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Firm Dynamics: The Death of New Canadian Firms: A Survival Analysis of the 2002 Cohort of Entrants to the Business Sector

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Symbols

The following standard symbols are used in Statistics Canada publications:

.	not available for any reference period
..	not available for a specific reference period
…	not applicable
0	true zero or a value rounded to *0* (zero)
0^s	value rounded to *0* (zero) where there is a meaningful distinction between true zero and the value that was rounded
^{p}	preliminary
^{r}	revised
x	suppressed to meet the confidentiality requirements of the *Statistics Act*
^{E}	use with caution
F	too unreliable to be published
*	significantly different from reference category ($p < 0.05$)

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Abstract

This paper examines the survival characteristics of firms, using microdata from the Longitudinal Employment Analysis Program (LEAP) of Statistics Canada. Entry rates and survival functions for the 2002 cohort are analyzed. The business sector is disaggregated along industry and size dimensions. The results indicate that groups with higher entry rates have lower survival probabilities. There is a statistically significant difference in the survival curves for most units from the remainder of the population; however, the magnitude of the difference is small.

More studies related to **industrial dynamics** are available in **Update on Economical analysis**.

Executive summary

This paper reports on entry patterns and survival probabilities for the cohort of firms that entered the Canadian business sector in 2002. The paper uses data from Statistics Canada's Longitudinal Employment Analysis Program (LEAP) to produce a special dataset, including a longitudinal identifier and business numbers, to track the 2002 cohort across multiple LEAP vintages.

The paper disaggregates the business sector along industry and size dimensions to provide an illustration of how the 2002 cohort fared. Consistent with previous findings, the results show that the services sector had more entrants and that, in many cases, service industries had higher entry rates. The lowest entry rate occurred in manufacturing. Across size classes, small firms were the most prevalent, with higher entry rates and a larger number of entrants than their larger counterparts.

Throughout the analysis, the results consistently show that groupings with higher entry rates have lower survival probabilities and that industries with higher entry rates are the industries most likely to have lower survival probabilities. Similarly, small-sized firms have high entry rates, but also have lower survival probabilities. For example, the entry rate for the smallest size class was 20% in 2002, but firms in this class had a one-year survival probability of 74%. In other words, one in five small firms in 2002 was new, but one-quarter of such firms were gone after one year. Seven years after entry, only 27% of small entrants remained. In comparison, entrants with 5 to 10 employees had an entry rate of 3%, a one-year survival probability of 93%, and a seven-year survival probability of 52%.

1 Introduction

Micro-economic studies examining firm dynamics emerged in the late 1980s and early 1990s, as statistical agencies began making longitudinal firm databases available to researchers and as computing power increased to facilitate the millions of necessary calculations. Researchers were able to empirically probe the micro-economic competition process for the first time, and the results since then have been surprising. For example, in Canada, around 70% of manufacturing labour productivity growth can be associated to changes in firm market share (Baldwin and Gu 2006).

The examination of firm dynamics took several forms. A number of studies looked at entry, exit, and turnover (see for example: Dunne *et al.* 1988; Baldwin 1995; Davis *et al.* 1998). An alternative branch, the one followed here, examined failure rates and survival curves. The first major papers examining firm survival were published in the early 1990s (Audretsch 1991; Mata and Portugal 1994). They illustrated that market conditions and industry characteristics affected the likelihood that a new firm would survive. These studies marked the beginnings of empirical examinations related to the entry and survival functions of entrepreneurs.

The examinations of firm survival explored a number of dimensions empirically, but were predominantly free of model-based hypotheses. Baldwin *et al.* (2000) moved to including model-based discussions of how and why particular variables may affect entry decisions and survival probabilities. The analysis echoed earlier studies, but involved a more rigorous examination. Baldwin *et al.* (2000) noted that size and inter-industry differences played roles in determining the success of entrants. This theme is found throughout the literature, and is also noted in this paper's results. In interpreting their results, Baldwin *et al.* posited that entry constitutes a form of experimentation. Where the costs of experimentation are lower (for example, smaller size classes or industries with lower fixed costs), one expects more entry and lower survival. The lower survival comes about through competition from new innovators and lower costs of failure.

Following the now-standard approach in the literature, this paper disaggregates business-sector entrants using industry and size categories. It uses the cohort of new entrants for the year 2002 in the Longitudinal Employment Analysis Program (LEAP) file. Similar to Baldwin *et al.* (2000), the results show differences in entry and survival curves across industry and size categories.

