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Who Trains? High-tech Industries or High-tech Workplaces?

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Preface

This study contributes to the expanding body of research in the area of information and communication technologies (ICT). Using data on business sector workplaces from the 1999 Workplace and Employee Survey (WES), we investigate factors related to the incidence and intensity of training. The study focuses on whether training incidence and training intensity are more closely associated with the technological competencies of specific workplaces than with membership in ICT- and science-based industry environments. The study finds that training incidence depends more on the technological competencies exhibited by individual workplaces. Among workplaces that decide to train, these technological competencies are also important determinants of the intensity of training.

Executive summary

The growth in micro-technologies and their widespread diffusion across economic sectors have given rise to what is often described as a *New Economy*—an economy in which competitive prospects are closely aligned with the firm's innovation and technology practices and its use of skilled workers. Training is one strategy that many firms undertake in order to improve the quality of their workforce.

This study contributes to the expanding body of research in the area of information and communications technology (ICT). Using data on business sector workplaces from the 1999 Workplace and Employee Survey (WES), we investigate factors related to the incidence and intensity of training. The study focuses on whether training incidence and training intensity are more closely associated with the technological competencies of specific workplaces than with membership in ICT and science-based industry environments.

Workplaces which score highly on our index of technological competency are over three times more likely to train than those that rank zero on the competency index. The size of the workplace is also a factor. Large and medium-sized workplaces are 3 and 2.3 times more likely to train than small workplaces, respectively. And workplaces with higher-skilled workforces are more likely to train than workplaces with lower-skilled workforces.

For workplaces that choose to train, their technological competency is the main determinant of training intensity. The size of the workplace, the average cost of training, and the skill level of the workforce are also influential factors—but to a lesser extent. Other factors, such as sector, outside sources of funding, and unionization status, are not influential factors in determining the intensity of training. Workplaces that have a higher average cost of training train fewer employees as a proportion of their workforce. However, the skill level of their employees moderates this effect, because as payroll-per-employee increases (a proxy for worker skills), plants train more.

Chapter 1. Introduction

The advent of new computer-based technologies has had a profound impact on the nature of work. New technologies in the workplace have focused much attention on the importance of “skilled labour”—workers who can fully exploit the productive benefits of advanced technology. Training is one strategy that firms utilize to bolster the productive capacity of their workforce. Training is an investment in skill acquisition, which leads to an accumulation of human capital in the firm.

Workplace training often centers on developing a small set of specialized skills and, characteristically, does not require the employee to bear any pecuniary costs. Firms will be reluctant to provide training unless they anticipate a reasonable return on their investment. Our objective in this study is to learn more about how workplace characteristics are associated with differences in training behaviour—first, in the propensity to train, and second, in the size of the training investment. Accordingly, this study investigates how different factors influence training decisions on the extensive and intensive margins. The analysis of the extensive margin centers on the incidence of training among all workplaces (i.e., on factors that influence the likelihood of training for the general workplace population). The analysis of the intensive margin focuses on the level of training intensity among the subset of workplaces that do train (and hence on factors that condition differences in the size of the training investment among active trainers).

Our primary relationship of interest is with how technological factors influence training practices. Technological intensity is measured in two ways. First, we rely on two industry classification systems, information and communications technology (ICT) industries and science-based industries, to identify a set of industry environments that place a relatively high premium on advanced technology and knowledge creation. Second, we devise a firm-based index that measures the technological competency of workplaces directly. Our central research question is whether training incidence and training intensity are more closely associated with the technological competencies exhibited by individual workplaces than with the location of workplaces in high-technology environments.

The organization of the paper is as follows. Chapter 2 is a brief discussion of related research on skilled labour and advanced technology. Chapter 3 describes the data source, and includes a discussion of the measures of technology and training that are used in this study. Results on training incidence (the extensive margin) and training intensity (the intensive margin) are presented and discussed in Chapters 4 and 5, respectively. Both descriptive tabulations and multivariate regressions are reported. Concluding remarks are found in Chapter 6.

Chapter 2. High-technology, training and worker skills

A growing empirical literature in labour economics is investigating the impact of advanced technology use on the demand for labour. Doms, Dunne and Troske (1997) argue that skill-biased technological change has led to increased returns to skilled labour. Bresnahan, Brynjolfsson, and Hitt (2002) argue that three complementary innovations—increased use of information technology, changes in organizational practices, and changes in products or services—combine to lead to a higher demand for skilled workers. This complementarity implies that firms will apply a mix of these innovations depending on adjustment cost and adjustment speeds.

Baldwin and Johnson (1995) use data from the 1992 *Survey of Growth Companies* to analyze the factors that influence the training decisions of firms. They find that training tends to occur when companies are innovative, technologically advanced, emphasize quality management and have developed human resource strategies. Further, they find that large firms have a higher incidence of training and train a larger proportion of their employees than small firms.

Using employee data from the *Workplace and Employee Survey* (WES), Wannell and Ali (2002) examine the link between technological investments and the education and training of employees. They find that investments in computer hardware and/or software are related to significant increases in computer-related training. Further, they find that workplaces with university-educated workers are more likely to invest in computer technology; that university-educated employees are more likely to work in the most technology-intensive plants; and that new hires in workplaces that make computer technology implementations are more educated than their longer-tenured co-workers. However, they do not focus on the broader question of whether technologically advanced workplaces train more and more intensively.[1] This is the subject of the present paper.

Montmarquette and Turcotte (2001) have also used the WES to examine factors that condition workplace and worker participation in training and the intensity of training. In their analysis of workplaces, the authors found a positive relationship between technological innovation and training. Focusing on employees, they found that previously acquired human capital plays a significant role in the incidence of classroom training. In contrast, on-the-job training is more uniformly distributed across different explanatory factors; significant differences, however, are still apparent.

Several differences in research design between Montmarquette and Turcotte (2001) and the present study warrant emphasis. First, this analysis focuses only on workplaces in the business sector (i.e., it excludes non-profit workplaces); second, it includes a detailed training cost, expenditure, and funding analysis; third, it examines whether high-technology environments (as defined by industry aggregates) are better predictors of training behaviour than location-specific technology profiles.

The third factor noted above—the role of industry and firm-specific factors—builds on recent work on the dynamics of high-technology business populations by Baldwin and Gellatly (1998, 2001). Using survey data on new small firms, the authors show that industry-level classification schemes that are often used to define high-technology populations can obscure the presence of substantial numbers of advanced firms (firms that stress innovation, technology use or human capital) in other, less visible sectors. Consequently, firm-based classification techniques can yield different perspectives on the location of high-technology populations. In what follows, we evaluate whether training incidence and training intensity are more sector- or firm-specific.

Endnote

1. Wannell and Ali only focus on workplaces that implement computer hardware and software and whether they engage in computer-related training.

Chapter 3. Data source

3.1 Workplace and Employee Survey (WES)

The WES is a longitudinal survey that links employers with their employees. The target population for the WES is all business locations operating in Canada that have paid employees, with the following exceptions: employers in Northwest Territories, Nunavut, and Yukon, employers operating in agriculture (crop production and animal production), fishing hunting and trapping, private households and public administration. An overall sample of 6,322 workplaces was collected, and is representative of an estimated population of 718,083 locations across Canada.

The workplace portion of the WES is used for this study.[2] This survey of business locations collects information on a range of workforce characteristics, including job organization, compensation, training, collective bargaining, workplace performance, innovation, technology use, and business strategies. Our focus herein is primarily with questions that deal with training. That said, questions on workplace performance, business strategy, innovation and technology use are used to create a location-specific index of technological competency. Other questions, such as those that deal with sources of competition, unionization, and outside sources of funding, are used to control for factors that may affect the incidence and intensity of training.

By design, the WES excludes workplaces operating in the public sector. This study focuses on the subset of private sector workplaces that operate in the business (for-profit) sector. Non-profit workplaces are excluded from this study because of the distinct nature of their objectives. Workplaces not motivated by profit are expected to behave in a fundamentally different way with regard to training. Accordingly, the investigation of non-profit workplaces will be left to future research.

As a result of these exclusions, the relevant sample for analysis is reduced from 6,322 to 5,501 observations, representing a population of 654,551 workplaces across Canada.[3] The reference period is the twelve-month period ending March 1999.[4] The sample is stratified by industry, region, and size (location size is defined using estimated employment). The terms “workplace” and “location” are used inter-changeably throughout this paper.

Various aspects of our research design are described below.

3.2 Dependent variables and estimation method

This paper uses a logit regression to examine the likelihood of training incidence and an employment weighted ordinary least squares (OLS) regression to investigate training intensity. This specification was chosen over several alternative approaches. A Tobit regression would be appropriate if the data on training are censored; however, the data are not censored—zeros in the data are present when workplaces decide not to train. A Heckman two-stage model was also considered. This specification would control for the possibility of selection bias—as workplaces that decide to train do not necessarily behave in the same way as locations that decide not to train.[5] To account for selection bias, the incidence of training equation should include one or more instruments—variables that determine the incidence of training, but not the intensity of training. It is not clear that such an instrument exists in the WES data. Thus, the selection issue is handled by separating the analysis into distinct steps—first, using a logit regression to evaluate the incidence of training, based on the sample of all workplaces, and second, using an employment weighted OLS to evaluate training intensity, based on the subset of workplaces that train.

Generally, training is an investment in human capital that is undertaken in the present with the expectation of future benefits. Both the employer and the employee must consider the costs and benefits of training; for training to occur the expected total net benefit must be greater than total cost for both the employer and the employee. The potential return to training is shared between the employer and the employee receiving the training, when training is specific (Becker, 1964).[6]

In this study, only the employer's characteristics are explicitly considered as the main determinants of training. It is assumed that firms enrol workers with positive expected net benefit in training activities in order to satisfy the firm's planned training objectives for a given period; thus, given the firm's pool of employees, it is assumed that the firm is always able to enlist trainees when a training objective exists.

A binary (yes/no) training variable is used as the dependent variable to investigate the incidence of training. Workplaces are deemed to have engaged in classroom training if the location reported training in any of the following areas: orientation for new employees, occupational health and safety, environmental protection, literacy or numeracy, managerial/supervisory, sales and marketing, group decision-making or problem solving, team-building, leadership, communication, professional, apprenticeship training, computer-hardware, computer-software, other office and non-office equipment training, and other training.

A training intensity measure (trained employees divided by total employment) is used as the dependent variable for the analysis of training at the intensive margin. Trained employees are equal to the number of employees receiving training during the reference period of the survey. Total employment is equal to the sum of full-time and part-time employees, as reported by the workplace, at the time the data were collected (see Appendix 5 for more details).

3.3 Industry classification systems

The role that new technologies play in promoting economic growth has resulted in an increasing amount of attention being paid to sectors of the economy where these new technologies have either been initiated or adopted. The rapid growth of technology-based firms and industries has lead to the emergence of a number of classification systems. This paper examines how training practices vary by sector by using two high-technology classification systems: information and communications technology industries and science-based industries.

The OECD (2000) has developed a classification system that identifies a small collection of goods and services industries as ICT-based. ICT manufacturing industries "must be intended to fulfil the function of information processing and communication including transmission and display, and "(m)ust use electronic processing to detect, measure and/or record physical phenomena or to control a physical process" (OECD, 2000, p.7) ICT service industries "must be intended to enable the function of information processing and communication by electronic means" (OECD, 2000, p.7). As such, the OECD's ICT classification system includes several industries that are widely described as part of high-technology sector, such as computer systems design and related services, and telecommunications services (see Appendix 1 for a more detailed discussion).

The science-based classification scheme (Baldwin and Johnson, 1999) identifies industries that place relatively more stress on the role of scientific knowledge—based on their use of both R&D and skilled workers.[7] Science-based industries are those in which (1) a comparatively large proportion of the workforce is accounted for by scientific personnel, and that (2) also exhibit a relatively high R&D intensity. The resulting science classification is broader in scope than the ICT classification; while most ICT industries are included in the science sector, the science sector also includes many heavy manufacturing industries, such as petrochemical and pharmaceutical manufacturing, along with several professional services, such as architecture and engineering. We take the union of these two classification systems to evaluate how patterns of training incidence and intensity vary by sector—by comparing science- and technology-based industries (our high-technology group) to the large cross section of other industries that are not included in this science and technology classification.

In the WES, the ICT and Science classifications have a substantial amount of overlap, 2.1% of all workplaces are classified to both the ICT and science-based sectors. Locations that are exclusive to the ICT and science sectors make-up 1.0% and 2.7% of the population of workplaces, respectively. The combined population of the ICT and science-based sectors amounts to 37,772 plants, or 5.8% of the workplace population covered by the WES (Table 1). In what follows, we refer to this ICT/science-based sector as the ICT-S sector, while industries outside of this science and technology group are referred to as the non-ICT-S sector.

Table 1. Distribution of workplaces by industry classification				
	Sample		Population	
	Size	Percentage	Counts	Percentage
ICT	45	0.8	6,454	1.0
Science-based	297	5.4	17,464	2.7
Both	178	3.2	13,854	2.1
Total in ICT and science-based sectors	**520**	9.5	**37,772**	**5.8**
Non-ICT and non science-based	4,981	90.5	616,779	94.2
Population total	5,501	100.0	654,551	100.0

3.4 Workplace-based technology indices

The main purpose of this paper is to compare industry- and location-based measures of technological competency in the context of training. This section defines and describes a location-based index that is used for these comparisons. This workplace-specific index is comprised of a series of sub-indices. These include innovation, technology implementation, implementation effect, and business strategy indices (see Table 2 for a description of the variables that comprise these indices).

