment group**: This group consists of firms that are at most 10 years old and is based on the Kauffman Foundation's criteria for employment scale-ups. Using this group, we can focus on understanding the dynamics of early firm growth.

Accordingly, when we present our results below for shares of scale-ups per definition, we provide separate graphs for each firm population. In this subsection, it would be inappropriate to compare scale-ups shares between groups, as they each comprise separate firm populations. So, we report them separately.

Scale-ups defined using the Kauffman Foundation criteria with varying revenue thresholds (Figure 3) become less common when more stringent revenue requirements are used. It is notable, however, that the largest drop was between the first $4 million increment, moving from a $2 million cut-off to a $6 million cut-off, with the number of scale-ups decreasing by a full percentage point. All scale-ups defined using this definition also follow a similar trajectory over time, experiencing similar downturns following the 2008-2009 financial crisis followed by recovery by 2012.

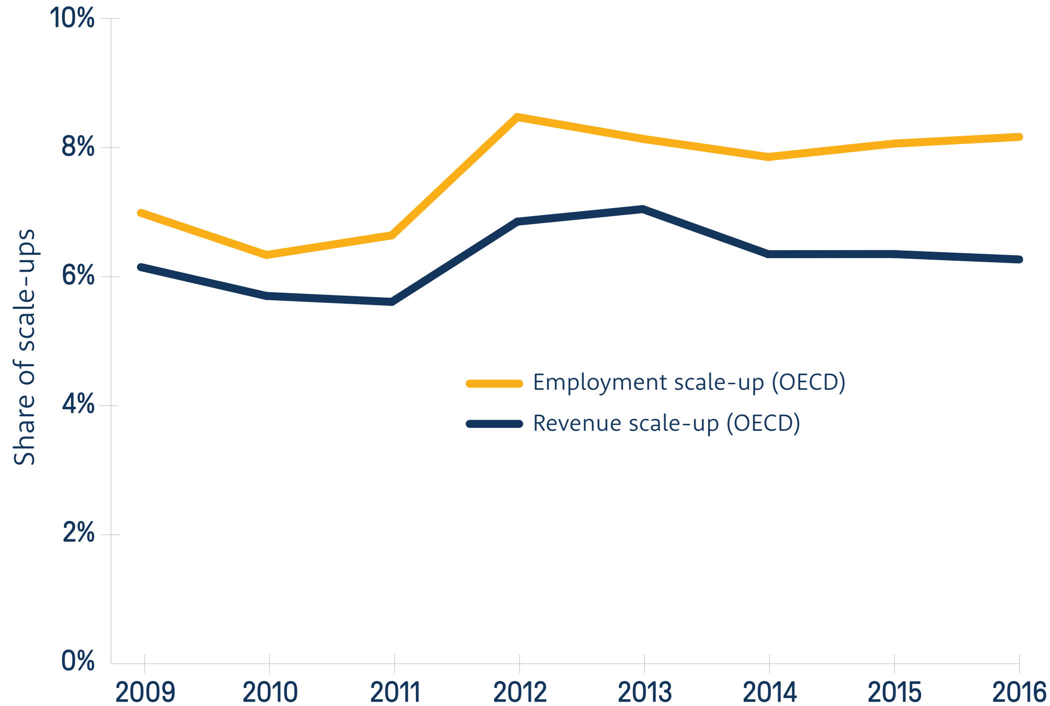
Figure 3

Share of Scale-ups, Kauffman Revenue Definitions



Source: NALMF, Authors' calculations

Figure 4
Share of Scale-ups, OECD Definitions



Source: NALMF, Authors' calculations

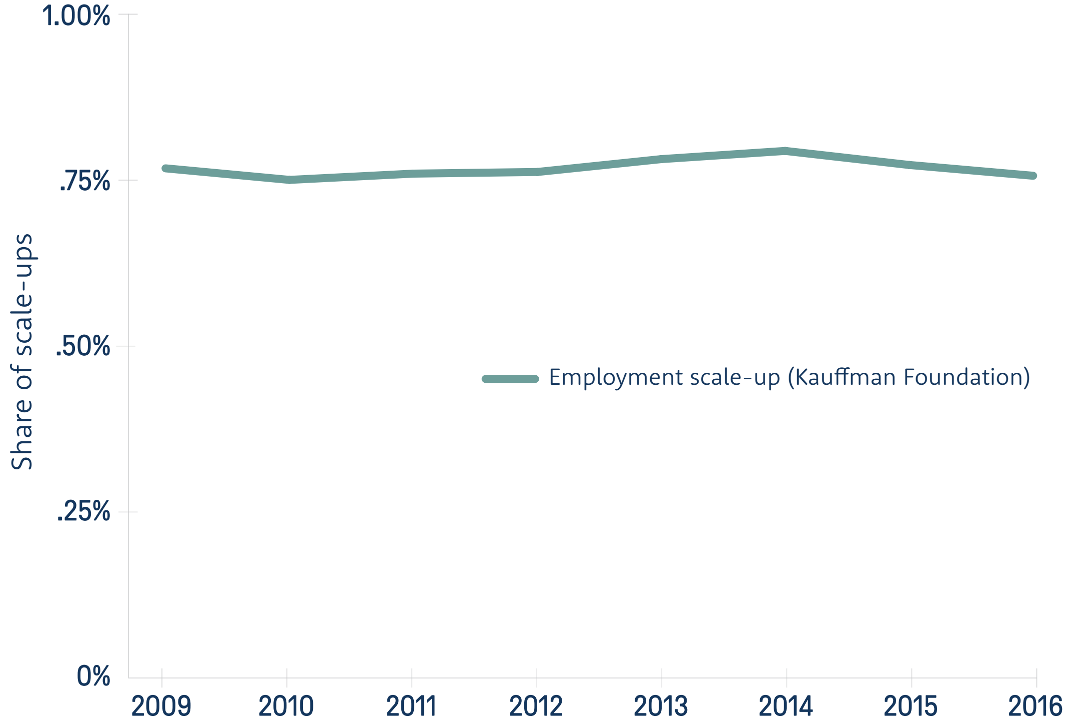
OECD revenue scale-ups have systematically higher shares compared to OECD employment scale-ups, while they share common trends (six to eight percent of firms in the population). Notably, both types of scale-ups experienced modest declines during the 2008-2009 financial crisis followed by full recoveries in 2012, mirroring those seen in Figure 3. This may not be surprising given the similarity between the core of the Kauffman Foundation revenue-based definition and OECD scale-up definitions, with the only difference being the growth threshold chosen for each of the definitions.

Finally, firms defined by the Kauffman Foundation's criteria for employment scale-ups (Figure 5) are notably different from the previous two scale-up definitions, exhibiting little cyclical behaviour, where the share of Kauffman employment scale-ups (as a share of young firms) did not experience significant reductions during the financial crisis, staying consistent at approximately 0.75 percent of all young firms throughout our measurement period (2009-2016). This lends credence to some of the theoretical ideas presented above regarding the process of firm growth. Passing an important employment threshold is a rare and significant event, which also implies that the chances such events occur are not likely to be impacted by short-term business conditions.

As each measurement year for this definition represents a specific firm cohort of firms (by age), changes in the share of scale-ups under this definition signals potential changes in business dynamism, or the structural ability of firms to grow. While others have flagged concerns with declining business dynamism in Canada (Clemens, Emes, and Veldhuis, 2015), our evidence on early-firm growth indicates that even if there is decline in the rate of new firm growth, such a decline does not seem to affect long-term structural change in the ability for firms to grow.

Figure 5

Share of Scale-ups, Kauffman Employment Definitions



Source: NALMF, Authors' calculations

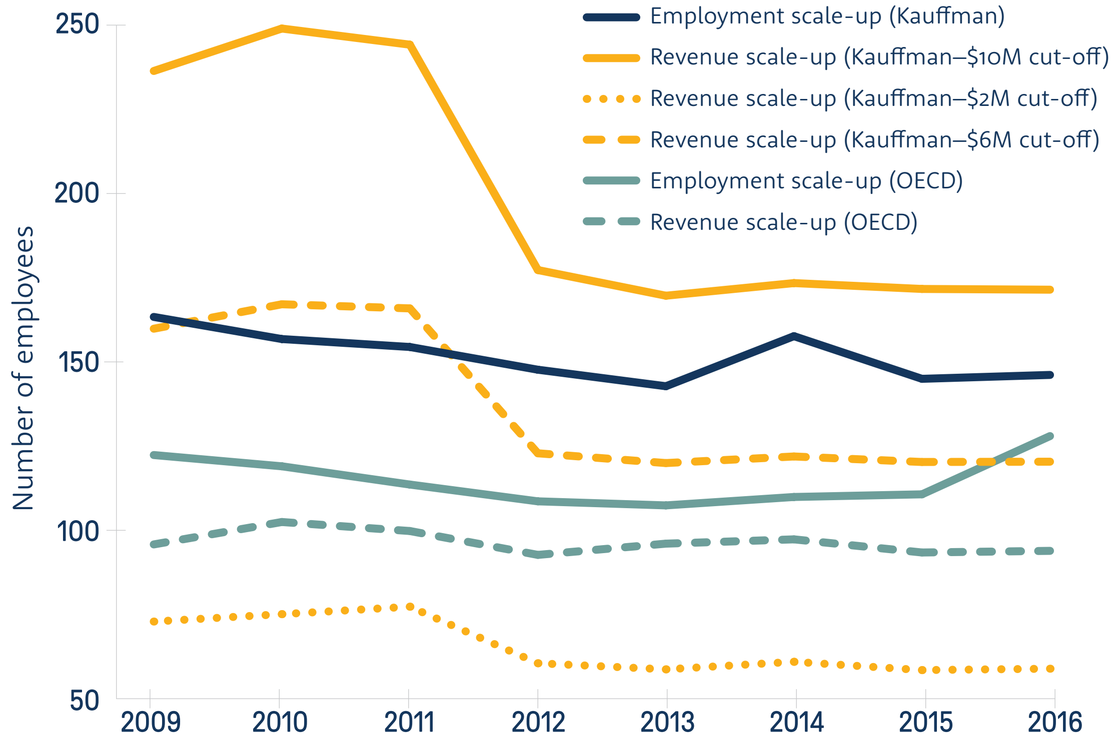
Employment and revenue contributions

Next, we look at the employment and revenue contributions of scale-ups (Figure 6). When we examine the number of employees who work in scale-ups based-on various definitions, the results are not particularly surprising. Revenue scale-ups with no or a low revenue threshold record fewer employees than employment scale-ups, while those with much higher revenue threshold also employ more workers. For Kauffman employment scale-ups, the average employment level far exceeds the growth threshold of 50 employees, recording around 150 employees throughout the measurement period. OECD revenue scale-ups and scale-ups based on the Kauffman Revenue criterion (with the $2-million cut-off) have the lowest levels of average employment. However, even the lowest average employment levels for Kauffman revenue scale-ups still exceed the most stringent employment threshold conditions in our definitions (50 employees). Average employment at Kauffman revenue scale-ups systematically decreased between 2011 and 2012, a fact we examine more closely later in this section. Average employment for OECD scale-ups, as well as Kauffman Employment, are more consistent throughout the measurement period.

When understanding employment levels at scale-up firms compared to non-scale-up counterparts, Kauffman employment scale-ups have the highest relative size to comparator firms (Figure 7). An average scale-up of this type employs 30 times the number of workers employed at non-scale-ups. This is likely due to the set of comparator firms for Kauffman employment scale-ups being young, small firms, and the rarity of the employment growth required to qualify for this scale-up definition. However, there is a gradual and systematic decline in the relative size for Kauffman Employment firms between 2009 and 2016. While further work is needed to understand why such a gradual decline is observed, one potential explanation points to research findings that firms founded during an economic downturn experience lower growth (Zarutskie and Yang, 2017), as later measurement years incorporate this cohort of young firms.

Figure 6

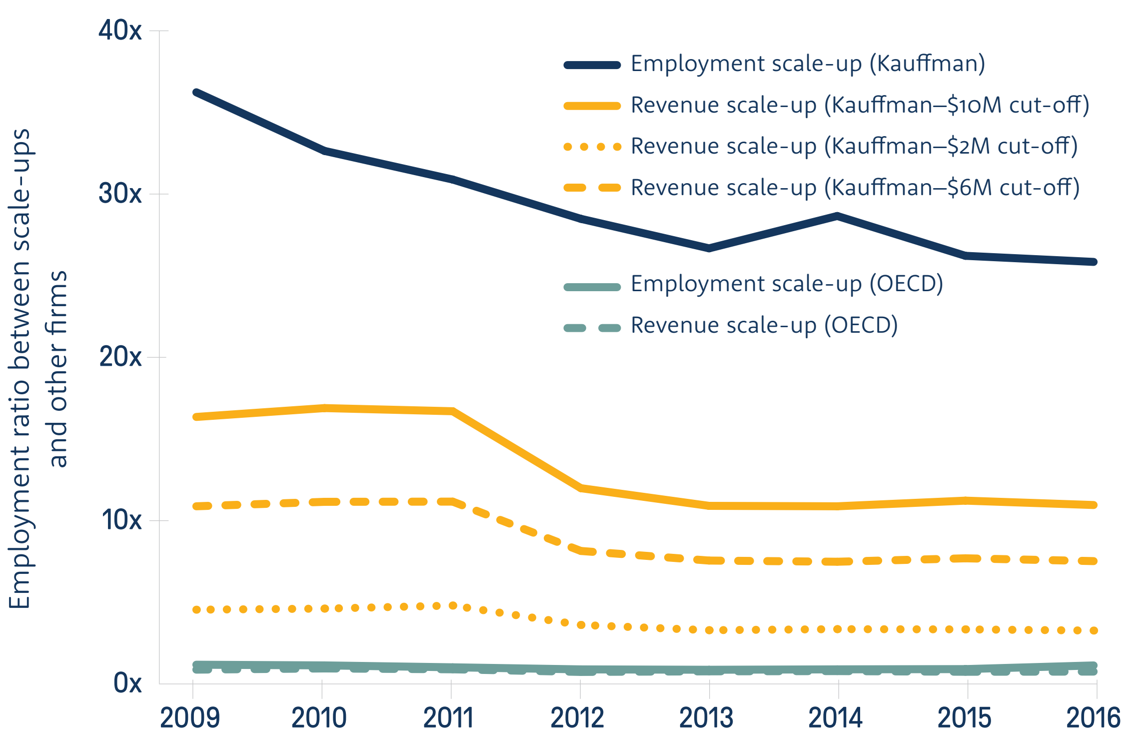
Employment Levels Over Time at Scale-ups in Canada, Various Definitions



Source: NALMF, Authors' calculations

Figure 7

Relative Employment Levels Over Time at Scale-ups In Canada, Various Definitions



Source: NALMF, Authors' calculations

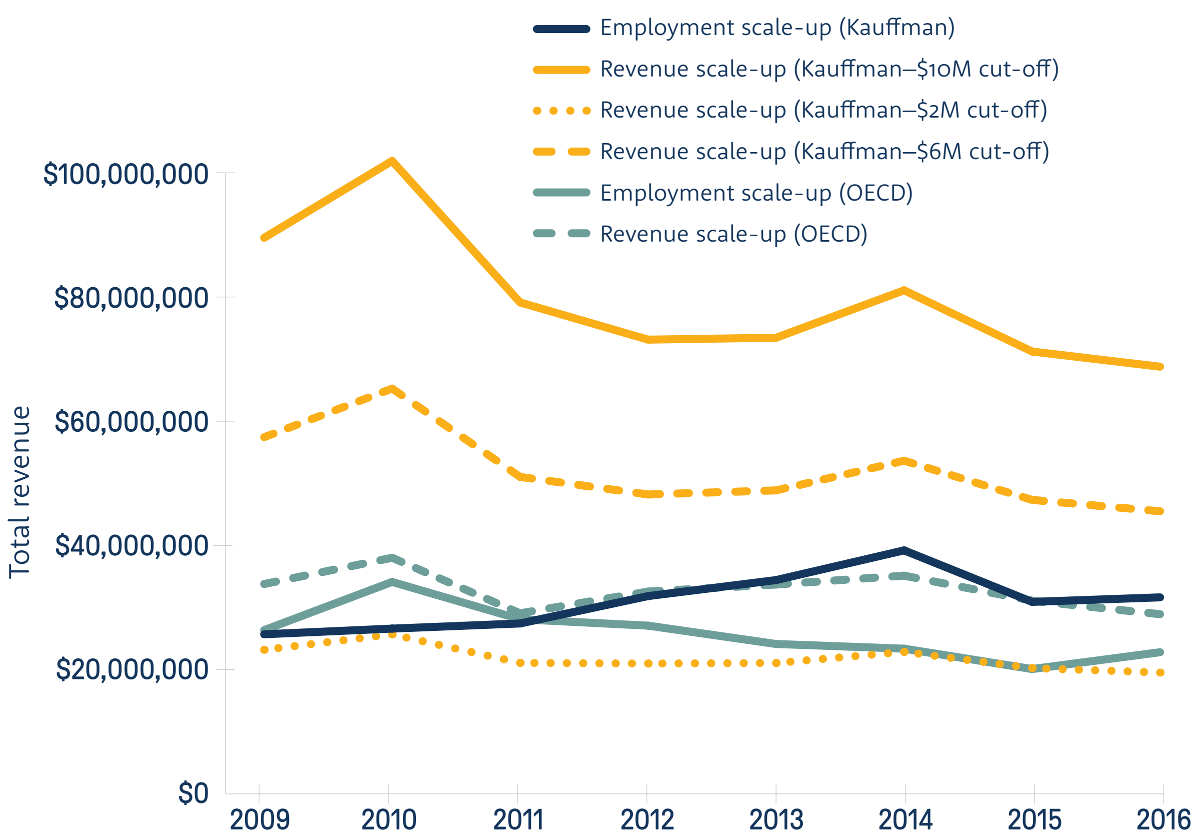
Employment levels at Kauffman revenue scale-ups declined between 2011 and 2012, consistent with the reduction in the number of employees observed in the same period. OECD scale-ups defined under both the revenue and employment criteria show the lowest relative size, likely because the comparator firms must have at least 10 employees at the beginning of the observation period, reducing the small firm-bias in such comparisons.

Scale-ups based on almost all the definitions experienced a significant decline in average revenue between 2010 and 2011 (Figure 8), except for those who qualified as scale-ups under Kauffman Foundation's Employment definition. For scale-ups that recorded the highest level of average revenue (Kauffman Foundation's $10M threshold), this decline amounted to 20 percent, or $20 million. The average revenue levels stabilized after 2011 with little significant change.

In Figure 9, we explore the over-time dynamics of relative revenue-sizes across all scale-up definitions. While we noted important differences between the absolute and relative scales when we explored employment levels (In Figure 6 and 7), relative revenue levels match absolute revenue levels (Figure 8) closely, implying common trends affecting both scale-ups and non-scale-ups.

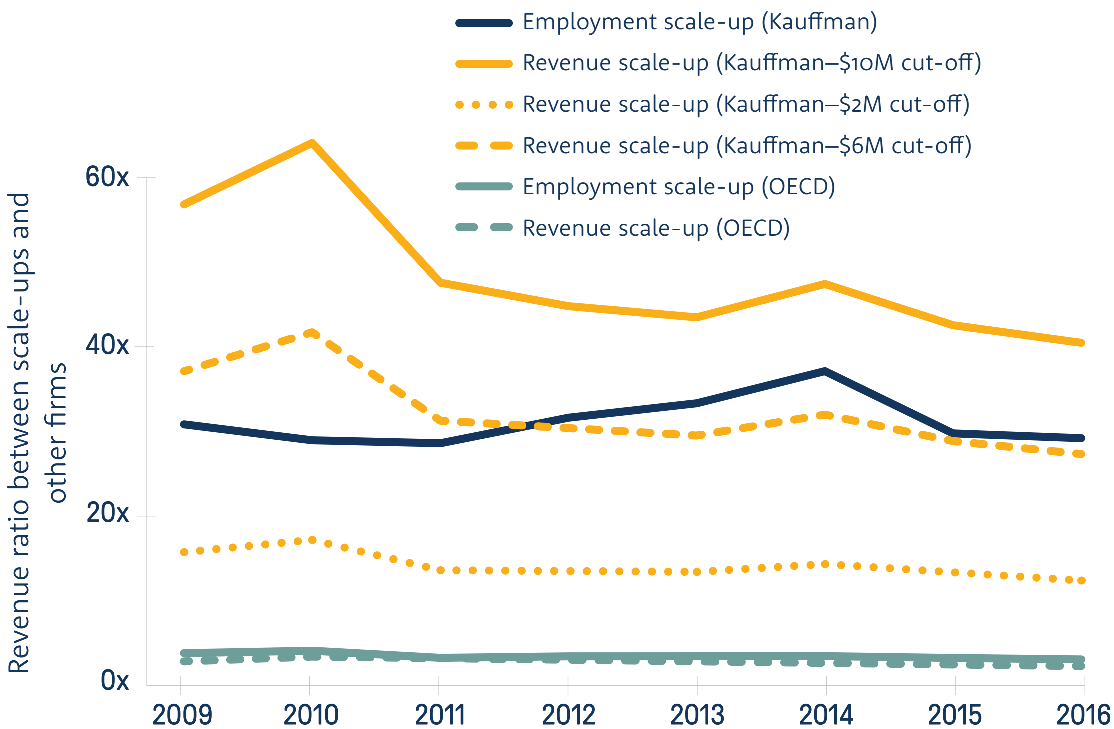
Figure 8

Revenue Levels Over Time at Scale-ups In Canada, Various Definitions



Source: NALMF, Authors' calculations

Figure 9
Relative Revenue Levels Over Time at Scale-ups in Canada, Various Definitions



Source: NALMF, Authors' calculations

The seven figures (Figure 3-9) we have explored thus far all captured important dynamics experienced by companies during the 2007-2008 recession. Notably, we observe three stylized facts, seemingly pointing to differing impacts across definitions:

1. The share of scale-ups based on the Kauffman Revenue definitions and OECD scale-up definitions increased most robustly from 2011 to 2012.

2. Average employment at scale-ups based on the Kauffman Revenue definition declined significantly from 2011 to 2012

3. Average revenue in Kauffman revenue scale-ups declined significantly from 2010 to 2011.

In understanding these dynamics, it is worth noting what is captured by the growth period for scale-up activity in 2011 and 2012. Scale-ups in 2011 reflect growth between 2008 and 2011, while scale-ups in 2012 capture growth dynamics between 2009 and 2012. This coincides with the 2008-2009 Great Recession period. The year 2009 is noted as the worst year of the recession (Cross, 2012). As a result, one can interpret the growth period of 2008-2011 to be one that considers pre-recession firm levels and resolves whether firms have grown above that level by 2011. Previous studies indicate that large firms have access to resources that ensure short-term disruption in employment level is less severe, and that during economic recessions, most employment reduction occurs in (relatively) smaller firms (Vu and Denney, 2020), and so it is likely that as smaller firms recovered, average employment at scale-ups decreased while the share of firms qualifying as scale-ups increased. Finally, the drop in average revenue at scale-ups between 2010 and 2011 can likely be attributed to the impact of the recession, even in large firms, with the recovery in revenue levels of these firms nullified by the inclusion of smaller firms in the scale-up definition post-recovery.

Activity across geographies

Using provincial and Economic Region (ER) data, we examine the geographic distribution of scale-ups, by revenue- and employment-based definitions (Figure 10-12). Due to the small sample sizes, we cannot isolate scale-up activity in the three northern territories. We present the statistics for the region below. However, the maps below show heterogeneity in patterns of scale-up incidences in various provinces and regions across Canada. For example, in 2016, Ontario does not appear to have a disproportionate share of scale-ups, while British Columbia had the highest share of scale-ups across two definitions compared to others in Canada. We discuss such geographical heterogeneity in this section.

Figure 10
Share of Kauffman Revenue Scale-ups in Canadian Provinces, 2016

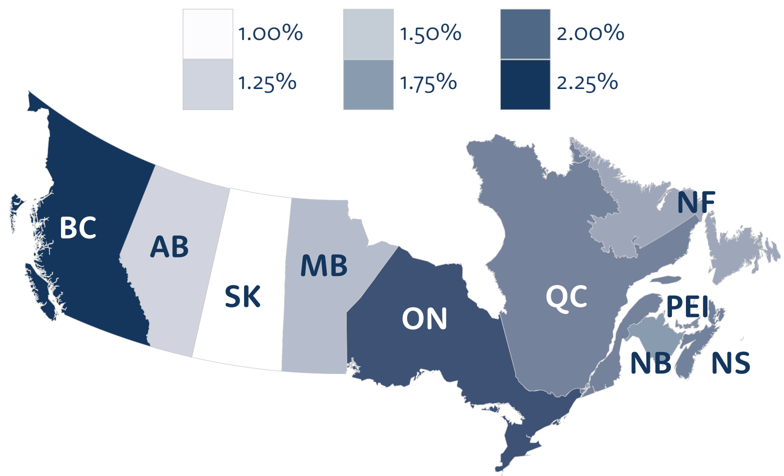


Figure 11
Share of OECD Employment Scale-ups in Canadian Provinces, 2016

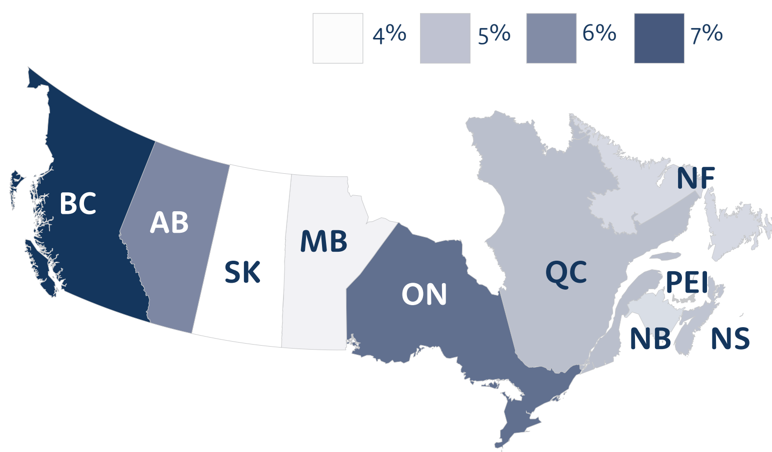
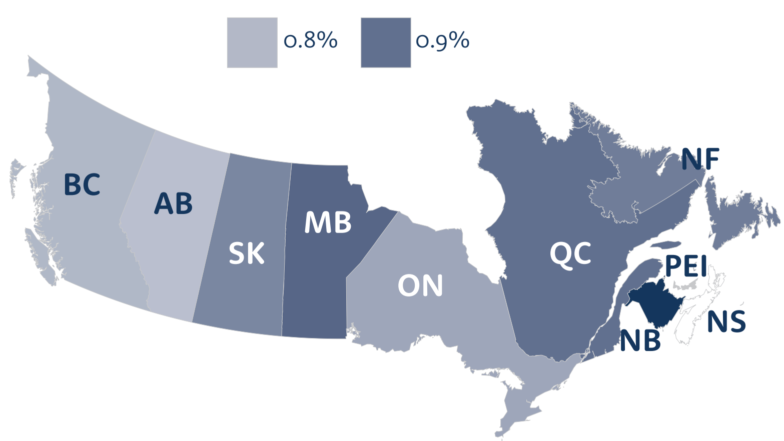


Figure 12
Share of Kauffman Employment Scale-ups in Canadian Provinces, 2016



Source for maps: NALMF; Authors' Calculations; Data for territories missing due to data suppression.

