

**BUSINESS DEMOGRAPHICS AS INDICATORS  
OF INNOVATION ACTIVITY**

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\*The author wishes to acknowledge the significant contribution of Fred Gault. Michèle LeBel provided research assistance; Serge Bourret and Ed Hamilton did the computer programming; and Claire Racine-Lebel assisted in the compilation of tables.

Science and Technology Redesign Project  
Statistics Canada  
October 1997

ST-97-12

Price: \$75.00



## **THE INFORMATION SYSTEM FOR SCIENCE AND TECHNOLOGY PROJECT**

The purpose of this project is to develop useful indicators of activity and a framework to tie them together into a coherent picture of science and technology in Canada.

To achieve the purpose, statistical measurements are being developed in five key areas: innovation systems; innovation; government S&T activities; industry; and human resources, including employment and higher education. The work is being done at Statistics Canada, in collaboration with Industry Canada and with a network of contractors.

Prior to the start of this work, the ongoing measurements of S&T activities were limited to the investment of money and human resources in research and development (R&D). For governments, there were also measures of related scientific activity (RSA) such as surveys and routine testing. These measures presented a limited and potentially misleading picture of science and technology in Canada. More measures were needed to improve the picture.

Innovation makes firms competitive and more work has to be done to understand the characteristics of innovative, and non-innovative firms, especially in the service sector which dominates the Canadian Economy. The capacity to innovate resides in people and measures are being developed of the characteristics of people in those industries which lead science and technology activity. In these same industries, measures are being made of the creation and the loss of jobs as part of understanding the impact of technological change.

The federal government is a principal player in science and technology in which it invests over five billion dollars each year. In the past, it has been possible to say how much the federal government spends and where it spends it. The current report, released early in 1997, begins to show what the S&T money is spent on. As well as offering a basis for a public debate on the priorities of government spending, all of this information will provide a context for reports of individual departments and agencies on performance measures which focus on outcomes at the level of individual projects.

By the final year of the Project in 1998-99, there will be enough information in place to report on the Canadian system on innovation and show the role of the federal government in that system. As well, there will be new measures in place which will provide a more complete and realistic picture of science and technology activity in Canada.

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## Highlights

- S Industries on the leading edge of technology are more volatile than most sectors of the economy: proportionately more firms enter and leave these industries.
- S The volatile industries tend to grow faster. Many new firms enter business and communication services industries to seize opportunities created by technological advances but stiff competition forces many to close down or merge with other firms. On balance, they have recorded the largest increases in the number of firms since 1983.
- S Within the business services sector, information-intensive industries are highly volatile and growing faster while stability characterizes the knowledge-based industries. The latter have low entry and exit rates mainly because the amount of human capital required to set up a professional practice is large.
- S The manufacturing sector is the least volatile of the major industry groups.

## 1. Introduction

The start-up of a new firm and the closure of an old one are both signals of economic change. Change characterizes those sectors of the economy that are becoming more competitive, that are responsible for more trade and for creation of high-skilled jobs. Change also characterizes those parts of the economy that are undergoing structural adjustment and are losing firms and jobs. Either way, change as measured by the creation and the closure of firms provides insights into the industry where it is happening. This study provides statistical indicators of change and then offers possible explanations. This is part of a wider project to examine innovation, technology diffusion, and related human resource characteristics in the Canadian economy.

Two indicators of change are presented. The first is the gross flow of firms. It is the sum of the number of new firms and of firms that ceased to exist in the period under consideration, as a percentage of the number of firms that were present at the beginning of the period. This is a volatility measure which shows which industries are undergoing the most change, but it does not indicate whether the change is due to the creation of new firms, or the closure of the old firms, or both. For this information, entry and exit rates are presented; they

represent the number of new firms and the number of firms that ceased to exist in the period, as a percentage of the number of firms that were present at the beginning of the period.

Once the indicators of activity are given, there is the question of why change has or has not occurred. In some industries, firms have a relatively short lifetime and there is an on-going entry and exit of firms, while other industries experience relatively little movement. There are many reasons for the differences, including the frequency with which new products and processes are introduced in the industry, the nature of the market in which the industry operates, the regulatory environment and other barriers to entry and exit of firms.