These sub-indices are developed to measure the degree to which workplaces plan, implement and succeed in initiating technological change. The aggregate index—our Technology Competency Index (TCI)—measures the extent to which a location is technologically competent and knowledge-based at various stages of the production process, ranging from planning to the final product.

The aggregate TCI uses survey data to measure the scope of a workplace's technological competence. The index increases incrementally, by one, for every competency for which the workplace affirms its participation. Table 2 lists the set of possible technological competencies. The maximum rank on the innovation index is four, while maximum ranks on the implementation index, implementation effect index and business strategy index are three, ten and six, respectively. Accordingly, the maximum rank for the TCI is twenty-three.

All component competencies in TCI are given the same weight. Due to the heterogeneous nature of workplaces, it is unlikely that one specific weighting scheme would apply to all locations. In the absence of any clear information within the data that indicates the importance of particular components, this study assumes that all competencies contribute equally to the workplaces' aggregate technological competency. We describe each of the four sub-indices below.

The Innovation Index captures innovation activities that are taking place within the workplace. This index focuses on whether workplaces are developing new products, new processes, improved products and improved processes. New products are goods and services that are considered to differ significantly in character or intended use from previously produced goods or services. The introduction of new methods of goods production or new methods of service delivery into the workplace are considered new processes. An improved product, which can be either a good or service, is introduced when its performance is

Table 2. Components of the technology competency index

Variable name	Percentage of locations
Innovation index	**48.3**
New product	33.8
New process	23.9
Improved product	38.5
Improved process	28.5
Implementation index	**28.7**
New software or hardware implementation	23.2
Computer controlled or assisted technology implementation	4.5
Other technology implementation	4.6
Implementation effect index	**6.3**
Effect of implementation on:	
Quality of product or service	0.1
Technological capabilities	0.1
Working conditions	0.8
Lead times	0.5
Range of products or services	0.1
Unit labour requirements	1.0
Unit energy requirements	1.4
Unit capital requirements	4.4
Unit material requirements	1.3
Unit design requirements	1.2
Business strategy index	**45.9**
Importance in your workplace's general business strategy of:	
Research & development	10.1
Develop new products or services	17.0
Develop new production/operating techniques	13.3
Research and development business strategy index	23.9
Reducing labour costs	20.5
Reducing other operating costs	26.1
Cost business strategy index	33.0
Re-organising the work process	12.3

significantly enhanced or upgraded. Similarly, improved processes are processes that have been significantly enhanced or upgraded (Statistics Canada, 1999; p. 31). The percentage of locations engaging in some type of innovation ranges from 23.9% to 38.5% (Table 2). If a new or improved product or process was introduced into the workplace during the reference period, then the innovation index is incrementally increased by one for each innovation category reported.

The Implementation Index measures the extent to which the plant is adopting new technology. There are three main implementations that are measured: new software or hardware; computer controlled or assisted technology and other technology implementations. The implementation index increases incrementally as each of the possible categories are put into service. New software or hardware implementations are the most prevalent form of technology adoption, with 23.2% of workplaces putting these technologies into service; computer controlled or assisted technology and other technology follow at 4.5% and 4.6%, respectively (Table 2).

The Implementation Effect Index measures the effectiveness of the "main" implementation of technology. The main implementation refers to the specific implementation category—either new software or hardware, computer controlled or assisted technology, or other technology implementations—with the largest approximate cost. This sub-index captures the degree to which output and input efficiency is improved by the adoption of new technology. Output improvements are increases in the quality of the product or service. Input improvements are realized in terms of lower unit cost requirements and increased productivity. Both of these improvements can ultimately influence profits. A location that adopts new technology that has little impact on its operations will rank lower on this sub-index than a plant whose implementations have affected operations. Thus, the aggregate TCI not only measures whether or not the workplace is adopting new technology, but how successful technology implementations are at improving its operations.

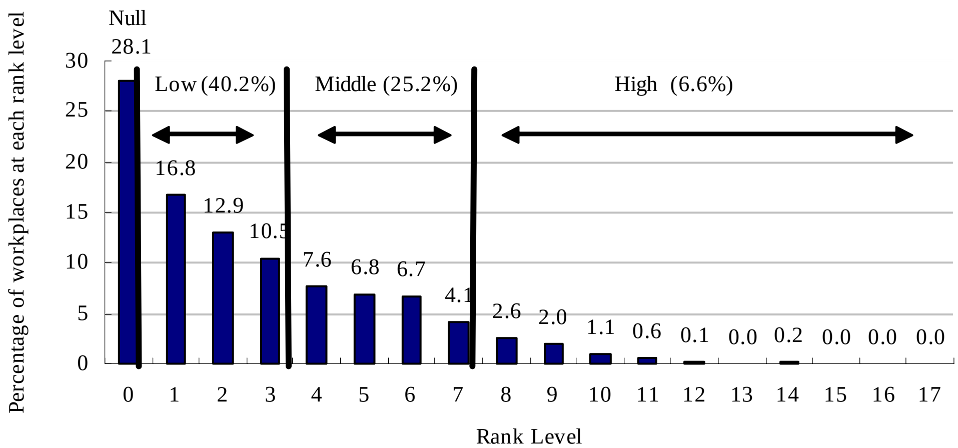
The Implementation Effect Index measures the effect of technology adoption on the location's input requirements, processes, and final output. Specifically, it measures the effect of the main implementation in the following areas: quality of the product or service, technological capabilities, working conditions, lead times, range of products or services and unit labour, energy, capital, material and design requirements. If the main implementation has had a positive impact in any one of these areas, then the index is increased by one. Relatively few workplaces report the effects of technology implementation in these areas. Unit capital requirements are the most affected, with 4.4% of locations reporting a positive impact (Table 2).

The Business Strategy Index measures the importance of strategic factors in a workplace's general business strategy. This index is important because it measures the extent to which a location orients its objectives and planning toward innovation and technology adoption. Thus, management's general attitude toward innovation, improved input efficiency, and organizational change is revealed.

The index increases incrementally as locations rank the following factors as very important or crucial to their business strategy: R&D, the development of new products or services, reducing labour costs, reducing other operating costs, and re-organizing the work process. To investigate the relationship between these factors, we combine information on R&D and the development of new products or services to create a R&D Business Strategy sub-index, while two cost variables—reducing labour costs and reducing other operating costs—are combined to create a Cost Business Strategy sub-index; finally, re-organizing the work process is treated separately. The R&D and Cost Business Strategy sub-indices are quite different, with 23.9% and 33.0% of plants adopting these strategies, respectively (Table 2). These sub-indices have a positive Pearson correlation coefficient of only 0.267. This implies that workplaces that believe R&D is important or crucial are not necessarily those that focus on cost strategies.

The component indices—the Innovation, Technology Implementation, Implementation Effect, and the Business Strategy Indices—combine to create the TCI. The aggregate index measures the level of workplace innovation, its adoption of technology, the effectiveness of these technological implementations, along with the location's R&D, cost and organisational strategies. About half of the plants (48.3%) engaged in some type of innovation, 45.9% had some business strategy geared towards innovation, 28.7% of plants implemented technology and only 6.3% had experienced the effects of the main technology implementation (Table 2).

Figure 1. Technology competency index



The TCI ranges from 0 to 23, where 23 implies that the workplace has engaged in all possible innovation and technology implementation categories, has experienced the effects of the technology adoption in all of the above noted areas and values all the aforementioned business strategies. For the population of workplaces, 28.1% have no ranking on the TCI (Figure 1). The remaining locations are ranked between 1 and 17. Only 2.0% rank between 10 and 17. Thus, the majority of workplaces place in approximately the bottom two-thirds of the achieved ranking. The TCI variable is used as a series of discrete variables; four binary variables—null (zero rank), low (1 to 3), middle (4 to 7), and high (8 to 17) are used in the following analysis.[8]

The distribution of workplaces, grouped by their sectoral and technology characteristics, is presented in Table 5. Of the population of workplaces, 5.8% are located in the ICT-S sector and 6.6% rank high on the TCI index. If all ICT-S locations are high-tech, then it could be said that the industry classification system captures the degree of technological specialization and variance that exists at the location level. However, only 11.3% of ICT-S plants rank high on the TCI. This is almost double the proportion of non-ICT-S plants that rank high (6.3%). Thus, ICT-S locations are more likely to be technologically competent than those located outside of science and technology industries, but not all ICT-S locations are technologically competent.

3.5 Control variables

Multivariate analysis will be used to study the extensive and intensive margins of training. In addition to the ICT-S sector and technology competency variables discussed above, other influential factors that are posited to affect the incidence of training are plant size, payroll-per-person, significance of competition and unionization. Similarly, for the intensive portion of the analysis, training intensity is regressed on plant size, ICT-S sector, technological competency, outside sources of funding, average cost, payroll-per-person, significance of competition, and unionization (see Appendix 3 for summary statistics on these variables). All of these characteristics are expected to significantly affect the likelihood of a workplace engaging in training activity.

Table 3. Distribution of workplaces by employment size

Sample size:						
Workplaces that have:	No training		Training		Total	
Workplace size:	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Small	2,210	93.56	1,888	60.15	4,098	74.50
Medium	140	5.93	958	30.52	1,098	19.96
Large	12	0.51	293	9.33	305	5.54
Total	2,362	42.94	3,139	57.06	5,501	100.0
Population counts:	No training		Training		Total	
Workplace size:	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Small	461,245	99.64	183,081	95.53	644,326	98.44
Medium	1,611	0.35	7,586	3.96	9,197	1.41
Large	47	0.01	981	0.51	1,028	0.16
Total	462,903	70.72	191,649	29.28	654,551	100.0

Generally, workplaces are heterogeneous. Large firms tend to engage more often in training, and train a larger percentage of their workforce, than small firms (Baldwin and Johnson, 1995). This stylized fact is consistent with several theories. Larger firms have greater access to cheaper capital (Hashimoto, 1979); these firms also have a reduced risk of loss on the training investment due to a pooling of risks and a diversification of training (Gunderson, 1974); and large firms can take advantage of economies of scale (Doeringer and Piore, 1971).[9] Thus, the size of a firm has been found to be positively correlated with the decision to train.

In this study, *workplace size* is determined by each location's total employment count. We classify small locations as those with between 0 and 100 total employees, medium locations as those with between 101-500 employees, and large locations as those with 501 or more employees.[10] Small locations make up 98.4% of the workplace population, followed by medium (1.4%) and large locations (0.2%), respectively (Table 3).

There exist various sources of funding for training outside of direct workplace expenditures. *Outside sources of funding* act as a subsidy and reduce losses in the face of risk. This subsidy increases the expected net benefit to the workplace on its investment in training. Outside sources of funding include federal and provincial government programs, training trust funds, union or employee associations, industry organizations, employees, equipment vendors, other private sector organizations and other outside sources. These sources of funding are only observed if the workplace makes the decision to provide classroom training to its workforce. Thus, outside sources are used as a control in the multivariate analysis of training intensity, since the availability of outside sources of funding may be critical in inducing the optimal amount of training. This outside sources variable is equal to one if any of these sources are present and zero if otherwise.

Training subsidies are posited to reduce the possible losses and uncertainty inherent in the risky venture of training and induce workplaces toward the socially optimal amount of training. Private sector workplaces acting to maximize profits can be expected to train only when:

$$E_{NB} = E_T - E_{NT} - C_T > 0 \qquad (1)$$

where the expected net benefit (E_{NB}) equals the expected benefit of training (E_T) less the expected benefit of not training (E_{NT}) and the cost of training (C_T). This behaviour may not result in the optimal quantity of training for society at large. The availability of funding external to the workplace may be a determining factor in the decision to train, in that the subsidy reduces the cost of training (C_T) to the workplace. Locations may be reluctant to provide training for their employees if they believe employees will deprive the workplace of its return on investment. Thus, the presence of subsidies reduces the risks to the workplace and should increase the incidence and intensity of training.[11]

The *average cost of training* controls for the location's training cost structure. The training cost structure of a workplace is not homogeneous and varies by workplace size, technological competency and industry. The training cost function is assumed to be decreasing with respect to employees trained. Thus, all else being equal, workplaces that train a larger proportion of their workforce will face lower average costs.

The average cost of training is defined as the ratio of total expenditures on classroom training to the number of classroom-trained employees. This variable is used as a control when investigating training intensity. It depends on the location's level of fixed and marginal training costs:

$$\frac{C_i}{N_i} = \frac{F_i}{N_i} + (\lambda)_i \frac{N_i}{N_i} \qquad (2)$$

where C = Classroom training expenditures
N = Classroom-trained employees
F = Fixed Cost
λ = Marginal Cost
i = delineation (location size, technological competency category or industry sector).

Fixed costs may include, but are not limited to, overhead costs such as classroom space, equipment (e.g., computers) and instructors. The marginal costs of classroom training include the wages or salaries of employees receiving training.

The inclusion of an average cost of training variable in the intensity regression does not present an endogeneity problem if the decision on how much to spend on training is made ex-ante.[12] Generally, firms build training expenditures into their operations or capital budgets based on past budgets, while adjusting for inflation and growth. Allocating expenditures to training based on past budgets reflects historical legitimacy, current organizational emphasis and presumed performance (Cyert and March, 1963). Essentially, if training is an element of a firm's objective set, then outlays must be budgeted for ex-ante.

Training expenditures may be included in capital budgets when firms make the decision to purchase capital equipment. This planning process necessarily takes place prior to the period in which the training is conducted. Further, firms may evaluate training expenditures in terms of a percentage of their operating budget. For example, of the for-profit workplaces that trained in this sample, the average spent by large, medium-sized and small workplaces is 0.24%, 0.15%, and 0.24% of gross revenue, respectively. Firms typically set an upper-bound or cap on training expenditures in any given fiscal period. As a result, decisions surrounding the quantity of persons trained may not be adequately captured by the classic production function, where output is the number of employees trained—since decision-making at the margin concerning optimal training may focus mainly on dollars and quality of training, as opposed to quantity trained.

