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Characteristics of Firms that Grow from Small to Medium Size: Innovation and Growth in Small Manufacturing Firms, 1997 to 1999

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Innovation and Growth in Small Manufacturing Firms,
1997 to 1999**

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Symbols

The following standard symbols are used in Statistics Canada publications:

- . not available for any reference period
- .. not available for a specific reference period
- ... not applicable
- 0 true zero or a value rounded to zero
- 0^s value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
- ^P preliminary
- ^r revised
- ^X suppressed to meet the confidentiality requirements of the Statistics Act
- ^E use with caution
- F too unreliable to be published

Note: Due to rounding, components may not add to totals

Characteristics of firms that grow from small to medium size

This series of working papers on *Characteristics of firms that grow from small to medium size* results from a joint project of Statistics Canada and the National Research Council's Industrial Research Assistance Program (NRC-IRAP). The project developed out of a need to better understand how and why certain businesses grow.

Existing studies on business growth are largely done on specific industries or with a limited set of factors. While building on this, the current project takes advantage of the specific data strengths of Statistics Canada's Science, Innovation and Electronic Information Division to provide a unique assessment of a broad range of growth factors as they relate to Canadian firms.

The foundation of this study is the analysis of firms that have made the transition from small to medium in our surveys: the Survey of Innovation 1999, the Research and Development in Canadian Industry survey, the Biotechnology Use and Development Survey, the Survey of Advanced Technology in Canadian Manufacturing (1998) as well as the Longitudinal Employment Analysis Program—Small Area File (LEAP-SAF). In addition to the statistical analysis, we have also conducted interviews of firms that have made the transition. Each of the five working papers in the series provides one perspective on the transition from small to medium size.

Background and purpose

This working paper will examine the question of whether the innovative characteristics of small manufacturing firms that exhibit high growth are significantly different from those other types of small manufacturing firms. Two groups of small firms are analysed, those which had 20-49 employees in 1997 and those that had 50-99 employees. Both groups of small firms have been further classified in four different growth categories dependent on the percentage increase in number of employees they exhibited over the period 1997 to 1999: high growth firms, growth firms, stable firms and declining firms. The definition of these categories and details on the methodology of this study are explained in detail in the “Concepts, definitions and data quality” section at the end of the paper.

The data analysed in this paper is from the *Survey of Innovation 1999* which was carried out by SIEID. It surveyed manufacturing provincial enterprises¹ with at least 20 employees and at least \$250,000 in revenues. Data from the *Survey of Innovation 1999* has been linked to the *Annual Survey of Manufacturers* for 1997 and 1999 and the growth of firms has been determined based on this data.

Eight different indicators of the innovative characteristics the two categories of small firms (i.e. those with 20-49 employees and those with 50-99 employees) have been developed. In the following section, indicators of innovation, research and development (R&D), intellectual property protection, cooperation for innovation and use of government support programs for innovation.

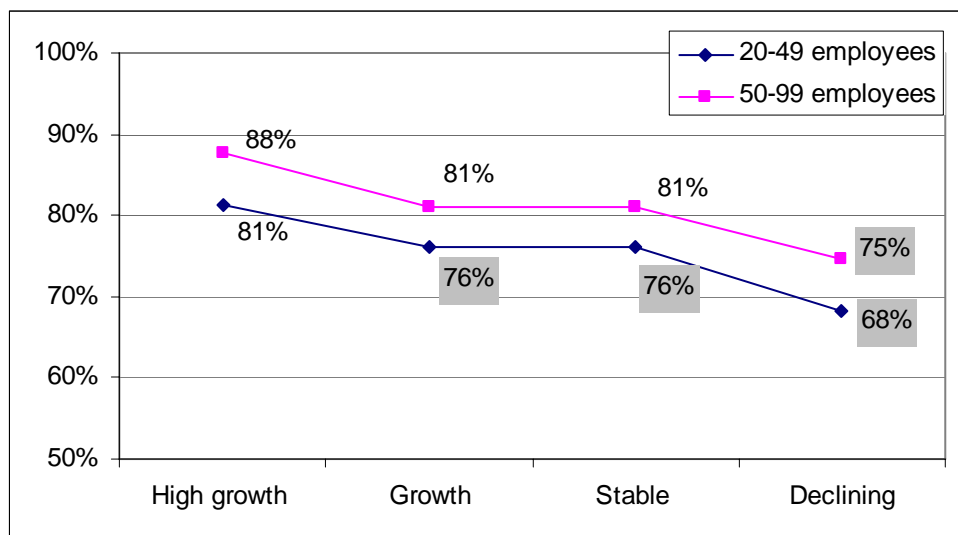
1. Details on the methodology of the *Survey of Innovation 1999* are available on the Statistics Canada web site: <http://www.statcan.ca/english/sdds/4218.htm> The statistical unit of the survey is the provincial enterprise. In this paper, the term “firm” will be used instead of the statistical term “provincial enterprise”.