In a number of cases, the magnitude of the differences is small, suggesting that, in a purely cross-sectional, static setting, the statistical results do not have much economic significance. However, in a dynamic setting, the small differences can lead to noteworthy cumulative changes. Small perturbations in entry and survival probabilities can lead to large changes in the composition of an economy's firm population when cumulated over time.

The remainder of the paper is ordered as follows. Section 2 describes the LEAP data employed. Section 3 describes the estimation of the survival curves and hypothesis tests. Kaplan-Meier survival curves and log-rank and Wilcoxon test statistics are used. Section 4 details the results, and Section 5 concludes.

2 Data

This study uses data from the 1997 through 2009 vintages of the Longitudinal Employment Analysis Program (LEAP) of Statistics Canada. LEAP files use payroll tax information to form longitudinal estimates of employment and payrolls for Canadian corporations through time, providing a rich dataset for examining micro-economic behaviour.

Because the LEAP dataset tracks firms through time, it is updated for changes in economic structure every year in order to eliminate false births and deaths resulting from mergers and divestitures. Merger and acquisition activity and divestitures present the largest obstacles for creating a new vintage, because historical series need to be adjusted for these changes. As a result, a new vintage of LEAP that updates the structure of firms in the economy is produced each year.

As a result of this updating procedure, the number of entrants and the number of firms differ in each vintage. Here, the entry cohort from the 2002 vintage is tracked across subsequent vintages to produce a consistent picture of how the 2002 cohort fared. Considerable effort is made to produce an underlying dataset that adequately accounts for merger activity. Firms are tracked by means of a longitudinal identifier and a business number. This allows for a tracking of firms engaged in merger and acquisition activity. If a firm merges with or acquires another, both firms are treated as surviving as long as their longitudinal identifier or business number is present.

Analysis in this paper focuses on the business sector and omits government enterprises, and government entities. The business sector examined here is similar to the commercial sector in Baldwin *et al.* (2000). A difference arises in the treatment of health care and social services and education. In Baldwin *et al.*, all health care and social assistance and education services are omitted. Here, only those areas with significant government involvement are omitted. Initially, an overall business-sector survival curve is estimated in order to provide an aggregate benchmark. Subsequently, the cohort is disaggregated along two dimensions: industries and size classes.

The industry dimension uses two-digit North American Industry Classification System (NAICS) codes for business-sector industries. The LEAP files contain an identifier for industry based on where the majority of a payroll occurs. If a firm runs a production process and a distribution centre, it will be classified as a manufacturing firm if the majority of its payroll goes to its manufacturing operations. The NAICS codes are used to disaggregate the data, and also to remove industries that have a notable presence of public-sector firms. The two areas most affected by this are Educational Services (NAICS 61) and Health Care and Social Assistance (NAICS 62).

In order to examine differences in firm survival by size class, the LEAP average labour unit (ALU) variable is used to classify firms by size class[1]. ALU employment is estimated as the ratio of total payroll in the firm to the average hourly earnings in its industry, which are taken from the Survey of Employment, Payrolls and Hours (SEPH).

1. For more information on ALUs or the LEAP database, see Lafrance and Leung (2010).

The resulting ALU employment variable in LEAP produces a range of employment levels, which allows the classification of firms from very small to large. Because the employment variable is estimated as the ratio of payroll to industry average hourly earnings, it can be, and in many cases is, less than 1. The size classes examined in the paper begin in the 0 to 1 ALU range and then rise to groupings of 1 to 5 ALUs, 5 to 10 ALUs, 10 to 20 ALUs, 20 to 50 ALUs, 50 to 100 ALUs, and over 100 ALUs.

Entry rates are calculated as the ratio of entrants in 2002 to the average of the firm populations in the 2001 and 2002 LEAP vintages (see Ciobanu and Wang [2012] for a discussion of entry measures). Entrants are taken to be all firms present in 2002 that were not present between 1997 and 2001. This definition of entry is preferred for estimating survival curves because the attrition rates for new entrants are high. Entry rules used in studies of employment growth or firm dynamics (see for example Ciobanu and Wang [2012]) prefer definitions based on presence in two consecutive years, in order to avoid measurement issues associated with a firm's month of entry into the market. These problems do not manifest themselves for the purposes of estimating a survival curve as the metric of interest is a 0−1 indicator of existence. Moreover, requiring two consecutive years as an entry rule necessarily eliminates the most vulnerable firms and thus biases survival estimates.

