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Long-run Perspectives on Mid-size Firms: The Role of Productivity and Geographic Scope

by Leonid Karasik and Anne-Marie Rollin

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by

Leonid Karasik and **Anne-Marie Rollin**

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Analytical Studies Branch
Research Paper Series

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Abstract

This paper uses Canadian business microdata for 1999 to 2013 to study the characteristics of private-sector medium-sized firms that transition to the large or small size classes. A firm's size class is defined over a three-year window to ensure that it represents the firm's long-term state rather than a transient state for a given year. The paper examines what distinguishes medium-sized firms that become large from those that revert to being small. It finds systematic differences between the two groups. These differences are observed both one year and five years prior to the transition. Medium-sized firms that are in the top productivity quartiles of their sector are more likely to become large and less likely to become small. Medium-sized firms that are in the bottom productivity quartiles of their sector are less likely to become large and more likely to become small. Medium-sized firms that employ workers in multiple provinces or territories are more likely to become large and less likely to become small. These and similar results hold after controlling for influential firm characteristics such as size, age and sector.

Executive summary

New firms typically start off with a small number of employees and grow slowly over time. The vast majority of firms will remain small (employ fewer than 100 workers) throughout their existence. Only a few firms will become medium-sized (employ 100 to 499 workers), and only a tiny minority will become large (employ at least 500 workers). Small and medium-sized enterprises (SMEs) are often discussed as a group, but medium-sized firms are in fact quite different from small firms. On average, medium-sized firms have been in existence for longer than small firms, and they have crossed many of the barriers typically associated with firm entry and the start-up phase (e.g., financing, market competition, recruitment and retention of employees). Statistics Canada's 2014 Survey on Financing and Growth of Small and Medium Enterprises revealed that a larger proportion of medium-sized firms than small firms expected to grow in the near future and expected to expand into new markets, nationally or internationally, in the next few years. This paper examines how often this intention on the part of medium-sized firms to grow and expand actually materializes.

From 2004 to 2010, an average of 82.1% of Canadian medium-sized firms remained medium-sized. An average of 16.1% became small or went out of business, and only 1.8% became large. This paper looks at why one in six medium-sized firms either revert to being small or disappear and only a select few become large. It seeks to determine whether the outcome is driven by idiosyncratic factors or systematic differences between the two sets of firms. In the case of the latter, this paper examines whether such differences exist five years prior to the transition.

This study uses Statistics Canada's T2-LEAP (Longitudinal Employment Analysis Program) database to investigate what distinguishes medium-sized firms that become large from those that revert to being small. The paper begins with a description of a new methodology for the study of firm transitions between size classes. The methodology uses a three-year window to determine firm size, and the paper highlights the advantages of this approach. To be classified as medium-sized in this study, a firm must satisfy the following two conditions: it employed 100 to 499 workers on average during the three years preceding the transition year and it employed 100 to 499 workers for at least two of those three years. A similar set of criteria is used to classify firms as medium-sized, large or small in the post-transition period.

The main contribution of the paper is to identify systematic differences between medium-sized firms that become large and medium-sized firms that become small that are evident both one year and five years before the transition period.

- **Productivity:** More productive firms are more likely to become large and less likely to revert to being small. The paper shows that productivity differences between the medium-sized firms that become large and the medium-sized firms that revert to being small are long-standing and evident even five years prior to the transition.

- **Geographic scope:** Firms that employ workers in multiple provinces or territories are more likely to eventually become large and less likely to become small. While most medium-sized firms (62.1%) operate only in one province or territory, 59.3% of firms that become large operate in multiple provinces or territories five years prior to the transition.

The influence of firm age on the outcome is more ambiguous. Young medium-sized firms under age 10 are more likely to become large than their older counterparts, but they are also more likely to revert to being small. The "up-or-out" dynamic of young firms applies to medium-sized firms, but the dynamic is better described as "up-or-down."

This paper also examines whether foreign-owned medium-sized firms are more likely to become large than their Canadian-owned counterparts. Foreign-owned medium-sized firms are larger and more productive on average than Canadian-owned ones. However, foreign ownership does not influence the probability that a firm will become large once size differences are controlled for. In fact, when productivity, employment level, age and geographic scope within Canada are taken into account, foreign-owned medium-sized firms are more likely to become small. This finding is worthy of further investigation.

1   Introduction

In 2015, there were 1.1 million private sector firms in Canada. Only 1,900 of these firms employed at least 500 workers, thereby satisfying Innovation, Science and Economic Development Canada's (ISED) definition of a large firm (Statistics Canada n.d.*f*). While they account for a minimal proportion of all firms (0.2%), large firms exert a significant impact on the Canadian economy through their disproportionate contribution to employment (40%), job creation (20%),[1] aggregate output (50%)[2] and exports (75%).[3] Large firms also typically pay higher wages[4] and provide their employees with greater job security.[5] Since large firms represent an enormous contribution to the Canadian economy, it is essential to understand their emergence process. Firms typically start off with a small number of workers and grow slowly over time. Hence, most large firms were at one point medium-sized. One approach to learn about the emergence process of large firms is to identify the characteristics of medium-sized firms that make them likely to become large.

In the Canadian context, medium-sized means having between 100 and 499 employees.[6] Canada's cut-off helps shape policies to encourage the growth and development of small and medium-sized enterprises (SMEs) in Canada.[7] These policies influence the number of medium-sized firms, as well as the number of medium-sized firms that become large and the number that revert to being small. Canada's firm-size classification and the 500-employee cut-off for large firms are based on those of the United States. In contrast, most member states of the Organisation for Economic Co-operation and Development (OECD) impose a cut-off of 200 or 250 employees for large firms.[8]

Canadian SMEs are often discussed as a group, but medium-sized firms are in fact quite different from small firms.[9] For one, medium-sized firms have been in existence longer. Medium-sized firms are 10 years older than small firms, on average. Moreover, medium-sized firms have crossed many of the barriers typically associated with firm entry and the start-up phase (e.g., financing, market competition, fluctuations in product demand, recruitment and retention of employees). Statistics Canada's 2014 Survey on Financing and Growth of Small and Medium Enterprises revealed that a larger proportion of medium-sized firms than small firms expected to grow in the near future and expected to expand into new markets, nationally or internationally, in the next few years. With regard to their plans over the next three years, 86.7% of medium-sized

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1. Large firms account for just under 40% of private sector employment in Canada and about one-fifth of job creation (Statistics Canada n.d.*f*). In the United States, large firms account for approximately 50% of private sector employment and 40% of job creation (Haltiwanger, Jarmin and Miranda 2013).
2. Large firms generate nearly half of Canada's gross domestic product (Leung, Rispoli and Chan 2012).
3. Given the well-documented barriers to export market participation, very few firms export. Those that do are typically the largest firms (Bernard et al. 2012). Three-quarters of Canada's exports in 2014 were generated by large firms (Statistics Canada 2015).
4. Evidence for an employer-size wage premium was found for Canada, the United States and many other countries (Leung and Ueberfeldt 2008).
5. Davis, Haltiwanger, and Schuh (1996) and Rollin (2012) documented that job destruction rates tend to be lower in large firms.
6. The conventional breakdown used by ISED is that large firms employ at least 500 workers in a calendar year, medium-sized firms employ from 100 to 499 workers, and small firms employ fewer than 100 workers (Government of Canada n.d.*a*). Approximately 98.9% of Canadian firms are small, 0.93% are medium-sized and 0.17% are large according to these definitions (Statistics Canada n.d.*f*).
7. Canada has a number of government bodies tasked with assisting SMEs. One example is the Office of Small and Medium Enterprises, which helps SMEs obtain government procurement contracts. Another is the Business Development Bank of Canada (BDC), which provides loans and advice to Canadian enterprises. Under its charter, the BDC "must give particular consideration to the needs of small and medium-sized enterprises" in designing its policies (Government of Canada n.d.*c*, 4(2)).
8. See the definition of small and medium-sized enterprises in the OECD *Glossary of Statistical Terms* (OECD n.d.).
9. All the facts and numbers presented in this paragraph use data from the 2014 Survey on Financing and Growth of Small and Medium Enterprises (Government of Canada n.d.*b*.). Previous iterations of this survey (2001, 2004, 2007 and 2011) revealed similar growth intentions on the part of medium-sized firms.

firms reported that they expected positive growth in sales, and 66.5% reported that they intended to expand sales into new markets. In contrast, 77.2% of small firms expected positive growth in sales, and 49.2% intended to expand into new markets.

How often does this intention on the part of medium-sized firms to grow and expand actually materialize? In a typical year from 2004 to 2010, 16.1% of medium-sized firms in the T2-LEAP (Longitudinal Employment Analysis Program) database reverted to being small, and only 1.8% became large. However, not much is known about what distinguishes the former from the latter. While the literature on the contribution of firms of different sizes to employment growth is voluminous,[10] little research has been done to identify the characteristics that distinguish growing and shrinking medium-sized firms. This paper aims to bridge this gap in the literature, using firm-level data on the operations of medium-sized Canadian corporations from 1999 to 2013.

The sole determinant of whether a medium-sized firm becomes large or small is not how close it is to the thresholds of 100 or 499 employees. Firms with close to 100 employees may seem likely to revert to being small, and those with close to 499 employees may seem more likely to become large. However, this is not necessarily the case. Only one-fifth of medium-sized firms with 100 to 199 employees revert to being small, and less than one-third of medium-sized firms with 400 to 499 employees become large. The objective of this paper is to identify other observable firm characteristics that shape a firm's fate.

Apart from size, the clearest determinants of a firm's outcome are its productivity and its geographic scope (i.e., the number of provinces or territories in which a firm employs workers). Firms that become large are typically more productive and more likely to operate in multiple provinces or territories than the average medium-sized firm. Those that decline are less productive and less likely to operate in multiple provinces or territories than the average medium-sized firm. These differences are evident even five years before a medium-sized firm transitions into either a small firm or a large firm.

These findings on the influence of productivity and intra-national geographic scope on firm growth closely match the findings from the international trade literature. Only a small minority of firms export, and those that do are typically larger and more productive than those that do not. Bernard et al. (2012) hypothesized that market-entry costs keep less productive firms out of foreign markets. The critical importance observed in this study of a firm's geographic scope within Canada suggests a need for greater research. The barriers that firms face in entering other provinces or territories and the extent to which these barriers resemble the barriers to international expansion could be studied further.

As Dixon and Rollin (2014) did, this paper finds that younger Canadian firms are more volatile than older ones. Medium-sized firms under age 10 are both more likely to become large and more likely to become small than their older counterparts. Both results are robust to conditioning on firm size, productivity, geographic scope, sector and year. Moreover, predicting the outcome for younger firms is more difficult than for older ones. Among medium-sized firms that become large, the youngest experience the fastest employment growth. This result is in keeping with previous findings of an inverse relationship between age and growth. Among medium-sized firms that become small, the youngest also suffer the sharpest employment losses. The authors are unaware of previous documentation of such a result for medium-sized firms.[11]

Firm-level data are known to be highly idiosyncratic, and the degree of idiosyncrasy is greatest for firms under age 10 (Haltiwanger, Jarmin and Miranda 2013; Dixon and Rollin 2014). The enhanced idiosyncrasy of young firms could be the "up-or-out" dynamic discussed by Haltiwanger,

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10. See Dixon and Rollin (2012) and Haltiwanger, Jarmin and Miranda (2013) and the references therein.
11. Dixon and Rollin (2014) also found a negative correlation between age and growth for growing firms and a positive one for shrinking firms. However, their findings are based on data on all firms. Therefore, they may not apply to the subset of medium-sized firms.

