

Skills Research Initiative

Initiative de recherche sur les compétences

Unionization, Training and Technology Related Skills Development

Richard Chaykowski (Queen's University)
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Working Paper 2005 B-05

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Abstract

This paper examines the relationship between unionization and the incidence and intensity of workplace training, technology usage, and technology-related training activity. The areas of training considered are as follows: basic training (including literacy and numeracy); occupational training (including professional, apprenticeship, and sales training); training related to human resource practices, such as team building, leadership and communication skills; and technology-related skills development, especially computer-based technologies. For each training type, both classroom and on-the-job training were examined. The empirical analysis utilizes both the employer and employee survey data from the *Workplace and Employee Survey*.

The results suggest that there is an association between unionization and technology usage, and between unionization and training, especially on-the-job training. The results also reveal that the association is somewhat complex. It depends on the type of training considered, and whether or not one considers the effect of establishment unionization versus whether or not an employee is covered by a collective agreement. For example, while a higher proportion of unionized establishments offered various types of training, a lower proportion of employees in unionized establishments received training. When we looked at employees, unionization is associated with a lower probability of participating in occupational and organizational classroom training, but is associated with a higher probability of participating in occupational and organizational on-the-job training. For basic training (such as literacy), unionization is associated with higher classroom and on-the-job training. Similarly complex results hold for technology related training: the probability of participating in classroom training is higher among unionized employees, but lower for on-the-job training; while in the event of technological change, the incidence of employee training is lower for unionized employees, but the training intensity is greater.

Taken together, the results suggest that unions serve as a significant mediating factor affecting training activity, technology usage, and the level of training activities among employees subject to technological changes. However, the nature of the effects varies. Policies aimed at affecting skills development in unionized establishments would likely require sufficient flexibility to account for these diverse effects. Several implications of these results for policies related to skills development are explored in the conclusions to the paper.

Résumé

Cette étude examine la relation entre la syndicalisation, l'incidence et la durée de la formation en milieu de travail, l'utilisation de la technologie, et la formation à caractère technologique. Les types de formation à l'étude sont les suivants : la formation de base, (incluant la littératie et la numéracie); la formation professionnelle (incluant la formation de spécialiste, d'apprenti et du domaine de la vente); la formation liée aux pratiques en matière de ressources humaines telles que la formation en travail d'équipe, leadership et communications; et le développement des compétences propres à la technologie, plus particulièrement les technologies informatisées. Les formations structurée et en cours d'emploi ont été examinées pour chaque type de formation à l'étude. Les données des employeurs et des employées de l'*Enquête sur le milieu de travail et les employés* sont utilisées lors de l'analyse empirique.

Les résultats montrent une association entre la syndicalisation et l'utilisation de la technologie, et entre la syndicalisation et la formation, en particulier la formation en cours d'emploi. Cette dernière association est plutôt complexe et dépend du type de formation étudié. Elle dépend également de l'effet de syndicalisation considéré lors des analyses, soit la syndicalisation de l'établissement ou de l'employé. Par exemple, alors qu'une plus forte proportion d'établissements syndiqués a fourni différents types de formation, une plus faible proportion d'employés oeuvrant dans des établissements syndiqués a participé à des activités de formation. Du point de vue des employés, la syndicalisation est associée à une faible probabilité de participer à de la formation structurée reliée à la profession et à l'entreprise, et une plus forte probabilité de participer à de la formation en cours d'emploi reliée à la profession et à l'entreprise. En ce qui concerne la formation de base, telle que la littératie, la syndicalisation est associée à davantage de formations structurée ou en cours d'emploi. Des résultats complexes sont aussi observés pour la formation à caractère technologique: la probabilité de participer à de la formation structurée est plus élevée pour les employés syndiqués mais plus faible pour la formation en cours d'emploi. Dans le cas d'un changement technologique, l'incidence de la formation est plus faible pour les employés syndiqués, mais la durée de la formation est plus grande.

L'ensemble des résultats suggère que les syndicats représentent un facteur de médiation important qui a un effet sur les activités de formation, l'utilisation de la technologie, et le niveau des activités de formation parmi les employés qui font face à des changements technologiques. Les effets sont multiples et divers. Les politiques publiques visant à inciter le développement des compétences dans les établissements syndiqués devraient être suffisamment flexibles pour tenir compte de ces effets divers. De nombreuses implications en matière de politiques publiques découlant des résultats sont explorées dans la conclusion de l'étude.

1. Introduction and Context

Human capital formation is generally taken to be a long run determinant of productivity growth in the economy. The importance of human capital development has been accentuated by the rapid technological change experienced in most workplaces. While formal education through the school system is one major component of human capital formation, employer-base training is another.

Technological change has been one of the major factors affecting the transformation of the Canadian labour market and workplaces. Computer-based technologies, for example, are now commonplace in Canadian and American workplaces. In Canada, in 1999 approximately 60% of Canadian employees used computers (Statistics Canada 1999). By 2001, approximately 54% of American employees used computers at work (Hipple and Kosanovich 2003).

Technological change has affected employment levels, altered skill requirements, and contributed to changes in the occupational distribution of employment. It has allowed management to reconfigure the way production and, hence, work is organized -- and how organizations are structured. While most observers agree that technological innovation has had substantial and positive labour market and workplace impacts over the long run, in the short run the firm-level impacts of technological change can involve deskilling, or job loss. The nature of the impact of technological change on skill levels, employment, and education and training, has, therefore, been the subject of controversy.¹

Firms have choices over the types and amounts of technologies they adopt and the manner in which they are introduced, but they may be subject to constraints on those decisions as well. One of the classic labour market institutions that can affect technology and training decisions is the union. The weight of the evidence to date appears to suggest that unionized establishments may be associated with greater technological advancement,

¹ For broader examinations of technology and its role and effects refer, for example, to Braverman (1974) and Dunlop (1958).

and that unions generally accept and adjust to technological change (see Keefe 1992:123,124). There is little in the way of empirical evidence that unionization *per se* is causally associated with either the adoption or diffusion of new technologies (e.g., see Keefe 1991; Taymaz 1991).² The adoption of new technologies also has implications for training and skills development, but again there is little in the way of empirical evidence on the relationship between unionization and technology-related skills development.

The purpose of this paper is to investigate the relationship between unionization, technology usage, and skill development. Our empirical analysis includes four aspects of unionization and training in Canada.

First we consider the determinants of training incidence and intensity. While we wish to characterize training establishments, our main interest here is whether or not unionization is associated with higher, or lower, training incidence and intensity. We focus on whether or not employees received formal classroom or on-the-job training.

Second, we examine the incidence of occupational training and whether or not unionization is associated with differences in training activity across establishments. The types of occupational training considered include managerial and supervisory, professional, apprenticeship and sales and marketing related training. A third purpose of this paper is to investigate the relationship between unionization and skills development that is related to human resources management and to the organization of work. The specific aspects of training considered here include group problem-solving, team building, leadership, communication, and occupational health and safety. Many of these types of training activities are undertaken by firms in order to increase their performance (productivity) and we expect that whether or not an establishment is unionized may impact human resource practices as well as the outcomes, if they are adopted.

One key aspect of human capital formation is the development of technology related skills in the workplace; typically, this is in the form of formal training that is undertaken

² Refer also to the review of research on unions and technology by Keefe (1992).

outside the firm, or informal or formal training on-the-job.³ In Canada, the presence of a union may have an important and substantial impact on technology related skills development in the workplace.⁴ We know, for example, that unions have been actively engaged in issues of skills development, training, and general education through the sectoral skills councils that now operate in a broad cross-section of Canadian industry.⁵ There is somewhat limited evidence, however, on the issue of whether unions support or hinder training at the workplace level. For the United States, Brown (1990:105-107) concludes that the evidence on unionization and training is “ambiguous.” In contrast, Tan et al (1992) examine a broader set of countries (including Australia, Britain and the US) and find that unionization is associated with a higher likelihood of training. More recently, Green et al (1999) come to a similar conclusion based on British evidence. For Canada, the evidence remains limited. An early study by Simpson (1984), for example, found no evidence of an effect of unionization on training duration.

Even so, we know from descriptive data that unions often negotiate collective agreement clauses regarding retraining rights, on-the-job training, and apprenticeship training (see Gervais 2002; Chaykowski and Lewis 1994: 20, Table 2). We also have some insights, derived from case study evidence, into the direct role that unions play in firm-level training programs. There is evidence that the role of unions in affecting workplace skills formation may be both direct and indirect. However, this descriptive data provides us with little understanding of the nature and extent of the impacts of unions on technology related training outcomes in the workplace.

The fourth aspect of skill development that we consider in our empirical analysis includes unions and technology related skill development. Among technologies, we are especially interested in computer-based technology adoption and utilization, and computer-assisted

³ The development of human capital is recognized as crucial to both individual worker and to firm productivity. For individuals, the human capital formation is associated with earnings growth; human capital formation supports firm productivity and, hence, macroeconomic growth; see Becker (1975) and Mincer (1974).

⁴ The decision to invest in training, and the amount of that investment, depends in general upon a number of factors, including the expected return on the investment, the availability of capital to invest, etc. Another important factor that affects these two decisions is the organizational context.

⁵ See Chaykowski (1998) specifically, and Gunderson and Sharpe (1998), generally.

design and manufacturing (CAD/CAM) technology. There is very little evidence on the factors affecting the adoption of these technologies in Canada, and even fewer results on the impacts of unions, although Betcherman (1988) found no effect of unions on the utilization of computer-based technologies. Our particular focus is on the question of whether or not unions are associated with a higher incidence or intensity of technology-related skill formation (e.g., training) in the workplace.⁶

In addition to considering the use of CAD/CAM systems, we also investigate which type of training best supported learning the technology (i.e., OJT, formal training, college or university training, etc.), whether or not employees are trained in the event of a change in the CAD/CAM technology; and, how much time was spent training in the event of a change in that technology.

The study begins, in the next section, with a framework for considering the effect of unionization on workplace training and technology adoption. The framework is presented in the context of the industrial relations and economics literature regarding unions and technology in the workplace. The main segment of the paper is an empirical examination of unions, training, and technology-related skills development, with a focus on computer-based technologies. The empirical analysis includes four main aspects of unions and training: unions and the incidence and intensity of workplace training; unions and occupational training; unions and training associated with human resources practices and organizational skills; and unions and technology-related skills development. The empirical analysis concentrates particularly on unions and training associated with computer-based technologies. The empirical analysis utilizes both the employee and employer surveys of the *Workplace and Employee Survey* (WES) to consider these issues.

The results shed new light on the basic issue of the role of unions in a variety of workplace centered training activities, especially computer-based technology adoption

⁶ By the incidence we mean whether or not technology is used and by intensity we mean time spent per week using computer applications.

and related skill formation within workplaces. Several policy matters illuminated by this research include whether or not unionization is associated with differences across employees in technology usage and whether or not unions influence the types of technology related training employees receive. The paper concludes with a discussion of the main results and consideration of these policy issues.

2. A Framework for Considering the Effect of Unionization on Training and Technology Adoption

Our analysis is focused on unions and training and, especially, on the possible effects of unions on training associated with the adoption and use of new technologies. We expect the effects of unions on technology-related training to be linked, however, to union effects on the technology adoption decision itself, so we begin by considering unions and technology adoption. In this section we consider the contributions of both industrial relations and economics to understanding the possible effects of unions on training, and on training associated with the adoption of new technologies. There is no single theory, however, of the impact of unions on training, training associated with new technologies, or unions and the technology adoption decision of firms.

2.1 Industrial Relations Perspectives on the Impacts of Unions on Training and Technology

The classical industrial relations connection between labour unions and technology is provided by Dunlop (1958). Dunlop's "systems framework" conceptualizes technology as an environmental factor that essentially conditions or constrains the workplace and employment outcomes generated through labour-management relations. Kochan, Katz and McKersie (1986) built upon this framework by introducing the importance of considering a strategic level of industrial relations activity. Thus management can strategically pursue their business and investment choices, including technologies and the way they are implemented in workplaces. These strategies can interact with, and be conditioned by such factors as work organization and human resource factors.

Typically, human resource practices such as training are thought of as being chosen to support the successful functioning of a production system. For example, management pursuing a strategy of improving product quality may require a highly skilled and motivated workforce, or the introduction of new technologies that, in turn, require a highly skilled workforce. Industrial relations theory yields little, however, in the way of

hypotheses about the expected effects of unions on training incidence or intensity, or technology adoption.

2.2 Economics Perspectives on Firm-Level Training, Technology and Unions

Economic theory views the training decision as a human capital investment. The notion being that the training investment is undertaken when the discounted value of the expected net returns exceed the costs. Of course, the firm/worker decision to invest in training is complicated by considerations of whether the training is “general” or “specific;” how the shares of the costs are borne and returns captured by the firm and worker, respectively; and, issues such as turnover. Unions would be viewed as potentially affecting these types of considerations, which would therefore impact the decision to undertake firm-level training. Training associated with technological change is further complicated by the fact that unions can affect the technology adoption decision itself. Unions are considered to have potentially positive and negative workforce effects on skill levels associated with new technologies – both of which are typically present when the technological adoption decision is made.

At the macro-economic level the focus of economic theory is generally on the role of technology in economic growth. Economic theory views technology as defining or being embedded in the firm’s production function, at the micro-level. The issue of management choice of technology at the firm level is not typically considered in the context of labour market outcomes. The focus, instead, is on the effects of changes in relative factor prices. For example, unions could raise wages, thereby inducing a change in the relative utilization of labour and capital. In this case, technology may be viewed as embodied in the capital that is employed by firms.

There are several alternative possible economic explanations for the expected effects of unions on the adoption of new technology and on technology-related training (e.g., see Keefe 1992; 1991). Two of the main explanations relate to the union relative wage effect and the ability of unions to impose direct costs of disagreement on management.

Higher labour costs associated with unionization, arising from the union wage premium, or from costly work rules and regulations in collective agreements, may induce firms to substitute capital for labour in the longer run. In this case, unionization would be associated with greater technology utilization. Further, as Keefe (1991:262) points out, union facilitation of voice may reduce turnover (see Freeman and Medoff 1984) which makes training investments required by new technologies attractive. In the event of technological change, unions may negotiate contract provisions that require the employer to (re)train employees who are displaced, or upgrade the training of workers using the new technologies.

Alternatively, unions may inhibit the introduction of new technologies (see Keefe 1991). Union staffing and other work rules may make investments in new technology too difficult or expensive for firms to pursue. Unions may also simply impose costs at the bargaining table by negotiating expensive severance, retraining and relocation packages for workers displaced or otherwise affected by technological change.⁷ Slichter, Healey, Livernash (1960:371) identify several classic responses that unions have put into practice:

“Three principal effects have been produced by union policies toward technological changes: (1) They have tended to give to the holders of jobs on the new machines or new processes somewhat higher wages relative to other workers in the same plant ... (2) They have tended to a slight extent to cause the new techniques to be operated with excessive crews and under make-work rules. (3) They have considerably eased the hardship of displacement...”

⁷ Alternatively, the fact that profitability is lower under unionism (see Menezes-Filho 1997; Bronars, Deere and Tracy 1994; Hirsch 1991; Freeman 1986) may either limit the financial capability of firms to invest in new technology or discourage such investment. Keefe (1991:262) explains:

“In union rent-seeking models, one source of union gains is the capture of quasi-rents flowing from sunk investments. As a result, a union firm is likely to maintain old and inefficient capital in order to moderate wage demands. The union capture of quasi-rents will ... deter new investment.”

While these responses may cushion the impacts of technological change on employees, they also impose costs on employers.

In the context of the past two decades, much of the technological change has been upward skill-biased, which tends to support higher wages (regardless of whether or not an establishment is unionized).⁸ Thus there are potentially positive impacts of technological change on skill levels and wages (or other working conditions such as health and safety) that unions would generally be expected to favour.⁹ Unions may also be concerned with technological change that deskills, in which case the union reaction would likely focus on (re)training.

2.3 A Framework for Considering the Impacts of Unions on Training in the Context of Technology Adoption

A framework for considering the role of training as part of a strategic response by management to respond to environmental pressures is presented in Figure 1. Firms have come under significant pressures related primarily to increased competition arising from such developments as the globalization of markets, deregulation, and privatization. This induces firms to formulate business strategies to address the competitive pressures, typically by initiating some combination of responses including improving product quality, reducing costs of production (especially labour costs), and increasing productivity (path A). These objectives can be implemented by means of several strategic management responses including (path B):

- adjusting wages and employment levels (to achieve cost reduction);
- adjusting capital intensity (to achieve cost reduction and increased productivity);
- adjusting technology (to achieve improved product quality, reduce costs and increase productivity); and

⁸ See, for example, Autor, Katz and Krueger (1993) and Bound and Johnson (1992).

⁹ There is some evidence, for example, that some types of technological change may affect the magnitude of the union wage premium across skill groups of workers (Betcherman 1991).

- adjusting work organization and human resource management practices (to achieve improved product quality, reduce costs and increase productivity).¹⁰

These strategic management responses can be, and in practice often are, utilized in conjunction with each other.

In the case of introducing new technologies, employee training may be required. For example, adjusting the capital intensity of production over the long run is often associated with changes in technology that require new employee skills. On the one hand, new technologies may result in deskilling. This was a hallmark of Tayloristic industrial production models that had the effect of “engineering skill and decision-making out of the production process” and that dominated much of the 20th century (e.g., see Cappelli et al 1997). However, recent technological advances, often closely associated with computer-based technologies, have often increased skill requirements (e.g., see Autor, Katz and Krueger 1997). This suggests that both a shift toward the employment of higher-skilled workers as well as increased training have occurred.

A major focus of this paper is training incidence and intensity associated with the utilization of technology by firms. The key issues that we consider are the impacts that unions may have on training related to the usage of (computer-based) technology and on the training required to learn newly introduced technologies. Our framework for considering the role of unions as a mediating factor affecting training associated with technology adoption and utilization is presented in Figure 2.

The initial condition for the framework is that firms generally adopt technological advances in order to achieve product quality, cost, or productivity improvements. We may assume that, for the most part, this is in response to increased competitive pressures, or a desire to increase market share, or to achieve some other objective. We assume that

¹⁰ For evidence on the impacts of work practices on productivity see, for example, Black and Lynch (2001) and Cappelli and Neumark (2001), Ichniowski, Shaw, and Prennushi (1997), Huselid (1995), and the review by Gunderson (2002).

changes in the firms' technology will generally require adjustments to work organization and/or human resource practices (for example, training).

These changes in human resource practices arising from technological change could, however, coincide with a strategic management decision to alter work organization and human resource practices to achieve higher firm performance – for any *given* technology. In practice, changes in human resources practices arising from either technological change or from some independent strategic choice to utilize a different human resources management system would likely be intrinsically inter-related and, therefore, difficult to empirically disentangle.

Concentrating on adjustments to work organization and human resource practices associated with technological change, we assume that there are essentially two pathways that generate different organizational and human resources outcomes, such as training:

- first, a pathway in which unions, collective bargaining and the collective agreement mediate the introduction of new technology, and associated training outcomes such as the incidence and intensity of training (paths U1, U2 and U3); and
- second, a nonunion alternative in which only management human resource strategy determines training outcomes arising from technological change (paths NU1 and NU2).

As noted above, unions may be supportive of some of the long run benefits of technological change to employees (e.g., higher skills and wages; improved working conditions). But technological change may have significant undesirable impacts on skills and on job security in the short run, making adjustment issues particularly relevant to workers – hence the traditional union emphasis on adjustment responses such as (re)training and severance packages for redundant employees. Slichter, Healey, Livernash (1960:346,347) identify the effects of the technological change as a key factor influencing union reaction:

“Three factors are of utmost importance to the unions: (1) the effect of the change on the number of jobs on the process or in the bargaining unit; (2) the effect on the degree of skill and responsibility of the employees; and (3) the effect on the kind of skill or other qualifications required to do the work.”