Workplace gross payroll-per-employee is used to control for a workforce's average return. Payroll-per-employee is the average return per location to the workforce for labour and human capital services.[13] This estimate is essentially a proxy measure for each location's workforce skill (Dunne and Schmitz, 1995). Dunne and Schmitz (1995) argue that plants that use advanced production methods pay higher wages than plants using less advanced methods. The wage premium reflects the additional value placed on the skill of the workforce.

Gross payroll-per-employee is an aggregate measure of skill at the workplace level. It essentially aggregates across individual characteristics, such as level of education and occupation. The gross payroll-per-employee variable is calculated by dividing gross payroll by total employment for each workplace.[14] This variable is used both as a discrete and continuous measure of skill, in the extensive and intensive portions of the analysis, respectively.

Significant competition is seen as a factor that influences the incidence and intensity of training. As the presence of competition intensifies, locations may be expected to engage in, or increase their investment in, training in order to improve productivity and enhance their competitive position. A *significance of competition* variable measures the extent to which workplaces face significant competition from domestic- or foreign-owned firms. Significant competition refers to a situation where the workplace faces a market in which its products and services are similar to those offered by other workplaces, and where customers are able to choose between the various offerings. If the workplace ranked the competition it faces as important, very important, or crucial, then the level of competition is considered significant.[15]

Workplaces that face significant competition only from locally and Canadian-owned workplaces have been categorized using an "only domestic competition" variable. Similarly, locations that face competition only from foreign-owned workplaces have been categorized using a "only foreign competition" variable. Workplaces that face significant competition from both foreign and domestic workplaces have been classed as "foreign-domestic". These variables equal one if significant competition is present and zero if otherwise.

The presence of employees in a workplace covered by a collective bargaining agreement is controlled for via a *union status* variable. If any employees at the plant are covered by a collective bargaining agreement, this variable equals one, and zero if otherwise. This variable will control for formal agreements (written or oral) between management and the workforce or ad hoc agreements that promote training.

Endnotes

2. Due to the small sample size within a workplace on the employee portion of the survey, the employee portion is not used to calculated estimates of mean employee characteristics within a workplace; alternatively, workplace variables are used as proxies for employee characteristics. For example, gross payroll-per-employee is used to proxy the average skill level of workers.
3. A final weight for each plant is calculated in such a manner that the weight represents the respondent's contribution to the total population. Estimates generated from these weights will be consistent with estimates for the population. The weight is calculated as a product of three factors: a design weight, which incorporates design information (the cluster and stabilization weight are used to calculate the design weight); a non-response adjustment, which compensates for non-responding locations and a factor that calibrates the sample to known population counts. The final weight also acts as an adjustment for coverage error.
4. Some of the questions in the employer survey referred to the previous year or pay period.
5. In a model of selection, the problem of truncation arises when the intensity of training (the proportion of employees trained) describes the desired quantity of training, but the actual amount of training is only observed if the workplace is training. It can be inferred from this that the benefit of training exceeds the benefit of not training and the cost of training. Thus, the intensity variable is incidentally truncated (Greene, 1990).
6. General training is transferable and can be used among various firms—and not just by the firm providing the training; accordingly, workplaces have little incentive to fund general training. As a result individuals will typically self-sponsor general training. Specific training provides skills that only have value to the firm providing the training; thus, when employers sponsor training , it can be considered specific training. The gains from specific training are shared through a bargaining process (Becker, 1964).
7. Baldwin and Johnson's classification system was closely based on earlier taxonomy of knowledge industries developed by Lee and Has (1996). The three measures of R&D are: R&D-to-sales ratio, the proportion of R&D personal to total employment and the proportion of professional R&D personnel to total employment; and the three human capital measures are: the ratio of workers with post-secondary education to total employment, the ratio of knowledge workers to total employment and the ratio of the number of employed scientists and engineers to total employment (Baldwin and Johnson, 1999). Knowledge workers are occupations in the natural sciences, engineering and mathematics, in education, managers and administrators, social sciences, law and jurisprudence, medicine and health, and writing. Scientists and engineers are occupations in the natural sciences , engineering and mathematics.

8. These discrete variables were defined to follow the four main groupings that emerge in Figure 1 (null, low, middle, high). The multivariate analysis was replicated with different category delineations to test the sensitivity of the results to the categorization of the TCI. Two main variations were tested. Case 1 used the following ranges: null (zero rank), low (1 to 3), middle (4 to 6), and high (7>). Ranges for Case 2 were: null (zero rank), low (1 to 2), middle (3 to 6), and high (7>). For these different cases, the results did not qualitatively change. Coefficient estimates are robust to changes in category delineation, as their magnitude, direction and statistical significance remained similar.
9. Economies of scale occur when output per unit costs fall as output increases.
10. These are the plant size category ranges that are traditionally used in the Canadian System of National Accounts.
11. The outside source of funding variable is not included in the estimation of training incidence due to endogeneity with the binary training variable. An outside source of funding is only observed in the data when training is observed.
12. Further, the Hausman specification test, with the null of exogeneity, could not be rejected at the 5% level.
13. This holds under the assumption of competitive labour markets.
14. See Appendix 5 for a description of total employment and a discussion of payroll-per-employee.
15. The remaining choices available to the workplace on this spectrum of competition were: not applicable (no competition), not important, slightly important, and don’t know. See Appendix 3 for descriptive statistics and Appendix 4, Section G for detailed survey questions.

Chapter 4. Extensive margin: An analysis of training incidence

Two main issues are addressed in the following sections. In this chapter, we investigate which factors are associated with the incidence of training among the general workplace population. In Chapter 5, we examine which factors are related to the intensity of training, among those workplaces that actively engage in training. Two types of analysis are presented in these sections, descriptive tabulations and multivariate regressions.

4.1 Types of training

There are two main styles of training that the WES collects information on—classroom and on-the-job training. In general, training is an activity intended to develop an employee's knowledge and/or skills via a structured format. Training is not location dependent, it can take place inside or outside the physical location of the workplace. Classroom training is defined as an activity with specific content, which is presented with a pre-defined objective and a pre-determined format and on which progress may be monitored and/or evaluated. On-the-job training is informal training, which does not necessarily have a pre-determined format, pre-defined objective and/or specific content (Statistics Canada, 1999).

WES collects information on various types of training. These can be grouped into three general classes: workplace training, general professional training and technology training. Workplace training covers the following areas: orientation for new employees, occupational health and safety, environmental protection, literacy or numeracy and other training. General professional training is training that enhances skills and/or knowledge that is career related. Examples include the following: managerial /supervisory, sales and marketing, group decision-making or problem solving, team-building, leadership, communication, professional and apprenticeship training. Technology training is computer-hardware, computer-software and other office and non-office equipment training. These various types of training can be conducted both in the classroom or on-the-job.[16]

The percentage of firms engaging in on-the-job training is typically higher than classroom training (Table 4). This is due to the informal and accessible nature of on-the-job training. Informal on-the-job training does not have the fixed cost component that is associated with formal training.[17] However, due to the formal nature of classroom training, it is more quantifiable, specifically in terms of measuring expenditures, than on-the-job training. Thus, the remainder of this analysis will focus on classroom training.[18]

Table 4. Incidence of training by type		
	Percentage of workplaces training	
Types of training	in classroom	on-the-job
General workplace:		
Orientation for new employees	9.3	28.4
Occupational health and safety, environmental protection	9.9	10.5
Literacy or numeracy	1.2	1.4
Other training	4.8	3.9
General professional:		
Managerial/supervisory training	8.9	11.0
Professional training	12.0	9.0
Apprenticeship training	5.7	9.2
Sales and marketing training	8.2	11.9
Group decision-making or problem-solving	5.0	7.2
Team-building, leadership, communication	7.4	10.1
Technology:		
Computer/hardware	7.7	9.9
Computer/software	13.7	19.2
Other office and non-office equipment	2.8	6.6

4.2 Descriptive tabulations

The frequency of classroom training by location size, industry and our location-specific measure of technological competency is reported in Table 5. For almost all types of training, large workplaces train more than medium-size workplaces and medium-size workplaces train more than small workplaces (Table 5). Locations that are in the ICT-S sector train more than those in non-ICT-S industries. Training is also correlated with technological intensity. Locations that rank high on the TCI (between 8 to 17) train more than those with a middle (4 to 7), low (1 to 3) or null ranks (0). Similarly, middle-ranked workplaces train more than their low-ranked counterparts, and low-ranked workplaces train more than those with a null rank. Locations that rank high on the TCI index also have a higher incidence of training than the ICT-S sector average.

These general relationships are not as apparent when our sector and technological competency variables are cross-tabulated by location size. For instance, large workplaces in the non-ICT-S sector have significantly more occupational health and safety and environmental protection training than those in ICT-S workplaces (Table 6). Further, within the ICT-S sector, medium-size locations appear to train more in certain areas than large workplaces—however, these data points are not significantly different. ICT-S locations are typically more likely to engage in technology training than non-ICT-S workplaces.

Table 7 presents the incidence of training, cross-tabulated by location size and technological competency. Small- and medium-size plants with high TCI scores generally tend to have significantly higher training frequencies than middle, low, and null-ranked workplaces. Specifically, the incidence of technology training (computer-hardware, computer-software, and other office and non-office equipment) is typically higher in locations with a high TCI. Guidelines for estimate suppression, due to high sampling variability, come from the WES users-guide (Statistics Canada, 2003).

Table 5. Incidence of classroom training by category (percentage)

Types of training	Workplace size: Small	Medium	Large	Sector: Non-ICT-S	ICT-S	Technology competency index: Null (0)	Low (1 to 3)	Middle (4 to 7)	High (8 to 17)
General workplace:									
Orientation for new employees	8.6	53.8	69.3	9.1	12.2	–	5.2	19.2	22.6
	(0.8)	(3.2)	(4.9)	(0.8)	(2.5)	–	(0.8)	(2.4)	(3.6)
Occupational health and safety, environmental protection	9.2	52.0	78.3	9.8	11.6	2.9	7.6	16.8	27.4
	(0.8)	(3.3)	(3.8)	(0.8)	(2.1)	(0.7)	(1.2)	(2)	(5.1)
Literacy or numeracy	–	6.5	11.3	–	–	–	–	–	–
	–	(1.3)	(1.9)	–	–	–	–	–	–
Other training	4.6	17.0	14.0	4.5	9.2	–	3.6	7.5	–
	(0.6)	(2.7)	(3.4)	(0.6)	(3)	–	(0.6)	(1.6)	–
General professional:									
Managerial/supervisory training	8.1	56.1	70.5	8.8	10.5	1.1	5.7	18.2	26.4
	(0.8)	(3.2)	(5.3)	(0.9)	(1.9)	(0.4)	(1.1)	(2.5)	(4)
Professional training	11.5	39.4	63.4	11.4	21.6	5.2	7.5	22.9	27.0
	(1)	(3.2)	(5.3)	(1)	(4.3)	(1.4)	(1.2)	(2.8)	(4.3)
Apprenticeship training	5.3	29.5	44.6	5.7	5.9	1.7	3.6	11.1	15.7
	(0.6)	(2.7)	(5.1)	(0.6)	(1.2)	(0.5)	(0.7)	(1.8)	(3.4)
Sales and marketing training	7.9	29.3	38.6	8.1	10.2	1.3	5.6	17.7	17.3
	(0.8)	(2.9)	(5)	(0.9)	(2.8)	(0.4)	(1)	(2.5)	(3.5)
Group decision-making or problem-solving	4.7	28.5	45.0	5.0	5.6	–	2.7	12.2	11.5
	(0.7)	(2.8)	(5)	(0.7)	(1.4)	–	(0.9)	(2.2)	(2.4)
Team-building, leadership, communication	6.8	46.7	67.0	7.3	9.3	–	4.8	15.5	18.1
	(0.8)	(3.3)	(5.1)	(0.8)	(1.8)	–	(1.1)	(2.2)	(3.2)
Technology:									
Computer/hardware	7.3	36.1	52.2	7.1	18.6	1.7	5.3	14.6	22.6
	(0.7)	(3.1)	(5.2)	(0.7)	(3.9)	(0.5)	(1)	(2)	(3.8)
Computer/software	12.9	61.1	77.2	12.7	30.6	3.3	10.7	24.9	33.6
	(0.9)	(3.2)	(5.1)	(0.9)	(4.8)	(0.7)	(1.4)	(2.5)	(4.5)
Other office and non-office equipment	2.4	22.9	29.8	2.6	6.0	–	1.3	6.0	9.7
	(0.3)	(2.9)	(4.2)	(0.3)	(1.6)	–	(0.3)	(1)	(2.4)
Population of workplaces in each category (percentage)	**98.4**	**1.4**	**0.2**	**94.2**	**5.8**	**28.1**	**40.2**	**25.2**	**6.6**

Note: Standard errors are presented in parenthesis. Estimates with "–" are suppressed because of high sampling variability, their coefficient of variation is over 33.3%. The coefficient of variation is calculated by dividing the standard error of the estimate by the estimate. Estimates with a coefficient of variation between 25.1-33.3% should be used with caution, this range is greater than the good (1 to 16.5%) and acceptable (16.6 to 25%) ranges.