3 Methodology

The paper uses survival analysis to examine the survival profiles of firms in the business sector. Survival analysis is a form of duration analysis that examines the probability that a firm randomly selected from its population will have a length of life X_T that exceeds a particular number of periods, or a particular duration, denoted:

$$S(t) = \Pr(X_T > t) \tag{1}$$

A central question addressed here is whether or not survival curves differ in a meaningful way when the business sector is disaggregated. The tested hypothesis is that survival functions are homogenous across industry and size dimensions. That is, regardless of industry or size, the likelihood that a firm survives is statistically the same as for the rest of the firm population. The hypotheses are tested by comparing each industry or size category against the business sector excluding that industry or size category. The two sets of null hypotheses examined here are the following:

$$\begin{aligned} H^1{}_O &: S^i(t) = S^{-i}(t);\ i = industries \\ H^2{}_O &: S^k(t) = S^{-k}(t);\ \mathrm{k} = \ firm\ sizes \end{aligned} \tag{2}$$

The null hypotheses are tested by means of a log-rank statistic and a Wilcoxon statistic. The tests compare the actual number of exits with an estimated number of exits. The two statistics differ in their weighting. The log-rank statistic gives equal weight to all observations. It is written as:

$$Log - Rank = \frac{\left[\sum_{t=1}^{T}\left(d_{i,t} - e_{i,t}\right)\right]^2}{Var\left(d_{i,t} - e_{i,t}\right)} \sim \chi^2(1);\ i = industries,\ firm\ sizes \tag{3}$$

where: $d_{i,t}$ is the recorded number of exits in an industry or size category in time t and $e_{i,t}$ is the expected number of exits. The expected number of exits is calculated as the overall exit rate for the business sector multiplied by the number of firms in that industry or size category:

$$e_{i,t} = n_{i,t}\left(\frac{d_t}{n_t}\right)$$

The Wilcoxon statistic weights the difference between actual and expected exits based on the number of observations:

$$Wilcoxon = \frac{\left[\sum_{t=1}^{T} n_i\left(d_{i,t} - e_{i,t}\right)\right]^2}{Var\left(d_{i,t} - e_{i,t}\right)} \sim \chi^2(1);\ i = industries,\ firm\ sizes \tag{4}$$

The Wilcoxon statistic uses the number of surviving firms in each year as weights while the log-rank statistic uses equal weights. As a result, the Wilcoxon test puts more weight in periods with a larger number of firms. It is more sensitive to divergences between an industry or size class in the years immediately after entry, since those years have a larger population. The log-rank test places equal weight on all time horizons and is thus more sensitive than the Wilcoxon test to divergences in later years.

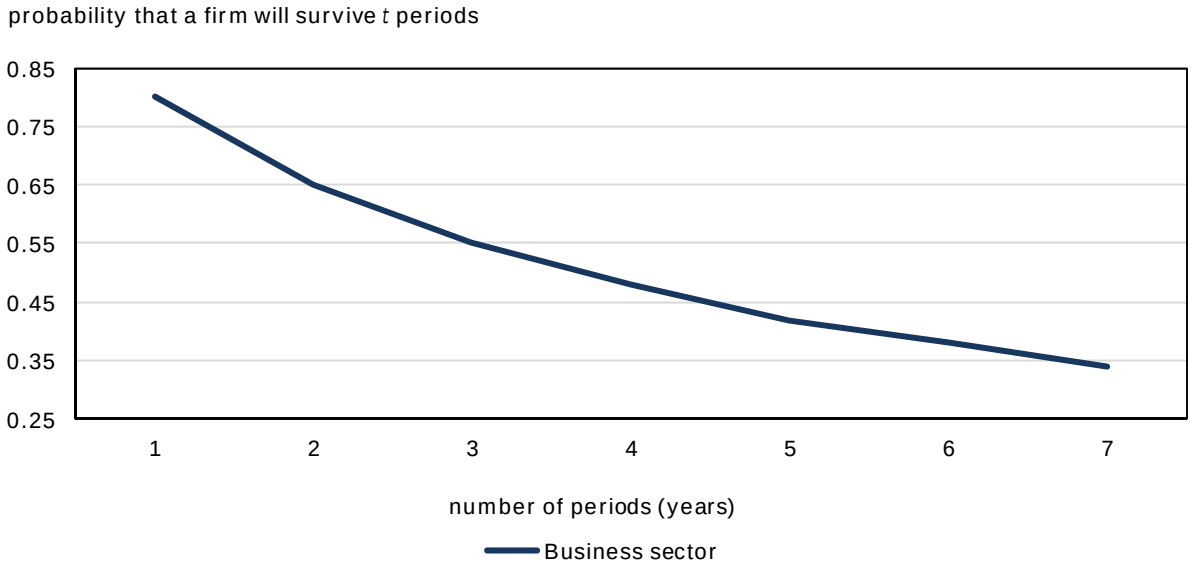
4 Business sector survival analysis

The population of interest is the 2002 cohort of new firms in the business sector of the Canadian economy. The survival curve for the 2002 cohort is depicted in Chart 1. For this cohort, 78% of firms remained after the first year, and 63% remained after the second year. By the fourth year, 46% of firms remained.