Results

Innovation

The Oslo Manual² which provides guidelines for the measurement of innovation defines innovation as the introduction of new or significantly improved products to the market or the introduction of new or significantly improved processes to the firm, during a given three year period. For the Survey of Innovation 1999, the three year period was 1997-1999. Figure 1 shows that the percentage of innovators among small high growth manufacturing firms with 20-49 employees is significantly higher than for other types of firms³. For small firms with 50-99 employees, the percentage of innovators for high growth firms is significantly higher than declining firms, but not significantly different from those that exhibit growth or are stable.

Figure 1: Percentage of small (20-99 employees) manufacturing firms that introduced new or significantly improved products and processes, 1997 to 1999



Source: Statistics Canada, Survey of Innovation 1999

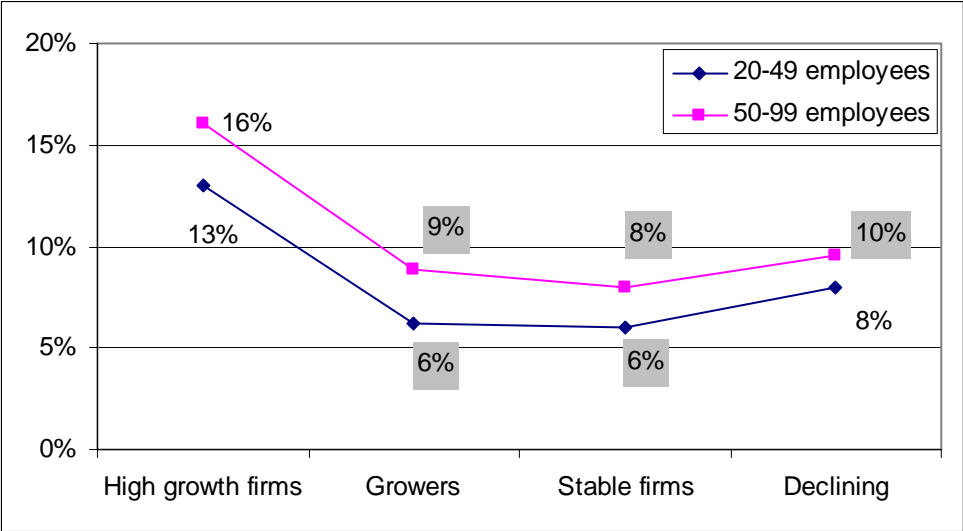
Note: Shading indicates that the percentages are significantly different than the percentages for high growth provincial enterprises.

The definition of an innovation, as specified by in the Oslo Manual, is a relatively broad one. Innovations are first to the firm, i.e. as long as it is the first time the firm introduces a new or significant product or process to the firm, it is considered to be an innovation, even though other firms might have already introduced the same innovation.

2. OECD/Eurostat, Proposed Guidelines for Collecting and Interpreting Technological Innovation Data (Oslo Manual), Paris, 1997.
3. A hypotheses test was done to determine if the difference between the percentage for high growth firms was significantly different from each of the other three types of firms. See the section on “Concepts, definitions and data quality” at the end of the paper for more details.