## **2. Life Cycles, Firm Entry and Exit**

Products (goods and services) and firms have their life cycles (Urban and Star, 1991). Like human beings, they are born, grow, mature, decay and finally disappear. The success and lifespan of a firm depends on its ability to manage the product life cycle through various stages to achieve profit levels that make risks taken in research and development and the commitment of resources worthwhile. In innovative industries, where product substitution takes place at a faster pace and consequently product life cycles are shorter, the time available to firms to make strategic choices at each stage of the cycle is increasingly shorter. Inefficient firms leave the market and new ones enter to seize the opportunities created by technological advances and changes in buyers' preferences.

In the introductory phase of a product, the emphasis is on gaining a foothold in the market and on competitive strategy and the competitors' response. New competitors are kept out, by planned obsolescence, by acquiring trademarks, patents and copyrights or by frequently upgrading the product which leaves competitors in the race to catch up while allowing the innovator to earn rent. The product price is typically high but the profit margin is usually low for the pioneering firms.

As the product progresses to the growth stage, it is an indication that it has a future. Therefore, many producers are attracted to the market. The product becomes standardized and easy to copy. Firms capturing a larger market share are able to reduce costs and prices because of the economies of scale in production.

In the maturity phase, increases in sales are limited. In the absence of

new markets or wider applications of the product, firms compete for a share of the shrinking market, competitors market aggressively, and prices fall further. Careful budgeting, planning and control become more commonplace. Some inefficient firms are forced out of the market.

The decline stage is marked by further price promotions. Efficiency becomes critical. Planning and control ominously become more stringent, and cuts are enforced. Firms which cannot sustain continued losses are forced to make choices. Their options range from diversifying the product line to forming alliances to going out of business.

New firms enter the market because they foresee opportunities. They have new or substantially improved products to offer, have developed new processes to produce and deliver existing products at lower cost or have found more applications for existing products. New firms are not necessarily greenfield operations; entities emerging from the mergers of existing firms or from the de-construction of large firms into smaller ones are also new. The actual form that the new business takes provides information about the amount of human and financial resources at its disposal, its willingness to bear the risk alone or share it with others in an alliance, and the nature of the market.

Thus there are two aspects to business demographics: the population (a stock concept) and flows of firms including births, deaths and inter-industry migration; and the organizational form in which flows occur. The former indicates the degree of what Schumpeterian economists call 'creative destruction' and what the practitioner of strategic call 'controlled chaos'; the latter reveals the success and survival strategies firms adopt to cope with the uncertainty created by the unpredictable actions of the competitors, by changes in buyers' preferences, and by the interdependence between the firm and its suppliers. This paper addresses the former, namely, the stocks and flows.

### **3. Analysis of Results**

Volatility is used as an indicator of economic change. It is calculated as the gross flow of firms -- entries plus exits -- divided by the stock or total number of firms which existed at the beginning of the period, expressed as a percentage. In order to reduce the influence of year-to-year fluctuations, a four-year average for the period 1991-1994 is used. The minimum value the measure can take is zero -- it would occur if no firm enters and no firm leaves the industry. Conversely, the volatility rises with the number of entries and exits.

High volatility usually characterizes industries in which the technology changes rapidly. However, a lack of volatility does not necessarily imply a lack

of technological change. Movements of firms into and out of an industry are also influenced by the nature of the market: monopolistic and oligopolistic industries, as well as regulated industries, can be very innovative despite a small number of firms entering and leaving the industry.

### **3.1 Services More Volatile than Goods Sector**

The picture emerging from the business demographic data differs from the one based on output data. Goods-producing industries experience large fluctuations in output because of the inventory cycles, while service industries are stable because of a better balance between demand and the actual output. However, defined by movements in the number of firms, the service economy is slightly more volatile than the goods sector. During 1991-94, the gross flow, expressed as a percentage of the total number of firms, averaged 31.4 per cent in the service sector (excluding government, education and health services) and 29.5 per cent in the goods-producing sector. In contrast, it was only 22.9 per cent in the manufacturing sector (Table 1).

It is significant that volatility in the service sector led to an increase in the number of firms as indicated by the difference between the entry rate and the exit rate in Table 1, whereas in the goods-producing sector as a whole and in manufacturing the net outcome was a decline.