Given union concerns over the potential short run employment impacts of technological change, there is some expectation that unions may oppose technological change associated with a high potential for labour displacement.¹¹ Keefe (1991:273) concludes, that:¹²

“...the most common response of unions to new technology has been willing acceptance, which tacitly recognizes management’s right to implement new technology. Historically, American unions have been most concerned with protecting their members’ employment and income security, and not with preventing change or impeding management initiatives for modernization.”

In the case of unionized organizations, we expect union power through collective bargaining to generate workplace rules and contractual obligations in the event of technological changes that essentially serve to constrain managerial prerogative to make technology adjustments.¹³ In turn, management’s approach to introducing new technologies, or the choice of technology, could be influenced by their observation of employee concerns or resistance, especially as mediated by a union and the collective

¹¹ See, for example, Link and Siegal (2002) on technological change in the U.S. Coal industry.

¹² Slichter, Healey, Livernash (1960:344) characterize five general union responses to technological change, although the main reactions include “acceptance,” “opposition,” and “adjustment.”

¹³ Of course, individual employees’ attitudes toward technological change, and hence the desired union response, are shaped by the effects on their work and employment terms, including skill requirements, wage levels, and job security (e.g., Gattoker and Paulson 1999). Therefore, union influences may result from some combination of union objectives that are formulated on the basis of institutional considerations independent of the concerns of the employees represented by the union, and of union objectives that are formulated more directly on the basis of employee workplace concerns.

agreement.¹⁴ For example, the union may not be indifferent between the types of technology that are implemented or the amount of training provided by the employer. There clearly exist both positive and negative workplace effects of technological change from the perspectives of unions and workers. This suggests that the *net* effect on training incidence and intensity would vary across establishments. Even so, where production technologies are common within an industry, and technological innovations are similar, we may expect the net effects to be comparable across unionized firms within an industry over time.

¹⁴ For example, see Bemmels and Reshef (1991) on the importance of unionization and collective agreement clauses relating to technological change as a determinant of managerial views of the resistance of employees.

Figure 1: Environmental Pressures and Firms' Strategic Responses

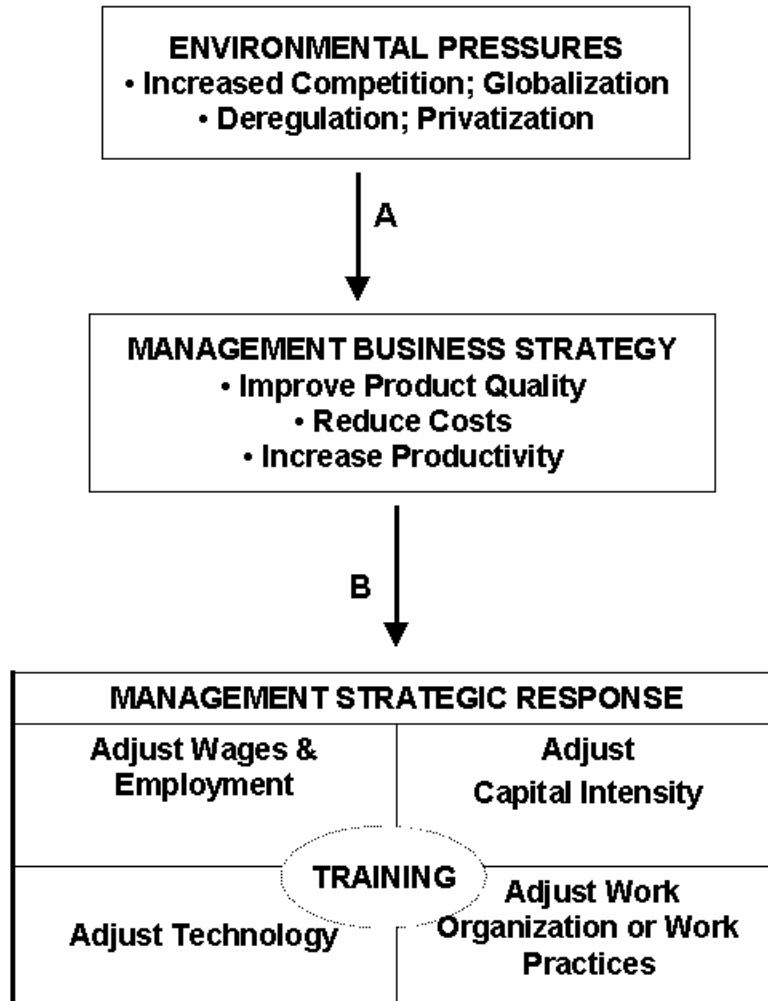
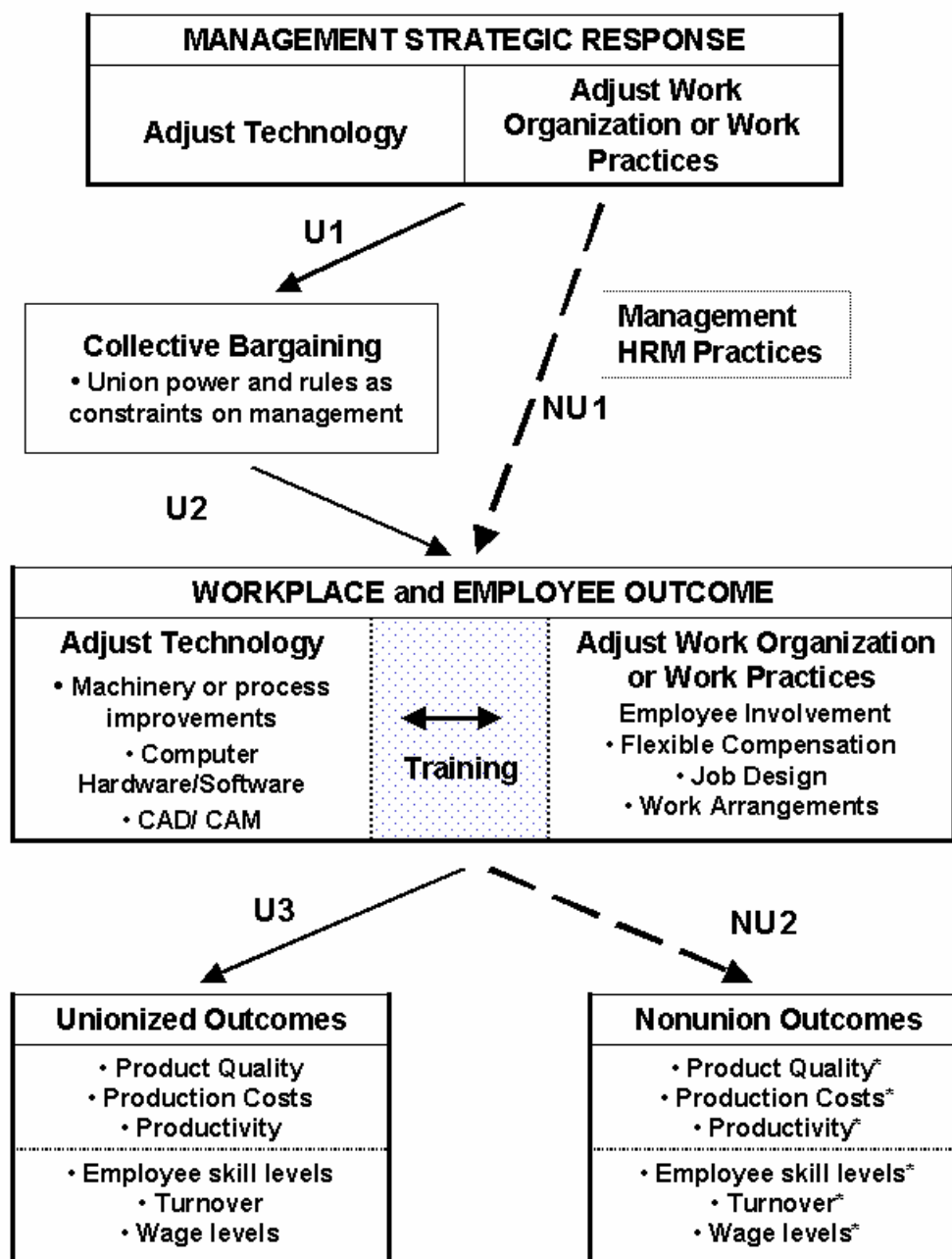


Figure 2: Technology Adoption and Unionization as a Mediating Factor



3. Data and Methodology

3.1 The Workplace and Employee Survey Data and Sample

The basis of the analysis is both the employee and employer surveys from the 1999 Workplace and Employee (WES). We imposed no exclusionary restrictions on the employee sample, so that all employees are included in the analysis. Not-for-profit firms and firms that had not completed a fiscal year in 1999 were excluded from the establishment sample. The employee sample includes approximately 23,540 workers, 28 per cent of which are unionized. From the WES employer file, there were roughly 5401 establishments, of which 26 per cent had employees who were unionized.¹⁵ In our analysis, workers are considered unionized if they are covered by a collective agreement; and an establishment is considered unionized if there is at least one bargaining unit at the establishment.

We expect firm characteristics such as firm size, innovation in production, the type of work organization utilized in an establishment, and industry in which the firm operates, to affect the type, incidence and intensity of workers' training. We also expect such characteristics to affect the likelihood that workers will use computer-based technologies and, given an employee uses a computer-based technology, the time they spend working with it and the training they receive on it. Consequently, in the analysis we also utilize workplace characteristics and practices derived from the establishment component of the WES. We identify these firm characteristics in the establishment survey and link these variables with the employee data.¹⁶ This creates a cross-section data set that includes employee-establishment matched observations. The final data excluded firm records for which the employer information could not be matched to an employee. The final employee weight was used in employee sample analysis and the establishment-employee

¹⁵ Note that in the WES, more than one establishment can correspond to the same firm, because the establishment is a unit of observation, not the firm.

¹⁶ First, we merged establishment data on federal jurisdiction (which is separate) with the workplace data. Then the workplace information was merged with the employee data. That is, information on the employee's workplace was attached to the employee record.

linked sample analysis; the final employer weight was used in the establishment sample analysis.

The focus variables from the employee sample are included in Table 1. These include variables that indicate whether or not employees received formal classroom training in the past 12 months, whether or not employees received on-the-job training in the past twelve months, technology usage, and the best methods of learning various computer-based technologies.¹⁷ The sets of variables relating to employees' employment characteristics, personal and demographic characteristics, and occupation, industry, and region of employment, along with their definitions, are provided in Table 2. From the employer data file, we constructed sets of variables related to whether or not classroom training was offered to employees, whether or not on-the-job training was offered to employees, and whether technological change (involving computer-based technologies) has occurred (refer to Table 3).¹⁸ The groups of variables relating to establishment institutional characteristics, financial and business characteristics, workforce characteristics, and technology and innovation are presented in Table 4.

One of the strengths of the WES is that it includes establishments across the full range of sizes. In the usable sample used for this analysis, roughly 88 % of establishments had 19 employees or less, 10.5% had 20-99 employees, 1.4% had between 100 and 499 employees while 0.1% had 500 or more. On the other hand, approximately 36% of workers were employed at establishments with 19 employees or less, 31% at establishments with 20-99 employees, 21% at establishments with 100-499 employees, and 12% at establishments with 500 or more employees. The samples include employees and establishments across all industries and all regions of Canada. Employees cover all major occupational groups, education levels, age and experience groupings, and usual weekly hours of work. Refer to Table 5 for descriptive statistics of establishments included in the sample. Refer as well to Table 6 for complete employee characteristics by

¹⁷ The survey questions underlying the construction of these variables are included in the notes to Table 1.

¹⁸ The survey questions underlying the construction of these variables are included in the notes to Table 3.

union status and to Appendix Table 1 for characteristics of the establishments at which those workers are employed.

3.2 Analytical Approach and Methodology

The organization of the empirical analysis follows the four areas identified above in the introduction. These four areas include unions and each of: the overall incidence and intensity of workplace training; occupational training activity; training related to human resources practices and organizational skills; and technology-related skills development.

In each of these four areas, we use the WES to consider the relationship between unionization and *incidence* and, for some aspects of training, the *intensity* of training, in a regression framework. Using the *employee* data, we can examine the incidence of training by defining a variable that takes a value of one if the employee trains and a value of zero otherwise. The *intensity* of usage is measured as the time spent training (for example, hours).

In each of the four areas, the analysis begins with a general characterization of unions and training incidence and intensity based upon descriptive statistics. The descriptive analysis also considers training among employees by various demographic, employment history, occupational, industrial and workplace characteristics. The core of the analysis, however, is to estimate a regression model in which training incidence or intensity is the dependent variable.

We expect the training of employees, whether or not it is related to computer-based technologies, and the number of hours they train, to be a function of demographic characteristics (e.g., birth origin; sex), personal characteristics that affect worker access to training, the potential returns to training, or productivity (e.g., years of experience in the labour market, occupation, with the employer, and at their current job; education) as well as establishment factors (firm size; innovation in production or products; work organization; and industry). In addition, we expect the union status of employees to affect

training incidence and intensity.¹⁹ We exploit the employee-establishment linked aspect of WES by the inclusion of relevant establishment characteristics as control variables in the regression analysis (e.g., Frazis et al 1998) of the determinants of employee *incidence* and *intensity* of usage of computer (or other technology). Refer to Tables 1 through 4 for a complete definition of each of the employee-specific variables and for definitions of the workplace characteristics that apply to the individual workers' workplace.

For each regression, we estimated two specifications. The first specification is a basic one that includes a vector of demographic characteristics, personal characteristics, union status, and a set of occupational control variables as well. The second, full specification, includes the full set of employee and workplace characteristics. As pointed out by Abowd and Kramarz (1999, 2661)

“The omission or aggregation of one or more of the [individual specific or firm specific] effects ... can change the meaning of the other effects in important and subtle ways that are not always clear from the specific equation that various authors have estimated. Variations in the set of conditioning effects, which gives rise to omitted-variable biases, are one source of confusion about the interpretation of the statistical parameters.”

Although we present the results for the employee sample, for purposes of comparison, our conclusions will be based on the establishment-employee linked sample (full specification).²⁰

¹⁹ For individual workers we define union status as covered by a collective bargaining agreement.

²⁰ In part, the rationale for a stepwise regression approach was to obtain results that are comparable with the existing literature. Industry and occupation controls are often used in the existing literature to partially capture omitted firm characteristics that are correlated with wage or computer use. In the case of the wage equation, controlling for occupation may not be appropriate. As pointed out by Krueger (1993: 39) “one would probably not want to control for whether a worker is in the computer programming occupation while estimating the effect of computer use on earnings.” This is because workers with computer skills might also be qualified for jobs in industries and occupations that pay higher wages.

In each of the regression equations, the union status variable is the key focus variable. While we expect union status to be an important determinant of employee training, since we control for a fairly large number of workplace characteristics not generally available in previous studies, we expect the magnitude of any effect to be smaller than we might otherwise suppose. Our expectations for the signs of the key workplace explanatory variables, including firm size, innovation, and work organization follow largely from our framework of union effects on technology. In what follows, we outline our estimation approach to the regression analysis used in each of the four areas of the analysis.

A. Unions and the Overall Incidence and Intensity of Training

In this first segment of the analysis we focus on the overall prevalence of training activity and how training varies according to the characteristics of workers and their workplaces. We are primarily interested in estimating the determinants of the firm's decision to train workers and the employee's decision to participate in a given training activity. We consider both classroom and on-the-job training in both decisions.

For the firm's training decision, first we estimate the firm's decision to offer either classroom or on-the-job training. This is accomplished by Probit estimation of

$$t_j = x_{1j}\beta_1 + e_{1j}$$

where $t_j = 1$ if the firm provides classroom (on-the-job) training and equals 0 otherwise; x_{1j} is a vector of explanatory variables that affect the decision to provide employer-sponsored training; β_1 is the corresponding coefficient vector; and, $e_1 \sim N(0,1)$ is an error term.

Next we use ordinary least squares (OLS) to estimate the determinants of the proportion of employees receiving training (p_j). The model is

$$p_j = x_{2j}\beta_2 + e_{2j}$$

where x_{2j} is a vector of explanatory variables that affect the proportion of the employees receiving training; β_2 is the corresponding coefficient vector; and, $e_2 \sim N(0, \sigma)$ is an error term.

We then estimate the employee's decision to participate in either classroom or on-the-job training as a Probit model:

$$et_i = x_{3i}\beta_3 + e_{3i}$$

where $et_i = 1$ if the employee participates in employer-sponsored classroom (on-the-job) training and equals 0 otherwise; x_{3i} is a vector of explanatory variables that affect the employee's decision to participate in employer-sponsored training; β_3 is the

corresponding coefficient vector; and, $e_3 \sim N(0,1)$ is an error term.

B. Unions and Occupational Training Activity

In this component of the analysis we consider the incidence of occupational training, including managerial and supervisory training, professional training, apprenticeship training, and sales and marketing training. For occupational training, we also consider the firm's decision to offer training as well as the employee's decision to participate in such training.

First we estimate the firm's decision to offer either occupational classroom or on-the-job training through a Probit estimation of

$$t_j = x_{1j}\beta_1 + e_{1j}$$

where $t_j = 1$ if the firm provides occupational classroom (on-the-job) training and equals 0 otherwise; x_{1j} is a vector of explanatory variables that affect the decision to provide occupational employer-sponsored training; β_1 is the corresponding coefficient vector; and, $e_1 \sim N(0,1)$ is an error term.

Similarly, we also estimate the employee's decision to participate in either occupational classroom training, or on-the-job training, as a Probit model:

$$et_i = x_{3i}\beta_3 + e_{3i}$$

where $et_i = 1$ if the employee participates in employer-sponsored occupational classroom (on-the-job) training and equals 0 otherwise; x_{3i} is a vector of explanatory variables that affect the employee's decision to participate in occupational employer-sponsored training; β_3 is the corresponding coefficient vector; and, $e_3 \sim N(0,1)$ is an error term.

C. Unions and Training Activity Associated with Human Resources Practices and Organizational Skills

The third component of the empirical analysis focuses on training activity associated with a set of organizational or human resource practices that would be aimed at increasing the productivity of the workforce. These activities include group decision-making or problem-solving, team building, leadership skills, communications skills, and health and safety and environmental training. We focus on the incidence of these types of training and, as with the other areas of training, with the firm's decision to provide organizational and human resource practices training and the employee's decision to participate in these types of training activities.

We first estimate the firm's decision to offer organizational and human resource practices training (formal classroom or on-the-job training) using a Probit model

$$t_j = x_{1j}\beta_1 + e_{1j}$$

where $t_j = 1$ if the firm provides organizational and human resource practices classroom (on-the-job) training and equals 0 otherwise; x_{1j} is a vector of explanatory variables that affect the employer's decision to provide training related to organizational and human resource practices; β_1 is the corresponding coefficient vector; and, $e_1 \sim N(0,1)$ is an error term.

We also estimate the employee's decision to participate in either classroom or on-the-job training in the area of organizational and human resource practices as a Probit model:

$$et_i = x_{3i}\beta_3 + e_{3i}$$

where $et_i = 1$ if the employee participates in employer-sponsored organizational classroom (on-the-job) training and equals 0 otherwise; x_{3i} is a vector of explanatory variables that affect the employee's decision to participate in organizational employer-sponsored training; β_3 is the corresponding coefficient vector; and, $e_3 \sim N(0,1)$ is an error term.

D. Unions and Training Activity Associated with Technology-Related Skills Development

The focal point of our analysis in this section is training activity associated with the use of computer-based technologies. The specific activities in which we are interested include computer usage, the utilization of software applications by employees, the time spent by employees using computers, and employee training on other computer-based technologies, specifically, CAD/CAM.²¹

Technology Usage

We begin by descriptively characterizing the use of computers and computer applications by employees, including what applications are used, the most helpful method for learning applications, and where most of the learning of the applications occurred, as a function of employee characteristics such as gender, education, and union coverage. Several aspects of computer-based technology are considered, including the usage of computers, CAD/CAM technologies, and “other technologies.” The “incidence” of computer or CAD/CAM technology usage is defined as whether or not computers or CAD/CAM are used by an employee. In addition to the incidence of technology usage, we examine the “intensity” of usage, defined as the time spent per week using a computer application, CAD/CAM technology, or “other technology.” The issues we examine are whether or not there are differences the incidence of computer and CAD/CAM technology usage by union status, and whether or not unionization is associated with different intensity of utilization.