An innovation can be classified according to its novelty, with the most restrictive class being a “world-first” innovation. Figure 2 shows that, of the firms in both size categories that described their most important innovation, high growth firms have a significantly higher percentage that introduced world-first innovations than other types of firms, with the exception of small declining firms with 20-49 employees.

Figure 2: Percentage of small (20-99 employees) manufacturing firms that described their most important innovation and indicated that the most important innovation was a world first, 1997 to 1999

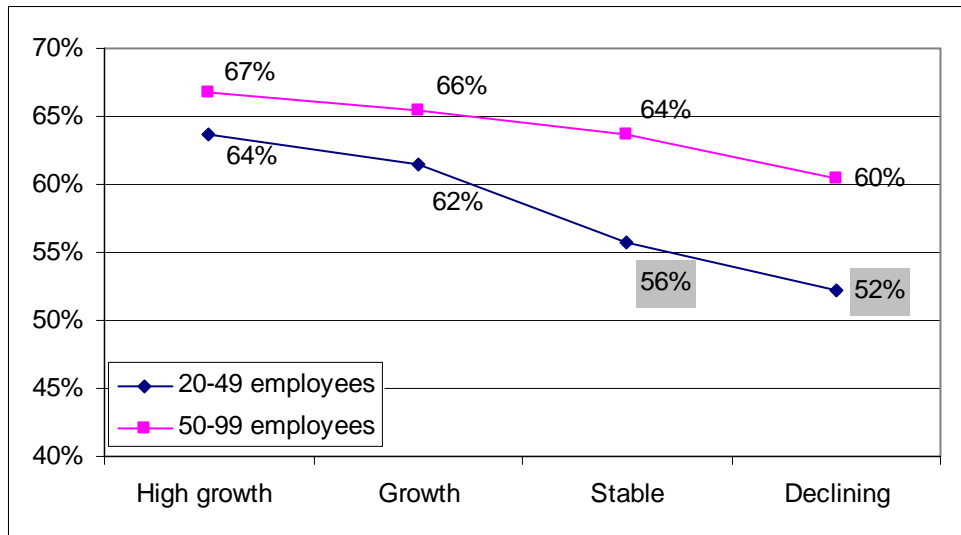


Source: Statistics Canada, Survey of Innovation 1999

Research and development (R&D)

Research and development is an important input to innovation. Figure 3 shows for firms with 50-99 employees that there is no significant difference between the percentage of high growth and other types of firms which are engaged in R&D. For firms with 20-49 employees, the percentage of growth firms undertaking R&D is not significantly different than high growth firms, however, high growth firms are significantly higher than stable and declining firms.

Figure 3: Percentage of small (20-99 employees) manufacturing firms that engaged in Research and Development (R&D) linked to innovative products and processes, 1997 to 1999