<b>Industry</b>	<b>Entry Rate</b>	<b>Exit Rate</b>	<b>Volatility</b>
Goods Sector	14.4	15.1	29.5
- Forestry	20.5	18.4	38.9
- Mining	14.9	13.4	28.2
- Manufacturing	11.2	11.6	22.9
- Construction	15.5	16.6	32.2
Services Sector*	15.9	15.5	31.4
- Transportation and storage	16.7	15.1	31.8
- Communication and other utilities	16.8	14.8	31.6
- Wholesale trade	13.1	11.8	24.9
- Retail trade	13.9	14.5	28.4
- Finance and insurance	12.9	17.9	30.8
- Real estate operators, etc.	12.3	12.4	24.7
- Business Services	17.4	14.2	31.6
- Traveller accommodation and food service	18.6	16.9	35.5
Total Economy*	15.6	15.4	31.0

\*Excludes government, education and health services.  
See Appendix for data interpretation.

Traveller accommodation and food services, business services, finance and insurance, communication and transportation service industries were among the most volatile sectors of the economy. Despite the regulations governing segments of the communication, transportation and financial and insurance services, movements of firms into and out of the non-regulated segments were large enough to place them among the most volatile industries. In regulated industries and industries with other barriers to entry, technological change must occur within existing firms. This contrasts with non-regulated industries where opportunities created by new technologies attract new firms.

The service industries which experienced high volatility are considered to be on the leading edge of technology except for the special case of traveller accommodation and food service industry. Movements in the food service segment come from entries and exits largely resulting from competition for the same clientele.

At the other end of the spectrum, the manufacturing sector has the least

volatility. Both the entry and the exit rates in this sector were the lowest in the economy due, in part, to the presence of traditional industries and large capital outlays required to set up new firms with efficient scales of production.

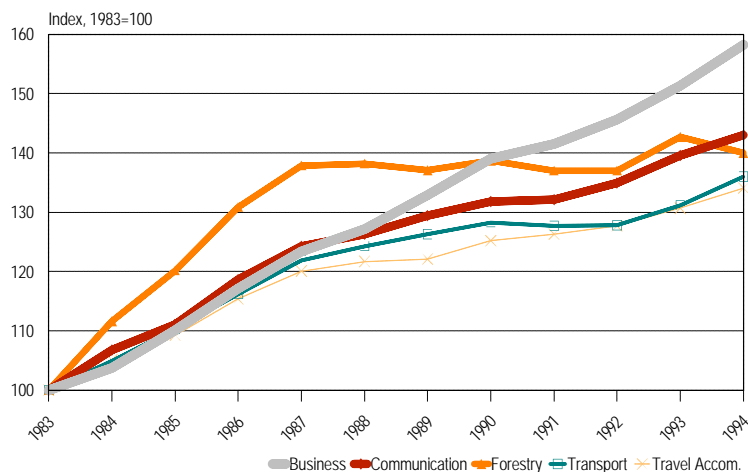
The relatively higher rates of volatility observed in the construction and forestry industries could partly be the result of the methodology used. A significant amount of economic activity in the construction industry takes place on a project-by-project basis, increasing the likelihood that some entries and exits in this industry pertain to projects rather than firms. The statistical error is also higher in industries in which there are many vertically integrated firms. This applies in particular to the forestry industry (see Appendix).

### 3.2. Service Industries the Fastest Growing

Gross flows, taken by themselves, can be misleading because they do not indicate whether the industry is growing, declining or static.

Since there are two components to volatility, any combination of entries and exits can yield a high volatility value. As a result, declining industries can appear to have higher volatility than the dynamic, growing industries. Therefore, the volatility measure is supplemented with net flows -- the difference between entries and exits, or the change in the total number of firms.

Chart 1: Five Fastest Growing Industries  
Number of Firms, 1983-94



Source: Statistics Canada

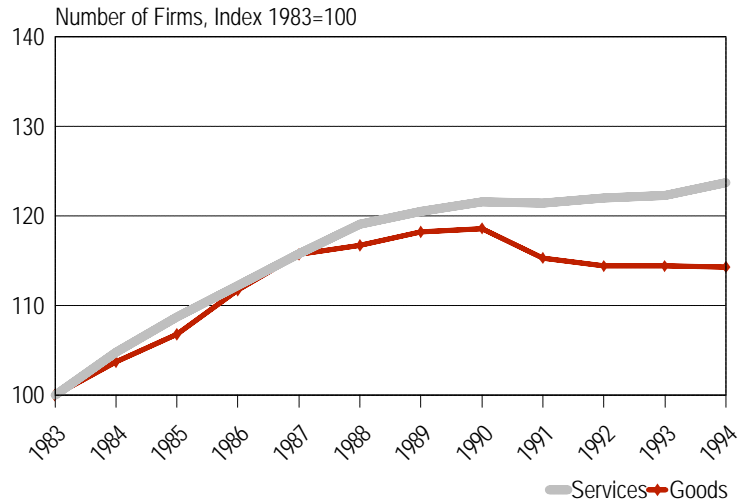
Chart 1 plots trends for the five fastest-growing industries for the period 1983-94, selected from the twelve commercial industry divisions. Excluded from the commercial category are government, education and health services, and agriculture and fishing industries.