Technology and Training

We also consider employee training on various technologies.²² Here we investigate the incidence of employer-sponsored classroom and on-the-job training as well as employee participation in these types of training.

²¹ We use the term CAD/CAM as a short hand to denote computer-controlled or computer-assisted technology (e.g., industrial robots, retail scanning systems, CAD/CAM).

²² A sixth category “other” has been excluded from consideration due to the low response rate.

We then consider training and technological change by examining the incidence of technological change, including technological change in CAD/CAM and “other technologies,” whether or not employees are trained in the event of a change in the technology, and examining how much time was spent training in the event of a change in that technology. Finally, we consider the incidence of employee training in the event of technology upgrades in CAD/CAM or “other devices” and the training intensity (measured as days of training) for technology upgrades. In each case, we consider whether or not these outcomes differ according to union status.

Modeling Approach

In the model we use in our empirical analysis, we begin by considering the firm’s decision to implement or adopt a technology and its decision to provide training to workers. We then examine the duration of training received by workers when the technology they use is upgraded or changed.

We expect that the firm will make the technology adoption (implement/upgrade/change) decision and the duration of training decision simultaneously. Firms choose to adopt a technology when the benefits of adoption outweigh the costs of adoption. Whether or not training is provided and, if provided, the duration of the training will enter the cost side of the cost-benefit calculation when the firm is deciding to adopt a new technology. Similarly, whether or not a new technology is adopted will affect the decision to provide training.

As researchers, however, we only observe the firm's training duration decision (and other associated costs of adopting a technology) given the firm adopted the technology. If firms made the adoption decision randomly we could ignore the fact that not all training decisions are observed. However, as argued above, it is unlikely that the firm's adoption decision is made independent of the training decision. Consequently, rather than

estimating a simultaneous equations models we are forced to estimate a sequential-decision model.²³

Given we need to use a sequential-decision model approach, the first decision made by the firm is whether or not to adopt a new technology. This decision is made at the firm level by management as part of a strategic response by management to respond to environmental pressures; although, in a unionized environment, the union preferences would also be taken into account. The adoption decision can be estimated using the Probit technique.

The second decision, given the firm has adopted the technology, is how much training to provide to workers assigned to use the technology. Hypothetically the firm's preferred amount (duration) of training to provide workers can be non-negative or negative. In practice the researcher will only observe duration of training values zero or greater. A positive value will be observed when workers need to be trained in order to use a new technology. A value of zero will be observed when the technology change was such that the worker does not require any additional training to use the technology; or, if beneficial, does not receive any additional training.²⁴ In cases where training would have been productive, but workers do not receive any additional training, the duration of training provided to workers can be thought of as taking on a negative value due to the depreciation of firm-specific human capital. The point is that, at least hypothetically, the duration of training variable can take on negative values.

Estimation Approach

First we estimate the firm's technological adoption decision. This is accomplished by Probit estimation of

$$a_j = x_{1j}\beta_1 + u_{1j}$$

where $a_j = 1$ if the technology was adopted and equals 0 otherwise; x_{1j} is a vector of

²³ See Maddala (1983: 278-283).

²⁴ This would be the case if the costs of training outweigh the benefits of training and training was not a mandatory requirement to use the technology.

explanatory variables that affect the adoption decision; β_1 is the corresponding coefficient vector; and, $u_1 \sim N(0,1)$ is an error term.

Next we estimate the firm's duration of training (y_j). The OLS model²⁵ is

$$y_j = x_{2j}\beta_2 + u_{2j}$$

where x_{2j} is a vector of explanatory variables that affect training duration; β_2 is the corresponding coefficient vector; and, $u_2 \sim N(0, \sigma)$ is an error term.

We assume that, when the firm makes the decision to adopt a technology, the firm knows which skill groups will be affected by the decision. That is, the adoption of a given technology by the firm is not necessarily applicable to all skill groups; for example, a newly adopted CAM technology may only be utilized by production employees (not other occupational groups such as clerical/administrative). On the other hand, a more "general purpose" technology, such as computers, may be used by many occupational groups. In addition, the complexity of the adopted technologies (which will affect training requirements) may also vary across skill groups (human capital groups). Consequently, we control for education and occupation in our analysis.

Above we discussed the firm's decision to adopt a technology, and the duration of training to provide, given the technology is adopted. We next present the empirical model from the workers viewpoint.

When a firm upgrades or changes a technology, workers using the technology may be eligible for training. In a nonunion environment management makes the decision. In a union environment the decision is made by management in consultation with the union and constrained by the clauses in the collective bargaining agreement (or CBA; for

²⁵ Another possibility is to use a Heckman two-step procedure. As discussed above, the firm's training decision depends upon whether or not a new technology was adopted. That is, positive values of y_j are only observed if the technology was adopted ($x_{1j}\beta_1 + u_{1j} > 0$). Consequently, we could include inverse Mill's ratio calculated in step 1 as an additional explanatory variable in the duration of training equation. Evidence is mixed on which procedure will perform better. Hay, Leu and Rohrer (1987) and Manning, Duan and Rogers (1987) find Monte Carlo evidence that OLS (or Tobit) may perform better than the Heckman procedure.

example, an education and training clause or technological change clause). As discussed above, data constraints force us use a sequential-decision model.

We estimate the upgrade/change decision using a Probit model of the form

$$C_i = z_{1i}\alpha_1 + v_{1i}$$

where $C_i = 1$ if the technology used by individual i is upgraded or changed and equals 0 otherwise; z_{1i} is a vector of explanatory variables that affect the upgrade/change decision; α_1 is the corresponding coefficient vector; and, $v_1 \sim N(0,1)$ is an error term.

Next we estimate the duration of training (y_i) received by the worker. We will specify an OLS model.²⁶ The model is

$$y_i = z_{2i}\alpha_2 + v_{2i}$$

where z_{2i} is a vector of explanatory variables the affect training duration; α_2 is the corresponding coefficient vector; and, $v_2 \sim N(0, \sigma)$ is an error term.

²⁶ See previous footnote.

4. Unions, Employer-Based Training, and Technology Related Skills Development

In this section we present and assess the empirical results for the incidence and intensity of training, especially training related to the usage of computer-based technologies and technological change. We begin with a brief portrait of establishment and employee training activity. Following the organization of the analysis described in Section 3 above, we then proceed to assay the results obtained in our empirical analysis of unions and the overall incidence and intensity of workplace training, occupational training activity, training related to human resources practices and organizational skills, and technology-related skills development.

4.1 Profile of Training Activity

As the data in Table 5 illustrates, the proportion of *establishments* offering of on-the-job training (at 45%) is higher than the proportion offering classroom training (at 29%). A larger proportion of unionized establishments offered either classroom (45%) or on-the-job training (60%) than the proportion of nonunionized establishments (at 28% and 44%, respectively). This pattern of results in which a larger proportion of unionized establishments offer training is consistent across types of classroom and on-the-job training, including occupational courses, organizational courses, and courses related to technology. Interestingly, across establishments, the proportion of employees receiving classroom and on-the-job training was higher among nonunionized establishments.

A mixed pattern of results is observed when one considers the proportion of *employees* who reported receiving different types of training by union status. As illustrated by the data in Table 6, around 12.7% of nonunionized workers received occupational *classroom* training compared to 10.8% of unionized workers; but around 28% of unionized workers received occupational training *on-the-job*, compared to 24.7% of nonunionized workers. For training related to organizational practices, a higher proportion of unionized workers received classroom training but a much higher proportion of nonunionized workers

received this type of training on-the-job (15.4% among nonunionized compared to 8.8% for unionized workers).

Approximately 61% of all workers use a computer at work, 12% use CAD/CAM, while 27% use some other computer-based technology (refer to Table 6). But a higher proportion of unionized workers received either classroom or on-the-job training related to the technology. For both unionized and nonunionized workers, the largest proportion of workers found on-the-job training to be the best method of learning computer applications, CAD/CAM technologies, and “other” technological devices.

It would appear, then, that the results for training across *establishments* are consistent. In general, a higher proportion of unionized establishments offered various types of training. But a lower proportion of employees in unionized establishments received training.²⁷ Considering employees, whether or not a higher proportion of unionized, versus nonunionized, employees received training depends upon the specific type of training considered.

²⁷ Refer to Appendix Table 1 for descriptive statistics for establishments in which workers in the sample are employed, by union status of the employees.

4.2 Unions and the Overall Incidence and Intensity of Training

Both formal and informal training occurred in the previous 12 months among about one-third of employees. (Refer to Table 7.) The proportion of unionized and nonunionized workers reporting receiving on-the-job training was about the same (at about 30%). But more unionized workers reported receiving formal training (at 41%) than did nonunionized employees (at 35%). The results for correlations among the use of various computer-based technologies and formal and on-the-job training, respectively, suggest a positive association between the usage of these technologies and training (see Table 8). The positive association holds consistently for all employees, as well as for unionized and nonunionized workers, separately. This positive association between technology usage and training is expected, but provides little in the way of insight into the nature of the influence of unionization on training. We return to this issue in section 4.5 below when we consider in greater depth the issue of unions and training related to technology-based skills development.

The regression results for the incidence of employer-sponsored classroom training and on-the-job training are presented in Table 9. The results for the proportion of employees receiving employer-sponsored classroom and on-the-job training appear in Table 10. The likelihood of offering classroom or on-the-job training tends to be lower at smaller establishments and, consistent with this, the proportion of employees receiving employer-sponsored classroom or on-the-job training tends to be higher at smaller establishments (0-19, 20-99 employees). But the proportion of employees receiving training is lower at medium sized establishments (100-499) than at large establishments (500+). In addition, both the probability of classroom and on-the-job training being offered by an establishment, as well as the proportion of employees receiving such employer-sponsored training, is higher (lower) the greater the percentage of quits and new hires (layoffs). As expected, the likelihood of an establishment offering classroom and on-the-job training, and the proportion of employees receiving employer-sponsored classroom and on-the-job training, are higher the more technological change and innovation occurs.

Interestingly, whereas the probability of classroom or on-the-job training being available at an establishment is higher at establishments with an HR Unit, the proportion of employees *receiving* either employer-sponsored classroom or on-the-job training is lower at establishments with an HR Unit. In addition, the probability of classroom (on-the-job) training being offered is lower (higher) at unionized establishments. But the proportion of employees receiving employer-sponsored classroom or on-the-job training is higher at unionized establishments. Unionization is, therefore associated with a greater likelihood of on-the-job training, but the results for classroom training are somewhat ambiguous.

The results for the incidence of basic training, including orientation, literacy and numeracy training, are provide in Table 11a for the incidence of employer sponsored classroom and on-the-job training, Table 11b for the incidence of employee participation in classroom training, and Table 11c for the incidence of employee participation in on-the-job training. The results for the likelihood of establishments offering training and employees receiving training across establishment sizes, for establishment and employees using computer-based technology and experiencing technological change or innovation, and for establishments with an HR unit, are all consistent with the results obtained above for training incidence.

With regard to unionization and the incidence of training being offered at establishments, the probability of basic classroom training being offered is lower at unionized establishments, while the probability of basic on-the-job training being offered is higher at unionized establishments. A somewhat different picture emerges from the analysis of the incidence of employee participation in other basic classroom and on-the-job training.

From the estimation using the employee sample, we find that the probability of an employee participating in employer sponsored other basic classroom training is greater for employees covered by a CBA. Using the establishment-employee linked sample, however, we find that, while being covered by a collective agreement is still associated with a higher likelihood of participating in training, at establishments that are unionized,

the probability of any given employee participating in employer sponsored basic classroom training is lower relative to nonunionized establishments.

The results for on-the-job training are also interesting. Based on the estimation using the employee sample, the probability of an employee participating in employer sponsored basic on-the-job training is lower for employees who are covered by a CBA -- but using the establishment-employee linked sample, we find that the probability of any given employee participating in basic on-the-job training tends to be higher at unionized establishments.

While employees who are unionized have a higher likelihood of participating in classroom basic training, working in a unionized establishment is associated with a lower likelihood of participation in basic classroom training. In contrast, employees who are unionized have a higher likelihood of participating in on-the-job basic training, working in a unionized establishment is also associated with a higher likelihood of participation in basic on-the-job training.

4.3 Unions and Occupational Training Activity

Among all establishments, about 20% offered occupational classroom training, while 25% offered on-the-job training in this area (refer to Table 5). For both classroom and on-the-job training, a larger proportion of unionized establishments offered classroom and on-the-job training. The regression results for the incidence of employer-sponsored classroom and on-the-job occupational training in establishments are provided in Table 12. Table 13 provides the incidence of employee participation in occupational classroom training, for the estimation using the employee sample and the establishment-employee linked sample as well. Corresponding results for on-the-job training are provided in Table 14.

Notably, the results suggest that while likelihood of a firm offering occupational classroom or on-the-job training tends to be lower at smaller establishments, the probability of an employee participating in employer sponsored occupational classroom training and on-the-job training tends to be higher at smaller establishments (0-19).

The likelihood of a firm offering both occupational classroom and on-the-job training is higher the more technological change and innovation that occurs. The probability of an employee participating in employer sponsored occupational classroom training tends to be higher (lower) if the employee uses a computer (other devices) at work, but the probability of an employee participating in on-the-job training tends to be lower if the employee uses a computer, CAD/CAM technology, or other devices at work.

The probability of occupational classroom training being offered is higher at establishments with an HR Unit, and the probability of an employee participating in employer sponsored classroom training tends to be higher at establishments with an HR Unit. On the other hand, the probability of occupational on-the-job training being offered is lower at establishments with an HR Unit, as is the probability of an employee participating.

Across establishments, the probability of both occupational classroom or on-the-job training being offered by a firm is higher at unionized establishments. Based on the results for the employee sample, we find that the probability of an employee participating in employer sponsored occupational classroom training is greater, and the probability of an employee participating in on-the-job training is lower, for employees covered by a CBA.

But for the estimation based upon the establishment-employee linked sample, the probability of an employee participating in occupational classroom training is lower, while the probability of participating in occupational on-the-job training is higher. As well, the probability of any given employee participating in occupational classroom training tends to be higher at establishments that are unionized, whereas the probability of an employee participating in occupational on-the-job training tends to be lower at establishments that are unionized.

These results suggest that unionization is generally associated with a higher probability occupational training will be offered by firms at the establishment level. But while establishment unionization is associated with a higher incidence of classroom training, it is also associated with a lower incidence of on-the-job training.

4.4 Unions and Training Activity Associated with Human Resources Practices and Organizational Skills

Among all establishments, about 14% offered classroom training in human resources practices and organizational skills, while 16% offered on-the-job training in this area. Twice the proportion of unionized establishments offered classroom and on-the-job training (at 30% for both) as did nonunionized establishments (see Table 5). The regression results for the incidence of employer-sponsored classroom and on-the-job human resources practices and organizational skills training in establishments are provided in Table 15. The incidence of employee participation in human resources practices and organizational skills classroom training are provided in Table 16, for the estimation using the employee sample and the establishment-employee linked sample, respectively, while the corresponding results for on-the-job training are provided in Table 17.

The likelihood of a firm offering human resource and organizational practices classroom or on-the-job training tends to be lower at smaller establishments. Consistent with this, the probability of an employee participating in human resource and organizational practices classroom or on-the-job training tends to be lower at smaller establishments. In the case of technology usage and innovation, the results differ between the establishment and employee sides. The likelihood of a firm offering classroom and on-the-job training is higher the more technological change and innovation that occurs; but the probability of an employee participating in employer sponsored classroom training tends to be greater (lower) if the employee uses a CAD/CAM technology (other devices) at work, while the probability of an employee participating in on-the-job training tends to be lower if the employee uses a computer, CAD/CAM technology, or other devices at work.

The probability of a firm offering human resource and organizational practices classroom or on-the-job training being offered is higher at establishments with an HR Unit. While the probability of an employee participating in employer sponsored classroom training

tends to be higher at establishments with an HR Unit, the probability of an employee participating in on-the-job training tends to be lower where there is an HR Unit.

The results regarding unionization are fairly consistent: the probability of a firm offering human resource and organizational practices classroom or on-the-job training is higher at unionized establishments. This result is consistent with those obtained using the establishment-employee linked sample, where we find that the probability of any given employee participating in classroom or on-the-job training tends to be higher at establishments that are unionized. However, based on the employee sample, we find that the probability of an employee participating in classroom training is greater, and the probability of an employee participating in on-the-job training is lower, for employees actually covered by a CBA. Conversely, using the employee-establishment linked sample, we find that the probability of receiving classroom training is lower, while the probability of receiving on-the-job training is higher, if the employee is covered by a collective agreement. Taken together, these results suggest a consistent effect of “establishment unionization” on training.

4.5 Technology, Unionization, and Training Activity Associated with Technology-Related Skills Development

Profile of Technology Usage and Training

Approximately 61% of all workers use a computer at work (see Table 6). Comparing unionized and nonunionized employees, several stylized regularities emerge from the descriptive profile of technology usage and training:

- Among computer users, unionized employees have a higher average wage but lower average hours per week using computers, lower hours per week using the (most used) application, and a lower average number of years of computer experience. These regularities are apparent among both male and female workers. (Refer to Tables 18 and 22);
- Among unionized computer users, hours per week decreases steadily with age whereas for nonunionized computer users hours increases up to age group 25-39 and then decreases thereafter; after age 25 or less, hours per week using a computer is greater among nonunionized computer users. Among unionized workers, the number of years of computer experience increases with age up to age 40-54 then essentially levels off whereas among nonunionized computer users experience increases steadily with age; in addition, years of computer experience is higher among nonunionized employees across all age groups. (Refer to Table 19.)
- Among unionized computer users, hours per week using a computer increases with education up to some college but then decreases thereafter, whereas among nonunionized employees hours increases up to college level but then levels off through the higher education levels of BA or higher; hours are also higher for nonunionized workers across all education levels. For unionized employees, number of years of computer experience increases up to college and then essentially levels off for higher education levels; among nonunionized workers,

years of computer experience increases steadily across education levels; here too, years of experience are higher among nonunionized workers at each education level – although the average hourly wage is lower.

- The most used computer applications were word processing and specialized office applications. For both of these, a larger proportion of computer users were female (in contrast, a larger proportion of computer users indicating spreadsheets and databases as the most used application were male); a larger proportion of computer users indicating word processing as the most used application were unionized while the converse was the case for specialized office applications; a larger proportion of computer users indicating self-learning was the most helpful method for learning the application were nonunionized, while a larger proportion indicating employer-paid formal training was most helpful were unionized. (Refer to Table 24.)
- Among all computer users, the percentage of workers receiving training in the most used application over the previous year varies considerably across applications; it is largest for communications, programming, and computer-assisted design and engineering (Refer to Table 22.)
- In considering computer-controlled or assisted technologies (CC/CA), about the same proportion of workers (around 12%) used CC/CA whether or not they were unionized, and spent (on average) about the same amount of time per week using the technology. Although a slightly larger proportion of nonunionized workers using CC/CA had their technology upgraded over the past year, a larger proportion of unionized CC/CA users received training for that technological change and they averaged one day longer in training – a sizeable difference. (Refer to Table 23.)
- For employees using other machines or technology devices, somewhat different results are observed. For these technologies, a larger proportion of nonunionized

employees used other machines or devices; although the time spent using such devices per week was about the same. In contrast to the results for CC/CA, a larger proportion of unionized workers indicated that the technology had been upgraded, but about the same proportion of unionized and nonunionized employees indicated they received training, and the nonunionized workers spent, on average, slightly longer time in training. (Refer to Table 24.)

Some differences in technology usage and training are evident from these results. Nonunionized workers use computers more intensively, and the pattern of computer usage by age and education differs somewhat between unionized and nonunionized workers. While about the same proportion of unionized and nonunionized workers use CC/CA technologies, and with similar intensity, unionized workers appear to receive more training. With these differences in mind, we turn in the remainder of the section to the main empirical results for the effect of unionization on the incidence and intensity of technology related training.