The results for large workplaces are also quite consistent. Large workplaces with high TCI scores do more technology training than middle, low, and null-ranked locations. For the remaining training types, large workplaces with a middle TCI rank do not have significantly different training incidences than those with high-ranking TCI workplaces, except for the following: orientation for new employees, occupational health & safety, environmental protection, and managerial/supervisory training. These are often significantly higher for large, high-ranking TCI workplaces than for those in lower TCI ranges. For apprenticeship, group decision-making or problem solving, and team-building training, large null-ranked locations have a greater training incidence than large workplaces with high TCI scores (Table 7).

From these cross tabulations, there is some initial evidence that training incidence, across all types of training, increases as workplace size increases. Further, workplaces in the ICT-S sector and those that rank high on the TCI also look to have generally higher training frequencies (the above mentioned exceptions noted). This said, conclusions regarding the impact of location size, industry, and technological competency on training incidence require multivariate analysis. We turn to this below.

Table 6. Incidence of classroom training by workplace size and sector (percentage)						
Workplace size	Small		Medium		Large	
Sector	Non-ICT-S	ICT-S	Non-ICT-S	ICT-S	Non-ICT-S	ICT-S
Types of training:						
General workplace:						
Orientation for new employees	8.5	10.1	51.1	73.0	69.6	67.7
	(0.9)	(2.5)	(3.5)	(6.3)	(5.6)	(6.2)
Occupational health and safety, environmental protection	9.1	10.1	52.0	51.5	80.7	65.3
	(0.9)	(2.1)	(3.5)	(9.2)	(4.2)	(7.5)
Literacy or numeracy	–	–	5.2	–	9.4	21.4
	–	–	(1.2)	–	(2)	(5.5)
Other training	4.4	–	14.7	33.5	12.5	21.8
	(0.7)	–	(2.6)	(10.5)	(3.9)	(5.4)
General professional:						
Managerial/supervisory training	8.1	8.2	53.5	74.8	69.2	77.0
	(0.9)	(1.8)	(3.4)	(6.1)	(6.1)	(6.1)
Professional training	11.0	20.5	38.1	49.1	61.7	72.7
	(1)	(4.4)	(3.5)	(9)	(6.2)	(6.6)
Apprenticeship training	5.4	4.9	28.8	34.4	45.0	42.5
	(0.6)	(1.2)	(3)	(7.5)	(5.8)	(7.2)
Sales and Marketing training	7.8	9.0	26.8	47.0	37.4	45.0
	(0.9)	(2.8)	(2.9)	(9.3)	(5.8)	(7.2)
Group decision-making or problem-solving	4.7	4.3	27.0	39.6	41.8	62.2
	(0.7)	(1.4)	(3)	(8)	(5.7)	(7.1)
Team-building, leadership, communication	6.7	7.1	43.2	71.7	65.3	76.2
	(0.8)	(1.7)	(3.5)	(6.7)	(5.9)	(6.3)
Technology:						
Computer/hardware	6.7	17.1	33.0	58.6	50.0	63.9
	(0.7)	(4)	(3.2)	(8.2)	(6)	(6.9)
Computer/software	12.0	28.8	58.2	81.8	76.3	82.1
	(0.9)	(4.9)	(3.5)	(5.3)	(5.9)	(5.8)
Other office and non-office equipment	2.3	5.2	22.2	28.7	26.8	45.9
	(0.3)	(1.7)	(3.2)	(7.5)	(4.6)	(7.3)

Note: Standard errors are presented in parenthesis. Estimates with “–” are suppressed because of high sampling variability, their coefficient of variation is over 33.3%. The coefficient of variation is calculated by dividing the standard error of the estimate by the estimate. Estimates with a coefficient of variation between 25.1-33.3% should be used with caution, this range is greater than the good (1 to 16.5%) and acceptable (16.6 to 25%) ranges.

4.3 Multivariate analysis of training incidence

This sub-section investigates workplace characteristics that influence the probability of classroom training. A binary (yes/no) training variable is used as the dependent variable to investigate the incidence of training across sectors and our workplace-specific measure of technological competency. The determinants of training are posited to be workplace size (small, medium, large), industry sector (ICT-S, non- ICT-S), technological competency (null, low, middle, high), the use of government training subsidies, payroll-per-employee, significance of competition, and unionization. All of these characteristics are expected to have a positive influence on the probability of training.

Three models are presented in this section. Each model includes the full set of control variables (workplace size, government subsidies, payroll-per-employee, significance of competition, and unionization). The models vary in the inclusion of the key variables of interest, sector and technological competency. The first model focuses on the impact of the ICT-S sector, the second on the impact of the TCI, and the third on the interaction between the sector and technological competency variables.

Table 7. Incidence of classroom training by workplace size and technology competency index (percentage)

Workplace size	Small				Medium				Large			
	Null	Low	Middle	High	Null	Low	Middle	High	Null	Low	Middle	High
Technology competency index	(0)	(1 to 3)	(4 to 7)	(8 to 17)	(0)	(1 to 3)	(4 to 7)	(8 to 17)	(0)	(1 to 3)	(4 to 7)	(8 to 17)
Types of training												
General workplace:												
Orientation for new employees	–	4.8	18.3	19.3	–	42.4	54.8	69.9	76.9	55.8	62.2	85.1
	–	(0.8)	(2.4)	(3.7)	–	(5.5)	(4.5)	(6.2)	(19.3)	(11.7)	(8.1)	(3.9)
Occupational health and safety,	2.8	7.2	15.7	25.3	–	51.9	56.8	53.1	82.7	67.1	72.5	91.4
environmental protection	(0.7)	(1.2)	(2)	(5.5)	–	(5.8)	(4.5)	(7.8)	(15.1)	(10.5)	(6.6)	(3.1)
Literacy or numeracy	–	–	–	–	–	–	8.8	4.3	–	–	10.3	16.4
	–	–	–	–	–	–	(2)	(1.3)	–	–	(2.9)	(4)
Other training	–	3.5	7.3	–	–	13.2	15.9	–	–	–	–	11.8
	–	(0.6)	(1.7)	–	–	(3.2)	(2.5)	–	–	–	–	(3.5)
General professional:												
Managerial/supervisory training	–	5.3	17.1	23.3	–	38.5	61.1	72.5	–	47.4	70.1	90.4
	–	(1.1)	(2.6)	(4.2)	–	(5.2)	(4.2)	(5.9)	–	(10.8)	(8.4)	(3)
Professional training	5.2	7.2	22.5	24.8	–	31.5	37.5	59.5	–	51.3	63.4	76.3
	(1.4)	(1.2)	(2.9)	(4.5)	–	(5)	(4.3)	(7)	–	(11.3)	(8.6)	(5.3)
Apprenticeship training	1.6	3.4	10.6	14.1	–	24.8	30.3	38.5	89.7	42.5	38.2	48.3
	(0.5)	(0.7)	(1.8)	(3.5)	–	(4.5)	(3.6)	(7.4)	(10.4)	(11.1)	(7.7)	(8.3)
Sales and marketing training	1.2	5.4	17.3	16.4	–	25.4	31.9	29.3	–	24.3	43.3	44.1
	(0.4)	(1)	(2.6)	(3.6)	–	(4.9)	(3.8)	(6.8)	–	(7.3)	(8.3)	(8.3)
Group decision-making or	–	–	11.7	9.6	–	21.3	29.2	39.6	82.7	30.8	41.3	53.6
problem-solving	–	–	(2.2)	(2.5)	–	(3.8)	(3.6)	(7.6)	(15.1)	(8.4)	(7.8)	(8.7)
Team-building, leadership,	–	4.5	14.7	15.0	–	38.4	42.7	64.9	89.7	36.0	77.3	70.6
communication	–	(1.1)	(2.3)	(3.3)	–	(5.3)	(4.2)	(6.5)	(10.4)	(9.1)	(6.3)	(8.8)
Technology:												
Computer/hardware	1.6	5.0	14.0	20.6	31.7	26.7	34.4	50.4	19.7	33.9	47.3	72.7
	(0.5)	(1)	(2.1)	(4)	(16.3)	(4.5)	(3.9)	(7.7)	(17.2)	(8.9)	(8.1)	(5.7)
Computer/software	3.2	10.2	23.9	30.8	–	57.4	59.6	74.8	–	54.7	83.3	89.9
	(0.7)	(1.4)	(2.6)	(4.7)	–	(5.8)	(4.6)	(5.6)	–	(11.8)	(7.3)	(3.5)
Other office and non-office	–	1.2	5.6	7.8	–	15.8	21.0	39.4	–	–	31.0	38.7
equipment	–	(0.3)	(1)	(2.5)	–	(3.8)	(3.2)	(8.1)	–	–	(7.5)	(7.1)

Note: Standard errors are presented in parenthesis. Estimates with "–" are suppressed because of high sampling variability, their coefficient of variation is over 33.3%. The coefficient of variation is calculated by dividing the standard error of the estimate by the estimate. Estimates with a coefficient of variation between 25.1-33.3% should be used with caution, this range is greater than the good (1 to 16.5%) and acceptable (16.6 to 25%) ranges.

Table 8. Logistic regression parameter estimates

Variable name	Model 1 ICT-science Coefficients	Model 1 ICT-science Standard error	Model 2 TCI Coefficients	Model 2 TCI Standard error	Model 3 ICT-S and TCI interactions Coefficients	Model 3 ICT-S and TCI interactions Standard error
Medium workplace size	1.966	0.213*	1.832	0.222*	1.849	0.227*
Large workplace size	3.361	0.566*	3.259	0.610*	3.260	0.609*
ICT-science	0.168	0.260				
Low			0.658	0.213*		
Middle			1.614	0.229*		
High			1.996	0.300*		
Non-ICT-S_low					0.639	0.219*
Non-ICT-S_middle					1.601	0.238*
Non-ICT-S_high					1.920	0.316*
ICT-S_null					-0.544	0.512
ICT-S_low					0.648	0.515
ICT-S_middle					1.546	0.382*
ICT-S_high					2.603	0.590*
Payroll per employee ranges:						
$10,001 to $30,000	1.173	0.297*	1.141	0.298*	1.138	0.299*
$30,001 to $50,000	1.721	0.315*	1.686	0.315*	1.683	0.316*
$50,001 ≥	1.629	0.337*	1.528	0.345*	1.524	0.349*
Only domestic competition	0.463	0.173*	0.257	0.184	0.262	0.184
Only foreign competition	0.905	0.341*	0.501	0.404	0.496	0.402
Foreign and domestic	1.081	0.220*	0.639	0.233*	0.638	0.233*
Unionized employees	0.437	0.228	0.260	0.246	0.263	0.247
Constant	-2.696	0.305*	-3.325	0.343*	-3.306	0.345*
Number of observations		5,501		5,501		5,501

Note: *Statistically significant at the 5% level.

The probability of training is modelled using a logit regression. The general model estimated is:

$$\ln\left(\frac{P_i}{1-P_i}\right)=X_i\beta+\varepsilon_i \qquad (3)$$

where P is the probability of classroom training, X_i represents the determinants of training, β is the vector of logit coefficients, ε is a random error, and *i* denotes the workplace.

In equation 4,

$$\hat{P}_i=\frac{e^{x_i b}}{1+e^{x_i b}}=\Lambda(x_i\, b) \qquad (4)$$

$\hat{P}_i$ is the predicted probability that is generated for each plant once the estimated *b* is obtained. $\Lambda(x_i b)$ is the logistic cumulative distribution function. The marginal effect on $\hat{P}_i$ with respect to x_j is:

$$\frac{\partial\hat{P}_i}{\partial x_j}=\Lambda(x_i\, b)[1-\Lambda(x_i\, b)]\, b_j \qquad (5)$$

Table 9. Distribution of workplaces, by sector and technology competency

Sample size by sector and technology competency:	Null	Low	Middle	High	Total
Non-ICT-S	912	1,784	1,620	665	4,981
ICT-S	60	128	228	104	520
Total by tech group	972	1,912	1,848	769	5,501

Percentage of the population by sector and technology competency:	Null 0	Low (1 to 3)	Middle (4 to 7)	High (8 to 17)	Total
Non-ICT-S	27.19	38.30	22.83	5.91	94.2
ICT-S	0.87	1.93	2.32	0.65	5.8
Total by tech group	28.1	40.2	25.2	6.6	100.0

Proportion of each sector by technology competency:	Null	Low	Middle	High
Non-ICT-S	28.9	40.7	24.2	6.3
ICT-S	15.1	33.4	40.2	11.3

The logistic regression results are presented in Table 8. Model 1 shows that when only ICT-S is included in the regression as the main variable of interest, it is positive but not significant. Thus, the ICT-S industry classification is not a significant determinant of a workplace's incidence of classroom training. This suggests that a multidimensional measure is necessary to capture the diversity of technological profiles across workplaces. The second model focuses on the technological competency variable, with the null rank as the omitted category. Results for Model 2 show that the TCI is a significant determinant of classroom training. Further, the probability of training increases as technological competency increases.

Model 3 interacts the ICT-S and TCI measures to test the robustness of Model 2's result. Previously we found that the ICT-S sector contains a larger percentage of locations with mid to high TCI scores than the non-ICT-S sector (Table 9). Model 3 investigates whether these TCI results are robust when interacted with the ICT-S variable.

For Model 3, the sample-mean probability of training is 0.49. All statistically significant variables have (the expected) positive impact on this probability of training. The sector and technology competency interactions are positive and significant. This indicates that, even after controlling for the ICT-S sector, the TCI is an influential factor in determining the incidence of classroom-training.

