Catalogue no. 61-526-XIE

Failure Rates for New Canadian Firms: New Perspectives on Entry and Exit

Statistics Canada Statistique Canada

Canada

How to obtain more information

Specific inquiries about this product and related statistics or services should be directed to National inquiries line: 1 800 263-1136. E-Mail inquiries: infostats@statcan.ca

For information on the wide range of data available from Statistics Canada, you can contact us by calling one of our toll-free numbers. You can also contact us by e-mail or by visiting our Web site.

National inquiries line	**1 800 263-1136**
National telecommunications device for the hearing impaired	**1 800 363-7629**
Depository Services Program inquiries	**1 800 700-1033**
Fax line for Depository Services Program	**1 800 889-9734**
E-mail inquiries	**infostats@statcan.ca**
Web site	**www.statcan.ca**

Ordering and subscription information

This product, Catalogue no. 61-526-XIE, is available on Internet free. Users can obtain single issues at http://www.statcan.ca/cgi-bin/downpub/freepub.cgi.

Standards of service to the public

Statistics Canada is committed to serving its clients in a prompt, reliable and courteous manner and in the official language of their choice. To this end, the Agency has developed standards of service which its employees observe in serving its clients. To obtain a copy of these service standards, please contact Statistics Canada toll free at 1 800 263-1136.

Statistics Canada

Failure Rates for New Canadian Firms: New Perspectives on Entry and Exit

John Baldwin, Lin Bian, Richard Dupuy, Guy Gellatly

Published by authority of the Minister responsible for Statistics Canada

February 2000

Catalogue no. 61-526-XPE
Frequency: Occasional

ISBN 0-660-17933-4

Ottawa

Note of appreciation

Canada owes the success of its statistical system to a long-standing partnership between Statistics Canada, the citizens of Canada, its businesses, governments and other institutions. Accurate and timely statistical information could not be produced without their continued cooperation and goodwill.

Canadian Cataloguing in Publication Data

Main entry under title:
Failure Rates for New Canadian Firms: New Perspectives on Entry and Exit

Issued also in French under title: Taux d'échec des nouvelles entreprises canadiennes : nouvelles perspectives sur les entrées et les sorties.
ISBN 0-660-17933-4
CS61-526-XPE

1. New Business Enterprises – Canada – Statistics.
2. Business Failures – Canada – Statistics.
I. Baldwin, John R. (John Russel). II. Bian, Lin. III. Dupuy, Richard. IV. Gellatly, Guy. V. Statistics Canada. VI. Title.

HG3789.C3 F34 2000 338.7'1 C00-988002-X

The paper used in this publication meets the minimum requirements of American National Standard for Information Sciences – Permanence of Paper for Printed Library Materials, ANSI Z39.48 – 1984.
∞

Table of Contents

Acknowledgements

This study is the product of staff from two research groups at Statistics Canada—the Micro-Economic Analysis Division (MEAD), and the Business and Labour Market Analysis Division (BLMA). Four individuals were involved in its preparation: John Baldwin, Guy Gellatly and Lin Bian, all of MEAD, and Richard Dupuy of BLMA.

Richard Dupuy was instrumental in the creation of the LEAP database and is responsible for its ongoing development. Without his efforts, a study of this sort would not have been possible. Lin Bian, Guy Gellatly and Richard Dupuy performed the data estimation. John Baldwin and Guy Gellatly wrote the report and are responsible for the argumentation presented herein.

We are indebted to several individuals, all of whom made substantial contributions to the development of this study. Valerie Thibault, Suzanne David, Louise Laurin and Francine Simoneau of the Analytical Studies Branch at Statistics Canada were responsible for the editing, design and production of the publication. Geoff Rowe of Statistics Canada and Donald McFetridge of Carleton University reviewed the manuscript and offered comments.

John Baldwin
Director
Micro-Economic Analysis Division
Statistics Canada

Garnett Picot
Director
Business and Labour Market Analysis Division
Statistics Canada

Preface

New firms play a key role in shaping economic change. Entrants are a source of dynamism—they offer consumers innovative goods and services, often by developing new, or responding to existing, market niches. They bring pressure to bear on older businesses, forcing them to structure their operations efficiently, and to respond more quickly to changes in consumer demand. In short, new firms are essential to the competitive process—the forces at play within an economy that reward certain firms and penalize others.

While new firms are important, the life of a new firm is a precarious one. Entrepreneurs take substantial risks when starting new ventures. While some realize significant returns, others, indeed the majority, exit the market after only a few years of operation. The large percentage of entrants that fail has focused attention on the factors that determine the success or failure of a new firm. This issue is of interest to entrepreneurs, credit lenders, public officials, economists, and indeed all who are interested in how an economy creates innovation and wealth. Like most intriguing issues, it has many different dimensions. Are firms that enter certain industries more likely to be successful? Are very young firms the most vulnerable to failure? Is failure driven more by the idiosyncrasies of individual firms than by the structure of certain markets? How influential is the timing of entry in determining success?

This report addresses many of these questions. It explores differences in failure rates across many important dimensions—such as a firm's province or industry of origin. It asks what role firm size plays in determining success or failure, along with factors that relate to the intensity of competition that young firms face. It examines how the determinants of failure differ across new firms at different stages of their lifecycle, and whether the factors that influence failure are consistent across different entry periods.

The report is the fourth in a series of studies that investigate dynamic change in key sectors of the economy. The first, *Strategies for Success* (Baldwin et al., 1994), examined small- and medium-sized firms that were growing during the last half of the 1980s. It found that innovation was strongly correlated with success, and that small growing firms stress the development of basic financial and management competencies. The second, *Successful Entrants: Creating the Capacity for Survival and Growth* (Johnson, Baldwin and Hinchley, 1997), focused on new small successful entrants, firms that reached their early teen years. It developed a more extensive profile of the financial structure and operating practices of these firms. Like its predecessor, it found that innovation is strongly associated with growth. It also demonstrated that the financial structure of successful firms varies depending upon the knowledge-intensity of the host industry. The third report, *Failing Concerns: Business Bankruptcy in Canada* (Baldwin et al., 1997), represented a departure from our traditional focus on 'more successful' firms, and instead examined factors that contribute to business bankruptcies. It found that both external shocks and internal deficiencies influence bankruptcy patterns, their relative importance varying considerably across firms. Of these internal deficiencies, basic shortcomings in management and financing were most consequential.

The present study represents a continuation of our research on the dynamics of success and failure—with a specific focus on the latter. While these previous three studies were based on firm surveys, this project draws on a special database developed at Statistics Canada using administrative data. This database can be used to track the characteristics of individual firms over time. This allows us to apply statistical methods that are designed specifically for analyzing differences in survival and failure rates. The principal advantage of this study, in our view, rests with its comprehensiveness—it represents the first analysis of survival patterns in all major sectors of the Canadian economy.

Executive Summary

This study investigates the determinants of failure for new Canadian firms. It explores the role that certain factors play in conditioning the likelihood of survival—factors related to industry structure, firm demographics and macroeconomic cycles. It asks whether the determinants of failure are different for new start-ups than for firms that have reached adolescence, and if the magnitude of these differences is economically significant. It examines whether, after controlling for certain influences, failure rates differ across industries and provinces.

Two themes figure prominently in this analysis. The first is the impact that certain industry characteristics—such as average firm size and concentration—have on the entry/exit process, either through their influence on failure costs or on the intensity of competition. The second centres on how the dimensions of failure evolve over time as new firms gain market experience.

Why Focus on New Firms?

New firms play a key role in the evolution of an industry. Entrants introduce new products and develop new technologies. As an important source of innovation, they bring competitive pressure to bear on established firms. These pressures often arise as new firms pursue customization and niche market strategies as a means of gaining market share.

For many new firms, however, life is short and uncertain. One-half of all entrants fail prior to their third birthday. Only one in five survive a decade. Those that do survive often grow. Over successive years, the cumulative effect of survivors on the industry landscape is substantial.

The line between success and failure is a tenuous one. Why do certain firms survive and prosper, while others decline and fail? Economists have expressed growing interest in the underlying causes of failure—specifically, whether they stem from the idiosyncrasies of individual firms, are endemic to certain industries, or reflect underlying macroeconomic conditions. Research on these issues finds a wide audience. Lenders of credit want to know if firms with certain characteristics are statistically more likely to fail. Public officials want to know if the causes of failure are, in some way, amenable to policy intervention. Prospective business owners want to be able to distinguish *safe* strategies from *risky* ones.

How are Entry and Exit Related?

Entry and exit are positively correlated: The more firms that enter an industry, the more firms that fail (Caves, 1998; Geroski, 1995). While previous studies have investigated the causes of failure, less attention has been devoted to exploring the formal relationship between the factors that condition exit and those that encourage entry. This analysis goes some way towards filling this void—by offering a basic model of the entry/exit process.

This framework draws on two major themes. The first is the costs of experimentation associated with the entry decision. For any *potential* new firm, the decision to enter is a risky one, as many entrants fail, often shortly after start-up. If the costs of the entry gamble are high—due, for example, to the existence of sunk costs – fewer firms can be expected to take the entry gamble. As a result, fewer new firms can be expected to fail. The second theme focuses on the role that competition plays in conditioning the failure rate. New firms may benefit from, or succumb to, changes in competitive pressure.

Our framework explores how certain facets of an industry's structure—such as its firm size characteristics, or its rate of job turnover—influence the entry decision, and hence, the failure rate.

How Does Industry Structure Influence the Hazard Rate?

Industry characteristics that affect the costs of entry lead to differences in aggregate survival rates. New firms in industries with relatively small firm sizes are more likely to fail than those in industries with larger size characteristics. This means that if failure costs increase with average industry firm size or average industry entrant size, then hazard rates are inversely related to the costs of experimentation. On the other hand, there is less evidence from aggregate survival rates that differences in competitive intensity influence failure patterns. At first blush, industry concentration and job turnover have less of an impact on hazard rates than an industry's firm size characteristics.

The above impressions are based on aggregate survival rates—rates that embody, but do not formally account for, the myriad of macroeconomic, industry-level and firm-specific factors that condition failure. After controlling for all these effects, industry-level characteristics such as concentration, turnover, and relative entrant size (measured as the ratio of an industry's average first-year firm size to its overall firm size) still influence the failure rate. However, their effect is often minor.

The nature of these industry effects can vary depending upon the age of the firm. Both concentration and relative entrant size affect infant firms and adolescents in different ways. For firms in their first-year, more concentration and larger entrant characteristics lead to a higher probability of survival. For firms in their fifth year, the reverse is true. For both infants and adolescents, an increase in turnover at the industry level leads to more failure.

Are New Firms in Certain Provinces More Likely to Fail?

There are some basic differences in survival rates across provinces, but these differences are more complicated than they first appear. In terms of aggregate survival rates, new firms in Ontario fare better than those in other provinces. However, differences between Ontario, Quebec, Alberta and British Columbia are slight. New firms in Manitoba and Saskatchewan fare somewhat less well, whereas the highest failure rates occur in Atlantic Canada.

After controlling for the influence of other factors on the hazard rate, differences in provincial survival rates remain, but the nature of these differences depends upon the age of the firm. The likelihood that start-ups will survive their initial year differs dramatically across provinces. Firms in their initial year of life exhibit a much higher success rate in Ontario (80%) than in the Atlantic Provinces (63%-67%). Business start-ups in British Columbia (78%), Quebec (77%) and Alberta (76%) are more likely to survive their first year than are those in Saskatchewan (73%) or Manitoba (70%).

For firms that have survived the vicissitudes of infancy, a very different pattern emerges. Five-year old firms in Ontario are no more likely to survive their fifth year than are firms in other provinces. Five-year old firms in Nova Scotia, New Brunswick, Prince Edward Island and Quebec are less likely to fail than their counterparts in Ontario. This said, provincial survival rates for five-year old firms are uniformly high (at roughly 90%).

Are New Firms in Certain Industries More Likely to Fail?

New firms in certain industries fare better than those in others; however, the nature of these differences changes over the course of an entrant's life-cycle. Among goods-producing industries, new firms in mining and manufacturing have among the highest aggregate survival rates. In the services sector, entrants in wholesale trade, real estate industries and business services fare relatively well.

Aggregate survival rates are affected by the characteristics of firms contained in an industry. When these are formally taken into account, a different view of the industrial landscape emerges. New firms in certain industries still fare better than those in others—for instance, entrants in fishing and trapping outperform their counterparts in manufacturing. The magnitude of these differences, however, is often slight. Stronger evidence of industry effects emerges at different stages of the entrant lifecycle, particularly among infant firms. New start-ups in wholesale trade, business services and real estate industries are among the most likely to survive their first year. These industry differences become less apparent among adolescent firms.

Are Start-Ups More Vulnerable than Adolescents?

Failure rates are often highest among newborn firms. Certain aspects of market structure that influence survival rates—for example, average size characteristics, average rates of entry—have a greater effect on start-ups than on adolescents. There is also some evidence of a honeymoon effect—the temporary insurance against failure afforded by a firm's initial stock of assets. When the effect of age is separated from other influences on the failure rate, the advantages of market experience become clear. The likelihood of failure decreases with age. This said, the advantages that experience brings tend to diminish over time.

While the likelihood of survival increases with the age of the firm, its effect on other factors that condition the survival rate is more complex. Geographic and industry-specific differences are more apparent in new start-ups than in adolescent firms. New firms are more vulnerable to basic changes in market structure. However, changes in relative efficiency, as proxied by relative size, are equally if not more important in older firms.

Are the Reasons for Failure Macroeconomic, Industry-Specific, or Firm-Specific?

The underlying dynamics of failure are varied and complex. There is no single reason why certain entrants fail while others succeed. The determinants of failure occur on different levels—and encompass the idiosyncrasies of individual firms, the structural characteristics of particular markets, and the vitality of the larger macroeconomy. There is evidence that each affects the failure rate of new firms.

In the first instance, firm-specific factors exert a strong influence on the failure rate. The likelihood of survival increases sharply with the age of the firm, and the factors that contribute to failure affect firms of various ages differently.

Size also plays a major role in determining success or failure—in particular, the size of new firms relative to the first-year entrant average within the industry. A proxy for relative efficiency, this measure of size is both firm- and industry-specific. An increase in relative firm size leads to a higher likelihood of survival. What is more, deviations from the average bring about sharp fluctuations in the failure rate. New firms that are relatively large are more likely to succeed, whereas those with size disadvantages are more likely to fail. This is true both for new start-ups and adolescents.

The firm size characteristics of industries also influence the failure rate. Start-ups that enter industries that have large entrants relative to the general business population have a lower likelihood of failure. The reverse is true of new firms when they reach adolescence—industries with large entrant characteristics bring about more failure.

Concentration and turnover—two conventional measures of the intensity of competition—also influence the failure rate. In the first instance, their effect on aggregate survival rates is largely ambiguous, suggesting that the relationship between competition and the survival rate is not necessarily unidirectional. When the failure rate is modelled formally, the nature of these effects becomes more apparent. Interestingly, these can differ depending upon the age of the firm. New start-ups will benefit from industry structures that are more concentrated. For adolescent firms, the opposite is true—more concentration leads to more, not less, failure. Increased turnover leads to more failure in start-ups and adolescents. This being said, changes in industry concentration and turnover have less impact on survival rates than those associated with changes in relative firm size.

Macroeconomic conditions also exert a modest influence on the survival rate. The fortunes of new firms vary cyclically with the business cycle—a higher growth rate in real output leads to more survival.

Does the Timing of Entry Matter?

Substantial differences in survival rates are evident across entry periods. These reflect underlying differences in macroeconomic conditions. As these often differ across regions, generalizations about the relative riskiness of different jurisdictions or industries should only be made with caution. Entrant cohorts that are associated with good macroeconomic conditions not only have a lower mean failure rate but are also less affected by size disadvantages. For these cohorts, changes in the intensity of competition play a greater role in determining success or failure. This suggests that the factors that motivate the entry decision differ across the business cycle.

Chapter 1 – Introduction

Entry and exit are central to the study of industrial dynamics. The net effect of new firms on an industry is principally determined by (i) the instantaneous and cumulative rates of entry, (ii) the growth rates exhibited by emerging firms, and (iii) the rate at which entrants fail. This study speaks to two of these issues directly—it focuses squarely on new firms, and it investigates the role that certain factors play in conditioning the exit process.

Our primary objective in undertaking this study is to gain a broader understanding of the post-entry performance of new firms. Numerous issues motivate research in this area: Are new start-ups more likely to fail than adolescent firms? Does more entry encourage more failure? Is failure a random or a systematic process? If the latter, are the causes of failure specific to individual firms, endemic to certain industry environments, or highly correlated with macroeconomic conditions?

While previous work has offered new insight into many of these issues, the present study has, in our view, two major advantages.

First, it is extremely comprehensive. Drawing from a Statistics Canada micro-database that tracks the payroll and employment characteristics of individual firms over time, it develops a profile of post-entry performance based on *all* entrants in goods and services industries over a period of ten or more years. This alleviates the traditional dependence on the manufacturing sector—often the primary focus of studies of firm survival; moreover, given that our estimates are based on actual population data, it removes the possibility of any potential bias that may result from the use of small and/or unrepresentative samples.

Second, the analysis offers a new perspective on the entry and exit process—one that goes some way towards developing more formal models of firm survival. As much of the research on failure rates is empirically driven, there is often little attempt to explore the determinants of exit in any formal way, other than to state and evaluate their hypothesized influence on the failure rate. We develop our view of the entry and exit process with two major themes in mind.

The first of these focuses on the costs of experimentation associated with entry. Entry can be seen as a risky gamble. New firms ascertain their relative competency by investing in knowledge both prior and subsequent to entry.[1] Industry characteristics that influence the cost of post-entry experimentation are thus likely to be correlated with the exit process. In industries where the cost of failure is high, potential entrants are more inclined to acquire information on their relative competency prior to entry. That is, they will be more inclined to invest in pre-entry evaluation. This leads to a higher probability of entrant survival in these industries. Conversely, industries where the costs of experimentation are lower encourage a larger complement of firms to take the entry gamble in order to ascertain their relative competency, leading to a higher failure rate among young firms.

[1] Our framework draws from Jovanovic (1982). In his seminal paper, firms gauge their relative efficiency from actual post-entry performance. Efficient firms, wherein "ability exceeds expectations", survive and grow; by contrast, inefficient firms, where the converse is true, decline and fail. For a useful overview, see Audretsch (1995).

The second theme focuses on the relation between competition and exit. The intensity of competition may affect the amount of market room available to new firms. More competition may have dire consequences for entrants (as the market is less forgiving), or it may create new opportunities (by giving rise to new market niches). The competitive intensity of markets also affects the ability of established firms to react to the threat posed by new entrants. Relative differences in these factors may help explain inter-industry differences in the failure rates of new firms.

The analysis is as follows:

Chapter 2 provides a brief overview of our data source—the Longitudinal Employment Analysis Program (LEAP) database.

Chapter 3 provides a first examination of entry and survival rates. We report entry and survival rates for new firms in 15 major industry divisions (e.g., manufacturing, wholesale trade, construction). Provincial survival rates are also investigated.

In Chapter 4, we present our conceptual framework of the entry and exit process—a stylized model in which certain industry characteristics influence the failure rate. Two industry variables—average firm size and average entrant size—are used to proxy the cost of market experimentation. Two others—a concentration ratio and the rate of job turnover—are proxies for the intensity of competition. Data and measurement issues are then addressed.

Chapter 5 investigates differences in survival and hazard rates across clusters of industries—clusters that are designed to evaluate the significance of our entry and exit framework. For instance, we ask whether new firms in industries with small average firm sizes are more, or less, likely to survive than are entrants in industries with larger firm sizes. An inverse relationship between firm size and the failure rate would provide some initial evidence that post-entry performance is correlated with the costs of market experimentation. After examining the impact of each of our proxies, we evaluate the relative strength of these effects by investigating the relation between entry rates and failure rates. As a final exercise, we report two parsimonious measures of inter-industry differences in failure rates—the average length of life (of new firms) and median length of life.

Chapter 6 investigates how differences in inter-industry failure rates evolve over time. Using a hazard rate analysis, we examine the risk of failure facing new firms at two distinct stages of the lifecycle: infancy and early adolescence.

The results outlined in previous sections are based on aggregate survival data. In these exercises, each of the factors that are posited to affect the failure rate is examined individually. In Chapter 7, we investigate the determinants of failure jointly—by looking at the importance of individual factors after controlling for the effects of others. Our analysis at this stage serves various objectives. These are summarized below.

- We estimate a regression model in which the probability of failure formally depends upon a set of explanatory variables. We extend the scope of our analysis to include firm-specific, industry-level and macroeconomic influences on the failure rate. While retaining a focus on certain industry-level characteristics (i.e., concentration and turnover), we investigate the impact of two firm-specific factors—size and age—on the hazard. In addition, this model controls for geographic and industry-specific variation in the failure rate.

- Using our regression framework, we investigate differences in the likelihood of survival across individual provinces and industries. These provide a useful complement to the aggregate survival rates reported in Chapter 3. In addition, we examine changes in survival rates brought about by variation in certain factors—relative measures of firm size, age, the intensity of competition, and economic growth.

- We revisit our earlier focus on the relation between age and the failure rate. In order to compare the determinants of failure at different stages of the entrant's lifecycle, we estimate a hazard rate model for new firms in their first and fifth years of life. We then examine differences in survival rates across individual provinces and industries, and evaluate the quantitative impact of changes in firm size, competition and economic growth.

- As a final exercise, we examine the relation between the timing of entry and the failure rate. Focusing on newborn firms, we estimate a hazard rate model that examines the determinants of failure across two entry periods: the 1980s and the 1990s. We then evaluate the impact of changes in relative efficiency and competitive intensity, and examine inter-provincial and inter-industry variation in the survival rate.

We conclude in Chapter 8 by reviewing the central findings of the study. Additional tabulations as well as supplementary discussion on measurement and methods are presented in appendix form.

Chapter 2 – The Data Source

Our tabulations are based on a Statistics Canada database—the Longitudinal Employment Analysis Program (LEAP). LEAP is a company-level database that includes all employers in Canada, both corporate and unincorporated.[2] This database tracks the employment and payroll characteristics of individual firms from their year of entry to their year of exit.

The identification of new businesses on LEAP is based on payroll deduction accounts. Every employer is required to register a payroll deduction account and issue a T4 slip to each employee that summarizes earnings received in a given fiscal year. The LEAP database includes every business that issues a T4 taxation slip. For each business, annual estimates of total payroll and employment are calculated.[3] The latter, used extensively in this analysis, is an average count of employees within the firm, and does not distinguish between full-time and part-time workers. This payroll and employment information is then organized *longitudinally*, that is, each observation on the database corresponds to a particular firm whose employment, payroll and industry characteristics are recorded at different points in time.

The longitudinal nature of LEAP allows entry and exit times to be measured with precision. Entrants (or 'births') in any given year are firms that have current payroll data, but that did not have payroll data in the previous year. Similarly, exits (or 'deaths') in any given year are identified by the absence of current payroll data, where such data had existed in the previous year.[4] While seemingly straightforward, obtaining accurate measurements of births and deaths is not a trivial task. The creation of the LEAP database requires considerable effort in distinguishing 'real' births and deaths from 'false' ones. Real births and deaths reflect actual entry and exit events (the creation of new firms and the failure of existing ones); false births and deaths may simply reflect organizational restructuring within a firm, or a change in its reporting practices. These false births and deaths are identified, and then corrected on the file, using a method of 'labour tracking'.[5] This approach essentially tracks workers as they move from company to company from one year to the next. If a new firm (or birth) contains a large majority of employees from a 'death' in the previous year, then the status of this death and birth is subject to verification. In cases where a birth and death share the same (or a similar) name, or the same payroll deduction account(s), this birth and death is reclassified as a continuing business.[6]

LEAP has traditionally been used to support research on employment dynamics. Picot, Baldwin and Dupuy (1994) and Picot and Dupuy (1996) examined job creation and loss within small and large firms. This study represents the first comprehensive analysis of survival and failure rates within the Canadian economy based on LEAP data.

The LEAP database is, in organizational terms, comprised of two distinct datafiles—a 'national' datafile and a 'provincial' datafile. Each is updated regularly to incorporate the most current employment and

[2] The self-employed that do not draw a salary are not included on the LEAP database. In addition, businesses comprised solely of individuals or partnerships who do not draw a salary are also excluded from LEAP.
[3] The basic unit of employment in the LEAP database is an ALU or 'Average Labour Unit'. For additional background on LEAP, see Picot and Dupuy (1996, Appendix 1).
[4] This allows us to ascertain that a firm that exists in year i but not $i + 1$ has exited some time in year i.
[5] For discussion, see Baldwin, Dupuy and Penner (1992).
[6] For a more detailed discussion of data reliability, see Appendix E.

payroll information on individual firms. The national datafile contains no information on a firm's province(s) of operation, which is maintained separately on the provincial file. This national/provincial distinction has important implications for the profile of entry and exit developed herein, as we draw extensively from both datafiles. The majority of our tabulations in Chapters 3-6 are based on the national file.[7] New entrants on this file are firms that commence operations anywhere in Canada. These are firms that are 'new' to Canada, irrespective of whether they established their operations in British Columbia, Newfoundland or any other province or territory.

Our multivariate analysis in Chapter 7 is, by contrast, based primarily on the provincial datafile—as one of our principal objectives at this stage is to examine differences in failure rates across provinces, while simultaneously accounting for a multitude of factors that, we posit, directly influence the hazard rate.[8] Unlike the national file, new entrants on the provincial file refer to businesses that are 'new' to a particular province. This means that certain businesses, those with operations in more than one province, will appear on the file more than once (as separate units). For example, a firm with longstanding operations in Ontario may establish new operations in Quebec. These new operations will trigger a birth in Quebec, apart from the earlier activities of the firm in Ontario. Similarly, the cessation of these new operations will trigger a death in Quebec, while the firm remains in operation in Ontario.

We outline several data issues below—those that pertain directly to the scope of our analysis. While these points are addressed in the ensuing text, they are worthy of emphasis here.

- Our focus is on new firms in commercial industries (that is, on entry driven by the profit motive). We exclude from the analysis all entrants in public, quasi-public and not-for-profit industries. These include new firms classified to government services, educational services, health and social services, and non-profit organizations.[9]

- Our analysis is based on new firms that entered the market over the 1984-1994 period. As entry and exit are measured in annual units, this observation period comprises eleven separate entry periods, and hence, eleven different cohort groups. Our choice of observation period is governed by data considerations. At the time of writing, all entrants on the national file were right-censored in 1995.[10] We modify this observation period slightly when conducting our multivariate analysis based on the provincial file. Here we are able to add one year to our observation period, as right-censoring occurs in 1996.

[7] One exception to this is the provincial survival rates reported in Table 5.
[8] The samples used for the regression analysis derive from the provincial file; that said, certain explanatory variables in this analysis are calculated from the national file.
[9] The non-profit sector is comprised of enterprises classified as membership organizations. In addition to the above sectors—each of which is excluded on the grounds that its economic activity is largely non-commercial in nature—we removed firms classified to Deposit Accepting Intermediary Industries from the subsequent analysis because of data limitations.
[10] That is, as of 1995, we are unable to distinguish between exits and continuing firms, because we lack 1996 data to ascertain which of firms alive in 1995 exit by the following year.