Jarmin and Miranda (2013). This dynamic could also be restricted to small start-ups struggling to survive. Since firms with at least 100 employees are not fledgling start-ups, they may be expected to exhibit dynamics similar to those of older firms, but they do not. One possible explanation of the finding that young medium-sized firms are more likely to decline is that they have a smaller consumer base. This makes them more vulnerable to the loss of a single client than older firms of a similar size.[12]

Canadian affiliates of foreign multinationals are found to be no more likely to become large than comparable Canadian-owned firms. Foreign-owned medium-sized firms are, on average, larger than Canadian-owned ones. Regressing the odds of a medium-sized firm becoming large on a foreign-ownership dummy yields a positive coefficient estimate. This is both statistically and economically significant. However, this result disappears once firm size is controlled for. In addition, this study uncovers evidence that foreign-owned medium-sized firms are more likely to contract or shut down than comparable domestically owned firms. This finding is consistent with the "footloose multinationals" hypothesis, whereby affiliates of foreign multinational corporations (MNCs) are more likely to shut down, because the parent can relocate the affiliate's operations elsewhere. Similar results (though in a different context) were shown by Görg and Strobl (2003) for Ireland, Bernard and Sjoholm (2003) for Indonesia, van Beveren (2007) for Belgium, and Alvarez and Görg (2009) for Chile.

In addition to its quantitative findings, this paper makes a methodological contribution to the study of how firms transition between size classes. Studies in this vein are hampered by the well-known regression to the mean bias discussed by Davis, Haltiwanger and Schuh (1996). This paper presents evidence that the methodology used to identify firms moving from one size class to another is crucial. Transient employment shocks are often large enough to skew a firm's two-year average employment, and these large swings are frequent. This poses a challenge when classifying firms into size classes, as well as when identifying the firms that transitioned between size classes. To minimize the impact of transient employment shocks, this study classified firms into size categories according to their average employment level over a three-year period and imposed the condition that their size class be observed at least twice over the three-year period. This set of criteria was used to identify which medium-sized firms to include in the sample and to classify them as either large, small or medium-sized after the transition year. This methodology ensures that the findings in this paper are not the result of random measurement errors or temporary firm employment shocks that typically confound analysis of firm-level employment growth. To the authors' knowledge, these criteria have not been used in the past to study firm transition between size classes.

The rest of this paper is organized as follows. Section 2 provides a discussion about the data and outlines the methodology used to classify firms into size categories. Section 3 presents the empirical approach, and Section 4 presents the regression results. Section 5 compares the results obtained with the main dataset, which pools all years together, and with each annual subsample. Section 6 concludes and proposes directions for future research.

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12. Recent empirical research on new exporters shows that buyer–seller relationships are frequently dissolved. This contributes to a high level of entry and exit for export markets. Older exporters typically have a larger number of buyers. They are therefore less vulnerable to the loss of a single client (Eaton et al. 2014).

2 Data sources and measurement issues

2.1 Data

The data used for the purposes of this study were drawn from Statistics Canada's T2-LEAP database, which was formed by merging T2 Corporation Income Tax Return records with the Longitudinal Employment Analysis Program (LEAP). Canadian employers must issue to each employee a T4 information slip detailing that employee's annual earnings. LEAP tracks every Canadian enterprise that issues at least one T4 information slip in a calendar year. A firm's total payroll is obtained by adding up the employee earnings from all the T4 information slips that the firm issues. A firm's provincial or territorial employment—or, more formally, its average labour units (ALUs)—is its payroll in a particular province or territory divided by the average wage in the firm's main industry and size class in that province or territory.[13] Summing ALUs across all provinces and territories yields the firm's aggregate employment in Canada. Since the firm's employment level is estimated by the ALU measure, it is subject to measurement error. If a firm offers higher wages than its competitors, its ALU value overestimates the firm's employment. If a firm offers lower wages than its competitors, its ALU value underestimates the firm's employment.

Canadian corporations are also required to file a T2 Corporation Income Tax Return with the Canada Revenue Agency (CRA). T2 tax files contain the firm's balance sheet, which includes data on its earnings, profits, capital cost allowance and net income. The T2 data were linked to LEAP first using the firm's business number—its CRA identifier—which does not correspond to a statistical unit of interest. The T2-LEAP database was further assembled at the enterprise level using Statistics Canada's Business Register.[14] The enterprise is an appropriate unit of analysis for the current study because key decisions, such as going into a new market, are made at the enterprise level rather than the establishment level.[15]

The T2-LEAP database contains a longitudinal firm identifier, as well as the firm's age and main industry at the four-digit North American Industry Classification System (NAICS) level. While some industries are well represented in the sample, many others have only a few medium-sized firms in a given year. The data were therefore aggregated at the sector level. Firms in the educational services (NAICS code 61), health care and social assistance (62), and public administration sectors (91) were omitted. Manufacturing (NAICS codes 31 to 33) was split into durable and non-durable manufacturing. This results in 18 sectors, which are listed in Table 3.[16]

Each year, Statistics Canada releases a new vintage of T2-LEAP data containing annual data from 1983 until the most recent year. All T2-LEAP vintages are stored separately, going back to 2007. The historical data exhibit slight variation across vintages. The variation is primarily the result of mergers and acquisitions. If, for example, a merger involving two firms took place in 2013, these formerly distinct firms are subsequently treated as a single firm in the 2013 vintage. The historical data in the 2013 vintage are adjusted accordingly so that these firms are retroactively treated as a single unit going back to the birth of the younger of the two.

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13. That is, $ALU = PAY / AAE$, where PAY denotes the firm's total payroll and AAE denotes the average annual earnings of a typical employee in that industry, firm-size class and province or territory. Data on average wages across provinces and territories and industries are drawn from Statistics Canada's Survey of Employment, Payrolls and Hours. A full description of LEAP is available (see Statistics Canada n.d.*a*).

14. The administrative data in the T2-LEAP database are structured at the level of the "statistical enterprise," which is the level associated with a complete set of financial statements. For simplicity's sake, this statistical unit is referred to as a "firm" in this study.

15. This is also the preferred approach of Haltiwanger, Jarmin and Miranda (2013), among others.

16. A list of sectors by two-digit NAICS code is available (see Statistics Canada n.d.*b*). The list of durable and non-durable manufacturing industries is available (see Statistics Canada n.d.*c*). The industry is known for all medium-sized firms found in the T2-LEAP data. Since medium-sized firms have 100 to 499 employees, they are unsurprisingly all classified in Statistics Canada's Business Register, even the youngest ones.

The benefit of this approach is that sudden firm-level employment shifts (either positive or negative) resulting from acquisitions or divestitures are avoided. In other words, firms do not suddenly become large as a result of an acquisition, nor do firms revert to being small because of a temporary restructuring when part of the company is disposed of. This methodology also prevents the sudden appearance of new large firms created through a merger of pre-existing ones.

The drawback of this methodology, however, is that discrepancies arise across T2-LEAP vintages for the same year. The data for the year 2011, for example, will vary slightly across the 2011, 2012 and 2013 vintages. Since the discrepancy widens over time, the historical data in the T2-LEAP database should be used with caution. The most recent years of each vintage should be used whenever possible.

This study uses seven T2-LEAP vintages (2007 to 2013) and uses data for the last several years of each vintage. Each vintage is used to study a transition year t, which is set three years before the final year of each vintage. (The reason for doing so is explained in the next section.) Therefore, the seven transition years studied are 2004 to 2010.

2.2 Regression to the mean and measurement errors

The simplest method of classifying firms into size categories is according to their employment level in a single year. Such an approach is subject to regression to the mean bias. As discussed by Davis, Haltiwanger and Schuh (1996) (DHS), a firm's employment level in a given year may not truly reflect its size for two reasons: (1) the firm may experience a temporary employment shock (either positive or negative) and will shortly regress to its mean, and (2) a random measurement error can result in a firm's employment being severely under- or overestimated. The latter is of particular concern. Although LEAP is the primary database for longitudinal studies of employment by Canadian enterprises, the ALU employment levels LEAP contains are estimates and are susceptible to measurement errors.

Let e_t denote a firm's employment level in year t, and let $\overline{e}_t = (e_t + e_{t-1})/2$ denote the firm's average employment in years $t-1$ and t. To reduce the issues created by regression to the mean bias and measurement errors, DHS proposed using $\overline{e}_t$ rather than e_t to classify firms into size categories in year t. This has become a standard method over the past two decades in studies of annual firm growth. This method has proven to be an effective solution to examine the contribution to employment by firms of different sizes. However, it may not be as effective when examining firms transitioning from one size category to another. This type of analysis is somewhat more permanent in nature and may require more than two years of data.

The reason for that is evident from the hypothetical example put forth by DHS to justify their methodology. DHS's Box 4.3 (Davis, Haltiwanger and Schuh 1996, p. 67) presents a hypothetical firm that employs 450 workers in the first and third years and 550 workers in the second year. If firms were categorized on the basis of their present-period employment (e_t), this hypothetical firm would be classified as medium-sized in the first and third years and large in the second year. With all else held constant, medium-sized firms would be found to experience positive employment growth while large firms would be found to experience negative employment growth over the sample period. This yields the by now controversial finding that firm growth and size are inversely correlated. In contrast, this hypothetical firm's two-year average employment level is 500 in years two and three. If $\overline{e}_t$ is used rather than e_t, this firm would be categorized as large in both years, and the mistaken inferences from the data would be avoided.

However, this hypothetical firm's average employment over the three-year period is 483.33, and the firm employed fewer than 500 employees in two out of the three years. If one is looking for

long-lasting evidence, classifying this hypothetical firm as a large firm may be inaccurate. This simple example acutely illustrates the possibility that a slight change in the number of years used for the average can significantly influence the number of firms classified in each size class.

To further illustrate this crucial consideration, Table 1 shows the number of medium-sized firms found in the T2-LEAP database using five different methodologies. Also presented for each methodology are the counts and proportions of medium-sized firms that become large or small after year t, which is called the "transition year." The one-year methodology compares the size of the firm in year t (pre-transition) and $t+1$ (post-transition). The two-year average methodology identifies medium-sized firms by computing the firm's average employment in years $t-1$ and t, and the post-transition outcome is determined based on the firm's average employment in years $t+1$ and $t+2$. The three-year average method is similar to the two-year average method, but the pre-transition period ($t-2$, $t-1$, t) and post-transition period ($t+1$, $t+2$, $t+3$) are longer. The fourth method builds on the three-year average method, but it also imposes the condition that the size class be observed for at least two years out of the three. The last column presents the final sample used in this study, which was constructed using the fourth method and by applying additional restrictions (explained below). For all methods presented, firms must have positive employment in all the pre-transition years (e.g., t for the one-year method; $t-2$, $t-1$ and t for the three-year method).

The seven vintages used from the T2-LEAP database contain 65,659 medium-sized firms in the private sector according to the one-year methodology, 63,894 according to the three-year average methodology and 61,630 when the two-out-of-three-years condition is imposed. Of interest is the number of medium-sized firms that transitioned to the large or small size classes after the transition year. Notice that these numbers increase between the one-year, two-year average and three-year average methods. When employment level is averaged over more years, fewer medium-sized firms are identified, but more are flagged as having transitioned to another size class.