Regions in Canada, though sharing many of the same economic conditions, differ significantly in scale-up activity over time (Figure 18-20). In the following section, we provide a brief overview of observed trends for each of these regions.

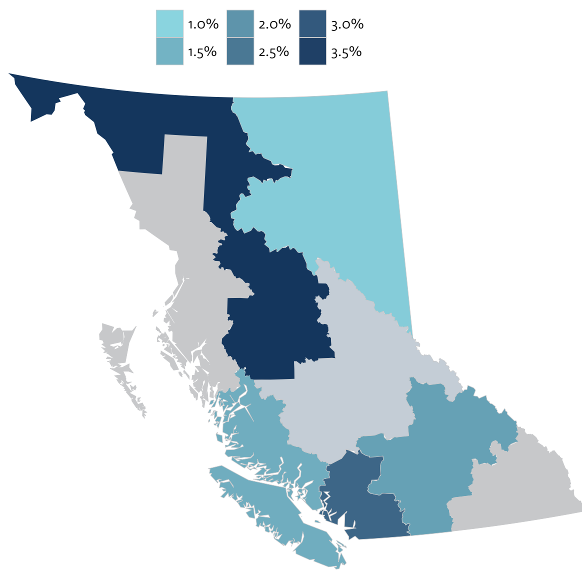
British Columbia

British Columbia is the only province that has consistently increased its share of scale-ups under all three definitions over time. Much of the scale-up activity in British Columbia is concentrated in the lower mainland, though specifically for Kauffman employment scale-ups, both the Vancouver Island ER and the ER encompassing the Okanagan Valley outperformed the lower mainland.

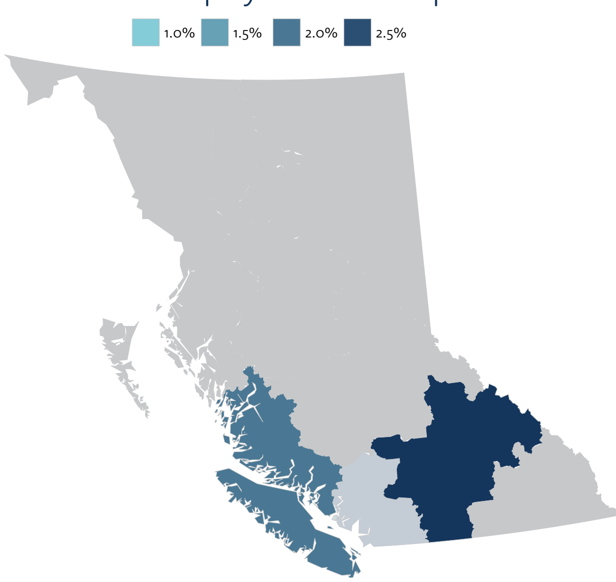
Figure 13

Share of Scale-ups in British Columbia Economic Regions, 2016

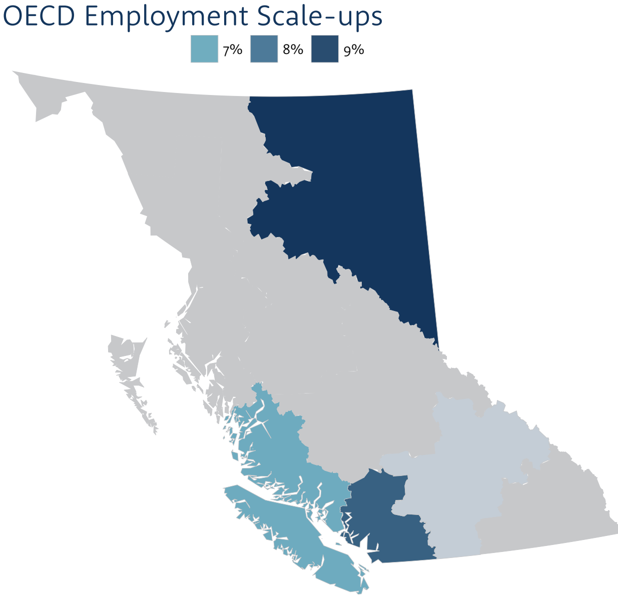
Kauffman Revenue Scale-ups



Kauffman Employment Scale-ups



OECD Employment Scale-ups



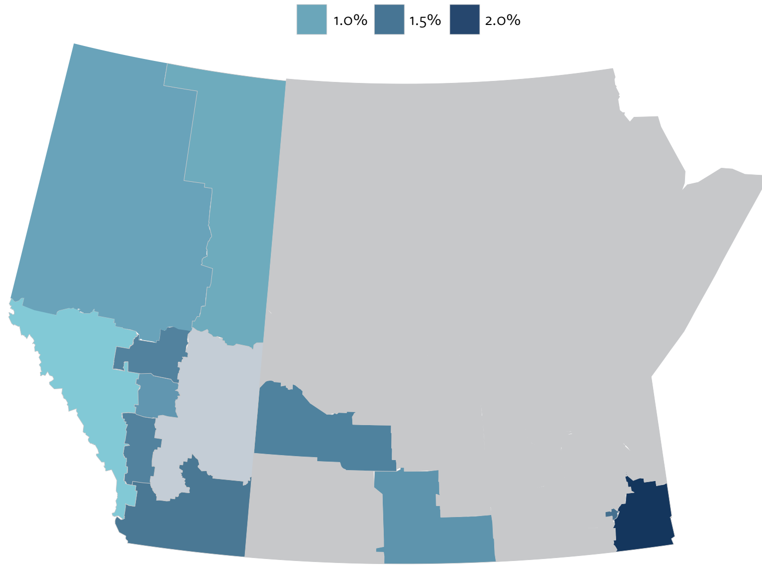
The Prairies

Provinces in the Canadian Prairies (Alberta, Saskatchewan, and Manitoba) also have a mixed record, where the share of employment scale-ups (under both definitions) peaked around 2013-2014, decreasing thereafter until 2016. This is likely due to the oil-sands crisis experienced most acutely in Alberta. Even then, a robust concentration of Kauffman revenue scale-ups and OECD employment scale-ups was found in Wood Buffalo (home to Fort McMurray), an important economic centre of oil sand activity in Alberta. However, no significant activity could be found in that region for Kauffman employment scale-ups, signalling that firms driving the dynamics in that region are likely older than 10 years. No other significant scale-up activity was identified apart from areas around large population centres in the three provinces that comprise this region.

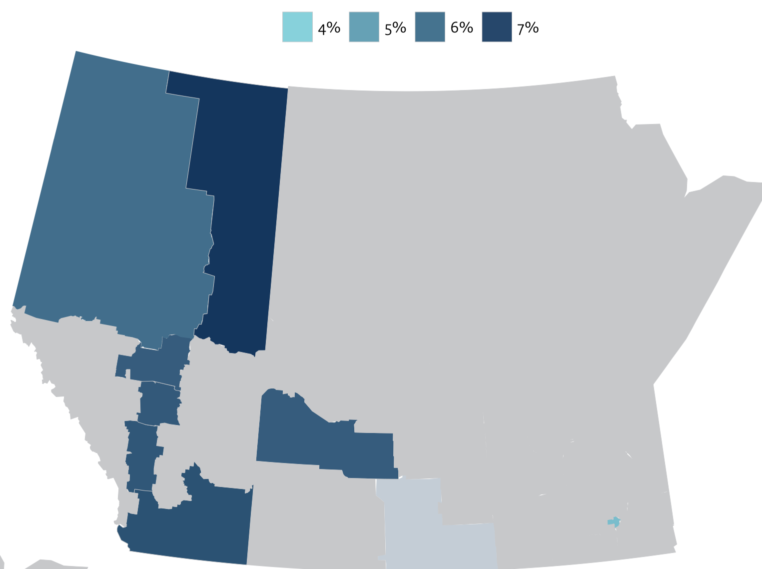
Figure 14

Share of Scale-ups in Prairie Economic Regions, 2016

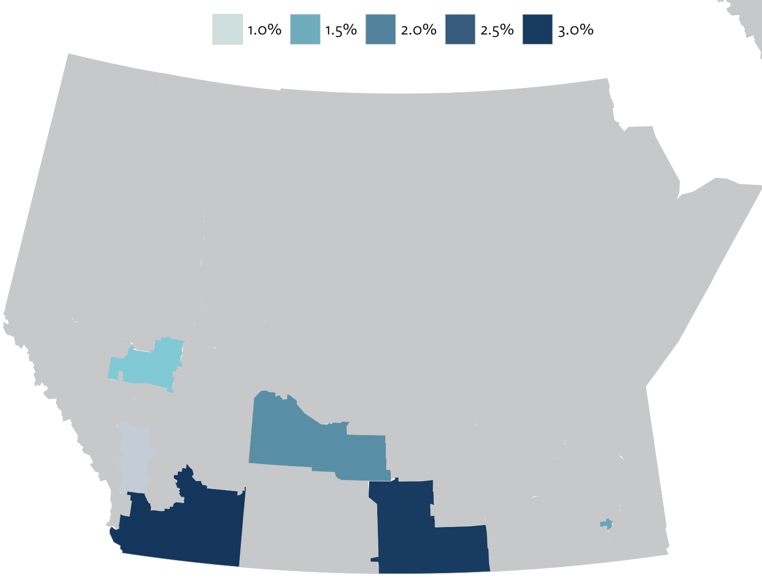
Kauffman Revenue Scale-ups



OECD Employment Scale-ups



Kauffman Employment Scale-ups



Ontario

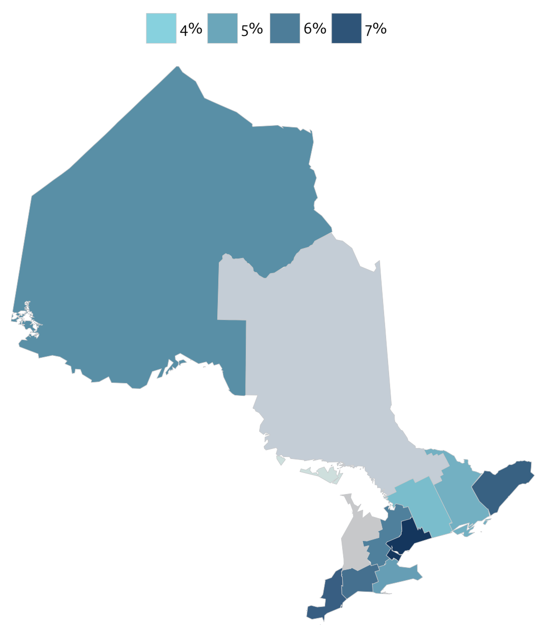
The record over the same period for Ontario, Canada's largest province, is mixed. While the share of Kauffman revenue scale-ups modestly increased, the share of OECD employment scale-ups stayed relatively the same, and the share of Kauffman employment scale-ups decreased. Much of the scale-up activity is concentrated in the southern part of the province, centered around Toronto. However, for Kauffman revenue scale-ups, the whole of southwestern Ontario (the province's industrial heartland) excelled. This finding cannot be simply explained with the shift to a more cognitive-cultural economy in the major urban agglomerations of this part of the province (Bramwell and Wolfe, 2016), as it covers a wide geographical area, including manufacturing-dominant areas such as Windsor. The northwest performs relatively well when it comes to both employment measures, a result consistent with that observed in Vu and Huynh (2018). The reason for this is difficult to identify, since despite having a relatively high share, there are too few scale-ups in the data to disaggregate it further.

Figure 15

Share of Scale-ups in Ontario Economic Regions, 2016

Kauffman Revenue Scale-ups

OECD Employment Scale-ups



Kauffman Employment Scale-ups

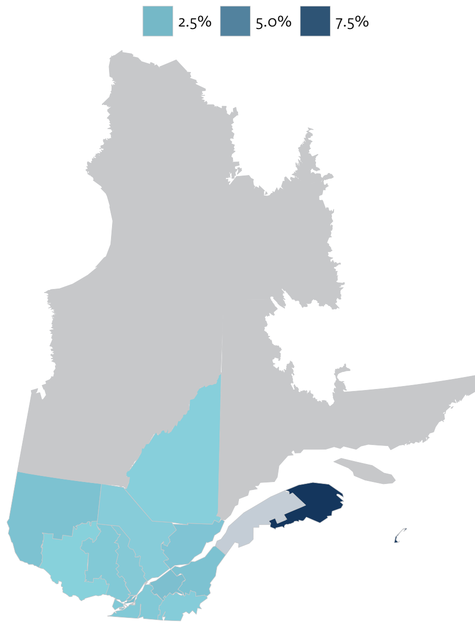
Québec

Québec, on the other hand, experienced consistent decline over time across all three scale-up definitions. Its scale-up activity in 2016 also experienced high levels of geographic inequality, with no significant scale-up activity in northern parts of the province, and most of the scale-up activity concentrated in the area around the St. Lawrence River, which contains the province's main population centres (namely, Montréal).

Figure 16

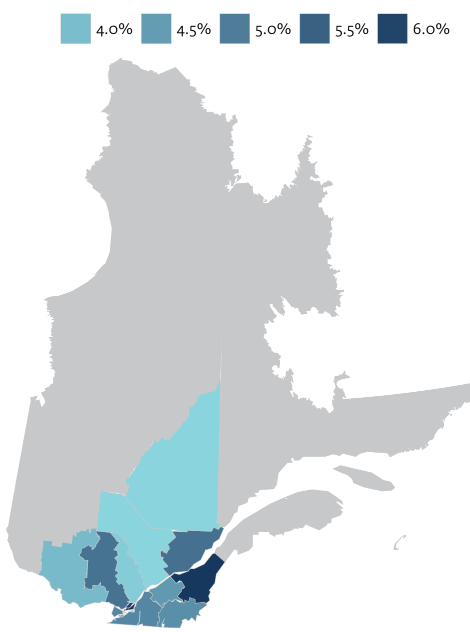
Share of Scale-ups in Québec Economic Regions, 2016

Kauffman Revenue Scale-ups



Kauffman Employment Scale-ups

OECD Employment Scale-ups



Atlantic Canada

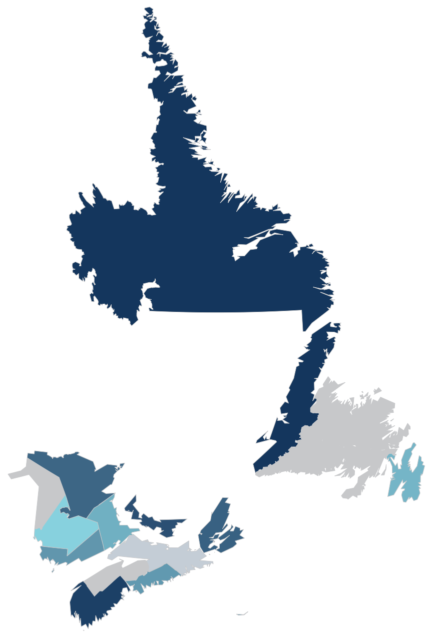
Provinces in Atlantic Canada, meanwhile, remain barely changed across the period of observation. Data for economic regions in these provinces were hard to obtain due to small sample sizes, with activities only being identified in the large population centres of the region.

Figure 17

Share of Scale-ups in Atlantic Economic Regions, 2016

Kauffman Revenue Scale-ups

2% 3% 4%



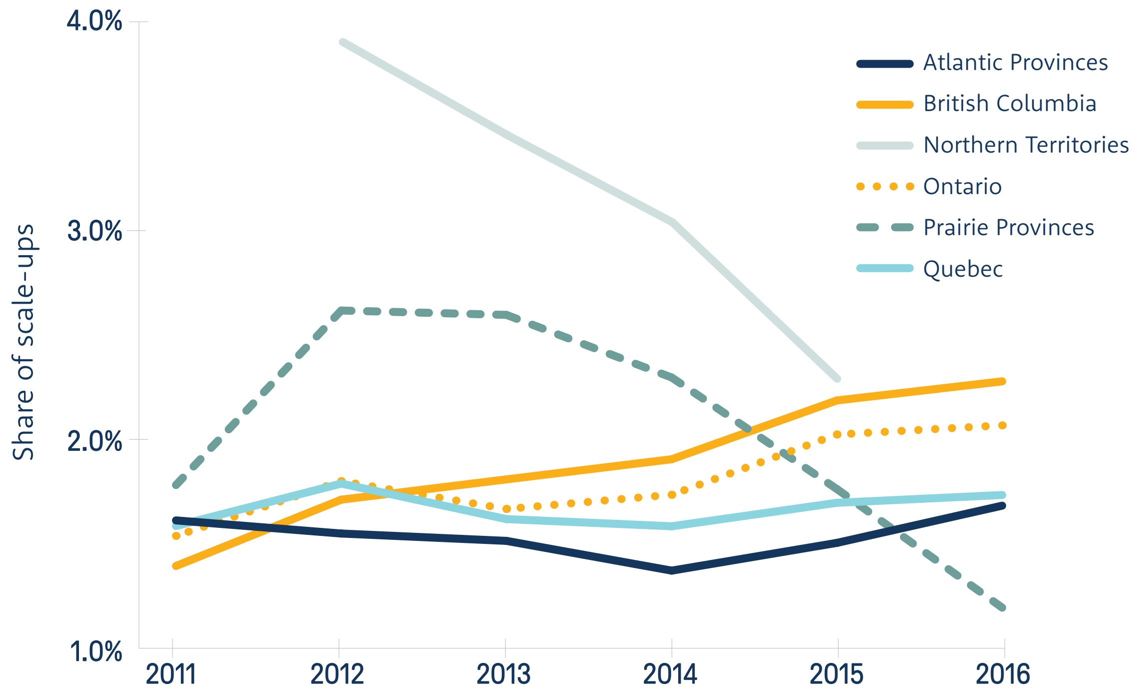
Kauffman Employment Scale-ups

2.4% 2.7% 3.0% 3.3%

OECD Employment Scale-ups

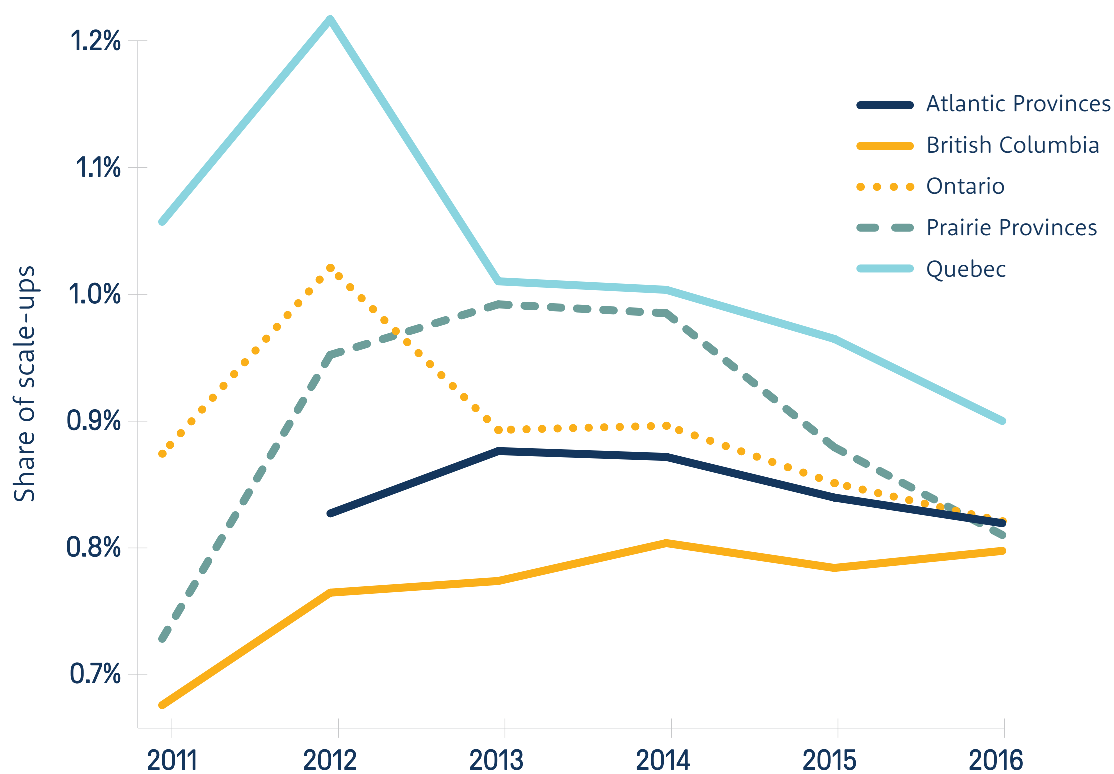
6.0% 6.5% 7.0% 7.5% 8.0%

Figure 18
Share of Kauffman Revenue Scale-ups in Canadian Regions Over Time



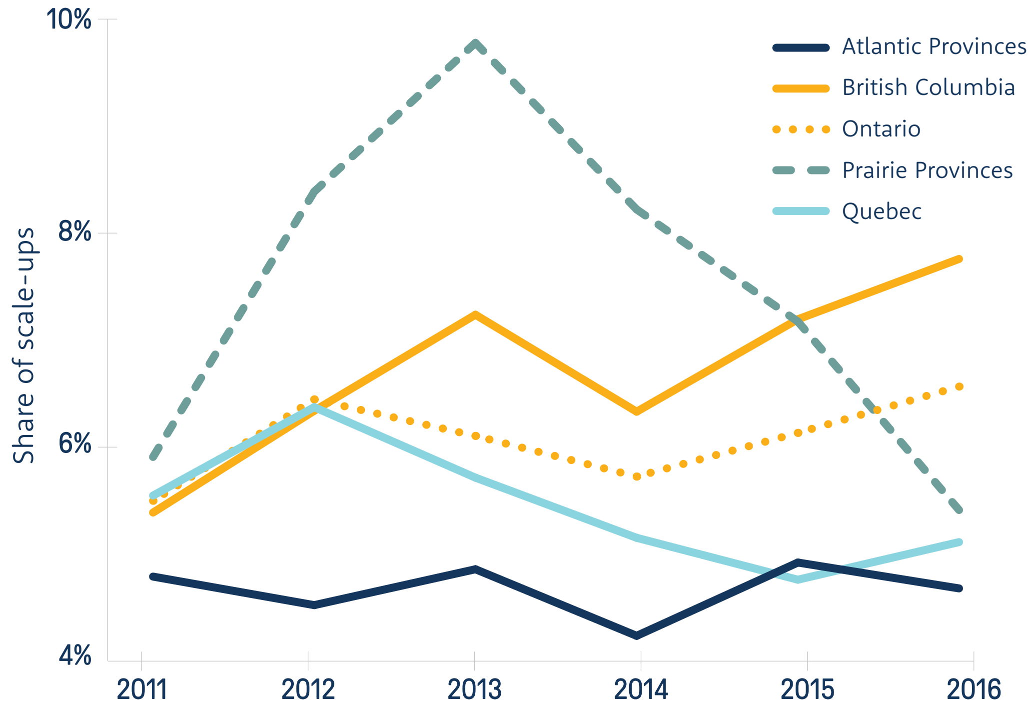
Source: NALMF, Authors' Calculations. Missing data is due to confidentiality suppression.

Figure 19
Share of Kauffman Employment Scale-ups in Canadian Regions Over Time



Source: NALMF, Authors' Calculations. Missing data is due to confidentiality suppression.