The finding that the survival rates decline quickly is expected. The literature consistently finds that cohorts are quickly reduced in size (see for example: Baldwin *et al.* 2000; Disney *et al.* 2003; or Knaup and Piazza 2007). What the survival curve does not indicate is why this occurs or what characteristics or environments support success. Baldwin *et al.* investigated how the industry, size, and regional aspects of the business sector are related to failure and reported that entrant size was an important characteristic explaining longevity. Larger firms required greater planning and effort to establish, and carry a higher penalty for failure. Their size can be viewed as an indication of the extra rigor required for their establishment. This feature of the data is so common that it is now taken as a stylized fact in all countries (Agarwal and Audretsch 2001). Baldwin *et al.* also reported that industry characteristics play an important part in survival probabilities. Barriers to entry, such as high fixed costs, characteristics of competition, and regulatory environments, are all features of industry competition that exert an influence on the entry and survival probabilities of firms.

Chart 1

Business sector survival curve, 2002 cohort



Source: Statistics Canada, authors' calculations.

5 The industry dimension

To examine the industry dimension of survival, the business sector is split into two-digit NAICS categories corresponding to private-sector activities. For the majority of industries, the distinction between the business sector and the private sector is irrelevant as all activity within the industry is both private and classified under the business sector in NAICS. The three industries where noteworthy differences occur are Educational Services (NAICS 61), Health Care and Social Assistance (NAICS 62), and Other Services (NAICS 81). In the cases of Educational Services and of Health Care and Social Assistance, the four-digit NAICS industries associated with public expenditures are removed. This includes primary and secondary schools, universities and colleges, hospitals and doctors' offices, and most of the social assistance expenditures. While not all of these types of expenditures are undertaken strictly by governments, none of the industries excluded can be argued to have a profit motive as the defining characteristic of their markets. Similarly, private households and religious, grant-making, civic, and professional organizations are omitted from other services.

Before moving to estimates of industry survival curves, the composition of the 2002 cohort across industries is examined. An investigation of the composition of the cohort illustrates which industries are likely to dominate aggregate activity and provides *a priori* information about the likelihood that births in that year will provide sufficient information to calculate survival curves for each industry.

Entry occurs among all industries in the business sector; however, three-quarters of entrants are in the services industries (Table 1). The two largest sources of new firms in the services sector are professional, scientific, and technical services, and retail trade. Together, they accounted for 36.3% of new services firms and 27.7% of new firms overall. In goods industries, construction accounts for 56% of entrants and for 13.3% of entrants in the 2002 cohort. Manufacturing, and mining and oil and gas extraction, two of the industries that are most affected by changing relative prices as oil prices and the exchange rate rise after 2002, account for 4.1% and 0.7% of new entrants, respectively.

Table 1
Entry by industry, 2002 cohort

	Firm population[1]	New firms	Entry rate	Share of entrants
	thousands		percent	
Business sector	865.8	89.4	10.3	100.0
Goods sector	233.8	21.4	9.2	23.9
Agriculture, forestry, fishing and hunting	61.5	4.7	7.6	5.3
Mining and oil and gas extraction	7.2	0.7	9.7	0.8
Utilities	0.7	0.1	14.3	0.1
Construction	106.9	11.9	11.1	13.3
Manufacturing	57.5	4.1	7.1	4.6
Services sector	632.0	68.0	10.8	76.1
Wholesale trade	53.5	4.1	7.7	4.6
Retail trade	107.6	9.9	9.2	11.1
Transportation and warehousing	43.3	5.0	11.5	5.6
Information and cultural industries	11.5	1.4	12.2	1.6
Finance and insurance	26.2	2.4	9.2	2.7
Real estate and rental and leasing	37.0	3.8	10.3	4.3
Professional, scientific, and technical services	115.1	14.8	12.9	16.6
Management of companies and enterprises	16.7	1.5	9.0	1.7
Administative and support, waste management, and remediation services	44.9	5.6	12.5	6.3
Educational services	7.8	1.0	12.8	1.1
Health care and social assistance	24.7	1.9	7.7	2.1
Arts, entertainment and recreation	17.5	1.7	9.7	1.9
Accommodation and food services	68.3	8.9	13.0	10.0
Other services	57.8	6.1	10.6	6.8

1. Follows Ciobanu and Wang (2012) and uses the average firm population between 2001 and 2002 as the firm population for comparison against entry.
Source: Statistics Canada, authors' calculations.