When technological competency is held constant and the ICT-S and non-ICT-S sectors are compared, there are no significant differences between the two sectors. However, when the sector is held constant and technological competency is allowed to vary, locations with high technological competencies are found to be significantly different than low-ranked and null-ranked locations (both in the ICT-S and non-ICT-S sectors) but not from middle-ranked locations (Table 10).[19] Further, middle-ranked locations are significantly different from null-ranked workplaces, but are not significantly different from low-ranked locations. Locations with TCI scores in the low range are significantly different than null-ranked workplaces.

Table 10. Joint tests of estimates from the Model 3 logistic regression

Are these parameter estimates significantly different?	chi2 (1)	Prob > chi2
Workplace size		
medium = large	5.160**	0.023
Sector * tech competency:		
Non-ICT-S_low = Non-ICT-S_middle	27.740**	0.000
Non-ICT-S_low = Non-ICT-S_high	21.560**	0.000
Non-ICT-S_middle = Non-ICT-S_high	1.190	0.276
Non-ICT-S_low = ICT-S_low	0.000	0.985
Non-ICT-S_middle = ICT-S_middle	0.020	0.878
Non-ICT-S_high = ICT-S_high	1.260	0.262
ICT-S_null = ICT-S_low	3.210*	0.073
ICT-S_null = ICT-S_middle	13.200**	0.000
ICT-S_null = ICT-S_high	18.790**	0.000
ICT-S_low = ICT-S_middle	2.430	0.119
ICT-S_low = ICT-S_high	7.140**	0.008
ICT-S_middle = ICT-S_high	2.700	0.101
Payroll per employee ranges: [1]		
Pay02 = Pay03	10.150**	0.002
Pay02 = Pay04	3.050*	0.081
Pay03 = Pay04	0.450	0.501
Level of competition:		
Only domestic = Only foreign	0.380	0.539
Only domestic = Foreign and domestic	3.510*	0.061
Only foreign = Foreign and domestic	0.120	0.725

Note: **Reject the null hypothesis that these parameter estimates are equal, at the 95% confidence level (chi2 critical value is 3.84). Estimates significant at the 90% confidence level are indicated by "*".

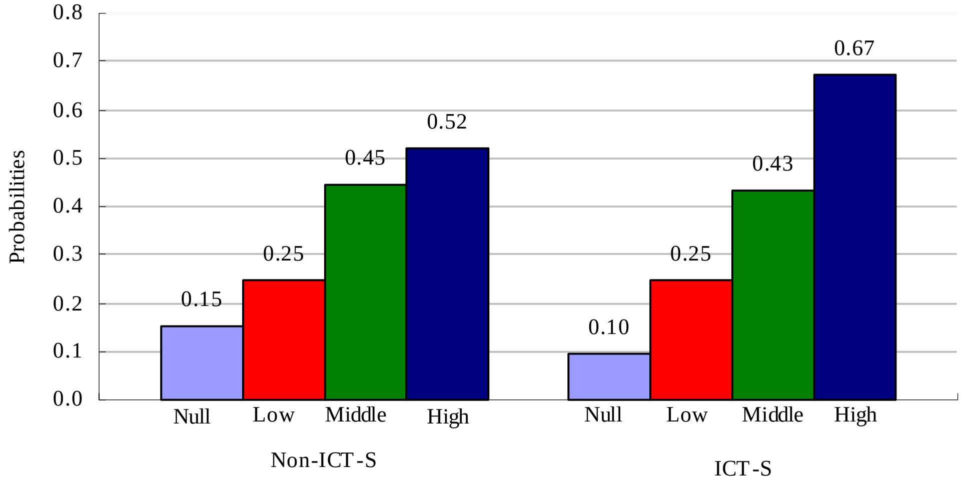
1. The payroll per employee ranges are pay02 is $10,001 to $30,000; pay03 is $30,001 to $50,000; and pay04 is $50,001 and greater.

For locations in the non-ICT-S sector, those with TCI scores in the middle range are significantly different than low- and null-ranked workplaces, and low-ranking workplaces are significantly different than those with a null rank. This indicates that the likelihood of a workplace deciding to train cannot be generalized based on membership in the ICT-S or non-ICT-S sectors, and that the decision to train is more multidimensional. The TCI captures the degree of technological diversity across the underlying workplace population, and is a more influential factor in the decision to train.

All payroll-per-employee categories are significantly different from each other except for the $30,001 to $50,000 and $50,001 or greater categories (Table 10). This indicates that, beyond a certain payroll-per-employee threshold, the impact of worker skills on the decision to train plateau. That is, locations with higher-skilled workforces will only differ from those with lower-skilled workforces in their decision to train up to an average income ceiling.

From the logistic coefficients, the predicted probability of training for each location can be generated using Equation 4. To calculate the average predicted probability for each of the explanatory variables, the binary explanatory variable in question is set equal to one for the entire sample and the remaining explanatory variables take on their actual values. Predicted probabilities are then calculated using the logistic coefficients and these predicted probabilities are averaged. These predicted probabilities are conditional on the explanatory

Figure 2. Sector and technology competency interactions (average conditional probabilities of training)



variable of interest being equal to one, while all other explanatory variables take on their actual values. The intuition is as follows: what is the average probability of training holding all other explanatory variables constant, if the binary explanatory variable of interest "is true"? This method is adopted from work done by Frenette et al. (2005), and Mellor (1998).

This differs from the more commonly used method of analysis, which defines a base set of characteristic and then measures the probability of an event if one of these characteristics changes. This common method is more restrictive, because it assumes a baseline case and all predicted probabilities are then measured from this base case. The common method is subject to problems that can be caused by the non-linearity present in the marginal effect (Equation 5). The method that is used in this study is more general and takes full advantage of the data rather than being restricted to an arbitrarily chosen "base workplace"—as such, it more accurately accounts for the heterogeneity across workplaces. The method used in this study essentially restricts the base set to one characteristic and then allows all observations to vary with what is observed in the data.

The sector and TCI interactions indicate that ICT-S and non-ICT-S locations are not significantly different once technological competency is controlled for in the model (Figure 2). As a result, the difference between the ICT-S and non-ICT-S probabilities should not be regarded as economically meaningful. Locations with high technological competency scores are between 3.4 times (non-ICT-S sector) and 4.4 times (ICT-S sector) more likely to classroom train than null-ranked plants. Middle-ranked and low-ranked locations (non-ICT-S sector) are approximately 2.9 times and 1.6 times more likely than null-plants to classroom train, respectively. The decision to train cannot be generalized as a phenomenon occurring in a specific sector. The decision to train is more pervasive and workplace specific, occurring across all industries.

Table 11. Average conditional probabilities of training

Variable	Probability[1]	Ratio[2]
Workplace size:		
Small	0.29	
Medium	0.66	2.3
Large	0.87	3.0
Payroll per employee ranges:		
≤ $10,000	0.12	
$10,001 to $30,000	0.28	2.3
$30,001 to $50,000	0.38	3.1
$50,001 ≥	0.35	2.9
Significance of competition:		
No competition	0.24	
Only domestic competition	0.29	1.2
Only foreign competition	0.33	1.4
Foreign and domestic	0.36	1.5
Collective bargaining:		
No union	0.29	
Union	0.34	1.2

1. The standard errors of all average conditional probabilities are less than 0.0001.
2. These are not odd ratios, but are simply ratios of the average probability within each category relative to a base, for example, for workplace size the base is small.

The employment size of the workplace is positively associated with the likelihood of training. Small workplaces have a 0.29 average predicted probability of training (Table 11). Medium-sized workplaces are 2.3 times more likely to classroom train and large workplaces are 3.0 times more likely to classroom train than are small workplaces.

The average predicted probability of training is generally increasing as payroll-per-employee increases. In general, this implies that workforces that have a higher level of skill typically tend to engage more in training (Table 11). Locations ranging from $10,001 to $30,000 dollars per worker are 2.3 times more likely to train than locations with a payroll-per-employee of $10,000 or lower. Locations that have a gross payroll-per-employee of $30,001 to $50,000 and $50,001 or greater are 3.1 and 2.9 times more likely to classroom train. For these two top payroll categories, these two ratios are not significantly different.

Competition also influences the probability of training. Locations reporting significant levels of foreign and domestic competition are 1.5 times more likely to train than plants with no significant competition. Similarly, the presence of employees covered by a collective bargaining agreement improves the probability of training by approximately 20%.

Endnotes

16. See Appendix 4 for survey questions on training.
17. A simple model of the cost of formal training is: $C_i = F_i + \lambda N_i$, where C is the cost of classroom training, F is the fixed cost component which contains an overhead, N is the number of employees trained and λ is the marginal cost of training, which would include trainees salaries, supplies, etc…, for the ith firm. For informal training the fixed cost component F is equal to zero.
18. See Montmarquette and Turcotte (2001) for a comparison of on-the-job and classroom training.
19. Although, in the non-ICT-S sector, high- and middle-ranked locations are significantly different at the 10% level.

Chapter 5. Intensive margin: An analysis of training intensity

The breadth of training is captured in a meaningful way by studying the frequency and probability of training; however, these incidence measures do not get at the depth of the training which is occurring. In this chapter, we investigate several intensity measures, designed to evaluate the degree to which workplaces are training. As with our analysis of incidence, the investigation of training intensity proceeds in two stages, a descriptive profile followed by regression analysis. Location size, sector, and technological competency are the categories used to present descriptive estimates of training intensity. The descriptive analysis does not control for other potential factors—such as outside source of funding, payroll per employee, significance of competition and unionization status—that may also serve to influence a workplace's training intensity. Multivariate analysis is used to test the significance of location size, sector and technological competency while controlling for these various factors.

5.1 The intensity of training

Measuring training intensity provides an indication of the depth of training taking place. Once a workplace makes the decision to train, training intensity describes how much training is occurring. This chapter focuses on aggregate classroom training intensity and does not make distinctions between the various types of training. (The number of classroom-trained employees is not available from the WES by type of classroom training). The measure that is used to evaluate the intensity of classroom training is the number of classroom-trained employees divided by total employment or the percentage of the workforce that receives training. This is a measure of the quantity of training taking place.

The quantity of training is postulated to be a function of training costs. An average cost per employee measure—classroom training expenditure divided by total employment—is presented as the net effect of the interaction between two factors: (1) classroom training expenditure divided by classroom-trained employees[20] and (2) classroom-trained employees divided by total employment. As the average costs of training (classroom training expenditure divided by classroom-trained employees) increase, the proportion of employees trained should decline. The relationship between these measures can be expressed as follows:

$$\frac{C_i}{TE_i} = \frac{C_i}{N_i} \times \frac{N_i}{TE_i} \qquad (6)$$

where C = Classroom training expenditure
TE = Total Employment
N = Classroom trained employees
i = delineation (workplace size, technology competency category or industry sector)

The estimates presented in this chapter are all employment-weighted ratios (see Appendix 2 for details and an example).

5.2 Descriptive tabulations

The comparison of the two measures—classroom expenditure divided by total employment and classroom expenditure divided by classroom-trained employees (average cost)—by location size shows that large plants have higher costs per employee and per employee trained than medium- and small-sized workplaces and medium-sized workplaces have higher costs than small locations (Table 12). Generally, medium size workplaces are not significantly different at the 95% confidence level, than small workplaces for both measures.

When these training measures are broken down by sector, locations in the ICT-S sector are, on average, spending more on training per employee and employee trained than those in the non-ICT-S sector (Table 12). These sectoral differences are generally statistically significant.

Cross tabulations of sector and location size show that, within the ICT-S sector, small, medium-sized, and large workplaces are all not significantly different in terms of the costs per employee trained (Table 12). This implies that ICT-based workplaces may have similar cost structures, regardless of differences in workplace size.

Differences in training intensity—classroom-trained employees to total employment—are not significant between medium-sized and large locations or between small and large locations. Estimates of classroom-trained employees to total employment range between 56% and 49%—falling across small and medium-sized locations, then rising for large workplaces (Table 12). These results show no clear pattern and only support Black, Noel, and Wang's (1999) findings over the medium and large workplace range;[21] however, other factors of influence, such as other sources of human capital, are not being controlled for at this descriptive level of analysis. In the multivariate regressions that follows, payroll per employee will be introduced to control for differences in the level of workforce skill.

There is no significant difference in training intensity between the ICT-S and non-ICT-S sectors; on average, locations in non-ICT-S and ICT-S sectors train about 53% and 58% of their workforces, respectively. Further, this holds even after workplace size is accounted for in the analysis. However, large ICT-S workplaces may be considered to train a substantially higher proportion of their workforce (64%) than those in non-ICT-S locations (52%).

Table 12. Trainers: ICT-science-based sector comparison of weighted intensity measures[1]

	Non-ICT-S	ICT-S	Totals by workplace size
Small workplaces			
Classroom expenditure by total employment[2]	378	790	418
	(32)	(163)	(33)
Classroom expenditure by classroom trained employees[2]	674	1421	746
	(58)	(274)	(61)
Classroom trained employees by total employment[3]	0.56	0.56	0.56
	(0.02)	(0.04)	(0.02)
Medium workplaces			
Classroom expenditure by total employment	390	818	454
	(27)	(162)	(38)
Classroom expenditure by classroom trained employees	808	1476	921
	(67)	(286)	(82)
Classroom trained employees by total employment	0.48	0.55	0.49
	(0.03)	(0.04)	(0.02)
Large workplaces			
Classroom expenditure by total employment	614	1271	736
	(75)	(275)	(85)
Classroom expenditure by classroom trained employees	1192	1979	1366
	(147)	(420)	(153)
Classroom trained employees by total employment	0.52	0.64	0.54
	(0.05)	(0.05)	(0.04)
Sector totals for all workplace sizes			
Classroom expenditure by total employment	421	926	
	(22)	(111)	
Classroom expenditure by classroom trained employees	791	1601	
	(45)	(184)	
Classroom trained employees by total employment	0.53	0.58	
	(0.02)	(0.03)	
	Non-ICT-S	ICT-S	Total
Small to large workplace ratios			
Classroom expenditure by total employment	0.62	0.62	0.57
Classroom expenditure by classroom trained employees	0.57	0.72	0.55
Classroom trained employees by total employment	1.09	0.87	1.04
Medium to large workplace ratios			
Classroom expenditure by total employment	0.63	0.64	0.62
Classroom expenditure by classroom trained employees	0.68	0.75	0.67
Classroom trained employees by total employment	0.94	0.86	0.91

1. Standard errors are presented in parenthesis.
2. Classroom expenditure by total employment and classroom expenditure by classroom-trained employees are measured in dollars.
3. Classroom trained employees by total employment is a proportion.