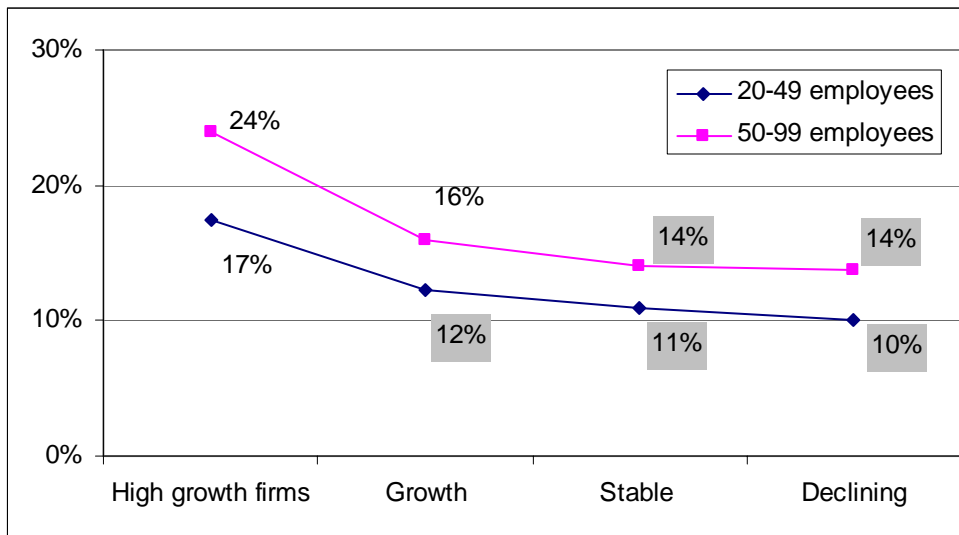


Source: Statistics Canada, Survey of Innovation 1999

Intellectual property protection

The protection of the intellectual property is another important activity for the firm. Patenting is a formal legal procedure to protect intellectual property. Figure 4 shows that a significantly higher percentage of high growth firms with 20-49 employees applied for a patent, during the period 1997 to 1999, than other types of firms. In the case of firms with 50-99 employees, the percentage is significantly higher than for stable and declining firms but not significantly different from that for growth firms.

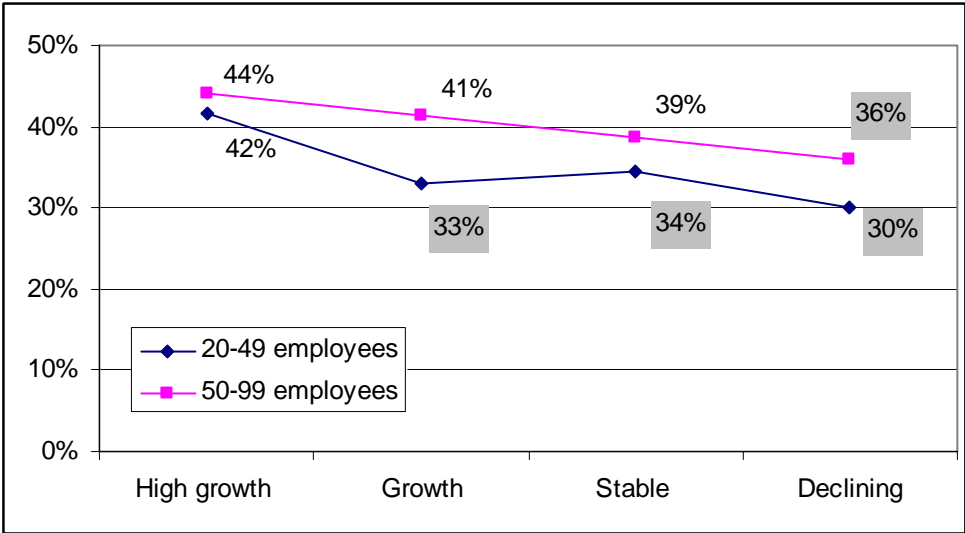
Figure 4: Percentage of small (20-99 employees) manufacturing firms that applied for a patent during the period 1997 to 1999



Source: Statistics Canada, Survey of Innovation 1999

Confidentiality agreements are another method used to protect intellectual property. Figure 5 shows the firms with 20-49 employees have a significantly higher percentage that use this form of protection than do other types of firms. In the case of the percentage of high growth firms with 50-99 employees using confidentiality agreements, there is no significant difference with growth or stable firms but the percentage is significantly higher than the declining ones.

Figure 5: Percentage of small (20-99 employees) manufacturing firms that use confidentiality agreements to protect their intellectual property during the period 1997 to 1999