Chapter 3 – Entry and Survival

For the majority of new firms, life is short and uncertain. Most entrants exit shortly after birth. About one in five new firms survive to their tenth birthday. This process of entry and failure is costly, both in dollar terms and in the time-costs borne by entrepreneurs. One may view this process as the investment that the market economy makes in finding the goods and services that consumers demand. It can also be regarded as an investment in managerial experience, as some of the entrepreneurs who fail will learn from their experiences and go on to found businesses that eventually succeed.

Entry rates by industry sector are reported in Table 1.[11] New firms, on average, accounted for 16% of the overall business population over the 1984-1994 period. Entry is more pronounced in the services sector (17%) than in the goods sector (15%).

Table 1. Entry Rates by Industry Sector (1984-1994)

Goods-Producing Industries	***Rate of Entry (%)***
Agriculture	13.6
Fishing and Trapping	17.0
Logging and Forestry	21.0
Mining, Quarrying and Oil Wells	14.2
Manufacturing	11.8
Construction	16.5
TOTAL (Goods)	14.8
Service-Providing Industries	
Transportation and Storage	16.7
Communications and Other Utilities	16.2
Wholesale Trade	12.2
Retail Trade	14.3
Finance and Insurance	17.2
Real Estate Operators and Insurance Agents	12.7
Business Services	17.0
Accommodation, Food and Beverage	18.3
Other Services	23.3
TOTAL (Services)	17.0
All Industries (Goods and Services)	***16.3***

[11] Regional entrant and firm populations are described in detail in Appendix D. We present data for individual industries over a range of entry periods.

Among goods-producing industries, logging and forestry (21%) and fishing and trapping (17%) exhibit the highest rates of entry. New firms are least prevalent in manufacturing (12%). Among services-providing industries, the highest rates occur in other services[12] (23%), accommodation, food and beverage (18%), and finance and insurance (17%). Relatively low rates of entry are evident for retail trade (14%), real estate operators and insurance agents (13%) and wholesale trade (12%).

The ultimate importance of entrants is determined not only by their rate of birth, but also by the rate at which they exit. Exit rates report, for a specific period, the ratio of failures to the total entrant population. However, as failure may occur at different times and at different rates across particular classes of firms, it is useful to represent the relation between entry and exit using two distinct measures of probability: the survivor and hazard functions. The survivor function, $S(j)$, specifies the probability that a unit from a population of entrants will have a lifetime in excess of duration (j).[13] In a nonparametric framework, the survivor function takes the form:

$$S(j) = \prod_{i=1}^{j} (n_i - d_i) / n_i$$

where d_i is the number of failures at age (i) and n_i is the population of firms at risk just prior to (i).[14] A related measure is given by the hazard function, $h(i)$, which specifies the probability that failure will occur at age (i), given that the risk of failure still exists at (i). The hazard rate is calculated by taking the ratio of the number of exits to the number of firms at risk at age (i), that is,

$$h(i) = \frac{d_i}{n_i}.$$

The survivor function can thus be expressed in terms of the hazard function:

$$S(j) = \prod_{i=1}^{j} (1 - h_i).$$

Survival and hazard rates for firms that entered commercial industries over the 1984-1994 period are reported in Table 2.[15]

---

[12] This industry sector is comprised of amusement and recreational services, as well as personal and household services, among others.

[13] Thus, the survivor function is simply the counterpart to the conventional distribution function, $F(j)$, which specifies the probability that a unit from the population will have a lifetime less than or equal to (j). Note that definitions for survivor and distribution functions are often modified in terms of the equality condition; alternatively, the former gives the probability that a lifetime is <u>equal to or greater than</u> (j) and the latter defines the probability that a lifetime is <u>less than</u> (j). Kiefer (1988) provides an illuminating discussion of distributions within the context of survival analysis.

[14] This is the standard product-limit estimator of the survivor function. For discussion, see Cox (1972), Kalbfleisch and Prentice (1980), and Lawless (1982). Much of our discussion is based on Kiefer (1988).

[15] A note on our terminology: we use the terms *survival rate* and *survivor function* interchangeably. In both cases, we are referring to the latter – the probability of surviving beyond a particular age. We adopt a similar convention for describing the *hazard rate*, often referring to the hazard simply as the *failure rate*. In either case, this is the likelihood of failure, given that the possibility of failure still exists. Note that detailed survival and hazard rates are reported in the appendices – including geography-by-industry combinations (Appendix B) and geography-by-firm size combinations (Appendix C).

Each of these survival rates gives the probability that a new firm will live beyond a certain age. A new firm has a 77% likelihood of surviving beyond its first year, a 36% probability of surviving past its fifth year, and a 20% likelihood of completing its first decade. By comparison, each of the hazard rates represents the likelihood of failure at a particular age—conditional upon the risk of failure still existing. Accordingly, a new firm that is still in business just prior to its second year has a 22% likelihood of failing during its second year. An entrant that remains in business prior to its fifth year has only a 14% chance of failing during this year.

Table 2. Survival and Hazard Rates, All Commercial Industries

Duration (years)	*Survival Rate*	*Hazard Rate*
1	0.77	0.23
2	0.61	0.22
3	0.50	0.18
4	0.42	0.16
5	0.36	0.14
6	0.31	0.13
7	0.27	0.12
8	0.24	0.11
9	0.22	0.10
10	0.20	0.10
11	0.18	0.10

The relationship between survival and hazard rates is explored in greater detail in Chapter 5. At present, we focus exclusively on survival rates—the likelihood that a new firm will live beyond a particular age. Survival rates for entrants in goods-producing and service-providing industries are reported in Tables 3 and 4, respectively.[16]

Table 3. Survival Rates, Goods-Producing Industries

Duration (years)	1	2	3	4	5	6	7	8	9	10	11
Agriculture	0.74	0.60	0.50	0.43	0.37	0.32	0.28	0.25	0.22	0.20	0.18
Fishing and Trapping	0.77	0.64	0.54	0.47	0.41	0.36	0.32	0.30	0.27	0.24	0.22
Logging and Forestry	0.73	0.55	0.44	0.37	0.31	0.27	0.24	0.21	0.20	0.18	0.16
Mining, Quarrying and Oil Wells	0.82	0.67	0.56	0.48	0.41	0.36	0.32	0.29	0.26	0.23	0.21
Manufacturing	0.83	0.68	0.58	0.50	0.44	0.40	0.36	0.33	0.30	0.28	0.26
Construction	0.75	0.59	0.49	0.41	0.35	0.31	0.27	0.24	0.22	0.19	0.17
All	**0.76**	**0.61**	**0.51**	**0.43**	**0.37**	**0.33**	**0.29**	**0.26**	**0.23**	**0.21**	**0.19**

[16] The corresponding hazard rates are reported in Appendix A.

Among goods-producing industries, early-period survival rates are highest in manufacturing and mining (Table 3). Firms in these sectors have a 68% and 67% likelihood of surviving beyond their second year, respectively. In later years, new manufacturing firms are still better off; a manufacturing entrant has a 33% probability of surviving beyond eight years.

In the services sector (Table 4), new firms in wholesale trade, real estate and insurance, finance and insurance, and business services have relatively high survival rates at two years (67%-69%), about the same as entrants in manufacturing industries. While firms in these industries continue to do better than the services average, those in wholesale trade maintain the highest survival rate in later stages of life. At the other extreme, new firms in the accommodation, food and beverage industry have some of the lowest survival rates. Here entrants have only a 60% chance of surviving beyond their second year and only a 22% chance of surviving beyond eight years. The latter probability is a good 12% less than wholesale industries and 9% less than business services. Firms in the residual group of 'other services'—including personal and household services—have an even lower likelihood of surviving beyond eight years (16%).

Table 4. Survival Rates, Service-Providing Industries

Duration (years)	1	2	3	4	5	6	7	8	9	10	11
Transportation and Storage	0.79	0.62	0.52	0.44	0.38	0.33	0.29	0.26	0.24	0.22	0.20
Communications and Other Utilities	0.80	0.63	0.51	0.44	0.37	0.32	0.29	0.26	0.23	0.21	0.20
Wholesale Trade	0.84	0.69	0.59	0.51	0.45	0.41	0.37	0.34	0.31	0.29	0.27
Retail Trade	0.82	0.64	0.52	0.43	0.37	0.32	0.28	0.25	0.22	0.20	0.18
Finance and Insurance	0.81	0.67	0.57	0.49	0.42	0.37	0.33	0.29	0.26	0.23	0.21
Real Estate Operators & Ins. Agents	0.83	0.68	0.58	0.51	0.44	0.39	0.35	0.31	0.28	0.26	0.23
Business Services	0.83	0.68	0.58	0.50	0.44	0.39	0.34	0.31	0.28	0.26	0.23
Accommodation, Food and Beverage	0.80	0.60	0.48	0.40	0.33	0.28	0.25	0.22	0.19	0.17	0.15
Other Services	0.68	0.49	0.38	0.30	0.25	0.21	0.18	0.16	0.14	0.12	0.11
All	**0.78**	**0.60**	**0.49**	**0.41**	**0.35**	**0.30**	**0.27**	**0.24**	**0.21**	**0.19**	**0.17**

The survival rates of new firms vary substantially across Canadian provinces (Table 5). Entrants in Ontario have the highest probability of surviving beyond their second year (63%). Roughly six in ten new firms in Quebec, Alberta and British Columbia reach this milestone. Second year survival rates are slightly lower in Saskatchewan and Manitoba, at 55% and 54% respectively. Business failures in very young firms are more apparent in the Atlantic Provinces. Just over four in ten new firms in Newfoundland survive beyond their second birthday.

Differences in survival rates across provinces are also evident in the longer term. Roughly one in four new firms in Ontario, Quebec, Alberta and British Columbia survive beyond their eighth birthday. For the Atlantic Provinces, Newfoundland excepted, the likelihood of doing so declines to one in five.

The reasons that new firms in some provinces fare better than those in others are varied and complex. In the first instance, differences in aggregate survival rates may mirror underlying differences in size characteristics and/or industry composition. If, for example, survival is positively correlated with firm size, provinces with relatively high shares of larger entrants, will, other things equal, tend 'to produce' more survivors. Differences in the industry mix between provinces will also affect survival rates. Finally, institutional factors or differences in policy regimes may prove consequential. All of this suggests that a systematic study of failure rates requires an underlying framework. It is to this that we now turn.

Table 5. Survival Rates by Province

Duration (years)	1	2	3	4	5	6	7	8	9	10	11
Newfoundland	0.58	0.41	0.32	0.26	0.21	0.18	0.15	0.13	0.11	0.10	0.08
Prince Edward Island	0.60	0.47	0.39	0.33	0.29	0.25	0.23	0.20	0.18	0.16	0.14
Nova Scotia	0.65	0.50	0.41	0.34	0.29	0.25	0.22	0.20	0.18	0.16	0.14
New Brunswick	0.62	0.48	0.39	0.33	0.28	0.25	0.22	0.20	0.18	0.16	0.14
Quebec	0.75	0.59	0.48	0.41	0.35	0.31	0.27	0.24	0.22	0.20	0.18
Ontario	0.79	0.63	0.51	0.43	0.37	0.32	0.28	0.25	0.22	0.20	0.18
Manitoba	0.69	0.54	0.45	0.38	0.33	0.28	0.25	0.22	0.20	0.18	0.16
Saskatchewan	0.71	0.55	0.45	0.38	0.32	0.28	0.24	0.22	0.19	0.17	0.15
Alberta	0.75	0.59	0.48	0.41	0.35	0.31	0.27	0.24	0.22	0.19	0.17
British Columbia	0.77	0.60	0.49	0.41	0.35	0.31	0.27	0.24	0.22	0.20	0.18

Chapter 4 – A Framework for Analysis

The interest in exploring the post-entry performance of new firms stems from the important role that entrants play. Entrants are seen as a positive force in most industries. They serve as the conduit through which new ideas are introduced (Audretsch, 1995). They are seen as a primary force that equilibrates industry profits (Geroski, 1991). The death of entrants, on the other hand, reduces these beneficial effects. It is for this reason that the factors that allow firms in certain industries to survive at higher rates than in others are worthy of investigation. Two factors have been posited to affect the survival rates of new firms. First, inter-industry variability in post-entry performance may be due to differences in competitive conditions. Second, the underlying costs of entry may condition differences in survival rates. Most studies of failure rates provide little in the way of a formal model. Often, the hazard is simply regressed on a series of variables, each of which is posited to affect the probability of exit in some way. In what follows, we first offer a conceptual framework—a stylized model of the entry and exit process.

4.1 A Model of Entry and Exit

To investigate the factors associated with survival, consider a basic model in which the quantity of entry, N, and the probability of survival, p, are determined by the interaction of two forces. The first of these is a supply curve that captures the relationship between the number of entrants and the probability of survival. To derive this supply curve, we posit a profit function for a representative entrant of the form:

$$PR = R - C(E)$$

where R equals revenue and $C(E)$ is the cost function. Entry decisions will depend upon the level of expected profit, (π). This, in turn, is a function of profits, PR, the probability of success, p, and the losses, L, that will occur if the firm fails:

$$\pi = E(PR) = p * PR + (1 - p) * L$$

Losses are the costs of entry that are not recouped upon failure. They consist of sunk costs of capital and equipment, other investments that are made at the pre-entry stage, and losses that occur after entry prior to failure.

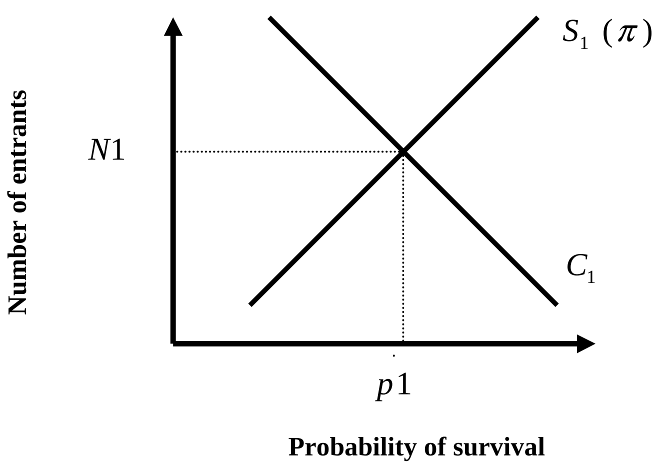
The aggregate supply curve of entrants is derived from the entry decisions of individual firms. Each of these can be modelled as an investment decision based on expected profits. Consider a world where capabilities differ. Some entrants will do quite well after entry because of their superior capabilities, while others will fail because of their inferior capabilities. In a world where expectations differ, some potential entrants will have high expectations of profitability. They will enter when the probability of success is lower. Others, because their expectations of their own capabilities are less, only enter when the probability of success increases. These differences will trace out the supply curve S_1 in Figure 1, which is positively sloped in the probability of success p. The location of this curve will depend on expected profits (π).

The second determinant of entry and success is a constraint C that determines the amount of 'market room' or 'demand' for entry. We represent this as the downward sloping curve in Figure 1. This constraint recognizes that all markets are finite and that the larger the entry pool, the less likely any one entrant will survive. It leads to an inverse relationship between the number of entrants and the probability of survival. In the simplest of worlds, where entry satisfies new demand and there is only enough room for one firm, this market constraint will trace out a rectangular hyperbola, that is,

$$N = 1/p.$$

In Figure 1, market equilibrium occurs at $p1$ and $N1$.

Figure 1. The Entry-Probability of Survival Relation



Hazard models, which calculate *p* as a function of certain industry characteristics, implicitly assume a system such as that represented in Figure 1.[17] Let us now consider what this model reveals about the relationship between the likelihood of survival (or failure) and certain market characteristics.

Since the supply curve is determined by the level of π, changes in expected profit will cause the supply curve to shift. Expected profits in the current framework are partially endogenous. They depend on both revenues and costs. Part of these costs involves information acquisition. Firms need to invest in market information, capital equipment, and human capital. In addition, they have to make basic expenditures to forecast their probability of success. Some of these costs can be incurred prior to entry. Others are incurred after entry.

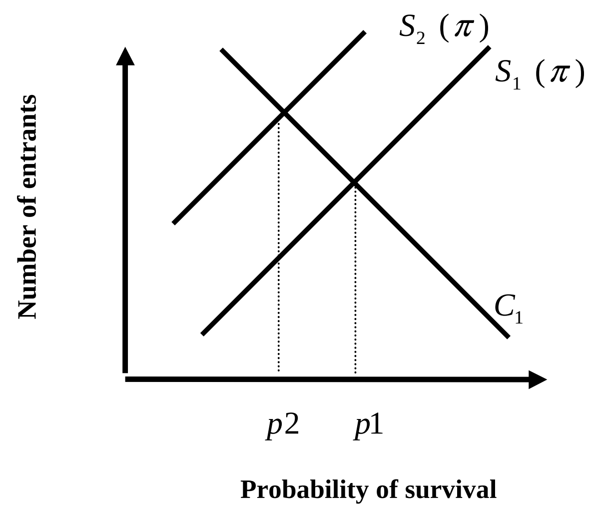
In Jovanovic's (1982) model of selection, the success of a firm depends principally on its relative efficiency, the state of which is unknown prior to entry. Only after taking the decision to enter will the firm learn of its relative competency. Thus "the efficient grow and survive; the inefficient decline and fail."[18] Baldwin and Rafiquzzaman (1995) demonstrate that entrants in manufacturing that fail are indeed the least efficient.

[17] A simplified version of this model would set expected profits equal to zero with *p* (the survival rate) adjusting to maintain this equilibrium condition. In this simplified model, the *S* curve becomes perfectly inelastic at *p*1.
[18] See Jovanovic (1982: 649).

By evaluating its managerial capabilities via this process, a firm risks potential losses L. This is a form of investment in information acquisition, the gains from which are lost if the firm fails. These costs will be relatively minor when there are few sunk costs, that is, when the extraction costs of an entrepreneur's investment are relatively low. When this is the case, there will be more of this form of information acquisition and concomitantly more entry.

In our framework, if one assumes a constant value for R, expected profit varies with the cost of entry experimentation. Where these costs are low, so is L and the higher is π. Market factors that signal a decrease in the cost of experimentation—for example, by reducing the initial costs of entry—will shift the S curve upwards, as greater numbers of new firms take the entry gamble at a given level of p. As seen in Figure 2, this reduces the equilibrium probability of survival from $p1$ to $p2$. We therefore expect a positive relationship between the likelihood of survival and the costs of experimentation. Lower experimentation costs will lead to a lower survival rate.

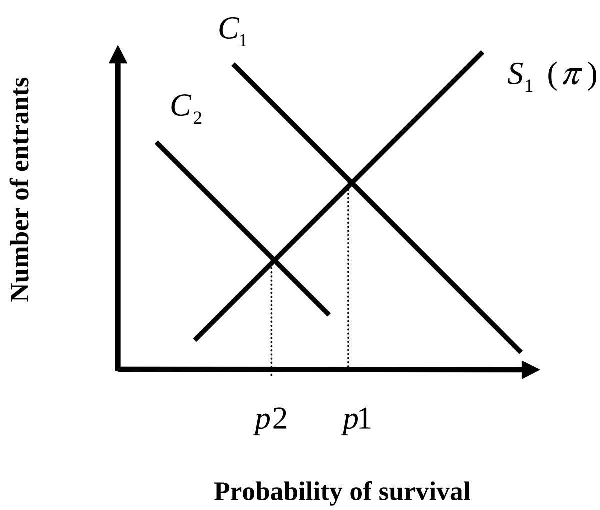
Figure 2. A Reduction in Entry Costs



Whereas profit conditions affect the position of the supply curve, the location of the constraint is determined by the competitive conditions of the industry. More generally, the position of the constraint will be determined by how much 'market room' there is for new firms. This will depend upon the industry's competitive environment. Adopting the life-cycle model (Abernathy and Utterbach, 1978; Rothwell and Zegveld, 1982; Gort and Klepper, 1982), we can posit that there exists considerable room for entrants in the early stages of an industry's life cycle. In these stages, new ideas are much more successful. It is only later in the industry life cycle that it becomes more difficult for entrants to survive, partially because firm sizes increase and it is more difficult for entrants to master all the skills that are required in larger firms immediately upon start-up. It is also at this stage that industries become more concentrated and the reaction of incumbent oligopolists to entrants may lead to a lower likelihood of success for a given number of new firms. We would therefore expect the C curve to be to the right in the early stages of an industry—with higher levels of both N and p. On the other hand, we would expect that the constraint would be to the left in more mature industries, with lower levels of both N and p. This may prove untrue, however, if the supply behaviour of entrants is also influenced by an industry's lifecycle. For instance, it may be that mature industries have higher failure costs, if in fact sunk costs are high. This reduces the number of actual entrants, seen here as a downward shift in the *S* curve, and leads to an increase in the equilibrium survival rate.

Changes in the intensity of competition will also affect the position of the market constraint, and hence, equilibrium N and p—though not in ways that are obvious a priori. On one hand, more competition will effect a leftward shift in the constraint curve. In this context, a more competitive market is less forgiving, and leads to more failure. This reduces the equilibrium levels of N and p, as seen in Figure 3. On the other hand, greater competition often gives rise to a more dynamic marketplace, and may actually create additional market space for new young firms. Entrants in dynamic markets may be more able to capitalize on new product ideas and production technologies, which in turn may afford them some advantage (at least in the short run) over competitor firms. These offsetting 'congestion' effects aside, changes in the intensity of competition may also influence expected profits, and hence the supply decisions of entrants. Accordingly, the net effect of competition on the survival rate can only be ascertained via empirical analysis.

Figure 3. An Increase in the Intensity of Competition (where competition leads to failure)



4.2 The Role of Industry Environment

We describe below a set of industry characteristics that, we posit, determine either the position of the supply curve or the market constraint. Two variables—average firm size and average size of entrant—are directly related to the cost of market experimentation. Another two—the concentration ratio and the rate of job turnover—are measures of the intensity of the competitive process. The relation of our final variable—the rate of entry—to the survival rate will depend on whether the market constraint or the supply curve varies more across industries.

Average Firm Size

In our framework, average size is taken as a proxy for the costs of market experimentation. The greater the average firm size within an industry, the more pronounced the input costs associated with the entry gamble. If a given percentage of costs are sunk, and thus irrecoverable in the event of failure, average firm size will be positively correlated with the amount that will be lost should failure occur. In a similar vein, average firm size can be seen as closely related to the barriers associated with scale, or financing costs, all of which increase the costs of entry. This will cause post-entry search costs to increase and will effect a downward shift in the entrant supply function. In turn, this will decrease the number of entrants in equilibrium and increase their likelihood of survival.

Average Entrant Size

As an alternative measure of size, average entrant size provides a more direct measure of the cost conditions facing new firms at the time of the entry decision. Upon failure, small entrants can expect to make fewer losses than large firms, as the former are less likely to incur sunk costs associated with *inter alia* scale or financing requirements. Lower experimentation costs will, in turn, encourage more firms to take the entry gamble. Hence, an increase in average entrant size shifts the *S* curve downwards, thereby increasing the survival rate.

Industry Concentration

Concentration ratios are often used as a proxy for the intensity of competition within a given industry. A concentrated industry, in which output is generated by a relatively small number of firms, suggests a correspondingly lower level of competition than that expected in industries where output shares are more equally distributed.

If less competition among incumbents also means that entrants face less competition, an increase in industry concentration serves to shift the market constraint rightwards, thereby increasing both the number of entrants and the probability of survival in equilibrium. On the other hand, if more concentration leads to more reaction by incumbents, the market room curve will shift to the left resulting in less entry and lower survival. And if concentration is associated with high experimentation costs due to sunk costs, this shifts the supply curve to the right and leads, other things equal, to less entry and higher survival. The effect of concentration on the post-entry performance of entrants in equilibrium is therefore ambiguous.

Rate of Job Turnover

An alternate measure of the intensity of competition within an industry is given by the rate of turnover. The rate of turnover captures the extent to which resources are being transferred from one firm to another. As Baldwin and Gorecki (1994) argue, the rate of turnover is a more direct measure of competition than are concentration ratios. The latter depict the overall firm size distribution but do not capture the degree to which firms are shifting position as a result of competition. Turnover more directly captures this phenomenon. In general, high rates of turnover suggest the presence of a volatile marketplace, characterized by unstable market shares brought on by the continual reorganization of competitor firms. Baldwin (1995) demonstrates that these are industries where profits return to normal more quickly when exogenous forces cause short run disequilibrium. Industries with considerable turnover are also those for which the parameters of competition are quite dynamic in nature, as evidenced by relatively high levels of innovation and technological change.

The effect of turnover on the failure rate of new firms is, like concentration, somewhat ambiguous *a priori*. On the one hand, an increase in the rate of turnover suggest that all firms, both entrants and incumbents, face more competition, and hence are more likely to fail, other things equal. We can represent this in our framework as a leftward shift in the constraint, or market room curve, leading to a decrease in the entrant survival rate. On the other hand, an increase in turnover may create more, not less, room for new firms if volatile markets create new niche opportunities.

Rate of Entry

Relative movements in the supply and market room curves will determine the relationship between the rate of entry and the survival rate. If the supply curve is constant and only the market room curve shifts due to changes in competitive conditions, then changes in equilibrium levels of entry and the probability of entrant survival will be positively related. On the other hand, if the market room conditions are constant, and there are differences across industries in the supply behaviour of entrants, then changes in equilibrium levels of entry and the probability of survival will be inversely correlated. When both the technical constraint and the supply curve vary, their relative volatility will determine the relationship between N and p.[19]

4.3 Defining Industry Clusters

To investigate these issues empirically, we propose the following method. For each industry variable, all 3-digit industries are rank-ordered and stratified into terciles, corresponding to high/large, medium, and low/small industry clusters, respectively.[20] In all cases, the ranking order is derived by calculating a weighted average over the period under study; that is, for each industry, a single value is calculated using information from all applicable years.[21] Our set of industry variables are defined below:

Average firm size $= \dfrac{\sum_i E_i}{\sum_i F_i}$

where E_i denotes total industry employment and F_i is the number of businesses. The time period is i =1983,...,1994.

Average entrant size $= \dfrac{\sum_i E_i^e}{\sum_i F_i^e}$

where E_i^e is the employment of entrants and F_i^e is the number of new firms within the industry, respectively. Years range from i =1984,…,1995.

Concentration ratio $= \dfrac{\sum_i E^*_i}{\sum_i E_i}$

where E^*_i is the employment of the four largest firms in the industry and E_i is total industry employment. In this case, i =1983,…,1994.

---

[19] This is equivalent to the question of identification in a supply and demand model.

[20] Note that in certain cases LEAP industries are aggregates of 3-digit industries.

[21] For example, for a given industry, entry rates are tabulated using the sum of births across all years divided by the sum of enterprises in all years. An alternative technique, not utilized here, is to simply take the arithmetic mean of the yearly rates. Given our view that there exists little volatility in each of our industry characteristics from year to year, the former method should suffice for the present exercise.

$$\textbf{Rate of job turnover} = \frac{\sum_i (G + L - NC)_i}{\sum_i E_i}$$

where G is gross job gains, L gross job losses, and NC denotes the net change. E_i is total industry employment.[22] Each component is defined only for continuing firms and expressed as an absolute value.[23] The time period is $i = 1983,\ldots,94$.[24]

$$\textbf{Rate of entry} = \frac{\sum_i B_i}{\sum_i F_i}$$

where B_i is the number of births and F_i is the total number of firms within the industry. The years range from $i = 1984,\ldots,1995$.