Incidence of Computer-Based Technology Usage: Computer, CAD/CAM and Other Device Usage

The results for the incidence of computer-based technology usage are presented in Table 25 for computer usage, in Table 26 for usage of CAD/CAM, and in Table 27 for Other Devices and technologies. The incidence of computer usage at work among employees is higher at unionized establishments; however, the incidence of employee computer usage at work is lower among employees covered by a CBA. The incidence of CAD/CAM technology usage at work is also higher at unionized establishments; but, unlike computer usage, the incidence of employee CAD/CAM technology usage at work is higher for employees covered by a CBA. Finally, it appears that the incidence of other technology device usage at work is lower at unionized establishments; however, the incidence of employee other technology device usage at work is lower for unionized employees using the employee sample but higher using the linked sample.

Intensity of Computer-Based Technology Usage: Computer, CAD/CAM and Other Device Usage

The intensity of technology usage is measured by hours worked per week by the employee using the given technology. The regression results for the usage intensity for computers, CAD/CAM and Other Technological devices are presented in Table 28, Table 29 and Table 30, respectively. While usage intensity for computers is lower for employees covered by a CBA, the number of hours per week using computers at work is higher at establishments that are unionized. In contrast, the number of hours per week using CAD/CAM technology, or other technological devices, at work is higher for employees covered by a CBA. But among all employees in an establishment, the number of hours per week using CAD/CAM technology, or other technological devices, at work is lower at establishments that are unionized. Union effects on intensity of usage appear to vary according to the type of technology considered, with different effects evident depending upon whether one considers unionized workers, or unionized establishments.

Incidence of Technology Related Training

The establishment sample regression results for the incidence of employer-sponsored technology-related training are presented in Table 31. The corresponding training incidence results for the employee sample and the employee-establishment linked sample are presented in Table 32 and Table 33 for classroom and on-the-job training, respectively. The probability of offering technology-related classroom or on-the-job training being offered is higher at unionized establishments. In addition, the results from the linked data suggest that the probability of an employee participating in employer sponsored technology-related training in the classroom or on-the-job tends to be higher at establishments that are unionized. Finally, the probability of an employee participating in employer sponsored technology-related classroom training is greater for employees covered by a CBA. These results unambiguously suggest that unionization is associated with a greater incidence of technology-related training activity, whether classroom or on-the-job.

Incidence of Technological Change

We considered the incidence of technological change in establishments involving new software, new computer controlled / assisted (CC/CA) technology, and other new technological devices. These results are presented in Table 34. The incidence of new software technological change is lower at unionized establishments, whereas the incidence of new CC/CA technology and other technological devices is higher at unionized establishments.

The results for the incidence of an upgrade or change in other computer CAD/CAM technologies among employees in the last 12 months are presented in Table 35 while the results for the incidence of experiencing a change in other technological devices among employees are presented in Table 36. The incidence among employees of an upgrade/change in both CAD/CAM technology and other technological devices used at work is higher for those employees covered by a CBA in the employee sample – but the incidence was lower for both types of technological change in the establishment-employee linked sample. Finally, the incidence among employees of upgrade/change in

both CAD/CAM technology and other technological devices used at work are both lower at *establishments* that are unionized.

Incidence of Employee Training in the Event of Technological Change

The analysis of the incidence of employee training in the event of technological change is presented in Table 37 for change relating to CAD/CAM Technologies and in Table 38 for change related to other technologies and devices. The incidence of employee training for an upgrade/change in CAD/CAM technology used at work is lower for those employees covered by a CBA, and the incidence of training is lower among employees at establishments that are unionized.

While the incidence of employee training for an upgrade/change in other technological devices used at work is higher for employees covered by a CBA in the employee sample, it is lower in the establishment-employee linked sample. Further, the incidence of employee training among employees is higher at establishments that are unionized.

Intensity of Employee Training in the Event of Technological Change

The intensity of employee training in the event of technological change is measured as the number of days of employee training. In considering an upgrade/change in CAD/CAM technology used at work, the number of days of employee training for an upgrade/change technology is higher for employees covered by a CBA, while the training intensity is lower among employees at establishments that are unionized.

The number of days of employee training for an upgrade/change in other technological devices used at work is lower for employees covered by a CBA in the employee sample but higher in the establishment-employee linked sample. The number of days of employee training for an upgrade/change in other devices used at work is lower at establishments that are unionized.

4.6 Summary of Key Results for the Incidence and Intensity of Training, Technology Usage, and Technology-Related Training

There are several key results that emerged from the analysis of employee participation in training by union status across types of skills development. Using the establishment-employee linked results, for basic, occupational, and organizational training we find:

Basic Skills (literacy, numeracy, etc.) Training:

- employees at unionized establishments have a lower probability of participating in employer-sponsored basic classroom training; however, employees covered by a CBA have a higher probability of participating in employer-sponsored basic classroom training.
- employees at unionized establishments have a higher probability of participating in employer-sponsored basic on-the-job training; and, employees covered by a CBA have a higher probability of participating in employer-sponsored basic on-the-job training.

Occupational Training:

- employees at unionized establishments have a higher probability of participating in employer-sponsored occupational classroom training; however, employees covered by a CBA have a lower probability of participating in employer-sponsored occupational classroom training.
- employees at unionized establishments have a lower probability of participating in employer-sponsored occupational on-the-job training; however, employees covered by a CBA have a higher probability of participating in employer-sponsored occupational on-the-job training.

Organizational Training:

- employees at unionized establishments have a higher probability of participating in employer-sponsored organizational classroom training; however, employees covered by a CBA have a lower probability of participating in employer-sponsored organizational classroom training.
- employees at unionized establishments have a higher probability of participating in employer-sponsored organizational on-the-job training; and, employees covered by a CBA have a higher probability of participating in employer-sponsored organizational on-the-job training.

We also examined the incidence and intensity of computer-controlled or computer-assisted technology usage and the incidence and intensity of other machine or technology device usage.

Based on the establishment-employee linked results, we find:

Establishment Incidence and Intensity of Technology Usage:

- the incidence of computer usage at work is higher at unionized establishments; however, the incidence of employee computer usage at work is lower for employees covered by a CBA.
- the incidence of CAD/CAM technology usage at work is higher at unionized establishments; and, the incidence of employee CAD/CAM technology usage at work is higher for employees covered by a CBA.
- the incidence of other device usage at work is lower at unionized establishments; however, the incidence of employee other device usage at work is higher for employees covered by a CBA.
- the number of hours per week using computers at work is higher at unionized establishments; however, the number of hours using computers at work is lower for employees covered by a CBA.
- the number of hours per week using CAD/CAM technology at work is lower at unionized establishments; however, the number of hours per using CAD/CAM technology at work is higher for employees covered by a CBA.
- the number of hours per week using other devices at work is lower at unionized establishments; however, the number of hours using other devices at work is higher for employees covered by a CBA.

Technological Change:

- the incidence of upgrade/change in CAD/CAM technology used at work is lower at unionized establishments; and, the incidence of upgrade/change in CAD/CAM technology used at work is lower for employees covered by a CBA.
- the incidence of upgrade/change in other devices used at work is lower at unionized establishments; and, the incidence of upgrade/change in other devices used at work is lower for employees covered by a CBA.

Incidence of Training Among Employees:

- employees at unionized establishments have a higher probability of participating in employer-sponsored technology-related classroom training; and, employees covered by a CBA have a higher probability of participating in employer-sponsored technology-related classroom training
- employees at unionized establishments have a higher probability of participating in employer-sponsored technology-related on-the-job training; however, employees covered by a CBA have a lower probability of participating in employer-sponsored technology-related on-the-job training

Incidence of Training and Training Intensity After a Technological Change:

- the incidence of employee training for an upgrade/change in CAD/CAM technology used at work is lower at unionized establishments; and, the incidence of employee training for an upgrade/change in CAD/CAM technology used at work is lower for employees covered by a CBA.
- the number of days of employee training for an upgrade/change in CAD/CAM technology used at work is lower at unionized establishments; however, the number of days of employee training for an upgrade/change in CAD/CAM technology used at work is higher for employees covered by a CBA.
- the incidence of employee training for an upgrade/change in other devices used at work is higher at unionized establishments; however, the incidence of employee training for an upgrade/change in other devices used at work is lower for employees covered by a CBA.
- the number of days of employee training for an upgrade/change in other devices used at work is lower at unionized establishments; however, the number of days of employee training for an upgrade/change in other devices used at work is higher for employees covered by a CBA.

5. Conclusions

Concern over training levels, especially the development of skills associated with technological advancement, has stemmed from recognition of the importance of human capital formation in supporting productivity growth. Yet, while much of the formation of human capital occurs through formal education, a significant amount of human capital investment also takes place within the workplace.

Workplace training is undertaken to provide basic skills, such as numeracy, where they are lacking in a workforce, to enhance technical skills and productivity associated with technologies currently in use in the production process, as well as to develop a range of skills necessary to successfully implement innovative human resource and organizational practices, such as teams, problem-solving, leadership, and health and safety. Unions may have a direct effect on training activity related to a broad range of organizational activities and outcomes. They are major stakeholders in a large proportion of private and public sector workplaces in Canada, so their potential effects on training activity are important for employers, employees, and well as policy makers concerned with the effectiveness of programs aimed at firm-level skills development.

This paper has examined the relationship between unionization and the incidence and intensity of workplace training, technology usage, and technology-related training activity. While we examined three broad areas of training, including basic, occupational, and organizational training, we focused special attention on technology-related training and training in the event of technological change. Since technology adoption and the successful utilization of new technologies is typically viewed as a major factor affecting firm-level productivity growth, union effects on technology adoption, training on technologies, and training in the event of technological change are important to understand. The remainder of the conclusion includes a summary of the main results of the empirical analysis, followed by a discussion of policy implications of the main results regarding unionization and training activity.

Key Results of the Analysis

From our descriptive results, we find that a higher proportion of unionized *establishments* offered various types of training – but a lower proportion of employees in unionized establishments received training. When we looked at *employees*, the specific type of training considered mattered with regard to unionization: for occupational and organizational *classroom* training, unionization is associated with a lower probability of participating, but for occupational and organizational *on-the-job* training, unionization is associated with a higher probability of participating. For basic training, such as literacy and numeracy, unionization is associated with higher classroom and on-the-job training. Taken together, these results suggest that there appears to be a positive association between unionization and training – especially on-the-job training.

The importance of technological change in workplaces, and its effect of productivity, further underscores the importance of firm-based training activity, since it is workers themselves who work with the new technologies. Indeed, the descriptive results confirm that there is a positive association between technology usage and training for workers. Furthermore, the likelihood that an establishment offers training, and the proportion of workers receiving training, are both higher the more technological change and innovation that occurs. This result is found whether we consider classroom or on-the-job training, or occupational training, or training associated with human resource practices and organizational skills.

What about unions and technology usage and training related to new technologies?

Unions' influence on skills development at the workplace level is likely to have a major impact on productivity growth in Canada. Understanding their role in training activity, especially technology-related training, is therefore critical to policies and programs aimed at enhancing the level and effectiveness of technology related skills development. We considered both the role of unions in technology usage, in training associated with technology usage, and in technological change.

There is some existing research evidence that unionization may be associated with the utilization of technology. The results here suggest that computer-based technology usage differs in important ways by the union status of workers. From the descriptive analysis, we see that a smaller proportion of unionized workers report using a computer at work relative to employees not covered by a contract. Moreover, computer users covered by a collective agreement, on average, use a computer fewer hours than do nonunionized computers users, and unionized computer users also have less total years of computer experience. While a smaller proportion of computers users tend to be unionized, they nonetheless tend to have a higher average hourly wage.

Being covered by a CBA actually lowers the probability of using a computer and the magnitude of the change in probability (covered versus not covered by a contract) is quite large; in contrast, unionization increases the probability of using CAD/CAM. Similarly the intensity of usage of computers is lower, and of CAD/CAM is higher, among unionized employees. While it is tempting to want to suggest an overall result regarding the effects of unionization on technology usage, since union-nonunion differences clearly exist; but union effects vary depending on the type of technology and training considered. Conservatively, the results consistently support the conclusion that unionization makes a difference in terms of computer-based technology usage and utilization, in some cases the effect being positive; while in other cases it is negative.

The results regarding technological change are more consistent. They clearly indicate that the *incidence* of technological change is lower among *unionized* employees. While this strong result is consistent with a broad conclusion that unions are associated with the “resistance to technology” outcome – for example, as identified by Slichter, Healey and Livernash (1960) and further tested by Keefe (1991) – the mixed results for technology *usage* would suggest that further analysis of why unionization is associated with higher usage of some technologies, but not others, would be in order. For example, our result that unions are associated with higher CAD/CAM usage could arise if unions facilitate its utilization; or, alternatively, because employers are substituting capital for union labour. These widely differing explanations could have dramatically different policy

implications. More generally, the results support the conclusion that union effects are somewhat nuanced and probably depend upon the impact of the class of technology or technological change on workplace outcomes, such as employment.

With regard to technology-related training, the results again present a somewhat complex picture. The descriptive results suggest that training activity is, generally, closely associated with (computer-based) technology usage. While the probability of participating in technology-related classroom training is higher among unionized employees, it is lower for on-the-job training. In the event of technological change in either CAD/CAM or Other Devices, the incidence of employee training is lower for unionized employees – but the training intensity is greater. These different effects on incidence versus intensity of worker training in the event of technological change are not necessarily inconsistent with a lower probability of technological change under unionization. That is, unionization is associated with less technological change and a lower incidence of training if there is technological change but, if you are trained in the event of technological change, the training is longer.

Finally, among the types of training that are potentially available to workers, including formal and informal on-the-job training, external to the firm classroom training, and self-learning, it is establishment-level on-the-job training and self-learning that appear to have the most benefit to workers in learning computer-based technology skills. These results suggest that policies that support on-the-job training and self-learning would be appropriate, especially in an era when computer-related skills are somewhat portable across workplace settings. This does not necessarily suggest that training outside the firm should not be a policy priority, especially where there may be a role for policy in reducing barriers to obtaining this training (e.g., ability to obtain time away from work; training time versus family responsibility conflict; or training costs).

It is convincing from the results that unions do appear to affect technology usage and training outcomes in Canadian establishments. This result has implications for the design

and implementation of training and skill development policies directed at employer-based training. We turn now to further discussion of the policy implications of the results.

Selected Policy Implications

The results have implications for training policies aimed at the workplace level. The implications depend, though, upon whether one considers the effects of unionization on *individuals* versus *establishments*. We begin by considering the case of unionized establishments.

In unionized establishments, we expect that the effect on training levels of having some employees unionized is to have a direct effect on those workers covered by a collective agreement as well as to have a “spillover” effect on all employees at the establishment. The extent of the spillover would likely increase with the proportion of employees covered by a union contract. Therefore unionization of some employees at an establishment may affect training decisions that affect all workers, whether or not they are unionized.

The effect of unionization on employer supported training levels at unionized establishments would likely depend upon the union effect on the expected net return to training. For example, all else being equal, to the extent that unions provide a “wage premium” to employees covered by a collective agreement, the firm may receive a lower share of the return to increased productivity arising from employee training. On the other hand, if unions reduce turnover then, all else equal, this could improve the attractiveness to the firm of training investments. The results herein suggest that, for many types of training, unionization is associated with a higher incidence of training – but that in some cases (e.g., classroom *basic* training or on-the-job *occupational* training) the incidence is lower.

The analysis also allows us to consider only those employees who are actually covered by a collective agreement – that is, those employees for whom the contract terms have a direct effect on their training activity. For example, contracts may stipulate rules for

allocating training, the amount of training workers are eligible for, and so forth. For these employees, our review of previous studies suggests no strong expectations for union effects on training. The empirical results reveal a similar pattern compared to the results obtained for establishment unionization: for all types of training, unionization is associated with a higher incidence of on-the-job training – but in the case of occupational and organizational training, respectively, it is associated with a lower probability of receiving classroom training.

Taken together, these results suggest that the effect of unionization on training differs depending upon whether or not one considers unionized establishments versus unionized employees. This may have implications for the level at which policies or programs would best be targeted. Second, the effects of unionization vary depending upon the type of employer –based training being considered (that is, basic, occupational, or organizational). Training programs may need to distinguish carefully among the types of training when accounting for union effects. Third, union effects appear to vary, as well, depending upon whether one considers classroom or on-the-job training. Whatever the underlying behavioral mechanism by which unions affect training outcomes, unions are associated with higher levels of some types of training activity, but associated with lower levels of others. Training programs may therefore benefit from distinguishing between on-the-job training versus other types of training.

The effects of unionization are most consistent, however, in the areas of the incidence of technological change, and training in the event of technological change. Whether or not one considers establishment unionization, or employee coverage by a collective agreement, the results consistently indicate that unionization is associated with a lower incidence of technological change. Further, at least in the case of technological change relating to CAD/CAM technologies, unionization is generally associated with lower levels of training activity among employees subject to technological change.

The technological change results are quite consistent with the explanation that, at least in the short run, unions may not be able to negotiate contract terms and conditions that mitigate negative technological-change related employment outcomes; and instead, unions may serve to make technological change more costly than it would be in the absence of unions. This could result in lower levels of technological change. If this were the case, then easing downside adjustment costs to employees of technological change, through labour policy, would presumably lessen union resistance to technological change.

Adjustment programs of the types developed, for example, by some sectoral councils (which often have a significant union involvement) may serve this objective. But the strong result on unionization and technological change suggests that, even with such existing initiatives, a union-nonunion “technological change gap” exists. Even if unions can successfully focus their efforts on negotiating terms that mitigate negative displacement effects on workers, for example, these results also suggest a possible technological-change training deficit among those unionized employees that remain. This suggests that there may be some scope for developing programs to encourage unions and employers to increase training associated with technological change.

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Table 1
Employee Dependent Variable Definitions

Variable	Definition
Technology Usage	
Use Computer at Work	= 1 if use a computer at work (0 otherwise)
Hours per Week Using Computer	Number of hours per week using a computer at work
Use Computer CAD/CAM Technology	= 1 if use computer-controlled or computer-assisted technology at work (0 otherwise)
Hours per Week Using CAD/CAM Technology	Number of hours per week using a computer-controlled or computer-assisted technology at work
Use Other Device or Technology	= 1 if use other machine or technology device at work (0 otherwise)
Hours per Week Using Other Device	Number of hours per week using an other machine or technology device at work
Technological Change in Last 12 Months	
Upgrade/Change in CAD/CAM Technology	= 1 if yes (0 otherwise)
Trained for Upgrade CAD/CAM Technology	= 1 if yes (0 otherwise)
Number Days Trained for CAD/CAM Technology	= Number of days spent training
Upgrade/Change in Other Devices	= 1 if yes (0 otherwise)
Trained for Upgrade Other Devices	= 1 if yes (0 otherwise)
Number Days Trained for Other Devices	= Number of days spent training
Classroom Training Last 12 Months	
Classroom Training Received	= 1 if the employee received formal classroom job training during last 12 months (0 otherwise)
Occupational Classroom Training Received	= 1 if the employee received occupational (managerial/supervisory training, professional training, apprenticeship training, sales and marketing training) classroom training (0 otherwise)
Organization Classroom Training Received	= 1 if the employee received organizational (group decision-making or problem solving, team building/leadership/communications, occupational health and safety/environmental protection) classroom training (0 otherwise)
Technological Classroom Training Received	= 1 if the employee received technology (computer hardware, computer software, other office or non-office equipment) classroom training (0 otherwise)
Basic Classroom Training Received	= 1 if the employee received other (orientation, literacy or numeracy, other) classroom training (0 otherwise)
On-the-Job Training Last 12 Months	
On-the-job Training Received	= 1 if the employee received on-the-job job training during last 12 months (0 otherwise)
Occupational On-the-job Training Received	= 1 if the employee received occupational (managerial/supervisory training, professional training, apprenticeship training, sales and marketing training) on-the-job training (0 otherwise)
Organization On-the-job Training Received	= 1 if the employee received organizational (group decision-making or problem solving, team building/leadership/communications, occupational health and safety/environmental protection) on-the-job training (0 otherwise)
Technological On-the-job Training Received	= 1 if the employee received technology (computer hardware, computer software, other office or non-office equipment) on-the-job training (0 otherwise)
Basic On-the-job Training Received	= 1 if the employee received other (orientation, literacy or numeracy, other) on-the-job training (0 otherwise)
Best Method of Learning Computer Application	
Self Learning	= 1 if self-learning (0 otherwise)
Employer Paid Formal Training	= 1 if employer paid formal training (0 otherwise)
Self-Paid Formal Training	= 1 if self-paid formal training (0 otherwise)
On-The-Job Training	= 1 if on-the-job training (0 otherwise)
University or Community College Course	= 1 if university or community college course (0 otherwise)

Best Method of Learning CAD/CAM Technology

Self Learning	= 1 if self-learning (0 otherwise)
Employer Paid Formal Training	= 1 if employer paid formal training (0 otherwise)
Self-Paid Formal Training	= 1 if self-paid formal training (0 otherwise)
On-The-Job Training	= 1 if on-the-job training (0 otherwise)
University or Community College Course	= 1 if university or community college course (0 otherwise)

Best Method of Learning Other Devices

Self Learning	= 1 if self-learning (0 otherwise)
Employer Paid Formal Training	= 1 if employer paid formal training (0 otherwise)
Self-Paid Formal Training	= 1 if self-paid formal training (0 otherwise)
On-The-Job Training	= 1 if on-the-job training (0 otherwise)
University or Community College Course	= 1 if university or community college course (0 otherwise)

The survey questions are:

Computer

- Do you use a computer in your job?