Table 1
Comparison of methodologies

	Methodology 1: One year employment	Methodology 2: Two-year average employment	Methodology 3: Three-year average employment	Methodology 4: Three-year average employment and firm belongs to the size class at least two years out of three	Methodology 5: Final sample — Methodology 4, and medium-sized firms that were previously large are excluded
	number				
Medium-sized firms	65,659	64,885	63,894	61,630	59,397
Outcome in post-transition period					
Remain medium-sized	57,259	53,869	50,876	50,341	48,787
Become large	923	1,256	1,499	1,230	1,061
Become small	7,251	8,456	9,220	7,638	7,544
Go out of business	226	1,304	2,299	2,111	2,005
	percent				
Remain medium-sized	87.2	83.0	79.6	82.1	82.1
Become large	1.4	1.9	2.3	2.0	1.8
Become small	11.0	13.0	14.4	12.5	12.7
Go out of business	0.3	2.0	3.6	3.4	3.4
Medium-sized status is observed at least twice in the three years preceding the transition year (t-2, t-1 and t)	88.8	93.4	96.0	100.0	100.0
Outcome size class is observed at least twice in the three years following the transition year (t+1, t+2 and t+3)					
Become large	80.4	87.9	91.0	100.0	100.0
Become small	77.8	90.4	93.3	100.0	100.0

Note: Data for the seven transition years studied are pooled (2004 to 2010).
Source: Statistics Canada, T2-LEAP database, 2002 to 2013.

Also of interest is the number of years between $t-2$ and t that firms were medium-sized. Most firms were medium-sized at least two out of the three years preceding the transition year. This proportion goes from 88.8% for the one-year method to 96.0% for the three-year average method. Even in the latter case, some firms were medium-sized for at most one out of the three years. To classify these firms as medium-sized would be questionable. The episode of medium-sized status is so brief that it may be the product of measurement error with the ALU calculation or a very temporary status. The fourth and fifth methodologies completely remove those firms from the sample.

The last rows of Table 1 focus on the subsample of firms that become either large or small, and report the share for which the outcome size class was observed at least twice over years $t+1$, $t+2$ and $t+3$. With the one-year method, only 80.4% of firms identified as having become large employed at least 500 workers in at least two out of the three years. The remaining 19.6% were classified as large as the result of a transient positive employment shock or a measurement error. Among firms that revert to being small, 77.8% employed fewer than 100 workers for at least two out of the three post-transition years. The remaining 22.2% were classified as small as the result of a transient negative employment shock or a measurement error. The three-year average method reduces these biases to 9.0% for firms that become large and 6.7% for firms that become small. Using more years to determine firm size classification not only increases the number of firms identified as having transitioned to another size class, it also increases the likelihood that such transitions are permanent and not the result of a one-year jump or drop in employment level.

The remaining classification bias can be eliminated with the addition of two further restrictions, as done in Methodologies 4 and 5. First, to be classified as medium-sized, a given firm must have a medium-sized employment level in at least two out of the three pre-transition years ($t-2$ to t). Second, a firm that grows into a large firm must have a large employment level in at least two out of the three post-transition years ($t+1$ to $t+3$). A firm that reverts into a small firm must have a small employment level in at least two of the three post-transition years. This approach reduces slightly the number of medium-sized firms, as well as the number of medium-sized firms that become large or small, but it eliminates the classification bias.

Some of the medium-sized firms identified may have been large in the recent past but reverted to being medium-sized. Such firms are fundamentally different from firms that have not been large previously. A final criterion was therefore added in Methodology 5 to filter out these cases. Let w_t denote a three-year window from $t-2$ to t. Firms that satisfy the criterion for being large in any three-year window between w_{t-4} and w_{t-1} were omitted. Note that firms that did not have positive employment every year in the pre-transition period ($t-2$, $t-1$ and t) were also excluded. This restriction effectively disqualifies all firms under age 3 from the sample.[17]

To recap, a firm must satisfy the following criteria to be included in the sample:

1. $E_t \in [100,500)$ where $E_t = (e_t + e_{t-1} + e_{t-2})/3$.

2. $M_t + M_{t-1} + M_{t-2} \geq 2$, with $M_t = 1$ if $e_t \in [100,500)$, and 0 otherwise.

3. $e_{t-2}, e_{t-1}, e_t > 0$.

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17. This is not a major concern, since the vast majority of young firms tend to be small and grow very slowly over time (Foster, Haltiwanger and Syverson 2016). Young firms that employ at least 100 workers are typically affiliates of foreign multinationals (Haltiwanger, Jarmin and Miranda 2013), or they are exceptional start-ups whose characteristics are inconsistent with the majority of firms their age.

4. $\qquad E_\tau < 500, \ \tau = \{t-4, t-3, t-2, t-1\}.$

5. $\sum\limits_{\delta=0}^{2} L_{\tau-\delta} < 2, \ \tau = \{t-4, t-3, t-2, t-1\}$, with $L_\tau = 1$ if $e_\tau \geq 500$, and 0 otherwise.

Once a firm is included in the sample, it can be classified as large, medium-sized or small in the post-transition period. A firm is classified as large in the post-transition period if it meets the following three requirements:

1. $\qquad E_{t+3} \geq 500.$

2. $\qquad L_{t+1} + L_{t+2} + L_{t+3} \geq 2$, with $L_\tau = 1$ if $e_t \geq 500$, and 0 otherwise.

3. $\qquad e_{t+1}, e_{t+2}, e_{t+3} > 0.$

Firms satisfying the following conditions are classified as small in the post-transition period:

1. $\qquad E_{t+3} < 100.$

2. $\qquad S_{t+1} + S_{t+2} + S_{t+3} \geq 2$, with $S_t = 1$ if $e_t < 100$, and 0 otherwise.

3. $\qquad e_{t+1}, e_{t+2}, e_{t+3} > 0.$

Firms with positive employment in every year of w_{t+3} that fail to meet the criteria to be characterized as either large or small are classified as firms that remain medium-sized. Firms that do not have positive employment in every year of w_{t+3} are classified as going out of business.

The last column of Table 1 presents the final sample, which consists of 59,397 observations. The vast majority (82.1%) of medium-sized firms remain medium-sized in the post-transition period. Only a small minority (1.8%) become large. The remaining 16.1% contract, either becoming small or going out of business. To simplify the exposition, the latter two are grouped together and categorized as declining firms for the remainder of the paper.[18] The objective is to determine what distinguishes medium-sized firms that become large from those that decline.

2.3   An overview of the data

Tables 2 and 3 present some descriptive statistics on the sample of medium-sized firms studied. Firms with a higher employment level in the pre-transition period are probably more likely to become large and less likely to decline. This affirmation is true, as can be seen in Table 2. This is the case because these firms require a smaller employment adjustment to reach 500 employees, and they can absorb a larger decline in employment and still remain above the 100-employee threshold. Among the largest medium-sized firms, 41.4% of those with at least 450 employees become large. This share is substantially larger than the 1.3% observed for firms with 200 to 299 employees. Similarly, more than one-quarter (26.7%) of firms with fewer than 150 employees in the pre-transition period become small, whereas 5.6% of firms with 200 to 299 employees did so.

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18. Some sensitivity analysis was performed for this specification. The main conclusions presented in the study are robust, whether or not firms that go out of business are included in the "become small" group.

Table 2
Share of firms in each outcome size class, by selected firm characteristics

	Become large	Remain medium-sized	Become small
		percent	
All medium-sized firms	1.8	82.1	16.1
Employment in pre-transition period (average ALU over years *t*-2, *t*-1 and *t*)			
100 to 199	0.1	78.9	21.0
100 to 149	0.1	73.3	26.7
150 to 199	0.3	89.7	10.0
200 to 299	1.3	93.1	5.6
300 to 399	7.7	89.0	3.4
400 to 499	30.3	67.2	2.5
400 to 449	24.1	73.7	2.2
450 to 499	41.4	55.7	2.9
Firm age			
Under 10 years	2.4	77.7	20.0
10 to 19 years	1.7	80.3	18.0
20 years or over	1.7	83.9	14.4
Country of ownership			
Canada	1.5	81.9	16.6
Others	2.8	83.1	14.1

Notes: ALU: average labour unit. Data for the seven transition years studied are pooled (2004 to 2010). Data on country of ownership cover transition years 2007 to 2010 only. The outcome 'become small' includes firms that go out of business.
Source: Statistics Canada, T2-LEAP database, 2002 to 2013.

While a firm's employment level in the pre-transition period is an important determinant of its post-transition size classification, it is not the whole story. Table 3 splits firms into six size categories. Note that among firms that become large, only 48.7% had an average employment level of at least 400 in the three years preceding the transition. In contrast, 91.0% of firms that become small had fewer than 200 employees on average in the pre-transition period. Firm size therefore seems to predict differently the likelihood of becoming large versus becoming small. While conditioning on E_t is indeed important in a regression framework, it is not the sole determinant of whether a firm remains medium-sized, becomes large or declines.

In Table 3, firms are split into three year t age categories: under 10 years, 10 to 19 years, and 20 years or over. Since firm growth is a slow process (Foster, Haltiwanger and Syverson 2016), the vast majority (61.8%) of medium-sized firms have unsurprisingly been in business for at least 20 years, and only 14.6% are under age 10. However, older firms are underrepresented among those that become large (58.0%) or declined (55.5%). In contrast, firms under age 10 are overrepresented in both transition categories (19.4% of those that become large and 18.2% of those that decline).

Older medium-sized firms are, on average, larger than younger ones (see last rows in Table 3). Firms under age 10 employ 175 workers on average during the three pre-transition years, while firms that are at least 20 years old employ 188 workers on average. The positive correlation between age and size also holds for the subset of firms that either become large or remain medium-sized. However, the correlation between age and size among firms that decline is negative. The average employment level for declining firms under age 10 is 145, and the average for those that are 20 or over is 136. This suggests that younger firms that decline shed employment at a faster rate than older ones. Further examination of this issue is deferred until the regression analysis presented in Section 4.

Table 3
Overview of the sample, by outcome size class

	All medium-sized firms	Become large	Remain medium-sized	Become small
	percent			
Employment in pre-transition period (average ALUs over years *t*-2, *t*-1 and *t*)				
100 to 149	46.0	1.2	41.0	76.2
150 to 199	23.9	4.0	26.1	14.8
200 to 299	19.9	14.6	22.6	6.9
300 to 399	7.3	31.5	7.9	1.5
400 to 449	1.8	24.8	1.7	0.3
450 to 499	1.0	23.9	0.7	0.2
Firm age category				
Under 10 years	14.6	19.4	13.8	18.2
10 to 19 years	23.6	22.6	23.1	26.4
20 years or over	61.8	58.0	63.1	55.5
Sector				
Agriculture, forestry, fishing and hunting	1.1	0.5	1.0	1.6
Mining, quarrying and oil and gas extraction	1.4	4.6	1.3	1.4
Utilities	0.4	0.7	0.4	0.2
Construction	6.5	9.6	6.5	6.2
Non-durable manufacturing	9.4	5.9	9.4	10.3
Durable manufacturing	13.9	9.2	13.4	16.9
Wholesale trade	9.4	5.6	9.6	8.9
Retail trade	13.1	11.5	13.3	12.1
Transportation and warehousing	5.0	5.0	5.1	4.4
Information and cultural industries	2.2	3.7	2.0	3.0
Finance and insurance	4.3	7.1	4.5	3.0
Real estate and rental and leasing	2.2	1.8	2.2	2.6
Professional, scientific and technical services	5.2	7.2	5.1	5.7
Management of companies and enterprises	1.4	2.4	1.2	2.4
Administrative and support, waste management and remediation services	6.6	14.2	6.1	7.9
Arts, entertainment and recreation	2.4	3.8	2.6	1.4
Accommodation and food services	10.9	3.9	11.4	9.1
Other services (except public administration)	4.5	3.5	4.8	3.0
Country of ownership				
Canada	87.0	78.6	86.9	88.8
Others	13.0	21.4	13.1	11.2
	number			
Average employment in pre-transition period (ALUs)				
All firms	183	377	188	138
Firm age				
Under 10 years	175	334	178	145
10 to 19 years	176	367	181	137
20 years or over	188	395	192	136
Country of ownership				
Canada	178	376	183	135
Others	218	389	223	152

Notes: ALU: average labour unit. Data from the seven transition years studied are pooled (2004 to 2010). Data on country of ownership cover transition years 2007 to 2010 only. The outcome 'become small' includes firms that go out of business.
Source: Statistics Canada, T2-LEAP database, 2002 to 2013.