Results are similar for our training measures when broken down by technological competency and location size. Training expenditures are generally increasing with location size (Table 13). Further, average costs tend to increase across the low, middle and high TCI ranges. Locations with a high TCI have average costs of $1122, which is significantly above those in the low, but not the middle ($727 and $889, respectively).

Table 13. Trainers: Technology competency index category comparison of weighted intensity measures[1]	Null (0)	Low (1 to 3)	Middle (4 to 7)	High (8 to 17)	Totals by workplace size
Small workplaces					
Classroom expenditure by total employment[2]	324	325	461	511	418
	(96)	(28)	(60)	(104)	(33)
Classroom expenditure by classroom trained employees[2]	642	657	742	955	746
	(179)	(45)	(101)	(202)	(61)
Classroom trained employees by total employment[3]	0.51	0.50	0.62	0.54	0.56
	(0.06)	(0.03)	(0.03)	(0.05)	(0.02)
Medium workplaces					
Classroom expenditure by total employment	–	379	443	457	454
	–	(42)	(53)	(59)	(38)
Classroom expenditure by classroom trained employees	1855	828	845	954	921
	(589)	(124)	(96)	(169)	(82)
Classroom trained employees by total employment	0.49	0.46	0.52	0.48	0.49
	(0.07)	(0.05)	(0.03)	(0.05)	(0.02)
Large workplaces					
Classroom expenditure by total employment	–	475	849	838	736
	–	(109)	(141)	(141)	(85)
Classroom expenditure by classroom trained employees	670	855	1475	1517	1366
	(140)	(237)	(251)	(254)	(153)
Classroom trained employees by total employment	–	0.56	0.58	0.55	0.54
	–	(0.1)	(0.05)	(0.05)	(0.04)
Technology competency totals for all workplace sizes					
Classroom expenditure by total employment	414	358	523	585	
	(130)	(24)	(44)	(60)	
Classroom expenditure by classroom trained employees	929	727	889	1122	
	(253)	(51)	(78)	(126)	
Classroom trained employees by total employment	0.45	0.49	0.59	0.52	
	(0.07)	(0.03)	(0.02)	(0.03)	
	Null	Low	Middle	High	Total
Small to large workplace ratios					
Classroom expenditure by total employment	–	0.68	0.54	0.61	0.57
Classroom expenditure by classroom trained employees	0.96	0.77	0.50	0.63	0.55
Classroom trained employees by total employment	–	0.89	1.08	0.97	1.04
Medium to large workplace ratios					
Classroom expenditure by total employment	–	0.80	0.52	0.55	0.62
Classroom expenditure by classroom trained employees	2.77	0.97	0.57	0.63	0.67
Classroom trained employees by total employment	–	0.82	0.91	0.87	0.91

1. Standard errors are presented in parenthesis.
2. Classroom expenditure by total employment and classroom expenditure by classroom-trained employees are measured in dollars.
3. Classroom trained employees by total employment is a proportion.

Estimates with "–" are suppressed because of high sampling variability, their coefficient of variation is over 33.3%. The coefficient of variation is calculated by dividing the standard error of the estimate by the estimate. Estimates with a coefficient of variation between 25.1-33.3% should be used with caution, this range is greater than the good (1 to 16.5%) and acceptable (16.6 to 25%) ranges.

After these aggregate measures are cross-tabulated by location size and technological competency, large sized high and middle locations have the highest ratio of classroom expenditure to total employment, followed by small locations in the high TCI range (Table 13). The average cost of training for medium-sized locations in the null range ($1855) is substantially larger than all other average costs estimates. On balance, these results suggest a general trend towards increasing expenditures as both workplace size and technological competency increase.

Next, we consider the proportion of the workforce trained. When aggregating across size categories, locations with a high TCI index train 52% of their workforce, compared to those in the middle (59%), low (49%) and null (45%) ranges, respectively (Table 13). The proportion of the workforce trained is higher for middle-ranked locations than for locations in the low and high TCI ranges.

The proportion of classroom trained to total employment is highest for small middle-ranking plants. Workplaces with a middle TCI rank, within location size categories, tend to have a higher training intensity (proportion of employees trained per workforce) than null, low, or high-ranked workplaces; however, these differences are not always statistically significant (Table 13).

The proportion of classroom trained to total workplace employment is our core measure of training intensity. This proportion generally falls as location size increases. However, a lower proportion of employees trained coincides with higher average costs of training. This indicates that a multivariate analysis of training intensity based on the ratio of classroom-trained employees to total employment will have to control for differences in average cost. We turn to this in the following section.

5.3 Multivariate analysis of training intensity

This section uses multivariate analysis to control for a range of factors, beyond our key variables of interest (sector and technological competency) that are posited to affect training intensity. Our analysis of the intensive margin looks at factors that influence the training intensity of locations that actively train. The central issue is: Of workplaces that train, can differences in training intensity be generalized to the sectoral level, or are these differences more workplace-specific and dependent on the technological characteristics of specific locations?

Some comments on methodology are warranted. For this analysis, the sample data is weighted by an adjusted final weight. To derive this adjusted weight, the final weight for the location is multiplied by the workplace's total employment. Hence, this adjusted weight places more importance on locations with higher total employment. These adjustments make the results comparable to the simple tabulations presented in Section 5.2. Further, these results are robust. Not only has the complex survey design been accounted for in the estimation procedure, but the estimation techniques used account for cross-sectional heteroscedasticity, using weighted least squares.

As was the case in the multivariate analysis of training incidence, our analysis of training intensity is based on three regression models. The first focuses on the impact that the ICT-S sector variable has on training intensity and the second on the impact of the TCI, the location-specific measure of technological competency. The third model examines the interaction between the sector and technological competency variables. All models include the following controls: location size, government subsidies, payroll per employee, significance of competition and union status.

Table 14. Intensive margin (OLS regression)[1]

Dependent variable: Proportion of employees who are training	Model 1 ICT-science		Model 2 TCI		Model 3 ICT-S and TCI interactions	
Variable name	Coefficients	Standard error	Coefficients	Standard error	Coefficients	Standard error
Medium workplace size	-0.061	0.029*	-0.059	0.029*	-0.060	0.029*
Large workplace size	-0.026	0.048	-0.026	0.046	-0.026	0.046
ICT-science	0.028	0.030				
Low			0.043	0.062		
Middle			0.138	0.061*		
High			0.077	0.066		
Non-ICT-S_low					0.065	0.066
Non-ICT-S_middle					0.161	0.065*
Non-ICT-S_high					0.081	0.071
ICT-S_null					0.165	0.096
ICT-S_low					0.032	0.076
ICT-S_middle					0.140	0.070*
ICT-S_ high					0.173	0.079*
Outside source of funding	0.031	0.026	0.031	0.025	0.029	0.025
Average cost of training	-9.830E-06	2.030E-06*	-9.620E-06	1.920E-06*	-9.720E-06	1.950E-06*
Average cost squared	8.930E-12	1.970E-12*	8.690E-12	1.860E-12*	8.790E-12	1.890E-12*
Payroll per employee	1.520E-06	7.020E-07*	1.560E-06	6.450E-07*	1.480E-06	6.420E-07*
Only domestic competition	-0.039	0.047	-0.039	0.046	-0.036	0.046
Only foreign competition	0.035	0.059	0.036	0.057	0.035	0.057
Foreign and domestic	-0.047	0.048	-0.050	0.047	-0.049	0.047
Unionized employees	-0.014	0.029	-0.017	0.028	-0.014	0.028
Constant	0.543	0.055*	0.457	0.072*	0.439	0.074*
Number of observations	3139		3139		3139	
R^2	0.0485		0.0618		0.0649	

Note: *Statistically significant at the 95% confidence level.

1. An adjusted final weight is used for this regression, the final weight is adjusted for plant employment size, thus the weight used is the (final weight * plant employment).

Results for the three models do not differ substantially. Among workplaces that train, factors such as outside sources of funding, competition and unionization are not influential determinants of training intensity (Table 14). These results are robust across specifications.

Size effects are apparent. Medium-sized workplaces have an approximately 6% lower level of training intensity level than small locations. This finding is consistent with the descriptive analysis.

Results for Models 2 and 3 indicate that technological competency is associated with training intensity in locations with middle or high TCI rankings. Middle-ranking locations in non-ICT-S industries have a 16.1% higher training intensity than null-ranked workplaces in the non-ICT-S sector (Model 3); similarly, interactions between the ICT-S sector variable and locations with middle and high TCI rankings result in 14.0% and 17.3% higher training intensities, respectively (compared to the null-ranked, non-ICT-S base group).

Table 15. Joint tests of estimates from the Model 3 OLS regression		
Are these parameter estimates significantly different?	**chi2 (1)**	**Prob > chi2**
Workplace size		
Medium = large	0.630	0.428
Sector * tech competency:		
Non-ICT-S_low = Non-ICT-S_middle	8.560*	0.004
Non-ICT-S_low = Non-ICT-S_high	0.170	0.684
Non-ICT-S_middle = Non-ICT-S_high	4.270*	0.039
Non-ICT-S_low = ICT-S_low	0.360	0.546
Non-ICT-S_middle = ICT-S_middle	0.240	0.622
Non-ICT-S_high = ICT-S_high	2.570	0.109
ICT-S_null = ICT-S_low	2.280	0.132
ICT-S_null = ICT-S_middle	0.090	0.764
ICT-S_null = ICT-S_high	0.010	0.929
ICT-S_low = ICT-S_middle	3.420	0.065
ICT-S_low = ICT-S_high	4.290*	0.038
ICT-S_middle = ICT-S_high	0.300	0.586
Level of competition:		
Only domestic = Only foreign	2.520	0.112
Only domestic = Foreign and domestic	0.160	0.686
Only foreign = Foreign and domestic	3.930*	0.048

Note: *Reject the null hypothesis that these parameter estimates are equal, at the 95% confidence level (chi2 critical value is 3.84).

Joint tests on the coefficient estimates (Table 15) affirm that differences in training intensity are driven more by location-specific differences in technological competency than by differences in sector (ICT-S versus non-ICT-S). Within the ICT sector, differences are apparent among locations with low- and high-ranking TCI scores; within the non-ICT-S sector, differences exist between low- and middle-ranking locations and between middle- and high-ranking locations. These results are consistent with the descriptive tabulations presented in the previous section.

Other factors that are associated with training intensity are the average cost of classroom training and payroll per employee. Training intensity decreases as average cost increases. For every thousand-dollar increase in average cost, the level of training intensity will fall by 0.97% (Table 14). However, the positive coefficient on the average cost squared term indicates that there are increasing returns to scale present. As payroll per person (i.e., the skill level of the workforce) increases, the percentage of the workforce trained also increases. Thus, for every ten thousand dollar increase in payroll per person, the level of training intensity increases by 1.5%. Competition and union status are not significantly correlated with training intensity.

The remaining factors of influence in this model are average cost and payroll per employee—both of which affect the training intensity of locations that train. Workplaces that have a higher average cost of training train fewer employees as a proportion of their workforce. Further, the proportion of the workforce trained increases as payroll per employee increases, a proxy for the skill level of employees. As employee skills increase, workplaces train more.

Endnotes

20. This is an average cost per employee receiving training measure, see Equation 2—where trained employees is the output.
21. Black, Noel and Wang (1999) suggest training intensity increases with firm size. They use an hours-per- week proportion to measure training intensity. They argue that their findings are consistent with the economies-of-scale hypothesis—that economies of scale allow relatively larger establishments to provide more training.

Chapter 6. Conclusion

This study uses the 1999 Workplace and Employee Survey to investigate how training decisions are influenced on the extensive and intensive margins. The study examines the extent to which basic differences in the incidence and intensity of training are sector and workplace specific. We do so by comparing science and technology-based industries to other industries and by comparing workplaces using a location-specific index of technological competency.

The study found that the level of training incidence depends, inter alia, on the technological competencies specific to workplaces and that membership in science and technology-based industries is not a significant predictor of training incidence and intensity once location-specific differences in technological competency are taken into account. These findings are consistent with a recent study (Baldwin and Gellatly, 1998) that found that innovative, technology-based firms are not confined solely to high-technology industries. Sizable concentrations of advanced firms exist in many different sectors of the economy. Similarly, sector level characterizations about the incidence and intensity of training may also prove limiting—as workplace-specific technology indicators may better account for the heterogeneity that exists across the underlying workplace population.

Locations that place more emphasis on technology have a higher incidence of training and are more likely to train than other locations. In regards to workplace size, this study found that large workplaces are more likely to train than medium-sized and small workplaces. Locations with higher skilled workforces only differ from those with lower skilled workforces in their decision to train up to a payroll per employee threshold.