Figure 20
Share of OECD Employment Scale-ups in Canadian Regions Over Time

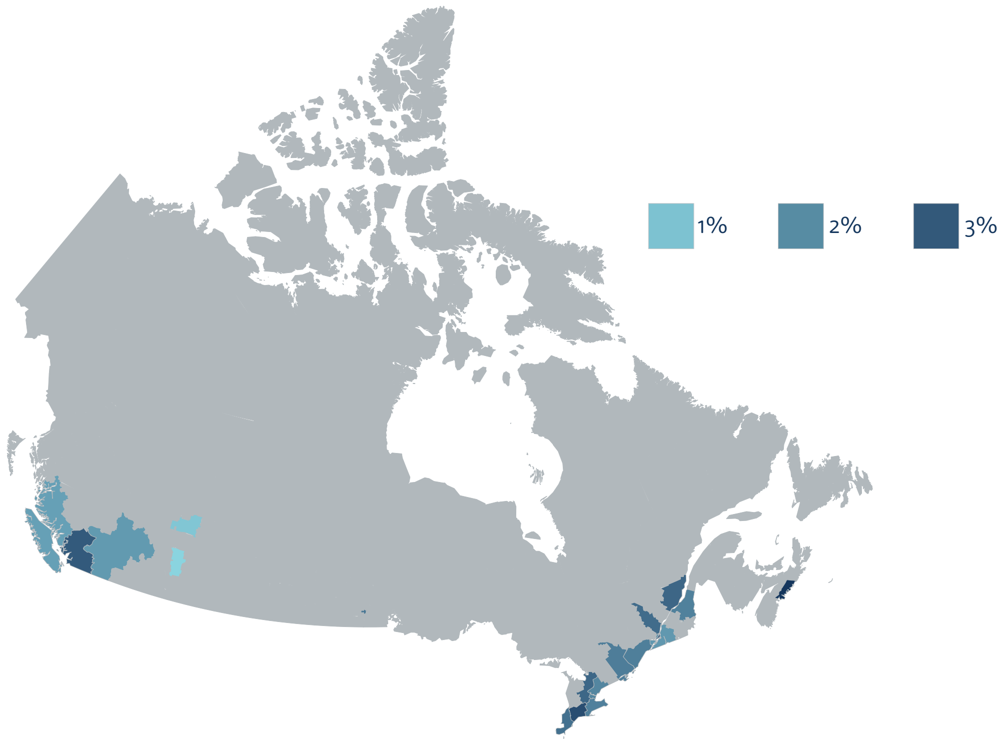


Source: NALMF, Authors' Calculations. Missing data is due to confidentiality suppression.

The trends identified thus far are shared among different industries, though with important variations. Within the technology sector, an industry of interest identified in our analytical framework, we note a difference between revenue and employment measures of scale-ups. Figure 21-23 show where tech scale-ups are concentrated. Overall, we observe a significantly greater proportion of tech revenue scale-ups relative to employment types (broadly consistent with overall trends). Revenue tech scale-ups can be found across Canada, both within and outside of the major urban centres. By the employment growth metric, however, scale-ups are only found in urban centres. For Kauffman employment scale-ups, a definition which identifies the fewest number of geographies with tech scale-up activity, this includes Vancouver, Calgary, Kitchener-Waterloo, Toronto, Ottawa, Montréal, and Québec City. For the OECD definition, of which a greater number of geographies with activity are observed, it also includes smaller urban areas, such as London and Hamilton in Ontario and Edmonton in Alberta. The notable revenue-employment difference for tech scale-ups is a major finding of this report, the implications of which are manifold. As will be shown in more detail below, this extends beyond just the activity across the provinces and the number of firms identified.

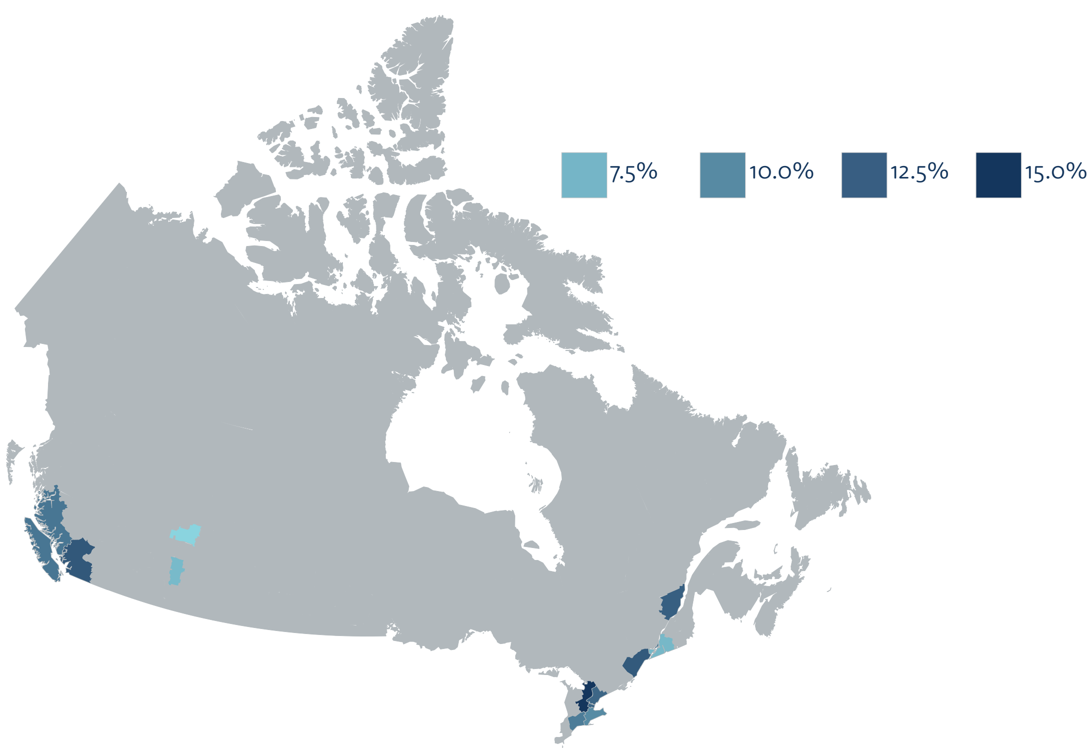
The differences in scale-up activity across provinces is most likely attributable to differences in local economic conditions and possibly regional development programs. Given the national focus of this report, we are unable to explore this further, but these findings are worthy of further research. Such considerations are important when examining how provinces are impacted by global, regional, or national economic shocks, where such events interact with the existing local economic conditions, creating heterogeneous effects even for the same industry across different provinces and types of scale-ups, as measured by different growth metrics and definitions.

Figure 21
Share of Kauffman Revenue Tech Scale-ups by Economic Regions, 2016



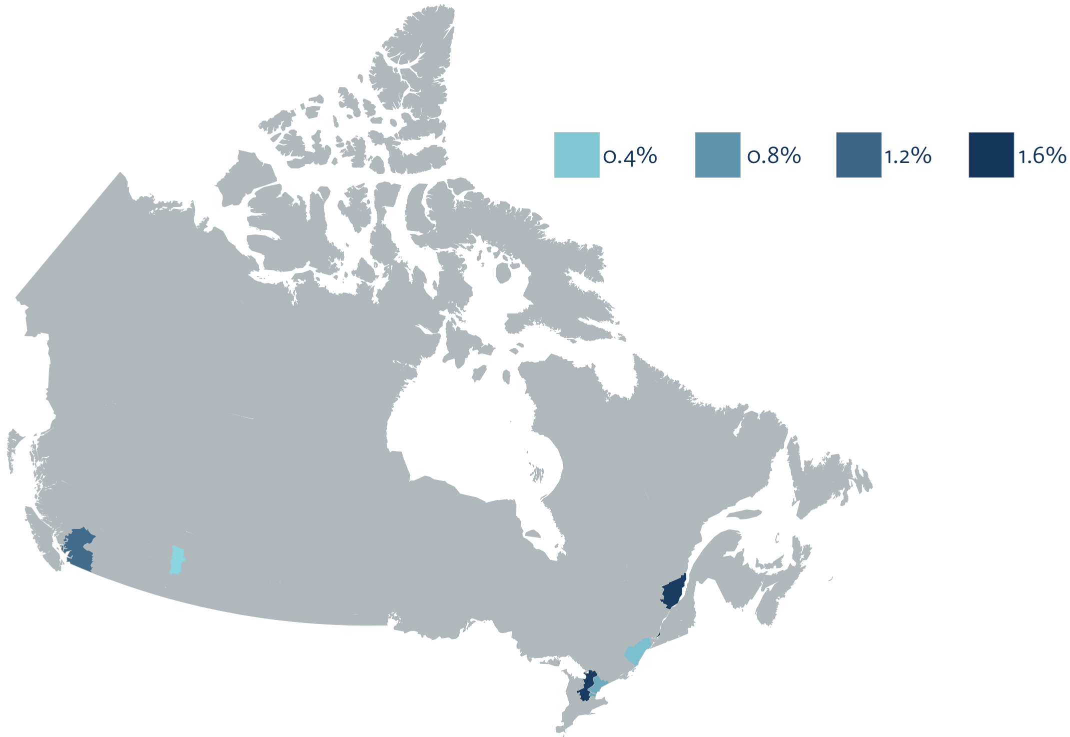
Source: NALMF, Authors' Calculations. Missing data is due to confidentiality suppression.

Figure 22
Share of OECD Employment Tech Scale-ups by Economic Regions, 2016



Source: NALMF, Authors' Calculations. Missing data is due to confidentiality suppression.

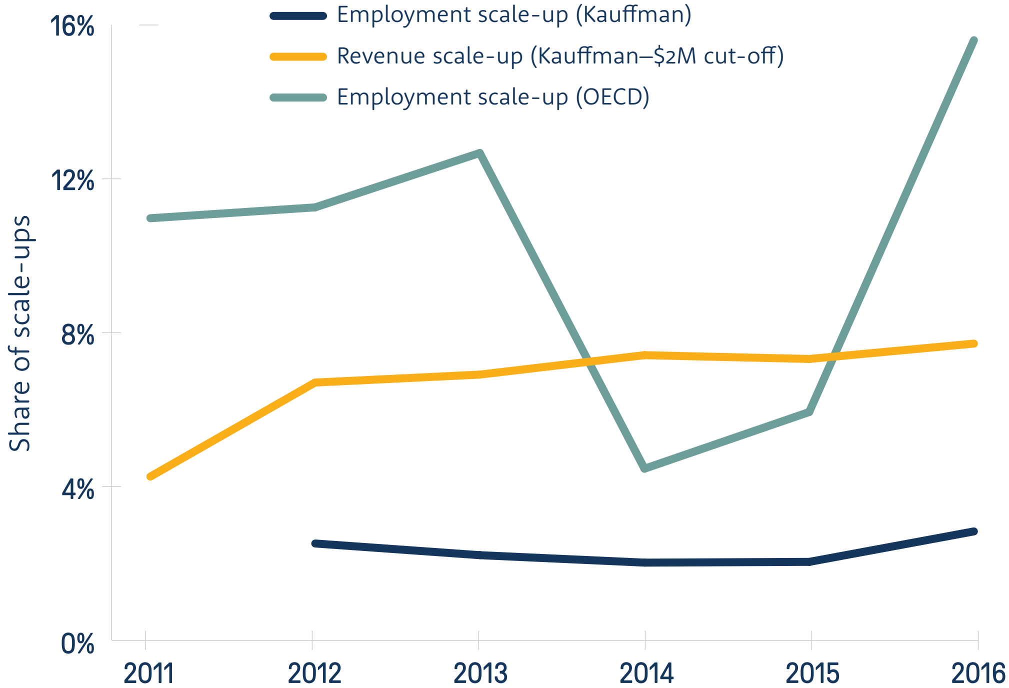
Figure 23
Share of Kauffman Employment Tech Scale-ups by Economic Regions, 2016



Source: NALMF, Authors' Calculations. Missing data is due to confidentiality suppression.

To conclude the subsection on the heterogeneous distribution of scale-up activity across Canada, we explore the share of foreign-owned firms operating in Canada that are scale-ups. We report these numbers cautiously, as any foreign-owned firm operating in Canada can likely only do so because they have already reached a certain stage of growth and have relatively more sophisticated and capable managerial structures, thereby making them much more likely to qualify as a scale-up under our various definitions. As a result, comparing foreign-owned firms at the same time as discussing firm dynamics in provinces would confuse such an analysis. Here, we note major differences between scale-up activities by foreign-owned firms only under various definitions. While the share of Kauffman employment scale-ups modestly declined between 2012 and 2015, it recovered in 2016. The share of Kauffman revenue scale-ups consistently increased over the six-year period, while the share of foreign-owned OECD employment scale-ups experienced the greatest variability, especially between 2013 to 2016. We are unsure if this is a result of data-related issues concerning how foreign-owned firms are classified in Canada, or indicative of other trends.

Figure 24
Share of Foreign-owned Scale-ups, Various Definitions



Source: NALMF, Authors' Calculations.

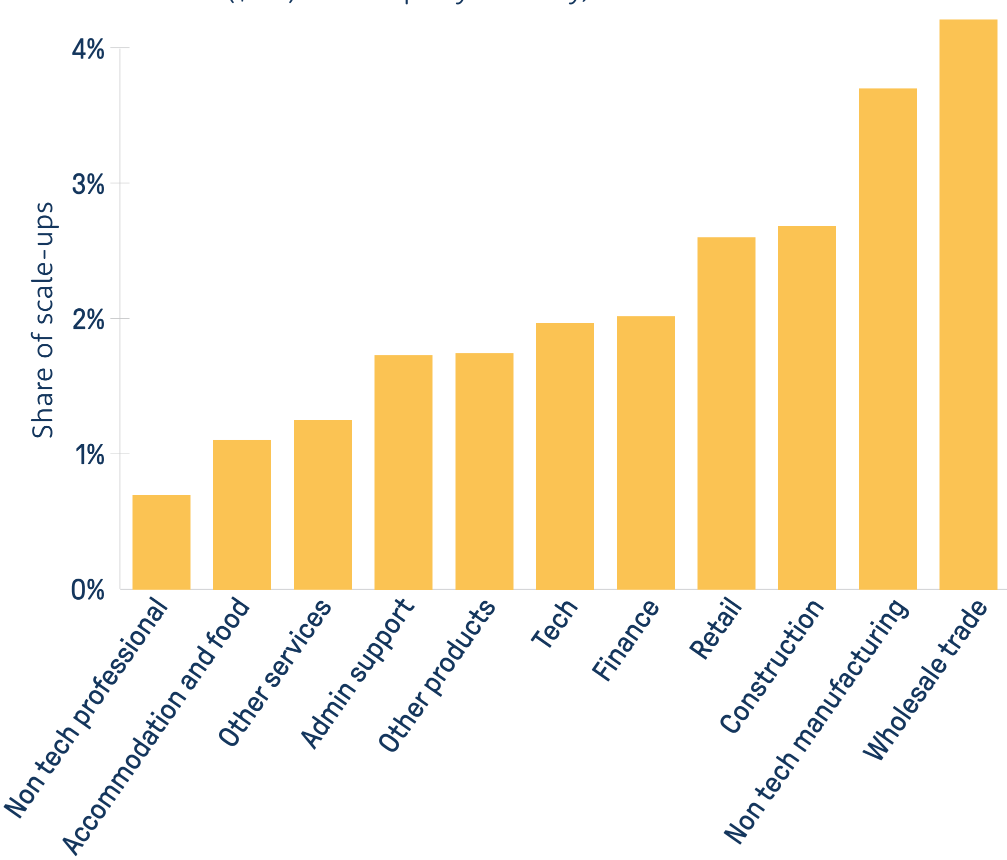
Shares by industry

The industry distribution of scale-ups measured through the various definitions further highlights a central finding about discussions on scale-ups: growth is not a uniform concept. Firms that grow along one dimension may not necessarily excel at growth along another dimension. The tech industry is a particularly salient example of this phenomenon. As defined above, the tech industry is an aggregation of four-digit NAICS where the share of tech workers employed in such industries is at least three times the average for all industries (or 17.5 percent). This definition allows us to identify industries for which tech workers comprise a significant part of the workforce, originally developed for the Canadian context in Lamb and Seddon (2016). We define tech workers as National Occupational Classification (NOC) occupations in a highly technological context or that require high levels of tech skills, as established in Vu, Zafar, and Lamb (2018).

When we consider the intensity of scale-ups in the Kauffman Employment definition, or rapid early growth experienced by new firms, the tech industry only performs moderately well compared to other industry groups, namely non-advanced manufacturing firms and companies in accommodation and food services. Tech firms are not more likely than companies in other sectors to experience rapid early growth in employment. However, this narrative is complicated when the tech industry is considered under the OECD Employment definition (that doesn't focus

Figure 25

Share of Kauffman Revenue ($2M) Scale-ups by Industry, 2016



exclusively on young firms as the Kauffman Employment definition does), where its share is highest among industries. This finding implies a very important point that, while achieving early growth as a tech firm in Canada is hard, once established, these firms are more likely to experience sustained growth. Also interesting is the finding that, under the OECD Employment definition, the accommodation and food services industry ranked last, while it ranked first for early growth scale-ups (i.e., under the Kauffman definition). These findings indicate the difficulty of sustaining early growth for firms in some sectors. It also indicates that, at least for tech, using employment growth as the metric for identifying scale-ups is problematic, something we explore in greater detail below.

While tech firms account for a high share of scale-ups by some employment definitions, the industry ranks much lower under the revenue scale-up definition. Herein lies an important distinction between various scale-up definitions: it is not common for firms that account for high shares of scale-ups according to one definition or growth metric to account for an equal or similar amount in another. Growing a company by employment is significantly different, and seemingly unassociated with revenue growth. This evidence supports one of our central arguments: the type of scale-ups captured differs significantly depending on the definition chosen. Correspondingly, scale-ups identified through different definitions are also suited to participate in different business activities, and thus achieve different policy objectives. The tech industry is a particularly salient example of this, given the policy interest in that industry. Later in this section, we focus on and synthesize the characteristics of tech scale-ups to underscore this point.

Figure 26

Share of Kauffman Employment Scale-ups by Industry, 2016

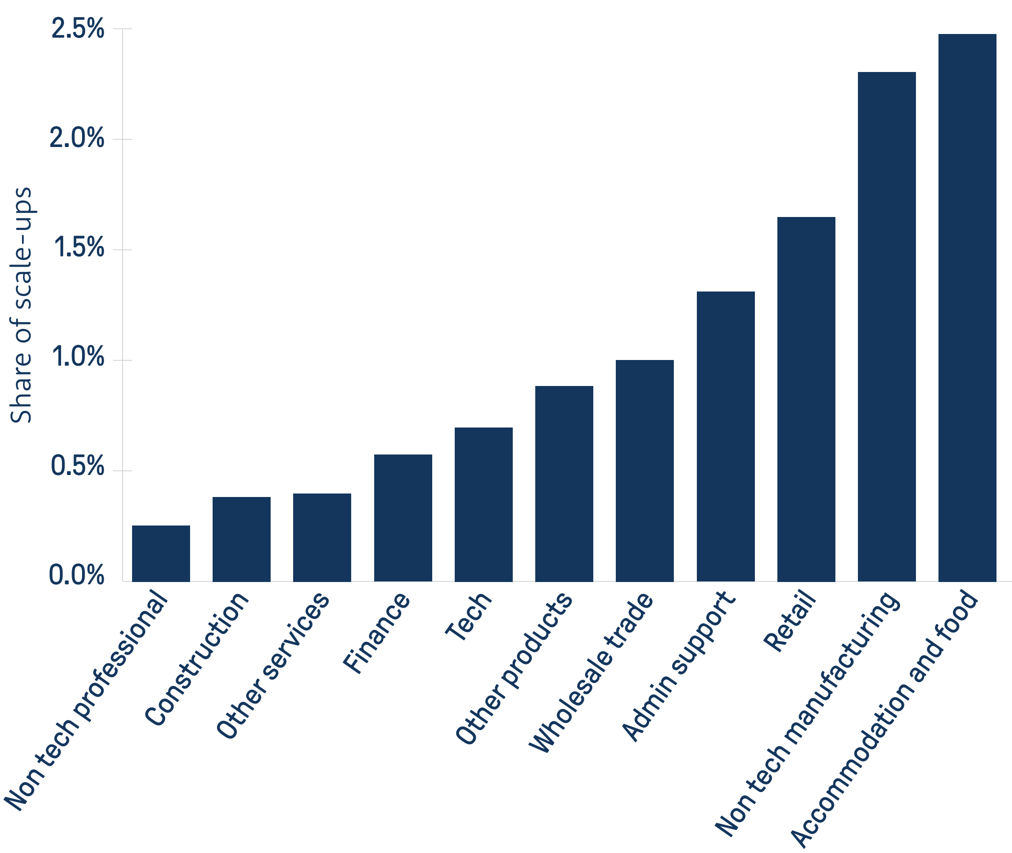


Figure 27
Share of OECD Employment Scale-ups by Industry, 2016

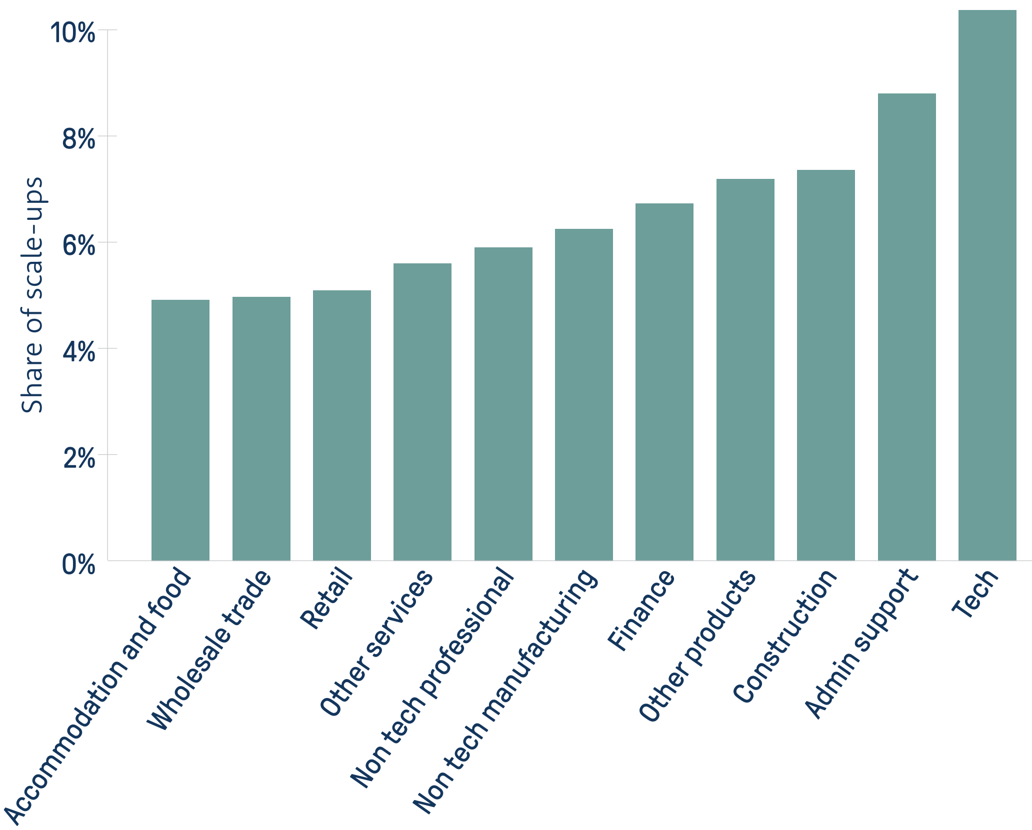
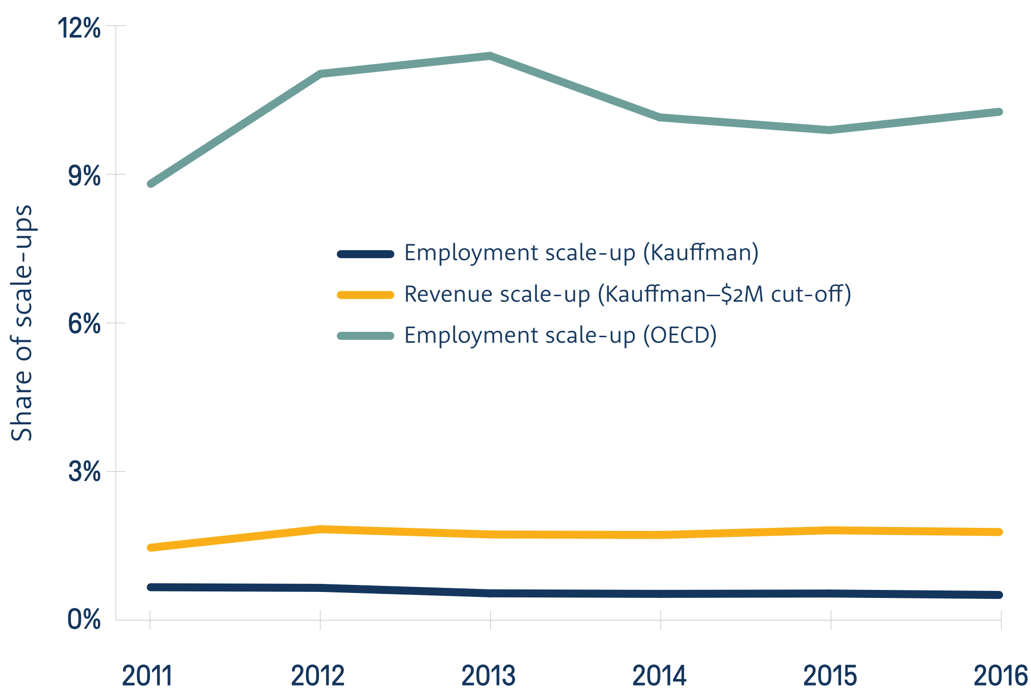


Figure 28
Share of Tech Scale-ups Over Time, Various Definitions



Source: NALMF, Authors' Calculations.