Table 3 also presents a sectoral breakdown of medium-sized firms. Note that medium-sized firms are unequally distributed across sectors. Some sectors (e.g., manufacturing; retail trade; and accommodation and food services) comprise over 10% of all medium-sized firms, and others (e.g., agriculture, forestry, fishing and hunting; and utilities) comprise barely 1%. The share of medium-sized firms that become large or decline varies across sectors. Manufacturing firms are

more prone to decline and less likely to become large than firms in other sectors during the period studied. In contrast, firms in three sectors (mining, quarrying, and oil and gas extraction; finance and insurance; and administrative and support, waste management and remediation services) are overrepresented among medium-sized firms that become large.

The cross-sector differences in the propensity of medium-sized firms to become large or decline may be driven by a restructuring of the economy during the period studied. The sample is constructed on the basis of firms' employment level in years $t-2$ to $t+3$, which correspond to a time range from the 2002-to-2007 period to the 2008-to-2013 period for the seven T2-LEAP vintages used. This period is marked by a severe contraction in manufacturing and strong growth in the construction and finance industries.[19] That manufacturing is overrepresented among firms that declined and construction and finance are overrepresented among firms that became large is not surprising. However, growing firms in declining sectors and declining firms in growing sectors are not uncommon (Haltiwanger 1997). For example, the wholesale trade sector expanded by 24% during the sample period (the same growth rate as the construction sector), but firms in the wholesale trade sector are underrepresented among those that became large.

The period studied also surrounds the 2008/2009 recession. The behaviours and prospects of medium-sized firms might have been different during the recession and the subsequent recovery period than during years unaffected by a global downturn. In the regression analysis, special attention is given to both sector and year effects. The main results are obtained by pooling all years together, but sensitivity analysis is carried out for each annual subsample in Section 5. Similar patterns are observed across years, which provide preliminary evidence that the main conclusions can be expected to hold throughout the business cycle.

Another variable that may determine whether a medium-sized firm becomes large is its country of control. Since start-ups are typically small, young firms with over 100 employees may be Canadian affiliates of foreign multinationals. This would be the case if an MNC entered the market through a greenfield investment. However, MNCs typically enter a market by acquiring an existing firm. Acquisition targets are often established firms that have been in business for a significant period of time.[20] Hence, the influence of age on whether a firm becomes large or declines may depend on whether the firm is foreign-owned. In addition, foreign direct investment is typically concentrated in particular industries.[21]

The T2-LEAP database provides data on the country of the ultimate owner of each firm, but comparability concerns exist with the pre-2007 data.[22] Therefore, firm ownership is examined only in the T2-LEAP vintages from 2010 to 2013 (i.e., four transition years from 2007 to 2010).[23] Table 3 displays a breakdown of medium-sized firms by ownership type. The vast majority of medium-sized firms (87.0%) are Canadian-owned. However, 21.4% of medium-sized firms that become large are foreign-owned, and only 11.2% of medium-sized firms that decline are foreign-owned. Foreign-owned firms are also larger and more productive. Therefore, without a regression analysis, it is not possible to determine whether the overrepresentation of foreign-owned firms among firms that become large is the result a composition effect.

Thus far, the focus has been on determinants in year t. However, 85.4% of the firms were in business for at least a decade prior to year t (see Table 3). Differences between firms that become large and those that revert to being small probably did not appear suddenly in year t but

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19. Source: CANSIM table 379-0031 (Statistics Canada n.d.*e*).
20. Blonigen et al. (2014) showed that acquisition targets are often firms that have an extensive export network and have experienced an adverse shock.
21. See Antràs and Yeaple (2014). For information on Canada, see CANSIM table 376-0153 (Statistics Canada n.d.*d*).
22. The redesign of Statistics Canada's Business Register during this period created a break in the methodology used to identify foreign-owned firms. Work has begun to reconcile the data before and after this redesign, and those improved data will be available in the future.
23. These vintages contain 34,739 of the 59,397 observations.

were apparent even a few years earlier. Given that productivity differences among firms are persistent (Foster, Haltiwanger and Syverson 2008; Syverson 2011), the differences were likely evident even five years prior to the transition.

The T2-LEAP database does not contain information on firms' capital stock. Productivity was therefore estimated using income statement and balance sheet data. This is similar to the methodology used by Gu and Lafrance (2014).[24] Let TLC denote total labour cost, CCA denote capital cost allowance, NI denote net income before taxes and E denote employment. Value added (VA) is the sum of the value of labour and capital employed by the firm adjusted for depreciation in the capital stock. The value of capital can be proxied by a firm's net income before taxes. Hence, value added can be expressed as $VA = TLC + CCA + NI$. A firm's productivity is simply its value added per worker, i.e., VA/E.

The actual productivity level is relevant when comparing firms in the same sector. Firms were split into four productivity quartiles for each year-sector pair. The least productive firms were grouped into the first quartile, and the most productive were grouped into the fourth quartile. Summary statistics are presented in Table 4. Most (69.4%) of the firms that become large are in the third and fourth productivity quartiles one year prior to the transition, while most (65.0%) of the firms that decline are in the first and second quartiles. The bottom panel reveals that these productivity differences existed even five years earlier. Two-thirds of firms that become large were already in the third and fourth productivity quartiles in year $t-5$, while 59.5% of firms that decline were in the first and second quartiles.[25]

Table 4
Share of firms in each productivity quartile in year *t* and year *t*-5, by outcome size class

	All medium-sized firms	Become large	Remain medium-sized	Become small
		percent		
Productivity quartile in year *t*				
First quartile	24.9	13.9	22.1	40.7
Second quartile	25.0	16.7	25.4	24.3
Third quartile	25.0	30.1	26.1	18.5
Fourth quartile	25.1	39.3	26.5	16.5
Productivity quartile in year *t*-5				
First quartile	24.9	17.1	23.3	33.9
Second quartile	25.0	15.9	25.1	25.6
Third quartile	25.0	27.1	25.5	22.3
Fourth quartile	25.1	39.9	26.1	18.2

Note: The outcome 'become small' includes firms that go out of business. The sum of shares for a given group may not be 100 because of rounding.
Source: Statistics Canada, T2-LEAP database, 1999 to 2013.

However, productivity differences cannot fully explain a firm's fate in the post-transition period. After all, about one-third of firms that become small are in the third and fourth productivity quartiles, and about one-third of firms that become large are in the first and second quartiles. A firm's growth rate leading up to the transition period is another factor that can shape the outcome. Table 5 focuses on employment and revenue growth in the pre-transition period. Both employment level and revenue were calculated on the basis of a three-year average, and the annual growth represents the change in this three-year moving average. Let E_t denote average employment between $t-2$ and t. Employment growth between $t-1$ and t is calculated as

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24. The authors thank Wulong Gu for his help in this process.
25. A firm's quartile in $t-5$ reflects its ranking compared with other firms in the sample. Not all firms were medium-sized in $t-5$.

$\ln E_t - \ln E_{t-1}$. Revenue growth is calculated in a similar manner. This approach is used to measure the firm's trend and to diminish the effect of annual fluctuations.

Firms that become large experienced higher employment and revenue growth even five years prior to the transition. Firms that decline, in contrast, are not as easily identifiable. They grew at the same rate (or even faster) than firms that remain medium-sized until at least two years prior to the transition. Firms that revert to being small are identifiable by their slower growth rate only from $t-2$ onwards. This suggests that declining firms are hit with an adverse shock two to three years prior to the transition. This shock curtails their growth, and they do not recover in the short term.

Table 5
Average growth in the pre-transition period, by outcome size class

Growth and period	All medium-sized firms	Become large	Remain medium-sized	Become small
		log growth		
Average employment growth				
t-6 to t-5	0.081	0.130	0.079	0.082
t-5 to t-4	0.078	0.131	0.077	0.078
t-4 to t-3	0.075	0.133	0.074	0.077
t-3 to t-2	0.072	0.135	0.070	0.075
t-2 to t-1	0.057	0.135	0.057	0.045
t-1 to t	0.030	0.166	0.040	-0.034
Average revenue growth				
t-6 to t-5	0.113	0.161	0.114	0.102
t-5 to t-4	0.119	0.168	0.120	0.108
t-4 to t-3	0.104	0.140	0.105	0.096
t-3 to t-2	0.092	0.171	0.092	0.081
t-2 to t-1	0.071	0.166	0.074	0.046
t-1 to t	0.046	0.152	0.056	-0.014

Notes: The outcome 'become small' includes firms that go out of business. Growth reports the difference in adjacent three-year averages. For example, employment growth between t-1 and t is calculated as $\ln(E_t) - \ln(E_{t-1})$ where E_t denotes average employment between t-2 and t, and E_{t-1} denotes average employment between t-3 and t-1.

Source: Statistics Canada, T2-LEAP database, 1999 to 2013.

Table 6 continues to exploit the time-series dimension of the data to explore the domestic geographic scope of medium-sized firms in the five years prior to transition. A firm's geographic scope is based on the number of provinces and territories in which the firm employs workers.[26] Nearly two-thirds of medium-sized firms employ workers in solely one province or territory throughout the entire six-year period, while only about one-fifth employ workers in three or more provinces or territories. In contrast, 59.3% of firms that become large employed workers in multiple provinces or territories as early as five years prior to the transition. This proportion is up to 68.0% in transition year t. An additional 8.7% of firms expanded employment beyond their main province or territory between $t-5$ and t. Among declining firms, about 70% employed workers only within one province or territory throughout the whole period.

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26. This variable, which can be derived from LEAP data, was first used by Rollin (2014).

Table 6
Geographic scope, from year _t_-5 to year _t_, by outcome size class

Size class and geographic scope	Year					
	_t_-5	_t_-4	_t_-3	_t_-2	_t_-1	_t_
	percent					
All medium-sized firms						
One province or territory	64.2	63.7	62.9	62.2	61.9	62.1
Two provinces or territories	16.0	15.8	16.0	16.2	16.1	15.9
Three or more provinces or territories	19.8	20.4	21.0	21.6	22.0	22.0
Become large						
One province or territory	40.7	39.1	37.4	35.0	33.7	32.0
Two provinces or territories	19.1	18.2	18.4	18.1	17.1	17.1
Three or more provinces or territories	40.2	42.7	44.3	46.9	49.2	50.9
Become small						
One province or territory	70.4	69.5	68.6	67.9	67.9	69.6
Two provinces or territories	15.9	16.2	16.6	17.0	17.1	16.4
Three or more provinces or territories	13.7	14.3	14.8	15.1	15.0	14.0

Notes: The outcome 'become small' includes firms that go out of business. Geographic scope is the number of provinces or territories in which the firm has employees. The sum of shares for a given group may not be 100 because of rounding.
Source: Statistics Canada, T2-LEAP database, 1999 to 2013.