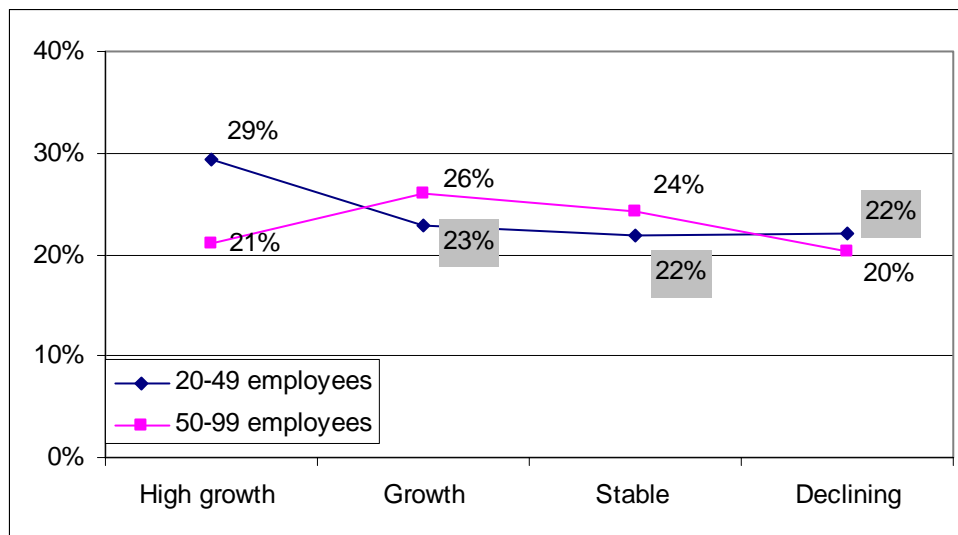


Source: Statistics Canada, Survey of Innovation 1999

Cooperation for innovation

The *Survey of Innovation 1999* asked innovative firms if they were involved in cooperative and collaborative arrangements with other firms or organizations for the purpose of developing new or significantly improved products and processes. Figure 6 shows that a significantly higher percentage of innovative high growth firms with 20-49 employees are involved in collaboration and cooperative arrangements than other types of innovative firms. The percentage of high growth firms with 50-99 employees involved in collaboration and cooperative arrangements is not significantly different than other types of firms.

Figure 6: Percentage of small (20-99 employees) innovative manufacturing firms that indicated that they were involved in collaborative and cooperative arrangements with other firms and organizations to develop innovative products or processes, 1997 to 1999



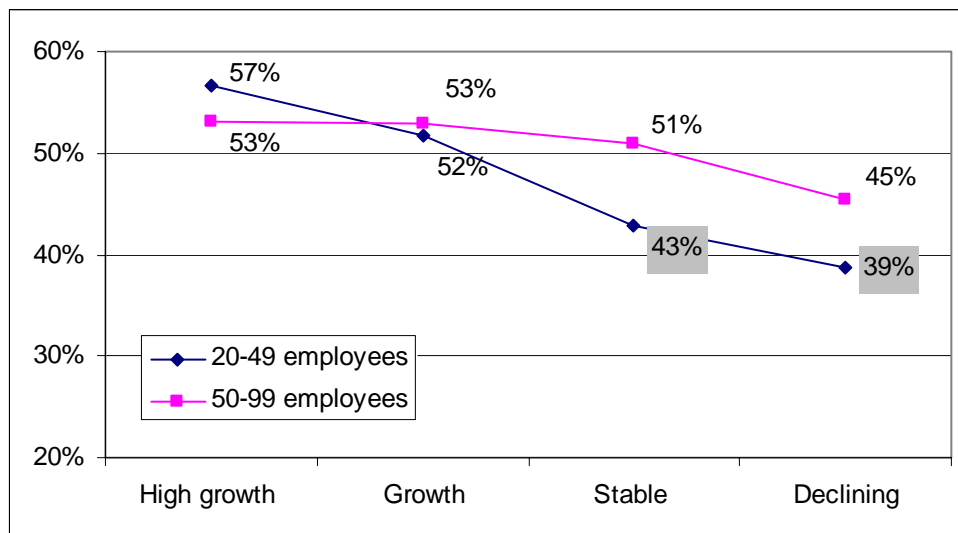
Source: Statistics Canada, Survey of Innovation 1999

Government support programs

One important source of support for innovation is government programs. The extent to which firms use available government programs can be taken as an indicator of their capability to access external resources (financial or other types of support). The *Survey of Innovation 1999* asked manufacturing firms, which of a list of government support programs, they used. The list programs included the following types of government support programs (both federal and provincial): research and development tax credits, research and development grants, venture capital support, technology support and assistance programs, information or internet services, and training.