Pay differentials

Having established the share of scale-ups across geographies and industries as well as the general employment and revenue impact of scale-ups across various definitions, it is also worth asking whether scale-ups are able to pay their employees higher wages compared to non-scale-ups. To do this, we now look at wages, comparing average pay, grouped at the industry and economic region level. To measure pay, we divide total payroll with average employment in a given year. To reduce dimensions, we aggregate our custom industries even further at the level of primary and secondary industries, service industries, and the tech industry.[16]

In Figure 29-30, we again see major differences between scale-up types. Those qualifying under both Kauffman Foundation definitions tend to pay more than corresponding non-scale-ups. However, scale-ups qualifying under OECD Employment definitions tend to pay significantly less than their non-scale-up counterparts.[17]

When we focus on specific industries, we note that scale-ups identified in services industries (e.g., accommodation and food services) under all three definitions tend towards similarly low average pay compared to non-scale-ups (i.e., they cluster around the dividing line at the bottom left), likely due to either the part-time nature of employment in this sector or the otherwise low pay regardless of whether the firm is a scale-up or not. Tech firms (scale-up or not) differ in this regard. Average pay at tech firms is generally at the upper-end of the spectrum. Average salaries are no lower than $80,500 and are as high as $89,000. Tech scale-ups identified through both the Kauffman Revenue measure and the Kauffman Employment measure record higher pay compared to their respective non-scale-up counterparts (see Table 3). And while the pay at tech scale-ups identified in the OECD Employment measure is lower than their non-scale-up counterparts, such a gap is not out of proportion compared to other industry sectors. These findings suggest that the quality of employment (as measured by pay) is high for the tech industry generally in Canada.[18]

Figure 29

Average Pay at Scale-ups and Non-scale-ups, Kauffman Revenue Definition, 2016

Figure 30
Average Pay at Scale-ups and Non-scale-ups, Kauffman Employment Definition, 2016

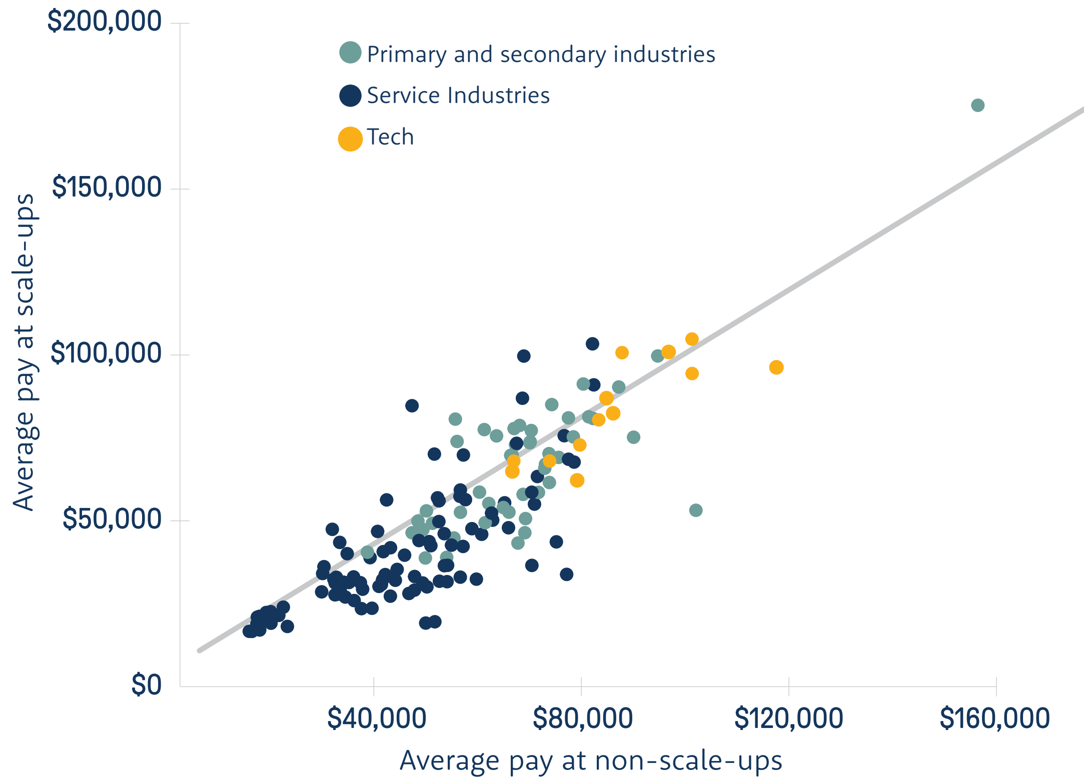


Figure 31
Average Pay at Scale-ups and Non-scale-ups, OECD Employment Definition, 2016

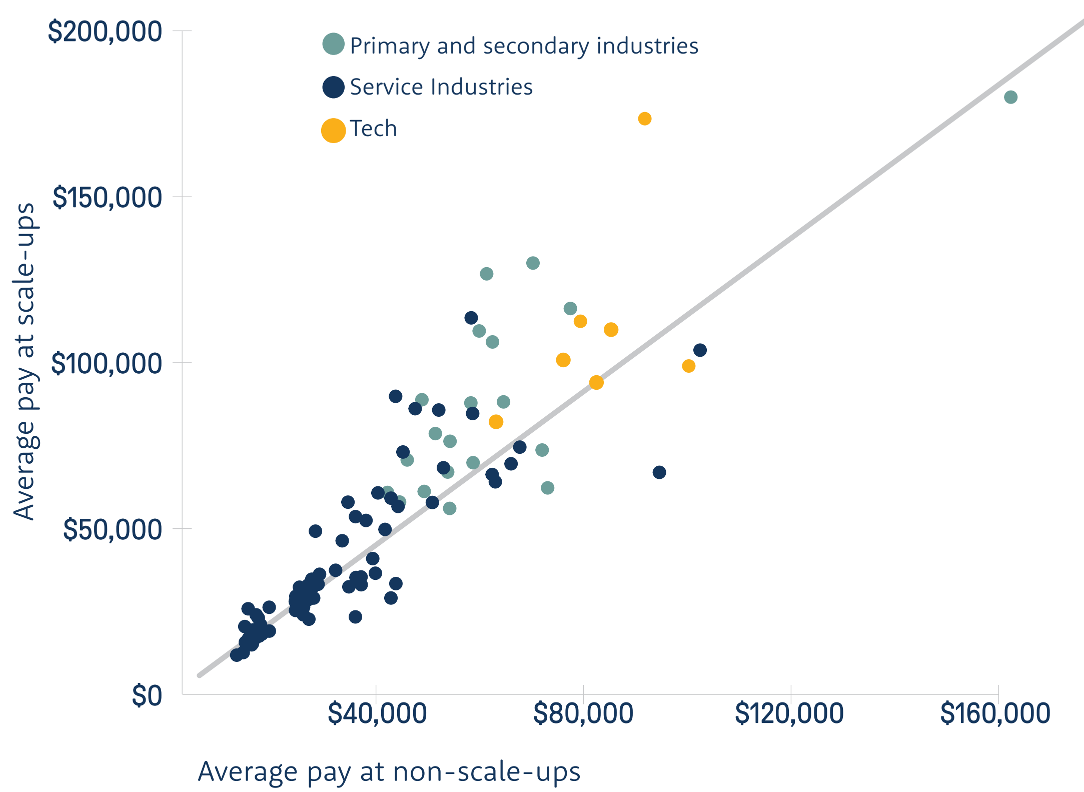


Table 3

Average pay between scale-ups and non-scale-ups, various definitions, 2016

Definition	Pay at non-scale-ups	Pay at scale-ups
Kauffman Revenue	$55,600	$64,000
Kauffman Employment	$46,700	$44,000
OECD Employment	$52,400	$49,600
Tech only		
Kauffman Revenue	$85,000	$85,700
Kauffman Employment	$80,500	$88,400
OECD Employment	$89,000	$83,400

Productivity differences

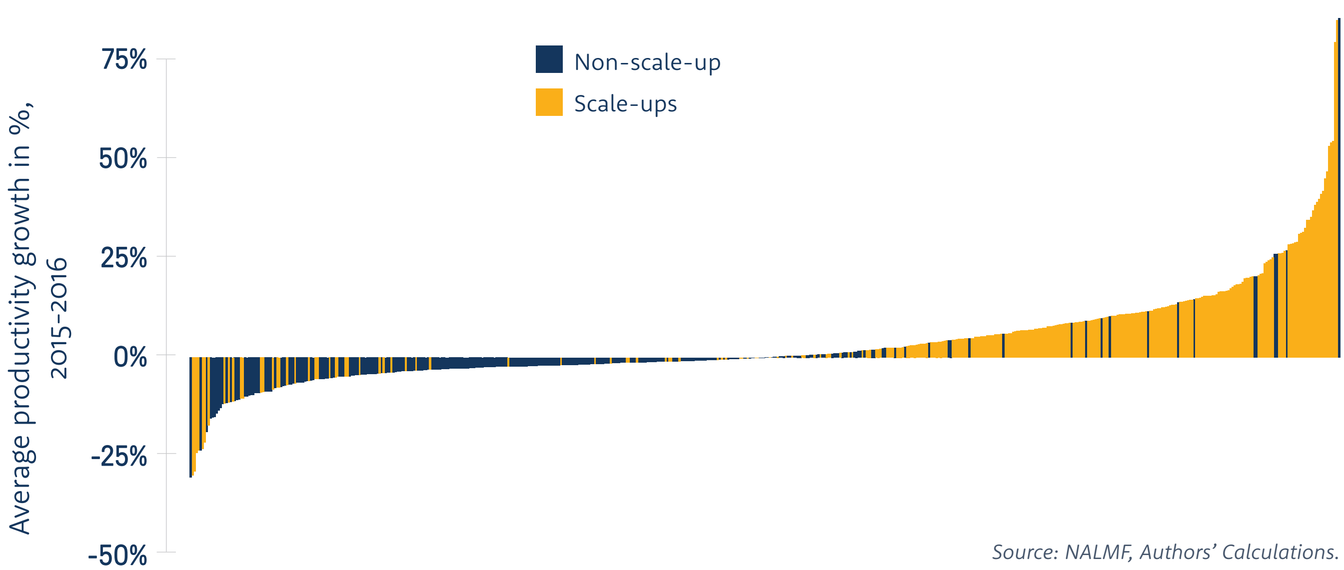
The assessment of employment and pay and output performance for scale-ups provides for rich analysis, but a consideration of productivity growth of these firms is necessary to fully assess their economic impact (and value). To do this, we focus on the differences in Average Productivity Growth (APG) of Total Factor Productivity (TFP), or the increase in value of outputs given some inputs (such as labour and capital), across revenue- and employment-based definitions of scale-ups throughout the period of observation.

APG is measured as the annual percent change in TFP at a firm. Simply stated, it shows how efficiently resources are used to create output. We acknowledge that productivity measures are often hard to interpret. We focus here on how productivity levels change, as opposed to the magnitude of such productivity.

The visualizations below show the APGs for scale-ups and non-scale-ups in industries and economic regions for which data are available in order (Figure 32-34). Each bar represents an industry/economic region decomposition. Relative to non-scale-ups, scale-ups are much more likely to register positive productivity growth, as evidenced by the dominance of scale-up on the right side of the graphs (where we observe large and positive productivity changes). This is the case for all three definitions. For the two employment definitions, scale-ups in some economic regions and industries are more likely (compared to revenue-based scale-ups) to show up with negative productivity growth, although the overall magnitude of change still means that scale-ups are significantly more productive than non-scale-ups.

Figure 32

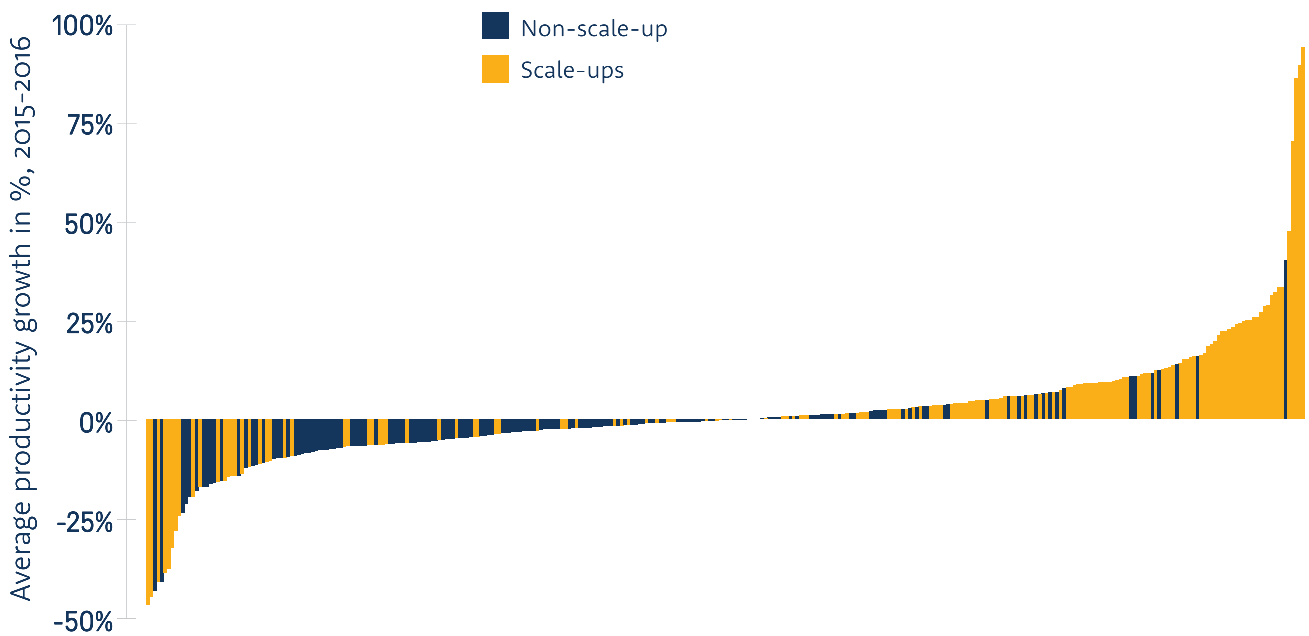
Productivity Growth in Scale-ups, Kauffman Revenue Definition, 2016



Source: NALMF, Authors' Calculations.

Figure 33

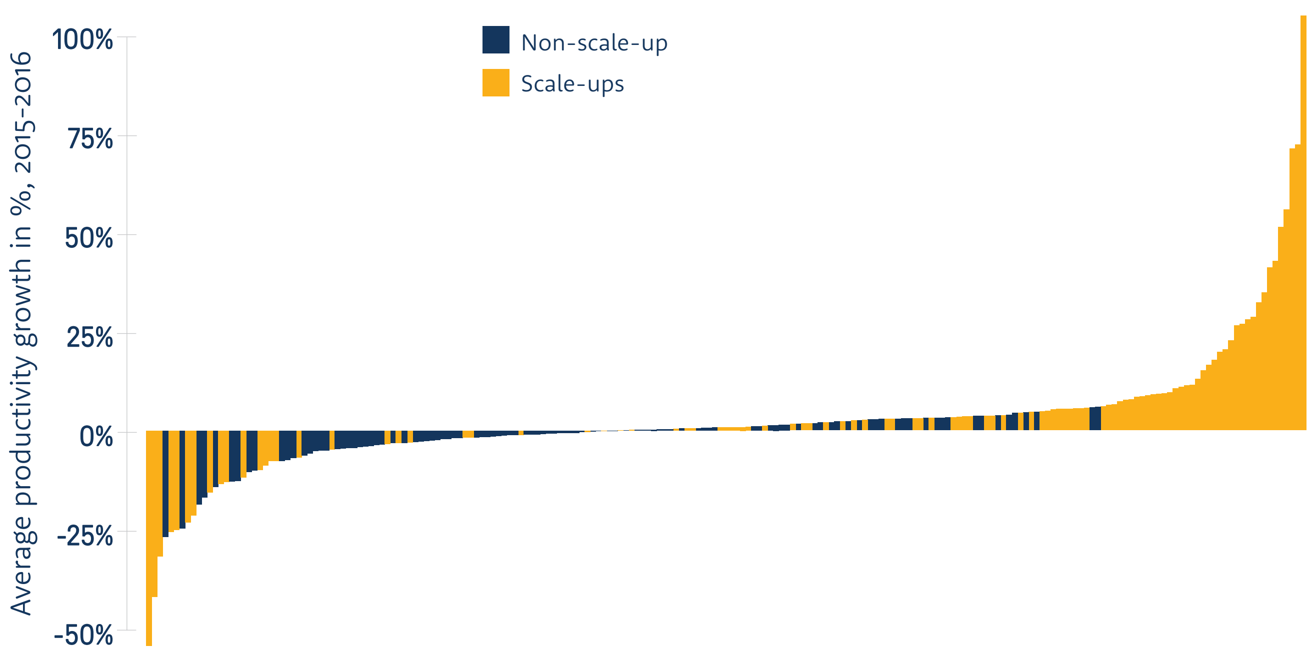
Productivity Growth in Scale-ups, Kauffman Employment Definition, 2016



Source: NALMF, Authors' Calculations.

Figure 34

Productivity Growth in scale-ups, OECD Employment Definition, 2016



Source: NALMF, Authors' Calculations.

The patterns observed for all industries are replicated when we focus on firms in the tech industry (Table 4). However, compared to the average for all scale-ups, the APG for tech scale-ups is substantially higher (by a magnitude of two to four times). With an APG of more than 17 percent, revenue scale-ups experienced the highest productivity growth. Given the growth metric of choice (revenue over employment), this is not exactly surprising. Investments in productivity-enhancing measures can be capital deepening and labour saving, resulting in more effective inputs to the production and sales process absent employment additions. This stands in contrast with non-tech services (e.g., accommodation and food services and related non-tech service industries), for which there is a great need for labour but less of a need for productivity-enhancing technologies. This said, it is still notable that even among employment scale-ups in tech, the APG is still substantially higher than the overall averages. In short, tech scale-ups make relatively good use of labour and capital inputs, providing notable economic value.

A longitudinal view confirms our findings. When we look at average annual productivity growth across all scale-ups and non-scale-ups in Canada using various definitions between 2011 and 2016, we observed consistent and large differences in average productivity growth.

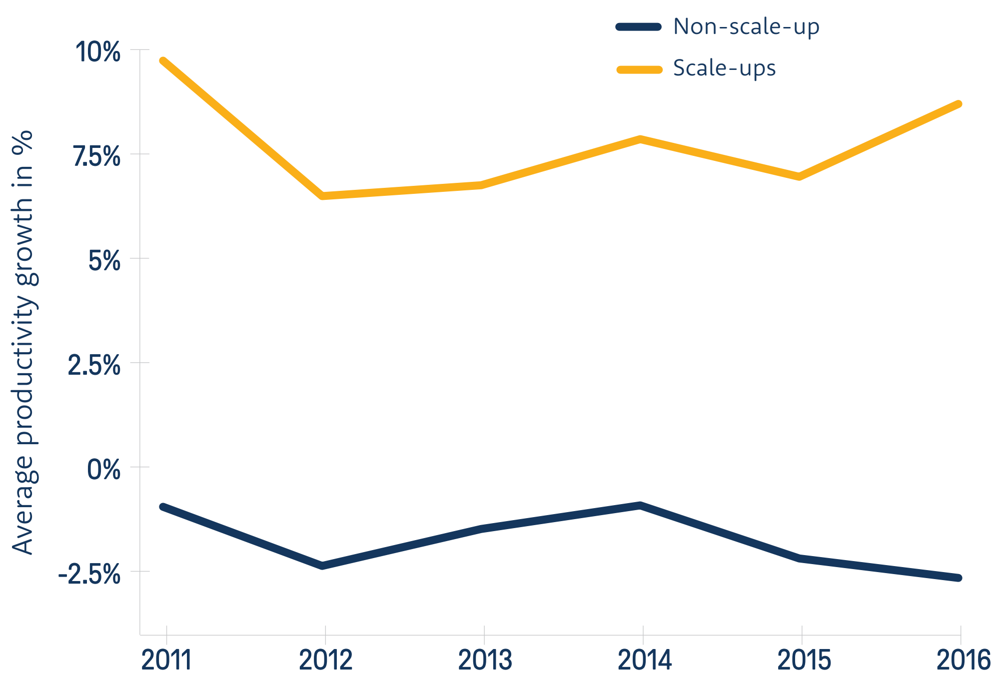
Table 4

Average productivity growth (APG) between scale-ups and non-scale-ups, various definitions, 2016

Definition	APG at non-scale-ups	APG at scale-ups
Kauffman Employment	-1.00%	2.87%
Kauffman Revenue	-2.69%	8.78%
OECD Employment	-1.67%	2.17%
Tech only		
Kauffman Employment	-1.49%	7.84%
Kauffman Revenue	-4.59%	17.30%
OECD Employment	-2.41%	8.54%

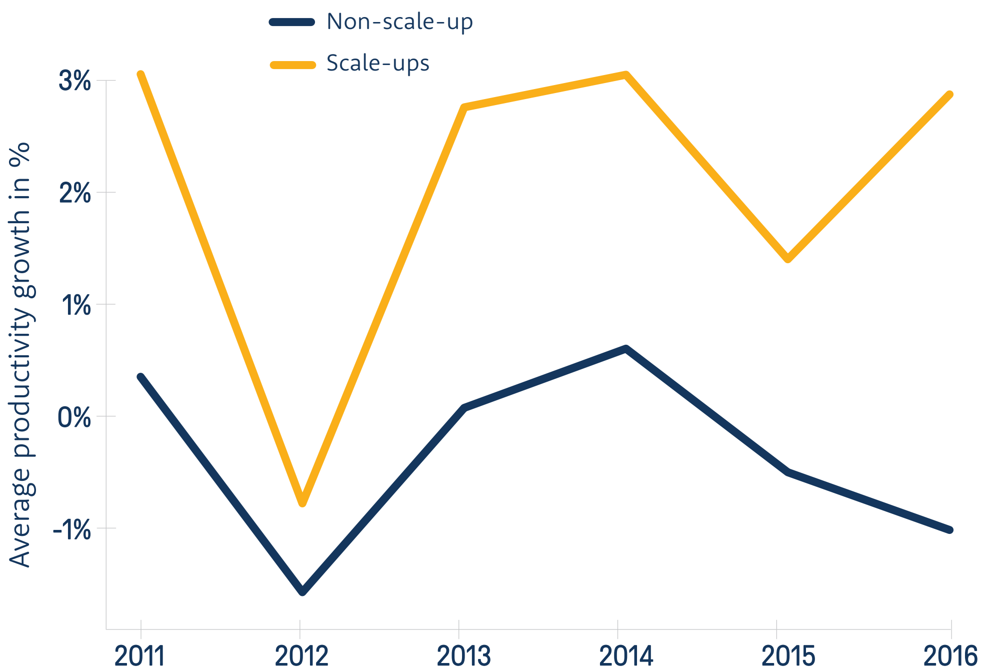
Figure 35

Average Productivity Growth Over Time, Kauffman Revenue Definition



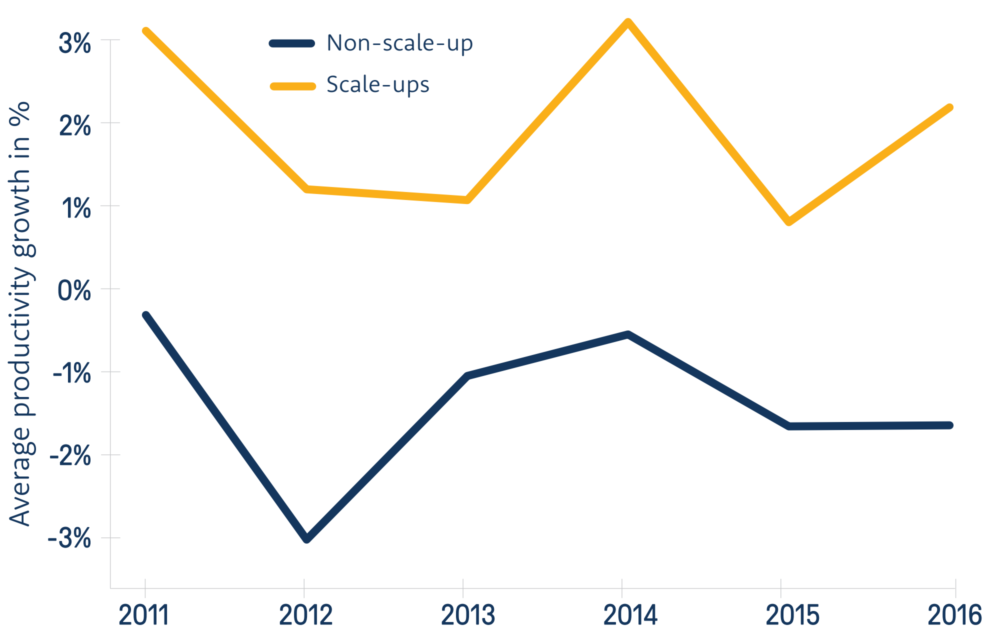
Source: NALMF, Authors' Calculations.

Figure 36
Average Productivity Growth Over Time, Kauffman Employment Definition



Source: NALMF, Authors' Calculations.

Figure 37
Average Productivity Growth Over Time, OECD Employment Definition



Source: NALMF, Authors' Calculations.