Minimum and maximum values for the various industry clusters are presented in Table 6. Each tercile (or cluster) contains just under 70 industries, and represents one-third of all commercial industries on the LEAP database. On this, one issue warrants special emphasis: While terciles contain equal numbers of industries, they do not represent ‘equal groupings’ of firms, as the number of firms, new or otherwise, varies substantially from industry-to-industry. Accordingly, the number of firms in the ‘medium’ group of industries may, for example, be substantially more (or less) than the number of firms in either the ‘small’ or ‘large’ industry groups. In what follows, we examine how survival and hazard rates differ across these industry clusters.

Table 6. Minimum and Maximum Values, by Industry Group[25]

Industry Variable	***Small/Low Group***	***Medium Group***	***Large/High Group***
Average firm size (ALUs)	(0.6, 11.1)	(11.2, 36.3)	(36.9, 1590.1)
Average entrant size (ALUs)	(0.2, 1.8)	(1.8, 4.6)	(4.6, 72.2)
Concentration ratio (%)	(1.2, 16.7)	(17.1, 38.7)	(40.1, 98.5)
Rate of job turnover (%)	(2.6, 16.9)	(17.0, 22.8)	(22.8, 50.0)
Rate of entry (%)	(4.4, 11.3)	(11.4, 15.0)	(15.2, 30.1)

[22] Earlier work on manufacturing firms demonstrated that output-based and employment-based turnover measures yield similar results.
[23] The entry and exit components of turnover are excluded as these represent the basic units of inquiry.
[24] Note that slight differences exist in the time horizon used in calculating the various industry variables. In all cases, we use as much information as possible when calculating the characteristics under study.
[25] ALU stands for ‘average labour unit’ – the basic unit of employment in the LEAP database.

Chapter 5 –Survival and Failure

5.1 Survival and Hazard Curves

We present our empirical results below. Our basic measure of duration, or survival time, is:

Duration = (death year – birth year) + 1. [26]

The maximum age for new firms under study is 11. Survival and hazard rates for the first set of industry clusters—ordered by average firm size (AFS) —are presented in Figures 4 and 5. [27]

Survival rates are correlated with an industry's firm size characteristics. Survival rates increase monotonically across the three industry clusters (from small-size industries to large-size industries). This, in turn, suggests that the costs of experimentation vary in accordance with firm size.

Differences in hazard rates across industry clusters become apparent in the initial year of life. Entrants in industries with small firm size characteristics have a much higher hazard in their first year. Beyond this point, hazard rates across the small- and medium-size clusters are virtually identical. In contrast, new firms in industries with large firm size characteristics have lower hazard rates at every duration.

It is also noteworthy that hazard rates increase from the first to the second year for entrants in both the medium and large size classes, but not for those in the smaller size class. The former provides some evidence of a 'honeymoon effect'—the notion that the firm's initial stock of assets will afford it some insurance against failure in early infancy. This effect is at work in the larger not the smaller size classes. Hence, failure rates for the larger firms are not expected to be at their highest in the first period of life—rather, they will reach a maximum at the point where initial assets are depleted (seen here as year 2) only to decline thereafter (Fichman and Levinthal, 1991). The existence of a honeymoon effect aside, our results do suggest that differences in failure rates are more substantial in the early years of life than in subsequent periods.[28]

[26] As exits cannot be identified in the terminal year, firms for which 1995 payroll data exist are, by definition, right-censored.
[27] Note that product-limit estimates are generally plotted as a step function. For ease of presentation, we plot our survival rates as a continuous curve. It should be noted, however, that these rates remain constant between durations and do not descend on a continuous scale. As such, valid point estimates occur only at discrete duration times. Survival and hazard rates for each of our industry clusters are presented in tabular form in Appendix A.
[28] Previous studies have found evidence of declining hazards over time; see (e.g.) Audretsch (1991) and Baldwin (1995). For a discussion of these studies, see Caves (1998).

Figure 4. Survival Rates, by Average Firm Size

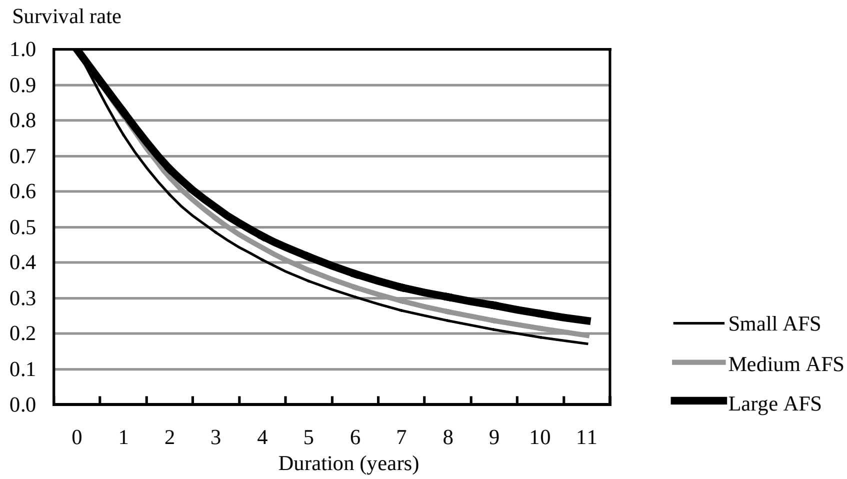
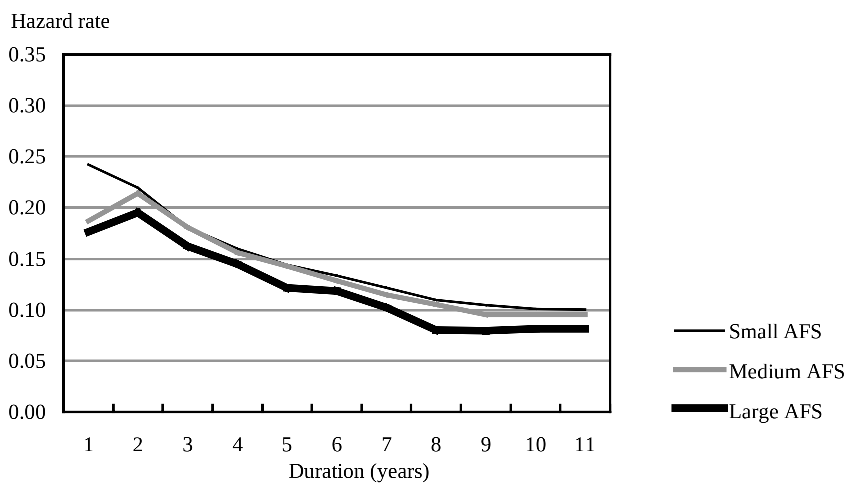


Figure 5. Hazard Rates, by Average Firm Size



Survival and hazard rates based on average entrant size (ASE) are plotted in Figures 6 and 7.

Figure 6. Survival Rates, by Average Entrant Size

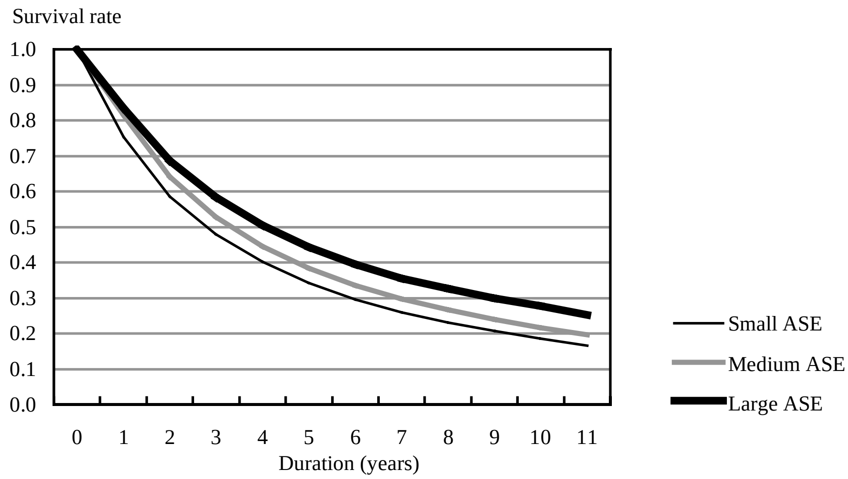
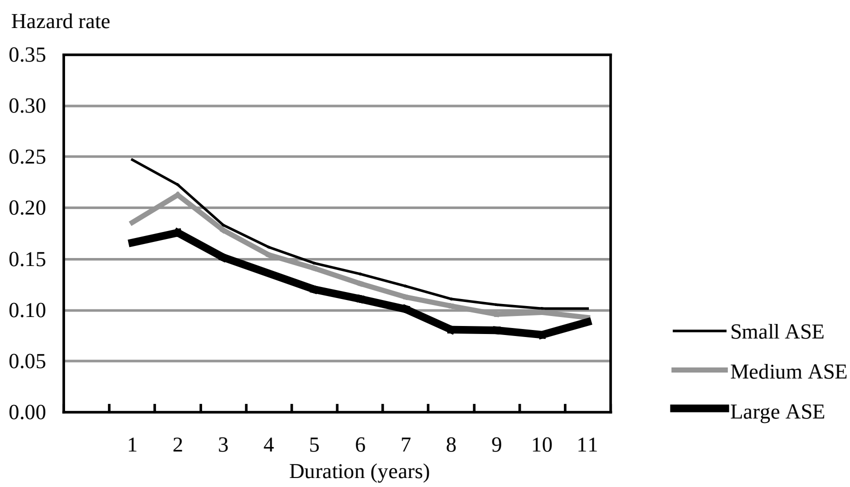


Figure 7. Hazard Rates, by Average Entrant Size



Ranking industries on the basis of average entrant size also reveals monotonic differences across the three industry clusters (low/medium/large). Once again, the survival rate of new firms is lower among industries with smaller firm sizes. New firms in industries with larger entrant sizes exhibit higher survival rates than those in the medium size range (Figure 6). Failure rates are everywhere lower in large-size industries (Figure 7). While a high first-year hazard in the small size cluster is apparent, once beyond this initial year, failure rates in small and medium size industries are again nearly equivalent. As before, hazard rates increase between years one and two in industries with medium and larger entrant sizes.

We now turn to address two conventional measures of market competition—concentration and turnover. Figures 8 and 9 report survival and hazard rates for industry clusters ranked by the degree of concentration. At first blush, there is little relationship between industry concentration and survival rates for new firms. That said, new firms in highly concentrated industries do have a slightly lower failure rate in their first year (Figure 9).

The fact that survival rates do not increase (or decrease) monotonically from more to less concentrated industries suggests that the impact of concentration on failure is not straightforward. A relatively low first-year failure rate in more concentrated industries suggests that incumbent response plays a minor role at start-up, and that very young firms benefit from less competition. Beyond this stage, however, concentration appears to have little effect on failure.

Figure 8. Survival Rates, by Concentration

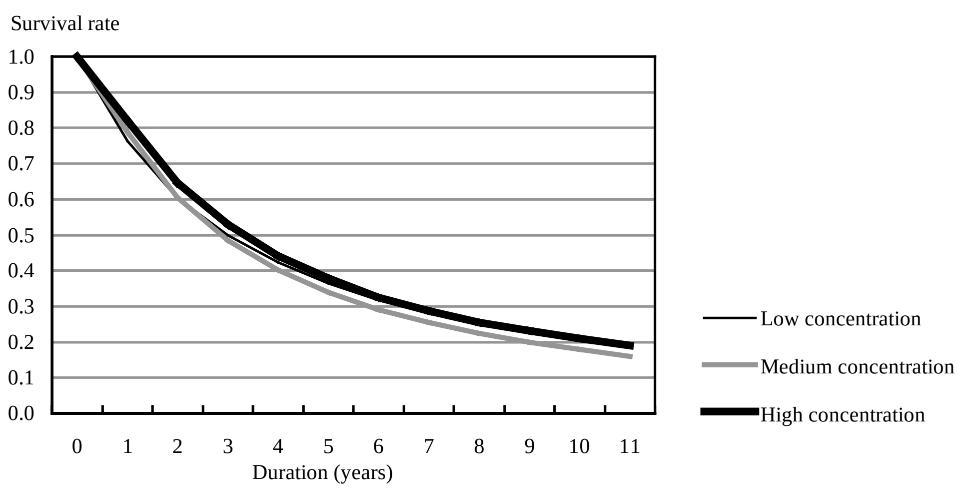
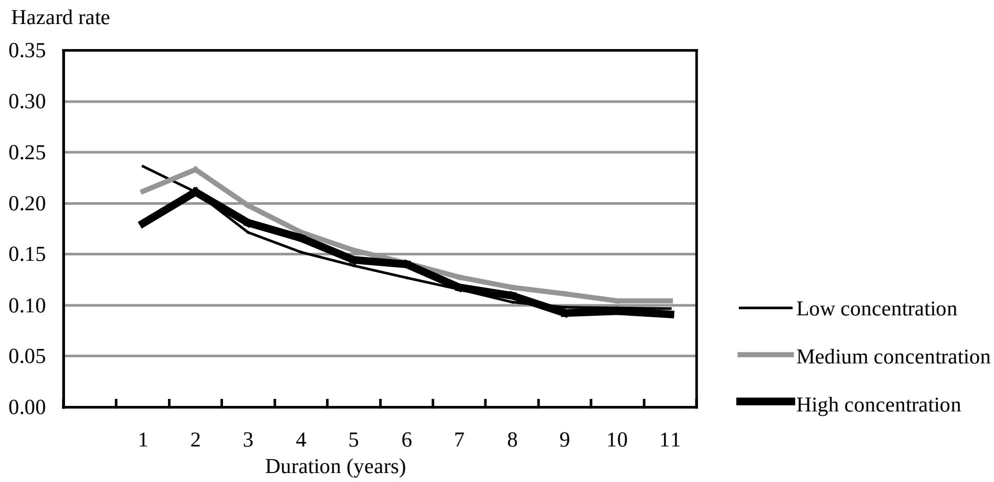


Figure 9. Hazard Rates, by Concentration



The results for job turnover (Figures 10 and 11) are similar to those for concentration in that our industry rankings produce no strong monotonic relationship. Entrants in industries with higher rates of job turnover (among continuing firms) do exhibit slightly lower survival rates than new firms in other industries (Figure 10) owing, once again, to a higher hazard rate in the first year (Figure 11). This suggests that very young firms are more adversely affected by a volatile marketplace. Beyond the first year, however, differences in failure rates are negligible.

Figure 10. Survival Rates, by Rate of Job Turnover

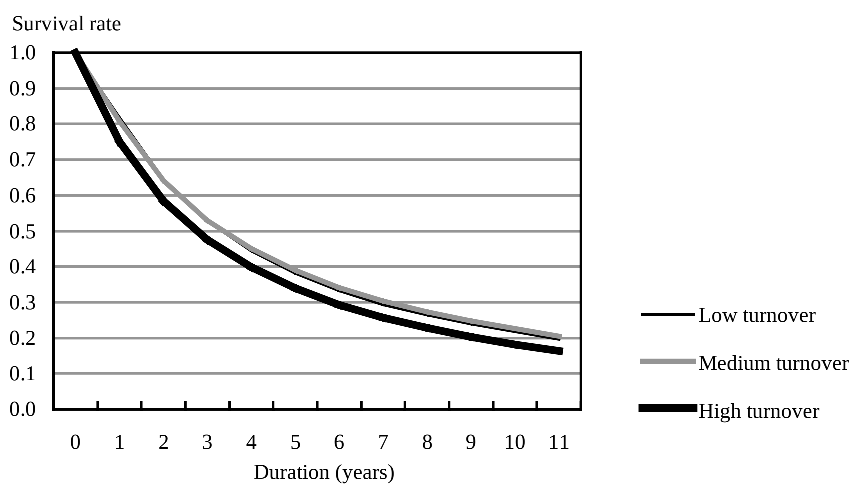
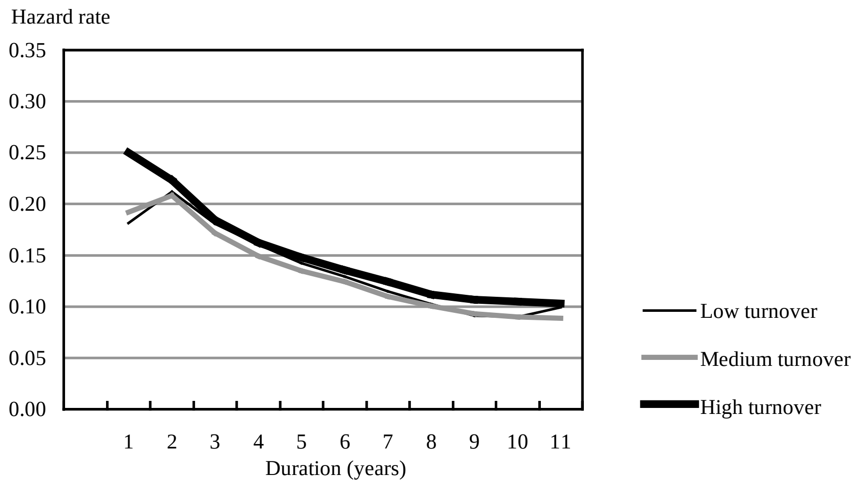


Figure 11. Hazard Rates, by Rate of Job Turnover



The results of our industry analysis suggest that intersectoral differences in firm size requirements bring about more variation in survival rates than do those associated with concentration and turnover. In our framework, this suggests that cross-industry variation in the supply curve (the position of which is influenced via changes in the costs of experimentation) is more apparent than cross-industry variation in the market room curve (the position of which is determined by changes in competitive intensity). In turn, we can expect a negative correlation between entry rates and survival rates for new firms. Survival and hazard rates across entry groupings are plotted in Figures 12 and 13.

Figure 12. Survival Rates, by Rate of Entry

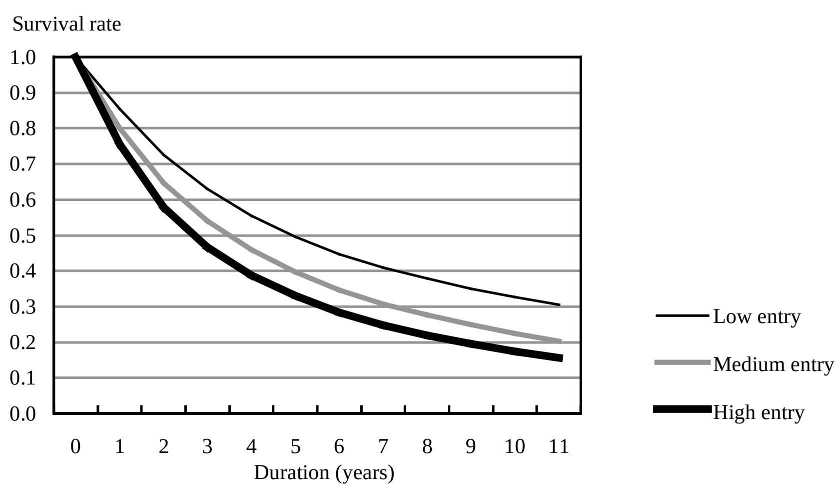
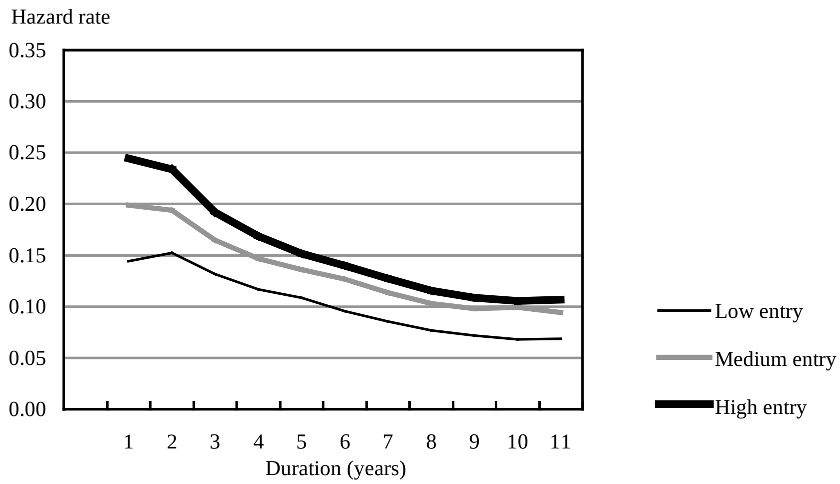


Figure 13. Hazard Rates, by Rate of Entry



The results confirm the positive correlation between entry and failure. This is true for entrants with different age profiles. A new firm in a high-entry industry has a 76% likelihood of surviving beyond its first year; this increases to 80% for entrants in medium-entry industries, and to 86% for new firms in low-entry industries. Calculated in year five, these probabilities stand at 33%, 40%, and 50% for high-, medium- and low-entry sectors, respectively. As seen in Figure 13, cross-industry differences in failure rates are more apparent in early years of life. These become less apparent in subsequent periods, although hazards in low-entry industries do remain consistently lower than those in other industries over the entire time period studied here.

It is noteworthy that cross-industry variation in hazard rates is most pronounced in early stages of life. It is in these years that the greatest disparity exists between the most and the least efficient firms, as the market has not yet had time to cull out the latter. Once this occurs, and as the remaining entrants mature, there is less variability in failure rates, as there is less disparity in operating efficiencies among the remaining population.

5.2 Length of Life Estimates

Survival and hazard curves constitute a useful first basis for inquiry. Both represent a locus of probability estimates calculated over a number of years. But these need to be supplemented with more parsimonious summary statistics in order to characterize differences in the exit process across industries. In this chapter, we use information on survival and hazard rates to estimate two such measures: the mean and median lifetime of new firms.

Mean Length of Life

To estimate average survival time for each of our industry clusters, we assume that the survival data follow a Weibull distribution.[29] A two-parameter distribution, hazard and survivor functions for the Weibull are defined as:

$$h(t) = \gamma\alpha(\gamma t)^{\alpha-1}$$

and

$$S(t) = \exp[-(\gamma t)^{\alpha}]$$

where ($\gamma > 0$) and ($\alpha > 0$).

Taking the natural logarithm of the Weibull survivor function and multiplying by (-1) yields:

$$-\log(S) = (\gamma t)^{\alpha}.$$

Transforming this into linear form, we have:

$$\log[-\log(s)] = \alpha[\log\gamma + \log t].$$

Accordingly, an OLS regression of the form:

$$y = a + bx + u$$

will yield estimates of the Weibull parameters where:

$$\gamma = \exp(a / \alpha)$$

and

$$\alpha = b.$$ [30]

The average length of life can then be recovered from the Weibull parameters by taking:

$$\frac{1}{\gamma}\Gamma[(\alpha+1)/\alpha].$$ [31]

---

[29] The Weibull distribution is generally used in practice in light of its convenient mathematical form. Standard plotting techniques provide some support for a Weibull – see Appendix F.

[30] For a useful discussion, see Lawless (1982).

[31] We include the following sample calculation of mean survival time. Hastings and Peacock (1975) write the Weibull survivor function for a random variable (x) as

$$S(x) = \exp[-(x/b)^{c}]$$

where b is the scale parameter and c denotes the shape parameter. The corresponding expression for the mean of the distribution is

$$b\Gamma[(c+1)/c].$$

In our notation, the scale parameter γ is equal to $\frac{1}{b}$. Consequently, the expression for the mean becomes

$$\frac{1}{\gamma}\Gamma[(\alpha+1)/\alpha]$$

Mean survival times for each of our industry clusters are reported in Table 7.

Table 7. Average Length of Life, by Industry Cluster (units = years)

	AFS	*ASE*	*CONC*	*TURN*	*ENTRY*
Low/small	5.8	5.7	6.2	6.1	9.1
Medium	6.1	6.2	5.4	6.4	6.5
High/large	7.1	7.6	6.0	5.6	5.4

New firms have short expected lives. In our sample, the average length of life for new firms across all industries is about 6 years. Estimates of survival time vary sensibly across each of our industry clusters. For example, new firms in industries with high rates of entry have an average length of life (5.4 years) that is roughly one-half that of entrants in low-entry industries (9.1 years). As expected, average entrant size (ASE) and average firm size (AFS) are positively correlated with survival time. Differences in average survival time are not strongly related to changes in competitive intensity—as measured by concentration (CONC) and turnover (TURN).

Median Length of Life

The Weibull survivor function can also be used to estimate median duration time—a measure of central tendency that is less influenced by outliers. Once again, this survivor function takes the form:

$$S(t) = \exp[-(\gamma t)^{\alpha}]$$

Transforming this into linear form and solving for log (t) yields:

$$\log(t) = c + d\log[-\log S(t)]$$

where

$$c = -\log\gamma$$

and

$$d = 1/\alpha.$$

Estimating the parameters (c, d) via an OLS regression yields a vector of predicted values for log (t).

where $\alpha = c$. To illustrate, our least squares estimates of α and γ for the low entry-rate class of industries are 0.829 and 0.122, respectively. Substituting these values into the above expression yields a mean of 9.06 which, then, is the average survival time for new firms in low-entry industries based on the Weibull distribution.

At the median survival time:

$\log[-\log S(t)] \equiv \log[-\log(0.5)]$.[32]

Thus, the predicted value of $\log(t)$ evaluated at $\log[-\log(0.5)]$ is the median value of log duration. Taking the antilog of the median converts the estimate to its appropriate time-scale.

Estimates of median survival time are reported for each of our industry clusters in Table 8. As might be expected from the skewness in the distribution of survival times (the preponderance of entrants die young, only a small percentage live for a long period), the median estimates reported in Table 8 are considerably lower than the means reported in Table 7. On average, the median survival time is roughly 3 years, while the mean is about 6 years.

Table 8. Median Survival Time, by Industry Cluster (units = years)

	AFS	*ASE*	*CONC*	*TURN*	*ENTRY*
Low/small	3.0	2.9	3.2	3.7	5.3
Medium	3.6	3.6	3.1	3.7	3.7
High/large	4.0	4.4	3.6	2.9	2.9

Differences in median survival time across industry clusters are generally consistent with the survival rates reported in Section 5.1.[33] New firms in industries with high entry rates exhibit a lower median survival time (2.9 years) than those in the medium and low entry-rate sectors. We again observe a monotonic relationship between firm size and survival time (AFS and ASE). Median survival time is not clearly related to either concentration (CONC) or turnover (TURN). This said, new firms in industries with high rates of job turnover do have shorter median lives than those in other industries. This result suggests that turnover captures differences in the intensity of competition, but that its effect is more evident in early years of life, which is consistent with the hazard rates presented in Figure 11.

[32] To see this, recall that a survivor function value of 0.5 at duration (t) indicates that a given unit from the population has a 50% probability of surviving in excess of duration (t); similarly, the median of a continuous frequency distribution is just the value of the random variable (x) such that an observation has a 50% probability of being greater than (x).

[33] Note that, while differences between nonparametric and Weibull medians do exist, they are generally slight.

Chapter 6 –The Risk of Failure: New Start-Ups versus Adolescents

In Chapter 5, we found that firm size characteristics, our proxies for the costs of entry experimentation, give rise to more inter-industry variation in survival rates than do our measures of competitive intensity, concentration and turnover. In all cases, when industry characteristics matter, they matter most in early periods, as indicated by relatively large differences in first-year hazard rates. During infancy, new firms still differ substantially in terms of their efficiency characteristics and culling is relatively more important.