3   Empirical strategy

A medium-sized firm can be in one of three states in the post-transition period: become large, remain medium-sized or become small. Given the multinomial nature of the outcome structure, multinomial logit (MNL) estimation is used to assess the factors that shape the outcome.[27] MNL simultaneously estimates $m-1$ logistic regressions, with m being the number of outcomes in the post-transition period and one outcome chosen as the reference outcome. The natural baseline outcome in this case is the status quo (remaining medium-sized). Equation (1) summarizes the regression to be estimated:

$$\ln\left(\frac{\Pr[\text{become Large}]}{\Pr[\text{remain medium}-\text{sized}]}\right)_{i,t} = x'_{i,t}\beta + \delta_h + \alpha_j + \theta_t + u_{i,t}, \tag{1a}$$

$$\ln\left(\frac{\Pr[\text{decline}]}{\Pr[\text{remain medium}-\text{sized}]}\right)_{i,t} = x'_{i,t}\gamma + \tau_h + \rho_j + \sigma_t + e_{i,t}. \tag{1b}$$

x'_i denotes a matrix of observable characteristics for firm i, while β and γ denote vectors of coefficient estimates. The firm characteristics examined in this study include the firm's age, size, productivity quartile and geographic scope within Canada. As denoted by the subscripts, all

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27. Since the possible states in the post-transition period are somewhat ordered (being large is preferable to being medium-sized, and being medium-sized is preferable to declining), estimation through ordered logit may seem to be a better choice. This is not the correct approach for this study, however. The coefficient estimates from an ordered logit regression reveal how changing a covariate has an impact on the probability that a firm will experience a higher ordered outcome. This assumes that the effect of each covariate is proportional between each pair of outcomes (i.e., a single set of coefficients is produced). For example, the effect of firm age is assumed to be the same both in sign and in magnitude when firms that become small are compared with those that remain medium-sized, as well as when firms that remain medium-sized are compared with those that become large. MNL estimates, in contrast, show how an observable characteristic has an impact on the probability that a firm will become large relative to remaining medium-sized separately from how it has an impact on the probability that a firm will decline relative to remaining medium-sized. This is the proper estimation approach given the descriptive statistics presented in Section 2.

regressions include the main province or territory (h),[28] sector (j) and year (t) fixed effects. Standard errors are clustered at the four-digit NAICS level to control for correlation across firms within an industry over time.

The coefficient estimates from (1a) show how a change in a regressor has an impact on the probability that a firm will become large rather than remain medium-sized. The estimates from (1b) show how such a change has an impact on the probability that a firm will decline rather than remain medium-sized. These ratios of probabilities are often referred to as odds ratios. In much of the following discussion, the two outcomes will be referred to as the odds of becoming large (1a) and the odds of declining (1b). Coefficient estimates from MNL are interpreted in the same manner as those from a regular (binary) logit estimation. This means that dividing a coefficient estimate by four gives an approximate elasticity for continuous variables (Cameron and Trivedi 2005). Continuous variables enter the regression in log form, and growth rates are log growth rates.

The empirical analysis focuses on two different years: the final pre-transition year (year t) and five years earlier (year $t-5$).

4   Regression results

This section presents two sets of estimation results. The first set examines the role that observable firm characteristics during the final pre-transition year play in shaping the outcome. The second set explores whether the firms that become large and those that decline are different five years prior to the transition.

4.1   Results for the final pre-transition year

Table 7 presents estimation results for Equation (1) using data for year t. Model 1 examines whether the outcome varies systematically with a firm's age, once employment differences are accounted for. Model 2 introduces an interaction term between firm age and firm size, which is kept in all subsequent models. Model 3 investigates the role played by productivity differences, and adds the firm's productivity quartile. Model 4, the fully specified model, further controls for the firm's geographic scope within Canada. For each model, two sets of estimation results are presented: the odds of becoming large in relation to remaining medium-sized, and the odds of declining in relation to remaining medium-sized.

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28. A firm's main province or territory is the one in which it employs the largest number of workers in year t and may not be the province or territory in which the firm's headquarters are located.

Table 7

Multinomial logit estimation results at year _t_, with remaining medium-sized as the base group

	Model 1	Model 2	Model 3	Model 4
	coefficient			
Employment				
Become large	5.711 ***	6.745 ***	6.763 ***	6.671 ***
Become small	-3.064 ***	-3.486 ***	-3.496 ***	-3.456 ***
Firm age (reference: 20 years or over)				
Become large				
3 to 4 years	0.787 **	19.329 ***	19.357 ***	19.082 ***
5 to 9 years	0.663 ***	13.497 ***	13.759 ***	13.770 ***
10 to 14 years	0.370 **	10.938 ***	10.856 ***	10.801 ***
15 to 19 years	0.838	5.037	4.878	4.900
Become small				
3 to 4 years	0.372 **	-8.520 ***	-8.981 ***	-8.886 ***
5 to 9 years	0.254 **	-5.920 ***	-6.046 ***	-5.990 ***
10 to 14 years	0.256 ***	-2.566 *	-2.541 *	-2.520 *
15 to 19 years	0.087	-2.817 *	-2.910 *	-2.860 *
Firm age × employment (reference age: 20 years or over)				
Become large				
3 to 4 years	…	-3.191 ***	-3.180 ***	-3.128 ***
5 to 9 years	…	-2.197 ***	-2.228 ***	-2.230 ***
10 to 14 years	…	-1.803 ***	-1.779 ***	-1.770 ***
15 to 19 years	…	-0.839	-0.802	-0.808
Become small				
3 to 4 years	…	1.802 ***	1.868 ***	1.848 ***
5 to 9 years	…	1.256 ***	1.255 ***	1.244 ***
10 to 14 years	…	0.574 **	0.555 *	0.550 *
15 to 19 years	…	0.591 *	0.600 *	0.590 *
Productivity quartile (reference: first quartile)				
Become large				
Second quartile	…	…	0.378 **	0.373 *
Third quartile	…	…	0.790 ***	0.762 ***
Fourth quartile	…	…	0.902 ***	0.859 ***
Become small				
Second quartile	…	…	-0.755 ***	-0.749 ***
Third quartile	…	…	-1.006 ***	-0.993 ***
Fourth quartile	…	…	-1.068 ***	-1.050 ***
Number of provinces or territories				
(reference: one province or territory)				
Become large				
Two provinces or territories	…	…	…	0.343 **
Three or more provinces or territories	…	…	…	0.446 ***
Become small				
Two provinces or territories	…	…	…	0.048
Three or more provinces or territories	…	…	…	-0.235 ***
	number			
Regression summary				
Log pseudo-likelihood	-25,846	-25,738	-25,025	-24,985
Pseudo R-squared[1]	0.1749	0.1784	0.2011	0.2024
Observations	59,397	59,397	59,397	59,397

… not applicable

* significantly different from reference category ($p < 0.05$)

** significantly different from reference category ($p < 0.01$)

*** significantly different from reference category ($p < 0.001$)

1. Each model provides a greater fit than the previous model, according to a log-likelihood ratio test ($p < 0.001$).

Notes: For multinomial logit, only the sign and significance of coefficient estimates are generally interpretable, not their magnitude (see Table 11 for predicted probabilities, and Footnotes 29 and 30 for an explanation on marginal effects). Robust standard errors are clustered at the four-digit North American Industry Classification System level. All regressions include main province or territory, sector and year fixed effects.

Source: Statistics Canada, T2-LEAP database, 2002 to 2013.

4.1.1 Age

Consistent with the "up-or-out" dynamic found by Haltiwanger, Jarmin and Miranda (2013), the youngest firms are the most likely to expand.[29] Relative to firms under age 5, older firms face significantly lower odds of becoming large, and the relative odds decline with firm age. The null hypothesis that firms between the ages of 5 and 9 face the same odds of becoming large as firms aged 10 or over can be rejected. This result remains robust even after productivity and geographic scope are included among the regressors.

The youngest firms are also the most likely to decline.[30,31] Relative to firms under age 5, firms that are 15 to 19 years old and those that are at least 20 years old face lower odds of declining. The null hypothesis that firms aged 10 to 14 face the same odds of declining as firms that are at least 15 years old can be rejected. These results are robust to the inclusion of additional controls.

As mentioned in Subsection 2.3, firm age and pre-transition period employment level are positively correlated for firms that remain medium-sized and for those that become large. This suggests that the influence of pre-transition period employment level on the odds of becoming large increases with firm age. To determine whether this is the case, an interaction of pre-transition employment level with the age dummies was included among the regressors in Equation (1). With respect to the odds of a medium-sized firm becoming large, the three interaction terms for the youngest age groups are negative and significant. This means that younger firms can become large with a lower initial employment level than older firms. In other words, younger firms grow faster than older ones. This is consistent with the findings of Haltiwanger, Jarmin and Miranda (2013). The fastest-growing firms are those under age 5. While firms aged 5 to 9 grow at a slower pace than their younger counterparts, they experience faster growth than firms that are aged 15 or over.[32]

The influence of pre-transition employment level on the odds of declining also varies with age. Regarding the odds of a firm becoming small, all four interaction terms are positive and significant. This means that younger firms can become small with a larger initial employment level than older firms. A given increase in initial employment (for example, a one-standard-deviation increase) increases the odds of shrinking more for firms that are under age 10 than for older ones. In other words, pre-transition employment level is a better predictor for older firms of whether a firm becomes large, remains medium-sized or declines. Younger firms exhibit a greater degree of idiosyncrasy, as was documented by Haltiwanger, Jarmin and Miranda (2013), and Dixon and Rollin (2014).

This idiosyncrasy warrants a more thorough investigation of the relationship between firm age and employment growth in the post-transition period. Let $G_t = \left(E_{t+3} - E_t \right) / V_t$ denote the midpoint

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29. This conclusion cannot be reached by looking at the coefficients in Table 7. In MNL, it is not always possible to infer the sign of a variable's marginal effect from the sign of the coefficient(s) involved. This impossibility arises frequently with models that include an interaction term (like Models 2, 3 and 4 in Table 7). It is so because probabilities are bounded between 0 and 1, but the estimated coefficients are not restricted. The marginal effect of a particular variable can be obtained with further estimation or hypothesis testing. Table 11, which presents predicted probabilities using Model 4 confirms the conclusion that the youngest firms are the most likely to expand. Some hypothesis testing results comparing firms of different ages are also presented in the text.
30. This conclusion cannot be reached by looking at the coefficients in Table 7. See the explanation provided in footnote 29. Table 11, which presents predicted probabilities using Model 4 confirms the conclusion that the youngest firms are the most likely to decline. Some hypothesis testing results comparing firms of different ages are also presented in the text.
31. The estimation results support the use of MNL rather than ordered logit for the purposes of this study. The youngest firms are the most likely to shrink (a lower ordered response than remaining medium-sized) and also the most likely to become large (a higher ordered response than remaining medium-sized). Such a result could not be derived from an ordered logit estimation.
32. The null hypothesis that the interaction term for firms aged 5 to 9 is the same as the interaction term for firms aged 15 to 19 is rejected at the 5% significance level for the fully specified model. The null hypothesis that the interaction term for firms aged 5 to 9 is the same as the interaction term for firms aged 20 or over can be rejected at the 1% significance level.

employment growth rate between the two periods, with $V_t = (E_{t+3} + E_t)/2$ being the average of pre- and post-transition employment.[33] Let $a_{i,t}^k$ denote a dummy variable that takes on the value of 1 if firm i is in the kth age category in year t. To determine whether employment growth between the two periods systematically varies with age, the following ordinary least squares (OLS) regression was estimated. The regression includes main province or territory (h), sector (j) and year (t) fixed effects.

$$G_{i,t} = \beta_1 + \sum_{k=2}^{5} \beta_k a_{i,t}^k + \beta_6 E_{i,t} + \delta_h + \alpha_j + \theta_t + u_{i,t}. \tag{2}$$

Column 1 in Table 8 presents the results for the entire sample. Column 2 restricts attention to the subset of firms that become large, Column 3 those that remain medium-sized and Column 4 those that decline.[34] Firm age and employment growth do not have a relationship for the sample as a whole. However, a relationship does exist within the three subsets of the sample. Columns 2 and 3 present evidence of an inverse relationship between firm age and employment growth for the subset of firms that either become large or remain medium-sized. This relationship is reversed for firms that decline. Column 4 reveals that young firms contract at a faster rate than older ones. Firms aged 5 to 9 with identical starting employment levels contract at a rate about 10% slower than that of firms under age 5. In contrast, firms that are at least 20 years old contract at a rate about 20% lower than firms under age 5.[35]

Table 8
Influence of firm age on post-transition employment growth

	Column 1	Column 2	Column 3	Column 4
	All medium-sized firms	Become large	Remain medium-sized	Become small
		coefficient		
Firm age (reference: 3 to 4 years)				
5 to 9 years	0.012	-0.027	-0.035 **	0.093 *
10 to 14 years	-0.001	-0.060	-0.067 ***	0.140 ***
15 to 19 years	0.014	-0.070	-0.067 ***	0.147 ***
20 years or over	0.020	-0.085 *	-0.086 ***	0.210 ***
Employment level	0.049 ***	-0.856 ***	-0.142 ***	-1.014 ***
Constant	-0.454 ***	5.690 ***	0.780 ***	4.042 ***
		number		
Regression summary statistics				
R-squared	0.02	0.67	0.09	0.27
Observations	59,397	1,061	48,787	9,549

* significantly different from reference category (p < 0.05)

** significantly different from reference category (p < 0.01)

*** significantly different from reference category (p < 0.001)

Notes: Estimation is through ordinary least squares, and the dependent variable is the employment growth rate from year t to year $t+3$. Robust standard errors are clustered at the four-digit North American Industry Classification System level. All regressions include main province or territory, sector and year fixed effects.