Exporter shares

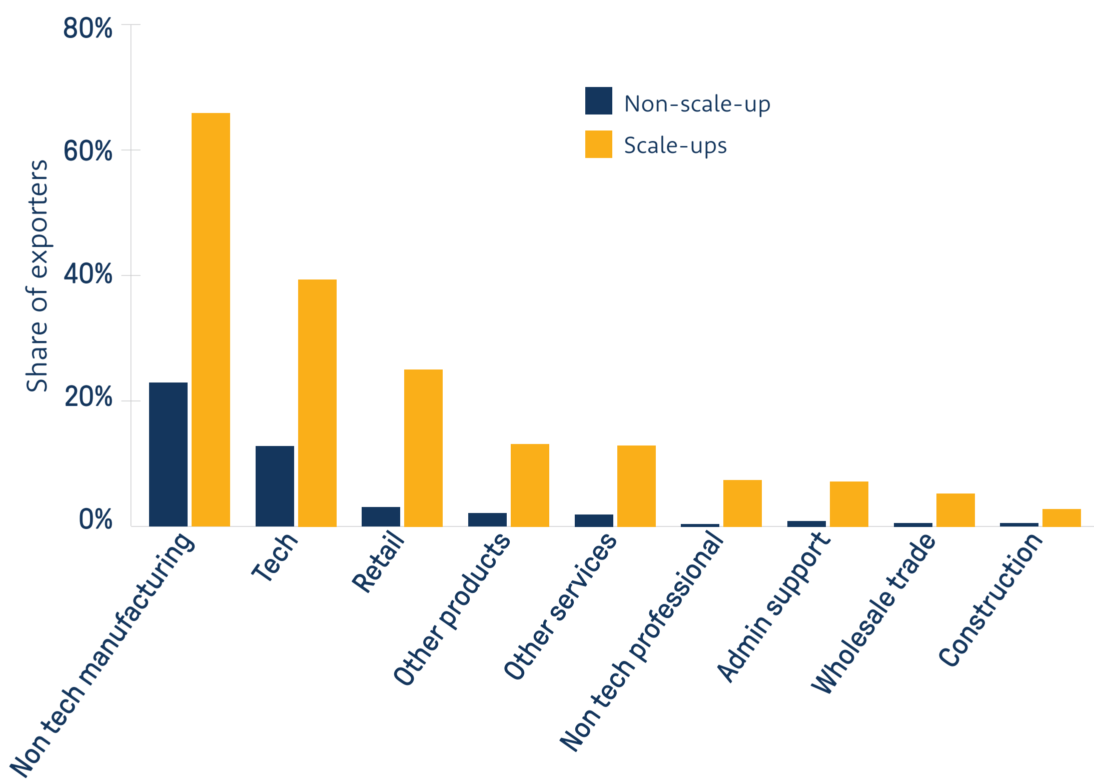
As a signal for growth intentions or potential and organizational sophistication, exporting is an important business activity. Below we report on the share of exporters in 2016 by scale-up status and industry across employment and revenue definitions. For all but the OECD Employment definition, scale-up firms are considerably more likely to be exporters. This finding lends credence to the idea that market size in Canada is too small to support scaling and larger-sized firms, especially considering the relative market sizes of the United States, and access to such markets being critical to firm growth (the U.S. constituted more than 75 percent of Canada's export share in 2019[19]).

Overall, we find the share of firms that export is greater for scale-ups across all industries and for all definitions. Although notable, this is not a surprising finding, as exporting firms are those that are growing. They are also threshold firms (see discussion above) with greater managerial capacity and sophistication. The relative export levels (Figure 41) reinforce just how much more likely scale-ups are to be exporters, especially for those meeting the Kauffman Employment and Revenue definitions.

However, we find some evidence that, while export status is a good indicator of firm type (and by extension, size), it might not be a straightforward indicator of the pace of firm growth. This is demonstrated in the relatively small gap between scale-ups and non-scale-ups observed among OECD employment scale-ups, which restricts the firm sub-population to those which have reached a specific growth threshold.

Figure 38

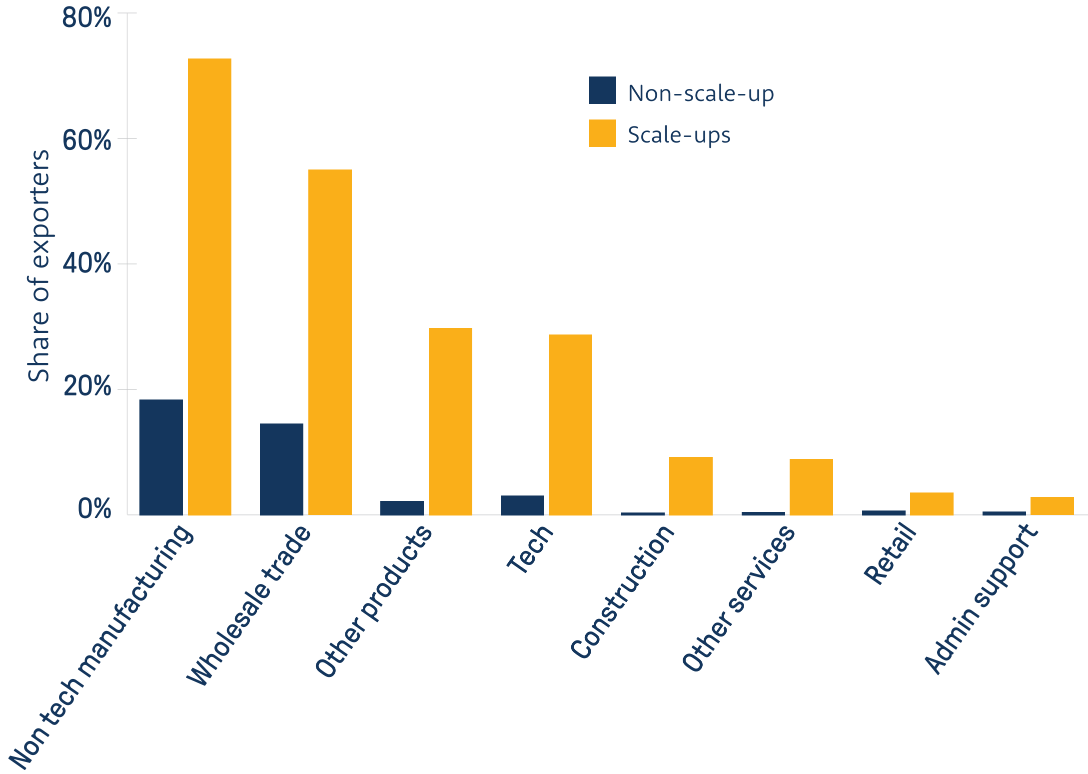
Share of Exporters by Industry, Kauffman Revenue Definition, 2016



Source: NALMF, Authors' Calculations.

Figure 39

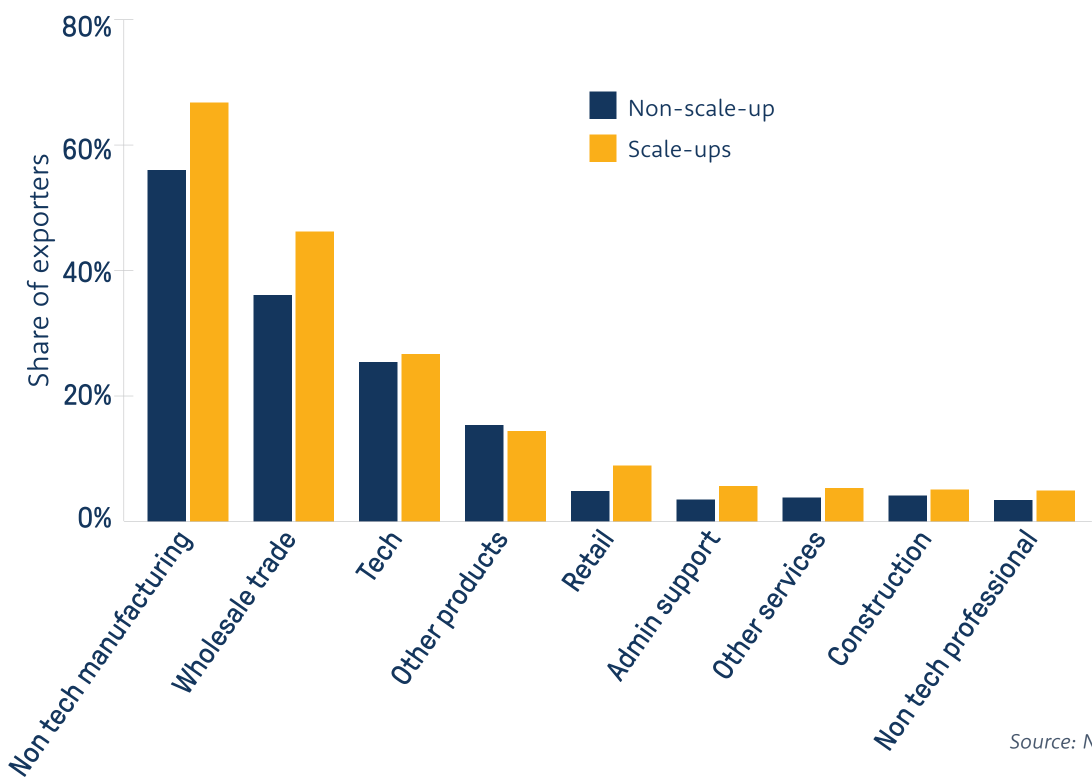
Share of Exporters by Industry, Kauffman Employment Definition, 2016



Source: NALMF, Authors' Calculations.

Figure 40

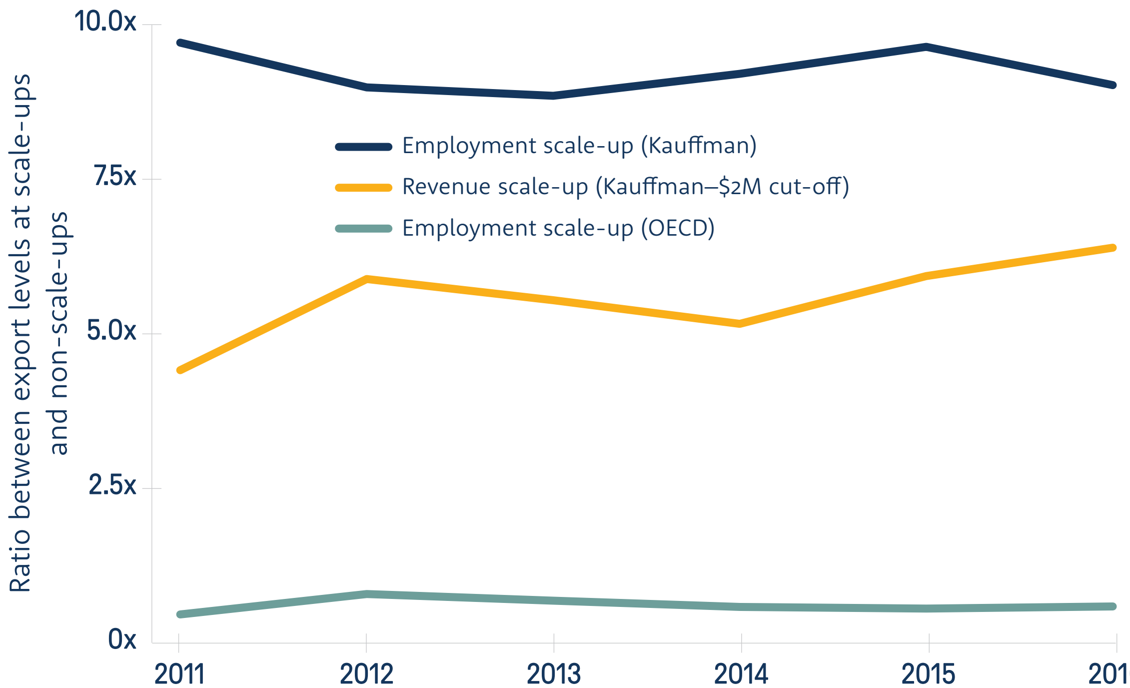
Share of Exporters by Industry, OECD Employment Definition, 2016



Source: NALMF, Authors' Calculations.

Figure 41

Relative Export Levels Over Time at Scale-ups in Canada, Various Definitions



Source: NALMF, Authors' Calculations.

The data in Table 5 shows that scale-up firms in the tech sector export more than the national average (an approximately seven to nine percentage point difference, depending on definition). It is important to note this fact especially in light of the fact that the Exporter Register does not capture export in services (including software services), and that such high export activity is therefore driven (in this dataset) by the set of tech firms that export physical goods, such as those in advanced manufacturing. Given the expansion of tech firms in big data, data analytics, cloud computing, fintech, and machine learning since 2010 (Denney, Southin, and Wolfe, 2021), we would expect that with the inclusion of data on service exports, this share would be considerably higher, but the data does not yet let us confirm it. Although we are not counting services, the fact that a greater proportion of tech firms export is a testament to their capacity for growth and sophisticated management relative to all firms.

Tech scale-ups compared to non-scale-ups show findings broadly consistent with overall trends. There are enormous differences between firm types for the Kauffman definitions, but much less so for OECD Employment firms (again, at least in part but probably mainly due to the sub-population of firms we are analyzing).

Table 5

Proportion of exporters between scale-ups and non-scale-ups, various definitions, 2016

Definition	Exporters at non-scale-ups	Exporters at scale-ups
Kauffman Employment	2.33%	21.00%
Kauffman Revenue	2.62%	17.28%
OECD Employment	14.60%	18.37%
Tech only		
Kauffman Employment	3.14%	28.92%
Kauffman Revenue	3.18%	25.50%
OECD Employment	25.94%	27.23%

R&D spenders

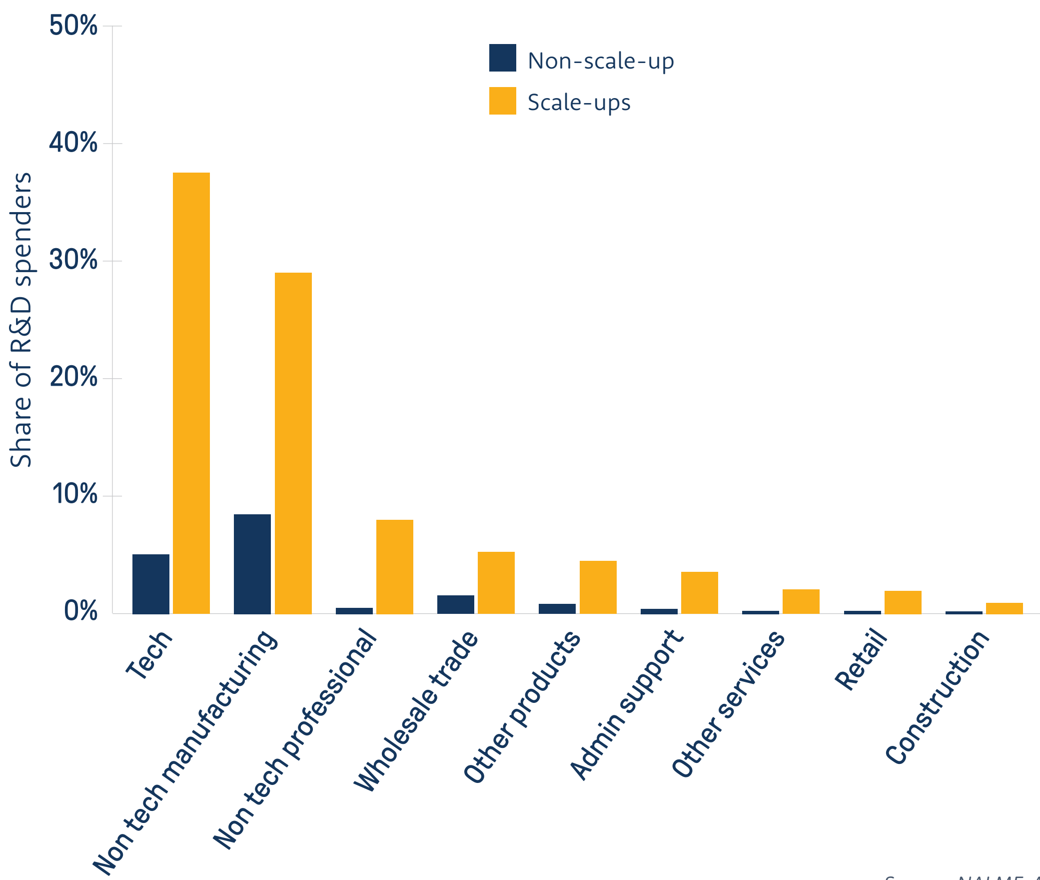
Below we report on the share of research and development (R&D) spenders by scale-ups status (across the three core definitions) and industry (Figure 42-44). As with exporting, for all but the OECD Employment definition, scale-ups are considerably more likely to invest in R&D (see the relative levels in Figure 45). This finding is consistent with the broader literature on the subject.

Notably, compared to other industry sectors, companies in the tech sector are significantly more likely to invest in R&D. Importantly, non-scale-up tech firms are not exceptional when it comes to their propensity to invest in R&D (being most comparable to non-scale-ups in non-tech manufacturing), while tech scale-ups are significantly more likely to invest in R&D than scale-ups in non-tech manufacturing firms.

It is also notable that scale-ups identified through employment growth are more likely to engage in R&D activity than those identified through revenue growth. Given the limitations of the data used here, it is not possible to say definitively why this is the case, but one plausible explanation for this finding is that companies claiming tax credits or other support for employment costs associated with R&D activities – primarily in providing credit for R&D personnel wages through the Scientific Research and Experimental Development (SR&ED) tax incentive program – are using such programs to expand their payroll. Another explanation could be that firms already reporting high revenue growth may not feel the need to invest in R&D, as they already have a proven product and business model that allows them to scale their revenue quickly.

Figure 42

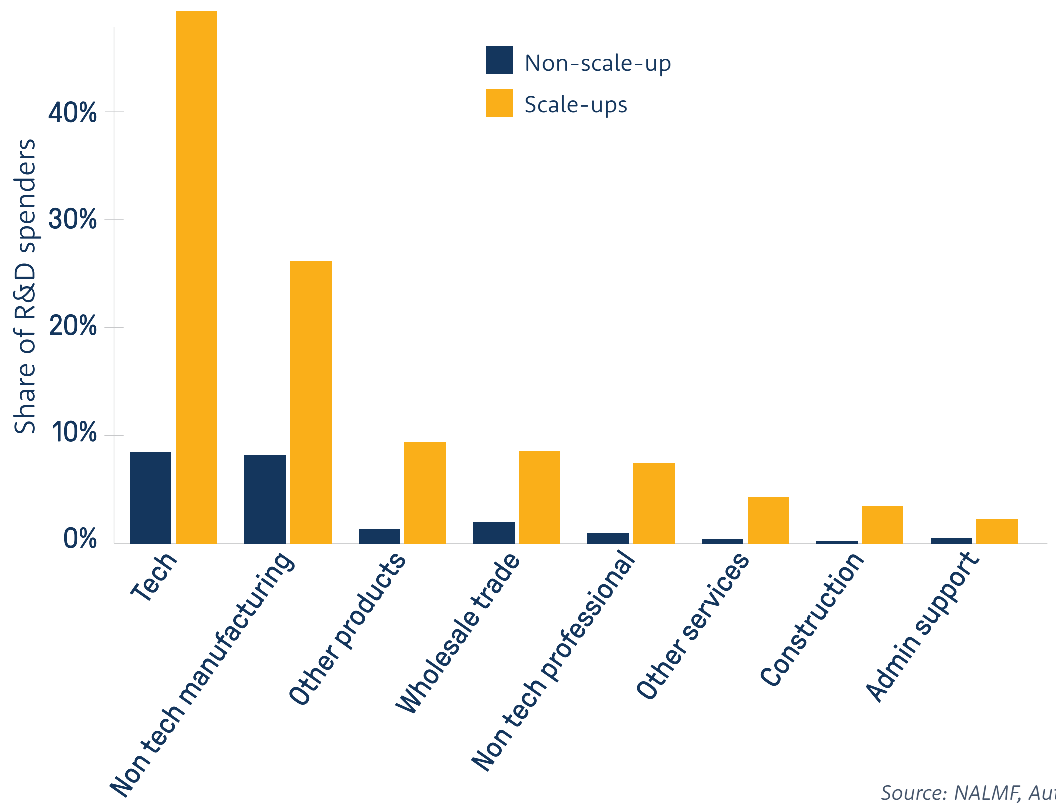
Share of R&D spenders, Kauffman revenue definition ($2M cut-off), 2016



Source: NALMF, Authors' Calculations.

Figure 43

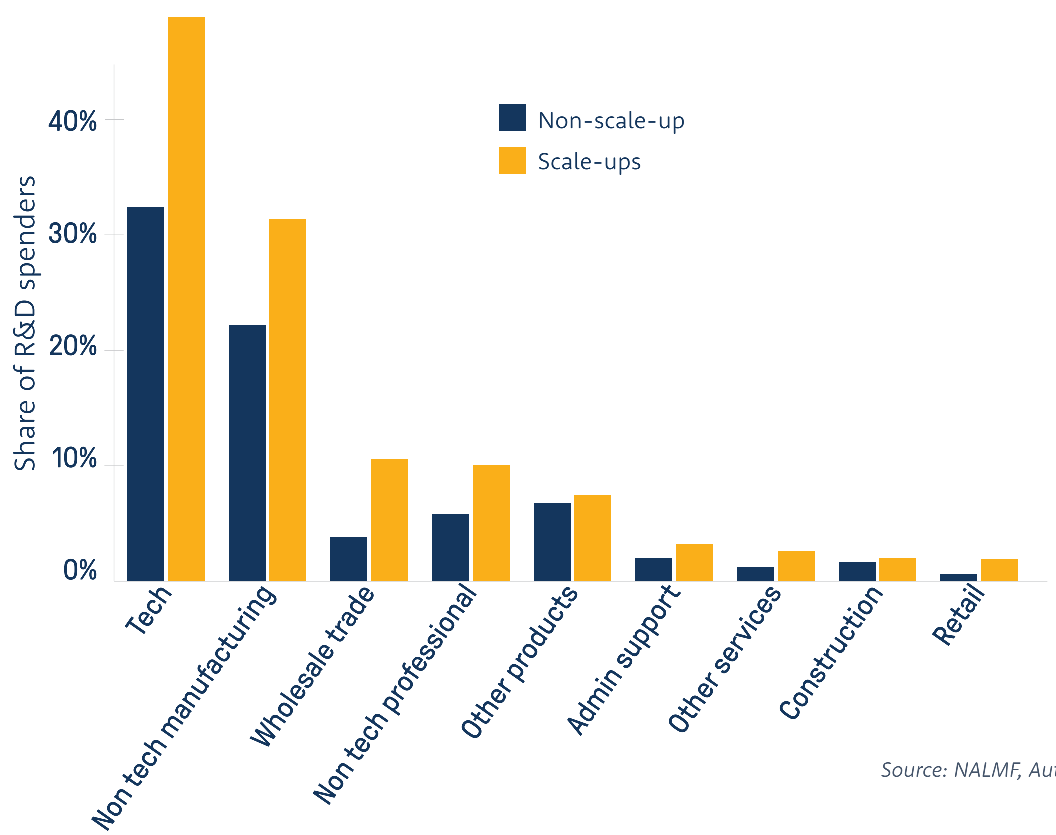
Share of R&D Spenders, Kauffman Employment Definitions, 2016



Source: NALMF, Authors' Calculations.

Figure 44

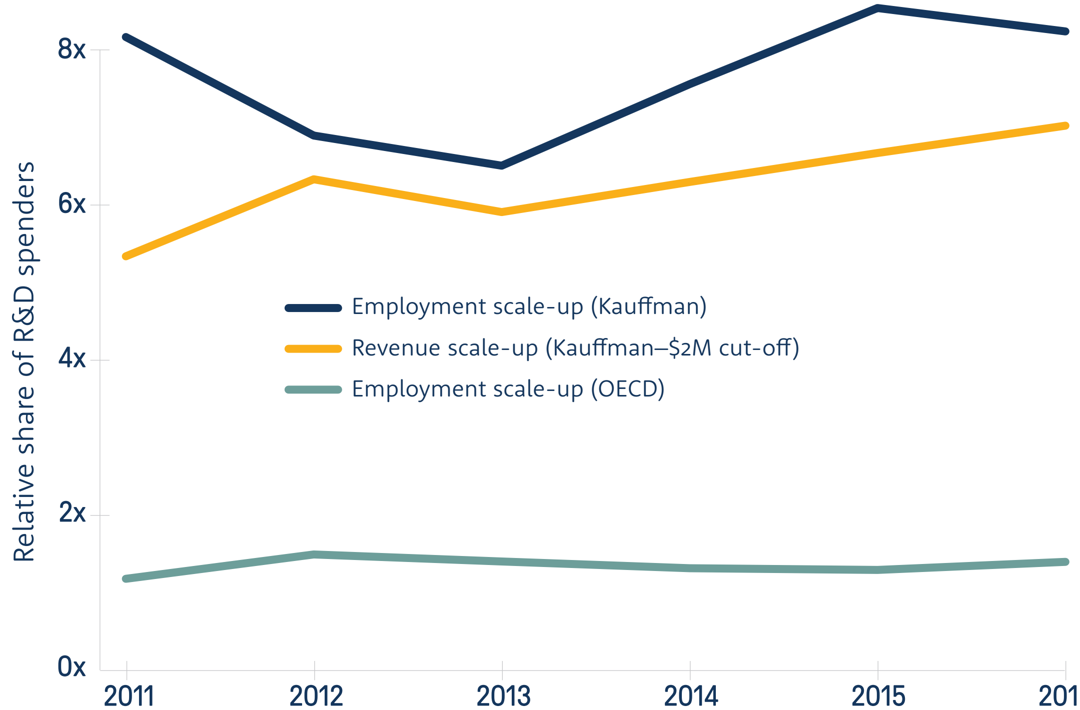
Share of R&D Spenders, OECD Employment Definitions, 2016



Source: NALMF, Authors' Calculations.