The share of new entrants across industries varies more than the entry rates across industries. The highest entry rates tend to be found in the services industries, where professional, scientific, and technical services, educational services, accommodation and food services, information and cultural industries, management of companies and enterprises, administrative and support, waste management, and remediation services, and transportation and warehousing have above-average entry rates for the business sector as a whole. In the goods sector, mining and oil and gas extraction, utilities, and construction have above-average entry rates. Manufacturing stands out because of its relatively low entry rate of 7.1%.

Even though entry occurs in all industries, it is improbable that a small industry will experience sufficient entry to match or exceed that of larger industries. Larger industries make up a larger share of the number of firms in a cohort and will therefore tend to dominate aggregated measures like the business sector. Although the entry rates range between 7.1% and 14.3%, in terms of the firm count, every industry except utilities, and mining and oil and gas extraction, has at least 1000 entrants. For mining and oil and gas extraction, there are 702 entrants; for utilities, there are 55. For all industries except utilities, there are enough data to produce a survival curve for examining differences between industry survival dynamics.

Survival curve estimates for the industries are presented in Table 2. Overall, the survival curve estimates for the goods and services sectors are similar and do not diverge from the business sector average in a meaningful fashion. However, there is a greater degree of discrepancy across individual industries. The highest survival probabilities are found in the private-sector portion of health care and social assistance. To a large extent, this covers dentists,

optometrists, chiropractors, speech pathologists, audiologists and the like. In their first year, 89% of entrants into the 2002 cohort remained in business. The lowest survival probabilities occur in the agriculture, forestry, fishing and hunting industry. In the first year, 75% of entrants from the 2002 cohort survived.

Aside from health care and social assistance and the agriculture, forestry, fishing, and hunting industry, the magnitude of the survival probabilities for individual industries does not diverge greatly from that for the overall business sector. While some industries are slightly higher or slightly lower, the remaining first-year survival probabilities tend to fall within one standard deviation from the mean survival rate across industries. In the goods sector, manufacturers' survival rates are not overly different from those in mining and oil and gas extraction in the first few years. After year three, manufacturers post higher survival probabilities than the average; this is unexpected given the increase in commodity prices, the appreciation of the Canadian dollar, and global trends in manufacturing between 2002 and 2008.

While the magnitude of the survival curves suggests that there are limited differences across industries, this observation is not borne out by the log-rank and Wilcoxon statistics. When individual industries are compared with the business sector minus themselves, the hypothesis that the individual industry is statistically the same as all other industries is rejected for the majority of industries (Table 3). While there is some difference between the results from the log-rank and Wilcoxon tests, for the most part, the results are consistent. The weighting scheme in the Wicoxon test places more weight on divergences between survival probabilities in the early periods, while the log-rank test is more sensitive to divergences at longer durations.

The industries where there is a statistically significant difference between that industry and the rest of the business sector at the 5% level based on the log-rank statistics are the following: agriculture, forestry, fishing and hunting; construction; manufacturing; wholesale trade; transportation and warehousing; information and cultural industries; professional, scientific, and technical services; administrative and support, waste management, and remediation services; health care and social assistance; accommodation and food services; and other services. Based on the Wilcoxon test at the 5% level, retail trade is added to the list of firms where there is a statistically significant difference from all other industries.

Table 2
Survival curve estimates by industry, 2002 cohort

	Survival probability						
	1 year	2 years	3 years	4 years	5 years	6 years	7 years
	probability						
Business sector	0.80	0.65	0.55	0.48	0.42	0.38	0.34
Goods sector	0.77	0.63	0.54	0.46	0.42	0.38	0.34
Agriculture, forestry, fishing and hunting	0.75	0.61	0.52	0.45	0.40	0.36	0.33
Mining and oil and gas extraction	0.81	0.68	0.58	0.49	0.43	0.38	0.33
Utilities	…	…	…	…	…	…	…
Construction	0.76	0.62	0.52	0.45	0.41	0.37	0.34
Manufacturing	0.82	0.68	0.58	0.51	0.45	0.41	0.37
Services sector	0.81	0.65	0.55	0.48	0.42	0.38	0.34
Wholesale trade	0.82	0.67	0.57	0.49	0.44	0.39	0.35
Retail trade	0.83	0.68	0.57	0.48	0.42	0.37	0.33
Transportation and warehousing	0.78	0.61	0.52	0.45	0.39	0.35	0.31
Information and cultural industries	0.77	0.61	0.50	0.43	0.38	0.34	0.31
Finance and insurance	0.76	0.63	0.54	0.48	0.43	0.39	0.35
Real estate and rental and leasing	0.78	0.65	0.56	0.49	0.43	0.39	0.36
Professional, scientific, and technical services	0.81	0.67	0.58	0.51	0.45	0.41	0.38
Management of companies and enterprises	0.77	0.63	0.54	0.48	0.43	0.38	0.34
Administative and support, waste management, and remediation services	0.78	0.63	0.53	0.46	0.40	0.36	0.33
Educational services	0.81	0.67	0.58	0.50	0.44	0.40	0.36
Health care and social assistance	0.89	0.78	0.71	0.65	0.61	0.57	0.52
Arts, entertainment and recreation	0.81	0.65	0.55	0.48	0.43	0.37	0.34
Accommodation and food services	0.82	0.64	0.51	0.42	0.36	0.31	0.27
Other services	0.80	0.64	0.54	0.46	0.40	0.35	0.31
Industry moments							
Average	0.80	0.65	0.56	0.48	0.43	0.38	0.35
Standard deviation	0.03	0.04	0.05	0.05	0.05	0.05	0.05
Spread	0.14	0.18	0.21	0.23	0.24	0.26	0.25