Source: Statistics Canada, T2-LEAP database, 2002 to 2013.

The key takeaway is that young firms that have reached medium-sized status are more likely than older firms to go in one of two opposite directions: grow at a very fast rate and become large or contract at a very fast rate and lose medium-sized status. Young firms that employ at least

33. The midpoint growth rate is used rather than the log growth rate, since E_{t+3} can equal zero for some declining firms.

34. All four regressions are estimated through OLS. Estimating the regression for the subset of firms that shrink through tobit (with left-censoring at -2) yields similar results.

35. The null hypothesis that firms under age 10 shrink at a rate not statistically different from firms that are over age 10 is rejected at the 5% significance level. The null hypothesis that firms over age 20 shrink at the same rate as firms aged 15 to 19 is rejected at the 1% significance level.

100 workers in two out of three years are not fledgling start-ups struggling to survive. Therefore, a priori, there is no reason to expect that the "up-or-out" dynamic applies to them as well. That they grow at a faster rate than their older counterparts is not surprising. However, that they are more likely to shrink and to do so at a faster rate was not clear. Ultimately, the dynamics of young medium-sized firms are best described as "up-or-down."[36]

One possible explanation for this finding is that younger firms have a smaller consumer base, as discussed by Foster, Haltiwanger and Syverson (2016). Losing a single client has a greater impact on the operations of younger firms than those of older ones. Recent research in international trade has found that new buyer–seller relationships are typically short-lived. This partially accounts for a large amount of idiosyncratic entry into and exit from markets on the part of exporters. The longevity of buyer–seller relationships tends to increase with age.[37] The results suggest that further research is required into the formation and dissolution of buyer–seller relationships in the domestic market. This research could examine whether the nature of buyer–seller relationships explains the greater idiosyncrasy in outcomes for younger medium-sized firms.

4.1.2 Productivity

Another key characteristic to take into account in predicting a medium-sized firm's outcome is the firm's productivity (Table 7). Productivity can be described as the firm's level of output per employee. The greater the firm productivity, the greater its efficiency. More efficient firms can sell goods at a lower price than their competitors. This can increase the firm's market share and lead to the need to hire more employees.

The productivity variable used in this study is a measure of relative productivity. It compares a given firm with all other medium-sized firms in the same sector. Firms in the top two productivity quartiles have a clear edge: they are more likely to become large and less likely to become small. Even firms in the second quartile face better odds than those in the first quartile.

4.1.3 Geographic scope

To capture firms' geographic scope, Model 4 in Table 7 introduces two dummy variables. The first variable has a value of 1 if a firm employed workers in two provinces or territories in year *t*, and the second variable has a value of 1 if a firm had workers in at least three provinces or territories in year *t*. Single-province or single-territory firms are the reference group. The coefficient estimates for both dummies confirm that geographic expansion within the domestic market reduces the odds that a firm will decline and increases the odds that it will become large. More precisely, operating in two or more provinces or territories increases the odds of becoming large, and operating in at least three provinces or territories reduces the odds of becoming small. These results are consistent with those presented in Table 6 and do not appear to be driven by age, employment level or productivity differences among firms.

Geographic scope is important in shaping the growth trajectory of medium-sized firms. Possible explanations for this include larger market shares for firms with a wider geographic coverage and greater risk diversification for these firms (in terms of demand for goods and input supply). Exploration of the precise mechanisms at play is left for future work.

4.1.4 Affiliates of foreign multinationals

While only 13.0% of medium-sized firms are foreign-owned, 21.4% of firms that become large are foreign-owned (Table 3). One interpretation of these statistics is that affiliates of MNCs possess an inherent advantage over domestically owned firms. This advantage may stem from superior

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36. Among firms under age 10 in the "become small" group, only 30% are out of business by year $t+3$.
37. See Eaton et al. (2014).

expertise, resources and branding associated with the MNC. An alternative interpretation of this statistic is that it arises from a composition effect. Average employment among foreign-owned firms in the pre-transition period was 218, and average employment among Canadian-owned firms was 178.

Table 9 investigates the role of foreign ownership on a medium-sized firm's odds of transitioning. As mentioned in Subsection 2.3, data on country of control are available for four transition years only (2007 to 2010). Model 1 is conditioned on a firm's age and foreign ownership status, Model 2 includes a control for pre-transition employment level, and Model 3 includes the entire set of controls. Without conditioning on employment level, foreign-owned firms have higher odds of becoming large and lower odds of declining. However, neither result is robust. Column 2 shows that foreign-owned firms have the same odds of becoming large as their Canadian-owned counterparts once employment is included among the regressors. In contrast, foreign-owned firms have higher odds of shrinking than Canadian-owned firms. Adding controls for productivity and geographic scope further strengthens this result.

The finding that foreign-owned firms are more likely than domestically owned ones to shrink is not unprecedented. After controlling for size and productivity differences, previous studies on firms in Belgium (van Beveren 2007), Chile (Alvarez and Görg 2009), Indonesia (Bernard and Sjoholm 2003) and Ireland (Görg and Strobl 2003) found that local branches of foreign-owned MNCs are more likely to be shut down than local firms. This tendency has typically been attributed to the fact that MNCs are capable of shifting production across various affiliates and are therefore less inclined to maintain a struggling business.

The fully specified regression model (Model 4 in Table 7) was applied to the subsample of foreign-owned firms.[38] The findings on productivity for all firms were also present for foreign-owned firms only. Foreign-owned firms in the third and fourth productivity quartiles face higher odds of becoming large and lower odds of becoming small. However, the results pertaining to geographic scope were different. Having employees in three or more Canadian provinces or territories does not increase the likelihood of foreign-owned firms becoming large (even though it decreases their odds of becoming small). This indicates that the national growth mechanisms at play are different for foreign-owned firms, which by definition, already have a wide geographic scope because of their international footprint.

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38. Given the smaller number of observations, groupings were modified. Three age categories were established instead of five (under 10 years old, 10 to 19 years old and 20 years old or over), and the sector variable was replaced by a goods/services indicator. Year fixed effects were included but not main province or territory fixed effects. Robust standard errors were clustered at the sector level.

Table 9
Influence of foreign ownership

	Model 1	Model 2	Model 3
	coefficient		
Foreign-owned			
Become large	0.690 ***	-0.115	-0.309
Become small	-0.302 ***	0.136	0.312 ***
Age	Yes	Yes	Yes
Employment level	No	Yes	Yes
Age × employment level	No	Yes	Yes
Productivity	No	No	Yes
Geographic scope	No	No	Yes
	number		
Regression summary			
Log pseudo-likelihood	-17,805	-14,816	-14,384
Pseudo R-squared	0.03	0.19	0.21
Observations	34,739	34,739	34,739

*** significantly different from reference category (p < 0.001)

Notes: Estimation is through multinomial logit. Robust standard errors are clustered at the four-digit North American Industry Classification System level. All regressions include main province and territory, sector and year fixed effects. Data on country of ownership cover transition years 2007 to 2010 only.

Source: Statistics Canada, T2-LEAP database, 2005 to 2013.

One possible concern is that LEAP likely overestimates employment for foreign-owned firms. As discussed in Subsection 2.1, a firm's employment measure depends upon the wage earned by an average employee in the firm's main industry and size class. Affiliates of MNCs typically pay higher wages than domestically owned firms.[39] The wage used to deflate the firm's labour costs is likely to be too low for foreign-owned firms. This makes them appear larger than they truly are. Whether affiliates of foreign MNCs are more likely to decline than Canadian-owned firms is therefore an issue that is worthy of further study. The identification of the factors contributing to the growth of MNCs within Canada is another research question left for future work.

4.2 Geographic scope, productivity and growth five years prior to the transition

The tabulations discussed in Subection 2.3 make clear that differences between firms that become large and those that decline did not appear suddenly in year t. The differences were already evident as early as five years prior to the transition. This section explores the degree to which a given firm's geographic scope, productivity and growth in year $t-5$ are useful barometers for determining which firms will become large and which will decline.[40]

The estimation results in Table 10, which focus on firm characteristics in year $t-5$, are in keeping with the tabulations discussed in Subsection 2.3. Firms that were more productive in year $t-5$ are more likely to become large and less likely to decline five years later. All else equal, the odds of becoming large are higher for firms in the third and fourth productivity quartiles than for those in the first quartile. The odds of declining are lower for firms in the second, third or fourth productivity quartiles than for those in the first quartile.

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39. See Breau and Brown (2011) for evidence of a multinational-wage premium in Canada.
40. The age categories continue to be based on the firm's age in year t.

Table 10

Multinomial logit estimation results at year *t*-5, with remaining medium-sized as the base group

	Model 1	Model 2	Model 3	Model 4
	coefficient			
Employment				
Become large	2.417 ***	2.442 ***	2.301 ***	2.331 ***
Become small	-0.729 ***	-0.758 ***	-0.712 ***	-0.757 ***
Firm age (reference: 20 years or over)				
Become large				
Under 10 years	11.164 ***	11.262 ***	10.852 ***	8.646 ***
10 to 14 years	9.767 ***	9.880 ***	9.552 ***	8.233 ***
15 to 19 years	4.479 **	4.673 **	4.425 **	3.771 *
Become small				
Under 10 years	-2.332 ***	-2.521 ***	-2.407 ***	-1.848 ***
10 to 14 years	-1.446 ***	-1.504 ***	-1.418 ***	-1.290 **
15 to 19 years	-1.752 ***	-1.850 ***	-1.786 ***	-1.667 ***
Firm age × employment (reference age: 20 or over)				
Become large				
Under 10 years	-2.022 ***	-2.025 ***	-1.946 ***	-1.599 ***
10 to 14 years	-1.790 ***	-1.804 ***	-1.743 ***	-1.520 ***
15 to 19 years	-0.783 *	-0.817 **	-0.770 *	-0.666 *
Become small				
Under 10 years	0.518 ***	0.538 ***	0.515 ***	0.406 ***
10 to 14 years	0.336 ***	0.336 ***	0.318 ***	0.296 ***
15 to 19 years	0.382 ***	0.395 ***	0.382 ***	0.362 ***
Productivity quartile (reference: first quartile)				
Become large				
Second quartile	…	0.091	0.078	0.155
Third quartile	…	0.591 ***	0.548 ***	0.655 ***
Fourth quartile	…	0.876 ***	0.813 ***	0.925 ***
Become small				
Second quartile	…	-0.386 ***	-0.376 ***	-0.391 ***
Third quartile	…	-0.556 ***	-0.538 ***	-0.569 ***
Fourth quartile	…	-0.825 ***	-0.797 ***	-0.846 ***
Number of provinces or territories (reference: one province or territory)				
Become large				
Two provinces or territories	…	…	0.323 *	0.271 *
Three or more provinces or territories	…	…	0.556 ***	0.594 ***
Become small				
Two provinces or territories	…	…	-0.078	-0.085
Three or more provinces or territories	…	…	-0.343 ***	-0.347 ***
Employment growth				
Become large	…	…	…	1.842 ***
Become small	…	…	…	-0.634 ***
Revenue growth				
Become large	…	…	…	0.141 **
Become small	…	…	…	-0.111 ***
	number			
Regression summary				
Log pseudo-likelihood	-26,895	-26,528	-26,459	-24,489
Pseudo R-squared[1]	0.0489	0.0618	0.0643	0.0687
Number of observations	54,603	54,603	54,603	50,631

… not applicable

* significantly different from reference category (p < 0.05)

** significantly different from reference category (p < 0.01)

*** significantly different from reference category (p < 0.001)

1. Each model provides a greater fit than the previous model, according to a log-likelihood ratio test (p < 0.001).

Notes: For multinomial logit, only the sign and significance of coefficient estimates are generally interpretable, not their magnitude (see Table 11 for predicted probabilities, and Footnotes 29 and 30 for an explanation on marginal effects). Robust standard errors are clustered at the four-digit North American Industry Classification System level. All regressions include main province or territory, sector and year fixed effects. Employment and productivity are based on year *t*-5 values. Employment and revenue growth is log growth between *t*-6 and *t*-5.