Figure 45

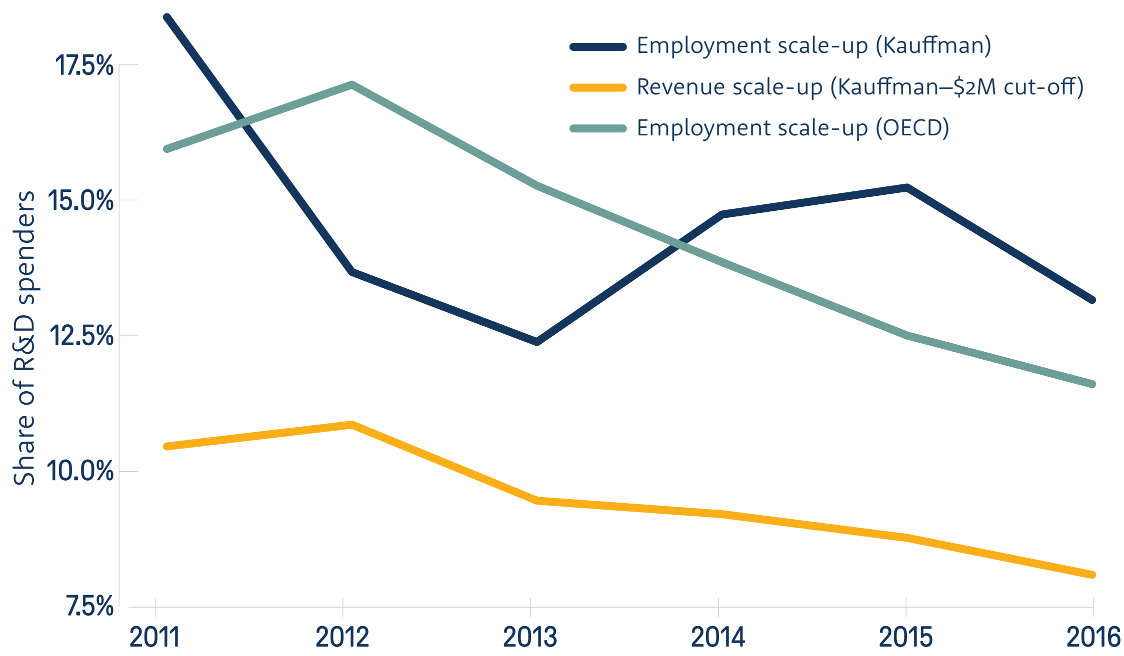
Relative Share of R&D Spenders Between Scale-ups and Non-scale-ups, Various Definitions



Source: NALMF, Authors' Calculations.

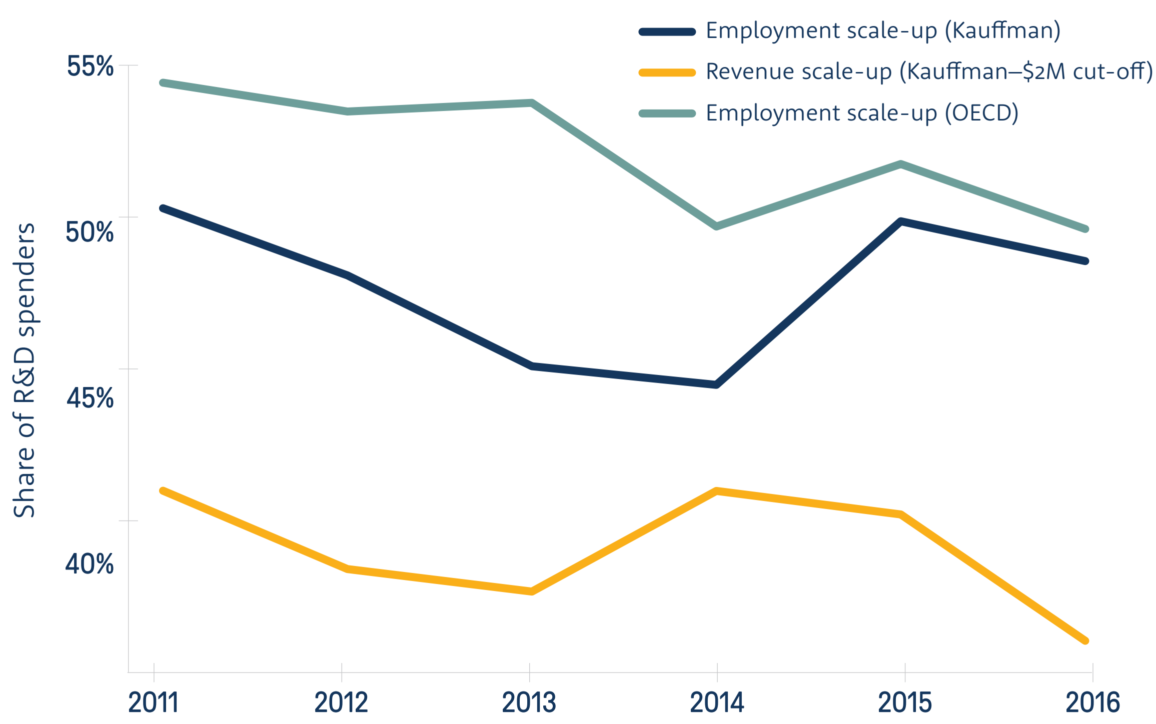
However, the results presented here may not be resolutely encouraging. As we show in Figure 46 and 47, there is a declining trend in the share of scale-ups that engage in R&D activity across all three definitions, more generally and in the tech industry.[20] The falling share of scale-ups engaging in R&D is on par with declines of R&D performers among the non-scale-up populations in the overall economy (Figure 48). However, interestingly, tech scale-ups appear to be somewhat insulated from this downward trend (Figure 49). We explore the implications of these findings, especially for the tech sector, below.

Figure 46
Share of R&D Spenders in Scale-ups in Canada Over Time, Various Definitions



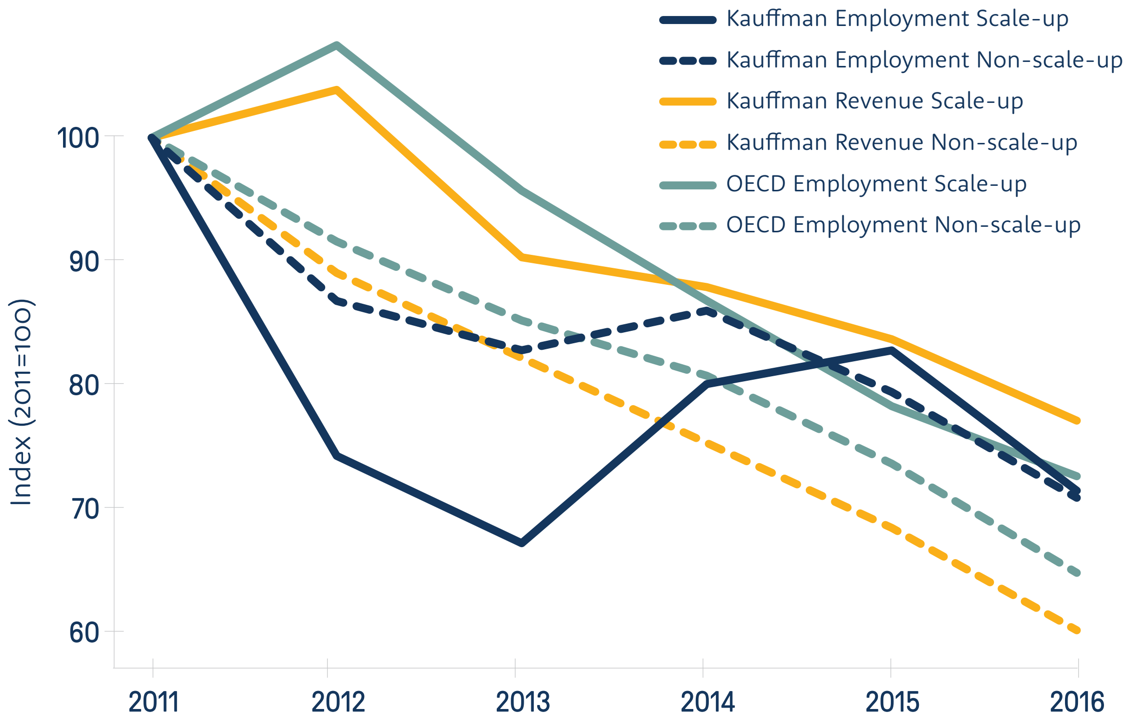
Source: NALMF, Authors' Calculations.

Figure 47
Share of R&D Spenders in Tech Scale-ups in Canada Over Time, Various Definitions



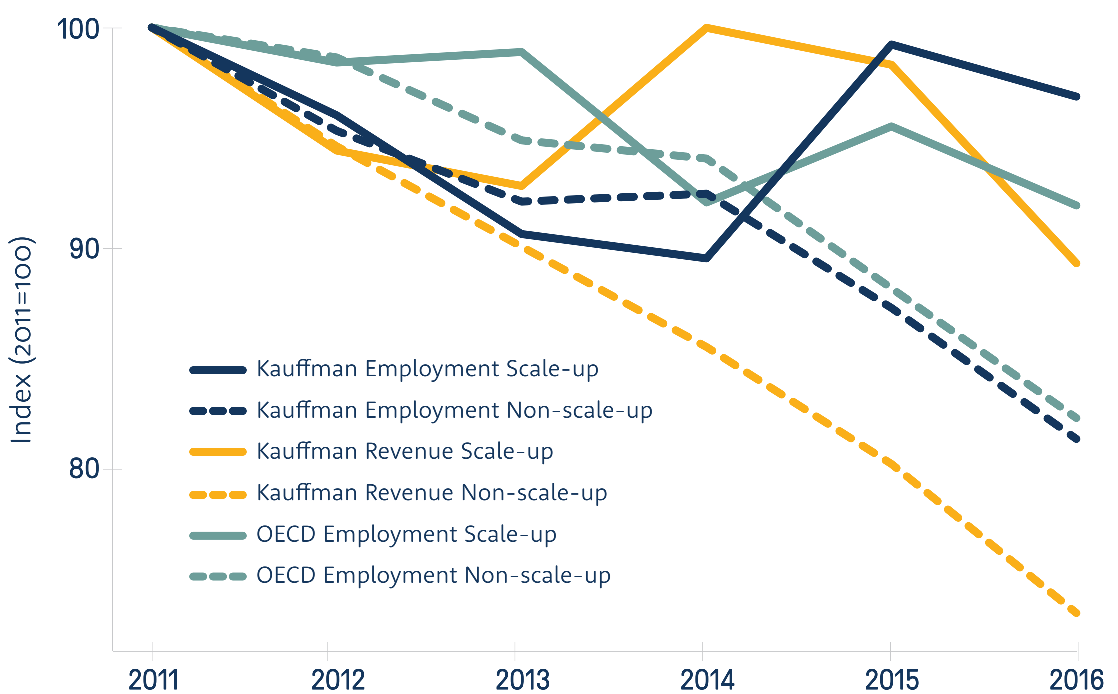
Source: NALMF, Authors' Calculations.

Figure 48
Trend in Share of R&D Spenders in Canada, Various Definitions



Source: NALMF, Authors' Calculations.

Figure 49
Trend in Share of R&D Spenders in Tech in Canada, Various Definitions



Source: NALMF, Authors' Calculations.

Table 6

Proportion of R&D spenders between scale-ups and non-scale-ups, various definitions, 2016

Definition	% R&D spenders at non-scale-ups	% R&D spenders at scale-ups
Kauffman Employment	1.6%	13.11%
Kauffman Revenue	1.14%	8.01%
OECD Employment	6.18%	11.55%
Tech only		
Kauffman Employment	8.42%	49.1%
Kauffman Revenue	5.09%	37.7%
OECD Employment	33.2%	50.1%

Tech Retrospective

Tech scale-ups: Leading the pack?

National discussions on scale-ups and policies supporting scale-ups and firm growth inevitably involve a focus on the technology ("tech") sector. For example, in 2019, the federal minister for Small Business,Export Promotion, and International Trade announced $20 million in funding to support Canadian firms to grow, $7 million of which was devoted to scale healthcare and biotechnology companies (ISED, 2020). Similarly, Innovation, Science and Economic Development Canada has committed $950 million in funding five tech-focused superclusters, covering areas such as artificial intelligence, advanced manufacturing, and agricultural technology.[21] In 2021, the Ontario Minister of Economic Development, Job Creation and Trade announced $100 million ($60 million committed under the previous government, $40 million in new funding) to focus on supporting tech-companies in Ontario to scale (Simpson, 2021).

There is a strong case that supporting Canada's tech sector is an indisputable matter of national (and, arguably, environmental) importance to facilitate the transition from extractive industries towards tech and other frontier industries crucial for promoting long-term national prosperity.

But do the findings presented in this report justify such an outsized focus on the tech industry? Are tech scale-ups more desirable compared to scale-ups in other industries? Throughout this report, tech scale-ups (and even some non-scale-ups) measure exceptionally well across several indicators, but not all of them. Our findings warrant a careful consideration of how we think about tech scale-up measurement and performance.

In this "tech retrospective," we explore how tech scale-ups stack up against the rest by evaluating their performance in key policy areas. In doing so, we also consider how we conceptualize and measure scale-ups in the first place.

Employment objectives

A commonly cited reason to support scale-ups, in the tech and other industries, is their expected employment impact. We find the employment contribution of tech firms is not straightforward. First, we observe that tech firms do not perform well when it comes to early growth, as evidenced by their relatively low share of employment scale-ups as per the Kauffman Foundation's criteria. However, among companies with proven business models (those with at least 10 employees, as per the OECD Employment definition), the share of scale-ups in tech is the greatest.

What do these diverging findings indicate? In our interpretation, they point to the relative difficulty (compared to other industries) tech firms face in achieving growth in the early years of operation. But once initial growth hurdles are overcome, the data indicate that it becomes easier for tech firms to sustain scale. Expanding more broadly on these findings, the evidence seems to reflect positively on start-up dynamism and the business environment for tech companies. When combined with the insights we explore below on innovation and productivity measurements, it suggests that the dynamics and conditions are such that poor-performing firms (i.e., those with little value-add, low innovation capacity, or products or services with poor market fit) are pushed out of the market.

Another dimension we consider is quality of employment, as measured through pay. Here we find that average pay at tech scale-ups exceeds that in almost all other industries across economic regions of Canada. Notably, the average pay at both tech scale-ups and non-scale-ups is significantly higher than the average pay for all scale-ups in Canada. There are some differences between tech firms by scale-up status (Kauffman employment scale-ups pay more, OECD employment scale-ups pay less), but with pay rates ranging from $80,500 to $89,000 annually, Canadian workers make better money at tech firms than they do just about anywhere else in the country. This does not mean, however, that scale-up and non-scale-up firms otherwise perform similarly.

Productivity and innovation objectives

While the employment impact of tech scale-ups is somewhat mixed, when it comes to productivity and innovation activities, these firms are clear winners. The average productivity growth (APG) for tech scale-ups across all definitions shows that they are considerably more productive than non-scale-up tech firms and scale-ups in other industries. We can confidently conclude that tech firms contribute significantly greater economic value than other firms by making better use of their inputs.

However, there is an important point to be considered given the lower levels of employment contribution observed for early growth tech firms. The evidence suggests that as tech firms scale in the earlier years of the firm life-cycle, they focus on making investments in productivity-enhancing measures that are capital deepening and labour saving (this is probably the reason why revenue scale-ups in tech are, by far, the most productive among the three types considered). In other words, younger tech scale-ups do not have as notable an employment impact as other industry sectors, because they are focused on making more effective use of other inputs to the production and sales processes without adding to payroll. Not until the firm is market validated do we see more notable performance gains (identified in this case by the OECD Employment definition).

Tech scale-ups are also R&D leaders, as defined by the share of firms spending on R&D. Given the importance of R&D to tech, this is not surprising, but it is nevertheless notable. Canada, like all advanced industrial economies, is increasingly moving towards an ideas-based, intangible economy (Lamb and Munro, 2020).

Interestingly, the gap between tech scale-ups and non-tech scale-ups for R&D spending is considerably smaller when it comes to those defined under the OECD Employment definition. As discussed, the sub-population of firms we consider for this definition involves those that have reached a baseline level of size that demonstrates a viable and sustainable business model.

One concerning trend we show is the gradual decline in the share of tech scale-ups that recorded R&D expenditures between 2011 and 2016. This finding lends further weight to what has been described as Canada's "low innovation equilibrium" (Nicholson, 2016), or where the country becomes a consumer of new technologies as opposed to a creator. This declining trend is observed despite government attempts to stimulate spending and investment.

Canada has long lagged behind its OECD peers in business expenditures on research and development, with no signs of improvement (Lamb, Munro, and Vu, 2018; Lamb and Munro, 2020), but the unwillingness (or inability) of Canadian firms, especially in the tech sector, to spend on R&D should be seen as a major problem. Considering the high proportion of tech scale-ups that export, having high levels of investment in R&D in the domestic market may mean little if these firms have to compete in international markets. While our measures of scale-ups and our chosen definition of tech firms are not well-suited for international comparisons, the trends are indeed concerning and should be further investigated.

Export objectives

The export activity findings are also consistent with what we would expect. The proportion of tech scale-ups that export (measured by exchange in goods) is in the range of 40 to 50 percent of all tech firms. Notably, tech firms do not export as much as other firms. Depending on the definition, we observe that a greater proportion of non-tech manufacturing firms, wholesale traders, or firms classified as selling other products export. But given the focus on goods exported, this is not surprising. It is also notable that revenue-based tech scale-ups rank second behind non-tech manufacturing.

As indicated by export behaviour data and what we know about this economic activity, we can say that tech scale-ups (and indeed, all scale-ups) likely meet an organizational requirement and have the type of administrative sophistication needed to make the most of support, funding and otherwise. Exporting is associated with a host of other desirable performance metrics and is a good indication of a firm's managerial and administrative sophistication and capacity (Harris, 2015). In short, firms that export can be understood as firms capable of managing complexity and are thus better candidates for government support. This notion is consistent with the "threshold firm" concept explored above.

Returning to the original questions posed in this section, the data and insights covered in this report do indeed support the strong focus on tech as contributors to Canada's economy. Whether these firms should be targets for government support is, as questions of public policy tend to be, a much harder question to answer. The evidence provided here supports the conclusion that some tech firms for certain reasons are likely worthy recipients of support. If, for instance, the goal is to provide support to market-validated firms who will make most productive use of new inputs, then the answer leans strongly in the affirmative. But there are broader findings and implications to consider.

First, it is often said that Canada has a robust tech start-up ecosystem (Gregson and Saunders, 2020), but it struggles to support the scaling of promising firms. What we observe differs slightly, but importantly, from this view. From the perspective of whether the scale-up environment in Canada is one that grows the right kind of firms, we see evidence for such an environment. In all performance metrics evaluated in the tech industry, we see large gaps between scale-ups and non-scale-ups. This indicates to us that while it can be difficult to attain growth as a young firm (explored through the Kauffman Employment definition), once one achieves initial scale, it becomes easier to maintain that size. These observations do not speak to the issue of whether those who have reached scale are supported adequately. This is a separate matter and one we discuss through the lens of R&D spending.

Overall, the finding of a greater proportion of R&D spenders in tech scale-ups (compared to other industries) is both expected and encouraging, as research consistently shows that the social returns to R&D spending are enormous (Jones and Summers, 2020). Accordingly, it is not surprising Canada's lacklustre performance in R&D spending has been a perennial concern. That we observe a declining trend in the propensity to invest in R&D among scale-ups highlights that these concerns are pervasive and salient even among dynamic tech-based businesses. Unfortunately, what exactly is causing this weak R&D performance, or what an effective solution might be remain unclear. Recent policy changes (not covered in our sample period) have adjusted the innovation policy support mix to include more direct support, e.g., grants and contributions, among other forms of support.

The performance differences between those companies receiving direct support for R&D and those who do not underscores the value of R&D spending and incentivizing and supporting such spending (Howell, 2017; Santoleri, Mina, Di Minin, and Martelli, 2020). Bérubé and Therrien (2016) show, in the Canadian context specifically, that both direct and indirect forms of R&D support yield better firm performance across a host of indicators (although direct support, used in combination with indirect, is associated with significantly better performance). These findings highlight the potential of targeted direct support as a vehicle to aid innovative businesses with the potential to scale. As well, recent research drawing on interviews with Canadian tech scale-ups documents their preferences for a policy mix that is more heavily weighted towards targeted forms of direct support—which suggests the current policy mix is not fully aligned with their needs (Denney, Southin, and Wolfe 2021). Future work could explore how different forms of government support have influenced the growth trajectories of tech scale-ups, which would help inform on whether the current policy mix adequately supports scale-ups.

To conclude, it is important to underscore the time dimension of the findings presented here. Given the limitations of federal data on firm activity, this report's analysis ends in 2016. More recent studies show that, at least in large urban centers like Toronto, domestic tech growth has only just begun to take off (Denney, Southin, and Wolfe, 2020). Given the record-breaking amounts of venture capital deals in the tech sector (especially in software) over the last five to seven years (Silcoff, Kiladze, Lundy, and Willis, 2021), as well as the increase in Initial Public Offering or IPOs (Orland, 2021), it stands to reason, although it is by no means certain, that the number and performance of Canada's tech scale-ups have changed, and possibly improved, over the past five years. Venture capital and private equity deals, given their concentration in a few firms, do not in and of themselves say all that much about the industry's total performance. But as a proxy measure they do signify a great deal of increased activity in the scale-up sector, and that is worthy of further investigation.

Econometric Findings

Given that we have characterized the economic activity of scale-ups in Canada through the commonly-used metrics of employment and revenue growth across geographies and industries, we now turn our attention to our regression-based findings for productivity, innovation, exporting behaviour, and R&D spending. The purpose of the analysis in this section is to examine key predictors of scale-up and business growth behaviour. We focus on identifying factors that serve as good predictors of scale-up and business growth behaviour.

It is important to underscore two potential sources for any measured strength of a predictor. The first is **selection effects**, whereby a specific business activity (e.g., exporting) that is predictive of scale-up status or positive growth reflects not the impact of exporting, but the identification of exporting firms *already predisposed to high-growth*. Stated otherwise, firms that grow tend to export. The second is **causal effects**, which means that a specific business activity, such as exporting, is predictive of high-growth behavior because exporting causes growth.[22]

Disaggregating these effects requires a careful identification strategy, something that is not the focus of the present research. Consequently, we interpret any predictive variable as a method to reasonably identify scale-ups or growth-oriented firms (i.e., measure of association). The findings presented in this section should not be read as providing evidence in support of any hypothesis that suggests targeting and encouraging such predictors (e.g., exporting, patenting) will increase or otherwise support the number of high-growth firms in Canada.

In the findings presented below, we present a fully specified model with controls, which adjust for geographic, industry, cohort year, and firm age variation. When we report outcomes from logged predictor variables, we exponentiate the findings to express them in percentage changes. Otherwise, the results are not intuitive or particularly readable. Alternative model specifications are presented in the online appendix.[23]

Productivity performance of scale-ups

First, we examine whether scale-up firms, across various definitions, contribute to broad productivity growth. To do this, we focus on the differences in average productivity growth (APG) at the firm level and the re-allocative efficiency (RE) at the census metropolitan area (CMA) level.

We examine APG, or the increase in the value of outputs given some inputs (such as labour and capital), across revenue- and employment-based definitions of scale-ups throughout the period of observation. The APG is based on firm productivity estimates derived from the same Total factor productivity (TFP) estimates explored in the previous section, as per Wooldrige (2009) and Petrin and Levinsohn (2012). Ordinary least squares (OLS) models are estimated, with the predictor a dichotomous variable for whether a firm is a scale-up by the two main employment definitions (OECD and Kauffman) as well as the Kauffman Revenue definition.

In addition to APG, we take another decomposition of the productivity measure by separating the aggregate productivity growth terms at the census metropolitan area (CMA) level to a re-allocative efficiency (RE) term. In the economic growth literature, productivity growth can be separated into two different components, the technical efficiency (TE) term, and the re-allocative efficiency (RE) term. The TE term denotes the changes in productivity due to direct changes in the technology employed in production; the RE term, on the other hand, denotes the changes in productivity due to different factors of production (such as talent and capital) being used by different firms (e.g., people switching jobs).

By focusing on the RE term, tested through a series of linear regressions (see Petrin and Levinson, 2012), we can determine whether scale-ups make better use of their resources than non-scale-ups, as the literature and our descriptive findings above strongly suggest. Notably, we do not split the aggregate productivity growth terms at the economic region level, so the geographical analysis here differs from the descriptive analysis. The reason we opt for CMAs over the ERs is simple: we wish to measure, to the extent possible, local labour and economic dynamics. This is precisely what CMAs are designed to do, unlike ERs. The OLS models regress the RE terms by scale-ups definitions (employment and revenue).

Average productivity growth

In **Table 7**, we report our APG findings for the OECD Employment as well as Kauffman Employment and Revenue definitions for scale-ups. Overall, we find that firms that grow their employment quickly experience structurally different productivity growth compared to firms that grow their revenue quickly. While revenue scale-ups experienced six percent annual productivity growth on average (compared to statistically insignificant growth rate for non-scale-up firms), employment scale-ups either saw no additional growth or even negative productivity growth (compared to a non-scale-up baseline). The findings are robust to multiple model specifications.

As noted above, two commonly-cited reasons for interest in scale-up firms are the employment impact these firms create and how these firms contribute to innovation. The picture that emerges from these results shows that these two outcomes do not always co-manifest. Though innovation as a concept is much broader than productivity, an innovative firm can be considered so because it is more productive (Mohnen and Hall, 2013). Thus, it is worth noting that firms with the greatest employment impact (i.e., employment scale-ups) tend to have negative productivity growth in the year that they attained such status.[24]

Findings for employment-based scale-ups contrast to the positive APG growth observed in revenue scale-ups, where the magnitude of such increases is also robust to industry and geographic controls. This indicates that a firm's attaining revenue scale-up status, regardless of industry, is a reasonable indicator of its productive nature. Though measures of innovation capacity and broader welfare value goes beyond employment impacts and productivity growth, this analysis shows that not all scale-up types are the same. These findings also stand in contrast to the simple descriptive results we presented in the previous section. It is important to control for industry, geography, as well as age in understanding the contribution of scale-ups to productivity growth.