In what follows, we formally examine differences in relative risk among infant firms (new businesses in their first two years of life) and then among adolescents (firms that are 5 to 7 years old). Our motivation for doing so is to ascertain whether differences in failure rates persist beyond the short run.

To investigate this, we define average hazard rates during infancy and adolescence. Denote these respectively as:

$$h(1,2)_j^i$$

and

$$h(5,7)_j^i$$

where the parenthetical expression indicates the age cohorts used to calculate the average, the superscript i denotes an industry cluster (e.g., small) and the subscript j represents an industry characteristic (e.g., average firm size). Average hazards in infancy, $h(1,2)_j^i$, are thus defined for any combination of i and j as the ratio of total deaths in years 1 and 2 to the total number of firms at risk during years 1 and 2. Average hazards in adolescence are similarly calculated for years 5 through 7 inclusive. For any industry characteristic j, we can define a series of *risk differentials* during infancy as:

$$h(1,2)_j^m - h(1,2)_j^l$$
$$h(1,2)_j^h - h(1,2)_j^m$$
$$h(1,2)_j^h - h(1,2)_j^l$$

where the superscripts l, m, and h denote low/small, medium, and high/large industry clusters, respectively. A risk differential thus measures the probability difference in average hazard rates between different groups of industries at a particular point in the lifecycle. For adolescents, these become:

$$h(5,7)_j^m - h(5,7)_j^l$$
$$h(5,7)_j^h - h(5,7)_j^m$$
$$h(5,7)_j^h - h(5,7)_j^l.$$

Each of the above hazard-rate differentials represents competing population proportions. For the purpose of illustration, let j equal the rate of entry. To test whether the hazard in medium-entry industries differs from the hazard in low-entry industries[34], we evaluate the null

$$H_o : h(1,2)_j^m - h(1,2)_j^l = 0.$$

To do so, we require an estimate of the pooled hazard based on industry classes l and m.
We can define this pooled estimate as

$$h(1,2)_j^{m,l} = \frac{N_l h(1,2)_j^l + N_m h(1,2)_j^m}{N_l + N_m}.$$

Tests of the null are based on the following test statistic:

$$Z = \frac{h(1,2)_j^m - h(1,2)_j^l}{\sqrt{\text{var}[h(1,2)_j^m - h(1,2)_j^l]}}.$$

Risk differentials are reported in Table 9. [35]

[34] For an overview of inference testing in regards to competing proportions, see Neter et al. (1982).
[35] In the event of a (significant) non-zero risk differential, we construct interval estimates in the following manner. Define the variance of the risk differential as

$$\text{var}[h(1,2)_j^m - h(1,2)_j^l] = \text{var}\, h(1,2)_j^m + \text{var}\, h(1,2)_j^l$$

where for all industry classes (i= l,m,h)

$$\text{var}[h(1,2)_j^i] = \frac{h(1,2)_j^i * (1 - h(1,2)_j^i)}{N(1,2)_j^i}.$$

The confidence interval takes the form

$$h(1,2)_j^m - h(1,2)_j^l \pm z * \sqrt{\text{var}[h(1,2)_j^m - h(1,2)_j^l]}$$

where z (0.90) equals 1.645.

Table 9. Average Risk Differentials, Infant Firms

	Risk Differential	*90% C. I.*
AFS:		
Medium vs. small sector	-3.5***	(-3.6, -3.3)
Large vs. medium sector	-1.4***	(-1.8, -1.0)
Large vs. small sector	-4.9***	(-5.2, -4.5)
ASE:		
Medium vs. small sector	-4.0***	(-4.1, -3.8)
Large vs. medium sector	-2.7***	(-3.0, -2.4)
Large vs. small sector	-6.7***	(-7.0, -6.4)
CONC:		
Medium vs. low sector	-0.5***	(-0.7, -0.4)
High vs. medium sector	-2.7***	(-3.1, -2.4)
High vs. low sector	-3.3***	(-3.6, -2.9)
TURN:		
Medium vs. low sector	0.4***	(0.2, 0.7)
High vs. medium sector	4.0***	(3.9, 4.2)
High vs. low sector	4.5***	(4.2, 4.7)
ENTRY:		
Medium vs. low sector	4.8***	(4.6, 5.1)
High vs. medium sector	4.4***	(4.2, 4.5)
High vs. low sector	9.2***	(9.0, 9.5)

**** significant at 1%, ** significant at 5%, * significant at 10%*

The above results allow us to examine cross-sectoral variation in failure rates among infant firms. New business start-ups in industries with medium rates of entry exhibit, on average, a 4.8% greater hazard rate than infants in low-entry industries. This gap in relative hazards increases to 9.2% in a comparison between high and low entry rate sectors. When industry clusters are based on entrant size (ASE), infants in industries with small entrants exhibit, on average, a 6.7% greater hazard than those in industries with large entrants. By way of contrast, differences in infant failure rates between the most and least concentrated sectors are only half as large.

We now turn to examine differences in relative risk during adolescence. Risk differentials are reported in Table 10.

Except for a strong correlation between entry and failure, only slight differences in relative risk exist among adolescent firms. While often statistically different from zero, the magnitude of these risk differentials in qualitative terms is not substantial. Emerging firms in industries with large entrant sizes have a 2.5% lower failure rate than adolescents in industries with small entrant sizes. Differences based on concentration or turnover are even less apparent. These results suggest that certain aspects of industry structure that may be correlated with failure are less consequential among firms that have survived to adolescence.

Table 10. Average Risk Differentials, Adolescent Firms

	Risk Differential	*90% C. I.*
AFS:		
Medium vs. small sector	-0.4***	(-0.7, -0.2)
Large vs. medium sector	-1.6***	(-2.2, -0.9)
Large vs. small sector	-2.0***	(-2.6, -1.4)
ASE:		
Medium vs. small sector	-0.8***	(-1.0, -0.6)
Large vs. medium sector	-1.7***	(-2.2, -1.2)
Large vs. small sector	-2.5***	(-3.0, -2.0)
CONC:		
Medium vs. low sector	1.4***	(1.2, 1.7)
High vs. medium sector	-0.7**	(-1.3, -0.2)
High vs. low sector	0.7**	(0.2, 1.3)
TURN:		
Medium vs. low sector	-0.6**	(-1.0, -0.2)
High vs. medium sector	1.3***	(1.0, 1.5)
High vs. low sector	0.7***	(0.3, 1.1)
ENTRY:		
Medium vs. low sector	2.9***	(2.6, 3.3)
High vs. medium sector	1.5***	(1.2, 1.7)
High vs. low sector	4.4***	(4.0, 4.7)

**** significant at 1%, ** significant at 5%, * significant at 10%*

Chapter 7 – Investigating the Determinants of Failure: A Multivariate Approach

We have explored several themes in previous sections. First, industry characteristics that proxy the costs of market experimentation—average firm size and average entrant size—play a greater role in conditioning the exit process than do variables that determine the amount of market room—such as turnover and concentration. As our conceptual framework suggests, this leads to an inverse relationship between the rate at which firms enter the marketplace and aggregate survival rates; higher entry, simply stated, gives rise to more failure. In Chapter 5, we presented these results in several ways—using, first, plots of survival and hazard rates and, second, estimates of mean and median lifetimes. A second major theme—introduced in our discussion of survival and hazard curves, and developed more fully in our examination of risk differentials in Chapter 6—is that the factors that influence intersectoral variation in failure rates tend to be more consequential in early stages of life, only to diminish as new firms mature.

While these conclusions are useful, they rely heavily on two-way, or binary, tabulations. Within a binary framework, it is often difficult to separate the influence of one factor on the hazard from those of others. For instance, when examined independently, both average firm size and job turnover may condition failure rates; if, however, the incidence of job turnover within industries is highly correlated with firm size, the effect of turnover on the hazard may be spurious. In this chapter, we investigate the determinants of failure using a multivariate framework—one that measures the contribution that individual factors play in conditioning hazard rates after all other factors have been taken into account.

At this stage, we extend the scope of our analysis to account for both macroeconomic and firm-specific influences on the hazard. What is more, differences in survival probabilities across both provinces and industries are investigated both qualitatively and quantitatively. As the factors that condition the hazard are not invariant to the age of the firm, these inter-provincial and intersectoral differences are examined at two distinct phases of the lifecycle—infancy (year one) and adolescence (year five). We also examine the impact of changes in firm size, competitive intensity and macroeconomic conditions on the failure rate at both stages of the entrant lifecycle (age one and age five).

To examine the above, we use a logit regression model where the hazard rate, $h(t)$, is functionally dependent upon a set of explanatory variables (or covariates).[36] These covariates capture the importance of cyclical, industry-level and firm-specific influences on the failure rate.

[36] An alternative approach to the logit regression is the complementary log-log model which is often preferred when event times are generated by a truly continuous process. In general, logit and complementary log-log models tend not to yield substantively different results. This is true in the present case, as the vast majority of our results were both qualitatively and quantitatively similar in comparisons between the two models.

7.1 A Hazard Rate Model

In our first exercise we pool observations across cohorts and base the regression on *all* available firm-year data on individual firms. Conceptually, then, the sample data for the regression encompasses firms born in different years (ranging from 1984-1994) and of various ages (1 to 12).[37]

Measuring the Probability of Failure

In a logit framework, the dependent variable is the log odds of the hazard. Formally, this takes the form

$$\log[h(t)/(1-h(t))]$$

where *h(t)* is the hazard rate or conditional probability of failure. Its operational measure is a binary (0,1) variable *y* which takes a value of 1 in the year during which exit occurs.[38]

Factors Influencing the Hazard

In addition to the influence of industry characteristics (the focus of previous sections), macroeconomic and firm-level factors may also play important roles in conditioning success or failure. Even after controlling for these effects, success may vary substantially depending upon the firm's host industry or province of origin. Our set of explanatory variables is discussed below.

Earlier evidence suggests that firm size characteristics should be strongly correlated with the hazard. Our bivariate analysis in Chapter 5 revealed that the survival prospects of new firms tend to be better, on average, in industries with larger average entrant sizes. In our view, this relates to differences in the costs associated with the entry gamble; in industries with larger incumbents, the costs of failure—measured in terms of sunk costs, physical and financial capital—are often higher. This reduces the number of potential firms that are willing to take the entry gamble, which, in equilibrium, increases the likelihood that actual entrants will survive. Our first explanatory variable (RASE) is the ratio of two size measures: the employment of the firm divided by the average employment of all first-year firms within that entrant's industry. For firms in their initial year of life, this is a direct proxy for relative efficiency at start-up. As new firms mature, it becomes a *de facto* proxy for growth, as it captures the evolution of firm size relative to the average initial entry size within the industry. We posit that this measure of relative size is negatively correlated with the likelihood of failure. As this ratio increases, the size disadvantages associated with entry fall.

[37] The version of the LEAP database used for the regression analysis allowed us to include 1995 data – as exit characteristics for this year could be accurately measured. Accordingly, the regression analysis excludes firm data for 1996 – the point at which right censoring occurs. To construct the sample data set, we converted our longitudinal database – the original data source that tracks individual firms over time – to a 'firm year' database. In this firm-year format, the firm's lifespan determines the number of observations that it will contribute to the data set. For example, a firm that lives for only one year will contribute one observation, whereas a firm that lives for five years will contribute five observations. For an overview of this estimation technique, see Allison (1984).

[38] To illustrate, a firm that lives from 1984 to 1987 contributes a total of four observations to the sample (as duration equals death year less birth year plus one). For its first three years of life (1984-86 inclusive), the variable *y* takes a value of 0. In 1987, *y* takes a value of 1, as this is the year during which failure occurs. In the case of right-censored observations, *y* never assumes a value of one. For instance, a firm born in 1989 which survives to 1996 (the point at which censoring occurs) will have 7 observations, each with a *y* value of zero.

Table 11. Explanatory Variables for Regression Analysis

Variable	*Description*	*Mean*	*5th and 95th Percentiles*
RASE	Ratio of firm size to average industry first-year entrant size	2.1	(0.04, 7.0)
CONC	Industry concentration ratio	15.4	(2.4, 36.3)
TURN	Industry rate of job turnover	25.9	(15.3, 40.4)
RESFS	Ratio of average industry first-year entrant size to average industry firm size	0.2	(0.12, 0.44)
GRATE	Growth rate in real GDP	2.3	(-1.9, 5.4)
AGE	Age of the firm	3.5	(1.0, 9.0)
AGE^2	Age of the firm squared	18.4	(1.0, 81.0)
PROV	Set of provincial dummy variables	--	--
IND	Set of industry dummy variables	--	--

The next two variables—(CONC) and (TURN)—capture changes in the hazard due to inter-industry variation in the intensity of competition. As outlined in Chapter 4, the effect of market concentration (CONC) on the survival rate is ambiguous. If more concentration implies that new firms face less competition, they may, other things equal, be less likely to fail; conversely, if more concentration implies greater incumbent response, any gains to entrants from diminished competition among incumbents may be offset by this more intensive reaction to entrants. Nor is the relation between labour market turnover (TURN) and entrant survival without its ambiguity. Turnover is a proxy for market volatility or 'churning'—the process of continual reorganization of labour and market share between incumbent firms. Industries in which continuing firms exhibit high rates of job turnover may, in the first instance, afford entrants increased market opportunity, as unstable incumbents are less able to react to new firms; moreover, workers displaced from incumbents may migrate directly to new firms, bringing their experience and knowledge of incumbent practices. This said, it might be that a highly volatile marketplace is equally tenuous for both entrants and incumbents, affording the former no competitive advantage. For such reasons, we reserve any speculation on the directionality of these effects.

In order to further examine the relation between firm size and exit, we include an additional variable that we posit to be related to entry costs (RESFS). This variable measures whether size variation in the entrant pool, relative to the industry average, affects the likelihood of failure—once again focusing on initial entry conditions. RESFS is thus the ratio of average first-year entrant size within an industry to average firm size within that industry. Entrants to industries in which start-ups are large relative to the overall firm average have to make greater investments at the time of entry. We therefore expect less experimentation and concomitantly lower failure rates.

Changes in the business cycle may also play a role in determining failure rates. All firms, including entrants, may reap the benefits of a robust economy. Conversely, economic downturns may lead to greater failure. To control for the effect of cyclical variation, we include the annual growth rate in real GDP (GRATE) in the regression analysis.

The age of the firm is expected to condition its likelihood of survival.[39] Age is a measure of relative efficiency. Young, newborn firms are posited to be less efficient and are, thus, more likely to fail than are firms that have weathered the perils of infancy. We include both the age of the firm (AGE) and its square (AGE^2); the latter term measures the second order effects of age, that is, whether the advantages of incumbency increase or decrease with time.[40]

The above factors aside, failure rates may be highly correlated with geographic areas or other elements of the industry environment. To control for these effects, we include two sets of dummy variables: (PROV) and (IND). These are binary variables that take a value of 0 or 1 depending on the firm's province and industry of origin, respectively.

The regression model takes the form:

$$\log[h(t)/(1-h(t))] = \alpha + \sum \beta_i x_i + \sum \gamma_i prov_i + \sum \partial_i ind_i$$

where the x_i variables include the size-related covariates (RASE, RESFS), standard measures of competitive intensity (CONC, TURN), the growth rate (GRATE), and age effects (AGE, AGE^2). Geographic and industry-specific influences on the hazard are controlled for via (PROV) and (IND), respectively.[41]

Pooled Regression Results

The results of the above regression are reported in Table 12. These are based on all entrants to commercial industries[42] over the period 1984-1994 excluding those based in the territories. For all variables other than the provincial and industry dummies, the sign of the parameter estimate reveals the qualitative impact that a change in the associated variable has on the hazard, while controlling for the effects of all other influences. In this model, a positive coefficient indicates that an increase in the explanatory variable leads to an increase in the likelihood of failure, or equivalently, a decline in the probability of survival. A negative coefficient reveals the opposite—the associated variable exerts a negative effect on the probability of failure, or a positive effect on the likelihood of survival. The interpretation of the parameter estimates on the provincial and industry dummies is slightly different. These are calculated against reference groups in Ontario and manufacturing, respectively. Accordingly, then, a positive coefficient for a given province indicates that its entrants have a higher probability of failure than do new firms located in Ontario. In a similar vein, a positive coefficient for a particular industry reveals a higher likelihood of failure in this sector than in manufacturing.

[39] Age is defined as *(current year – birth year) + 1*.

[40] See Audretsch and Mahmood (1995), and Mata, Portugual and Guimaraes (1995). Note that the age variable captures the effects of both learning and selection. Firms learn as they acquire market experience, which improves their relative efficiency. The loss of competitors over time also reduces the hazard. One cannot disentangle these effects.

[41] For an overview of discrete-time logistic estimation, see Cox (1972) and Allison (1984).

[42] The industry exclusions outlined in Chapter 2 are still in effect. In addition to entrants in non-commercial industries (government services, education services, health services, membership organizations), those classified to Deposit Accepting Intermediary Industries (a sub-industry within the Finance and Insurance group) are omitted from the regression analysis.

Table 12. Results of the Pooled Logit Regression

Variable	***Parameter Estimate***
Intercept	-1.1044***
RASE (ratio of firm size to average industry first-year entrant size)	-0.3088***
CONC (industry concentration ratio)	-0.0007***
TURN (industry rate of job turnover)	0.0071***
RESFS (ratio of average industry first-year entrant size to average industry firm size)	-0.0456**
AGE (age of the firm)	-0.1421***
AGE^2 (age of the firm squared)	0.0052***
GRATE (growth rate in real GDP)	-0.0134***
Provincial Dummies:	
Newfoundland	0.3566***
Prince Edward Island	0.2462***
Nova Scotia	0.2338***
New Brunswick	0.2423***
Quebec	0.0447***
Ontario	--
Manitoba	0.1843***
Saskatchewan	0.1424***
Alberta	0.0847***
British Columbia	0.0632***
Industry Dummies:	
Agriculture	0.1799***
Fishing and Trapping	-0.1865***
Logging and Forestry	0.3072***
Mining, Quarrying and Oil Wells	0.0331**
Manufacturing	--
Construction	0.1809***
Transportation and Storage	0.1432***
Communications and Other Utilities	0.1792***
Wholesale Trade	-0.0424***
Retail Trade	0.2319***
Finance and Insurance	-0.1569***
Real Estate Operators and Insurance Agents	-0.1022***
Business Services	-0.0552***
Accommodation, Food and Beverage	0.3282***
Other Services	0.5038***
Summary Statistics:	
-2 Log Likelihood:	4,667,546
Pr > chi-square:	0.0001
Percentage of observations correctly predicted:	69.1
Number of observations:	5,071,673

***** significant at 1%, ** significant at 5%, * significant at 10%**

The above model yields sensible results. Our measure of relative size that captures the employment characteristics of individual firms directly (RASE) has the hypothesized sign. An increase in firm size, relative to the first-year entrant average within that firm's industry, decreases the likelihood of failure. This provides additional firm-level evidence to support the proposition that the survival rate and firm size characteristics are closely linked.

Gains in average entrant size relative to average firm size (RESFS) also decrease the likelihood of failure. This suggests that new firms in industries in which entrant sizes are comparable to incumbents suffer less from systemic scale disadvantages and make greater investments in pre-entry evaluation.

Our proxies for the intensity of competition—(TURN) and (CONC)—reinforce the role that competition plays in culling out new firms. Industries characterized by intense competition—as measured by the transfer of resources from one firm to another—are those in which new firms are more likely to fail. Thus, market volatility does not afford new firms a competitive advantage. Similarly, industries with lower concentration have higher failure rates. This suggests that new firms in more concentrated industries do not face a greater likelihood of incumbent response.

The age of the firm (AGE) is also positively correlated with survival. This is consistent with the proposition that new firms acquire 'survival momentum' as they grow older. This reflects the advantages that accrue with tenure—the development of managerial, marketing and financial competencies—that give rise, other things equal, to a lower likelihood of failure. As indicated by the positive coefficient on the (AGE^2) term, however, this effect diminishes over time.

Macroeconomic factors also affect the failure rate. A higher rate of growth of real output increases the probability that new firms will survive. A decline in the growth rate leads to more failure.

The hazard rate for new firms differs across provinces. After controlling for other influences on the hazard, firms that are located outside of Ontario are more likely to fail. Industry effects are also apparent. Relative to manufacturing, firms in wholesale trade, finance and insurance, real estate, fishing and trapping, and business services have a higher survival rate, while those in all other industries fare less well.

While the qualitative distinctions outlined above are useful, they do not directly provide us with the actual magnitude of failure rate differentials—that is, numeric differences in the likelihood of failure (or survival) that exist across individual provinces or industries. However, probabilities of these events can be recovered directly from the logit regression model. The probability of success P_s is defined as

$$P_s = 1 - P_f$$

where P_f denotes the likelihood of failure. In the logit model, this takes the form

$$P_f = \frac{e^{bx}}{1 + e^{bx}}$$

where b is the set of parameter estimates and x represents values for the covariates, evaluated here at the mean.

This yields the following set of estimates of P_s for individual provinces and industries.[43]

Table 13. Probability Estimates at the Mean, Province and Industry

	Likelihood of Survival
Province:	
Newfoundland	81.5
Prince Edward Island	83.1
Nova Scotia	83.3
New Brunswick	83.2
Quebec	85.7
Ontario	86.3
Manitoba	84.0
Saskatchewan	84.5
Alberta	85.2
British Columbia	85.5
Industry:	
Agriculture	85.4
Fishing and Trapping	89.4
Logging and Forestry	83.8
Mining, Quarrying and Oil Wells	87.2
Manufacturing	87.5
Construction	85.4
Transportation and Storage	85.9
Communications and Other Utilities	85.5
Wholesale Trade	88.0
Retail Trade	84.8
Finance and Insurance	89.2
Real Estate Operators and Insurance Agents	88.6
Business Services	88.1
Accommodation, Food and Beverage	83.5
Other Services	80.9

Despite the differences in the coefficients attached to the different regions (Table 12), the probability values indicate that there are only modest differences in the survival rates of new firms across provinces. In Ontario, the province with the highest success rate, the likelihood of survival (when all covariates are evaluated at the mean) is 86%, and yet for Newfoundland, the province with the lowest estimate, it stands at 82%. Among industries, fishing and trapping and finance and insurance have the highest survival rates (89%), while the residual group of other services—including, among others, amusement and recreational services and personal and household services—has the lowest rate (81%).

[43] Note that all survival rates reported in Chapter 7 are based on logistic regressions. These rates are not calculated in the same manner as the nonparametric survival rates that were reported earlier.

To quantify the effects of firm size, competition, age and growth on the survival rate, we examine the impact of each variable at the 5th and 95th percentiles within its distribution, holding all other variables constant (at their respective means). This allows us to ascertain whether or not changes in these variables exert substantial effects on the survival rate, while controlling for the influence of all other factors. To illustrate, consider the variable (RASE). This is the ratio of two size measures: the employment of the new firm divided by the average first-year employment of all entrants within that firm's industry. For the new firm, this is a proxy for changes in efficiency relative to the entrant pool. Survival rates calculated at the 5th percentile allow us to examine the quantitative impact of being considerably smaller than the entrant average, other things equal, whereas the rate calculated at the 95th percentile reveals the impact of being considerably larger than the industry entrant average.

The survival rate estimates for our continuous variables are reported below.

Table 14. Survival Rates at the 5th and 95th Percentiles

Variable	*All new firms*
RASE (ratio of firm size to average industry first-year entrant size)	(75.6, 96.4)
CONC (industry concentration ratio)	(85.3, 85.6)
TURN (industry rate of job turnover)	(86.4, 84.1)
RESFS (ratio of average industry first-year entrant size to average industry firm size)	(85.4, 85.5)
AGE (age of the firm)	(80.5, 92.8)
AGE^2 (age of the firm squared)	(86.5, 80.9)
GRATE (growth rate in real GDP)	(84.7, 85.9)

The size of the firm relative to the entrant pool (RASE) has the most significant impact on failure rates. New firms that are small relative to the first-year entrant average within their industry have a survival rate of 76%, whereas those that are large relative to this first-year average exhibit a 96% survival rate.

Changes in the age of the firm (AGE) also exert a strong influence on the failure rate. Firms that are young relative to the overall average for new firms are 12% less likely to survive than are firms that are mature relative to this average. The gains that accrue with tenure, however, diminish sharply with time.

While an increase in concentration (CONC) and in the size characteristics of the entrant pool (RESFS) both reduce the likelihood of failure, deviations from the industry average, in either case, have virtually no quantitative effect on the failure rate. Moving from an industry that is substantially more concentrated to one that is less concentrated only results in a 0.3% decline in the survival rate. The effect of a similar shift based on the relative size characteristics of the entrant pool is even smaller.

Changes in industry turnover (TURN) are only slightly more significant than (CONC) and (RESFS). New firms in industries with high turnover are about 2% less likely to survive than are entrants in industries with low turnover.

Finally, macroeconomic conditions bring about only small changes in the survival rate after controlling for other effects (just over 1%).

7.2 Age-specific Hazards: New Start-Ups versus Adolescents

The above exercise using regression analysis produced less variation in inter-provincial survival rates than was evident from the aggregate survival rates reported in Chapter 3. This is because the regression obscures some of the variation in failure rates that occurs at different phases of the lifecycle by presuming that the effect of each variable is independent of age. The survival estimates presented above are based on a pooled regression that combines firms of different ages from across different cohorts. While our regression reveals that the age of the firm is positively associated with the probability of survival, the model tacitly assumes that all the parameter estimates remain constant across firms with different age profiles. If the determinants of failure are highly age-specific, pooled regressions of the sort outlined above may obscure important differences in these relationships.

To investigate the determinants of survival at different phases of an entrant's lifecycle, we perform two age-specific regressions. The first regression includes data for all cohort groups, but limits the sample only to firms in their initial year of life. The evidence presented in earlier chapters suggests that differences in hazard rates are more pronounced in infancy. In early years, entrants differ considerably in terms of their relative efficiency, and culling is apt to play a greater role in removing less efficient firms from the market. We then estimate a second age-specific regression, focusing on firms in their fifth year of life. These are entrants that have survived the vicissitudes of infancy and have reached early adolescence. These age-specific regressions allow us to clearly distinguish between the post-entry performance of brand new firms and those that emerge into early adolescence.

We again use a logit regression to model the hazard and estimate survival probabilities. The estimation equation takes the same functional form as earlier, except that we omit the (AGE) and (AGE^2) terms from the set of explanatory variables. The regressands are (0,1) binary variables—$y(1)$ and $y(5)$—defined as follows:

- When the sample is limited to all firms of age 1, $y(1)$ takes a value of 1 if exit occurs, 0 if otherwise.
- When the sample is limited to all firms of age 5, $y(5)$ takes a value of 1 if exit occurs, 0 if otherwise.

The results of the above regressions, along with probability estimates for provinces and industries, are reported in Table 15.