Source: Statistics Canada, authors' calculations.

The picture that emerges from examining the industry dimension of the business sector is that, although survival probabilities appear close on first inspection, there is considerable heterogeneity between industries. Entry rates, and statistical testing, show differences for the 2002 cohort. What is not clear is whether or not these differences are meaningful.

The large sample size in LEAP will illuminate even small differences across groups and make those differences statistically significant. In many cases, the survival probabilities differ by only 1 percentage point to 3 percentage points from the overall business sector. The magnitude of these differences may not be large enough to matter. On the other hand, industries with higher entry rates also have lower survival probabilities. The small differences in survival probabilities can generate large differences in firm composition when placed into a dynamic context. The work here does not delve into the dynamic properties of firm populations, but does note that the seemingly small differences in cross-sectional survival probabilities may become meaningful over time. Further research into firm population dynamics would be necessary in order to understand the thresholds at which differences in the entry-rate survival dynamics affect the composition of business-sector firms in a significant fashion.

Table 3
Test results for individual industries

Industries	Log-rank test p-values	Wilcoxon test p-values
	percent	
Agriculture, forestry, fishing and hunting	0.0	0.0
Mining and oil and gas extraction	72.6	35.9
Utilities	0.1	0.4
Construction	0.1	0.4
Manufacturing	0.0	0.0
Wholesale trade	1.1	0.2
Retail trade	55.4	0.0
Transportation and warehousing	0.0	0.0
Information and cultural industries	0.2	0.1
Finance and insurance	96.3	16.6
Real estate and rental and leasing	12.4	64.1
Professional, scientific, and technical services	0.0	0.0
Management of companies and enterprises	78.9	32.0
Administative and support, waste management, and remediation services	0.8	0.3
Educational services	11.2	9.8
Health care and social assistance	0.0	0.0
Arts, entertainment, and recreation	67.3	54.8
Accommodation and food services	0.0	0.0
Other services	0.0	0.3

Source: Statistics Canada, authors' calculations.

6 The size dimension

In order to examine differences in survival by firm size, this paper groups firms that enter the market in 2002 according to their ALUs. The ALUs are estimates of employment based on a firm's payroll divided by the average hourly earnings of the firm's industry in SEPH.

For the 2002 cohort, the size of 63.7% of entrants was less than or equal to 1 ALU (Table 4). This reflects a number of features of the entry data. Firms tend to be smaller when they initially enter the market. It is not surprising therefore that a large proportion of entrants were of that size. Furthermore, small entrants tend to be less productive than large firms and hence pay lower wages. Since ALUs are estimated as payroll divided by an industry average wage, the lower productivity and lower pay of small firms lead to lower estimates of labour input. Lastly, entry does not necessarily occur in January of each year. Because the measured data are annual, it is not possible to distinguish firm life in months and make the necessary corrections to payroll levels in order to account for different length of life in the first year. This has the effect of making some entrants look smaller than they actually are. While this presents an issue for categorizing firms, using an entry rule such as existence in two consecutive years to alleviate this problem produces bias in survival curve estimates. Here, the choice is made to allow for more accurate survival curve estimation at the expense of being able to more accurately categorize firms by size class.

The second-largest group of entrants fell into the "greater than 1, and less than or equal to 5 ALU" size range. This next-smallest size class contained 29.3% of entrants. For the 2002 cohort, the size of 93.0% of entrants was less than or equal to 5 ALUs. The number of entrants then declined quickly as the size class increased. Only 1% of entrants fell in the "greater than 20, and less than or equal to 50 ALUs" category, while less than 0.9% were larger than that.