Gross flows (volatility) and net flows, together, reveal three interesting points. First, volatility in the goods-producing sector is accompanied by only a

small net increase in the number of firms. Only the forestry industry ranked among the five fastest-growing industries in the economy.

By contrast, four of the economy's five fastest-growing industries are in the service sector. The business and communication services industries had the most rapid growth in the whole economy. Volatility and rapid growth are typical of industries such as business and communication services where technological obsolescence is rapid, product life cycles are shorter, new products are introduced frequently, and some new products replace inferior products of other industries.

Chart 2: Shift to Services  
Number of Firms



Source: Statistics Canada

The rapid growth of the service sector was, in part, at the expense of the goods-producing sector (Chart 2). Pressed to improve productivity in the wake of the 1990-91 recession, goods-producing industries began to focus on their core competencies. As a result, some service inputs previously supplied in-house were contracted out to the service sector where they could be produced more efficiently, with the application of the state-of-the-art technologies. In addition, some goods-producing firms spun off their service-producing divisions as separate firms which then became classified as service firms (Statistics Canada, 1995).

### 3.3 Focus on Business Services Industries

For the balance of this section, the business services sector is the focus of further analysis for a number of reasons. It is the fastest growing sector (Chart 1) of the economy and displays high volatility. It is R&D-intensive (Gault, 1996), creates high-skilled and better paying jobs and a good portion of its output is exported. As suppliers of intermediate inputs into the production process, firms

in these industries have upstream and downstream linkages and facilitate knowledge flows. Most importantly, their principal products -- information and knowledge -- lie at the core of the economy's ability to compete in the global market.

Industries in the business services sector can be grouped in different ways depending on the purpose of the analysis. The approach adopted here recognizes the central role of both knowledge and information in the modern economy. Information-intensive business services industries provide, process and disseminate information, and are here defined to include advertising services firms and software developers and computer service providers. Knowledge-based industries cover accountants, architects, engineers and other scientific and technical services, lawyers and management consulting industries. Industries not assigned to the either group are employment agencies and personnel suppliers, and a miscellaneous group encompassing dozens of different industries. The focus is on the business services sector (SIC 77), and information-intensive and knowledge-based industries classified to other industrial sectors are not covered here. Volatility and growth will be examined in more detail for

the knowledge-intensive and information-intensive business service industries.

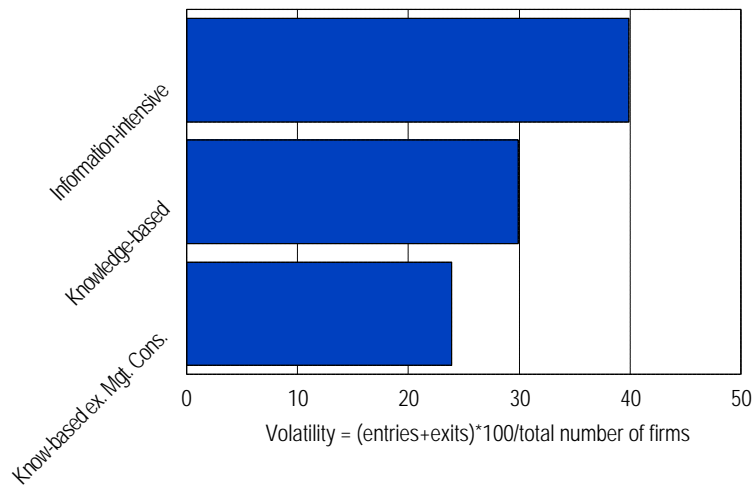
### 3.3.1 Information-intensive Industries Highly Volatile

Information-intensive business services industries are highly volatile (Chart 3), with both the advertising and the software

development and computer service industries experiencing large movements.