Table 15. Results of Age-Specific Logit Regressions and Associated Probability Estimates

	AGE=1		AGE=5	
Variable	*Parameter Estimate* (1)	*Probability of Survival (%)* (2)	*Parameter Estimate* (3)	*Probability of Survival (%)* (4)
Intercept	-1.0398***	--	-1.8178***	--
RASE (ratio of firm size to average industry first-year entrant size)	-0.2218***	--	-0.3274***	--
CONC (industry concentration ratio)	-0.0092***	--	0.0035***	--
TURN (industry rate of job turnover)	0.0055***	--	0.0072***	--
RESFS (ratio of average industry first-year entrant size to average industry firm size)	-0.9930***	--	0.6293***	--
GRATE (growth rate in real GDP)	-0.0105***	--	-0.0122***	--
Provincial Dummies:				
Newfoundland	0.8653***	62.5	-0.0044	89.8
Prince Edward Island	0.8419***	63.0	-0.1563***	91.2
Nova Scotia	0.6619***	67.1	-0.0671***	90.4
New Brunswick	0.7420***	65.3	-0.1521***	91.1
Quebec	0.1871***	76.7	-0.0797***	90.5
Ontario	--	79.8	--	89.8
Manitoba	0.5408***	69.7	-0.0172	90.0
Saskatchewan	0.3987***	72.7	0.0066	89.7
Alberta	0.2042***	76.3	-0.0056	89.9
British Columbia	0.1150***	77.9	0.0213	89.6
Industry Dummies:				
Agriculture	0.3886***	72.2	0.0544*	91.0
Fishing and Trapping	0.1448***	76.8	-0.3274***	93.7
Logging and Forestry	0.3540***	72.9	0.2554***	89.2
Mining, Quarrying and Oil Wells	0.1247***	77.2	0.0710	90.8
Manufacturing	--	79.3	--	91.4
Construction	0.1985***	75.8	0.1460***	90.2
Transportation and Storage	0.0036	79.2	0.1921***	89.8
Communications and Other Utilities	0.4101***	71.7	0.0039	91.4
Wholesale Trade	-0.1948***	82.3	0.0531*	91.0
Retail Trade	0.0432***	78.6	0.3243***	88.5
Finance and Insurance	-0.0093	79.4	-0.2025***	92.9
Real Estate Operators and Insurance Agents	-0.1017***	80.9	-0.0493	91.8
Business Services	-0.1336***	81.4	0.0118	91.3
Accommodation, Food and Beverage	0.1635***	76.5	0.3657***	88.1
Other Services	0.6193***	67.3	0.3327***	88.4
Summary Statistics:				
-2 Log Likelihood:	1,499,487		321,140	
Pr > chi-square	0.0001		0.0001	
Percentage of observations correctly predicted:	63.7		71.2	
Number of observations:	1,368,785		409,517	

***** significant at 1%, ** significant at 5%, * significant at 10%**

The qualitative impact of the explanatory variables in the first year of life (Table 15, column 1) is virtually identical to the result reported earlier when we combined firms of all ages. The sign on the (RASE) variable is again negative—an increase in firm size relative to the average first-year size of all entrants in the same industry enhances the likelihood of survival. New firms benefit from larger firm size at start-up. Similarly, gains in average industry first-year entrant size relative to average industry firm size (RESFS) are associated with less failure. Once again, concentration is positively associated with survival, while more industry turnover leads to concomitantly more failure among newborns. Finally, start-ups benefit from more robust macroeconomic conditions (GRATE).

Qualitative differences in provincial and industry hazard rates are similar to those reported earlier. After controlling for other factors, entrants in their first year of life fare better in Ontario than in other provinces. Unlike our earlier results, however, the magnitude of these inter-provincial differences is now substantial (Table 15, column 2). Firms in their initial year of life exhibit a much higher success rate in Ontario (80%) than in the Atlantic Provinces (63%-67%). Business start-ups in British Columbia (78%), Quebec (77%) and Alberta (76%) are more likely to survive their first year than are those in Saskatchewan (73%) or Manitoba (70%).

Variation in first-year survival rates across industries is also apparent. Business start-ups with the highest likelihood of surviving their first year occur in wholesale trade (82%), business services (81%) and real estate industries (81%). New firms in agriculture (72%), communications (72%) and other services (67%) fare less well.

Our second age-specific regression focuses on firms in a different stage of their lifecycle—those in their fifth year. These firms have weathered the vicissitudes of early infancy. They are older than the median firm. They did not fail when the factors encouraging exit are most consequential. In this respect, they represent more successful new firms.

Increases in fifth-year firm size relative to the first-year entrant average (RASE) lead to a higher probability of survival (Table 15, column 3). Adolescent firms that have grown, or that maintain size advantages over start-ups are likely to be better off. While both start-ups and adolescent firms benefit from gains in relative firm size, the average size characteristics of the entrant pool (RESFS) will affect these firms in different ways. For start-ups, changes in the size distribution of entrants capture differences in the cost of the entry gamble; for adolescents, they influence the amount of competitive pressure that start-ups can exert on existing firms. An increase in relative entrant size leads to more survival among start-ups; this, in turn, increases the intensity of competition facing adolescents, resulting in more failure.

While more turnover (TURN) leads to higher failure rates in both infants and adolescents, industry concentration (CONC) affects firms of different ages in different ways. In five-year old firms, increased concentration leads to more, not less, failure. This suggests that incumbent response plays a greater role in conditioning hazard rates after firms emerge from infancy, when incumbents can identify which entrants constitute the greatest potential threat.

These age-specific differences in concentration support our interpretation of the entry process as one of experimentation—one in which differences in the costs associated with the entry gamble affect initial survival rates. In some industries, concentration brings about a higher likelihood of failure in mature entrants. And it is in these situations where one would expect to find less experimentation on the part of entrants in general, and therefore relatively lower failure rates, during the years when entrants are being culled out. There is, in this sense, a dynamic interplay between short and long run failure rates; more failure in the long run may lead to more cautious entry, and hence lower failure rates in the short run.

Geographic influences on the hazard rate are also strikingly different for adolescent firms. Previously, when new firms of different ages were examined simultaneously, entrants in Ontario had a lower likelihood of failure than entrants in other provinces. The same was true when we focused exclusively on firms in their first year of life. Interestingly, this is not the case for adolescent firms. In four provinces—Nova Scotia, New Brunswick, Prince Edward Island and Quebec—adolescents are less likely to fail than their counterparts in Ontario. This may reflect more stable market structures in these provinces—markets in which adolescent firms face less competition. In addition, differences in hazard rates between Ontario and all other provinces are not statistically significant. This being said, quantitative differences in survival probabilities across provinces—even when these differences are statistically significant—are not large. What is more, the survival rates are all extremely high (Table 15, column 4). Irrespective of their province of origin, new firms that survive to their fifth year have roughly a 90% likelihood of surviving this year.

These age-related differences in survival rates across regions are compatible with underlying differences in economic or competitive environments—though not in ways that are necessarily obvious at first thought. Ontario, the largest and most developed region, has the lowest failure rates in the initial year; but it fares less well relative to other provinces when firms reach early adolescence. This suggests a more dynamic economy for incumbents. And it is in these situations where entrants should be more cautious—leading to lower rates of failure in initial years.

Post-entry performance across industries also varies in accordance with the age of new firms. Start-ups in mining and communications are more likely than their counterparts in manufacturing to fail during their first year. Start-ups in real estate industries and business services are more likely than those in manufacturing to survive their first year. None of these sectoral differences are apparent in year five. Other age-specific differences in relative performance also emerge. For instance, start-ups in fishing and trapping are less likely than those in manufacturing to survive their first year, while adolescents in the former are more likely to survive their fifth year. The reverse is true of new firms in wholesale trade. Such differences aside, the probability that a five year old firm will survive the year is uniformly high, regardless of its industry of origin.

Size, Competition and Growth: Their Effects Over Time

The results of our regression analysis reveal that (1) survival rates for new firms differ across provinces and industries, and that (2) the nature and extent of these differences are closely tied to the *age* of new firms. Business start-ups in Ontario fare better in their first year of life than do those in other provinces. This is not true, however, of adolescent firms, as those in certain provinces—Nova Scotia, New Brunswick, Prince Edward Island and Quebec—are less likely to fail than their counterparts in Ontario, while those in the remaining provinces are no better, nor worse, off. The performance of new firms in certain industries also differs by age group. While entrants in manufacturing have a lower failure rate in their initial year of life than those in fishing and trapping, mining or communications, this is not true of adolescents. These differences underscore the effect that age, or more to the point, market experience, has on survival rates—due to changes over time in relative efficiency and competitive advantage. Since both of these factors are influenced by the costs of experimentation associated with entry, these results also emphasize the fact that entrant performance in early infancy is often inversely related to entrant performance in early adolescence, that entrants appear to anticipate later difficulties when it comes to entry by experimentation. Sectors where experimentation is seen as costly will dissuade potential entrants from taking the entry gamble. This, in turn, will remove 'less efficient' firms from the entry pool, leading to higher survival rates in early years. A more 'cautious' (and efficient) entry cohort may lead to more intense competition among these firms as they mature, and concomitantly, higher failure rates in early adolescence.

Our survivor and hazard rate analysis in Chapter 5 demonstrated that industry characteristics that influence the entry decision—such as the size characteristics of firms entering the market—have a larger effect on failure rates among infants than among adolescents. In what follows, we again focus *inter alia* on the effects of size and competition in order to ascertain whether or not their influence on the survival rate is more significant at different stages of the entrant lifecycle. It may be the case that deviations in firm size relative to the entrant average have more of an effect on the survival rate for first-year start-ups than for emerging firms. The same may prove true of certain industry-level characteristics, such as concentration or turnover.

To investigate these issues, we utilize the results of our two age-specific regressions and, once again, estimate the effects of size, competition and growth variables at their 5^{th} and 95^{th} percentiles, holding all other variables constant (at their respective means). The survival rates are reported in Table 16, for both first-year firms and those in their fifth year.

Table 16. Survival Rates at the 5^{th} and 95^{th} Percentiles

Variable	***Firms in their first year***	***Firms in their fifth year***
RASE (ratio of firm size to average industry first-year entrant size)	(72.1, 83.3)	(78.9, 98.6)
CONC (industry concentration ratio)	(74.0, 79.5)	(90.4, 89.4)
TURN (industry rate of job turnover)	(77.3, 74.8)	(90.7, 89.1)
RESFS (ratio of average industry first-year entrant size to average industry firm size)	(73.6, 79.3)	(90.8, 89.0)
GRATE (growth rate in real GDP)	(75.3, 76.8)	(89.6, 90.4)

Comparisons of first-year and fifth-year survival rates prove illuminating. The size of new firms relative to the industry first-year entrant average (RASE)—our base measure of relative efficiency—is the principal determinant of survival (or failure). The quantitative effect of deviations in firm size from the first-year average significantly exceeds those of the other variables. For first-year firms, those with substantial size disadvantages have a 72% likelihood of surviving the year. Those with size advantages, by contrast, have an 83% probability of surviving their initial year. The effect of changes in firm size relative to the first-year average is even more pronounced in the fifth year of life. Small firms (relative to the first-year industry average) have a 79% likelihood of surviving their fifth year, while large firms are virtually certain to survive (99%). That changes in relative size are as, if not more, consequential for adolescent firms is noteworthy, given earlier evidence that the factors that influence failure are more active in early life.

Relative differences in the intensity of competition at various stages of the entrant's lifecycle have less of an effect. Industry concentration (CONC) is more significant for new start-ups than for adolescents. New firms in industries with relatively low levels of concentration have a 74% likelihood of surviving their first-year, whereas those in highly concentrated sectors have an 80% likelihood of doing so. As discussed earlier, this provides some evidence that new start-ups benefit more from less competition, and are less likely to face incumbent response. For new firms in their fifth year, these effects work in the opposite direction. That said, adolescents have roughly a 90% chance of surviving their fifth year, irrespective of whether their industry is more or less concentrated. Changes in the size characteristics of entrants (RESFS) have a similar effect. First-year firms in industries with large entrants are 5% more likely to survive their initial year than are first-year firms in industries with small entrants. Changes in the industry size characteristics of first-year firms have less of an impact on adolescents.

Compared to concentration and relative entrant size, changes in job turnover exert slightly less of an influence on the survival rate for start-ups. The first-year survival rate in low and high turnover industries stands at 77% and 75% respectively. For firms in their fifth year, both rates are once again roughly 90%.

Macroeconomic effects (GRATE) on the survival rate are also fairly consistent among these age groups. A move from a low growth rate to a high growth rate increases the likelihood of survival marginally for both first-year and fifth-year firms.

7.3 The Timing of Entry: Differences Across Birth Years

In the previous section, we examined factors that condition failure at two distinct stages of the entrant lifecycle: infancy and adolescence. Several findings emerged from this exercise: (1) inter-provincial and inter-industry variation in the hazard rate is far more prevalent among newborns than among adolescents, (2) changes in competitive intensity can affect infants and adolescents differently, and (3) the impact of changes in relative efficiency can be more consequential for adolescents than for newborns. In this section, we explore a final issue—how the timing of entry affects the characteristics of the hazard function.

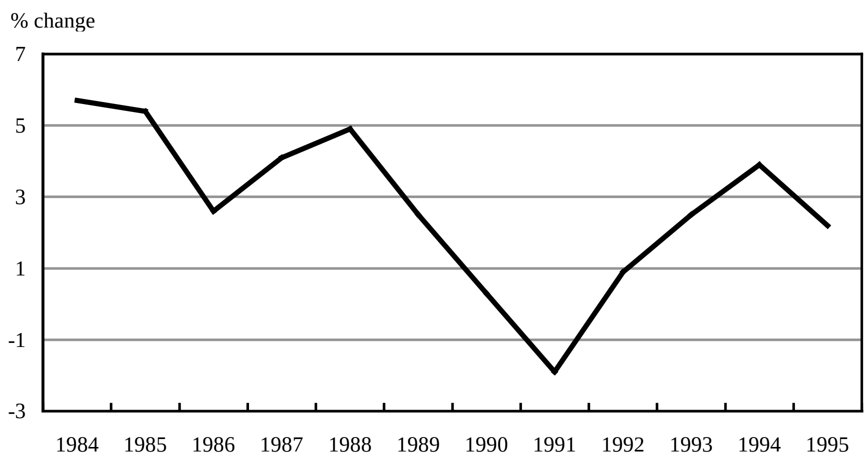
Earlier, we controlled for the impact of cyclical variation on the hazard rate by including the growth rate in GDP as a covariate in our regression models. While this variable captures differences in the failure rate associated with the timing of the entry decision, it does not evaluate whether the determinants of failure differ across cohorts in accordance with the timing of entry. It may be that the effects of certain covariates (e.g., relative firm size, and concentration) vary across cohorts since some cohorts may be more 'advantaged' than others. In particular, when the macroeconomic environment is generally favourable, a different set of entrants may try their luck. This will lead to different reactions to the variables that reflect the nature of the difficulties that new firms face. We do not have strong priors on the nature of these differences. If good times lead to less cautious entry, new firms may respond less to variables that proxy the obstacles that they will face down the road. On the other hand, a poor economic climate may, through the push factor associated with poorer alternate economic opportunity, bring about entry by less well prepared entrepreneurs and hence encourage less cautious behaviour.

We investigate this issue by examining differences in the hazard function for newborns over two distinct entry periods: 1980s cohorts (firms that enter during 1984-89) and 1990s cohorts (those that enter during 1990-94).

Our focus on newborns—firms in their first year of life—stems from the fact that failure rates among very young businesses are relatively high. Unlike adolescents, these are inexperienced firms that are more vulnerable to the selection process (the separation of efficient and inefficient firms). Consequently, differences in the hazard function related to the timing of the entry decision may be more apparent among newborn firms than among older entrants.

Our decision to decompose entry cohorts into two dichotomous groupings (1980s and 1990s) serves two objectives. In the first instance, a dichotomous grouping which pools entry cohorts into two groups is analytically expedient, as this allows for the convenient use of interaction terms to test for formal differences in the effects of other covariates on the hazard rate—differences that follow directly from the timing of the entry decision. An alternative strategy would be to examine the effects of each cohort individually (by including dummy variables for birth year in a manner analogous to the industry or geographic dummies in the previous regression). Our primary interest, however, lies not with examining whether differences in the likelihood of failure exist across different entry cohorts (relative to some reference group), but rather with ascertaining whether the influence of other factors on the hazard rate—relative efficiency, competitive intensity—is more or less significant across broad groupings of cohorts that differed in terms of the economic environment that they faced upon initial entry.

Figure 14. Percentage Change in Real GDP (1992 Prices)



Our second objective in adopting this approach centres on the convenient division between the 1980s and the 1990s. Given that our focus is on first-year firms, this divides the sample into two groups of entry cohorts (1984-89 and 1990-94 respectively). We are interested in examining whether the determinants of failure are different for new firms in the 1990s than they were for firms in the 1980s. This division captures differences in the business cycle. The economy experienced relatively high growth rates in real GDP during the mid-to-late 1980s (roughly 3% and higher); by contrast, growth rates were substantially lower through the first few years of the 1990s (Figure 14).

To evaluate differences in the two entry periods, we estimate a model of the following form:

$$y = \alpha + \sum \beta_i x_i + \sum \gamma_i prov_i + \sum \partial_i ind_i + \omega D + \sum \tau_i D * x_i + \sum \theta_i D * prov_i + \sum \rho_i D * ind_i$$

where *D* is a dummy variable that takes a value of 1 if the firm entered in the 1980s and a value of 0 if the firm entered in the 1990s. The dependent variable *y* is once again the log-odds of the hazard rate. This model is equivalent to the earlier age-specific regression, except for the inclusion of interactive terms on all the covariates and a dummy intercept term.

Once again, we have restricted the sample only to firms in their first year of life. Accordingly, the dependent variable takes a value of 1 if the firm failed during its initial year and a value of 0 if failure did not occur during this year. We present the results in Table 17.

In this regression, the parameter estimates on the non-interaction variables (Table 17, column 1) correspond to entry cohorts in the 1990s, while the interaction terms (Table 17, column 2) test whether the effects of individual covariates on the failure rate differ across the two entry periods (1980s versus 1990s). For all variables in column 1 other than the provincial and industry dummies, a positive coefficient indicates that an increase in the associated variable leads to an increase in the probability of failure for first-year firms that entered in the 1990s. To illustrate, an increase in industry concentration (CONC) leads to a higher likelihood of survival for newborns that entered during the 1990-94 period. By contrast, the parameter estimate on the corresponding interaction term in column 2 examines whether this relationship is more or less important in the 1980s. The negative coefficient on the interaction term for (CONC) indicates that its positive effect on the survival rate is more pronounced during the 1980s.[44]

The interpretation of parameter estimates on the provincial and industry dummies is more complex given that these are calculated against reference groups—Ontario and manufacturing, respectively. The positive parameter on the Prince Edward Island term in column 1 indicates that first-year start-ups in Prince Edward Island that entered during the 1990s are more likely to fail than are first-year start-ups in Ontario over the same period. The negative parameter estimate on the associated interaction term (column 2) indicates that new start-ups in Prince Edward Island do slightly better relative to Ontario in the 1980s than they do in the 1990s.[45] In a similar vein, the negative coefficient on wholesale trade in column 1 indicates that first-year wholesalers that enter in the 1990s are more likely to survive than their counterparts that enter manufacturing industries. The negative and significant coefficient on the associated interaction term indicates that this was increasingly so during the 1980s—wholesalers did even better relative to manufactures if they entered during the 1980s.

[44] In all cases, the coefficient estimate for the 1980s is just the sum of the 1990s coefficient (column 1) and the coefficient on the interaction term (column 2). If both are negative, they sum to a *larger* negative number, which then indicates that the associated variable leads to a higher likelihood of survival during the 1980s. Conversely, if the interaction term was positive, the sum of these two terms is a *smaller* negative number (assuming that the absolute value of the 1990s coefficient was larger than the coefficient on the interaction term). In this case, the associated variable exerts less of a positive influence on the survival rate during the 1980s.

[45] This parameter estimate is statistically significant and its absolute magnitude is smaller.

Table 17. Results of Interactive Logit Regression (Firm Age=1)

	Parameter Estimates for 1990s Cohorts (1)	*Parameter Estimates for Interaction terms (2)*
Intercept	-1.1476***	-0.0840***
RASE (ratio of firm size to average industry first-year entrant size)	-0.2465***	0.0474***
CONC (industry concentration ratio)	-0.0020***	-0.0116***
TURN (industry rate of job turnover)	0.0030***	0.0029***
RESFS (ratio of average industry first-year entrant size to average industry firm size)	-0.0498	-1.4635***
GRATE (growth rate in real GDP)	0.0034**	0.0383***
Provincial Dummies:		
Newfoundland	0.8589***	-0.0307
Prince Edward Island	0.9875***	-0.3451***
Nova Scotia	0.6826***	-0.0673***
New Brunswick	0.5721***	0.2567***
Quebec	0.0856***	0.1627***
Ontario	--	--
Manitoba	0.6007***	-0.1288***
Saskatchewan	0.4802***	-0.1710***
Alberta	0.2006***	-0.0155
British Columbia	0.0483***	0.1072***
Industry Dummies:		
Agriculture	0.3123***	0.1484***
Fishing and Trapping	-0.0939**	0.3804***
Logging and Forestry	0.3105***	0.0968***
Mining, Quarrying and Oil Wells	0.0032	0.2299***
Manufacturing	--	--
Construction	0.3202***	-0.2122***
Transportation and Storage	0.0250	-0.0174
Communications and Other Utilities	0.0302	0.6472***
Wholesale Trade	-0.1372***	-0.1080***
Retail Trade	-0.0326**	0.1340***
Finance and Insurance	-0.0349	0.0283
Real Estate Operators and Insurance Agents	-0.0664***	-0.0683**
Business Services	-0.1851***	0.0752***
Accommodation, Food and Beverage	0.0347**	0.2284***
Other Services	0.1881***	0.7235***
Summary Statistics:		
-2 Log Likelihood:	1,491,881	
Pr > chi-square	0.0001	
Percentage of observations correctly predicted:	64.3	
Number of observations:	1,368,785	

**** significant at 1%, ** significant at 5%, * significant at 10%*

On balance, the above exercise yields sensible findings. The structure of the hazard function for first-year firms in the two entry periods (Table 17) is generally consistent with the overall hazard function for all first-year firms (Table 15, column 1).[46] To examine the sensitivity of changes in firm size, competitive intensity and growth on the failure rate in each of the two entry periods, we supplement the regression data in Table 17 with estimates of the survival rate at the 5th and 95th percentiles (Table 18).

Table 18. Survival Rates at the 5th and 95th Percentiles

Variable	***First-year firms that enter in the 1980s***	***First-year firms that enter in the 1990s***
RASE (ratio of firm size to average industry first-year entrant size)	(75.1, 84.6)	(70.2, 83.2)
CONC (industry concentration ratio)	(75.4, 82.9)	(74.5, 75.7)
TURN (industry rate of job turnover)	(79.6, 77.1)	(75.6, 74.2)
RESFS (ratio of average industry first-year entrant size to average industry firm size)	(74.7, 82.7)	(74.9, 75.2)
GRATE (growth rate in real GDP)	(81.7, 76.4)	(75.3, 74.8)

As expected, an increase in firm size relative to the industry first-year entrant average (RASE) enhances the likelihood of survival—suggesting that changes in relative efficiency are strongly correlated with the failure rate. Inefficient firms that, on average, enter the market during years with robust growth rates are comparatively better off (a survival rate of 75%) than those that do so in the 1990s (a survival rate of 70%). Reducing the size disadvantage, however, is slightly less important during the 1980s (a survival rate differential of 10%) than during the 1990s (a survival rate differential of 13%). Other things equal, a strong economy affords smaller, less efficient firms some minor advantage in their first year of life that a weaker economy does not, and makes them slightly better off relative to larger entrants.

As before, new firms in more concentrated industries (CONC) are more likely to succeed. This suggests that new start-ups benefit from lower levels of competition and do not face much incumbent response. The positive association between market concentration and the success rate is more apparent for first-year firms in the 1980s than for those in the 1990s. Differences in the survival rate between firms in 'much less' and 'much more' concentrated industries are also larger for newborns in the first entry period. Unlike firm-specific characteristics such as relative efficiency, the effects of market structure on the survival rate of brand new entrants are more evident in times of robust growth than in times of anaemic growth.

Results for turnover (TURN) provide additional evidence that the impact of market structure varies across the two entry periods. An increase in turnover leads to more failure among first-year firms. This effect is slightly more apparent in the 1980s.

[46] Note once again that the estimated parameter for the 1980s is just the sum of the 1990s parameter and the interaction term.

The effects of the remaining continuous variables—relative industry entrant size (RESFS) and GDP growth (GRATE)—on the hazard rate across these two entry periods are less obvious. In contrast to the first-year regression that pooled all entry cohorts (Table 15), the failure rate for newborns in the 1990s is not affected by changes in relative industry entrant size. That said, there is evidence from the interaction model that its impact on the failure rate is more pronounced during the 1980s. Differences in survival rates related to the size characteristics of entrants are more prevalent in the 1980s, while, during the 1990s, they are negligible.

More curious is the sign on the growth rate variable (GRATE). In the interactive model, this coefficient is positive, suggesting that higher GDP growth leads, in effect, to more failure. What is more, this positive association between growth and failure is stronger during the 1980s than during the 1990s. The explanation for this may be largely statistical in nature. In much of our preliminary analysis, the directionality of macroeconomic effects was very sensitive to changes in model specification. This is especially true when estimating hazard models over subsamples such as particular cohorts or age groups. The growth variable in the earlier work was essentially capturing the difference between the 1980s and the 1990s rather than individual-year effects.

Investigating the effects of firm size, competition and growth on the failure rate in the two entry periods is relatively straightforward. As noted earlier, this is less true when examining provincial or industry dummies because these variables are calculated directly against a reference group. Changes in the relative performance of a province over time reflect the performance of start-ups in that province and the performance of start-ups in the reference province (here Ontario). The net effects are captured in the interaction terms presented in Table 17.

Our interactive regression does provide some evidence of changes in relative performance over the two entry periods. Certain provinces—Prince Edward Island, Nova Scotia, Manitoba and Saskatchewan—were better off relative to Ontario in the 1980s than they are in the 1990s. British Columbia, New Brunswick and Quebec were relatively worse off in the 1980s.

Variation in inter-industry performance is also apparent across the two entry periods. Certain industries—construction, wholesale trade and real estate—are better off relative to manufacturing during the 1980s. Others, such as agriculture, fishing, retail trade and business services, are worse off.

A more expedient method of examining differences in post-entry performance across the two entry periods is simply to examine the associated survival rates. We present these in Table 19.

Some clear differences in the failure rate of first-year firms emerge over these two entry periods. The Atlantic Provinces, with the exception of New Brunswick, experience sharp declines in the success rate during the 1990s, as do Manitoba and Saskatchewan. Alberta is also better off in the 1980s. Quebec, Ontario and British Columbia experience small to modest declines in the success rate during the 1990s. Only New Brunswick fares as well in the more recent entry period as it does in the 1980s.[47]

[47] The results for British Columbia provide an excellent illustration of the difference between absolute and relative post entry performance. The interaction term on the regression indicates that British Columbia was worse off relative to Ontario during the 1980s, yet its survival rate is actually higher in this period. First-year firms performed relatively better in Ontario in the 1980s, which, in turn, gives rise to this net change for British Columbia.