Once workplaces make the decision to train, sector, outside sources of funding, competition, and unionization are not significant factors influencing the intensity of training. For workplaces that decide to train, the main factors affecting the intensity of training are technological competency and size, followed by the average cost of training and the skill level of the workforce. Workplaces that place more emphasis on technology train a higher proportion of their workforce than other locations. Locations that have a higher average cost of training, train fewer employees as a proportion of their workforce. However, the skill level of workers moderates this effect, because as payroll per employee increases, workplaces train more.

Appendix 1: Identifying ICT and science-based industries

The Workplace and Employee Survey (WES) classifies the workplaces surveyed by the North American Industry Classification System (NAICS). NAICS-based ICT sector industries are presented in Table A1.1.

The science-based classification scheme advanced by Baldwin and Johnson (1999) is based on the 1980 Standard Industrial Classification. As the WES is primarily employment based, a concordance between science-based SIC industries and NAICS-based industries was created using employment as the weighting factor in the development of the NAICS-based specification.

The following procedure was employed:

- From the year-end 2001 Business Register, the existing SIC specification for science-based industries (51 4-digit industries) is used to select 63,820 establishments with employees (representing approximately 1,218,200 employees).

- These same establishments are classified to 152 different 6-digit NAICS codes. Using these 152 NAICS codes as the selection criteria yields 163,000 establishments representing approximately 2,495,100 employees. This figure is about twice as large as the existing SIC-based estimate of science-based employment.

- Accordingly, each of the 152 NAICS codes is evaluated for inclusion in the new NAICS-based science specification using its share of employment in science. (Many of these NAICS codes include both science and non-science components in that their establishments are classified to either science and/or non-science SIC industries). Individual NAICS industries are selected if their science employment (based on the SIC definition) represents more than 50% of its total employment.

This algorithm resulted in a selection of 78 NAICS codes, which covered 1,196,030 total employees. Of these employees, 98.4% are science-based.

Table A1.1 NAICS-based ICT sector industries

Manufacturing	
33331	Commercial and service industry machinery
33411	Computer and peripheral equipment
33421	Telephone apparatus
33422	Radio and television broadcasting and wireless communications equipment
33431	Audio and video equipment
33441	Semiconductor and other electronic components
33451	Navigational, measuring, medical, and control instrumentation
33592	Communication and energy wire and cable
Services	
51121	Software publishers
51322	Cable and other program distribution
5133	Telecommunication services
51419	Other information services
51421	Data processing services
54151	Computer systems design and related services
81121	Electronic and precision equipment repair and maintenance
41731	Computer, computer peripheral and pre-packaged software wholesaling
41732	Electronic components, navigational and communications equipment and supplies wholesaling
41791	Office and store machinery and equipment wholesaling
53242	Office machinery and equipment rental and leasing

Table A1.2 NAICS-based science sector industries

221111	Hydro-electric power generation
221112	Fossil-fuel electric power generation
221113	Nuclear electric power generation
221119	Other electric power generation
221121	Electric bulk power transmission and control
221122	Electric power distribution
324110	Petroleum refineries
324121	Asphalt paving mixture and block manufacturing
324190	Other petroleum and coal products manufacturing
325110	Petrochemical manufacturing
325120	Industrial gas manufacturing
325130	Synthetic dye and pigment manufacturing
325181	Alkali and chlorine manufacturing
325189	All other basic inorganic chemical manufacturing
325190	Other basic organic chemical manufacturing
325210	Resin and synthetic rubber manufacturing
325313	Chemical fertilizer (except potash) manufacturing
325314	Mixed fertilizer manufacturing
325320	Pesticide and other agricultural chemical manufacturing
325410	Pharmaceutical and medicine manufacturing
325520	Adhesive manufacturing
325910	Printing ink manufacturing
325920	Explosives manufacturing
325991	Custom compounding of purchased resins
325999	All other miscellaneous chemical product manufacturing
332991	Ball and roller bearing manufacturing
333110	Agricultural implement manufacturing
333120	Construction machinery manufacturing
333130	Mining and oil and gas field machinery manufacturing
333210	Sawmill and woodworking machinery manufacturing
333220	Rubber and plastics industry machinery manufacturing
333291	Paper industry machinery manufacturing
333299	All other industrial machinery manufacturing
333310	Commercial and service industry machinery manufacturing
333413	Industrial and commercial fan and blower and air purification equipment manufacturing
333416	Heating equipment and commercial refrigeration equipment manufacturing
333611	Turbine and turbine generator set unit manufacturing
333619	Other engine and power transmission equipment manufacturing
333910	Pump and compressor manufacturing
333920	Material handling equipment manufacturing
333990	All other general-purpose machinery manufacturing
334110	Computer and peripheral equipment manufacturing
334210	Telephone apparatus manufacturing
334220	Radio and television broadcasting and wireless communications equipment manufacturing
334290	Other communications equipment manufacturing
334310	Audio and video equipment manufacturing
334410	Semiconductor and other electronic component manufacturing
334511	Navigational and guidance instruments manufacturing
334512	Measuring, medical and controlling devices manufacturing
335311	Power, distribution and specialty transformers manufacturing
335312	Motor and generator manufacturing
335315	Switchgear and switchboard, and relay and industrial control apparatus manufacturing
335920	Communication and energy wire and cable manufacturing
335990	All other electrical equipment and component manufacturing
336410	Aerospace product and parts manufacturing
486110	Pipeline transportation of crude oil
486210	Pipeline transportation of natural gas
486910	Pipeline transportation of refined petroleum products
486990	All other pipeline transportation

Table A1.2 NAICS-based science sector industries - ***concluded***

511210	Software publishers
512110	Motion picture and video production
513220	Cable and other program distribution
513310	Wired telecommunications carriers
513320	Wireless telecommunications carriers (except satellite)
513330	Telecommunications resellers
513340	Satellite telecommunications
513390	Other telecommunications
514210	Data processing services
532420	Office machinery and equipment rental and leasing
541310	Architectural services
541320	Landscape architectural services
541330	Engineering services
541340	Drafting services
541360	Geophysical surveying and mapping services
541370	Surveying and mapping (except geophysical) services
541380	Testing laboratories
541510	Computer systems design and related services
541620	Environmental consulting services
541690	Other scientific and technical consulting services
541710	Research and development in the physical, engineering and life sciences

Appendix 2: Weighted approach to measuring training intensity

An example:

The measure used for analyzing training intensity in this study is the weighted ratio as opposed to the unweighted ratio. In the example below, T is equal to total training expenditure and E is total employment for the i^{th} class, where classes can be location size and industry, or some combination of these key variables. N is the sample size.[22]

Weighted ratio:

$$\frac{\sum_i T_i}{\sum_i E_i} = \sum_i (w_i)\frac{T_i}{E_i}\text{, where, } w_i = \frac{E_i}{\sum_i E_i} = \frac{E_i}{E} \text{ and } \frac{\sum_i T_i}{\sum_i E_i} = \frac{\sum_i T_i}{E}$$

Unweighted ratio:

$$\frac{\sum_i \left(\frac{T_i}{E_i}\right)}{N}$$

The employment-weighted measure adjusts the workplace's ratio of classroom training expenditure to total employment by its share of total employment. The use of this measure gives less weight to plants with smaller shares of employment; accordingly, entities with smaller shares and unusually large expenditures are given less weight than entities with large shares and typical expenditures. The unweighted calculation takes the sum of the ratio of classroom training expenditure to total employment across each location, and then divides this by the total number of locations. The unweighted measure does not take into consideration the heterogeneity of locations. The weighted ratio presents a more accurate picture of training intensity—for this reason, we report employee-weighted results herein.

Endnote

22. A specific example is presented here to illustrate a weighted ratio; however, the description could be more general, with T and E being any variables of interest.

Appendix 3: Summary statistics for control variables

Table A3.1 Of those that train: Percentage of workplaces receiving funding by source

Sector	Small		Medium		Large		Totals by workplace size by categories
	Non-ICT-S	ICT-S	Non-ICT-S	ICT-S	Non-ICT-S	ICT-S	
Federal Government	2.3	2.8	5.1	4.5	8.6	13.4	2.5
Provincial Government	5.6	2.2	7.9	7.3	14.4	12.3	5.4
Training trust funds	4.5	3.2	6.8	3.2	4.8	4.7	4.5
Union or employee association	1.5	1.0	2.8	2.6	4.0	0.9	1.5
Industry organisation	7.7	2.7	6.8	1.0	7.6	5.6	7.3
Employees	3.2	1.6	4.6	4.6	7.4	5.5	3.1
Equipment vendors	4.7	4.7	10.3	25.5	13.5	11.9	5.1
Other private sector organisations	5.5	2.7	6.2	8.9	5.9	4.3	5.3
Other outside source of funding	13.7	12.1	8.1	1.9	6.1	14.0	13.3
Government training subsidy[1]	8.1	7.3	16.4	25.7	15.0	30.8	8.5
All outside sources of funding[2]	47.5	28.9	44.3	51.2	43.3	60.8	45.9
Population count	168,112	14,969	6,520	1,066	823	158	191,649

1. Government training subsidy is more specific than the general federal/provincial training programs that workplaces may have accessed.
2. All outside sources of funding includes all of the above sources, from federal government to other outside sources of funding, it also includes Government training subsidy.

Table A3.2 Of those that train: Percentage of workplaces receiving funding by source

	Technology competency categories												Totals by workplace size by categories
	Small				Medium				Large				
	Null[1]	Low	Middle	High	Null	Low	Middle	High	Null	Low	Middle	High	
Federal Government	2.0	3.9	1.5	1.3	2.2	8.0	4.0	4.1	0.0	17.6	4.4	12.3	2.5
Provincial Government	4.8	3.1	7.2	5.5	1.0	7.3	5.2	13.7	0.0	15.7	11.4	17.8	5.4
Training trust funds	0.5	3.8	5.6	6.3	1.7	4.8	7.1	7.4	0.0	3.2	4.2	6.8	4.5
Union or employee association	4.0	1.7	0.8	0.1	0.4	4.2	2.2	2.8	0.0	3.3	4.2	3.2	1.5
Industry organisation	6.1	5.9	9.5	5.2	3.2	5.3	6.2	6.8	0.0	25.4	3.9	2.8	7.3
Employees	2.6	3.3	0.8	10.2	3.4	3.0	5.8	4.3	2.6	13.9	3.8	8.1	3.1
Equipment vendors	4.0	6.6	3.8	3.6	5.3	4.3	12.9	21.3	0.0	17.2	13.8	12.1	5.1
Other private sector organisations	11.2	6.4	2.9	4.1	2.4	6.7	6.5	7.2	0.0	18.2	4.4	1.5	5.3
Other outside source of funding	22.0	14.3	12.2	7.8	10.2	3.2	11.7	3.4	0.0	17.3	6.6	4.0	13.3
Government training subsidy[2]	5.0	6.7	9.4	10.4	7.2	19.5	11.3	28.2	0.0	15.2	9.7	29.9	8.5
All outside sources of funding[3]	56.5	44.4	45.2	42.0	27.3	40.0	48.5	48.7	2.6	59.2	42.7	48.4	45.9
Population count	23,044	61,762	75,080	23,196	394	1,984	3,198	2,012	39	177	414	351	191,649

1. Workplaces with null technological competency have a zero rank on the index, low rank between 1 and 3, middle rank workplaces between 4 and 7, and high rank workplaces between 8 and 15.
2. Government training subsidy is more specific than the general federal/provincial training programs that workplaces may have accessed.
3. Any source of funding includes all of the above sources, from federal government to other outside sources of funding.

Table A3.3 Cost of classroom training

Statistic	Average cost[1]
N	3,139
Mean	1,004
25th percentile	167
Median	401
75th percentile	1,000
90th percentile	2,000
95th percentile	3,000

1. The average cost of training is classroom expenditures divided by classroom trained employees; measured in dollars.

Table A3.4 Gross payroll per person descriptive statistics[1]

	Workplaces that have:	
Statistic	No training	Training
N	2,362	3,139
Mean	24,355	30,475
25th percentile	13,249	17,143
Median	20,000	26,667
75th percentile	30,000	38,619
90th percentile	42,500	51,852
95th percentile	53,571	63,949

1. All descriptive statistics are measured in dollars—estimates are representative of the population.

Table A3.5 Level of significant competition measures[1]

	Workplaces that have:		
Percentage of workplaces with competition from:	No training	Training	Total
Domestic:			
Locally-owned	63.5	68.5	65.0
Canadian-owned	26.9	44.9	32.2
Total domestic-owned	69.6	80.1	72.7
Foreign:			
United States-owned	12.9	27.4	17.2
Other internationally-owned	5.5	12.7	7.6
Total foreign-owned	14.4	29.4	18.8
Mutually exclusive categories:			
No significant competition	29.0	16.9	25.5
Domestic-owned	56.5	53.7	55.7
Foreign-owned	1.4	3.0	1.9
Foreign and domestic competition	13.1	26.4	17.0

1. Workplaces with competition ranked important, very important, or crucial are included in these measures as having significant competition.

Table A3.6 Collective bargaining status

	Workplaces that have:				
	No training		Training		
Statistic	Frequency	Percentage	Frequency	Percentage	Total
No union	438,268	94.7	171,183	89.3	93.1
Union	24,635	5.3	20,465	10.7	6.9

Appendix 4: Excerpts from the 1999 Workplace and Employee Survey

This questionnaire includes questions relating to the characteristics of the employees at this physical location only. Please include only paid employees of this workplace receiving a T4 Supplementary slip who work on-site, off-site such as customer service representatives or telecommuters, and employees who are on paid leave.