The advertising services industry was substantially affected in recent years by technological changes. Some changes were directly related to the television broadcasting industry, including: the introduction of remote control channel changer; the advent of pay-TV and specialty services in 1983; and the

Chart 3: Volatility in Business Service Industries, Average 1991-1994  
Information-intensive and Knowledge-based Industries



Source: Statistics Canada

proliferation of 'boutique channels' after more specialty services were licensed in 1989 (Gorman and Crompton, 1997). Other technological changes affecting the advertising service industry arose from the convergence of computing, communicating and entertainment technologies. Together, they altered the relative importance of advertising media and how the intended audiences were reached. Changes in the people's age profile and growing popularity of non-television leisure activities prompted advertisers to better identify their target audiences and find alternative means of reaching them. The availability of detailed and up-to-date information on the buying patterns of consumers -- made possible by the implementation of scanning bar code technologies -- made it easier for advertisers to identify and locate desired audiences. The emergence of new media and technology provided alternative means of reaching the audience. Some examples include: beaming advertisements through boutique TV channels; advertising at major sports and other events on closed-circuit TV; more innovative uses of billboards; and the use of cassettes and video-cassettes.

The software development and computer service industry is a catalyst for change in other industries while it is concurrently influenced by innovations in other industries. Increases in the speed, storage capacity and memory of personal computers and technological developments in networks (from the LAN to Internet and Intranet) opened up opportunities for new products while shortening product life cycles. For example, the 4K processing chip was commercially introduced six years after the 1K chip was introduced (Urban and Star, 1991), but subsequent processing chips with exponentially increasing power were introduced at much shorter intervals. Software upgrades are another example of the shortening product life cycle.

Knowledge-based business services industries, on the other hand, are relatively stable because of the high cost of entry and of exit (Chart 3). Although very little physical and financial capital is required to start a new professional practice, the amount of human capital needed is large and, more importantly, not easily obtainable: it takes two decades of schooling to accumulate enough capital to set up a practice in these industries. Switching professions means writing-off a huge amount of human capital, not to mention the length of time needed to accumulate capital required to start a practice in a different profession. The high cost of entry and of exit means that firms must quickly adopt any innovation introduced by the pioneering firm. Further, firms and most of their employees must meet standards set and enforced by professional associations. All of these factors keep both the entry and exit rates low in knowledge-based industries. Where high volatility does exist in some segments of the knowledge-based industries such as book-keeping, it is often because less has been invested in workers and therefore the cost of exit is not high.

Unlike the relative stability in the knowledge-based industries as a whole, large movements of firms were observed in the management consulting industry. This is not surprising because this industry is unique inasmuch as there are no educational or certification requirements to set up a practice and there are few other barriers to entry. Since cost are less of an impediment to either entry or exit, it is easier for firms to move into and out of the industry. In addition, the original source from which data on management consulting firms is drawn is not as refined as it is for many other service industries, and work is under way to improve it.

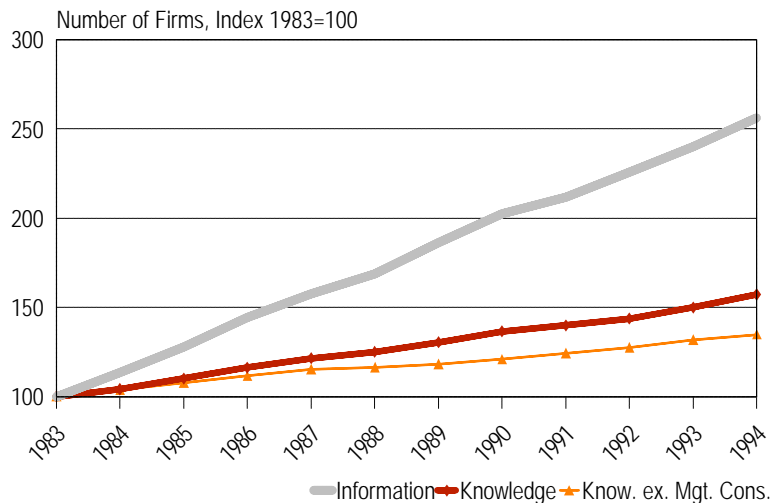
### 3.3.2 Industries with Higher Volatility Growing Faster

High volatility in the information-intensive business services industries

reflects the fast pace of technological change. The vast opportunities offered by new technologies attract firms to these industries. However, many are unable to withstand the rapid pace of change and are forced out of the market. On balance, however, many firms survive (Chart 4). Numerous factors contributed to the surge in the number of firms.