Source: Statistics Canada, T2-LEAP database, 1999 to 2013.

A firm's geographic scope in year $t-5$ is another factor that distinguishes firms that will eventually become large from those that will eventually decline. A firm that was active in two or more provinces or territories in year $t-5$ has higher odds of becoming large than a comparable single-province or single-territory firm. Further, the odds of declining are lower for firms active in at least three provinces or territories in year $t-5$.

A firm's outcome in the post-transition period is also associated with its previous growth rates. Firms with higher employment growth in year $t-5$ have higher odds of becoming large and lower odds of declining in year t. The same holds for revenue growth, but this influence is more muted.

4.3   Predicted probabilities

The following firm characteristics were found to influence the odds of a medium-sized firm becoming large or small: size, age, productivity, geographic scope within Canada and foreign ownership. This section examines how the probabilities of becoming large or small differ for different firm characteristic values. Table 11 presents probabilities predicted using the MNL regressions implemented, namely the fully specified models (Model 4 in Table 7 for year t, Model 4 in Table 10 for year $t-5$, and Model 3 in Table 9 for foreign-owned status).

Unsurprisingly, firm size in the pre-transition period plays a central role, especially for firms very close to the boundaries of the medium-sized class. Firms with an average employment level of 475 in the pre-transition period have a 32.5% probability of becoming large, whereas firms with an average size of 125 in the pre-transition period have a 24.4% probability of becoming small. The influence of a firm's size in shaping the outcome is significant, but other factors are also consequential and should not be overlooked. Only 48.7% of medium-sized firms that become large had over 400 employees in the pre-transition period (Table 3). Factors other than size explain the rapid growth for the remaining 51.3%.

The firms that manage to reach medium-sized status in their youth face higher probabilities of transitioning to the large and small size classes than their older counterparts. All else equal, medium-sized firms under age 5 have a 3.0% probability of becoming large and an 18.5% probability of becoming small. Firms aged 20 or over have a 1.5% probability of becoming large and a 15.5% probability of becoming small. These differences are statistically significant.

With regard to productivity, firms in the top quartile in year t have a 2.2% probability of becoming large—twice that of firms in the bottom quartile, which have a 1.1% probability. Those in the top productivity quartile five years prior—in $t-5$—have an even greater probability of becoming large (2.6%). The probability of the firms in the top productivity quartile in year $t-5$ becoming small (11.0%) is also half that of firms in the bottom productivity quartile in that same year (22.1%).

With regard to the firm's geographic scope within Canada, significant differences in probabilities are observed at year t and at year $t-5$. Having employees in at least three provinces or territories in year $t-5$ provides a higher probability of becoming large (2.4%) than having them in only one province or territory (1.3%), all else being equal. It also corresponds with a lower probability of becoming small (12.5% versus 16.7%).

Finally, foreign-owned firms have a higher probability of becoming small (19.7%) and a lower probability of remaining medium-sized (78.9%) than Canadian-owned ones. The two groups have the same probability of becoming large at the 5% significance level, all else being equal.

Table 11
Predicted probabilities

	Become large		Remain medium-sized		Become small	
	probability	standard error	probability	standard error	probability	standard error
Employment, average for years *t*-2, *t*-1 and *t*						
125 (reference)	0.0	0.0	75.5	0.7	24.4	0.7
200	0.4 ***	0.1	92.0 ***	0.5	7.6 ***	0.4
300	3.6 ***	0.2	93.9 ***	0.4	2.5 ***	0.2
400	15.8 ***	0.8	83.2 ***	0.8	1.0 ***	0.1
475	32.5 ***	1.8	67.0 ***	1.8	0.6 ***	0.1
Age, year *t*						
3 to 4 years	3.0 **	0.4	78.5 **	1.7	18.5 *	1.6
5 to 9 years	2.7 **	0.3	80.2 **	1.0	17.1 †	0.9
10 to 14 years	2.1 **	0.2	80.3 ***	0.7	17.6 **	0.7
15 to 19 years	1.7	0.2	82.4	0.8	15.9	0.8
20 years or over (reference)	1.5	0.1	83.0	0.6	15.5	0.6
Productivity quartile, year *t*						
First quartile (reference)	1.1	0.1	74.1	1.3	24.8	1.2
Second quartile	1.5 **	0.1	83.7 ***	0.7	14.7 ***	0.7
Third quartile	2.1 ***	0.1	85.7 ***	0.5	12.2 ***	0.5
Fourth quartile	2.2 ***	0.1	86.1 ***	0.5	11.6 ***	0.5
Productivity quartile, year *t*-5						
First quartile (reference)	1.0	0.1	76.9	1.0	22.1	1.0
Second quartile	1.2	0.1	82.5 ***	0.7	16.3 ***	0.8
Third quartile	2.0 ***	0.1	84.0 ***	0.6	14.0 ***	0.6
Fourth quartile	2.6 ***	0.2	86.4 ***	0.5	11.0 ***	0.6
Number of provinces or territories with employment, year *t*						
One province or territory (reference)	1.4	0.1	82.1	0.6	16.4	0.6
Two provinces or territories	1.9	0.1	81.1	0.7	17.0 **	0.7
Three or more provinces or territories	2.1 ***	0.1	84.1 **	0.6	13.8 ***	0.6
Number of provinces or territories with employment, year *t*-5						
One province or territory (reference)	1.3	0.1	82.0	0.6	16.7	0.6
Two provinces or territories	1.7 *	0.2	82.7	0.7	15.6	0.7
Three or more provinces or territories	2.4 ***	0.2	85.1 ***	0.6	12.5 ***	0.6
Foreign-owned, year *t*						
No (reference)	1.8	0.1	82.3	0.7	15.9	0.6
Yes	1.4 †	0.2	78.9 **	1.1	19.7 ***	1.1

* significantly different from reference category (p < 0.05)
** significantly different from reference category (p < 0.01)
*** significantly different from reference category (p < 0.001)
† significantly different from reference category (p < 0.10)

Notes: The numbers presented are average marginal probabilities over the sample, based on multinomial logistic regression. The probabilities and associated standard errors were multiplied by 100. The estimation models used are Model 4 in Table 7 for year *t*, and Model 4 in Table 10 for year *t*-5. For foreign-owned status, the estimation model is Model 3 in Table 9, and the data cover transition years 2007 to 2010 only.
Source: Statistics Canada, T2-LEAP database, 1999 to 2013.

5   Reproducibility of the results over time

This section addresses whether the results can be reproduced for different periods. The current study uses all the vintages available from the T2-LEAP database. Adding new decades of data is not possible. However, an alternative approach is to break down the sample, which covers transition years 2004 to 2010, into different periods. Data from the 2008/2009 recession, in the middle of the study period, enable the construction of subsamples at distinct points of the business cycle. The initial sample is large enough to construct seven subsamples, one for each transition year studied. Table 12-1 describes each annual sample.

Table 12-2 presents the marginal effects on predicted probabilities for these seven subsamples. Overall, the results are consistent with those demonstrated above. The influence of productivity (both in year t and year $t-5$) on the probability of becoming small or on the probability of becoming large is found in all seven subsamples. Regarding the influence of the number of provinces or territories in which a firm has employees, evidence is found in most subsamples. That is, having employees in at least three provinces or territories (either in year t or in year $t-5$) lowers the probability of shrinking and increases the probability of becoming large relative to having employees in only one province or territory. Employment level and employment growth in year $t-5$ also have a significant impact on the transition probabilities in all subsamples. This provides some preliminary evidence that the results obtained in this study are not particular to the years studied. The results can be expected to be found in other periods.

Table 12-1
Description of annual samples

Sample feature	All years pooled	Transition year (year t)						
		2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Year t-5	…	1999	2000	2001	2002	2003	2004	2005
Pre-transition period (years)	…	2002 to 2004	2003 to 2005	2004 to 2006	2005 to 2007	2006 to 2008	2007 to 2009	2008 to 2010
Post-transition period (years)	…	2005 to 2007	2006 to 2008	2007 to 2009	2008 to 2010	2009 to 2011	2010 to 2012	2011 to 2013
Presence of the 2008/2009 recession in the pre-transition and/or post-transition period	…	No	No	Post	Post	Pre and post	Pre	Pre
Number of observations	59,397	8,092	8,266	8,300	8,494	8,797	8,816	8,632
Share that become small (percent)	16.1	16.0	15.3	16.1	17.6	18.3	16.3	13.0
Share that become large (percent)	1.8	1.9	2.1	1.8	1.5	1.5	1.6	2.1

… not applicable
Source: Statistics Canada, T2-LEAP database, 1999 to 2013.