Please exclude sales terminals, scanners, machine monitors, etc. – these are covered in another question. NOTE: By a computer, we mean a microcomputer, minicomputer or mainframe computer that can be programmed to perform a variety of operations.

- How much time do you spend using a computer in a typical work week?

By this we mean using or developing computer applications, rather than just having the computer turned on.

- What method was the most helpful in learning this application?

Self-learning (manuals, books, on-line tutorials, etc.)

Employer-paid formal training

Self-paid formal training

On-the-job training (co-workers, supervisors, resource people, friends)

University or community college courses

Other Technology

- Do you use a computer-controlled or computer-assisted technology in the course of your normal duties?

For example, industrial robots, retail scanning systems, CAD / CAM systems.

- How much time do you spend with this technology in a typical work week?
- What method was the most helpful in learning to use that technology?

On-the-job training (co-workers, supervisors, resource people, friends)

Employer-paid formal training

Self-learning (manuals, books, on-line tutorials, etc.)

Self-paid formal training

University or community college courses

- Has there been an upgrade or change in that technology in the past 12 months?
- Did you receive any informal or formal training related to that change in technology?
- Approximately how many days did you spend on that training?

Include only the time actually spent in training sessions.

Other Devices

- Do you use any other machine or technological device for at least one hour a day in the course of your normal duties?

This question is meant to be inclusive and would include, for example, cash registers, sales terminals, scanners, manual typewriters, industrial machinery and vehicles.

- How much time do you spend with the device or machine.
- Thinking of the machine or technological device you use the most, what has been the most helpful learning method to use that technology?

On-the-job training (co-workers, supervisors, resource people, friends)

Employer-paid formal training

Self-learning (manuals, books, on-line tutorials, etc.)

Self-paid formal training

University or community college course

- Has there been an upgrade or change in that technology in the past 12 months?
- Did you receive any informal or formal training related to that change in technology?
- Approximately how many days did you spend on that training? Include only the time actually spent in training sessions.

Table 2
Employee Explanatory Variable Definitions

Variable	Definition
Hours, Weeks & Union Status	
Covered by a CBA	= 1 if covered by CBA (0 otherwise)
Usual Hours per Week	Usual number of hours of work per week
Weeks per Year	Number of weeks worked per year
Federal Jurisdiction	= 1 if employed in a workplace under federal jurisdiction (0 otherwise)
Age & Experience	
Years Using Computer	Number of years person has used a computer
Years in Labour Market	Number of years of labour market experience
Years With Current Employer	Number of years with current employer
Years Job Experience	Number of years at current job
Age	Age in years
Demographic	
Canadian Born	= 1 if Canadian born (0 otherwise)
Male	= 1 if male (0 otherwise)
Married	= 1 if married (0 otherwise)
Language at Work English (Omitted)	= 1 if work language is English (0 otherwise)
Language at Work French	= 1 if work language is French (0 otherwise)
Language at Work Other	= 1 if work language is Other (0 otherwise)
Education	
BA or Higher	= 1 if BA or more (0 otherwise)
College Degree	= 1 if completed college or university certificate/diploma below BA (0 otherwise)
Some College	= 1 if some college, some university or teachers' college (0 otherwise)
High School (Omitted)	= 1 if completed high school (0 otherwise)
Less Than High School	= 1 did not complete high school (0 otherwise)
Occupation	
Managers (Omitted)	= 1 if Manager (0 otherwise)
Professionals	= 1 if Professional (0 otherwise)
Technical	= 1 if Technical (0 otherwise)
Trades	= 1 if Trades (0 otherwise)
Marketing/Sales	= 1 if Marketing/Sales (0 otherwise)
Clerical/Administrative	= 1 if Clerical/Administrative (0 otherwise)
Production	= 1 if Production (0 otherwise)
Industry	
Forestry/Mining	= 1 if Forestry/Mining (0 otherwise)
Labor Intensive Tertiary Manufacturing	= 1 if Labor Intensive Tertiary Manufacturing (0 otherwise)
Primary Manufacturing (Omitted)	= 1 if Primary Manufacturing (0 otherwise)
Secondary Manufacturing	= 1 if Secondary Manufacturing (0 otherwise)
Capital Intensive Tertiary Manufacturing	= 1 if Capital Intensive Tertiary Manufacturing (0 otherwise)
Construction	= 1 if Construction (0 otherwise)
Transport/Storage/Wholesale	= 1 if Transport/Storage/Wholesale (0 otherwise)
Communications/Utilities	= 1 if Communications/Utilities (0 otherwise)
Retail/Commercial	= 1 if Retail/Commercial (0 otherwise)
Finance/Insurance	= 1 if Finance/Insurance (0 otherwise)
Real Estate	= 1 if Real Estate (0 otherwise)
Business Services	= 1 if Business Services (0 otherwise)
Education/Health Care	= 1 if Education/Health Care (0 otherwise)
Information/Cultural	= 1 if Information/Cultural (0 otherwise)
Region	
Atlantic	= 1 if Atlantic (0 otherwise)
Quebec	= 1 if Quebec (0 otherwise)
Ontario (Omitted)	= 1 if Ontario (0 otherwise)
Prairie	= 1 if Manitoba or Saskatchewan (0 otherwise)
Alberta	= 1 if Alberta (0 otherwise)
British Columbia	= 1 if British Columbia (0 otherwise)

Table 3
Establishment Dependent Variable Definitions

Variable	Definition
Classroom Training Offered	
Classroom Training	= 1 if firm provides classroom training (0 otherwise)
Occupational Classroom Training	= 1 if the firm provides occupational (managerial/supervisory training, professional training, apprenticeship training, sales and marketing training) classroom training (0 otherwise)
Organization Classroom Training	= 1 if the firm provides organizational (group decision-making or problem solving, team building/leadership/communications, occupational health and safety/environmental protection) classroom training (0 otherwise)
Technological Classroom Training	= 1 if the firm provides technology (computer hardware, computer software, other office or non-office equipment) classroom training (0 otherwise)
Basic Classroom Training	= 1 if the firm provides other (orientation, literacy or numeracy, other) classroom training (0 otherwise)
Proportion Received Classroom Training	= the proportion of employees receiving classroom training in the last 12 months
On-the-Job Training Offered	
On-The-Job Training	= 1 if the firm provides on-the job training (0 otherwise)
Occupational On-The-Job Training	= 1 if the firm provides occupational (managerial/supervisory training, professional training, apprenticeship training, sales and marketing training) on-the-job training (0 otherwise)
Organization On-The-Job Training	= 1 if the firm provides organizational (group decision-making or problem solving, team building/leadership/communications, occupational health and safety/environmental protection) on-the-job training (0 otherwise)
Technological On-The-Job Training	= 1 if the firm provides technology (computer hardware, computer software, other office or non-office equipment) on-the-job training (0 otherwise)
Basic On-The-Job Training	= 1 if the firm provides other (orientation, literacy or numeracy, other) on-the-job training (0 otherwise)
Proportion Received On-The-Job Training	= the proportion of employees receiving on-the-job training in the last 12 months
Technological Change Last 12 Months	
Implemented New Software	= 1 if workplace introduced new software in last 12 months (0 otherwise)
Implemented New Computer Controlled Technology	= 1 if workplace introduced new computer controlled/assisted hardware in last 12 months (0 otherwise)
Implemented New Other Devices or Technologies	= 1 if workplace introduced other new devices in last 12 months (0 otherwise)

The survey questions are:

Computers

- *Between April 1, 1998 and March 31, 1999, has your workplace implemented a major new software application and/or hardware installation?*

Here we are speaking of hardware installations or entirely new applications rather than upgrades. In either case, the implementations would affect at least half of the users in the workplace or a department within the workplace.

Computer Assisted Technology

- *Between April 1, 1998 and March 31, 1999, has your workplace implemented computer-controlled or computer-assisted technology?*

For example, retail scanning technologies, manufacturing robots, optical, laser, audio, photographic technologies, hydraulic or other mechanical technologies.

Other Devices

- *Between April 1, 1998 and March 31, 1999, has your workplace had any major implementations of other technologies or machinery?*

Table 4
Establishment Explanatory Variable Definitions

Variable	Definition
Establishment Size	
1-19	= 1 if firm size is 1 to 19 employees (0 otherwise)
20-99	= 1 if firm size is 20 to 99 employees (0 otherwise)
100-499	= 1 if firm size is 100 to 499 employees (0 otherwise)
500+ (Omitted)	= 1 if firm size is 500 or more employees (0 otherwise)
Institutional	
Human Resource Unit	= 1 if workplace has a human resource unit (0 otherwise)
Number of Variable Pay Practices	Number of variable pay practices (individual incentives, gain sharing, profit sharing, merit pay)
Financial	
Operating Revenue Per Employee	Operating revenue per employee at firm
Gross Pay per Employee	Gross payroll per employee
Non-Wage Benefits per Employee	Gross non-wage benefits per employee
Percentage Foreign Held Assets	Percent of Firm Assets that are Foreign Held
Turnover	
Proportion Quit	Proportion of total employment that quit in last 12 months
Proportion Layoff	Proportion of total employment laid off in last 12 months
Proportion New Hires	Proportion of total employment hired in last 12 months
Competition	
Compete Local	= 1 if compete with local firms (0 otherwise)
Compete Canada	= 1 if compete with Canadian firms (0 otherwise)
Compete USA	= 1 if compete with American firms (0 otherwise)
Compete Rest of World	= 1 if compete with firms from rest of the world (0 otherwise)
Compete None	= 1 if no competitors (0 otherwise)
Workforce Characteristics	
Proportion Full-Time	Proportion of employees that are full-time
Federal Jurisdiction	= 1 if workplace is a federal jurisdiction (0 otherwise)
Technology & Innovation	
Innovation	= 1 if introduced a new product, improved product, new process, or improved process within last 12 months (0 otherwise)
Technological Change	Number of different types of technology change in the last 12 Months (new software, computer controlled/assisted Hardware, other devices)
Proportion of Workers using Computers	Proportion of employees that use computers at work
Computers Used at Firm	= 1 if computer used at the firm (0 otherwise)
Occupational Distribution	
Proportion Managers	Proportion of total employment that are managers
Proportion Professionals	Proportion of total employment that are professionals
Proportion Technical/Trades	Proportion of total employment that are technical/trades
Proportion Marketing/Sales	Proportion of total employment that are marketing/sales
Proportion Clerical/Administrative	Proportion of total employment that are clerical/administrative
Proportion Production	Proportion of total employment that are production
Industry	
Forestry/Mining	= 1 if Forestry/Mining (0 otherwise)
Labor Intensive Tertiary Manufacturing	= 1 if Labor Intensive Tertiary Manufacturing (0 otherwise)
Primary Manufacturing (Omitted)	= 1 if Primary Manufacturing (0 otherwise)
Secondary Manufacturing	= 1 if Secondary Manufacturing (0 otherwise)
Capital Intensive Tertiary Manufacturing	= 1 if Capital Intensive Tertiary Manufacturing (0 otherwise)
Construction	= 1 if Construction (0 otherwise)
Transport/Storage/Wholesale	= 1 if Transport/Storage/Wholesale (0 otherwise)
Communications/Utilities	= 1 if Communications/Utilities (0 otherwise)
Retail/Commercial	= 1 if Retail/Commercial (0 otherwise)
Finance/Insurance	= 1 if Finance/Insurance (0 otherwise)
Real Estate	= 1 if Real Estate (0 otherwise)

Business Services	= 1 if Business Services (0 otherwise)
Education/Health Care	= 1 if Education/Health Care (0 otherwise)
Information/Cultural	= 1 if Information/Cultural (0 otherwise)

Region	
Atlantic	= 1 if Atlantic (0 otherwise)
Quebec	= 1 if Quebec (0 otherwise)
Ontario (Omitted)	= 1 if Ontario (0 otherwise)
Prairie	= 1 if Manitoba or Saskatchewan (0 otherwise)
Alberta	= 1 if Alberta (0 otherwise)
British Columbia	= 1 if British Columbia (0 otherwise)

Table 5
Establishment Descriptive Statistics by Establishment Union Status in 1999

Variable	Unionized	Non-Unionized	All
	Establishment	Establishment	
	Mean	Mean	Mean
Establishment Size			
0-19	.6403	.8964	.8784
20-99	.2625	.0941	.1059
100-499	.0846	.0088	.0141
500+	.0124	.0006	.0014
Institutional			
Human Resource Unit	.0896	.0211	.0259
Number of Variable Pay Practices	.5917	.6534	.6491
Financial			
Operating Revenue per Employee	180289.10	148213.40	150469.60
Gross Payroll per Employee	31754.52	25911.72	26322.70
Non-Wage Benefits per Employee	3000.84	736.67	895.93
Percentage Foreign Held Assets	.0606	.0270	.0293
Turnover			
Percentage Quits	.1409	.1857	.1826
Percentage Layoffs	.1710	.1125	.1166
Percentage New Hires	.5579	.3136	.3308
Competition			
Compete Local-Owned	.7782	.7887	.7880
Compete Canada-Owned	.4825	.3842	.3912
Compete USA-Owned	.2546	.2201	.2225
Compete ROW-Owned	.1838	.1178	.1224
Compete None	.1056	.1495	.1464
Workforce Characteristics			
Proportion Full-Time	.8200	.7155	.7229
Technology and Innovation			
Innovation Occurred	.5688	.4722	.4790
Number of Technological Changes	.4843	.4358	.4397
Proportion of Workers using Computer	.3751	.4675	.4610
Technology Introduced			
New Software	.3443	.3313	.3323
New Computer Controlled Technology	.0919	.0404	.0441
New Other Devices	.0554	.0463	.0470

Occupational Distribution			
Proportion Managers	.1207	.2059	.1997
Proportion Sales	.0489	.1283	.1226
Proportion Technical & Trades	.3165	.1382	.1512
Proportion Professional	.0396	.0787	.0759
Proportion Administrative & Clerical	.1890	.2222	.2198
Proportion Production	.2850	.2263	.2306
Industry			
Forestry/Mining	.0159	.0195	.0192
Labour Intensive Tertiary Manu.	.0256	.0308	.0304
Primary Manufacturing	.0397	.0086	.0108
Secondary Manufacturing	.0350	.0170	.0183
Capital Intensive Tertiary Manu.	.0210	.0250	.0247
Construction	.2315	.0788	.0895
Transport/Storage/Wholesale	.1133	.1403	.1384
Communications/Utilities	.0368	.0104	.0123
Retail / Commercial	.2926	.3442	.3406
Finance/Insurance	.0406	.0543	.0534
Real Estate	.0162	.0388	.0372
Business Services	.0526	.1208	.1160
Education/Health Care	.0491	.0951	.0918
Information/Cultural	.0294	.0157	.0167
Classroom Training			
Classroom Training Offered	.4470	.2803	.2920
Professional Courses Offered	.3691	.1875	.2003
Organizational Courses Offered	.3037	.1250	.1376
Technology Courses Offered	.3307	.1364	.1501
Basic Courses Offered	.2271	.1249	.1321
Proportion Workers Received Training	.6087	.6227	.6212
On-the-Job Training			
On-the-Job Training Offered	.5964	.4388	.4499
Occupational Courses Offered	.4075	.2347	.2469
Organizational Courses Offered	.3003	.1528	.1631
Technology Courses Offered	.3551	.2073	.2177
Basic Courses Offered	.3891	.3002	.3064
Proportion Workers Received Training	.5871	.6625	.6555
Number of Observations	1402	3999	5401

Table 6
Employee Characteristics by Union Status in 1999

Variable	Covered by CBA	Not Covered by CBA	All
	Mean	Mean	Mean
Hours, Weeks & Union Status			
Covered by a CBA			.2789
Usual Hours Per Week	35.66	36.98	36.62
Weeks Per Year	49.72	50.73	50.45
Federal Jurisdiction	.0362	.0330	.0339
Hourly Wage	20.35	17.82	18.52
Age & Experience			
Number Years Using Computer	4.87	6.24	5.86
Years Work Experience	17.25	15.74	16.16
Years Current Employer	12.31	7.60	8.92
Years Job Experience	8.98	5.70	6.61
Age	41.74	38.79	39.61
Demographic			
Born in Canada	.8568	.8119	.8244
Male	.5038	.4698	.4793
Married	.5874	.5572	.5656
Language at Work is English	.6763	.8040	.7684
Language at Work is French	.3097	.1745	.2123
Language at Work is Other	.0138	.0213	.0192
Education			
Highest Degree BA or Higher	.2138	.1858	.1936
Completed College or Univ. Certificate	.2020	.2068	.2055
Some College or University	.1157	.1617	.1489
High School	.2719	.2819	.2791
Less Than High School	.1964	.1634	.1726
Occupation			
Managers	.0331	.1964	.1508
Professional	.2430	.1299	.1615
Technical	.1911	.2216	.2131
Trades	.2397	.1526	.1769
Marketing/Sales	.0321	.1039	.0839
Clerical/Administrative	.1350	.1415	.1397
Production	.1257	.0537	.0738

Region			
Atlantic	.0512	.0657	.0628
Quebec	.3260	.2075	.2307
Ontario	.3541	.4195	.4067
Prairies	.0595	.0653	.0642
Alberta	.0529	.1207	.1074
BC	.1560	.1211	.1279
Technology Usage			
Use Computer at Work	.5153	.6434	.6077
Hours per Week Using Computer	7.76	13.15	11.65
Use Computer CAD/CAM Tech	.1208	.1193	.1197
Hours per Week Using CAD/CAM Technology	1.48	1.49	1.49
Use Other Device or Technology	.2412	.2798	.2690
Hours per Week Using Other Devices	0.70	0.51	0.57
Technological Change in Last 12 Months			
Upgrade/Change in CAD/CAM Technology	.4195	.4338	.4298
Trained for Upgrade CAD/CAM Technology	.6096	.5642	.5767
Number Days Trained for CAD/CAM Technology	3.92	2.78	3.11
Upgrade/Change in Other Devices	.2830	.2543	.2615
Trained for Upgrade Other Devices	.6162	.6139	.6145
Number Days Trained for Other Devices	2.13	2.33	2.27
Classroom Training			
Occupational Courses Received	.1080	.1272	.1218
Organizational Courses Received	.0904	.0619	.0698
Technology Courses Received	.1214	.1107	.1137
Basic Courses Received	.1952	.1478	.1610
On-the-Job Training			
Occupational Courses Received	.2799	.2472	.2705
Organizational Courses Received	.0878	.1540	.1069
Technology Courses Received	.3830	.3000	.3591
Basic Courses Received	.4007	.4387	.4117
Best Method of Learning Computer Application			
Self-Learning			
Employer Paid	.1726	.2506	.2289
Self Paid	.1079	.0922	.0966
On-the-Job (Informal)	.0102	.0113	.0110
University	.2028	.2462	.2341
Best Method of Learning CAD/CAM Technology			
Self-Learning			
Employer Paid	.0279	.0294	.0290
Self Paid	.0162	.0087	.0108
On-the-Job (Informal)	.0020	.0014	.0016
University	.0726	.0751	.0744
	.0015	.0036	.0030
Best Method of Learning Other Devices			
Self-Learning	.0646	.0884	.0818
Employer Paid	.0179	.0108	.0128
Self Paid	.0072	.0047	.0054
On-the-Job (Informal)	.1395	.1591	.1536
University	.0074	.0069	.0071
Number of Observations	7234	16306	23540

Table 7
Employee Reported Formal and On-The-Job Training in Last 12 Months, 1999

	All	Covered by CBA	Not Covered by CBA
Formal Training	.3689	.4130	.3519
On-The-Job Training	.2995	.3089	.2952

Table 8
Correlation: Employee Reported Formal and On-The-Job Training in Last 12 Months with Technology Usage in 1999

	All Workers				
	Formal Training	On-The-Job Training	Use Computer at Work	Use Computer Technology at Work	Use Other Device at Work
Formal Training	1.0000				
On-The-Job Training	0.0462*	1.0000			
Use Computer at Work	0.2066*	0.1262*	1.0000		
Use Computer Technology at Work	0.0227*	0.0773*	0.0486*	1.0000	
Use Other Device at Work	-0.0765*	0.0658*	-0.1528*	0.0345*	1.0000

	Covered by CBA				
	Formal Training	On-The-Job Training	Use Computer at Work	Use Computer Technology at Work	Use Other Device at Work
Formal Training	1.0000				
On-The-Job Training	0.0514*	1.0000			
Use Computer at Work	0.1784*	0.0938*	1.0000		
Use Computer Technology at Work	0.0048	0.0168	0.0019	1.0000	
Use Other Device at Work	-0.0147	0.0335*	-0.0725*	0.0387*	1.0000

	Not Covered by CBA				
	Formal Training	On-The-Job Training	Use Computer at Work	Use Computer Technology at Work	Use Other Device at Work
Formal Training	1.0000				
On-The-Job Training	0.0431*	1.0000			
Use Computer at Work	0.2304*	0.1431*	1.0000		
Use Computer Technology at Work	0.0298*	0.1011*	0.0684*	1.0000	
Use Other Device at Work	-0.0972*	0.0787*	-0.1920*	0.0332*	1.0000

Note: * denotes statistically significant at a 95% level of confidence.