First, the information-intensive segment of the business services sector is highly competitive, with a small number of large firms and a large number of small firms. Segmentation and niches are the strategies that entrants adopt. Since their products are often specialized and sometimes customized in the introductory stage, their operations are usually small and do not require much upfront capital. Venture capital is usually difficult to attract because of the high risk. However, paradoxical as it may seem, established industry leaders sometimes finance the start-up of new firms by acquiring equity in them. They do so for strategic reasons. By acquiring significant control over some new firms, industry leaders can reduce marketplace uncertainty arising from the

Chart 4: Growth in Business Service Industries  
Information-intensive and knowledge-based Industries



Source: Statistics Canada

unpredictable actions of competitors, and the dependence on suppliers. New firms can be dissuaded from producing substitutes and encouraged to produce goods and services that would complement the financiers' products or become intermediate inputs into their production. Besides, acquiring control through equity in new firms avoids problems of integration which can beset the acquisition of existing firms (Porter, 1987).

Second, the growth of joint ventures also contributed to the rapid increase in the number of firms in the information-intensive segment of the business services sector. Some firms have ideas to test on the market, but lack sufficient human resources. They form joint ventures to share their expertise, synergy and technologies as well as the risks associated with operating in a fast-paced industry.

Third, while advances in computing and communicating technologies have tended to reduce the importance of proximity as a factor in location decisions, these same technologies have also introduced products that can be provided more efficiently if the vendors and the clients are located close to each other. Thus systems integrators, outsourcing vendors and firms specializing in facilities management have set up separate firms in various regions to serve their clients better (Hamdani, 1995).

Finally, industrial restructuring played a significant role in increasing the number of firms. It worked in three ways. First, some firms in other segments of the economy found it more cost-effective to outsource for services previously provided in-house. Second, some goods-producing firms with relatively large divisions to provide services for own use, spun these divisions off as separate firms. Third, the privatization of crown corporations originally set up to supply government departments further added to the number of firms.

Just as the level of activity in the knowledge-based industries was relatively lower, so too the number of firms increased slowly. However, this did not necessarily mean slower growth in activity. The number of self-employed individuals increased very rapidly but this did not have to translate into a higher number of firms. Instead of setting up their own practice, they could have joined large partnerships as partners.

#### **4. Conclusions**

This paper examined the relationship between business demographics and economic activity at the industry level in a static framework. The results are in accord with *a priori* expectations. Industries generally considered to be on

the forefront of technology show high volatility levels as well as high growth rates. Second, the more detailed analysis of the business services industry illustrates that there may be significant inter-industry differences within the large industrial groups used in the study -- differences which could be taken into account in the analysis of the propensity to innovate, to adopt new technologies or to train and develop human resources as part of these activities.

This analysis, as well as providing statistical support for expectations, also suggests further work. An obvious extension is an analysis of the creation and loss of employment at the same level of aggregation. Once the patterns of entry, exit and volatility are established for firms and jobs, more detailed analysis would serve to shed light on those industries which are leading in the creation of firms and jobs. Finally, the ability of an economy to innovate lies both in introducing new technologies and in their diffusion through knowledge flows between sectors. The demographic variables of firms are not suitable for this kind of analysis; an input/output analysis is needed to quantify the linkages.



## **Appendix: Concepts and Methodology**

### **Defining a Firm**

The appropriate concept of firm depends on the purpose of the study. Decisions concerning strategic choices are made at the corporate level and therefore an enterprise or company is the appropriate unit to study strategic choices. However, decisions affecting production, introduction of new products and the implementation of new processes are carried out at the production unit level so this is the appropriate measurement unit to analyse the impact of innovation on business demographics. This is the level where the impact of creative destruction first appears.