Figure 7 shows that the percentage high growth firms with between 20-49 employees that use at least one government support program is not significantly different than growth firms but it is significantly higher than stable or declining ones. In the case of firms with between 50 and 99 employees, the percentage using at least one government program is not significantly different than the other types of firms.

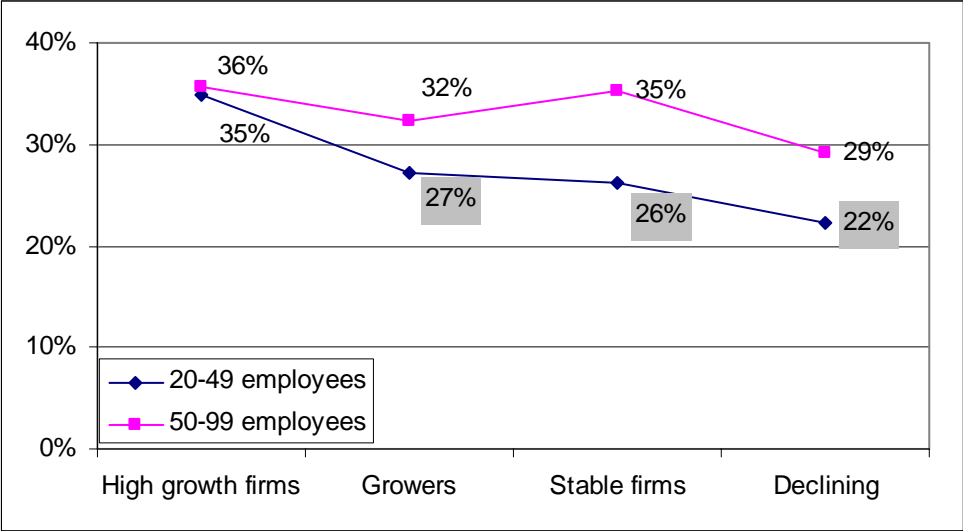
Figure 7: Percentage of small (20-99 employees) manufacturing firms using at least one government support program, 1997 to 1999



Source: Statistics Canada, Survey of Innovation 1999

Figure 8 shows that for one specific government support programs, R&D tax credits, high growth firms with 20-49 employees have a significantly higher percentage of firms that use the program than other types of firms. For high growth firms with 50-99 employees, the percentage is not significantly different than the other types of firms.

Figure 8: Percentage of small (20-99 employees) manufacturing firms using R&D tax credit programs, 1997 to 1999



Source: Statistics Canada, Survey of Innovation 1999

Conclusion

The objective of this paper was to determine whether high growth small firms have significantly different characteristics than other types of firms. Based on the eight indicators that are summarized on Table 1, this study has shown, with a few exceptions, that small high growth firms with between 20-49 employees are significantly different than other firms in their size category, whereas high growth firms with between 50-99 employees are, with a few exceptions, have similar characteristics.

Table 1: Summary of innovation indicators: a comparison of small (20-99) high growth manufacturing firms with small growth, stable and declining firms during the period 1997 to 1999

	Are high growth firms with 20-49 employees significantly different than:			Are high growth firms with 50-99 employees significantly different than:		
	Growth	Stable	Declining	Growth	Stable	Declining
% of innovators	Yes	Yes	Yes	No	No	Yes
% that applied for patents	Yes	Yes	Yes	No	Yes	Yes
% that used R&D tax credits	Yes	Yes	Yes	No	No	No
% involved in innovation collaboration	Yes	Yes	Yes	No	No	No
% that used confidentiality agreements	Yes	Yes	Yes	No	No	Yes
% involved in R&D	No	Yes	Yes	No	No	No
% that used at least one government program	No	Yes	Yes	No	No	No
% of world first innovators	Yes	Yes	No	Yes	Yes	Yes

The most notable exception of both size categories is the percentage of firms that indicated that their most important innovation was a world-first, the high growth firms have a significantly higher percentage than all other types of firms, with one exception. Declining firms with 20-49 employees have a percentage that is not significantly different than the high growth firms in the same size category. A possible explanation of this finding is the high risk nature of world first innovations. Firms that engage in this type of activity, if successful could experience high growth, but if unsuccessful could experience a decline in the number of employees.