Questions used to calculate total gross payroll per employee:

SECTION A: WORKFORCE CHARACTERISTICS AND JOB ORGANIZATION

1 (a) In the last pay period of March 1999, how many people were employed at this location?
[__[__[__[__[__[__]

SECTION B: COMPENSATION

7. What was the total gross payroll for all employees at this location *between April 1, 1998 and March 31, 1999*? *(If the information is not available for the specified period, give the total gross payroll for the calendar year.)*

$ [___[___[___[___[___[___[___[___[___[___]

Gross payroll is the total remuneration paid to employees before deductions. The amount should be equivalent to the sum of the monthly taxable employment income reported in box 14 of the T4 slip and on the Revenue Canada "Remittance Form for Current Source Deductions."

It includes:
· regular wages and salaries
· commissions
· overtime pay
· paid leave
· piecework payments
· special payments
· taxable allowances and benefits that are recognized by Revenue Canada

It excludes:
· employer's contributions to pension plans
· employment insurance premiums and other employee benefits
· compensation in kind
· travel expenses
· non-taxable allowances and benefits
· recreational facilities provided by the employer
· moving expenses paid by the employer and employee counselling services

SECTION C: TRAINING

This section covers the nature and extent of workplace training. It is meant to include all types of training intended to develop your employees' skills and/or knowledge through a structured format, whether it takes place inside or outside the location.

14 (a) *Between April 1, 1998 and March 31, 1999*, did this workplace pay for or provide any of the following types of classroom job-related training?

Classroom training includes:
· all training activities, which have a pre-determined format, including a pre-defined objective;
· specific content;
· progress may be monitored and/or evaluated.

01 ○ No classroom training ————> **Go to Question 16 (a)**
02 ○ Orientation for new employees
03 ○ Managerial / supervisory training
04 ○ Professional training
05 ○ Apprenticeship training
06 ○ Sales and marketing training
07 ○ Computer / hardware
08 ○ Computer / software
09 ○ Other office and non-office equipment
10 ○ Group decision-making or problem-solving
11 ○ Team-building, leadership, communication
12 ○ Occupational health and safety, environmental protection
13 ○ Literacy or numeracy
14 ○ Other training, specify _____________

14 (b) Please estimate the number of employees who received classroom training *between April 1, 1998 and March 31, 1999*. (Include full-time, part-time, permanent and temporary employees.)
[___[___[___[___[___]

14 (c) *Between April 1, 1998 and March 31, 1999*, were any of the following a source of funding for classroom training of employees at this location? (Check all that apply.)

1 ○ Federal government programs
2 ○ Provincial government programs
3 ○ Training trust funds
4 ○ Union or employee association funding
5 ○ Industry organizations
6 ○ Employees
7 ○ Equipment vendors
8 ○ Other private sector organizations
9 ○ Other outside sources of funding, specify _____________

15 (a) Please estimate this workplace total training expenditures, *between April 1, 1998 and March 31, 1999*.
$ [___[___[___[___[___[___[___[___[___[___]

If total training expenditures equal 0, **Go to Question 15 (c)**.

15 (b) Which of the following are included in that estimate?

1 ○ Trainers' salaries
2 ○ Trainees' salaries
3 ○ Contracts to vendors
4 ○ Direct tuition to schools or training institutions
5 ○ Training materials
6 ○ Travel or living costs for trainees and trainers
7 ○ Overhead or office costs for training
8 ○ Other training expenses
9 ○ Other, specify ______________

15 (c) *Between April 1, 1998 and March 31, 1999*, did the amount of training time for the category of employees with the largest number of employees…

1 ○ increase?
2 ○ remain about the same?
3 ○ decrease?

16 (a) Does this workplace subsidize, assist or reimburse employees for training or courses taken outside of their paid working hours?

This question is meant to be inclusive. Besides direct subsidies (i.e. helping with tuition or fees), assistance could include: helping with registration, arranging travel, arranging discounts or offering salary incentives to training.

1 ○ Yes
3 ○ No ————> **Go to Question 16 (c)**

16 (b) *Between April 1, 1998 and March 31, 1999*, how many employees has this workplace subsidized, reimbursed or assisted?
[___[___[___[___[___]

16 (c) *Between April 1, 1998 and March 31, 1999*, did this workplace pay for or provide any of the following types of on-the-job training?

01 ○ No on-the-job training ————> **Go to Question 17.**
02 ○ Orientation for new employees
03 ○ Managerial / supervisory training
04 ○ Professional training
05 ○ Apprenticeship training
06 ○ Sales and marketing training
07 ○ Computer / hardware
08 ○ Computer / software
09 ○ Other office and non-office equipment
10 ○ Group decision-making or problem-solving
11 ○ Team-building, leadership, communication
12 ○ Occupational health and safety, environmental protection
13 ○ Literacy or numeracy
14 ○ Other training, specify ______________

16 (d) Please estimate the number of employees who received on-the-job training *between April 1, 1998 and March 31, 1999*. (Include full-time, part-time, permanent and temporary employees.)
[___[___[___[___[___]

SECTION G: BUSINESS STRATEGY

36. Do you directly compete with locally, Canadian or internationally-owned firms? (Check all that apply.)

1 ○ Yes, locally-owned firms
2 ○ Yes, Canadian-owned enterprises
3 ○ Yes, American-owned enterprises
4 ○ Yes, other internationally-owned enterprises
5 ○ No ————> **Go to Question 40.**

36 (a) To what extent do these firms offer significant competition to your business?

Significant competition refers to a situation where other firms market products / services similar to your own which might be purchased by your customers.

	Not applicable	Not important	Slightly important	Important	Very important	Crucial	Don't know
A. Locally-owned	○	○	○	○	○	○	○
B. Canadian-owned	○	○	○	○	○	○	○
C. American-owned	○	○	○	○	○	○	○
D. Other internationally-owned	○	○	○	○	○	○	○

Appendix 5: Estimates of total employment and gross payroll per employee

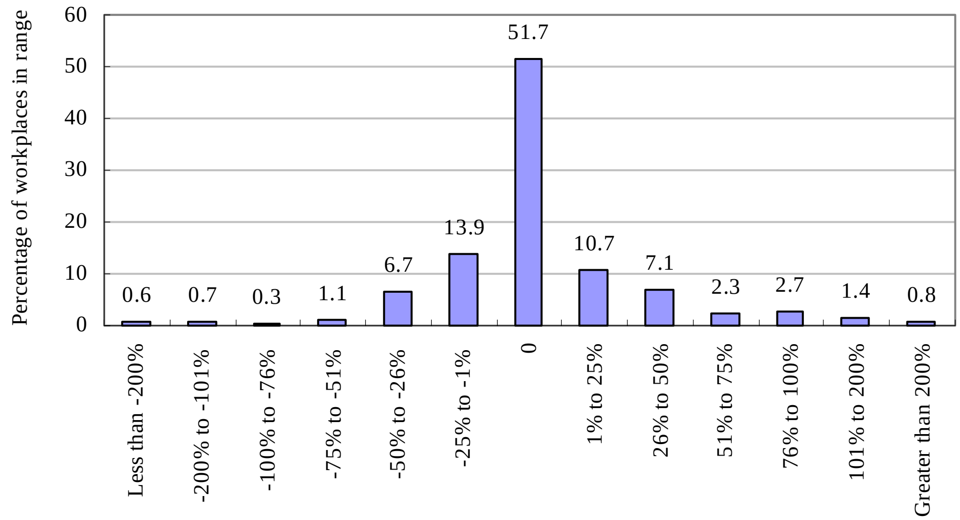
The gross payroll per employee variable is calculated by dividing gross payroll by total employment for each plant. It is important to note that the total employment value used is for March 1999, the last month of the survey's reference period. This is in contrast to the total gross payroll value, which is for all employees at the workplace over the reference period, between April 1st 1998 and March 31st 1999 (or the total gross payroll for the past calendar year, the response depended upon the availability of the information to the respondent). The total gross payroll should be equivalent to the sum of the workplace's monthly taxable employment income reported on the T4 slip over the period chosen (see Appendix 4 for detailed survey questions).

The implicit assumption being made is that the total employment estimate is an average of mean monthly employment (over twelve months) for the respondent's chosen reference period. The use of total gross payroll and total employment measures to generate a gross payroll per employee estimate is only problematic if workplaces experience a drastic increase or decrease in the total number of employees at the end of the reference period. For example, a workplace that doubled its workforce in February would have a gross payroll per employee estimate that is approximately half of the average monthly gross payroll per employee for the reference period.

The gross payroll per employee measure of skill should not be problematic if changes in employment for each workplace are at the beginning of the reference period, as opposed to the end. Net changes in total employment early in the reference period will typically be accompanied by a similar change in gross payroll, and thus, the estimate of each measure over the period is comparable. Thus, the two questions to be answered are: Is total employment change sporadic (mainly occurring at the beginning of the reference period) or gradual? And what is the magnitude of the net change in total employment across workplaces?

Of the total 654,551 business sector workplaces represented in the survey, 56.6% reported new hiring and 56.6% reported some type of employment reduction. The possible sources of employment reduction are quits (no incentives), layoffs (no recall), special workforce reductions, dismissal for cause, and retirement (no incentive). From the possible additions and reductions to the workforce, 67.8% of workplaces have some type of change occurring to employment from either hires or reductions. Thus, 32.2% of workplaces report no hires and no reductions.

Figure A5.1 Net change in total employment over the reference period



The percentage change in total employment over the reference period, for each workplace, is calculated by dividing net change (new hires minus reductions) over the workplace's approximated total employment at the beginning of the period. Total employment at the beginning the reference period (April 1998) is estimated by taking total employment in March 1999, and subtracting net change.

In addition to 32.2% of workplaces reporting no hires and no reductions, 16.7% had a net change in employment of zero; thus, 51.7% of all workplaces had no change in total employment over the reference period (see Figure A5.1). Of the remaining workplaces, 25% had a positive and 23.3% had a negative net employment change. The majority of workplaces (76.3%) net change falls into the –25% and +25% range. Thus, the majority of workplaces do not have extreme changes in the level of total employment.

Due to the fluctuations in total employment over the reference period, it is important to have an indication of when the majority of the changes are occurring. The seasonality of many types of business will result in workforce variability over the reference period. Workplaces were asked to identify months of peak employment. For all workplaces, 31% reported monthly peaks in employment, and for most of these plants, the peaks were reported for the months June, July, and August (see Table A5.1). These peak months are within the first half of the reference period. As a result, it appears that the effect on total gross payroll from changes in total employment reaches a maximum at the beginning of the reference period and then declines over the remaining months.

Table A5.1 Workplaces reporting a peak in employment

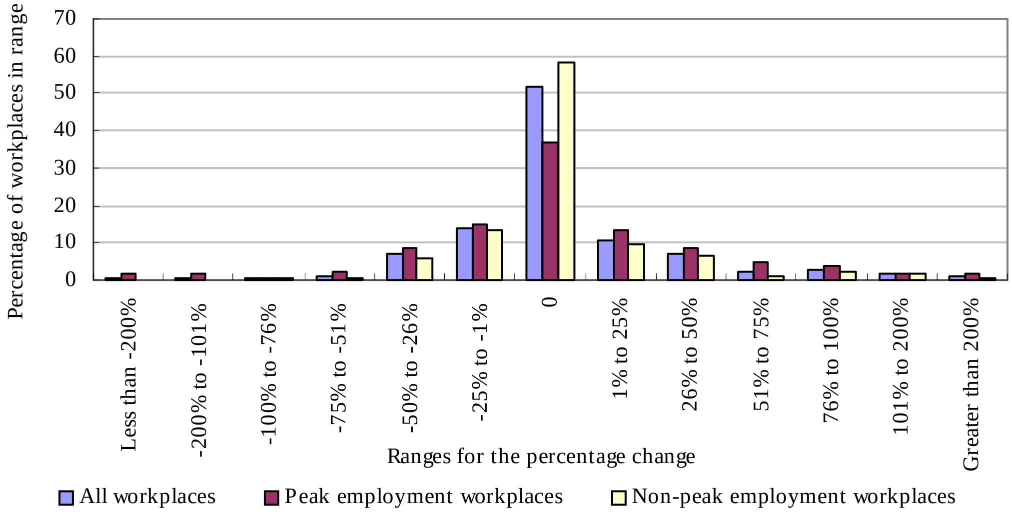
Peak in employment	Percentage	Count
Yes	31.0	203,103
No	69.0	451,448
Total	100.0	654,551
Of the workplaces that reported a peak in employment, the peaks were identified for the following months:[1]	Percentage[2]	Count
April	27.0	54,753
May	45.1	91,567
June	59.0	119,786
July	59.6	121,116
August	57.7	117,218
September	46.2	93,761
October	33.3	67,649
November	28.0	56,886
December	33.5	68,000
January	13.0	26,377
February	14.3	29,017
March	19.8	40,302

1. The reporting of peak employment is not mutually exclusive, workplaces can report peak employment in more than one month.
2. Percentage of workplaces reporting a peak in employment in the identified month.

A comparison of workplaces that report peak employment periods to non-peak employment plants shows that peak employment workplaces have greater variability in total employment over the reference period. Only 37.1% of peak employment workplaces, compared to 58.3% of non-peak, have no net change in total employment over the reference period (Figure A5.2). Further, the peak employment workplaces, on average, have higher percentage net total employment changes.

In summary, the employment data indicates that the use of total employment and total gross payroll to generate a gross payroll per employee estimate is not problematic. The majority of workplaces experience most of their employment change at the beginning of the reference period; and as a result, the net effects on total gross payroll come at the beginning of the period. Thus, the total employment and total gross payroll variables on average are comparable.

Figure A5.2 Change in total employment over the reference period: Comparison of peak and non-peak employment workplaces



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