Table 9
Incidence of Employer-Sponsored Classroom and On-the-Job Training, 1999
Establishment Sample Probit

Variable	Classroom Training Offered		On-the-Job Training Offered	
	Coefficient dF/dx	t-value	Coefficient dF/dx	t-value
Establishment Size				
0-19*	-.570	-11.42	-.477	-13.11
20-99*	-.212	-4.99	-.216	-4.68
100-499*	-.131	-2.93	-.262	-5.76
Institutional				
Human Resource Unit*	.305	48.50	.054	9.42
Unionized*	-.068	-19.81	.161	38.85
Number of Variable Pay Practices	.082	86.41	.092	84.99
Financial				
Operating Revenue per Employee	-.921e-07	-20.67	-.189e-06	-33.07
Gross Payroll per Employee	.146e-06	2.27	-.134e-05	-17.95
Non-Wage Benefits per Employee	.343e-04	53.53	.128e-04	21.38
Percentage Foreign Held Assets	-.448e-03	-8.94	-.615e-03	-11.46
Turnover				
Percentage Quits	.032	10.91	.350	84.86
Percentage Layoffs	-.028	-13.95	-.030	-16.59
Percentage New Hires	.002	1.17	.061	29.83
Competition				
Compete Local-Owned*	.003	0.94	.067	18.81
Compete Canada-Owned*	.039	18.97	.123	55.52
Compete USA-Owned*	.059	24.03	.010	3.81
Compete ROW-Owned*	.049	17.59	-.089	-27.64
Compete None*	-.005	-1.15	.023	5.18
Technology and Innovation				
Innovation Occurred*	.126	71.05	.119	64.05
Number of Technological Changes	.073	51.37	.108	67.54
Proportion of Workers using Computer	.081	27.82	.083	26.17
Occupational Distribution				
Proportion Sales	.029	6.35	.393	79.14
Proportion Technical & Trades	.181	40.29	.281	54.25
Proportion Professional	.111	22.70	.177	31.82
Proportion Administrative & Clerical	-.080	-19.54	.016	3.73
Proportion Production	-.106	-23.63	.117	24.97
Log-Likelihood	-203696		-218277	
Pseudo-R Squared	0.2178		0.2188	
Number of Observations	4107		4107	

Note: * dF/dx is calculated for a discrete change of the dummy variable from 0 to 1. Other establishment controls included: Region, Industry, Federal Jurisdiction, and Proportion Full-Time.

Table 10
Proportion of Employees Receiving Employer-Sponsored Classroom and On-the-Job Training, 1999

Establishment Sample OLS

Variable	Proportion Receiving Classroom Training		Proportion Receiving On-the-Job Training Offered	
	Coefficient	t-value	Coefficient	t-value
Establishment Size				
0-19	.089	5.44	.075	5.22
20-99	.017	1.09	.045	3.16
100-499	-.003	-0.19	-.031	-2.14
Institutional				
Human Resource Unit	-.047	-11.51	-.045	-12.65
Unionized	.130	39.91	.042	15.09
Number of Variable Pay Practices	-.023	-25.20	-.003	-4.07
Financial				
Operating Revenue per Employee	-.644e-08	-1.86	-.420e-07	-12.23
Gross Payroll per Employee	.119e-05	6.33	-.540e-06	-7.38
Non-Wage Benefits per Employee	-.236e-05	-5.01	-.747e-06	-2.15
Percentage Foreign Held Assets	.305e-03	7.43	-.116e-04	-0.28
Turnover				
Percentage Quits	.012	3.18	.073	39.26
Percentage Layoffs	-.002	-1.35	-.024	-14.42
Percentage New Hires	.024	9.27	.042	23.22
Competition				
Compete Local-Owned	-.190	-61.19	.015	5.68
Compete Canada-Owned	.348e-04	0.02	-.057	-32.35
Compete USA-Owned	-.001	-0.52	.052	27.22
Compete ROW-Owned	.055	22.96	.015	7.33
Compete None	-.097	-21.68	.109	29.52
Technology and Innovation				
Innovation Occurred	.007	3.74	.080	51.44
Number of Technological Changes	.034	24.36	.011	9.68
Proportion of Workers using Computer	.126	38.74	.305	130.32
Occupational Distribution				
Proportion Sales	.319	56.68	.038	11.99
Proportion Technical & Trades	.044	8.40	.028	7.53
Proportion Professional	-.050	-8.72	-.202	-44.41
Proportion Administrative & Clerical	.061	11.92	.025	7.24
Proportion Production	-.014	-2.26	.025	7.01
Constant	.461	24.68	.327	19.88
Root MSE	.3003		.2930	
R Squared	0.2197		0.2605	
Number of Observations	2531		2860	

Note: Other establishment controls included: Region, Industry, Federal Jurisdiction, and Proportion Full-Time.

Table 11A
Incidence of Employer-Sponsored Basic Classroom and On-the-Job Training, 1999
Establishment Sample Probit

Variable	Other Classroom Training Offered		Other On-the-Job Training Offered	
	Coefficient dF/dx	t-value	Coefficient dF/dx	t-value
Establishment Size				
0-19*	-.135	-9.36	-.330	-12.68
20-99*	.023	1.98	-.054	-2.36
100-499*	.050	3.83	-.047	-1.99
Institutional				
Human Resource Unit*	.370	81.90	.130	25.97
Unionized*	-.025	-13.26	.087	23.43
Number of Variable Pay Practices	.024	44.66	.062	67.73
Financial				
Operating Revenue per Employee	.657e-08	2.82	-.138e-06	-24.86
Gross Payroll per Employee	-.767e-06	-16.19	-.221e-05	-30.76
Non-Wage Benefits per Employee	.110e-04	35.12	.150e-04	33.63
Percentage Foreign Held Assets	.304e-04	1.18	-.526e-03	-10.96
Turnover				
Percentage Quits	.042	20.57	.376	103.52
Percentage Layoffs	-.012	-8.16	-.020	-11.10
Percentage New Hires	.002	1.25	.045	27.50
Competition				
Compete Local-Owned*	.024	14.23	.062	20.50
Compete Canada-Owned*	.012	10.30	.127	62.24
Compete USA-Owned*	.033	23.72	.055	23.67
Compete ROW-Owned*	.009	6.45	-.062	-23.31
Compete None*	.031	11.67	.067	15.62
Technology and Innovation				
Innovation Occurred*	.079	71.12	.132	75.92
Number of Technological Changes	.030	38.67	.022	15.58
Proportion of Workers using Computer	.002	1.60	-.009	-3.11
Occupational Distribution				
Proportion Sales	.082	30.69	.271	61.69
Proportion Technical & Trades	.094	34.52	.143	31.17
Proportion Professional	.037	11.70	.084	17.10
Proportion Administrative & Clerical	-.074	-27.16	-.006	-1.51
Proportion Production	.012	4.52	.203	46.78
Log-Likelihood	-132482		-200644	
Pseudo-R Squared	0.2236		0.2239	
Number of Observations	4107		4107	

Note: * dF/dx is calculated for a discrete change of the dummy variable from 0 to 1. Other establishment controls included: Region, Industry, Federal Jurisdiction, and Proportion Full-Time.

Table 11B
Incidence of Employee Participation in Employer-Sponsored Basic Classroom Training, 1999
Probit

Variable	Employee Sample		Establishment-Employee Linked Sample	
	Coefficient dF/dx	t-value	Coefficient dF/dx	t-value
Hours, Weeks & Union Status				
Covered by a CBA*	.063	179.00	.017	36.67
Usual Hours Per Week	.001	77.20	.001	82.16
Weeks Per Year	-.696e-03	-33.11	.548e-03	21.09
Age & Experience				
Number Years Using Computer	.853e-03	13.31	.001	14.47
Number Years Using Computer Squared	-.108e-03	-39.72	-.131e-03	-42.08
Years Work Experience	-.001	-27.95	.742e-03	11.36
Years Current Employer	.001	27.44	-.002	-34.27
Years Job Experience	-.002	-37.60	.002	32.81
Age	.007	67.83	.002	21.32
Demographic				
Born in Canada*	.044	139.34	.045	128.05
Male*	.021	79.32	.012	39.63
Married*	.021	82.38	.026	89.80
Language at Work is French*	.003	5.59	-.634e-04	-0.10
Language at Work is Other*	-.052	-60.26	-.030	-29.04
Education				
Highest Degree BA or Higher*	.057	130.18	.036	76.86
Completed College or Univ. Certificate*	.013	36.84	.003	9.04
Some College or University*	.048	122.91	.029	67.17
Less Than High School*	-.019	-53.61	-.019	-48.59
Occupation				
Professional*	.002	6.45	-.025	-50.52
Technical*	-.002	-7.15	-.016	-37.58
Trades*	.014	33.10	-.003	-6.47
Marketing/Sales*	-.002	-4.81	-.022	-35.29
Clerical/Administrative*	-.040	-94.15	-.046	-97.67
Production*	-.028	-52.15	-.039	-63.44
Technology Usage at Work				
Use Computer*	.071	207.94	.037	91.21
Use Computer CAD/CAM*	.041	118.68	.054	133.62
Use Other Devices*	-.003	-13.26	.008	26.69
Firm Controls				
Establishment Size				
0-19*			-.057	-88.60
20-99*			-.035	-61.68
100-499*			-.033	-72.18
Institutional				
Human Resource Unit*			-.001	-4.15
Unionized*			-.010	-23.74
Financial				
Operating Revenue per Employee			-.211e-08	-5.17
Gross Payroll per Employee			.311e-06	31.74
Technology and Innovation				
Innovation Occurred*			.013	45.82
Number of Technological Changes			-.014	-68.44
Proportion of Workers using Computer			-.018	-36.50
Log-Likelihood	-3239479		-2576372	
Pseudo-R Squared	0.0603		0.0935	
Number of Observations	19454		16379	

Note: * dF/dx is calculated for a discrete change of the dummy variable from 0 to 1. Other employee controls included are: Federal Jurisdiction, Years Work Experience Squared, Years Squared, and Region. Other Establishment controls included are:

variable from 0 to 1. Other employee controls included are: Current Employer Squared, Years Job Experience Squared, Age Number of Variable Pay Practices, Non-Wage Benefits per

Employee, Percentage Foreign Assets, Turnover controls, Proportion Full-time, Competition controls, Occupational distribution, and industry.

Table 11C

Incidence of Employee Participation in Employer-Sponsored Basic On-the-Job Training, 1999 Probit

Variable	Employee Sample		Establishment-Employee Linked Sample	
	Coefficient dF/dx	t-value	Coefficient dF/dx	t-value
Hours, Weeks & Union Status				
Covered by a CBA*	-.010	-27.50	.002	5.04
Usual Hours Per Week	-.776e-03	-50.13	-.685e-03	-33.56
Weeks Per Year	-.581e-03	-23.72	.802e-04	2.49
Age & Experience				
Number Years Using Computer	.003	50.30	.005	76.84
Number Years Using Computer Squared	-.213e-03	-77.97	-.296e-03	-96.06
Years Work Experience	-.003	-54.47	-.004	-63.40
Years Current Employer	.672e-03	9.34	.496e-03	5.92
Years Job Experience	.004	56.24	.003	42.81
Age	.003	37.52	.006	51.52
Demographic				
Born in Canada*	-.037	-111.14	-.038	-97.93
Male*	.014	50.26	.023	69.27
Married*	.001	5.08	.008	26.22
Language at Work is French*	.026	39.33	.037	51.34
Language at Work is Other*	.033	35.63	.029	27.75
Education				
Highest Degree BA or Higher*	-.046	-100.38	-.048	-89.57
Completed College or Univ. Certificate*	-.027	-72.20	-.030	-67.67
Some College or University*	-.034	-83.32	-.011	-24.08
Less Than High School*	.014	35.18	.014	32.75
Occupation				
Professional*	.004	9.59	.006	11.51
Technical*	.010	23.10	-.012	-24.90
Trades*	.001	2.17	-.014	-23.32
Marketing/Sales*	.027	48.20	.017	23.73
Clerical/Administrative*	-.030	-61.55	-.037	-64.07
Production*	.003	6.15	.474e-03	0.62
Technology Usage at Work				
Use Computer*	-.106	-293.08	-.094	-214.37
Use Computer CAD/CAM*	-.055	-146.44	-.063	-142.38
Use Other Devices*	-.039	-133.29	-.033	-98.71
Firm Controls				
Establishment Size				
0-19*			-.052	-65.17
20-99*			-.054	-76.71
100-499*			-.031	-51.68
Institutional				
Human Resource Unit*			-.048	-91.80
Unionized*			.002	5.55
Financial				
Operating Revenue per Employee			-.356e-07	-75.81
Gross Payroll per Employee			.148e-06	13.58
Technology and Innovation				
Innovation Occurred*			-.008	-24.61
Number of Technological Changes			-.015	-65.45
Proportion of Workers using Computer			-.006	-11.44
Log-Likelihood	-3546834		-2892829	
Pseudo-R Squared	0.0722		0.0842	
Number of Observations	19454		16379	

Note: * dF/dx is calculated for a discrete change of the dummy variable from 0 to 1. Other employee controls included are: Federal Jurisdiction, Years Work Experience Squared, Years Current Employer Squared, Years Job Experience Squared, Age Squared, and Region. Other Establishment controls included are: Number of Variable Pay Practices, Non-Wage Benefits per Employee, Percentage Foreign Assets, Turnover controls, Proportion Full-time, Competition controls, Occupational distribution, and industry.

Table 12
Incidence of Employer-Sponsored Occupational Classroom and On-the-Job Training, 1999
Establishment Sample Probit

Variable	Occupational Classroom Training Offered		Occupational On-the-Job Training Offered	
	Coefficient dF/dx	t-value	Coefficient dF/dx	t-value
Establishment Size				
0-19*	-.676	-19.84	-.453	-18.53
20-99*	-.197	-11.01	-.127	-6.92
100-499*	-.140	-7.39	-.078	-4.02
Institutional				
Human Resource Unit*	.058	15.90	-.007	-1.93
Unionized*	.035	13.04	.172	49.63
Number of Variable Pay Practices	.064	81.51	.076	96.21
Financial				
Operating Revenue per Employee	-.202e-07	-5.49	-.100e-06	-18.36
Gross Payroll per Employee	-.102e-06	-1.19	-.584e-06	-9.23
Non-Wage Benefits per Employee	.171e-04	41.68	.278e-05	7.97
Percentage Foreign Held Assets	-.385e-03	-10.86	.897e-03	21.37
Turnover				
Percentage Quits	.007	2.95	.161	33.04
Percentage Layoffs	-.046	-15.11	-.010	-6.79
Percentage New Hires	-.016	-5.75	.022	14.08
Competition				
Compete Local-Owned*	-.008	-3.45	.069	25.60
Compete Canada-Owned*	.027	16.10	.063	33.66
Compete USA-Owned*	.082	40.89	.026	12.48
Compete ROW-Owned*	-.015	-7.24	-.060	-25.23
Compete None*	-.078	-24.96	.059	14.52
Technology and Innovation				
Innovation Occurred*	.089	61.81	.152	95.13
Number of Technological Changes	.026	23.35	.008	6.98
Proportion of Workers using Computer	.018	7.79	.066	25.45
Occupational Distribution				
Proportion Sales	.004	1.11	.067	16.64
Proportion Technical & Trades	.144	39.64	.258	61.23
Proportion Professional	.167	42.81	.109	22.34
Proportion Administrative & Clerical	-.065	-18.16	-.217	-54.77
Proportion Production	-.134	-35.19	-.122	-30.23
Log-Likelihood	-170839		-186738	
Pseudo-R Squared	0.2297		0.2381	
Number of Observations	4107		4107	

Note: * dF/dx is calculated for a discrete change of the dummy variable from 0 to 1. Other establishment controls included: Region, Industry, Federal Jurisdiction, and Proportion Full-Time.

Table 13
Incidence of Employee Participation in Employer-Sponsored Occupational Classroom Training,
1999 Probit

Variable	Employee Sample		Establishment-Employee Linked Sample	
	Coefficient dF/dx	t-value	Coefficient dF/dx	t-value
Hours, Weeks & Union Status				
Covered by a CBA*	.016	53.29	-.009	-25.44
Usual Hours Per Week	.001	98.41	.002	168.59
Weeks Per Year	.002	88.51	.002	69.63
Age & Experience				
Number Years Using Computer	.829e-03	15.34	-.001	-28.00
Number Years Using Computer Squared	-.302e-04	-13.40	.528e-04	23.59
Years Work Experience	.001	36.05	.823e-03	16.59
Years Current Employer	.002	38.84	.002	43.31
Years Job Experience	-.006	117.87	-.004	-78.48
Age	.414e-03	5.14	.003	34.82
Demographic				
Born in Canada*	.023	92.45	.020	79.94
Male*	-.011	-48.88	.001	4.66
Married*	.006	28.61	-.004	-21.54
Language at Work is French*	-.010	-21.64	-.009	-19.51
Language at Work is Other*	.012	17.45	.045	56.07
Education				
Highest Degree BA or Higher*	.078	208.37	.068	171.79
Completed College or Univ. Certificate*	.033	106.84	.043	129.70
Some College or University*	.023	72.53	.017	48.42
Less Than High School*	-.021	-66.78	-.002	-7.27
Occupation				
Professional*	-.029	-94.10	-.023	-67.25
Technical*	-.001	-4.16	.005	17.31
Trades*	-.044	-136.98	-.016	-40.96
Marketing/Sales*	-.025	-61.44	-.012	-27.35
Clerical/Administrative*	-.069	-235.06	-.054	172.92
Production*	-.056	-134.45	-.028	-61.00
Technology Usage at Work				
Use Computer*	.042	143.12	.045	147.71
Use Computer CAD/CAM*	.004	16.92	-.009	-31.35
Use Other Devices*	-.885e-03	-3.82	-.009	-41.06
Firm Controls				
Establishment Size				
0-19*			.014	26.32
20-99*			-.010	-21.87
100-499*			-.003	-10.05
Institutional				
Human Resource Unit*			.016	44.89
Unionized*			.010	30.13
Financial				
Operating Revenue per Employee			.796e-08	26.19
Gross Payroll per Employee			.115e-06	15.06
Technology and Innovation				
Innovation Occurred*			-.002	-10.26
Number of Technological Changes			-.007	-48.30
Proportion of Workers using Computer			-.027	-74.35
Log-Likelihood	-2597174		-1933314	
Pseudo-R Squared	0.0829		0.1332	
Number of Observations	19454		16379	

Note: * dF/dx is calculated for a discrete change of the dummy variable from 0 to 1. Other employee controls included are: Federal Jurisdiction, Years Work Experience Squared, Years Current Employer Squared, Years Job Experience Squared, Age Squared, and Region. Other Establishment controls included are: Number of Variable Pay Practices, Non-Wage Benefits per Employee, Percentage Foreign

Assets, Turnover controls, Proportion Full-time, Competition controls, Occupational distribution, and industry.