Differences in industry survival rates across these periods also emerge. Of these industries, only the first-year performance of communications firms and those in other services improve significantly in the 1990s. Most industries exhibit increased failure rates, the magnitude of which is sometimes substantial (e.g., wholesale trade, construction). Most other industries show modest declines in the success rate.

Table 19. Probability Estimates at the Mean, Province and Industry

	First- year firms in the 1980s	***First-year firms in the 1990s***
Province:		
Newfoundland	66.6	60.3
Prince Edward Island	70.6	57.1
Nova Scotia	71.2	64.4
New Brunswick	66.6	66.9
Quebec	78.1	76.7
Ontario	82.0	78.2
Manitoba	74.0	66.3
Saskatchewan	77.0	68.9
Alberta	79.1	74.5
British Columbia	79.6	77.3
Industry:		
Agriculture	74.8	70.2
Fishing and Trapping	77.9	78.0
Logging and Forestry	75.7	70.2
Mining, Quarrying and Oil Wells	78.8	76.2
Manufacturing	82.4	76.3
Construction	80.8	70.0
Transportation and Storage	82.3	75.8
Communications and Other Utilities	70.4	75.8
Wholesale Trade	85.7	78.7
Retail Trade	80.9	76.9
Finance and Insurance	82.5	76.9
Real Estate Operators and Insurance Agents	84.3	77.5
Business Services	84.0	79.5
Accommodation, Food and Beverage	78.3	75.7
Other Services	65.4	72.7

In conclusion, it is evident that the exit process varies not only by age of entrant but also by cohort. In particular, cohorts that enter in periods of felicitous economic circumstances react to or are affected differently by firm and industry-specific conditions. First, it is apparent that industry and geographic effects vary. This is simply a reflection of the fact that industries and regions are affected differently by the business cycle. An evaluation of any multivariate analysis of regional or industry differences in survival or hazard rates must not treat the results as immutable but rather should take into account the fact that the specific results reported may be highly susceptible to the time period chosen and the economic circumstances of the time. Second, the results show that variables that proxy inefficiency and the intensity of competition have qualitatively similar though quantitatively different impacts. During the 1980s, survival rates were more strongly correlated with changes in the intensity of competition (e.g., turnover and concentration). At the same time, being smaller during these boom years has less of an impact on the likelihood that a start-up will fail. This suggests that, in good times, firms are less vulnerable to their own mistakes resulting from choosing an inappropriate size, but, at the same time, are more vulnerable to external competition.

Chapter 8 – Conclusions

Dynamic change in the firm population results from a competitive process that replaces old firms with new ones (Baldwin, 1995). Part of this occurs as market share shifts from incumbents in decline to those who are growing. But an important component of this process comes from the entry of new firms who displace others. New firms are important since they provide new ideas essential for innovation and are a vital source of discipline to incumbents.

While substantial numbers of new firms enter the marketplace each year, many of these firms exit quickly. Failure rates among entrants are extremely high. Some 40% have exited by their second birthday. About 75% die by their eighth birthday. On average, mean survival time is about six years, while the median length of life is approximately three years.

The early years are the most difficult for entrants. Hazard rates are high in the first years of life, but these failure rates decline as firms mature. The probability that a new firm will not live past its first birthday is 23%. The probability that a new firm that has reached the age of five will fail during its fifth year is 14%. This indicates that the process of culling out the least efficient is most vigorous among very young firms. This is consistent with earlier work (Baldwin and Rafiquzzaman, 1995) that found that competition removes the most inefficient of new entrants.

The high turnover in the entrant population has led some to describe the process as a revolving door (Audretsch, 1995). While it is true that the majority of entrants fail within ten years of birth, many remain, and do grow (Baldwin, 1999). Behind the revolving door is an escalator that rewards those that survive the perils of infancy. The net result of the failure of some members of a cohort and the growth of survivors is to leave the importance of a representative birth cohort essentially unchanged, at least over the first five years of life. However, the effect of entry accumulates over time as more and more cohorts of new firms arrive to compete with incumbents.

Understanding inter-industry differences in failure rates requires a conceptual framework. Entry can be viewed as a process that replaces old firms with new more efficient ones. In this case, exit occurs when competition is more intense. Alternatively, entry can be regarded as a process that involves an experiment. This process involves a considerable investment in knowledge by new firms—knowledge of how to organize, how to produce, how to invest, how to market, and how to manage. Some of this knowledge can be acquired before entry. Additional knowledge can be acquired after entry. The latter will be pursued extensively in situations where experimentation is less expensive. In industries where this is true, we would expect to find both high entry and high exit. Many firms will test out the market when experimentation is less costly. And many of these entrants will find their skills lacking and subsequently exit the marketplace. On this view, failure is a natural part of experimentation. Moreover, higher rates of exit in certain industries only indicate basic differences in the cost of experimentation and not the existence of market imperfections related to competitive conditions.

While we find some evidence of industry-level effects associated with the competitive environment, they are not the sole cause of failure. Nor are they necessarily the most important. For instance, aggregate survival rates are not strongly correlated with differences in inter-industry concentration or turnover. This suggests that the relationship between competition and failure is not one-dimensional. While the effects of competition are more apparent after controlling for other influences on the hazard rate, they depend upon the age of the firm, and they are generally small. Among new start-ups, more concentration leads to more survival, which suggests that very young firms benefit from less competition and that incumbent response at this stage is not particularly robust. Among adolescents, however, more industry concentration leads to more failure—although its impact on the hazard is small. Changes in turnover, while positively associated with the hazard at both stages of the entrant lifecycle, have only a minor impact on the failure rate of start-ups.

Evidence that experimentation costs influence the failure rate is somewhat stronger. Aggregate survival rates are positively correlated with an industry's firm size characteristics. Larger size requirements presuppose higher failure costs—accordingly, industries in which failure is less expensive encourage more entrants, and thus more failure. That entry and hazard rates are positively correlated is further evidence of this.

Our multivariate analysis is consistent with this entry-as-experimentation framework. In general, entrants to industries in which first-year firms are large relative to the average firm are more likely to succeed. This is true at start-up—the point at which new firms have to make substantial investments in the entry gamble. There is evidence that an increase in relative entrant size, in turn, leads to more failure among adolescents, as firms at this stage will face greater competition from more efficient entry cohorts.

The impact of relative firm size is increasingly significant when viewed from the standpoint of the individual firm. On this view, it is not so much the average entrant, but rather the size of a new firm relative to this industry average that determines success or failure. Thus, both firm- and industry-specific attributes condition the likelihood of survival. Firms that are large relative to the industry first-year average stand a much better chance of surviving than those that are small relative to this average. Large new firms make more substantial investments in the entry process, and thus, have more to lose in the event of failure. Large entrants are also more likely to be subsidiaries of firms that exist elsewhere and may have more expertise to call on.

Our conclusion that relative firm size has a significant impact on the failure rate is consistent with much of the empirical literature on post-entry performance. New firms that suffer from scale disadvantages are more likely to exit. A review of the evidence is found in Audretsch (1995) who discusses the role of scale disadvantages within the context of a dynamic selection process. Many suboptimal scale firms enter the marketplace—those that do not address their size disadvantages are likely to be culled; those that do grow and obtain minimum efficient scale are apt to survive. In this light, growth can be seen as a necessary condition for survival. Both Audretsch (1995) and Jovanovic (1982) advance a view of the selection process in which the inefficient exit and the efficient remain, where efficiency is closely tied to scale (or size) optimality.

The results of our age-specific regressions are consistent with the dynamic selection hypothesis advanced by Audretsch and Jovanovic. We investigate the consequences of deviations in relative size at two stages of the lifecycle—infancy and adolescence. Start-ups that are small relative to the first-year entrant average are more likely to fail than those that are large relative to this average; the same holds true of adolescents. That the positive impact of size advantages on the survival rate is more pronounced for adolescents is illuminating. In our regression exercise, infants that are much larger than the industry first-year entrant average have a 83% probability of survival; for comparable five year old firms, the rate stands at 99%. Growth and scale advantages, in this sense, are important determinants of success.

Other firm-specific effects, such as age, also affect the failure rate. The likelihood that new firms will survive increases as firms acquire market experience. This is also consistent with earlier studies (for an overview, see Audretsch, 1995). The benefits that accrue with age, however, tend to diminish with time. This said, there is some evidence that failure rates do not decline uniformly as new firms age. While, in general, hazard rates are high for very young firms, only to decline gradually and level out as new firms emerge from infancy, the shape of the hazard curve *during* the early years of life is, in certain cases, consistent with the existence of a honeymoon effect—especially for larger firms. Aggregate survival rates for new firms in industries with medium and large average firm sizes (and average entrant sizes) are illustrative. These show an increasing hazard rate from the first to the second year. Inefficient firms in these industries—sectors with relatively high experimentation costs—may have greater resources to draw upon prior to being culled. Consequently, failure rates do not reach a maximum at year one, but rather in the second year, after which much of the initial asset stock has presumably been depleted.

The impact of age on other determinants of failure is more complex. For instance, changes in competitive intensity affect firms of different ages in different ways. Newer entrants benefit from more concentration—adolescents do not. Both benefit from gains in relative size.

Differences in failure rates across provinces and industries are far greater among very young firms than among those that survive infancy. Newborn firms in Ontario have a lower hazard rate than those in other provinces—when compared to the Atlantic Provinces, these differences are very significant. By the time new firms reach adolescence, a different pattern emerges. New firms in other provinces fare just as well as those in Ontario, and, in certain cases, are better off. This said, differences in hazard rates among adolescent firms tend to be minor. Similar age-effects are evident across industries—differences in failure rates at the industry-level are greater among new start-ups than among adolescents.

In the final analysis, the evidence presented herein sheds light on the length of time we should use to classify a firm as new. Dramatic changes occur in the evolution of entrants in their first five years of life. This is driven by the process of selection that all new firms face—the dynamics of competition that reward the more competent and that remove the less competent. This process is most active among very young firms, as any group of newborns will be characterized by wide disparities in operating efficiencies. Firms that reach their fifth year have, to a large degree, weathered this process, and, consequently, exhibit less variation in their efficiency characteristics. While both infants (first-year firms) and adolescents (fifth-year firms) can be described as ‘new’, the ‘liability of newness’, as it is commonly understood, pertains more so to the former—to business start-ups that have not yet emerged from infancy. Accordingly, hazard rate differentials across provinces and industries are far more prevalent among newborns than among adolescents. The role that competitive intensity and relative efficiency play in conditioning the hazard rate also differs in accordance with the age profile of new firms—though in ways that are not necessarily obvious *a priori*. In the first instance, variation in industry concentration, a basic proxy for changes in competitive intensity, has a greater impact on the failure rate for infants than on the failure rate for adolescents. For newborns, the likelihood of survival increases with more industry concentration, while the reverse is true of adolescents. For both groups, gains in relative efficiency measured at the level of the firm increase the survival rate—particularly for adolescents. These lifecycle effects reinforce the structural differences that exist between brand new firms and those with market experience. While both are in a broad sense ‘new’, infants and adolescents should not be seen as equivalent firms.

Lastly, the study has shown that there are substantial cohort effects. The survival rate differences across regions depend very much on how the economic cycle has affected these regions. Industry and regional fortunes vary across entry periods and thus generalizations about the relative riskiness of different political jurisdictions or industries should only be made with caution. The results also show that entrant cohorts that are associated with good macroeconomic conditions not only have a lower mean failure rate but they are less affected by size disadvantages. The economic environment is related to differences not only in these firm characteristics but also in how the industry environment affects failure. While the reasons for these differences must await further research, they suggest that the factors that motivate the entry decision differ across the business cycle.

Appendix A – Supplementary Tables

This appendix contains a small number of supplementary tables that correspond directly to tables and/or figures that appear in the main text of the report.

Tables A1 and A2 report hazard rates for new firms in goods-producing and service-providing industries, respectively. These complement the survival rates reported in Tables 3 and 4 of the text (Chapter 3).

Tables A3 and A4 report survival and hazard rates for each of the industry clusters examined in Chapter 5. These were represented graphically in Figures 4 through 13.

Table A1. Hazard Rates, Goods-Producing Industries

Duration (years)	1	2	3	4	5	6	7	8	9	10	11
Agriculture	0.26	0.19	0.16	0.15	0.14	0.14	0.12	0.11	0.11	0.11	0.10
Fishing and Trapping	0.23	0.17	0.15	0.13	0.12	0.12	0.11	0.08	0.09	0.09	0.09
Logging and Forestry	0.27	0.24	0.20	0.17	0.15	0.13	0.12	0.10	0.08	0.10	0.10
Mining, Quarrying and Oil Wells	0.18	0.19	0.16	0.15	0.14	0.13	0.10	0.10	0.11	0.09	0.09
Manufacturing	0.17	0.18	0.15	0.13	0.12	0.11	0.10	0.08	0.07	0.07	0.07
Construction	0.25	0.21	0.18	0.16	0.14	0.13	0.12	0.11	0.10	0.10	0.11
All	**0.24**	**0.20**	**0.17**	**0.15**	**0.13**	**0.13**	**0.12**	**0.10**	**0.10**	**0.10**	**0.10**

Table A2. Hazard Rates, Service-Providing Industries

Duration (years)	1	2	3	4	5	6	7	8	9	10	11
Transportation and Storage	0.21	0.21	0.17	0.15	0.14	0.13	0.11	0.10	0.08	0.08	0.08
Communications and Other Utilities	0.20	0.21	0.19	0.15	0.14	0.14	0.11	0.10	0.11	0.07	0.08
Wholesale Trade	0.16	0.18	0.15	0.13	0.12	0.10	0.09	0.08	0.09	0.07	0.07
Retail Trade	0.18	0.22	0.19	0.17	0.15	0.14	0.12	0.11	0.10	0.10	0.11
Finance and Insurance	0.19	0.17	0.15	0.14	0.14	0.12	0.11	0.11	0.11	0.10	0.12
Real Estate Operators & Ins. Agents	0.17	0.17	0.15	0.13	0.13	0.12	0.10	0.10	0.09	0.10	0.08
Business Services	0.17	0.18	0.15	0.14	0.13	0.12	0.11	0.09	0.09	0.09	0.09
Accommodation, Food & Beverage	0.20	0.24	0.20	0.18	0.16	0.14	0.13	0.12	0.11	0.12	0.11
Other Services	0.32	0.28	0.22	0.19	0.17	0.16	0.15	0.13	0.13	0.12	0.11
All	**0.22**	**0.22**	**0.18**	**0.16**	**0.15**	**0.13**	**0.12**	**0.11**	**0.10**	**0.10**	**0.10**

Table A3. Survival Rates, Industry Clusters (Duration=Years)

	1	2	3	4	5	6	7	8	9	10	11
Average Firm Size											
Small	0.76	0.59	0.48	0.41	0.35	0.30	0.27	0.24	0.21	0.19	0.17
Medium	0.81	0.64	0.52	0.44	0.38	0.33	0.29	0.26	0.24	0.21	0.19
Large	0.82	0.66	0.56	0.47	0.42	0.37	0.33	0.30	0.28	0.26	0.24
Average Entrant Size											
Small	0.75	0.59	0.48	0.40	0.34	0.30	0.26	0.23	0.21	0.19	0.17
Medium	0.81	0.64	0.53	0.45	0.38	0.33	0.30	0.27	0.24	0.22	0.20
Large	0.83	0.69	0.58	0.50	0.44	0.39	0.35	0.33	0.30	0.28	0.25
Concentration Ratio											
Low	0.76	0.60	0.50	0.42	0.36	0.32	0.28	0.25	0.23	0.21	0.19
Medium	0.79	0.60	0.48	0.40	0.34	0.29	0.25	0.22	0.20	0.18	0.16
High	0.82	0.65	0.53	0.44	0.38	0.33	0.29	0.26	0.23	0.21	0.19
Rate of Job Turnover											
Low	0.82	0.65	0.53	0.44	0.38	0.33	0.29	0.26	0.24	0.22	0.20
Medium	0.81	0.64	0.53	0.45	0.39	0.34	0.30	0.27	0.25	0.23	0.21
High	0.75	0.58	0.48	0.40	0.34	0.29	0.26	0.23	0.20	0.18	0.16
Rate of Entry											
Low	0.86	0.73	0.63	0.56	0.50	0.45	0.41	0.38	0.35	0.33	0.30
Medium	0.80	0.65	0.54	0.46	0.40	0.35	0.31	0.28	0.25	0.22	0.20
High	0.76	0.58	0.47	0.39	0.33	0.28	0.25	0.22	0.20	0.17	0.16

Table A4. Hazard Rates, Industry Clusters (Duration=Years)

	1	2	3	4	5	6	7	8	9	10	11
Average Firm Size											
Small	0.24	0.22	0.18	0.16	0.14	0.13	0.12	0.11	0.10	0.10	0.10
Medium	0.19	0.21	0.18	0.16	0.14	0.13	0.11	0.11	0.10	0.10	0.10
Large	0.18	0.20	0.16	0.15	0.12	0.12	0.10	0.08	0.08	0.08	0.08
Average Entrant Size											
Small	0.25	0.22	0.18	0.16	0.15	0.14	0.12	0.11	0.11	0.10	0.10
Medium	0.19	0.21	0.18	0.15	0.14	0.13	0.11	0.10	0.10	0.10	0.09
Large	0.17	0.18	0.15	0.14	0.12	0.11	0.10	0.08	0.08	0.08	0.09
Concentration Ratio											
Low	0.24	0.21	0.17	0.15	0.14	0.13	0.12	0.10	0.10	0.10	0.10
Medium	0.21	0.23	0.20	0.17	0.15	0.14	0.13	0.12	0.11	0.10	0.10
High	0.18	0.21	0.18	0.17	0.14	0.14	0.12	0.11	0.09	0.09	0.09
Rate of Job Turnover											
Low	0.18	0.21	0.18	0.16	0.14	0.13	0.11	0.10	0.09	0.09	0.10
Medium	0.19	0.21	0.17	0.15	0.14	0.12	0.11	0.10	0.09	0.09	0.09
High	0.25	0.22	0.18	0.16	0.15	0.14	0.12	0.11	0.11	0.11	0.10
Rate of Entry											
Low	0.14	0.15	0.13	0.12	0.11	0.10	0.09	0.08	0.07	0.07	0.07
Medium	0.20	0.19	0.16	0.15	0.14	0.13	0.11	0.10	0.10	0.10	0.09
High	0.24	0.23	0.19	0.17	0.15	0.14	0.13	0.12	0.11	0.11	0.11

ELECTRONIC PUBLICATIONS AVAILABLE AT

www.statcan.ca

Appendix B – Survival and Hazard Rates, Industry by Region

In this appendix, we report survival and hazard rates for various industry/region combinations. Our focus is again on new firms that enter the market during the 1984-1994 period. As all entrants are right-censored in 1995, the maximum survival time under study is 11 years.

Two tables are presented for each of the 15 industries examined in the report—the first contains survival rates, and the second, the associated hazard rates. These are calculated at the regional level (Atlantic Provinces, Quebec, Ontario, Prairie Provinces, British Columbia). The decision to move from the provincial to a regional level is due to small numbers of entrants (and by extension, exits) in certain industry/province combinations.

Note that these rates are calculated from the provincial datafile and are not directly comparable to the rates reported in Tables 3 and 4 of the text.

Table B1. Survival Rates in Agricultural Industries

Duration (years)	***Atlantic Provinces***	***Quebec***	***Ontario***	***Prairie Provinces***	***British Columbia***
1	0.65	0.76	0.75	0.68	0.72
2	0.55	0.63	0.61	0.54	0.58
3	0.47	0.54	0.51	0.45	0.48
4	0.42	0.46	0.44	0.38	0.41
5	0.36	0.41	0.38	0.32	0.35
6	0.32	0.36	0.33	0.28	0.30
7	0.28	0.32	0.29	0.24	0.26
8	0.26	0.29	0.27	0.21	0.23
9	0.24	0.26	0.24	0.18	0.21
10	0.22	0.23	0.22	0.16	0.18
11	0.20	0.20	0.20	0.14	0.16

Table B2. Hazard Rates in Agricultural Industries

Duration (years)	***Atlantic Provinces***	***Quebec***	***Ontario***	***Prairie Provinces***	***British Columbia***
1	0.35	0.24	0.25	0.32	0.28
2	0.16	0.17	0.19	0.20	0.19
3	0.13	0.15	0.16	0.17	0.17
4	0.12	0.13	0.15	0.16	0.15
5	0.13	0.12	0.13	0.15	0.14
6	0.12	0.12	0.13	0.15	0.14
7	0.12	0.10	0.11	0.14	0.14
8	0.10	0.10	0.09	0.12	0.12
9	0.08	0.11	0.09	0.13	0.08
10	0.07	0.11	0.11	0.12	0.14
11	0.11	0.10	0.08	0.11	0.12

Table B3. Survival Rates in Fishing and Trapping Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.75	0.65	0.59	0.57	0.69
2	0.64	0.54	0.45	0.40	0.53
3	0.55	0.45	0.38	0.29	0.44
4	0.48	0.36	0.32	0.20	0.38
5	0.43	0.31	0.27	0.16	0.32
6	0.39	0.24	0.25	0.11	0.27
7	0.35	0.21	0.22	0.11	0.21
8	0.32	0.19	0.22	0.10	0.18
9	0.29	0.18	0.20	0.07	0.15
10	0.27	0.16	0.17	0.05	0.13
11	0.24	0.16	0.15	0.05	0.11

Table B4. Hazard Rates in Fishing and Trapping Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.25	0.35	0.41	0.43	0.31
2	0.15	0.17	0.23	0.30	0.23
3	0.14	0.18	0.17	0.27	0.17
4	0.12	0.19	0.15	0.31	0.14
5	0.11	0.14	0.17	0.22	0.15
6	0.10	0.22	0.07	0.28	0.18
7	0.10	0.13	0.12	0.04	0.23
8	0.08	0.11	0.00	0.05	0.12
9	0.08	0.04	0.10	0.36	0.15
10	0.09	0.11	0.13	0.29	0.16
11	0.10	0.00	0.11	0.00	0.13

Table B5. Survival Rates in Logging and Forestry Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.66	0.70	0.69	0.67	0.73
2	0.51	0.54	0.51	0.50	0.55
3	0.42	0.43	0.39	0.40	0.44
4	0.35	0.36	0.32	0.34	0.36
5	0.30	0.32	0.26	0.28	0.30
6	0.27	0.27	0.23	0.24	0.26
7	0.23	0.24	0.21	0.20	0.23
8	0.21	0.22	0.19	0.18	0.20
9	0.20	0.20	0.18	0.16	0.19
10	0.18	0.17	0.16	0.14	0.17
11	0.16	0.16	0.14	0.11	0.15

Table B6. Hazard Rates in Logging and Forestry Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.34	0.30	0.31	0.33	0.27
2	0.23	0.24	0.26	0.25	0.25
3	0.18	0.20	0.23	0.20	0.20
4	0.17	0.16	0.18	0.15	0.17
5	0.12	0.13	0.18	0.18	0.17
6	0.12	0.14	0.12	0.15	0.14
7	0.13	0.12	0.10	0.17	0.11
8	0.09	0.09	0.10	0.11	0.11
9	0.08	0.09	0.06	0.10	0.09
10	0.10	0.12	0.11	0.11	0.09
11	0.08	0.06	0.10	0.22	0.13

Table B7. Survival Rates in Mining, Quarrying and Oil Well Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.62	0.72	0.70	0.79	0.71
2	0.47	0.59	0.54	0.67	0.53
3	0.36	0.47	0.44	0.57	0.42
4	0.29	0.40	0.35	0.50	0.33
5	0.27	0.34	0.29	0.44	0.27
6	0.22	0.30	0.25	0.38	0.22
7	0.17	0.27	0.21	0.35	0.20
8	0.15	0.23	0.18	0.31	0.17
9	0.11	0.21	0.15	0.28	0.14
10	0.10	0.20	0.11	0.26	0.11
11	0.10	0.20	0.11	0.23	0.09

Table B8. Hazard Rates in Mining, Quarrying and Oil Well Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.38	0.28	0.30	0.21	0.29
2	0.25	0.19	0.23	0.15	0.26
3	0.24	0.19	0.18	0.14	0.21
4	0.19	0.16	0.21	0.12	0.20
5	0.08	0.15	0.18	0.13	0.21
6	0.17	0.12	0.14	0.12	0.18
7	0.24	0.09	0.17	0.10	0.09
8	0.11	0.13	0.15	0.10	0.15
9	0.24	0.10	0.14	0.09	0.17
10	0.15	0.03	0.25	0.08	0.18
11	0.00	0.00	0.05	0.12	0.23

Table B9. Survival Rates in Manufacturing Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.64	0.81	0.83	0.72	0.79
2	0.51	0.66	0.69	0.58	0.64
3	0.43	0.56	0.59	0.48	0.54
4	0.36	0.48	0.51	0.42	0.47
5	0.32	0.42	0.45	0.37	0.41
6	0.28	0.38	0.41	0.33	0.37
7	0.25	0.34	0.37	0.29	0.33
8	0.22	0.31	0.33	0.27	0.31
9	0.19	0.29	0.31	0.25	0.29
10	0.18	0.27	0.29	0.23	0.26
11	0.16	0.24	0.27	0.22	0.24

Table B10. Hazard Rates in Manufacturing Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.36	0.19	0.17	0.28	0.21
2	0.20	0.19	0.17	0.20	0.19
3	0.16	0.16	0.15	0.16	0.16
4	0.15	0.14	0.12	0.14	0.13
5	0.13	0.12	0.12	0.12	0.12
6	0.11	0.11	0.10	0.11	0.11
7	0.10	0.10	0.10	0.10	0.09
8	0.12	0.08	0.09	0.08	0.07
9	0.13	0.08	0.07	0.08	0.07
10	0.08	0.07	0.08	0.07	0.08
11	0.12	0.09	0.08	0.07	0.09

Table B11. Survival Rates in Construction Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.65	0.78	0.74	0.68	0.72
2	0.51	0.64	0.58	0.53	0.55
3	0.42	0.54	0.47	0.44	0.45
4	0.35	0.47	0.39	0.37	0.37
5	0.31	0.41	0.33	0.32	0.32
6	0.27	0.36	0.28	0.28	0.28
7	0.24	0.32	0.24	0.24	0.25
8	0.21	0.29	0.21	0.22	0.22
9	0.19	0.27	0.18	0.20	0.20
10	0.17	0.24	0.16	0.18	0.18
11	0.15	0.21	0.14	0.16	0.16

Table B12. Hazard Rates in Construction Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.35	0.22	0.26	0.32	0.28
2	0.21	0.18	0.22	0.22	0.24
3	0.18	0.15	0.19	0.18	0.18
4	0.16	0.14	0.18	0.16	0.16
5	0.13	0.12	0.16	0.15	0.14
6	0.13	0.12	0.15	0.13	0.12
7	0.11	0.12	0.14	0.12	0.12
8	0.12	0.09	0.13	0.10	0.11
9	0.11	0.09	0.12	0.10	0.10
10	0.10	0.10	0.11	0.10	0.10
11	0.11	0.11	0.12	0.11	0.12

Table B13. Survival Rates in Transportation and Storage Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.70	0.81	0.77	0.72	0.76
2	0.55	0.66	0.61	0.54	0.59
3	0.46	0.56	0.51	0.44	0.49
4	0.39	0.49	0.42	0.37	0.41
5	0.33	0.43	0.36	0.31	0.36
6	0.29	0.38	0.31	0.27	0.31
7	0.26	0.34	0.27	0.23	0.28
8	0.23	0.31	0.24	0.20	0.25
9	0.20	0.29	0.22	0.19	0.23
10	0.18	0.27	0.20	0.17	0.21
11	0.16	0.25	0.19	0.15	0.19