Table 7
Average productivity growth (APG) for scale-ups

	APG 1 OECD Employment	APG 2 Kauffman Employment	APG 3 Kauffman Revenue
Scale-up	-7.29×10^{-4} (0.003)	**-0.02**** (0.007)	**0.058***** (0.002)
Firm age	**0.002***** (9.89×10^{-5})	**-0.003***** (1.59×10^{-4})	**0.001***** (4.18×10^{-5})
Constant	-0.04 (0.04)	-0.018 (0.05)	-0.063 (0.036)
Industries	Yes	Yes	Yes
Provinces	Yes	Yes	Yes
Year	Yes	Yes	Yes
N	1,192,895	1,522,914	4,333,913
Adjusted R^2	0.04	0.05	0.02

Results from OLS regressions, dependent variable for all three models is the annual average productivity growth at the firm level. Standard errors are clustered at the firm ID level. Significance levels are as follows: (*) p<0.05, (**) p<0.01, (***) p<0.001

Re-allocative efficiency

Having established the differences in average productivity growth (APG) by employment and revenue, we turn now to the re-allocative efficiency (RE) term findings to determine whether geographies (census metropolitan areas—CMAs–as explained above) with higher proportions of scale-ups are more efficiently re-allocating inputs therein, thus leading to better performance. Table 8 reports our findings.

The results show no statistically significant effects across all definitions. That is, we cannot say CMAs with higher proportions of scale-ups more efficiently re-allocate inputs within those local labour markets. Given our findings in the preceding APG section and in the descriptive statistics on productivity above, this is a surprising but noteworthy finding. So, while we can conclude that scale-ups are more productive (compared to non-scale-ups), this does not translate to local labour markets. Canadian CMAs with a higher proportion of otherwise more productive firms are not more efficient in their re-allocation of labour and capital (and other factors of production).

However, an important caveat ought to be mentioned here–in our analysis, we examine where scale-ups are legally headquartered. A scale-up's impact likely exists outside of the specific local geography where it is located, as many have offices and employees across multiple jurisdictions. Further refinement in how we discuss the spillover impact of scale-ups is likely needed to fully understand such cluster impacts.

Table 8
Re-allocation efficiency of CMAs with higher proportion of scale-ups

	(1-2) Kauffman Revenue		(2-3) Kauffman Employment		(3-4) OECD Employment	
Scale-up share	-0.038 (0.05)	-0.044 (0.05)	-0.088 (0.114)	-0.087 (0.115)	0.017 (0.013)	0.016 (0.014)
Constant	-3.06×10^{-4} (0.001)	0.002 (0.002)	8.08×10^{-4} (0.001)	**-0.004*** (0.001)	**-0.002*** (8.79x10-4)	**-0.005**** (0.001)
Year fixed effects	No	Yes	No	Yes	No	Yes
N	2,056	2,056	1,180	1,180	1,615	1,1615
Adjusted R^2	2.67×10^{-4}	0.006	5.03×10^{-4}	5.51×10^{-4}	9.48×10^{-4}	0.007

Results from OLS regressions, dependent variable for all three models is the re-allocative efficiency portion of the annual average productivity growth at the firm level. Standard errors are clustered at the firm ID level. Significance levels are as follows: (*) p<0.05, (**) p<0.01, (***) p<0.001

Business activities and firm performance: Innovation, exporting, and R&D

Next, we explore the association between firm performance and certain business activities. Specifically, we examine innovation-related activities (patent filing and R&D spending) and exporting. To explore the predictive value of these various activities, we first regress scale-up firm status (across various definitions) by these business activities. Second, we explore firm performance more generally by determining the association between patenting and R&D spending as well as exporting on revenue and employment growth behavior (measured continuously).
We consider different conceptions of business activities for which we have sufficient data coverage. For patenting and R&D, we consider the concepts of the "trigger," "switch," and "volume."

The first way we conceptualize the importance of a specific business activity on performance is the **trigger**. Conceptually, we use triggers to discuss structural changes that occur when a firm first engages in a business activity. For example, when a company first receives a patent or the first time it exports, and how such events signal a fundamental shift in the way the company operates. This concept is meant to capture the idea that firms have to invest considerably in building up their firm infrastructure for engaging in exporting (specific expertise in dealing with the legal and financial implications of exporting, as well as sales resources with export market knowledge), and innovation (both the capacity to engage in R&D, and the legal expertise in managing a patent). This business moment represents a new complexity in the company, and a structural shift in how a business conducts its activity.

The second way we conceptualize a specific business activity on firm performance is the **switch**.In this case, the importance of this behaviour on performance is the signal implied by a firm's participation in a particular business activity *in any given year*. Businesses, despite having the infrastructure to engage in a business activity, may choose not to export or file for a patent in a particular year – this allows us to focus not just on a one-time change, but shifts along the business life cycle. We operationalize this concept by measuring any time a firm patents or exports. Having a new patent granted implies that a new product or innovation is ready to be commercialized; a year of engaging in exporting implies access to markets outside of Canada for that particular year.

The final conception of a business activity under consideration is **volume**. This concept seeks to measure the association of additional instances of a business activity. For example, is having 10 patents the same as only having one? Or, is exporting $100 million worth of goods and services the same as exporting $10 million? We operationalize this concept by measuring the total value of a company's exports or the total number of patent grants each year.

For the measures of association with scale-ups, we specify logit regressions for the binary outcome variable (scale-up or not), with statistical controls for industry, province, year of observation, and firm age. This gives us a read on how scale-ups compare to the baseline (non-scale-ups).

For trigger, switch, and volume models, we use ordinary least squares (OLS) models with total real revenue and average employment specified as the outcome variables. In several cases, we do not specify or report findings for all scale-up definitions (both logged). In the case of patents, we omit the OECD Employment definition due to data suppression. For exporting, we omit consideration for Kauffman employment scale-ups, as the Exporter Register only covers the period 2011 to 2016 (i.e., inadequate coverage). We report the full model specifications here, inclusive of statistical controls.

Patent grants

First, we explore the relationship between patenting, as an innovation measure, and firm performance. Derived from PATSTAT (see above), we first regress patent filings (grants) by employment and revenue scale-up definitions and report log odds and odds ratios in Table 9. We find that while the patent grant was predictive of scale-up status for the Kauffman Employment definition, it was not associated with the likelihood that a company scales up under the Kauffman Revenue definition. This could be the case because a patent grant is not necessarily related to a direct or immediate increase in new product introductions and associated revenue increases. We leave room for future research to look at the lagged revenue impact of introducing patents. As discussed previously as well, patents are not the only form of intellectual property that a firm can hold, and the growth impact of these other forms of intellectual property also deserve further research. Kauffman Employment scale-up companies are 1.3 times more likely to patent than non-scale-ups. These findings are robust to multiple specifications that include corrections for industry, province, year cohorts, and firm age.

Table 9

Patenting and firm performance

	Patent 1 Kauffman Employment	Patent 2 Kauffman Revenue
Patent grants	**0.297***** (0.04)	0.03 (0.027)
Firm age	**-0.058***** (0.002)	**-0.019***** (5.04x10-4)
Constant	**-3.08***** (0.412)	**-2.69***** (0.109)
Industries	Yes	Yes
Provinces	Yes	Yes
Year	Yes	Yes
N	8,818,644	16,600,000
Pseudo R^2	0.072	0.031

Results from logit regressions with MLE, dependent variable for all three models are indicators for scale-up status at the firm level. Standard errors are clustered at the firm ID level. Significance levels are as follows: (*) p<0.05, (**) p<0.01, (***) p<0.001

That scale-ups are more likely to patent is consistent with our performance expectations, given that scale-ups are understood as having sufficient organizational and administrative capacity to manage and fund this type of innovation and business activity. What, then, is the impact on growth trajectories more generally, especially when we take into account different conceptions of business activities (i.e., the trigger, switch, and additive effects)? In Table 10, we report findings across all dimensions of patent activities for employment and revenue. For both employment and revenue, we find positive and significant associations across all conceptions of patenting. However, the associations are not all the same, and the differences are suggestive of how patenting, as an innovative activity, might impact growth.

We observe for both employment and revenue a substantive levelling-up effect for an initial patent. In the case of employment, the associated impact is a 13-percentage increase compared to the reference group (non-scale-ups). For revenue, the magnitude is much greater (a 67 percent increase). However, the association with the patent switch (the impact each time a patent is filed) is substantially greater in magnitude for employment (24 percent) and revenue (116 percent). The additive association (volume) of patenting is similarly positive. For every additional patent, there is a 0.14 percentage point increase for employment level and 0.73 percentage point increase for revenue level (the employment coefficient is only significant at the 90 percent level).

The difference in the estimates between the trigger and switch activities suggest diminishing returns after the initial moment. In other words, firms must continue to patent in order to continue reaping growth benefits. The benefit from additional patenting is small, but not insignificant (statistically or otherwise).

These findings include firm age controls and consider lagged employment and revenue, as well as corrections for industry and provincial differences. Notably, the estimates are highly likely influenced by self-selection bias. That is, firms already poised to grow are those most likely to file patent grants, so they would have hypothetically grown with or without patenting their ideas, processes, or systems.

Table 10

Various concepts of patenting activities and growth

	Patent as trigger		Patent as switch		Patent volume	
	Employment	Revenue	Employment	Revenue	Employment	Revenue
Patent variable	**0.129***** (0.003)	**0.673***** (0.016)	**0.242***** (0.005)	**1.16***** (0.027)	0.001	0.007
Lagged Emp/Rev	**0.943***** ($1.62x10^{-4}$)	**0.782***** ($3.65x10^{-4}$)	**0.944***** ($1.62x10^{-4}$)	**0.782***** ($3.65x10^{-4}$)	**0.944***** ($1.63x10^{-4}$)	**0.782***** ($3.65x10^{-4}$)
Age	**-0.004***** ($1.97x10^{-5}$)	**7.35x10-4***** ($1.18x10^{-4}$)	**-0.004***** ($1.97x10^{-5}$)	**6.82x10-4***** ($1.18x10^{-4}$)	**-0.004***** ($1.97x10^{-5}$)	**-6.74x10^{-4}******* ($1.18x10^{-4}$)
Constant	0.316	**3.16***** (0.03)	0.315	**3.16***** (0.03)	0.314	**3.16***** (0.03)
Industry	Yes	Yes	Yes	Yes	Yes	Yes
Province	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
N	14,125,278	22,858,380	14,125,278	22,858,380	14,125,278	22,858,380
Adjusted R^2	0.874	0.603	0.874	0.603	0.874	0.874

Exporting

Finally, we report our results from the export models. What is the association between exporting and scale-up status and growth trajectories more generally? Table 11 reports the log odds and the odds ratios for the logit models. We observe that for both the OECD Employment and Kauffman Revenue definitions, there is a positive and significant association between exporting and scale-ups status. More specifically, employment scale-ups are 1.1 times and revenue scale-ups 1.2 times more likely than non-scale-ups to export. Given the observational nature of our data and the research design, we cannot say that exporting is more likely to make a firm scale up, but the evidence is consistent with theoretical expectations of needing to access international markets to further a company's expansion after passing a specific threshold.

Table 11

Exporting and scale-up status

	Export 1 *OECD Employment*	Export 2 *Kauffman Revenue*
Log export value	**0.098*** (0.04)	**0.181***** (0.033)
Firm age	**-0.902***** (0.22)	**-0.73***** (2.33×10^{-7})
Constant	2.61 (1.52)	0.295 (1.16)
Industries	Yes	Yes
Provinces	Yes	Yes
Year	Yes	Yes
N	427	932
Pseudo R^2	0.104	0.091

Results from logit regressions with MLE, dependent variable for all three models are indicators for scale-up status at the firm level. Standard errors are clustered at the firm ID level. Significance levels are as follows: (*) p<0.05, (**) p<0.01, (***) p<0.001

In addition to the association between exporting and firm type, we also consider the relationship that exporting has on growth trajectories by employment and revenue (Table 12). We observe that exporting has significant and substantive association with growth. For employment, if a firm exports, there is a 20 percent increase in employment. The association with revenue is substantially greater in magnitude (100 percent increase).

Table 12

Exporting and growth trajectories

	Export 1 Employment	Export 2 Revenue
Log export value	**0.202***** (0.007)	**1.00***** (0.028)
Lagged employment	**0.866***** (9.92×10^{-4})	**0.688***** (0.001)
Firm age	**-0.125***** (7.19×10^{-4})	**-0.374***** (0.003)
Constant	**1.13***** (0.04)	**5.73***** (0.173)
Industries	Yes	Yes
Provinces	Yes	Yes
Year	Yes	Yes
N	600,564	1,384,045
Adjusted R^2	0.735	0.509

Results from OLS, dependent variable for models are employment and revenue levels respectively. Standard errors are clustered at the firm ID level. Significance levels are as follows: (*) p<0.05, (**) p<0.01, (***) p<0.001

R&D spending

In addition to patenting behavior, we also examine the association between spending on research and development (R&D) and firm performance. As was done for patenting, we also examine the relationship between different conceptions of R&D as a business activity and the association with growth. The variable for R&D counts all firm expenditures on research and development, again from the National Accounts Longitudinal Microdata File (NALMF). The R&D data is based on tax filings (form T-661) and accounts for all expenditures.

In the instance of an R&D trigger, we measure this as simply whether a firm recorded any R&D expenditures for the first time. For the R&D switch, this is measured by whether a firm recorded any R&D expenditures in a given year. The volume models take R&D spending as a continuous variable. Also, different from the patent models, we include an additive model for *only* firms spending on research and development ("volume II", or the fourth column in **Table 13 & 14**). The baseline for R&D spenders is minimum spenders, not firms with no expenditures (as it is for "volume I" models). Across all specifications reported on here, we include statistical controls for employment and revenue (lagged), firm age, industry, and cohort year. **Table 13 and 14** report the findings.

For all conceptions of spending and growth metrics, we find statistically significant and substantive associations. For both employment and revenue, the association between initial R&D spending and growth is large. There is a 10 percent increase in employment and a 74 percent increase in revenue. The difference in magnitude for the R&D switch is instructive. We observe that for additional instances of R&D spending, there is a 17 percent increase in employment and a 113 percent increase for revenue. As seen in the case of patenting, the difference in magnitude between the trigger and switch indicates diminishing returns to the initial R&D expenditures. This is also not surprising; to continually reap the gains associated with R&D spending, a firm must continue to spend on it.

What, then, is the association with continuous R&D spending? Among all firms, a one percentage increase in R&D spending is associated with a 1.5 percent increase in employment and a 1.1 percent increase for R&D spenders only. The association with revenue is even stronger. For every one percentage increase in R&D spending, there is a 9.7 percent increase in revenue. Limited to R&D spenders only, revenue increases less, but at 6.4 percent, the association is still substantial. Such a positive association extends further, where firms that are engaged in R&D activities are more likely to attain scale-up status, in all three definitions. These results are detailed in **Table 15**.

Table 13

R&D and employment performance

	R&D as trigger	R&D as switch	R&D volume I (All firms)	R&D volume II (Among R&D spenders)
R&D variable	**0.105***** (8.69x10⁻⁴)	**0.172***** (9.62x10⁻⁴)	**0.015***** (7.96x10⁻⁵)	**0.011***** (1.28x10⁻⁴)
Lagged employment	**0.94***** (1.67x10⁻⁴)	**0.94***** (1.67x10⁻⁴)	**0.94***** (1.67x10⁻⁴)	**0.95***** (6.36x10⁻⁴)
Age	**-0.004***** (1.97x10⁻⁵)	**-0.004***** (1.97x10⁻⁵)	**-0.004***** (1.97x10⁻⁵)	**-0.006***** (1.4x10⁻⁵)
Constant	0.323	0.325 (0.741)	0.33	0.162 (0.203)
Industry	Yes	Yes	Yes	Yes
Province	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
N	14,125,278	14,125,278	14,125,278	589,425
Adjusted R^2	0.875	0.875	0.875	0.913

Results from OLS. Standard errors are clustered at the firm ID level. Significance levels are as follows: (*) p<0.05, (**) p<0.01, (***) p<0.001

Table 14

R&D and revenue performance

	R&D as Trigger	R&D as Switch	R&D Volume I (All Firms)	R&D Volume II (Among R&D Spenders)
R&D variable	**0.735***** (0.005)	**1.13***** (0.004)	**0.097***** (3.55×10^{-4})	**0.064***** (7.23×10^{-4})
Lagged revenue	**0.78***** (3.66×10^{-4})	**0.78***** (3.66×10^{-4})	**0.78***** (3.66×10^{-4})	**0.76***** (2.89×10^{-3})
Age	**-0.001***** (1.18×10^{-4})	**-0.001***** (1.18×10^{-4})	**-0.001***** (1.18×10^{-4})	**-0.01***** (6.47×10^{-4})
Constant	**3.21***** (0.03)	**3.20***** (0.03)	**3.21***** (0.03)	**2.86***** (0.44)
Industry	Yes	Yes	Yes	Yes
Province	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
N	22,858,380	22,858,380	22,858,380	699,891
Adjusted R^2	0.604	0.604	0.604	0.659

Results from OLS. Standard errors are clustered at the firm ID level. Significance levels are as follows: (*) p<0.05, (**) p<0.01, (***) p<0.001

Table 15

R&D and scale-up status

	R&D1 OECD Employment	R&D2 Kauffman Revenue	R&D3 Kauffman Employment
R&D	**0.06***** (0.001)	**0.191***** (0.002)	**0.224***** (0.003)
Firm age	**-0.081***** (7.33×10^{-4})	**-0.06***** (0.002)	**-0.063***** (0.002)
Constant	**-0.63***** (0.12)	**-2.93***** (0.264)	**-3.07***** (0.413)
Industries	Yes	Yes	Yes
Provinces	Yes	Yes	Yes
Year	Yes	Yes	Yes
N	1,952,861	3,738,910	8,818,644
Pseudo R^2	0.05	0.064	0.096

Results from logit regressions with MLE, dependent variable for all three models are indicators for scale-up status at the firm level. Standard errors are clustered at the firm ID level. Significance levels are as follows: (*) p<0.05, (**) p<0.01, (***) p<0.001

As an additional test of association, we performed a quantile regression across different planes of the growth distribution.[25] We surmise that the effect and importance of research and development is not likely to have the same impact for a smaller firm as it has for a larger one. To account for this, we estimate the regression plane for multiple quantiles across the distribution of firms by employment and revenue. Specifically, we regress at the 25th, 50th, 75th, 90th, and 99th percentile of the distributions. For reference, Table 16 (below) identifies the employment and revenue sizes at each of the quantiles.

Table 16

Firm sizes at different points in the distribution

Quantile	Employment size	Revenue Level (million)
25th	10.33	$.548
50th	15.75	$1.42
75th	31	$ 3.87
90th	69.5	$ 11.23
99th	601.3	$ 104.6

Distribution based on the population of firms with 10 or more employees.

Table 17 and 18 report the findings. For both employment and revenue, we find that the magnitude of the coefficient on R&D spending is conditional on firm size and that larger firms have more substantive associations (i.e., suggesting that R&D has greater impacts for larger firms). Even for firms at the 90th percentile, the association between a one-percent increase in R&D and growth is relatively small (1.8 percent for revenue and 0.7 percent for employment) when compared with firms in the 99th percentile (12.7 percent for revenue and 2.6 percent for employment).

The large change in the effect of increasing R&D expenditure at different firm scales needs to be interpreted carefully. It is much harder to increase R&D expenditure substantially when one is already spending substantially on R&D. For instance, smaller firms may be more likely to become an R&D performer or significantly increase their R&D budgets, leading to large impacts on growth. In other words, while the marginal effect of increasing R&D is greater in magnitude at larger firms, they may also face higher marginal costs in increasing R&D at that scale. Moreover, there is a noticeable drop in the association between current and lagged revenue at the 99th percentile. This is difficult to interpret without further investigation, but could indicate that these firms have more tenuous revenue streams, and that R&D spending is an important

Table 17

Quantile regression results—total revenue

	Q(25)	Q(50)	Q(75)	Q(90)	Q(99)
R&D expenditure	**0.004*** ** (7.23×10^{-5})	**0.003***** (5×10^{-5})	**0.005***** (6.9×10^{-5})	**0.018***** (2.46×10^{-4})	**0.127***** (0.02)
Lagged revenue	**0.997***** (1.01×10^{-4})	**1***** (1.52×10^{-5})	**0.982***** (3.17×10^{-4})	**0.852***** (0.001)	**0.206***** (0.001)
Firm age	**-2.83×10^{-4}***** (3.23×10^{-5})	**-0.002***** (1.66×10^{-5})	**-0.005***** (2.4×10^{-5})	**-0.008***** (6.68×10^{-5})	**0.004***** (6.43×10^{-4})
Constant	-0.002 (0.007)	**0.099***** (0.004)	**0.611***** (0.007)	**3.06***** (0.027)	**16.6***** (0.209)
Pseudo R^2	0.67	0.68	0.63	0.48	0.25

Results from quantile regressions based on firm population with 10 or more employees. Standard errors are clustered at the firm ID level. Significance levels are as follows: (*) p<0.05, (**) p<0.01, (***) p<0.001 part of maintaining or improving their competitive position.

We do not have the space in this report to further explore the implications of these findings, but these correlations suggest that smaller firms may not benefit as much from commensurate R&D spending as larger firms. Given the expected relative impact of early growth events on smaller firms, this finding is deserving of much further research consideration to assess its robustness.

Table 18:
Quantile regression results—total employment

	Q(25)	Q(50)	Q(75)	Q(90)	Q(99)
R&D expenditure	**0.003***** (5.08x10^{-5})	**0.003***** (4.01x10^{-5})	**0.005***** (5.24x10^{-5})	**0.007***** (1.45.x10^{-4})	0.026*** (06.71x10^{-4})
Lagged employment	**1.01***** (1.5x10^{-4})	**0.994***** (8.33x10^{-5})	**0.968***** (1.07x10^{-4})	**0.927***** (3.06x10^{-4})	**0.757***** (0.001)
Firm age	**8.31x10^{-4}***** (3.02x10^{-5})	-0002*** (1.76x10^{-5})	**-0.005***** (2.03x10^{-5})	**-0.012***** (6.01x10^{-5})	**-0.024***** (2.22x10^{-4})
Constant	-0.121 (0.005)	**0.106***** (0.004)	**0.404***** (0.005)	0.905*** (0.01)	**2.88***** (0.08)
Pseudo R^2	0.599	0.68	0.699	0.68	0.62

Results from quantile regressions based on firm population with 10 or more employees. Standard errors are clustered at the firm ID level. Significance levels are as follows: (*) p<0.05, (**) p<0.01, (***) p<0.001

Conclusion

This report set out with a task of creating a framework for understanding scale-up activity in Canada. Through this approach, we sought to understand the impact that scale-up firms have on employment, technological innovation, and economic competitiveness. The disproportionate economic impact that scale-ups have in Canada is clear, but it is not sufficient to simply say "scale-ups are the solution." We demonstrate throughout this report the importance of clarity in policy objectives (desirable impact), definitions (metrics for firm growth), and context (geography or industry). All of these factors interact in a dynamic way and must be taken into account when thinking about what scale-ups are and why they matter.

We recap in this conclusion the characteristics of scale-ups that, based on our analysis, best achieve specific policy objectives. We then conclude with some general reflections on where the research and conversation ought to go from here.

Employment contributions

Given the centrality of employment contributions to the stated or perceived value of firms and the policy supports offered, we start here. It is not a surprise that firms that grow their employment rapidly also contribute significantly to employment levels, but it is still notable just how much they do contribute. We find that employment-based scale-ups routinely employ five to ten times as many people as their non-scale-up counterparts. Scale-ups identified as having significant employment contributions varied substantially, even when distinguishing between scale-ups with significant early growth (Kauffman Employment definition) and scale-ups with persistent employment growth (OECD Employment definition). If employment gains are the main policy objective, there are a number of factors to take into account.

First, early-growth scale-ups are the rarest type. This underscores a point emphasized throughout this report: employee growth is difficult, and even more so when the company has to cross a growth threshold (in this case, 50 employees). This is contrasted with companies that have already passed an employee threshold (employing more than 10 employees) and their relatively high propensity to continue growing their employment (as we see in the OECD Employment definition of scale-ups).

Furthermore, the dichotomy between firms represented in early growth, compared to growth after establishing a business model, is instructive. Many industries that excel in early growth, such as firms in retail and accommodation and food services, are among the worst performers in the OECD Employment definition of scale-ups. The permanence of jobs created, as well as the ability for a company to persistently create new jobs, varies across scale-ups.

The pay of jobs across scale-ups varies as well. We note that average pay in companies that excel at creating early growth scale-ups (those defined in the Kauffman Foundation's Employment scale-up definition) tends to be much lower than what can be reasonably expected in a full-time position. This is likely a result of a reliance on part-time workers and a low-wage environment to support business models. Tech companies stand apart from all other industries, as companies show low levels of early growth but high levels of sustained, more mature growth. Across any scale-up type, they create jobs that are highly paid (even among the *non*-scale-up firms).

We also note that business conditions do seem to matter. While firms that export and firms that file a patent are more likely to employ more people, and more likely to qualify for a scale-up status, employment scale-up firms are also not associated with higher productivity growth (compared to non-scale-ups). This drives home a point most pertinent to the tech sector but more broadly applicable: if the policy goal is to support employment growth, then those firms most productive are not where one should go looking. This may strike some readers as obvious. Firms reliant on high levels of employment, such as those in the food and accommodation sector, are not investing in labour-saving and productivity-enhancing technologies and investments, but the point is worth emphasizing nonetheless.

Output contributions

Among the various definitions explored in this report, the greatest number of scale-up companies are captured by the revenue-based definition using the Kauffman Foundation's revenue definition. In particular, we also tested whether the revenue threshold of $2 million was too lenient, and found that revenue scale-ups identified through more stringent revenue thresholds ($6 million and $10 million) responded to external shocks in the same ways.

Across the geographic regions of Canada, we note a marked decline in the share of revenue scale-ups in the northern territories and Prairie provinces, while shares in all other regions and provinces are on steady increases (Atlantic Canada) or modest but positive trajectories (Ontario and British Columbia). Quebec's share is holding steady behind Ontario and British Columbia.