In terms of the other seven indicators (excluding world-first innovation), high growth firms with 20-49 employees have significantly different characteristics than stable and declining firms for all of these indicators. High growth firms are significantly different than growth firms for 5 of the 7 indicators, the exception being the percentage of firms involved R&D and the percentage of firms using at least

one government program, where the growth firms' characteristics are not significantly different from the high growth firms.

In terms of the other seven indicators (excluding world-first innovation), the characteristics of high growth firms with 50-99 employees are not significantly different than the growth firms. High growth and stable firms are significantly different for only one characteristic: the percentage of stable firms that applied for a patent. Declining firms are significantly different than high growth firms for three characteristics: percentage of innovators, percentage of firms that applied for patents and percentage of firms that used confidentiality agreements.

Concepts, definitions and data quality

Survey of Innovation 1999

This study uses data from the Statistics Canada 1999 Survey of Innovation. The survey provides data for 5,455 provincial-enterprises in the manufacturing sector, representing a total population of 9,303 (weighted population). A provincial-enterprise includes all establishments of a given enterprise in the same province in the same industry group (defined at the four-digit NAICS level).⁴ The survey was designed to provide national and provincial estimates according to definitions outlined in the OECD/Eurostat Oslo Manual.⁵

The response rate for manufacturing industries in the Survey of Innovation 1999 was 95%. These firms represent 9,303 firms which comprised 91.3% of manufacturing value added and 93.5% of sales of manufactured goods in 1997 and 90.6% of the manufacturing value added and 95.1% of the sales of manufactured goods in 1999.

The measurement of growth

Data from the Survey of Innovation 1999 has been linked to the Annual Survey of Manufacturers for 1997 and 1999 and growth of firms has been determined based on this data. The period 1997 to 1999 represents a growth period of only two years compared to other studies in this series that use a five-year time frame. The effect of using a shorter time period on the data is not known.

This study, undertaken with IRAP, defined "high-growth firms" as firms that at least doubled their number of employees over a five year period. As data for the Survey of Innovation 1999 represents at two year time period, 1997 to 1999. Growth rates were pro-rated. High growth firms had at least 32% growth in number of employees. Growth firms are those with at least 7.6% growth in revenues or number of employees from 1997 to 1999 but less than 32% growth. Stable firms are defined as those that had a change in number of employees of between 7.6% and -7.6%. Decliners are firms that had a decrease in number of employees or revenues of at least 7.6%.

4. For more details on the methodology of the survey see: Susan Schaan and Brian Nemes, Survey of Innovation 1999, Methodological Framework: Decisions Taken and Lessons Learned. Statistics Canada, SIEID Working Paper No. 12, Catalogue No. 88F0006XIE, June 2002 and Susan Schaan and Brian Nemes, "Survey of Innovation 1999-Methodological Framework, Decisions Taken and Lessons Learned", in Fred Gault (ed.), Understanding Innovation in Canadian Industry, McGill-Queen's University Press, 2004.

5. OECD/Eurostat, Proposed Guidelines for Collecting and Interpreting Technological Innovation Data (The Oslo Manual), Paris, 1997.

The period 1997-1999 was a period of growth in manufacturing which saw its percentage of GDP rising from 17.4% in 1997 to 18.0% in 1999.

Data quality and the calculation of significant difference

As the sample drawn for the Survey of Innovation 1999 was only one of many possible samples that could have been drawn, a sampling error is attributed to it. Standard errors are used to provide a guide as to the reliability of the results.

All estimates used in the analysis for this paper were deemed to have either very good or good reliability. Estimates were evaluated as to whether they were significantly different from one another. Upper and lower confidence intervals were applied to each estimate. Where confidence intervals overlapped with one another estimates were deemed to be not significantly different. Where confidence intervals did not overlap, estimates were significantly different from one another, either significantly higher or significantly lower.