Table B14. Hazard Rates in Transportation and Storage Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.30	0.19	0.23	0.28	0.24
2	0.21	0.18	0.21	0.24	0.22
3	0.17	0.16	0.17	0.19	0.18
4	0.15	0.13	0.17	0.17	0.15
5	0.14	0.12	0.14	0.15	0.14
6	0.12	0.11	0.14	0.14	0.14
7	0.11	0.10	0.12	0.14	0.10
8	0.13	0.09	0.10	0.11	0.09
9	0.12	0.07	0.08	0.09	0.09
10	0.10	0.07	0.10	0.10	0.09
11	0.13	0.07	0.05	0.08	0.07

Table B15. Survival Rates in Communications and Other Utility Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.66	0.80	0.82	0.72	0.76
2	0.52	0.63	0.67	0.57	0.57
3	0.43	0.51	0.54	0.45	0.48
4	0.36	0.43	0.46	0.39	0.41
5	0.33	0.36	0.40	0.33	0.36
6	0.27	0.31	0.36	0.30	0.29
7	0.22	0.28	0.32	0.26	0.26
8	0.21	0.26	0.30	0.23	0.22
9	0.16	0.23	0.28	0.21	0.19
10	0.14	0.21	0.25	0.19	0.17
11	0.13	0.20	0.23	0.18	0.17

Table B16. Hazard Rates in Communications and Other Utility Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.34	0.20	0.18	0.28	0.24
2	0.21	0.22	0.18	0.21	0.25
3	0.18	0.18	0.19	0.21	0.15
4	0.16	0.17	0.15	0.14	0.15
5	0.09	0.16	0.12	0.14	0.12
6	0.16	0.14	0.11	0.09	0.20
7	0.19	0.09	0.10	0.12	0.11
8	0.07	0.08	0.08	0.14	0.14
9	0.22	0.11	0.06	0.09	0.13
10	0.11	0.07	0.10	0.08	0.09
11	0.07	0.09	0.08	0.07	0.00

Table B17. Survival Rates in Wholesale Trade Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.70	0.82	0.83	0.77	0.82
2	0.58	0.67	0.68	0.64	0.67
3	0.50	0.57	0.58	0.55	0.57
4	0.44	0.49	0.51	0.48	0.50
5	0.39	0.43	0.45	0.43	0.44
6	0.35	0.39	0.40	0.39	0.39
7	0.31	0.35	0.36	0.35	0.36
8	0.29	0.32	0.33	0.32	0.33
9	0.26	0.29	0.30	0.29	0.30
10	0.24	0.27	0.28	0.27	0.28
11	0.22	0.25	0.25	0.24	0.26

Table B18. Hazard Rates in Wholesale Trade Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.30	0.18	0.17	0.23	0.18
2	0.17	0.19	0.18	0.17	0.18
3	0.14	0.15	0.14	0.14	0.14
4	0.12	0.13	0.13	0.12	0.13
5	0.11	0.12	0.12	0.11	0.12
6	0.11	0.11	0.11	0.10	0.11
7	0.09	0.09	0.09	0.09	0.09
8	0.08	0.08	0.09	0.10	0.09
9	0.09	0.10	0.09	0.09	0.08
10	0.09	0.08	0.07	0.08	0.07
11	0.09	0.05	0.10	0.09	0.05

Table B19. Survival Rates in Retail Trade Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.69	0.81	0.80	0.76	0.80
2	0.54	0.63	0.63	0.59	0.63
3	0.44	0.51	0.52	0.48	0.51
4	0.37	0.43	0.43	0.40	0.43
5	0.31	0.36	0.36	0.34	0.36
6	0.27	0.31	0.31	0.29	0.32
7	0.24	0.28	0.27	0.25	0.28
8	0.21	0.24	0.24	0.23	0.25
9	0.19	0.22	0.22	0.20	0.22
10	0.17	0.20	0.19	0.18	0.20
11	0.15	0.18	0.17	0.16	0.17

Table B20. Hazard Rates in Retail Trade Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.31	0.19	0.20	0.24	0.20
2	0.22	0.22	0.22	0.22	0.21
3	0.19	0.19	0.18	0.19	0.19
4	0.16	0.17	0.17	0.17	0.16
5	0.15	0.15	0.15	0.15	0.15
6	0.13	0.14	0.14	0.13	0.13
7	0.12	0.12	0.12	0.13	0.12
8	0.11	0.12	0.12	0.11	0.11
9	0.10	0.10	0.10	0.11	0.11
10	0.09	0.10	0.10	0.10	0.11
11	0.12	0.08	0.12	0.12	0.11

Table B21. Survival Rates in Finance and Insurance Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.71	0.81	0.79	0.78	0.80
2	0.57	0.66	0.65	0.65	0.66
3	0.49	0.56	0.54	0.56	0.56
4	0.43	0.48	0.47	0.48	0.48
5	0.36	0.42	0.40	0.42	0.41
6	0.33	0.37	0.34	0.37	0.36
7	0.30	0.32	0.30	0.33	0.32
8	0.25	0.29	0.26	0.29	0.28
9	0.22	0.26	0.23	0.26	0.26
10	0.20	0.23	0.21	0.23	0.23
11	0.18	0.21	0.18	0.20	0.20

Table B22. Hazard Rates in Finance and Insurance Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.29	0.19	0.21	0.22	0.20
2	0.20	0.18	0.18	0.16	0.17
3	0.13	0.15	0.16	0.14	0.15
4	0.13	0.14	0.14	0.14	0.15
5	0.15	0.14	0.15	0.12	0.15
6	0.10	0.12	0.14	0.12	0.11
7	0.09	0.12	0.12	0.12	0.11
8	0.15	0.10	0.13	0.10	0.12
9	0.14	0.11	0.13	0.10	0.09
10	0.08	0.11	0.09	0.13	0.10
11	0.12	0.09	0.13	0.10	0.15

Table B23. Survival Rates in Real Estate and Insurance Agent Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.68	0.79	0.83	0.77	0.81
2	0.55	0.64	0.70	0.64	0.67
3	0.47	0.53	0.60	0.55	0.58
4	0.40	0.45	0.52	0.47	0.51
5	0.34	0.39	0.46	0.41	0.45
6	0.30	0.34	0.40	0.36	0.40
7	0.27	0.30	0.36	0.33	0.36
8	0.24	0.27	0.32	0.29	0.33
9	0.22	0.24	0.29	0.26	0.31
10	0.20	0.22	0.26	0.24	0.28
11	0.18	0.20	0.24	0.22	0.26

Table B24. Hazard Rates in Real Estate and Insurance Agent Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.32	0.21	0.17	0.23	0.19
2	0.19	0.20	0.16	0.17	0.17
3	0.15	0.17	0.14	0.15	0.14
4	0.15	0.14	0.13	0.14	0.12
5	0.15	0.14	0.12	0.14	0.12
6	0.10	0.12	0.12	0.11	0.11
7	0.11	0.11	0.11	0.10	0.09
8	0.12	0.11	0.10	0.11	0.08
9	0.08	0.10	0.10	0.09	0.07
10	0.07	0.11	0.10	0.11	0.09
11	0.10	0.09	0.08	0.08	0.08

Table B25. Survival Rates in Business Services Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.69	0.82	0.83	0.78	0.81
2	0.55	0.66	0.68	0.64	0.67
3	0.47	0.55	0.58	0.54	0.57
4	0.40	0.47	0.50	0.47	0.49
5	0.35	0.41	0.43	0.41	0.43
6	0.31	0.35	0.38	0.36	0.38
7	0.27	0.31	0.34	0.32	0.34
8	0.24	0.28	0.31	0.29	0.32
9	0.22	0.25	0.28	0.27	0.29
10	0.21	0.23	0.25	0.24	0.26
11	0.19	0.21	0.23	0.22	0.24

Table B26. Hazard Rates in Business Services Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.31	0.18	0.17	0.22	0.19
2	0.20	0.19	0.17	0.19	0.18
3	0.16	0.16	0.15	0.15	0.15
4	0.14	0.14	0.14	0.13	0.13
5	0.14	0.14	0.13	0.12	0.12
6	0.12	0.14	0.12	0.11	0.11
7	0.10	0.12	0.11	0.11	0.11
8	0.11	0.10	0.09	0.10	0.08
9	0.08	0.10	0.11	0.09	0.08
10	0.06	0.09	0.10	0.10	0.09
11	0.08	0.09	0.09	0.09	0.10

Table B27. Survival Rates in Accommodation, Food and Beverage Service Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.66	0.77	0.79	0.72	0.78
2	0.50	0.57	0.62	0.53	0.60
3	0.40	0.45	0.50	0.42	0.48
4	0.33	0.37	0.41	0.34	0.40
5	0.28	0.31	0.34	0.29	0.34
6	0.24	0.26	0.29	0.24	0.29
7	0.22	0.23	0.26	0.21	0.25
8	0.19	0.20	0.22	0.18	0.22
9	0.17	0.18	0.20	0.16	0.20
10	0.15	0.16	0.17	0.15	0.17
11	0.13	0.14	0.15	0.13	0.15

Table B28. Hazard Rates in Accommodation, Food and Beverage Service Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.34	0.23	0.21	0.28	0.22
2	0.24	0.26	0.22	0.26	0.24
3	0.21	0.21	0.19	0.21	0.20
4	0.16	0.18	0.18	0.19	0.17
5	0.16	0.17	0.16	0.16	0.15
6	0.14	0.14	0.15	0.15	0.15
7	0.10	0.13	0.13	0.14	0.13
8	0.12	0.12	0.12	0.13	0.12
9	0.13	0.11	0.11	0.11	0.11
10	0.10	0.12	0.13	0.11	0.12
11	0.14	0.11	0.13	0.12	0.10

Table B29. Survival Rates in Other Service Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.49	0.58	0.78	0.73	0.75
2	0.32	0.41	0.59	0.53	0.54
3	0.24	0.32	0.46	0.41	0.42
4	0.18	0.26	0.37	0.34	0.34
5	0.14	0.22	0.31	0.28	0.28
6	0.11	0.19	0.26	0.24	0.23
7	0.09	0.16	0.22	0.21	0.20
8	0.08	0.14	0.19	0.18	0.17
9	0.06	0.13	0.17	0.16	0.15
10	0.05	0.12	0.15	0.14	0.13
11	0.04	0.10	0.13	0.13	0.12

Table B30. Hazard Rates in Other Service Industries

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.51	0.42	0.22	0.27	0.25
2	0.35	0.30	0.25	0.27	0.28
3	0.25	0.21	0.22	0.22	0.23
4	0.23	0.18	0.19	0.18	0.20
5	0.22	0.16	0.17	0.17	0.17
6	0.21	0.15	0.16	0.15	0.16
7	0.19	0.13	0.15	0.14	0.15
8	0.16	0.12	0.14	0.13	0.13
9	0.16	0.11	0.14	0.12	0.13
10	0.18	0.10	0.11	0.12	0.13
11	0.17	0.12	0.10	0.10	0.12

Appendix C – Survival and Hazard Rates, Firm Size by Region

In this appendix, we report survival and hazard rates for various province/firm size combinations. We again focus on entrants over the 1984-94 period. Censoring occurs in 1995 and the maximum survival time is 11 years. We calculate rates at the provincial level—grouping entrants into 3 broad size ranges:

Micro-firms (less than 5 employees)
Small and medium size firms (5-99 employees)
Large firms (100+ employees)

Firms are allocated to a particular size class based on employment in their initial year.

Table C1. Survival Rates for Micro-Firms

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.61	0.74	0.78	0.72	0.76
2	0.45	0.58	0.62	0.56	0.59
3	0.37	0.47	0.50	0.46	0.48
4	0.30	0.40	0.42	0.39	0.40
5	0.26	0.34	0.36	0.33	0.34
6	0.22	0.30	0.31	0.29	0.30
7	0.19	0.26	0.27	0.25	0.26
8	0.17	0.23	0.24	0.22	0.23
9	0.15	0.21	0.21	0.20	0.21
10	0.13	0.19	0.19	0.18	0.19
11	0.12	0.17	0.17	0.16	0.17

Table C2. Hazard Rates for Micro-Firms

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.39	0.26	0.22	0.28	0.24
2	0.25	0.22	0.21	0.22	0.23
3	0.19	0.18	0.18	0.18	0.19
4	0.17	0.16	0.16	0.16	0.16
5	0.15	0.14	0.15	0.15	0.15
6	0.14	0.13	0.14	0.13	0.13
7	0.13	0.12	0.13	0.13	0.12
8	0.12	0.10	0.12	0.11	0.11
9	0.11	0.10	0.11	0.11	0.10
10	0.10	0.10	0.10	0.10	0.11
11	0.12	0.09	0.10	0.11	0.11

Table C3. Survival Rates for Small and Medium Sized Firms

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.86	0.90	0.91	0.89	0.91
2	0.74	0.78	0.79	0.75	0.78
3	0.65	0.68	0.69	0.65	0.68
4	0.58	0.61	0.61	0.57	0.61
5	0.52	0.54	0.55	0.51	0.55
6	0.47	0.49	0.49	0.46	0.50
7	0.43	0.44	0.44	0.42	0.46
8	0.39	0.41	0.40	0.39	0.43
9	0.36	0.38	0.37	0.36	0.39
10	0.34	0.35	0.33	0.33	0.36
11	0.30	0.32	0.31	0.30	0.34

Table C4. Hazard Rates for Small and Medium Sized Firms

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.14	0.10	0.09	0.11	0.09
2	0.14	0.14	0.13	0.15	0.14
3	0.13	0.12	0.13	0.14	0.12
4	0.11	0.11	0.11	0.12	0.11
5	0.11	0.11	0.11	0.11	0.10
6	0.09	0.10	0.10	0.10	0.09
7	0.08	0.09	0.10	0.09	0.08
8	0.09	0.08	0.09	0.08	0.06
9	0.08	0.08	0.08	0.08	0.08
10	0.06	0.08	0.09	0.08	0.08
11	0.10	0.07	0.08	0.07	0.05

Table C5. Survival Rates for Large Firms

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.89	0.92	0.92	0.89	0.92
2	0.82	0.84	0.85	0.82	0.82
3	0.79	0.75	0.78	0.79	0.79
4	0.72	0.69	0.72	0.71	0.71
5	0.68	0.61	0.68	0.67	0.69
6	0.58	0.54	0.64	0.66	0.68
7	0.54	0.49	0.59	0.61	0.64
8	0.48	0.47	0.56	0.60	0.61
9	0.45	0.45	0.53	0.55	0.54
10	0.39	0.43	0.52	0.53	0.54
11	0.39	0.43	0.47	0.50	0.54

Table C6. Hazard Rates for Large Firms

Duration (years)	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1	0.11	0.08	0.08	0.11	0.08
2	0.08	0.09	0.08	0.08	0.10
3	0.04	0.10	0.08	0.04	0.04
4	0.08	0.08	0.07	0.09	0.09
5	0.06	0.12	0.06	0.06	0.04
6	0.15	0.12	0.05	0.02	0.02
7	0.08	0.09	0.08	0.07	0.06
8	0.10	0.04	0.04	0.02	0.04
9	0.05	0.04	0.05	0.09	0.11
10	0.13	0.06	0.03	0.03	0.00
11	0.00	0.00	0.10	0.06	0.00

Appendix D – Firm and Entrant Populations, Industry by Region

This appendix provides additional detail on industry and regional business populations. For each of the 15 industries, we present time series data on both the regional firm populations and regional entrant populations.

We include these tables to provide the reader with some basic information, first, on how firm and entrant populations in specific industries vary across regions, and second, on how industry demographics within these regions evolve over time.

We address the issue of entry rate measurement in detail in Appendix E.

Table D1. Firm Population in Agricultural Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	3,566	12,564	17,372	25,804	5,105
1984	3,719	12,006	17,476	26,724	5,277
1985	3,679	12,113	17,056	27,126	5,229
1986	3,782	12,379	16,584	27,807	5,337
1987	3,904	12,109	15,893	27,540	5,481
1988	3,916	11,680	15,072	26,630	5,449
1989	3,885	11,301	14,197	26,769	5,399
1990	3,989	11,250	13,459	25,565	5,267
1991	3,996	11,169	13,034	24,581	5,084
1992	4,085	11,257	12,641	24,077	5,005
1993	4,064	11,240	12,526	23,386	5,072
1994	4,092	11,045	12,321	22,658	5,081
1995	3,937	10,944	11,974	22,026	5,029

Table D2. Entrant Population in Agricultural Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	710	2,022	2,421	4,918	941
1984	578	2,018	1,998	4,564	781
1985	646	2,074	1,995	4,584	849
1986	645	1,902	1,783	4,298	943
1987	595	1,691	1,539	3,635	772
1988	542	1,597	1,391	4,102	738
1989	631	1,716	1,373	3,618	740
1990	583	1,623	1,273	3,486	680
1991	623	1,544	1,147	3,591	704
1992	560	1,531	1,269	3,325	792
1993	611	1,546	1,287	3,393	774
1994	595	1,447	1,238	3,353	725
1995	548	1,455	1,359	3,545	774

Table D3. Firm Population in Fishing and Trapping Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	2,570	171	219	135	618
1984	2,802	205	225	134	615
1985	3,056	217	226	118	652
1986	3,321	239	228	128	722
1987	3,617	254	217	147	766
1988	3,867	295	205	157	763
1989	3,946	314	186	149	784
1990	4,193	359	182	133	781
1991	4,497	355	182	130	743
1992	4,566	352	189	128	717
1993	4,553	347	190	108	692
1994	4,401	352	191	97	712
1995	4,205	361	184	116	738

Table D4. Entrant Population in Fishing and Trapping Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	616	66	41	47	131
1984	653	51	30	35	172
1985	686	60	35	43	187
1986	688	76	35	55	185
1987	687	95	22	45	152
1988	608	79	21	35	159
1989	758	108	20	31	154
1990	833	73	25	32	128
1991	662	62	23	37	129
1992	572	65	26	23	108
1993	523	76	28	31	148
1994	533	77	19	41	171
1995	566	68	16	69	123

Table D5. Firm Population in Logging and Forestry Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	1,078	1,246	933	511	2,903
1984	1,216	1,457	1,008	576	3,170
1985	1,336	1,537	1,062	621	3,487
1986	1,433	1,695	1,239	664	3,752
1987	1,535	1,796	1,301	702	3,923
1988	1,575	1,808	1,231	693	3,944
1989	1,579	1,827	1,118	696	3,872
1990	1,639	1,936	1,125	706	3,876
1991	1,635	1,960	1,095	760	3,773
1992	1,659	1,962	1,122	772	3,694
1993	1,702	2,040	1,143	822	3,860
1994	1,760	2,173	1,228	985	4,007
1995	1,872	2,404	1,287	1,059	4,172

Table D6. Entrant Population in Logging and Forestry Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	330	510	284	164	756
1984	343	446	274	180	868
1985	348	493	403	165	902
1986	390	455	347	171	878
1987	359	369	258	161	766
1988	299	352	196	137	680
1989	348	429	241	167	740
1990	321	392	209	202	644
1991	319	365	216	189	591
1992	330	397	219	214	762
1993	386	486	284	314	769
1994	456	660	283	308	822
1995	369	719	255	266	716

Table D7. Firm Population in Mining, Quarrying and Oil Well Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	268	389	777	2,924	846
1984	281	400	796	3,080	875
1985	263	402	805	3,323	855
1986	262	465	835	3,379	923
1987	267	467	856	3,316	1,003
1988	267	461	817	3,381	945
1989	262	441	794	3,302	899
1990	246	430	783	3,342	889
1991	258	407	743	3,438	826
1992	241	390	693	3,322	791
1993	250	418	667	3,511	847
1994	250	421	676	3,807	890
1995	275	440	686	3,977	880

Table D8. Entrant Population in Mining, Quarrying and Oil Well Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	61	66	136	507	231
1984	35	60	134	588	176
1985	52	105	163	461	239
1986	58	71	164	473	295
1987	56	62	122	492	190
1988	46	50	105	400	175
1989	44	55	111	484	177
1990	57	48	92	515	149
1991	47	46	84	395	158
1992	55	64	94	643	223
1993	57	58	107	754	217
1994	82	72	112	698	186
1995	95	108	133	825	262

Table D9. Firm Population in Manufacturing Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	3,533	14,352	18,523	7,350	6,068
1984	3,696	14,980	19,240	7,544	6,322
1985	3,751	15,528	20,230	7,805	6,578
1986	4,051	16,365	21,264	8,103	6,918
1987	4,212	16,896	22,115	8,315	7,160
1988	4,356	17,234	22,809	8,478	7,347
1989	4,342	17,585	23,073	8,521	7,587
1990	4,505	17,609	23,345	8,657	7,920
1991	4,589	17,273	22,705	8,753	8,027
1992	4,546	17,024	22,247	8,542	8,209
1993	4,460	16,930	22,043	8,632	8,300
1994	4,526	17,239	22,438	8,813	8,494
1995	4,617	17,871	22,686	8,947	8,657

Table D10. Entrant Population in Manufacturing Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	632	2,080	2,330	1,104	995
1984	585	2,131	2,606	1,173	1,047
1985	764	2,399	2,872	1,275	1,170
1986	766	2,287	2,791	1,261	1,155
1987	772	2,105	2,769	1,188	1,064
1988	690	2,191	2,474	1,139	1,117
1989	795	2,022	2,449	1,240	1,186
1990	824	1,879	2,037	1,216	1,121
1991	772	1,852	2,111	1,066	1,144
1992	739	1,886	2,181	1,200	1,121
1993	833	2,127	2,495	1,326	1,119
1994	945	2,554	2,493	1,391	1,209
1995	895	2,299	2,378	1,401	1,213

Table D11. Firm Population in Construction Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	7,378	16,551	29,200	18,841	13,562
1984	8,055	17,795	30,918	18,801	13,453
1985	8,409	18,979	33,055	18,990	13,556
1986	8,969	20,628	36,085	19,420	14,227
1987	9,287	22,809	39,092	19,347	14,739
1988	9,487	23,857	40,424	18,944	15,200
1989	9,617	24,861	41,917	18,810	16,212
1990	10,167	25,466	41,739	19,330	17,787
1991	10,270	24,861	38,368	19,041	17,940
1992	10,412	24,792	36,604	19,226	19,026
1993	10,585	24,335	35,509	19,126	19,926
1994	10,715	24,359	35,152	19,342	20,398
1995	10,340	24,026	33,791	19,200	19,466

Table D12. Entrant Population in Construction Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	1,898	3,025	5,510	3,774	2,483
1984	1,745	3,177	6,075	3,769	2,660
1985	1,871	3,711	7,270	3,715	3,042
1986	1,891	4,387	7,802	3,413	2,995
1987	1,870	3,827	6,974	3,000	2,962
1988	1,744	4,096	6,986	2,956	3,364
1989	2,053	3,618	6,375	3,497	3,907
1990	1,952	3,056	4,871	3,162	3,505
1991	1,975	3,231	4,984	3,401	4,020
1992	2,019	3,036	5,091	3,169	4,144
1993	2,141	3,250	5,346	3,368	3,936
1994	1,888	3,246	4,676	3,347	3,308
1995	1,724	2,944	4,818	3,440	3,284

Table D13. Firm Population in Transportation and Storage Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	2,523	5,781	6,246	6,625	4,531
1984	2,706	6,247	6,550	6,762	4,727
1985	2,782	6,701	6,897	7,086	4,958
1986	2,980	7,245	7,381	7,201	5,239
1987	3,174	7,806	7,850	7,217	5,401
1988	3,298	8,020	8,036	7,210	5,522
1989	3,471	8,219	8,084	7,107	5,656
1990	3,653	8,523	8,083	7,258	5,835
1991	3,694	8,471	7,863	7,299	5,981
1992	3,721	8,677	7,726	7,155	5,980
1993	3,783	9,102	7,716	7,340	6,058
1994	3,869	9,698	8,006	7,824	6,232
1995	3,820	10,288	8,173	8,200	6,403

Table D14. Entrant Population in Transportation and Storage Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	629	1,232	1,133	1,348	891
1984	537	1,269	1,293	1,488	930
1985	650	1,425	1,386	1,369	1,053
1986	685	1,549	1,476	1,337	1,000
1987	654	1,298	1,320	1,299	955
1988	697	1,266	1,257	1,154	931
1989	736	1,344	1,249	1,332	1,041
1990	674	1,223	1,099	1,286	1,106
1991	681	1,309	1,076	1,194	940
1992	656	1,457	1,102	1,429	974
1993	746	1,641	1,291	1,640	1,055
1994	727	1,793	1,283	1,822	1,117
1995	756	1,641	1,264	1,911	1,187

Table D15. Firm Population in Communications and Other Utility Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	367	856	1,186	671	497
1984	415	917	1,250	712	522
1985	410	968	1,324	720	535
1986	438	1,097	1,390	764	572
1987	465	1,173	1,431	804	577
1988	471	1,245	1,433	804	576
1989	504	1,254	1,454	822	603
1990	525	1,295	1,472	822	646
1991	545	1,310	1,484	803	638
1992	546	1,328	1,526	821	650
1993	590	1,375	1,555	857	682
1994	602	1,406	1,606	909	690
1995	602	1,525	1,667	974	679

Table D16. Entrant Population in Communications and Other Utility Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	95	160	173	136	83
1984	66	189	205	120	98
1985	89	264	207	155	113
1986	96	240	214	159	92
1987	89	218	188	131	83
1988	102	199	206	135	106
1989	116	243	198	129	139
1990	121	245	185	128	108
1991	117	241	217	150	108
1992	133	257	221	172	119
1993	133	242	226	184	108
1994	128	332	238	215	129
1995	111	272	244	227	158

Table D17. Firm Population in Wholesale Trade Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	3,924	12,937	16,372	10,040	6,605
1984	4,047	13,143	16,816	10,224	6,676
1985	4,119	13,574	17,456	10,338	6,777
1986	4,331	14,074	18,129	10,692	7,032
1987	4,477	14,578	18,844	10,944	7,360
1988	4,636	14,825	19,308	11,043	7,642
1989	4,735	15,073	19,839	11,103	7,861
1990	4,847	15,585	20,415	11,430	8,442
1991	5,013	15,664	20,593	11,629	8,773
1992	4,955	15,756	20,610	11,643	8,996
1993	5,091	15,765	20,944	11,759	9,372
1994	5,109	15,802	21,261	11,865	9,774
1995	5,187	16,139	21,677	12,006	10,114

Table D18. Entrant Population in Wholesale Trade Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	637	1,621	2,143	1,415	930
1984	579	1,710	2,212	1,351	943
1985	671	1,834	2,334	1,481	1,045
1986	705	1,959	2,514	1,568	1,151
1987	703	1,802	2,377	1,439	1,139
1988	692	1,755	2,373	1,373	1,091
1989	732	2,027	2,645	1,564	1,391
1990	837	2,030	2,601	1,613	1,342
1991	736	1,976	2,501	1,536	1,320
1992	840	1,966	2,747	1,591	1,469
1993	802	2,008	2,778	1,631	1,529
1994	869	2,216	2,819	1,694	1,634
1995	865	2,180	2,960	1,681	1,705