Revenue-based scale-ups are also the firms that show the highest levels of productivity growth, outperforming scale-ups defined by both employment definitions. These firms are the only type of scale-ups for which there is a positive association with productivity growth. While this fact is likely not surprising, it again underscores the importance of delineating between different policy objectives when discussing scale-ups.

And while firms identified as revenue scale-ups did not record disproportionately high levels of employment (compared to non-scale-ups), engaging in exporting and R&D activities still showed a positive impact on employment levels. We also saw that once a Canadian scale-up reached a certain size (in both employment and revenue), exporting became an important part of how these companies sustained their growth. Furthermore, revenue-based scale-ups were also more likely to sustain jobs with higher pay than their non-scale-up counterparts.

Productivity and innovation contributions

Given the problems associated with Canada being a consumer of new technologies, rather than an innovation leader, the findings for R&D behaviour are of the utmost importance. In Canada, we identify two industry sectors that are the most likely to invest in research and development: the tech sector and non-tech manufacturing companies. In addition, across all three of our definitions, we find that scale-ups disproportionately engage in innovation activities compared to non-scale-ups. Those who successfully file a patent, while rare, are also more likely to become scale-ups.

These findings at first glance seem to be welcome news. However, we also observe a gradual decline over our measurement period of R&D activity, a fact consistent with other research that documents the same facts. Such a trend, if sustained, is concerning. It risks putting Canada into an economic landscape that privileges consuming technology, as opposed to creating it. This warning is especially important, as we saw that business dynamism in the tech sector in Canada showed promising signs that it is good at growing firms that engage in innovative activities. Targeted government interventions that specifically support innovation activities, without hanging them on employment impact, is likely to help invigorate the innovation sectors in our economy and help to reverse this trend.

We also examined the ecosystem impact of having scale-ups in a local region, where they might be competing for talent and resources with other companies, and whether they were able to use such talent and resources wisely. We find that regions with a high incidence of scale-up headquarters (under all three definitions we tested) do not derive a greater share of their productivity growth through talent and resources being allocated to these firms. While this is just one way to understand the effect of spillovers, it certainly opens up the question of whether all scale-ups realize these spillover events, or if such effects are restricted to specific kinds of scale-ups firms. Future work can also explore the spillover impact beyond a firm's legal jurisdiction (geography where they are headquartered), as scale-ups likely have economic impacts beyond the local regions where they are registered.

Future discourse on scale-ups

In future discussions, we propose the following questions to guide discourse and especially policymaking on scale-ups:

Guiding questions for discussing scale-ups:

1. Why do you care about scale-ups? To answer this question, focus on the desired impact you want scale-ups to achieve, and ensure that you focus on objectives that these firms are documented to achieve.

2. Given the objective(s), what would be an appropriate measure for firm growth? For this question, focus on determining whether growth from an input perspective (such as employment) and/or an output perspective (revenue) would prove more fruitful.

3. Are you focused on fostering scale-up activity in a specific context, such as a specific geography or industry?

We acknowledge that there are many questions and concerns left unanswered or unaccounted for in this report. Some are likely conceptually straightforward, such as characterizing the impact of scale-ups across jurisdictions and not just simply in the region where they are registered. More complicated questions might include how to think about and measure firm growth in the context of contractor or non-employee growth scenarios involving mergers, acquisitions, and franchises. In this case, we lacked the necessary data to answer these questions.

There are additional questions of importance. We know some types of firms (and entrepreneurship) add little value and may, in fact, be more rent-seeking and destructive, adding little (or no) value for the economy. Other types of firms may be more productive, but include externalities that are harmful to the environment; however, there is no good framework to identify a firm's impact on the environment. We implore both Statistics Canada, and those who engage in research in this area, to improve measurements so we can understand the type of firms that are worth investing in.

In achieving the primary goal of this report, conveying the argument that there is no single "scale-up" that will satisfy all policy objectives, and that we must support the growth of many types of firms if we are to satisfy desirable objectives, we concede that many other important timely questions have been omitted. We fully expect, and actively support, the use of this research as a way to generate further hypotheses and plan future studies. We see the following areas of research to be worth exploring in particular:

- Impact of firm acquisition(s) and merger(s) in the process of firm growth
- Longer-term impacts on firm growth of holding intellectual property (not restricted to patents)
- Economic spillover from scale-ups to a local labour market
- Investigating improvements in measuring value-added and profit growth in scale-ups

Finally, we urge researchers, policymakers, industry actors, and those discussing issues related to scale-ups to reflect upon the assumptions they hold about the potential impact of these firms, as well as the types of firms these must be. Without doing so, we are unlikely to reach a place where productive discussions can be had on designing the best policy instruments to support these firms.

Of particular significance for policymakers is our finding that the characteristics and sectoral location/basis of scale-up firms varies significantly by whether we adopt one of the two employment definitions of the revenue definition to define a scale-up firm. Scale-ups based on the input criterion of employment differ significantly from those based on the output criterion of revenue growth. The importance of clarity in policy objectives based on the known interaction between firm types, industries, and locations cannot be understated. Once a scale-up firm becomes a threshold firm, and impacts the entire ecosystem of firms around them, they can likely satisfy multiple policy objectives.

If the sole policy objective of scale-ups is employment growth, then that will determine the mix of policy supports put in place to stimulate the growth of scale-up firms. If, however, policy objectives are more focused on the broader goals of supporting exporting, innovation, and productivity without requiring these firms to also contribute to employment gains, then that will generate a very different policy mix. Previous qualitative research on tech-based scale-up firms strongly suggests that this is the preferred approach (Denney, Southin and Wolfe, 2021).

Appendix A: Economic regions

Below are listed the 76 Economic Regions (ERs) explored in this report. There is one instance where the ER boundary is not constituted by aggregated Census Division (CD) boundaries. The CD for Halton is divided between the ER of Hamilton–Niagara Peninsula and the ER of Toronto.

Economic region	Province
Toronto	Ont.
Lower Mainland–Southwest	B.C.
Montréal	Que.
Montérégie	Que.
Calgary	Alta.
Hamilton–Niagara Peninsula	Ont.
Edmonton	Alta.
Ottawa	Ont.
Kitchener–Waterloo–Barrie	Ont.
Vancouver Island and Coast	B.C.
Capitale-Nationale	Que.
Winnipeg	Man.
London	Ont.
Windsor–Sarnia	Ont.

Economic region (continued)	Province
Laurentides	Que.
Northeast	Ont.
Thompson–Okanagan	B.C.
Lanaudière	Que.
Kingston–Pembroke	Ont.
Laval	Que.
Chaudière-Appalaches	Que.
Halifax	N.S.
Outaouais	Que.
Muskoka–Kawarthas	Ont.
Saskatoon–Biggar	Sask.
Estrie	Que.
Regina–Moose Mountain	Sask.
Stratford–Bruce Peninsula	Ont.

Economic region (continued)	Province
Lethbridge–Medicine Hat	Alta.
Saguenay–Lac-Saint-Jean	Que.
Avalon Peninsula	N.L.
Athabasca–Grande Prairie–Peace River	Alta.
Mauricie	Que.
Centre-du-Québec	Que.
Northwest	Ont.
Red Deer	Alta.
Moncton–Richibucto	N.B.
Prince Albert	Sask.
Camrose–Drumheller	Alta.
Bas-Saint-Laurent	Que.
Saint John–St. Stephen	N.B.
Cariboo	B.C.
Campbellton–Miramichi	N.B.
Kootenay	B.C.
North Shore	N.S.
Abitibi-Témiscamingue	Que.
Prince Edward Island	P.E.I.
Wood Buffalo–Cold Lake	Alta.
Fredericton–Oromocto	N.B.
Cape Breton	N.S.
Annapolis Valley	N.S.
Southeast	Man.

Economic region (continued)	Province
Southwest	Man.
Southern	N.S.
Notre Dame–Central Bonavista Bay	N.L.
West Coast–Northern Peninsula–Labrador	N.L.
Swift Current–Moose Jaw	Sask.
Côte-Nord	Que.
Interlake	Man.
Gaspésie–Îles-de-la-Madeleine	Que.
North	Man.
Banff–Jasper–Rocky Mountain House	Alta.
Yorkton–Melville	Sask.
Edmundston–Woodstock	N.B.
Northeast	B.C.
South Central	Man.
North Coast	B.C.
North Central	Man.
Nord-du-Québec	Que.
Northwest Territories	N.W.T.
Parklands	Man.
Nechako	B.C.
Northern	Sask.
Nunavut	Nvt.
South Coast–Burin Peninsula	N.L.
Yukon	Y.T.

Appendix B: Industry definitions

Using the 2016 Census data, we classify any industry that has more than three times the average concentration of tech workers in the industry as a tech industry. This means that if an industry's tech workforce accounts for more than 17.46 percent of the industry workforce, that industry will be classified as "tech." The occupations considered to be tech occupations are discussed in length in Vu, Zafar, and Lamb (2019).

NAICS code	Tech worker concentration (in %)
2211 Electric power generation, transmission and distribution	20.31
3333 Commercial and service industry machinery manufacturing	24.04
3341 Computer and peripheral equipment manufacturing	33.98
3342 Communications equipment manufacturing	36.39
3343 Audio and video equipment manufacturing	23.39
3344 Semiconductor and other electronic component manufacturing	27.16
3345 Navigational, measuring, medical and control instruments manufacturing	27.68
3346 Manufacturing and reproducing magnetic and optical media	23.49
3353 Electrical equipment manufacturing	18.29
3364 Aerospace product and parts manufacturing	17.88
4173 Computer and communications equipment and supplies merchant wholesalers	36.05
4861 Pipeline transportation of crude oil	17.53

NAICS code (continued)	Tech worker concentration (in %)
4862 Pipeline transportation of natural gas	22.84
5112 Software publishers	58.62
5122 Sound recording industries	29.71
5152 Pay and speciality television	19.38
5171 Wired telecommunications carriers	48.14
5172 Wireless telecommunications carriers (except satellite)	36.01
5174 Satellite telecommunications	47.25
5179 Other telecommunications	43.23
5182 Data processing, hosting, and related services	42.97
5211 Monetary authorities—central bank	26.63
5261 Pension funds	18.31
5413 Architectural, engineering and related services	34.37
5415 Computer systems design and related services	67.09
5417 Scientific research and development services	27.28
8112 Electronic and precision equipment repair and maintenance	21.98

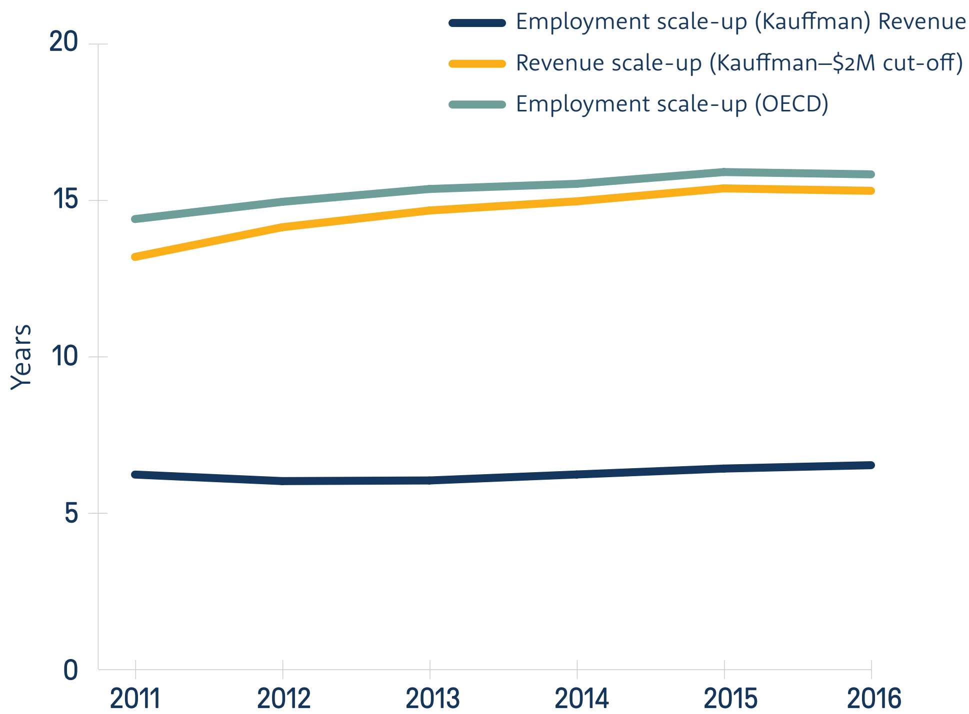
Appendix C: Additional firm information and insights

Below we provide some additional firm insights. First, the average age of scale-ups by definition. As explained in detail throughout the manuscript, the employment-based scale-ups per the Kauffman Foundation's criteria are early growth, whereas the OECD definition for employment scale-ups and the Kauffman revenue scale-ups are much older firms (>10 years).

Second, we report average pay for Kauffman Revenue and OECD Employment for tech scale-ups with domestic ownership and foreign country of control to supplement the analysis provided in "pay differentials" in the section, Scale-ups' Economic Footprint (above).

Figure C1

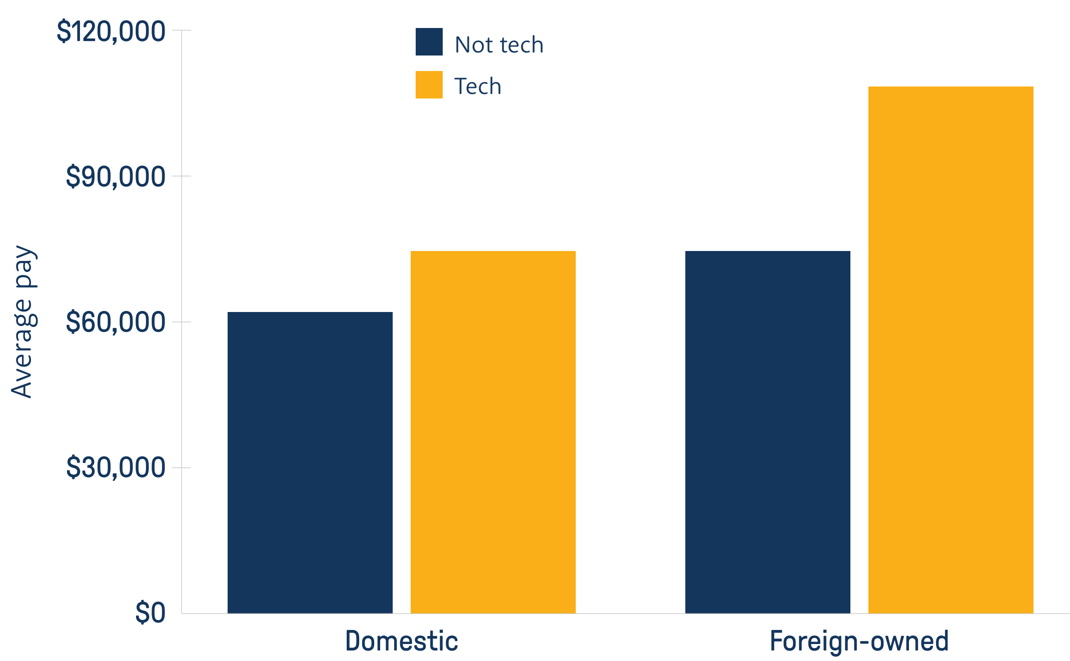
Average Age of Scale-ups, Various Definitions



Source: NALMF, Authors' Calculations.

Figure C2

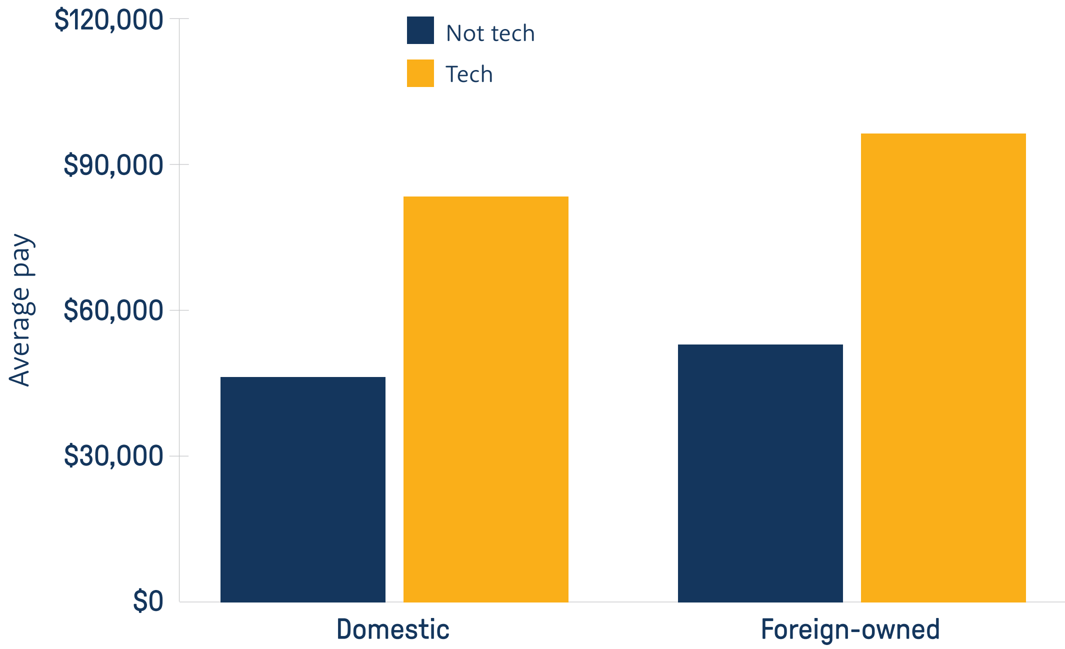
Average Pay of Scale-ups by Country of Control and Industry, Kauffman Revenue ($2M cut-off)



Source: NALMF, Authors' Calculations.

Figure C3

Average Pay of Scale-ups by Country of Control and Industry, OECD Employment



Source: NALMF, Authors' Calculations.

Endnotes

1 In this report, we use “scale-up” and “high-growth firm” synonymously. There is much definitional confusion in the literature on these firms, some of which we seek to resolve through this research.

2 There are other challenges, too. For example, net jobs created does not distinguish between new jobs (organic growth) and jobs created through mergers and acquisitions. Furthermore, firms that grow their revenue rapidly do not necessarily grow their workforce at the same rate (the opposite is also true). Geographical factors are also important in capturing scale-ups’ economic impact, since employment impacts may not be felt where a firm is headquartered or located for tax purposes. Problems with focusing on firm employment impacts are well documented (e.g., Anyadike-Danes, Hart, and Du, 2015). We do not mean to say that the employment impact of employment-based scale-ups is unimportant or theoretically uninteresting, but we do hold that a more careful theoretical motivation needs to be developed regarding interest in scale-ups.

3 Here, spillovers refer to the impact of scale-ups on other firms within the same industries (vertical spillover) or across them (horizontal spillover).

4 The literature on high-growth firms often finds that high-growth status, or behavior, is hard to maintain. Firms that achieve high-growth status in one period are not likely to repeat it in the next measurement period. This discussion is complicated, as the literature has commonly found that high- growth behaviour is usually not persistent. Firms that achieve high-growth status in one period are not likely to repeat high growth behaviour in the next measurement period. For example, a study in New Zealand shows that high-growth firms have death rates up to four times greater than other contemporary firms (Satterthwaite and Hamilton, 2017). This same research also notes, however, that surviving high-growth firms do retain their employment size. Research in other jurisdictions confirms this lack of persistence, although the degree of persistence varies across jurisdictions and definitions (Hölzl, 2013; Daunfeldt, and Halvarsson, 2015; Moschella and Tamagni, 2019).

5 As per Baumol (1990), there are two main types of entrepreneurship: productive and destructive. Productive entrepreneurship is found in firms that create new value for the economy, whereas destructive entrepreneurship is observed in firms that exist solely to extract rent (or redistribute resources) from the economy. Baumol cites important institutional factors, especially the strength of government and its incorruptibility, as factors affecting the relative dominance of one or the other type of entrepreneurship. What this means generally is that we ought not to care about all firms, but rather those that add economic value (taken broadly to include societal, environmental, etc.). Given space and data constraints, we do not explore the quality of entrepreneurship or the value-add of Canadian firms, but the question is important and worthy of further consideration.

6 In “A Brief Guide to the Business Register,” Statistics Canada (2010) reviews the different concepts of a business, such as the enterprise (our choice), company, establishment, and location.

7 Another implication of choosing tax filing as a unit of observation is the inability to robustly treat franchises. Often, a franchise acts as a de-facto location for a larger enterprise. However, due to the nature of franchising, they are registered as independent and separate enterprises for tax purposes, obfuscating economic indicators for both the franchisor and the franchisee. Unfortunately,

the size of franchise activity across the economy is not well understood, and methodologies used in associating a franchisee's business to a franchisor are even less understood. This is an issue that cannot be overcome by tax records alone.

8 In this framework, the individual labour productivity of workers is considered an input (and as a result, wage), while a firm's total factor productivity (estimated), or innovation output (such as a patent, which serves as a signal of a firm's productivity) would fall into the production technology.

9 The robustness of this definition was tested through a sensitivity analysis, which concluded that the OECD's scale-up definition is broadly relevant across member countries, taking into account the importance of cross-country comparability and ease of data collection and calculation. The analysis looked at alternative scale-up definitions using value-added and profit (as opposed to turnover), foreign/domestic ownership, and growth by acquisition. It also tested several different growth thresholds and ways of calculating growth.

10 Industry consultations, with more than 80 CEOs of Canadian scale-ups and multiple industry actors across Canada, took place as part of an ongoing research project, "The Scale-up Challenge for Canada: Obstacles to High-Growth Technology-based Firms and the Policy Response," a Mitacs Accelerate research project managed by one of the report's authors (Steven Denney) through the Innovation Policy Lab at the Munk School of Global Affairs & Public Policy, University of Toronto.

11 The "kink point" approach builds on the Eurostat-OECD- definition and is a method for including firms with less than 10 employees. According to this approach, firms with less than 10 employees at the beginning of a three-year observation period need to grow by eight employees or more (Clayton, Sadeghi, Talan, and Spletzer, 2013). The top decile defines high-growth enterprises as those with a compound average growth rate value at or above the tenth decile value for the distribution of by class, size and industry, rather than a fixed value for employment growth. For use of the top deciiee approach and the BLS kink approach, see Côté and Rosa (2017).

12 Where any industry with the share of tech workers employed in the industry is at least three times the share of tech workers in the economy is considered to be a tech industry.

13 Where each occupation in the National Occupational Classification system (NOCs) is ranked by its technical intensity, aggregating occupation-specific skills, knowledge, and work activity measures. The top five percent of occupations in this ranking are defined as tech occupations.

14 Average ages of scale-ups by the three definitions used for detailed analysis in this report are provided in Appendix D.

15 Ten employees or more is often the cut-off for small firms (to omit small firm bias). In Canada, it is worth noting that nearly three-quarters of businesses (73.4 percent) employ less than 10 employees (ISED, 2019).

16 Primary and secondary industries include: other products, construction, wholesale trade, non-tech manufacturing. Service industries include: finance, wholesale trade, retail, other services, administrative support, non-tech professional, accommodation and food. Tech is defined as previously explained.

17 This finding is likely driven by the differences in firm populations, as firms qualifying under OECD Employment definitions had at least 10 employees in 2012 (at the beginning of the observation period of high growth), but we cannot conclude this definitively.

18 Relevant to discussions over pay rates between domestic- and foreign-owned scale-up companies in Canada (Bergen, 2021), we find significant differences in pay between the two (see Appendix D), although given the difference between a homegrown and foreign-owned firm, one should consider such differences carefully.

19 A trade summary for Canada in 2019 can be read here: https://wits.worldbank.org/CountryProfile/en/Country/CAN/Year/LTST/Summarytext.

20 There is a potential limitation in using tax data to assess longitudinal trends in R&D performers, as there were policy changes in 2014 that may

have affected the uptake of SR&ED tax incentives. Despite this limitation, the overall decline in R&D performers appears robust. The decline in R&D performers captured in the NAMLF data starts before the policy changes came into effect and do not show a noticeable break in 2014. As well, the survey instrument used by Statistics Canada to produce national R&D estimates also shows a significant decline in R&D performers during this period—the level of performers fell from roughly 24,000 performers in 2011 to 18,000 performers in 2016 (a 25 percent decline). Though, this comparison also needs to be interpreted with caution, as there were major methodology changes to the Annual Survey of Research and Development in Canadian Industry (RDCI) in 2014.

21 Read about Canada's Superclusters initiative here: https://www.ic.gc.ca/eic/site/093.nsf/eng/00016.html.

22 Identifying the causal impact of specific business characteristics or growth events is extremely difficult (Storey, 1994; Hölzl, 2009). Recent research emphasizes the importance of initial business characteristics (e.g., founder characteristics, industry-specific factors, etc.) as opposed to subsequent business decisions in predicting firm growth (Guzman and Stern, 2017; Catalini, Guzman, and Stern, 2019). This literature argues that the association between important business events (e.g., exporting, patenting) and growth or productivity gains mainly reflects the self-selection of more efficient and productive firms, rather than evidence that these events drive growth or cause increases in productivity (Love and Roper, 2015).

23 All model specifications shown in this report are robust to alternative specifications. Models without certain controls (e.g., firm age, industry composition, or provinces) do not differ in any substantive way to those presented here. For more information or further explanation, please contact the authors.

24 However, once industry and geographic controls are accounted for, the negative productivity association decreases substantially in magnitude (from -6.3 percent to -1.6 percent), indicating important industry composition differences for employment scale-up firms, which we discussed extensively in the previous section.

25 OLS estimates the conditional mean of the outcome variable (in our case, average employment or real total revenue) across the value of the predictor variable (R&D expenditures).

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