Table 14
Incidence of Employee Participation in Employer-Sponsored Occupational On-the-Job Training,
1999 Probit

Variable	Employee Sample		Establishment-Employee Linked Sample	
	Coefficient dF/dx	t-value	Coefficient dF/dx	t-value
Hours, Weeks & Union Status				
Covered by a CBA*	-.039	-96.09	.001	2.61
Usual Hours Per Week	.982e-03	55.83	.001	60.81
Weeks Per Year	-.002	-71.55	-.002	-54.51
Age & Experience				
Number Years Using Computer	.007	98.22	.008	95.79
Number Years Using Computer Squared	-.363e-03	-113.23	-.366e-03	-100.46
Years Work Experience	-.004	-66.12	-.005	-76.52
Years Current Employer	.003	44.54	.009	96.73
Years Job Experience	.005	64.58	.001	17.17
Age	.001	13.58	.004	29.23
Demographic				
Born in Canada*	-.032	-83.91	-.037	-83.05
Male*	.007	21.31	.019	50.11
Married*	.024	78.36	.027	75.31
Language at Work is French*	.047	62.56	.083	106.42
Language at Work is Other*	.037	36.82	.036	31.37
Education				
Highest Degree BA or Higher*	.013	28.38	.036	66.23
Completed College or Univ. Certificate*	-.001	-4.44	.025	52.49
Some College or University*	.027	62.66	.059	119.75
Less Than High School*	.009	23.31	.014	31.16
Occupation				
Professional*	-.084	-130.07	-.086	-113.30
Technical*	-.046	-86.77	-.052	-84.06
Trades*	-.082	-139.02	-.066	-92.53
Marketing/Sales*	-.037	-53.52	-.042	-48.56
Clerical/Administrative*	-.100	-167.25	-.099	-144.29
Production*	-.109	-142.64	-.115	-126.34
Technology Usage at Work				
Use Computer*	-.137	-335.50	-.120	-244.25
Use Computer CAD/CAM*	-.038	-89.48	-.049	-100.27
Use Other Devices*	-.045	-139.85	-.050	-132.63
Firm Controls				
Establishment Size				
0-19*			.021	25.20
20-99*			-.040	-52.48
100-499*			-.029	-44.79
Institutional				
Human Resource Unit*			-.009	-17.32
Unionized*			-.015	-29.55
Financial				
Operating Revenue per Employee			-.620e-09	-1.19
Gross Payroll per Employee			.262e-06	20.81
Technology and Innovation				
Innovation Occurred*			-.006	-16.68
Number of Technological Changes			-.014	-55.49
Proportion of Workers using Computer			-.064	-102.92
Log-Likelihood	-4067170		-3280698	
Pseudo-R Squared	0.0607		0.0814	
Number of Observations	19454		16379	

Note: * dF/dx is calculated for a discrete change of the dummy variable from 0 to 1. Other employee controls included are: Federal Jurisdiction, Years Work Experience Squared, Years Squared, and Region. Other Establishment controls included are:

variable from 0 to 1. Other employee controls included are: Current Employer Squared, Years Job Experience Squared, Age Number of Variable Pay Practices, Non-Wage Benefits per

Employee, Percentage Foreign Assets, Turnover controls, Proportion Full-time, Competition controls, Occupational distribution, and industry.

Table 15
Incidence of Employer-Sponsored Organizational Classroom and On-the-Job Training,
1999

Variable	Establishment Sample Probit			
	Organizational Classroom Training Offered		Organizational On-the-Job Training Offered	
	Coefficient dF/dx	t-value	Coefficient dF/dx	t-value
Establishment Size				
0-19*	-.484	-21.29	-.310	-15.50
20-99*	-.101	-10.09	-.093	-7.62
100-499*	-.056	-4.92	-.025	-1.77
Institutional				
Human Resource Unit*	.127	37.47	.010	3.06
Unionized*	.056	24.22	.081	30.61
Number of Variable Pay Practices	.050	87.17	.070	111.47
Financial				
Operating Revenue per Employee	-.115e-07	-4.73	-.109e-06	-19.54
Gross Payroll per Employee	-.439e-06	-9.84	-.109e-05	-19.14
Non-Wage Benefits per Employee	.136e-04	33.19	.637e-05	23.60
Percentage Foreign Held Assets	.318e-03	12.47	-.156e-03	-4.87
Turnover				
Percentage Quits	.003	1.93	.063	30.23
Percentage Layoffs	-.817e-03	-0.86	.004	6.98
Percentage New Hires	.002	2.14	.002	3.17
Competition				
Compete Local-Owned*	.041	22.71	-.002	-1.08
Compete Canada-Owned*	.021	16.87	.099	64.36
Compete USA-Owned*	-.018	-13.60	.031	18.63
Compete ROW-Owned*	-.009	-5.89	-.038	-22.36
Compete None*	.012	4.69	.038	12.24
Technology and Innovation				
Innovation Occurred*	.060	53.79	.128	99.49
Number of Technological Changes	.015	18.38	.021	22.35
Proportion of Workers using Computer	-.015	-8.52	-.007	-3.83
Occupational Distribution				
Proportion Sales	.045	16.13	-.093	-29.76
Proportion Technical & Trades	.035	12.39	-.012	-3.79
Proportion Professional	-.087	-24.36	-.154	-39.50
Proportion Administrative & Clerical	-.049	-17.49	-.127	-40.47
Proportion Production	-.026	-8.91	.008	2.86
Log-Likelihood	-137046		-157767	
Pseudo-R Squared	0.2321		0.2376	
Number of Observations	4107		4107	

Note: * dF/dx is calculated for a discrete change of the dummy variable from 0 to 1. Other establishment controls included: Region, Industry, Federal Jurisdiction, and Proportion Full-Time.

Table 16
Incidence of Employee Participation in Employer-Sponsored Organizational Classroom Training,
1999 Probit

Variable	Employee Sample		Establishment-Employee Linked Sample	
	Coefficient dF/dx	t-value	Coefficient dF/dx	t-value
Hours, Weeks & Union Status				
Covered by a CBA*	.010	51.61	-.008	-38.39
Usual Hours Per Week	.001	122.22	.744e-03	82.95
Weeks Per Year	.001	62.95	.609e-03	39.72
Age & Experience				
Number Years Using Computer	-.881e-03	-22.69	-.002	-57.65
Number Years Using Computer Squared	.194e-04	11.46	.530e-04	33.78
Years Work Experience	-.729e-03	-22.71	.328e-03	10.17
Years Current Employer	.001	36.78	.001	29.58
Years Job Experience	-.190e-03	-3.97	.001	25.41
Age	.002	44.66	-.480e-03	-7.90
Demographic				
Born in Canada*	.003	16.37	.004	25.98
Male*	.020	119.86	.021	122.80
Married*	.012	73.46	.012	76.97
Language at Work is French*	-.001	-4.79	-.005	-14.77
Language at Work is Other*	-.037	-77.40	-.027	-58.72
Education				
Highest Degree BA or Higher*	-.005	-21.62	.489e-03	1.93
Completed College or Univ. Certificate*	-.005	-25.19	.884e-03	3.96
Some College or University*	-.009	-39.59	-.002	-11.80
Less Than High School*	-.002	-12.25	.001	5.34
Occupation				
Professional*	.021	61.06	.006	18.88
Technical*	.034	114.57	.020	70.32
Trades*	.029	96.34	.009	33.05
Marketing/Sales*	-.987e-03	-2.72	.014	35.12
Clerical/Administrative*	-.012	-39.77	-.016	-60.32
Production*	.045	105.10	.024	61.61
Technology Usage at Work				
Use Computer*	-.003	-14.07	.006	29.60
Use Computer CAD/CAM*	.017	79.45	.018	85.99
Use Other Devices*	-.003	-21.84	-.002	-12.52
Firm Controls				
Establishment Size				
0-19*			-.014	-38.97
20-99*			.003	9.79
100-499*			.012	45.57
Institutional				
Human Resource Unit*			.007	33.46
Unionized*			.002	12.67
Financial				
Operating Revenue per Employee			.608e-08	29.95
Gross Payroll per Employee			.260e-06	47.91
Technology and Innovation				
Innovation Occurred*			.014	89.88
Number of Technological Changes			-.003	-33.42
Proportion of Workers using Computer			-.016	-59.11
Log-Likelihood	-1795410		-1379455	
Pseudo-R Squared	0.0602		0.1212	
Number of Observations	19454		16379	

Note: * dF/dx is calculated for a discrete change of the dummy variable from 0 to 1. Other employee controls included are: Federal Jurisdiction, Years Work Experience Squared, Years Squared, and Region. Other Establishment controls included are:

variable from 0 to 1. Other employee controls included are: Current Employer Squared, Years Job Experience Squared, Age Number of Variable Pay Practices, Non-Wage Benefits per

Employee, Percentage Foreign Assets, Turnover controls, Proportion Full-time, Competition controls, Occupational distribution, and industry.

Table 17
Incidence of Employee Participation in Employer-Sponsored Organizational On-the-Job Training,
1999 Probit

Variable	Employee Sample		Establishment-Employee Linked Sample	
	Coefficient dF/dx	t-value	Coefficient dF/dx	t-value
Hours, Weeks & Union Status				
Covered by a CBA*	-.027	-60.58	.003	4.78
Usual Hours Per Week	.308e-03	16.60	.640e-03	27.04
Weeks Per Year	-.002	-83.06	-.002	-52.83
Age & Experience				
Number Years Using Computer	.003	38.67	.005	54.19
Number Years Using Computer Squared	-.186e-03	-53.57	-.208e-03	-53.62
Years Work Experience	-.001	-19.84	-.004	-52.70
Years Current Employer	.002	31.63	.007	72.67
Years Job Experience	.010	107.02	.006	56.26
Age	.005	42.83	.008	53.76
Demographic				
Born in Canada*	-.049	-119.11	-.048	-100.75
Male*	.021	59.26	.028	68.59
Married*	.014	43.22	.018	46.78
Language at Work is French*	.049	59.98	.079	92.06
Language at Work is Other*	.052	47.92	.046	37.31
Education				
Highest Degree BA or Higher*	-.010	-19.55	.007	12.38
Completed College or Univ. Certificate*	.010	22.01	.030	58.70
Some College or University*	.005	12.40	.038	70.58
Less Than High School*	.012	27.64	.022	42.51
Occupation				
Professional*	-.043	-64.93	-.053	-67.79
Technical*	-.033	-60.05	-.055	-85.88
Trades*	-.055	-89.09	-.064	-85.70
Marketing/Sales*	-.022	-30.33	-.022	-24.73
Clerical/Administrative*	-.067	-107.94	-.075	-104.88
Production*	-.087	-111.36	-.097	-103.80
Technology Usage at Work				
Use Computer*	-.146	-327.90	-.119	-220.63
Use Computer CAD/CAM*	-.069	-150.94	-.076	-143.17
Use Other Devices*	-.079	-222.51	-.074	-181.22
Firm Controls				
Establishment Size				
0-19*			-.024	-25.93
20-99*			-.073	-87.91
100-499*			-.044	-61.52
Institutional				
Human Resource Unit*			-.051	-83.29
Unionized*			.003	6.41
Financial				
Operating Revenue per Employee			-.937e-08	-16.39
Gross Payroll per Employee			.273e-06	20.52
Technology and Innovation				
Innovation Occurred*			-.002	-6.31
Number of Technological Changes			-.008	-29.60
Proportion of Workers using Computer			-.076	-112.90
Log-Likelihood	-4428769		-3553607	
Pseudo-R Squared	0.0764		0.0932	
Number of Observations	19454		16379	

Note: * dF/dx is calculated for a discrete change of the dummy variable from 0 to 1. Other employee controls included are: Federal Jurisdiction, Years Work Experience Squared, Years Squared, and Region. Other Establishment controls included are:

variable from 0 to 1. Other employee controls included are: Current Employer Squared, Years Job Experience Squared, Age Number of Variable Pay Practices, Non-Wage Benefits per

Employee, Percentage Foreign Assets, Turnover controls, Proportion Full-time, Competition controls, Occupational distribution, and industry.

Table 18
Employee Descriptive Characteristics (Mean) in 1999 Employee Sample by Union Status and Gender

Gender	Hourly Wage	Hours Per Week Using Computer	Hours Per Week Using Application (Most Used)	Number of Years Computer Experience	Software Training Last Year (Percent)
Male					
Covered by CBA					
Mean: Computer Users	24.68	13.70	10.14	7.92	11.54
Mean: Non-Computer Users	18.82	0.00	0.00	1.28	0.87
Not Covered by CBA					
Mean: Computer Users	23.59	19.00	13.43	8.60	13.54
Mean: Non-Computer Users	14.99	0.00	0.00	1.50	0.36
Female					
Covered by CBA					
Mean: Computer Users	21.14	16.25	12.70	8.46	22.25
Mean: Non-Computer Users	16.49	0.00	0.00	1.36	3.16
Not Covered by CBA					
Mean: Computer Users	17.60	21.64	16.02	8.95	15.71
Mean: Non-Computer Users	11.62	0.00	0.00	1.79	0.93

Table 19
Employee Descriptive Characteristics (Mean) in 1999 Employee Sample by Union Status and Age

Age	Hourly Wage	Hours Per Week Using Computer	Hours Per Week Using Application (Most Used)	Number of Years Computer Experience	Software Training Last Year (Percent)
25 or Less					
Covered by CBA					
Mean: Computer Users	14.56	17.64	14.71	2.57	18.16
Mean: Non-Computer Users	11.90	0.00	0.00	0.43	0.18
Not Covered by CBA					
Mean: Computer Users	11.27	16.50	13.41	3.02	5.84
Mean: Non-Computer Users	9.57	0.00	0.00	0.85	0.33
25-39					
Covered by CBA					
Mean: Computer Users	21.01	15.50	11.77	7.22	14.89
Mean: Non-Computer Users	16.97	0.00	0.00	1.40	2.56
Not Covered by CBA					
Mean: Computer Users	18.72	21.95	15.60	7.76	15.52
Mean: Non-Computer Users	14.04	0.00	0.00	1.52	0.39
40-54					
Covered by CBA					
Mean: Computer Users	24.05	14.92	11.33	9.12	18.92
Mean: Non-Computer Users	18.84	0.00	0.00	1.36	1.51
Not Covered by CBA					
Mean: Computer Users	23.58	19.80	14.36	10.83	15.74
Mean: Non-Computer Users	14.14	0.00	0.00	2.23	1.18
55 or More					
Covered by CBA					
Mean: Computer Users	25.53	13.34	10.39	9.02	17.09
Mean: Non-Computer Users	20.25	0.00	0.00	1.50	2.68
Not Covered by CBA					
Mean: Computer Users	23.34	18.64	14.23	11.08	14.20
Mean: Non-Computer Users	14.19	0.00	0.00	1.48	0.30

Table 20
Employee Descriptive Characteristics (Mean) in 1999 Employee Sample by Union Status and Education

Education	Hourly Wage	Hours Per Week Using Computer	Hours Per Week Using Application (Most Used)	Number of Years Computer Experience	Software Training Last Year (Percent)
Less Than High School					
Covered by CBA					
Mean: Computer Users	20.15	13.62	11.05	5.95	10.95
Mean: Non-Computer Users	17.03	0.00	0.00	0.74	0.44
Not Covered by CBA					
Mean: Computer Users	15.90	16.17	12.88	6.78	5.74
Mean: Non-Computer Users	12.25	0.00	0.00	0.69	0.45
High School					
Covered by CBA					
Mean: Computer Users	19.76	16.35	13.37	7.65	15.10
Mean: Non-Computer Users	17.91	0.00	0.00	1.41	1.27
Not Covered by CBA					
Mean: Computer Users	17.96	19.54	15.14	8.42	12.17
Mean: Non-Computer Users	13.16	0.00	0.00	1.48	0.53
Some College					
Covered by CBA					
Mean: Computer Users	18.32	17.75	14.13	8.71	19.40
Mean: Non-Computer Users	15.87	0.00	0.00	1.84	0.57
Not Covered by CBA					
Mean: Computer Users	18.26	20.60	15.41	8.82	15.23
Mean: Non-Computer Users	12.47	0.00	0.00	2.42	0.74
College Degree					
Covered by CBA					
Mean: Computer Users	20.57	15.61	12.26	8.47	22.79
Mean: Non-Computer Users	18.41	0.00	0.00	1.46	5.46
Not Covered by CBA					
Mean: Computer Users	19.13	21.81	15.70	9.21	16.64
Mean: Non-Computer Users	14.39	0.00	0.00	1.86	0.17
BA or Higher					
Covered by CBA					
Mean: Computer Users	28.82	13.22	8.87	8.83	15.64
Mean: Non-Computer Users	20.80	0.00	0.00	2.05	4.49
Not Covered by CBA					
Mean: Computer Users	26.99	21.63	14.12	9.54	18.70
Mean: Non-Computer Users	17.51	0.00	0.00	3.88	2.61

Table 21
Percent of Computer Users by Most Used Application in 1999 Employee Sample

Application	All	Female	Male	Covered by CBA	Not Covered by CBA
Word Processor	23.48	25.42	21.18	29.89	21.50
Spreadsheets	9.61	8.27	11.20	4.01	11.35
Databases	9.66	9.21	10.19	10.32	9.45
Desktop Publishing	0.80	0.89	0.70	0.67	0.84
General Management Applications	2.15	2.42	1.82	1.04	2.49
Communications	7.32	5.08	9.97	6.82	7.47
Programming Languages	1.02	0.78	1.31	0.85	1.07
Specialized Office Applications	23.92	25.85	21.62	21.77	24.58
Data Analysis	0.72	0.56	0.91	0.76	0.71
Graphics & Presentation	1.54	1.02	2.16	2.02	1.39
Computer-Aided Design	1.03	0.38	1.80	0.69	1.13
Computer-Aided Engineering	0.38	0.07	0.75	0.17	0.45
Expert Systems	2.41	2.64	2.12	3.03	2.21
Other	15.97	17.40	14.27	17.96	15.35
Most Helpful Method for Learning Application					
Self-Learning	38.57	38.49	38.66	37.43	39.47
Employer-Paid Formal Training	14.20	13.34	15.35	19.66	12.68
Self-Paid Formal Training	2.05	2.47	1.48	1.91	2.12
On-the-Job Training	41.11	41.90	40.06	38.12	42.64
University or Community College Courses	3.01	2.98	3.05	2.88	3.09
Other	1.07	0.82	1.40	n.a.	n.a.
Where did Most Learning of Application Occur					
On Company Time	64.99	68.25	61.11	63.36	65.50
About Equally on Company and Own Time	21.31	19.94	22.95	17.77	22.41
On Own Time	13.69	11.81	15.94	18.87	12.09

Note: n.a. means not available due to a small sample size.