Table D19. Firm Population in Retail Trade Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	11,515	38,865	41,362	21,397	15,952
1984	12,105	40,226	42,995	22,104	16,504
1985	12,518	41,409	44,478	22,818	16,772
1986	12,913	42,963	45,847	23,570	17,141
1987	13,184	43,634	46,969	23,902	17,528
1988	13,322	43,524	47,109	23,668	17,539
1989	13,301	43,159	47,053	23,165	17,442
1990	13,653	43,377	47,752	23,571	18,236
1991	13,659	42,569	46,513	23,522	18,335
1992	13,562	41,871	46,020	23,282	18,774
1993	13,698	41,165	45,814	23,331	18,813
1994	13,671	40,783	46,026	23,685	19,095
1995	13,485	40,459	45,591	23,681	19,097

Table D20. Entrant Population in Retail Trade Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	2,260	6,550	6,665	3,643	2,783
1984	2,228	6,537	6,947	3,878	2,746
1985	2,358	7,198	7,020	3,897	2,847
1986	2,307	6,952	7,280	3,880	2,884
1987	2,262	6,119	6,613	3,393	2,470
1988	2,070	5,788	6,463	3,135	2,449
1989	2,277	6,146	7,126	3,649	3,114
1990	2,301	5,542	5,911	3,464	2,705
1991	2,209	5,390	6,181	3,370	2,976
1992	2,333	5,390	6,358	3,674	2,878
1993	2,328	5,478	6,653	3,851	3,025
1994	2,297	5,624	6,306	3,763	2,877
1995	2,145	5,156	6,643	3,620	2,985

Table D21. Firm Population in Finance and Insurance Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	980	2,443	6,821	5,111	3,718
1984	995	2,517	6,962	5,060	3,706
1985	1,027	2,755	7,351	5,118	3,797
1986	1,073	2,968	7,898	5,278	3,851
1987	1,065	3,105	8,071	5,355	3,928
1988	1,123	3,266	8,367	5,311	4,046
1989	1,178	3,580	8,795	5,457	4,425
1990	1,237	3,707	9,051	5,677	4,738
1991	1,221	3,786	9,045	5,791	4,948
1992	1,264	3,829	8,808	5,779	5,123
1993	1,262	3,764	8,613	5,883	5,367
1994	1,232	3,749	8,455	5,955	5,516
1995	1,238	3,698	8,397	6,008	5,581

Table D22. Entrant Population in Finance and Insurance Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	163	447	1,257	959	716
1984	161	598	1,377	976	723
1985	189	603	1,605	1,058	732
1986	189	641	1,441	1,021	718
1987	215	657	1,589	967	817
1988	212	739	1,620	978	979
1989	216	639	1,604	1,012	976
1990	166	659	1,543	973	919
1991	222	600	1,362	877	903
1992	206	541	1,242	909	972
1993	184	525	1,222	935	951
1994	222	505	1,289	968	966
1995	228	570	1,424	1,060	927

Table D23. Firm Population in Real Estate and Insurance Agent Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	1,856	6,443	11,665	6,093	5,189
1984	1,924	6,779	11,932	6,162	5,191
1985	2,005	7,238	12,390	6,335	5,235
1986	2,148	7,689	13,003	6,511	5,344
1987	2,167	8,077	13,447	6,617	5,500
1988	2,179	8,126	13,689	6,643	5,533
1989	2,168	7,937	13,846	6,624	5,629
1990	2,183	7,832	13,932	6,769	5,863
1991	2,220	7,703	13,834	6,741	6,069
1992	2,295	7,552	13,660	6,853	6,285
1993	2,297	7,456	13,554	6,818	6,360
1994	2,331	7,330	13,384	6,864	6,502
1995	2,316	7,262	13,124	6,886	6,543

Table D24. Entrant Population in Real Estate and Insurance Agent Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	317	1,133	1,511	972	763
1984	353	1,255	1,704	1,043	689
1985	394	1,366	1,814	963	722
1986	319	1,339	1,814	962	745
1987	341	1,093	1,692	860	762
1988	297	916	1,599	828	764
1989	318	877	1,594	949	842
1990	355	967	1,708	904	942
1991	388	907	1,480	979	898
1992	357	866	1,368	863	863
1993	396	886	1,341	911	882
1994	399	918	1,336	1,017	927
1995	397	1,021	1,426	1,063	926

Table D25. Firm Population in Business Services Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	2,846	12,596	21,766	12,221	8,627
1984	2,994	13,569	22,369	12,414	8,810
1985	3,147	14,678	23,796	13,160	9,197
1986	3,441	16,021	25,295	13,780	9,823
1987	3,652	17,023	26,800	14,078	10,360
1988	3,834	17,609	27,777	14,351	10,590
1989	4,003	18,256	28,991	14,768	11,201
1990	4,269	19,244	30,046	15,650	12,246
1991	4,533	19,352	30,018	16,332	12,815
1992	4,654	19,827	30,567	16,833	13,506
1993	4,886	20,062	31,545	17,629	14,368
1994	5,171	20,614	32,961	18,831	15,444
1995	5,469	21,972	34,338	19,985	16,463

Table D26. Entrant Population in Business Services Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	634	2,705	3,743	2,324	1,759
1984	646	2,965	4,305	2,637	1,768
1985	743	3,314	4,526	2,571	1,993
1986	744	3,324	4,735	2,541	2,093
1987	761	3,024	4,433	2,464	1,893
1988	782	3,060	4,555	2,520	2,115
1989	859	3,330	4,749	2,839	2,448
1990	1,019	3,293	4,624	2,949	2,380
1991	986	3,367	4,771	3,015	2,509
1992	1,002	3,247	5,186	3,221	2,704
1993	1,121	3,489	5,488	3,669	2,999
1994	1,255	4,351	5,873	3,916	3,100
1995	1,266	4,275	6,738	4,377	3,308

Table D27. Firm Population in Accommodation, Food and Beverage Service Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	3,969	14,532	15,538	8,275	6,525
1984	4,148	15,219	16,289	8,701	6,903
1985	4,366	15,868	17,179	9,205	7,219
1986	4,672	16,621	18,212	9,678	7,704
1987	4,907	17,153	18,978	9,984	7,941
1988	4,967	17,525	19,170	9,962	8,051
1989	4,996	17,516	19,378	9,971	8,207
1990	5,231	17,787	20,354	10,273	8,605
1991	5,408	17,781	20,494	10,639	8,825
1992	5,467	17,810	20,556	10,726	9,059
1993	5,581	18,082	20,879	11,071	9,394
1994	5,741	18,548	21,371	11,512	9,818
1995	5,846	18,916	21,587	11,795	10,031

Table D28. Entrant Population in Accommodation, Food and Beverage Service Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	798	3,229	2,853	1,794	1,366
1984	866	3,208	3,104	1,980	1,453
1985	989	3,473	3,487	2,086	1,642
1986	1,081	3,550	3,622	2,121	1,559
1987	1,007	3,509	3,356	1,860	1,453
1988	946	3,053	3,411	1,831	1,475
1989	1,122	3,437	4,046	2,092	1,776
1990	1,136	3,137	3,476	2,193	1,632
1991	1,141	3,207	3,379	2,169	1,639
1992	1,187	3,302	3,548	2,341	1,820
1993	1,340	3,731	3,905	2,601	2,005
1994	1,379	3,883	3,947	2,751	1,936
1995	1,342	3,848	4,203	2,556	2,015

Table D29. Firm Population in Other Service Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	11,878	27,067	31,633	14,802	11,038
1984	14,172	29,778	33,297	15,869	11,876
1985	14,511	26,424	34,785	16,670	12,748
1986	14,453	26,169	36,089	17,413	13,392
1987	14,458	26,056	37,522	17,928	14,366
1988	14,642	25,442	37,980	17,885	14,815
1989	14,104	25,027	38,655	18,040	15,167
1990	14,848	25,726	41,152	18,850	16,446
1991	14,260	25,767	41,960	19,370	17,462
1992	14,178	25,276	41,827	19,662	17,964
1993	14,368	24,723	40,641	19,727	17,795
1994	13,890	24,200	39,404	19,882	17,740
1995	13,265	24,215	37,808	19,848	17,735

Table D30. Entrant Population in Other Service Industries

Year	*Atlantic Provinces*	*Quebec*	*Ontario*	*Prairie Provinces*	*British Columbia*
1983	7,319	11,863	7,595	4,425	3,274
1984	6,964	8,614	8,094	4,585	3,501
1985	5,975	7,610	7,980	4,277	3,480
1986	5,725	6,703	8,121	4,165	3,703
1987	5,566	5,787	7,304	3,665	3,432
1988	4,868	5,198	7,417	3,509	3,337
1989	5,040	5,554	8,915	4,019	4,161
1990	4,306	5,102	7,880	3,971	4,113
1991	4,399	4,737	7,065	4,026	3,840
1992	4,532	4,298	6,362	3,833	3,425
1993	4,028	3,982	6,117	3,952	3,570
1994	3,612	4,295	5,673	3,866	3,570
1995	3,134	4,247	5,922	3,933	3,668

Appendix E – Entry Rate Measurement

Empirical studies of the entry and exit process had been restricted primarily to case studies (e.g., Mansfield, 1962) until the advent of large micro-databases, most of which had been developed when statistical agencies and private firms computerized their files on firm populations during the 1970s and 1980s. These databases originate from official statistical agency files often derived from the manufacturing population (the Canadian Census of Manufactures or the LRD at the U.S. Bureau of the Census), or from private sector sources such as the longitudinal file developed at the Small Business Administration from Dun and Bradstreet records. Similar files exist in other countries. In this study, we use a more extensive file on the firm population derived from tax records (see Baldwin, Dupuy and Penner, 1992). In this file, an entrant is defined as a firm that has begun to submit remittance payments to the government but had not done so in the previous year.

These micro-databases are not perfect and all too often have been accepted without careful examination of the flaws inherent in them. The Dun and Bradstreet records have received the closest public scrutiny.[48] Two problems are noteworthy. The first deals with the coverage of the population, the second with the operational definition of entry. We take these up in reverse order below.

In these files, entry is measured as the appearance of a new entity. Entities are records in a file. Entry then is an event that causes the administrators of these files to issue a new record number. Unfortunately, many files were not originally established with clear rules as to when old record-identifiers would be terminated and new record-identifiers birthed. In some files, entities were arbitrarily assigned new record numbers over time; thus an ongoing entity falsely appears to die and then be born. This often arises when a merger or a change in control occurs, leading to an overestimation of the number of births and deaths when these files are used. If there are a large number of false births and deaths, entry rates will be overstated, as will hazard rates.

Two practical solutions to this problem are available. First, estimates of the error rates can be derived by sampling the database. This was done for the manufacturing database that has been used to study firm dynamics in this sector (see Baldwin, 1995). Second, outside information can be used to correct the database. For example, the Canadian longitudinal file derived from tax records tracks workers over time to correct for false births and deaths (Baldwin, Dupuy and Penner, 1992). In essence, all workers are linked to firms and tracked over time. If a firm dies and its workers are mainly found in another firm in the following year, then this event is registered as a false death. Despite the effort that is devoted to this correction process, it is imperfect. We, therefore, present new evidence to evaluate the degree of error in the entry rates that are produced by the file used for this study.

[48] See Baldwin and Gorecki (1990, ch.5), and Davis et al (1996, pp. 70-72) for a discussion of the shortcomings of the D&B files.

The issue of coverage can be summarized as follows. New firms go through several stages. They may just be an idea in an entrepreneur's mind, or a tentative experiment that may consist only of the founder working in his garage or home office. Usually at a later stage, this firm begins to hire employees. At a still later stage, it is incorporated into official business registers and surveyed either by a statistical agency or by a credit rating agency. It is clear from this taxonomy that there is no 'correct' time at which entry should be measured. Most databases capture firms at an arbitrary point in their birthing experience.

In this paper, we use the LEAP database to measure entry and exit. Despite the work that has been done to reduce the extent to which false births are registered in this file (described in Baldwin, Dupuy and Penner, 1992), this problem has not been completely eliminated. This occurs because the method for analyzing worker movements is more accurate with regards to the largest units. When a firm with 100 workers dies and 80 or so are found in another firm in the following year, the probability that the second is an extension of the first is very high. When a firm with three workers dies and all three are found together the next year, the probability of the second being an extension of the first is much less. Therefore, little attempt is made to edit the LEAP database for units of under five workers. Consequently, entry rates derived from LEAP may be biased upwards.

An estimate of the size of this bias can be obtained using a special survey that was conducted in 1993. This survey involved a random sample of all firm births that were registered on the file that, in turn, is used to generate the LEAP database. The survey was done within six to nine months of the entity making its first remittances to the government. New entities were contacted and asked whether their commencing to remit payments to the government for employees was the result of one of several factors. Some of these can be described for our purposes as resulting in false births.

The factors are divided into two groups. The first set of firms are those which we would classify as false births. They are:

i) A reorganization of the firm into new payroll units.
ii) A reorganization brought about by a merger or control change.
iii) A new entity that is a new location or branch of an existing business.

The second are legitimate births. These are:

i) Existing firms that just started to hire employees.
ii) New firms—firms that had remitted but that had already failed by the time the survey was conducted. These are firms that remit on behalf of employees but that die before the survey date and so indicate when contacted.
iii) New firms—firms that had remitted but that had died by the time the survey was conducted and that could not even be contacted.
iv) New firms that do not fall into any of the above categories.

The importance of the various components is presented in Table E1. About 10% of new remittants that show up as new firms were involved in a form of reorganization that should not be construed as a birth—reorganizations, ownership changes, or new locations. Another 15% are firms that have legitimately filed remittances but that died almost immediately. A good 28% are firms that existed previously but suddenly started hiring employees. Finally 48% are firms that are new and have just started to hire employees. This means that only 90% of the entities that are listed as start-ups on the original LEAP database prior to editing would fall under our definition of genuine births.

Table E1. Distribution of Categories for New Entities

Category	*Percent*
New business	48.4
Non-employer with employees	28.2
Inactive	8.3
No contact	6.2
New location	0.1
Ownership change	6.2
Restructuring of payroll accounts	2.6
Total	100.0

The edited LEAP database makes corrections for these false births and deaths using the labour-tracking program that is described above. This procedure removes 10% of the entrants, a figure very close to the survey estimate of false births. We can, therefore, be relatively confident that the entry and exit phenomena that are being measured in this paper refer mainly to the creation of new units that have employment for the first time.

It should be noted that the entry rates that are produced by LEAP and the survey are not quite the same because they have different coverages, with LEAP being slightly more extensive. The entry rates using LEAP and the survey are presented in Table E2. It should also be noted that the rates are not calculated on exactly the same populations. LEAP uses all entities that filed a remittance for 1993 (including those who do so in the subsequent year). The survey examined a rolling sample during the year and therefore omitted all new firms that were late filers—those that only file after the end of the year. LEAP also used a larger frame, including the very smallest firms in the business register—firms that are so small that formal industry classification procedures are not followed for them except after a lag. The two estimates give an idea of the nature of the differences that arise because of differences in sample coverage. For the commercial population being examined here, LEAP gave an entry rate of 15%. The survey, using a reduced entrant population, produced a rate of 12%.

Table E2. Comparison of Entry Rates for 1993 (%)

Industry	*LEAP*	*Survey*
Logging and Forestry	20.0	16.0
Mining, Quarrying and Oil Wells	17.0	14.0
Manufacturing	10.8	9.8
Construction	15.0	12.5
Transportation and Storage	16.1	12.4
Communications and Other Utilities	17.3	14.4
Wholesale Trade	13.0	12.1
Retail Trade	13.7	11.1
Finance and Insurance	15.0	10.5
Real Estate Operators and Insurance Agents	11.2	9.1
Business Services	17.2	13.7
Accommodation, Food and Beverage	18.2	13.7
Other Services	18.3	10.6
Total	15.1	11.8

ELECTRONIC PUBLICATIONS AVAILABLE AT

www.statcan.ca

Appendix F – Data Plots for Goods and Services Sectors

Parametric forms are often used to describe the distribution of event times. In Chapter 5, we calculated the mean and median survival times of new firms based on a Weibull distribution. The appropriateness of the Weibull can be evaluated graphically. A Weibull should be linear in the log of—log(s) and log t. Figures F1 and F2 plot the log negative log of the survivor function against log duration for the goods and services sectors, respectively. Figures F3 and F4 fit a linear regression line through these data plots.

Figure F1. Log(-log survivor) vs. Log Duration
Goods-Producing Sector

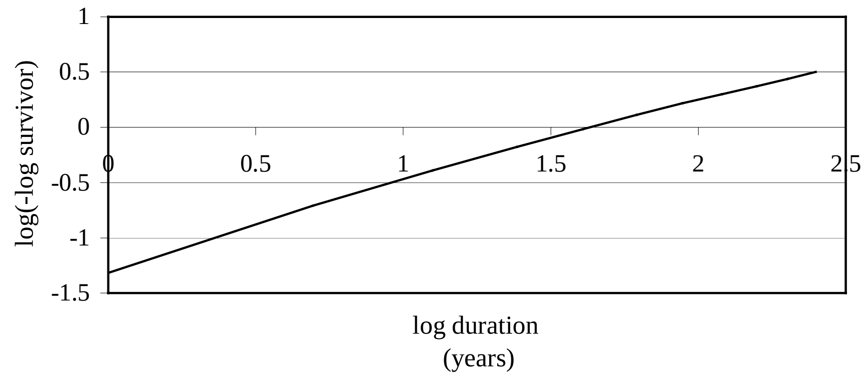


Figure F2. Log(-log survivor) vs. Log Duration
Service-Providing Sector

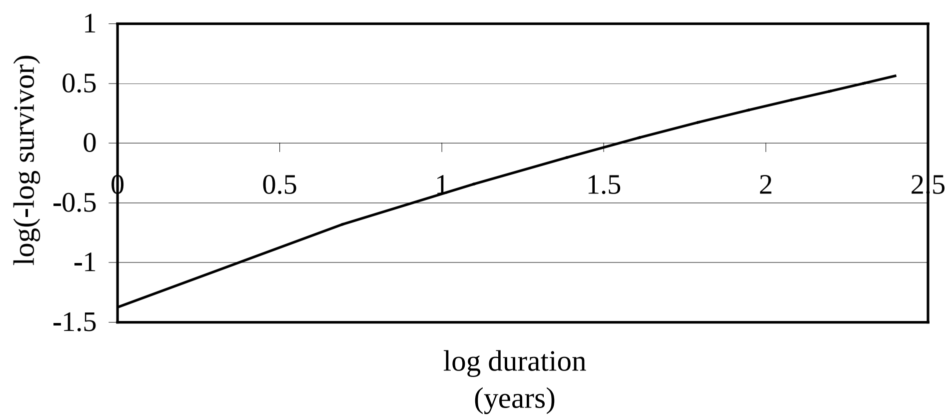


Figure F3. Actual Value (Y) vs. Predicted Value
Goods-Producing Sector

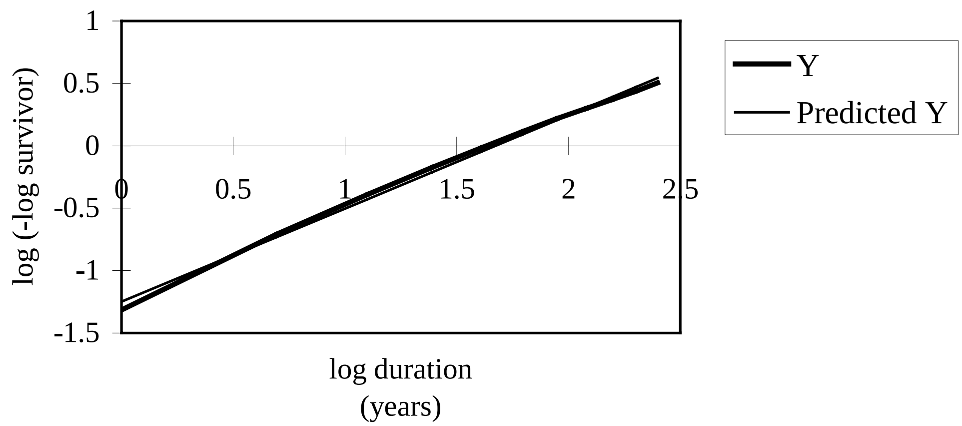
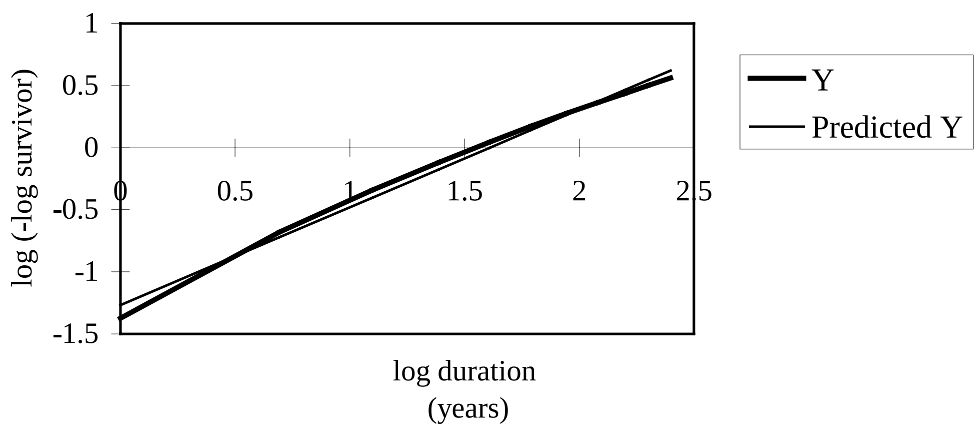


Figure F4. Actual Value (Y) vs. Predicted Value
Service-Providing Sector



References

Abernathy, W.J. and J.M. Utterbach. 1978. "Patterns of Industrial Innovation," *Technology Review* June/July 80:41-7.

Allison, P.D. 1984. "Event History Analysis: Regression for Longitudinal Event Data" *Quantitative Applications in the Social Sciences*. No. 46. California: Sage Publications, Inc.

Audretsch, D.B. 1991. "New-Firm Survival and the Technological Regime," *Review of Economics and Statistics* 73, 3: 441-50.

Audretsch, D.B. 1995. *Innovation and Industry Evolution*. Cambridge, Mass: MIT Press.

Audretsch, D.B. and T. Mahmood. 1995. "New Firm Survival: New Results Using a Hazard Function," *Review of Economics and Statistics* 77: 97-103.

Baldwin, J.R. 1995. *The Dynamics of Industrial Competition: A North American Perspective*. New York: Cambridge University Press.

Baldwin, J.R. 1999. *A Portrait of Entrants and Exits*. Research Paper No. 121. Analytical Studies Branch. Ottawa: Statistics Canada.

Baldwin, J.R., W. Chandler, C. Le and T. Papailiadis. 1994. *Strategies for Success: A Profile of Growing Small and Medium-sized Enterprises (GSMEs) in Canada*. Catalogue 61-523-RPE. Ottawa: Statistics Canada.

Baldwin, J.R., R. Dupuy and W. Penner. 1992. "Development of Longitudinal Panel Data from Business Registers: Canadian Experience," *Statistical Journal of the United Nations Economic Commission for Europe* 9: 289-314.

Baldwin, J.R. and P.K. Gorecki. 1990. *Structural Change and the Adjustment Process: Perspective on Firm Growth and Worker Turnover*. Economic Council of Canada and Statistics Canada. Ottawa: Minister of Supply and Services.

Baldwin, J.R. and P. Gorecki. 1991. "Firm Entry and Exit in the Canadian Manufacturing Sector, 1970-82" *Canadian Journal of Economics* 24: 300-21.

Baldwin, J.R. and P. Gorecki. 1994. "Concentration and Mobility Statistics," *Journal of Industrial Economics* 42: 93-104.

Baldwin, J.R., T. Gray, J. Johnson, J. Proctor, M. Rafiquzzaman and D. Sabourin. 1997. *Failing Concerns: Business Bankruptcy in Canada*. Catalogue No. 61-525-XPE. Ottawa: Statistics Canada.

Baldwin, J.R. and M. Rafiquzzaman. 1995. "Selection Versus Evolutionary Adaptation: Learning and Post-Entry Performance," *International Journal of Industrial Organization* 13: 501-22.

Caves, R.E. 1998. “Industrial Organization and New Findings on the Turnover and Mobility of Firms,” *Journal of Economic Literature* XXXVI: 1947-1982.

Cox, D.R. 1972. “Regression Models and Life-Tables,” *Journal of the Royal Statistical Society* B 34: 187-220.

Cox, D.R and D. Oakes. 1984. *Analysis of Survival Data.* New York: Chapman and Hall.

Davis, S.J., J. Haltiwanger and S. Schuh. 1996. *Job Creation and Destruction*. MIT Press.

Fichman, M. and D.A. Levinthal. 1991. “Honeymoons and the liability of adolescence: A new perspective on duration dependence in social and organizational relationships,” *Academy of Management Review* 16: 442-468.

Geroski, P.A. 1991. *Market Dynamics and Entry*. Oxford: Basil Blackwell.

Geroski, P.A. 1995. “What Do We Know About Entry?” *International Journal of Industrial Organization* 13: 421-440.

Gort, M. and S. Klepper. 1982. “Time Paths in the Diffusion of Product Innovations,” *Economic Journal* 92: 630-53.

Hastings, N.A.J. and J.B. Peacock. 1975. *Statistical Distributions.* London: Butterworths.

Johnson, J., J. Baldwin and C. Hinchley. 1997. *Successful Entrants: Creating the Capacity for Survival and Growth*. Catalogue No. 61-524-XPE. Ottawa: Statistics Canada.

Jovanovic, B. 1982. “Selection and the Evolution of Industry,” *Econometrica* 50: 649-70.

Kalbfleisch, J.D. and R.L. Prentice. 1980. *The Statistical Analysis of Failure Time Data.* New York: John Wiley & Sons.

Kiefer, N.M. 1988. “Economic Duration Data and Hazard Functions,” *Journal of Economic Literature* 26: 646-79.

Kmenta, J. 1971. *Elements of Econometrics*. New York: The Macmillan Company.

Lawless, J.F. 1982. *Statistical Models and Methods for Lifetime Data*. New York: John Wiley & Sons.

Mansfield, E. 1962. “Entry, Gilbrat’s Law, Innovation and the Growth of Firms,” *American Economic Review* 52:1023-51.

Mata, J., P. Portugual and P. Guimaraes. 1995. “The Survival of New Plants: Start-up Conditions and Post-Entry Evolution,” *International Journal of Industrial Organization*, 13: 459-82.

Neter, J., W. Wasserman and G.A. Whitmore. 1982. *Applied Statistics.* 2nd Edition. Boston: Allyn and Bacon.

Picot, G., J.R. Baldwin and R. Dupuy. 1994. *Have Small Firms Created a Disproportionate Share of New Jobs in Canada? A Reassessment of the Facts*. Research Paper No. 71. Analytical Studies Branch. Ottawa: Statistics Canada.

Picot, G. and R. Dupuy. 1996. *Job Creation by Company Size Class: Concentration and Persistence of Job Gains and Losses in Canadian Companies*. Research Paper No. 93. Analytical Studies Branch. Ottawa: Statistics Canada.

Rothwell, R. and W. Zegveld. 1982. *Innovation and the Small and Medium-Sized Firm.* London: Francis Pinter.