### **Measuring Firm Entries and Exits**

There are several sources of data on entry and exit of firms. Registrations and bankruptcies (Canadian Federation of Independent Business) provide direct counts of business starts and closures. Payroll deduction (PD) accounts opened and closed during the year -- which every employer is required to maintain with Revenue Canada in order to deduct personal income tax, employment insurance and CPP/QPP contributions on behalf of its employees -- provide data on business births and deaths. The Business Entry and Exit Survey conducted by Statistics Canada over 1993-95 offers refinements of PD accounts data (Business Register Division, 1995). The LEAP (Longitudinal Employment Analysis Program) database, which draws information from the PD accounts file and from the Survey of Employment, Payrolls and Hours (SEPH), is another source. However, the LEAP database excludes firms which do not have paid employees, a segment of the economy usually associated with experimentation and risk-taking. This limitation is not unique to the LEAP database.

The present study is based on the LEAP database because of certain advantages it has over others, in particular, a time series and linkages with other databases which facilitates the study of the economic, financial and human resource characteristics of firms entering and leaving the industry.

Entries and exits are estimated by comparing firms in an industry between two years. An exit is recorded when a firm which existed in the first year of the reference period does not appear in the last year of the reference period. The firm may have closed down, merged with another firm in the same industry, moved into another industry or may have changed its legal form of organization to a sole proprietorship or partnership, i.e., it no longer has paid employees. Similarly, a firm is defined as an entry in the final year of the

reference period if it was not found in the database in the first year of the reference period. As an exit is not always a bankruptcy, so also an entry is not necessarily a new business start (Hamdani, 1991).

The unit of measurement is the company or legal entity, i.e. a business unit that issues a record of employment earnings to its paid employees for income tax purposes (a T4 slip). It is not precisely the business unit of interest in this analysis but it is close. There is an almost one-to-one mapping between companies (legal entities) and establishments; only 5 per cent of the companies are multi-establishment enterprises (Business Register Division, 1994). At the individual industry level, however, the percentage is likely higher for forestry, mining and manufacturing which have proportionately larger numbers of multi-establishment enterprises. In service industries, by comparison, the correspondence is close.

While starting or closing a business is an economic decision made in the light of market conditions, the data compilation is also influenced by statistical methods. The finer the level of industrial disaggregation, the higher will be the statistical error. At the economy-wide level, a new PD account may simply be a new account number for an existing business. Similarly, the closure of a business may not be recorded until several years after the firm has ceased operations, pending fulfilment of the administrative requirements. Of somewhat less importance is the fact that an entry may simply be the result of a change in the legal form of the business. For instance, a firm qualifies for inclusion in the database if it changes its status from a partnership to a corporation. At the industry level, there are additional sources of error, which arise from the classification of firms. For example, a firm may be reclassified as the result of a better understanding of the nature of its business, leading to the creation of a new firm in the industry to which it is assigned and the closure of one in the industry where it originally belonged. Neither represents an economic decision.

The statistical error is likely higher in the goods-producing sector, for two reasons. First, economic activity in some industries, construction in particular, takes place on a project-by-project basis. For example, trade and general contracting firms account for all but 10 per cent of firms in the construction industry. Firms can open a new PD account for several reasons, including the start-up of a new project. Therefore, some entries and exits in the construction industry may actually pertain to projects rather than firms. Second, the treatment of vertically-integrated firms, most of which are in the good-producing sector, poses special problems because their classification may change with changes in the number of employees at the establishment level from one

year to the next. Tests suggest that the forestry industry is the most affected.

The following comments provide an indication of the magnitude of statistical influences. Most businesses have one PD account; overall, 10 per cent of the businesses have more than one PD account (Business Register Division, 1995; Picot and Dupuy, 1996). The percentages is likely higher in industries where firms conduct business on a project-by-project basis. This problem is partially remedied by matching employees associated with a new PD account with those in existing PD accounts, thus ensuring, to some extent, that a new account is a genuine business start-up and not merely a new account number for an existing business. Finally, comparisons of the LEAP data and statistics gathered through the Business Entry and Exit Survey show that for industries and years common to both, the magnitudes of firm flows are higher in the LEAP data but the industrial patterns of flow/stock ratios are similar.

### **Reference Period**

The choice of time span to study volatility is quite important. Most industries display volatility over a long period. On the other hand, if the reference period covers a business cycle or a phase of it, it is hard to argue whether inter-industry differences in volatility are due to business cycles or product cycles. Any choice is subject to some bias. A shorter time frame is more appropriate to highlight the difference between stable and volatile industries. The present study focuses on the most recent period for which data are presently available, 1991 to 1994.

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#### Volume 21

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