Table 12-2

Marginal effects on the probability of becoming large or small — Firm characteristics

Sample feature	All years pooled	Transition year (year *t*)						
		2004	2005	2006	2007	2008	2009	2010
				marginal effect				
Employment, average for years *t*-2, *t*-1 and *t*								
Become small	-35.5 ***	-33.2 ***	-29.8 ***	-34.0 ***	-37.2 ***	-40.8 ***	-41.3 ***	-32.7 ***
Become large	8.2 ***	8.5 ***	9.2 ***	8.5 ***	7.3 ***	6.7 ***	7.7 ***	9.8 ***
Age, year *t* (reference: 20 years or over)								
3 to 4 years								
Become small	3.0 *	5.7 *	1.0	2.8	2.5	3.0	3.5	2.8
Become large	1.5 **	0.8	1.6 †	1.2	1.2	2.0 *	1.9 *	1.6
5 to 9 years								
Become small	1.6 †	0.2	0.3	3.1 *	2.9 †	2.5	1.2	0.6
Become large	1.1 **	0.9 †	0.3	0.7	1.0 **	1.6 ***	1.4 *	2.3 *
10 to 14 years								
Become small	2.1 **	2.1 †	2.0	2.8 **	1.7	1.3	3.0 **	1.9
Become large	0.6 **	0.8 †	0.7 *	0.6	0.6	0.1	0.4	1.2 **
15 to 19 years								
Become small	0.4	1.9	-1.2	1.2	-0.2	0.7	0.7	-0.4
Become large	0.2	-0.2	1.0 *	-0.1	-0.1	-0.4	-0.3	0.9 †
Productivity quartile, year *t* (reference: first quartile)								
Second quartile								
Become small	-10.1 ***	-11.6 ***	-11.2 ***	-10.8 ***	-10.2 ***	-10.4 ***	-8.3 ***	-8.6 ***
Become large	0.4 **	0.4	0.5 †	0.5	0.4 †	0.1	0.3	0.9 *
Third quartile								
Become small	-12.7 ***	-14.9 ***	-14.5 ***	-11.8 ***	-11.3 ***	-14.8 ***	-10.9 ***	-11.3 ***
Become large	1.0 ***	0.8	1.5 ***	0.7 *	0.8	1.3 ***	0.6 *	1.2
Fourth quartile								
Become small	-13.2 ***	-13.5 ***	-13.9 ***	-13.0 ***	-13.7 ***	-15.0 ***	-12.6 ***	-11.4 ***
Become large	1.1 ***	0.7	1.5 ***	1.5 ***	0.7 *	1.4 ***	1.1 **	1.3 ***
Productivity quartile, year *t*-5 (reference: first quartile)								
Second quartile								
Become small	-5.8 ***	-6.8 **	-6.2 ***	-5.0 ***	-5.3 **	-6.0 ***	-6.9 ***	-4.6 ***
Become large	0.2	0.3	0.9 **	0.3	-0.4	0.2	0.2	0.0
Third quartile								
Become small	-8.1 ***	-9.9 ***	-8.9 ***	-6.8 ***	-6.2 ***	-9.1 ***	-9.1 ***	-7.0 ***
Become large	1.0 ***	0.8 †	1.7 ***	0.5	0.9	0.8 †	0.9 *	1.2 ***
Fourth quartile								
Become small	-11.1 ***	-11.2 ***	-11.1 ***	-9.3 ***	-10.4 ***	-12.1 ***	-13.7 ***	-9.8 ***
Become large	1.6 ***	1.4 *	2.3 ***	1.7 **	0.9 *	1.4 **	1.7 ***	1.6 ***

* significantly different from reference category ($p < 0.05$)

** significantly different from reference category ($p < 0.01$)

*** significantly different from reference category ($p < 0.001$)

† significantly different from reference category ($p < 0.10$)

Notes: The estimation models used are Model 4 in Table 7 for year *t*, and Model 4 in Table 10 for year *t-5*. All regressions include sector and main province or territory fixed effects, and the regressions using all years also include year fixed effects. Robust standard errors are clustered at the four-digit North American Industry Classification System level for the sample using all years, and at the sector level for the annual sub-samples. The marginal effects presented are average marginal effects over the sample. The following three variables are in log form in the estimation model: employment level, employment growth and revenue growth. For these variables, the marginal effect is harder to interpret. A good approximation can be obtained by multiplying the marginal effect in the table by 0.1. The result is the average change in probability, when the explanatory variable increases by about 10% (because a change of 0.1 in the log represents an increase of about 10%). For example, in the sample that used all years, a 10% increase in employment in the pre-transition period decreases the probability of becoming small by about 3.6%, and increases the probability of becoming large by about 0.8%, all else being equal.

Source: Statistics Canada, T2-LEAP database, 1999 to 2013.

Table 12-2
Marginal effects on the probability of becoming large or small — Firm characteristics (continued)

Sample feature	All years pooled	Transition year (year *t*)						
		2004	2005	2006	2007	2008	2009	2010
	marginal effect							
Number of provinces or territories with employment, year *t* (reference: one province or territory)								
Two provinces or territories								
Become small	0.6	1.7 *	-1.3	0.1	1.6	-0.8	1.2	2.0 †
Become large	0.5 **	-0.2	0.2	0.5	0.4	0.3	0.6	1.2 *
Three or more provinces or territories								
Become small	-2.6 ***	-2.9 *	-4.1 ***	-2.8 **	-2.8 †	-2.8 *	-1.8 †	-0.8
Become large	0.6 ***	0.5 †	0.5	0.6 *	0.6 †	0.4	1.0 *	0.7 †
Number of provinces or territories with employment, year *t*-5 (reference: one province or territory)								
Two provinces or territories								
Become small	-1.1 †	-1.7	-1.7	-0.9	-0.2	-1.7	-1.7	0.0
Become large	0.4 *	-0.2	0.6	0.5	0.2	0.5	0.1	1.0 **
Three or more provinces or territories								
Become small	-4.2 ***	-1.6	-4.5 ***	-5.4 ***	-5.2 *	-4.8 **	-4.4 **	-3.0 **
Become large	1.1 ***	0.9 †	1.4 **	1.3 **	1.0	1.1	0.8 †	1.1
Employment growth, between year *t*-6 and year *t*-5								
Become small	-8.3 ***	-8.0 **	-8.0 *	-9.6 **	-8.8 **	-9.4 *	-7.8 **	-7.2 †
Become large	3.0 ***	2.8 **	3.0 ***	3.8 ***	3.0 ***	3.4 ***	3.0 **	3.2
Revenue growth, between year *t*-6 and year *t*-5								
Become small	-1.4 ***	-1.3 ***	0.4	-1.3	-2.7 ***	-5.3 ***	-1.2	-2.4 **
Become large	0.2 ***	0.3	0.1	0.0	0.2	0.3 †	0.5 **	0.5 **

* significantly different from reference category (p < 0.05)

** significantly different from reference category (p < 0.01)

*** significantly different from reference category (p < 0.001)

† significantly different from reference category (p <0.10)

Notes: The estimation models used are Model 4 in Table 7 for year *t*, and Model 4 in Table 10 for year *t-5*. All regressions include sector and main province or territory fixed effects, and the regressions using all years also include year fixed effects. Robust standard errors are clustered at the four-digit North American Industry Classification System level for the sample using all years, and at the sector level for the annual sub-samples. The marginal effects presented are average marginal effects over the sample. The following three variables are in log form in the estimation model: employment level, employment growth and revenue growth. For these variables, the marginal effect is harder to interpret. A good approximation can be obtained by multiplying the marginal effect in the table by 0.1. The result is the average change in probability, when the explanatory variable increases by about 10% (because a change of 0.1 in the log represents an increase of about 10%). For example, in the sample that used all years, a 10% increase in employment in the pre-transition period decreases the probability of becoming small by about 3.6%, and increases the probability of becoming large by about 0.8%, all else being equal.

Source: Statistics Canada, T2-LEAP database, 1999 to 2013.

6   Conclusion

This paper develops a rigorous methodology for studying firms transitioning between size classes. This methodology avoids the biases resulting from transient employment shocks and measurement errors. The methodology was applied to Canadian data from 1999 to 2013 to construct a sample of private-sector medium-sized firms and identify the characteristics that influence whether medium-sized firms become large or revert to being small.

Differences between medium-sized firms that become large and those that become small are evident as early as five years prior to the transition. Apart from being larger, the firms that become large are more productive and tend to employ workers outside of their home province or territory. Barriers to productivity gains and geographic expansion are therefore among the primary obstacles to firm growth. Identifying such barriers could provide additional insight into the dynamics of firm growth and, therefore, employment and output.

Like previous studies, this paper finds evidence of a negative correlation between age and employment growth. However, unlike what previous studies have shown, this correlation holds only for firms that either remain medium-sized or become large and is reversed for declining firms. Young medium-sized firms that revert to being small shed employment at a faster rate than their older counterparts. One explanation for this finding is that younger firms have a smaller consumer base and are therefore more affected by the loss of a single buyer. This issue is worthy of further study. In particular, greater attention could be directed to the study of the formation, duration and dissolution of buyer–seller relationships for firms of different ages, with a special focus on the firm's first decade.

This paper also finds that medium-sized firms owned by foreign multinationals are more likely to become small than domestically owned firms when productivity, employment level, age and geographic scope within Canada are taken into account. Given that many governments offer foreign multinationals incentives to locate within their borders, further research is necessary to determine whether the growth patterns of affiliates of foreign multinationals are systematically different from those of domestically owned firms. Since a large share of foreign direct investment takes the form of mergers and acquisitions rather than greenfield investment, further research is needed to determine whether these findings are sensitive to the mode of foreign investment.

It is important to reiterate that the main findings of this study are very similar to conclusions from the international trade literature. Specifically, the few firms that export tend to be larger and more productive. This connection throws into relief the need to study simultaneously the national and international expansions of firms as they become larger and more productive.

7   Appendix

7.1   Model specification

The regression models presented in the main text treat employment level as a continuous variable (in log form). This also applies to the interaction term between firm age and employment level. Another option is to create size categories and include employment level as a set of dummy variables. The advantage of this latter approach is to capture possible nonlinearity in the interaction term. This model specification was tested and yielded very similar results (Appendix Table 1) to those of the continuous variable model. This latter model was chosen because of its greater fit (pseudo R-squared of 0.20 compared with 0.18) and greater simplicity.

Appendix Table 1

Marginal effects on the probability of becoming large or small, employment as a continuous variable versus a categorical variable

	Become large		Become small	
	Employment as a continuous variable	Employment as a categorical variable	Employment as a continuous variable	Employment as a categorical variable
		marginal effect		
Employment (reference: 100 to 149 when categorical / 125 when continuous)				
150 to 199 when categorical / 175 when continuous	0.3 ***	0.2 ***	-16.4 ***	-13.6 ***
200 to 299 when categorical / 250 when continuous	1.2 ***	1.3 ***	-20.5 ***	-20.3 ***
300 to 399 when categorical / 350 when continuous	6.9 ***	8.1 ***	-22.6 ***	-22.8 ***
400 to 449 when categorical / 425 when continuous	21.2 ***	26.3 ***	-24.1 ***	-23.7 ***
450 to 499 when categorical / 475 when continuous	34.0 ***	32.4 ***	-22.7 ***	-23.9 ***
Age, year *t* (reference: 20 years or over)				
3 to 4 years	1.5 **	1.6 **	3.0 *	3.1 *
5 to 9 years	1.1 **	1.1 **	1.6 †	1.8 †
10 to 14 years	0.6 **	0.6 **	2.1 **	2.2 **
15 to 19 years	0.2	0.2	0.4	0.7
Productivity quartile, year *t* (reference: first quartile)				
Second quartile	0.4 **	0.4 **	-10.1 ***	-10.1 ***
Third quartile	1.0 ***	1.0 ***	-12.7 ***	-12.8 ***
Fourth quartile	1.1 ***	1.1 ***	-13.2 ***	-13.4 ***
Productivity quartile, year *t*-5 (reference: first quartile)				
Second quartile	0.2	0.2	-5.8 ***	-6.0 ***
Third quartile	1.0 ***	1.0 ***	-8.1 ***	-8.1 ***
Fourth quartile	1.6 ***	1.5 ***	-11.1 ***	-10.8 ***
Number of provinces or territories with employment, year *t* (reference: one province or territory)				
Two provinces or territories	0.5 **	0.4 *	0.6	0.2
Three or more provinces or territories	0.6 ***	0.7 ***	-2.6 ***	-3.7 ***
Number of provinces or territories with employment, year *t*-5 (reference: one province or territory)				
Two provinces or territories	0.4 *	0.4 *	-1.1 †	-1.1
Three or more provinces or territories	1.1 ***	1.1 ***	-4.2 ***	-4.2 ***

* significantly different from reference category (p < 0.05)

** significantly different from reference category (p < 0.01)

*** significantly different from reference category (p < 0.001)

† significantly different from reference category (p < 0.10)

Notes: The marginal effects presented are average marginal effects over the sample. The estimation models used are Model 4 in Table 7 for year *t* and Model 4 in Table 10 for year *t*-5. When employment is defined as a categorical variable, six categories are used (100 to 149; 150 to 199; 200 to 299; 300 to 399; 400 to 449 and 450 to 499). Robust standard errors are clustered at the four-digit North American Industry Classification Sytem level. All regressions include main province or territory, sector and year fixed effects.
Source: Statistics Canada, T2-LEAP database, 1999 to 2013.

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