Table 4

Entry by size category in the 2002 cohort

Size categories	Firm population[1]	New firms	Entry rate	Share of entrants
	thousands		percent	
Business sector (all firms)	865.8	89.3	10.3	100.0
Greater than 0, and less than or equal to 1 ALU	284.7	56.9	20.0	63.7
Greater than 1, and less than or equal to 5 ALUs	344.3	26.2	7.6	29.3
Greater than 5, and less than or equal to 10 ALUs	103.3	3.6	3.5	4.0
Greater than 10, and less than or equal to 20 ALUs	62.7	1.5	2.4	1.7
Greater than 20, and less than or equal to 50 ALUs	44.7	0.8	1.8	0.9
Greater than 50, and less than or equal to 100 ALUs	15.1	0.2	1.3	0.2
Greater than 100 ALUs	11.0	0.1	0.9	0.1

1. Follows Ciobanu and Wang (2012) and uses the average firm population between 2001 and 2002 as the firm population for comparison against entry.

Note: ALU: average labour unit.

Source: Statistics Canada, authors' calculations.

The preponderance of entrants in the 2002 cohort were small, and their survival rates were lower (Table 5). For those firms whose size was less than or equal to 1 ALU, 74% survived the first year. After seven years, 27% of small entrants remained. The probability of survival increases monotonically up to the "greater than 50, and less or equal to 100 ALUs" firm size category and rises at all durations. This is consistent with findings that larger firms tend to have a higher survival rate than smaller firms (Baldwin *et al.* 2000).

Table 5

Survival curve estimates by size category, 2002 cohort

	Survival probability						
	1 year	2 years	3 years	4 years	5 years	6 years	7 years
	probability						
Size categories							
Greater than 0, and less than or equal to 1 ALU	0.74	0.57	0.47	0.40	0.35	0.30	0.27
Greater than 1, and less than or equal to 5 ALUs	0.89	0.76	0.66	0.59	0.53	0.48	0.44
Greater than 5, and less than or equal to 10 ALUs	0.93	0.83	0.74	0.66	0.61	0.56	0.52
Greater than 10, and less than or equal to 20 ALUs	0.94	0.85	0.78	0.70	0.65	0.60	0.56
Greater than 20, and less than or equal to 50 ALUs	0.95	0.88	0.81	0.74	0.68	0.63	0.60
Greater than 50, and less than or equal to 100 ALUs	0.96	0.88	0.83	0.78	0.75	0.72	0.67
Greater than 100 ALUs	0.99	0.91	0.86	0.80	0.74	0.69	0.66
Firm-class moments							
Average	0.92	0.81	0.74	0.67	0.62	0.57	0.53
Standard deviation	0.08	0.12	0.13	0.14	0.14	0.14	0.14

Note: ALU: average labour unit.
Source: Statistics Canada, authors' calculations.

Additionally, the degree of decline is reduced as firms get larger. For firms that enter with "greater than 0, and less than or equal to 1 ALU," the change in survival rates from the first year to the seventh year is a decline of 47 percentage points. In other words, the slope of the survival curve is steep. The slope flattens out as firm size increases, reaching a decline of 29 percentage points for firms in the "greater than 50, and less than or equal to 100 ALU" size class, and then steepens for the largest firms to 32 percentage points.

The 2002 cohort illustrates the "classic" features of firm entry and survival. The majority of firms are small. The small firms are removed by market forces at a faster pace than their larger contemporaries. As well, the small firms experience a greater degree of loss at all time horizons.

Table 6
Test results for individual size categories, 2002 cohort

Size categories	Log-rank test p-values	Wilcoxon test p-values
	percent	
Greater than 0, and less than or equal to 1 ALU	0.0	0.0
Greater than 1, and less than or equal to 5 ALUs	0.0	0.0
Greater than 5, and less than or equal to 10 ALUs	0.0	0.0
Greater than 10, and less than or equal to 20 ALUs	0.0	0.0
Greater than 20, and less than or equal to 50 ALUs	0.0	0.0
Greater than 50, and less than or equal to 100 ALUs	0.0	0.0
Greater than 100 ALUs	0.0	0.0

Note: ALU: average labour unit.
Source: Statistics Canada, authors' calculations.

The log-rank and Wilcoxon tests reject the hypothesis that any of the size categories can be treated as similar to the overall business sector excluding that size category (Table 6). In the case of the size classifications, the results need to be interpreted with more caution than do the results from the industry disaggregation. Since firms with less than 1 ALU make up 63.7% of entrants in the 2002 cohort, the inclusion or exclusion of this category will dominate the test results. Nevertheless, the statistical testing, survival probabilities, and entry rates find the same stylized facts as Baldwin *et al.* (2000) and those noted in Agarwal and Audretsch (2001).

7 Conclusion

This study documents differences in survival outcomes for the 2002 cohort from the Longitudinal Employment Analysis Program (LEAP) of Statistics Canada. The business sector from the 2002 cohort is disaggregated to examine survival probabilities across industries and size categories.

Throughout the analysis, the results consistently show that groupings with higher entry rates have lower survival probabilities. Baldwin *et al.* (2000) argued that entry can be viewed as an experiment where the outcome can be known only *ex post facto* and that higher levels of experimentation via entry are likely to be accompanied by higher rates of exit. Regardless of how the entrants from the 2002 cohort are disaggregated, the notion that increased experimentation leads to decreased survival probabilities cannot be rejected. While this may appear problematic since experimentation has a cost, what is not revealed from the survival curves is the degree to which areas with increased experimentation may have increased payoffs to those who are successful. (Lafrance [2012] shows that smaller firms, particularly those in the 1 to 5 ALU size class, have a higher return on assets and greater volatility in their returns than other firm sizes).

Across all groupings, the results exhibit considerable heterogeneity. It is difficult to argue that industries or size classes exhibit consistent survival probabilities. Within each sub-division of the business sector, a number of reasons discussed in Baldwin *et al.* (2000), such as regulatory structure, size mixes, trade openness, concentration ratios, minimum efficiency scale, or industry mixes, may be responsible for the differences.

The size of firms is shown to be a strong determinant of survival probabilities. This is consistent with Baldwin *et al.* (2000). For the smallest firms in the 2002 cohort, the probability of surviving one year is 74%, and the probability of surviving seven years is 27%. For entrants with 50 to 100 ALUs, the one-year survival probability is 96%, and the seven-year survival probability is 67%.

References

Audretsch, D. 1991. "New-Firm Survival and the Technological Regime." *The Review of Economics and Statistics*. Vol. 73. No. 3. p. 441−450.

Agarwal, R., and D. Audretsch. 2001. "Does Entry Size Matter? The Impact of the Life Cycle and Technology on Firm Survival." *The Journal of Industrial Economics*. Vol. 49. No. 1. p. 21−43.

Baldwin, J. 1995. *The Dynamics of Industrial Competition: A North American Perspective*. Cambridge, U.K. Cambridge University Press.

Baldwin, J., and W. Gu. 2006. *Competition, Firm Turnover and Productivity Growth*. Statistics Canada Catalogue no. 11F0027M. Ottawa, Ontario. Economic Analysis (EA) Research Paper Series. No. 42.

Baldwin, J., L. Bian, R. Dupuy, and G. Gellatly. 2000. *Failure Rates for New Canadian Firms: New Perspectives on Entry and Exit*. Statistics Canada Catalogue Number 61-526-XIE. Ottawa, Ontario.

Ciobanu, O., and W. Wang. 2012. *Firm Dynamics: Firm Entry and Exit in Canada, 2000 to 2008*. Statistics Canada Catalogue no. 11-622-M. Ottawa, Ontario. The Canadian Economy in Transition. No. 22.

Davis, S., J. Haltiwanger, and S. Schuh. 1998. *Job Creation and Destruction*. Cambridge, Massachusetts. The MIT Press.

Disney, R., J. Haskel, and Y. Heden. 2003. "Entry, Exit and Establishment Survival in UK Manufacturing." *The Journal of Industrial Economics*. Vol. 52. No. 1. p. 91−112.

Dunne, T., M. Roberts, and L. Samuelson. 1988. "Patterns of Firm Entry and Exit in U.S. Manufacturing Industries." *The RAND Journal of Economics*. Vol. 19. No. 4. p. 495−515.

Knaup, A.E., and M.C. Piazza. 2007. "Business Employment Dynamics Data: survival and longevity, II." *Monthly Labour Review*. September. p. 3−10.

Lafrance, A. 2012. *Firm Dynamics: Variation in Profitability Across Canadian Firms of Different Sizes, 2000 to 2009*. Statistics Canada Catalogue no. 11-622-M. Ottawa, Ontario. The Canadian Economy in Transition. No. 26.

Lafrance, A., and D. Leung. 2010. *T2-LEAP (1984-2007): A Longitudinal Database of Incorporated Firms in Canada.* Ottawa, Ontario. Analytical Studies Branch. Statistics Canada. Technical report. Unpublished.

Mata, J., and P. Portugal. 1994. "Life Duration of New Firms." *The Journal of Industrial Economics*. Vol. 42. No. 3. p. 227−245.