Table 22
Employee Descriptive Characteristics (Mean) by Most Used Application in 1999 Employee Sample

Application	Hourly Wage	Hours Per Week Using Computer	Hours Per Week Using Application	Number of Years Computer Experience	Software Training Last Year (Percent)
Word Processor	23.09	18.18	12.34	9.09	17.89
Spreadsheets	22.16	20.02	12.07	9.62	14.74
Databases	18.50	18.37	13.58	8.07	15.64
Desktop Publishing	19.95	21.55	15.31	7.74	14.18
General Management Applications	19.62	18.11	12.93	8.27	13.10
Communications	31.46	18.05	10.20	9.84	21.49
Programming Languages	22.29	29.51	19.08	9.50	28.63
Specialized Office Applications	17.47	20.31	16.88	8.39	13.83
Data Analysis	23.88	15.99	10.44	10.12	14.72
Graphics & Presentation	23.01	22.19	14.16	8.06	9.73
Computer-Aided Design	24.93	26.55	19.58	8.38	16.84
Computer-Aided Engineering	26.98	18.67	14.51	10.25	21.41
Expert Systems	17.58	19.70	17.43	7.34	8.36
Other	18.58	18.09	14.63	7.86	12.02
Mean: Computer Users	20.90	19.17	14.05	8.65	15.33
Mean: Non-Computer Users	14.84	0.00	0.00	1.53	1.08
Covered by CBA					
Mean: Computer Users	22.79	15.06	11.51	8.21	17.26
Mean: Non-Computer Users	17.76	0.00	0.00	1.32	1.91
Not Covered by CBA					
Mean: Computer Users	20.32	20.45	14.84	8.79	14.73
Mean: Non-Computer Users	13.30	0.00	0.00	1.65	0.64

Table 23
Percentage of Employees Using Computer-Controlled or Computer-Assisted Technology in 1999
Employee Sample

	All	Covered by CBA	Not Covered by CBA
Use Technology	.1198	.1208	.1193
Time Spent Using Technology Per Week	12.50	12.28	12.56
Technology Upgraded or Changed Last 12 Months	.4298	.4195	.4338
Received Training Related to Technology Change	.5767	.6095	.5642
Days Spent On Training	3.11	3.92	2.78
Most Helpful Method for Learning Technology			
Self-Learning	.2425	.2310	.2470
Employer-Paid Formal Training	.0904	.1348	.0730
Self-Paid Formal Training	.0137	.0172	.0123
On-the-Job Training	.6214	.6008	.6295
University or Community College Courses	.0254	.0124	.0305
Other	.0066	.0038	.0078

Table 24
Percentage of Employees Using Other Machines or Technology Devices in 1999 Employee Sample

	All	Covered by CBA	Not Covered by CBA
Use Other Devices	.2690	.2412	.2798
Time Spent Using Devices Per Week	22.50	22.34	22.58
Technology Upgraded or Changed Last 12 Months	.2615	.2830	.2543
Received Training Related to Technology Change	.6145	.6162	.6138
Days Spent On Training	2.27	2.13	2.33
Most Helpful Method for Learning Technology			
Self-Learning	.3041	.2681	.3161
Employer-Paid Formal Training	.0478	.0743	.0389
Self-Paid Formal Training	.0202	.0301	.0169
On-the-Job Training	.5709	.5783	.5685
University or Community College Courses	.0265	.0310	.0249
Other	.0305	.0182	.0346

Table 25
Incidence of Employee Computer Usage at Work, 1999
Probit

Variable	Employee Sample		Establishment-Employee Linked Sample	
	Coefficient dF/dx	t-value	Coefficient dF/dx	t-value
Hours, Weeks & Union Status				
Covered by a CBA*	-.081	-138.50	-.153	-181.27
Usual Hours Per Week	.005	193.42	.004	167.96
Weeks Per Year	.004	130.93	.002	66.41
Age & Experience				
Number Years Using Computer	.116	1060.40	.093	851.09
Number Years Using Computer Squared	-.003	-713.20	-.002	-625.37
Years Work Experience	-.005	-65.88	-.123e-03	-1.33
Years Current Employer	.026	184.83	.008	58.09
Years Job Experience	-.028	-187.54	-.016	-104.51
Age	.279e-03	1.72	.893e-03	5.28
Demographic				
Born in Canada*	.031	52.66	.073	109.16
Male*	.035	70.74	-.042	-83.69
Married*	.041	85.92	.028	59.02
Language at Work is French*	-.074	-59.60	-.047	-42.32
Language at Work is Other*	-.127	-91.69	-.049	-34.64
Education				
Highest Degree BA or Higher*	.084	106.00	.044	53.59
Completed College or Univ. Certificate*	.040	66.21	-.013	-19.89
Some College or University*	.013	20.57	.016	25.42
Less Than High School*	-.020	-34.15	.010	18.77
Occupation				
Professional*	.177	181.56	.044	38.05
Technical*	-.119	-151.08	-.149	-160.89
Trades*	-.332	-400.75	-.377	-371.91
Marketing/Sales*	-.210	-204.71	-.292	-225.19
Clerical/Administrative*	.097	113.59	.004	4.46
Production*	-.376	-355.27	-.443	-323.90
Firm Controls				
Establishment Size				
0-19*			-.040	-33.32
20-99*			-.029	-28.17
100-499*			-.007	-7.85
Institutional				
Human Resource Unit*			-.020	-24.90
Unionized*			.038	52.84
Financial				
Operating Revenue per Employee			.102e-07	11.83
Gross Payroll per Employee			.193e-05	102.49
Technology and Innovation				
Innovation Occurred*			.006	12.96
Number of Technological Changes			-.014	-40.00
Proportion of Workers using Computer			.393	478.99
Training Offered				
Classroom*			.071	125.48
On-the-Job*			-.039	-67.54
Log-Likelihood	-2905289		-1826576	
Pseudo-R Squared	0.4792		0.5792	
Number of Observations	19454		16379	

Note: * dF/dx is calculated for a discrete change of the dummy variable from 0 to 1. Other employee controls included are: Federal Jurisdiction, Years Work Experience Squared, Years Current Employer Squared, Years Job Experience Squared, Age Squared, and Region. Other Establishment controls included are: Number of Variable Pay Practices, Non-Wage Benefits per Employee, Percentage Foreign Assets, Turnover controls, Proportion Full-time, Competition controls, Occupational distribution, and industry.

Table 26
Incidence of Employee Usage of Computer CAD/CAM Technology at Work, 1999 Probit

Variable	Employee Sample		Establishment-Employee Linked Sample	
	Coefficient dF/dx	t-value	Coefficient dF/dx	t-value
Hours, Weeks & Union Status				
Covered by a CBA*	.041	126.35	.029	66.41
Usual Hours Per Week	-.823e-03	-63.27	.863e-04	5.20
Weeks Per Year	.001	48.53	.002	69.29
Age & Experience				
Number Years Using Computer	.012	221.36	.009	151.03
Number Years Using Computer Squared	-.402e-03	-152.30	-.263e-03	-96.43
Years Work Experience	-.001	-27.40	-.914e-03	-15.52
Years Current Employer	-.279e-03	-4.18	-.590e-03	-7.94
Years Job Experience	.001	18.80	.001	19.14
Age	-.001	-19.19	.003	35.33
Demographic				
Born in Canada*	.047	159.09	.039	119.36
Male*	.067	251.44	.073	257.70
Married*	-.012	-50.75	-.012	-43.95
Language at Work is French*	-.035	-70.43	.001	2.22
Language at Work is Other*	.041	47.94	.059	56.72
Education				
Highest Degree BA or Higher*	-.008	-22.40	-.009	-23.20
Completed College or Univ. Certificate*	.017	50.94	.025	65.70
Some College or University*	.014	41.85	.020	51.42
Less Than High School*	-.020	-59.93	-.025	-71.73
Occupation				
Professional*	-.056	-134.96	-.030	-62.23
Technical*	-.030	-82.19	-.017	-42.95
Trades*	.028	65.37	.043	86.78
Marketing/Sales*	.067	120.78	.004	8.27
Clerical/Administrative*	-.070	-175.67	-.052	-120.22
Production*	-.037	-72.94	-.052	-96.67
Firm Controls				
Establishment Size				
0-19*			-.040	-63.15
20-99*			-.007	-12.46
100-499*			.622e-03	1.25
Institutional				
Human Resource Unit*			-.021	-52.17
Unionized*			.013	32.08
Financial				
Operating Revenue per Employee			.827e-08	18.34
Gross Payroll per Employee			-.767e-06	-68.17
Technology and Innovation				
Innovation Occurred*			.033	120.52
Number of Technological Changes			.024	122.37
Proportion of Workers using Computer			.039	88.64
Training Offered				
Classroom*			-.004	-13.32
On-the-Job*			-.013	-38.66
Log-Likelihood	-3064251		-2331642	
Pseudo-R Squared	0.0671		0.1400	
Number of Observations	19454		16379	

Note: * dF/dx is calculated for a discrete change of the dummy variable from 0 to 1. Other employee controls included are: Federal Jurisdiction, Years Work Experience Squared, Years Current Employer Squared, Years Job Experience Squared, Age Squared, and Region. Other Establishment controls

included are: Number of Variable Pay Practices, Non-Wage Benefits per Employee, Percentage Foreign Assets, Turnover controls, Proportion Full-time, Competition controls, Occupational distribution, and industry.

Table 27
Incidence of Employee Usage of Other Devices or Technologies at Work, 1999
Probit

Variable	Employee Sample		Establishment-Employee Linked Sample	
	Coefficient dF/dx	t-value	Coefficient dF/dx	t-value
Hours, Weeks & Union Status				
Covered by a CBA*	-.006	-13.87	.051	77.55
Usual Hours Per Week	.993e-03	52.88	.001	59.18
Weeks Per Year	-.002	-89.12	-.002	-61.63
Age & Experience				
Number Years Using Computer	-.014	-188.98	-.009	-110.87
Number Years Using Computer Squared	.387e-03	109.58	.274e-03	67.65
Years Work Experience	.008	115.31	.009	122.51
Years Current Employer	.005	59.48	.009	82.91
Years Job Experience	-.002	-24.94	-.006	-58.58
Age	-.016	-131.66	-.016	-109.39
Demographic				
Born in Canada*	.026	60.55	-.005	-10.12
Male*	.008	22.26	.025	59.21
Married*	-.047	-132.64	-.043	-106.36
Language at Work is French*	-.107	-140.37	-.119	-144.25
Language at Work is Other*	.038	33.78	.005	4.46
Education				
Highest Degree BA or Higher*	-.056	-100.33	-.028	-44.46
Completed College or Univ. Certificate*	-.018	-37.97	-.007	-13.53
Some College or University*	-.070	-147.30	-.065	-121.01
Less Than High School*	-.057	-125.74	-.055	-111.43
Occupation				
Professional*	-.069	-100.62	.006	7.39
Technical*	.048	82.57	.097	143.33
Trades*	.085	137.25	.131	174.39
Marketing/Sales*	.265	333.64	.229	242.00
Clerical/Administrative*	-.020	-31.91	.041	55.30
Production*	.038	48.85	.059	63.79
Firm Controls				
Establishment Size				
0-19*			.060	60.12
20-99*			-.010	-12.04
100-499*			-.028	-38.28
Institutional				
Human Resource Unit*			-.013	-20.70
Unionized*			-.053	-89.75
Financial				
Operating Revenue per Employee			-.686e-07	-86.45
Gross Payroll per Employee			-.387e-06	-25.69
Technology and Innovation				
Innovation Occurred*			.031	75.90
Number of Technological Changes			.014	49.33
Proportion of Workers using Computer			.026	38.85
Training Offered				
Classroom*			-.011	-25.56
On-the-Job*			.013	26.93
Log-Likelihood	-4586536		-3566250	
Pseudo-R Squared	0.0820		0.1004	
Number of Observations	19454		16379	

Note: * dF/dx is calculated for a discrete change of the dummy variable from 0 to 1. Other employee controls included are: Federal Jurisdiction, Years Work Experience Squared, Years Current Employer Squared, Years Job Experience Squared, Age Squared, and Region. Other Establishment controls included are: Number of Variable Pay Practices, Non-Wage Benefits per Employee, Percentage Foreign Assets, Turnover controls, Proportion Full-time, Competition controls, Occupational distribution, and industry.

Table 28
Employee Hours per Week Using Computers at Work, 1999
OLS

Variable	Employee Sample		Establishment-Employee Linked Sample	
	Coefficient	t-value	Coefficient	t-value
Hours, Weeks & Union Status				
Covered by a CBA	-1.543	-167.43	-2.874	-223.86
Usual Hours Per Week	.211	458.81	.213	389.86
Weeks Per Year	.061	125.35	.029	47.48
Age & Experience				
Number Years Using Computer	1.723	946.11	1.274	637.56
Number Years Using Computer Squared	-.048	-564.96	-.035	-410.88
Years Work Experience	-.075	-52.34	.007	4.59
Years Current Employer	.222	97.13	.008	3.41
Years Job Experience	-.466	-192.17	-.235	-90.31
Age	.001	0.43	-.160	-53.01
Demographic				
Born in Canada	-1.326	-130.05	-.955	-88.74
Male	-1.814	-208.92	-3.135	-334.39
Married	.113	14.06	-.156	-18.42
Language at Work is French	-2.376	-123.69	-1.227	-63.34
Language at Work is Other	-1.203	-51.46	.337	13.21
Education				
Highest Degree BA or Higher	1.133	80.76	-.248	-17.04
Completed College or Univ. Certificate	.975	87.36	.410	33.93
Some College or University	.419	36.72	.852	68.33
Less Than High School	-.211	-22.55	.334	32.43
Occupation				
Professional	6.521	383.51	2.445	134.53
Technical	-.712	-49.30	-1.453	-95.21
Trades	-5.840	-417.97	-8.008	-497.63
Marketing/Sales	-4.501	-261.68	-3.975	-203.71
Clerical/Administrative	4.394	281.19	2.207	134.32
Production	-5.732	-357.68	-6.289	-346.19
Constant	2.043	37.73	4.632	63.21
Firm Controls				
Establishment Size				
0-19			-2.138	-105.97
20-99			-.451	-26.53
100-499			.367	24.26
Institutional				
Human Resource Unit			.395	30.48
Unionized			1.076	85.64
Financial				
Operating Revenue per Employee			-.663e-06	-53.18
Gross Payroll per Employee			.352e-04	113.85
Technology and Innovation				
Innovation Occurred			-.420	-46.83
Number of Technological Changes			-.485	-78.66
Proportion of Workers using Computer			5.946	376.27
Training Offered				
Classroom			-.500	-48.37
On-the-Job			-.285	-26.14
Root MSE	10.243		9.6941	
R-Squared	0.4701		0.5334	
Number of Observations	19454		16379	

Note: Other employee controls included are: Federal Jurisdiction, Squared, Years Job Experience Squared, Age Squared, and Variable Pay Practices, Non-Wage Benefits per Employee,

Years Work Experience Squared, Years Current Employer Region. Other Establishment controls included are: Number of Percentage Foreign Assets, Turnover controls, Proportion Full-

time, Competition controls, Occupational distribution, and industry.

Table 29
Employee Hours per Week Using Computer CAD/CAM Technology at Work, 1999
OLS

Variable	Employee Sample		Establishment-Employee Linked Sample	
	Coefficient	t-value	Coefficient	t-value
Hours, Weeks & Union Status				
Covered by a CBA	.579	85.16	.482	51.27
Usual Hours Per Week	.005	31.53	.021	87.97
Weeks Per Year	.026	76.05	.039	102.51
Age & Experience				
Number Years Using Computer	.180	174.35	.113	92.59
Number Years Using Computer Squared	-.007	-169.30	-.004	-91.37
Years Work Experience	-.029	-35.20	-.021	-21.23
Years Current Employer	.017	14.18	.031	22.03
Years Job Experience	-.004	-3.46	-.628e-03	-0.38
Age	-.021	-14.38	.028	14.78
Demographic				
Born in Canada	.607	112.00	.574	99.16
Male	.505	99.07	.711	124.93
Married	-.223	-44.06	-.257	-44.48
Language at Work is French	-.764	-81.83	-.256	-26.14
Language at Work is Other	-.477	-45.50	-.128	-10.08
Education				
Highest Degree BA or Higher	-.430	-57.93	-.722	-91.54
Completed College or Univ. Certificate	.154	22.61	.322	41.17
Some College or University	.219	30.11	.299	34.37
Less Than High School	-.279	-40.98	-.352	-46.53
Occupation				
Professional	-.829	-97.92	-.621	-63.22
Technical	-.654	-81.52	-.479	-54.63
Trades	.739	81.04	.716	72.27
Marketing/Sales	1.649	139.82	.915	63.60
Clerical/Administrative	-.921	-109.21	-.663	-72.21
Production	-.235	-21.39	-.727	-61.00
Constant	.420	12.51	.901	17.90
Firm Controls				
Establishment Size				
0-19			-.228	-17.37
20-99			-.061	-5.22
100-499			.620	57.04
Institutional				
Human Resource Unit			.080	8.31
Unionized			-.264	-33.99
Financial				
Operating Revenue per Employee			-.765e-07	-10.27
Gross Payroll per Employee			-.197e-05	-10.07
Technology and Innovation				
Innovation Occurred			.237	41.89
Number of Technological Changes			.291	66.26
Proportion of Workers using Computer			1.509	152.89
Training Offered				
Classroom			.100	15.25
On-the-Job			-.016	-2.45
Root MSE	6.4078		6.3678	
R-Squared	0.0288		0.0579	
Number of Observations	19454		16379	

Note: Other employee controls included are: Federal Jurisdiction, Years Work Experience Squared, Years Current Employer Squared, Years Job Experience Squared, Age Squared, and Region. Other Establishment controls included are: Number of Variable Pay Practices, Non-Wage Benefits per Employee, Percentage Foreign Assets, Turnover controls, Proportion Full-time, Competition controls, Occupational distribution, and industry.

Table 30
Employee Hours per Week Using Other Devices or Technologies at Work, 1999
OLS

Variable	Employee Sample		Establishment-Employee Linked Sample	
	Coefficient	t-value	Coefficient	t-value
Hours, Weeks & Union Status				
Covered by a CBA	.197	41.30	.378	65.21
Usual Hours Per Week	.008	43.32	.011	43.76
Weeks Per Year	.002	9.69	.566e-04	0.17
Age & Experience				
Number Years Using Computer	-.061	-83.39	-.040	-49.35
Number Years Using Computer Squared	.002	79.04	.001	36.09
Years Work Experience	.037	62.83	.040	58.03
Years Current Employer	-.012	-16.41	-.001	-1.35
Years Job Experience	.028	29.87	-.009	-8.64
Age	-.041	-33.68	-.011	-8.17
Demographic				
Born in Canada	.057	14.93	.041	9.77
Male	.209	69.54	.236	74.05
Married	.073	23.16	.021	5.93
Language at Work is French	-.612	-92.65	-.507	-72.67
Language at Work is Other	.358	27.76	-.454	-62.75
Education				
Highest Degree BA or Higher	-.300	-65.28	-.062	-12.72
Completed College or Univ. Certificate	.038	7.41	.132	24.46
Some College or University	-.272	-60.57	-.087	-17.99
Less Than High School	-.363	-75.74	-.213	-39.50
Occupation				
Professional	-.148	-33.44	.158	38.99
Technical	-.014	-2.80	.376	77.95
Trades	.573	86.96	.682	103.27
Marketing/Sales	.248	35.82	.625	85.47
Clerical/Administrative	-.061	-12.57	.260	59.15
Production	.094	12.13	.424	52.92
Constant	.919	34.16	-.609	-17.29
Firm Controls				
Establishment Size				
0-19			.550	64.32
20-99			.266	34.32
100-499			.202	28.15
Institutional				
Human Resource Unit			-.056	-10.16
Unionized			-.153	-29.66
Financial				
Operating Revenue per Employee			-.584e-07	-15.33
Gross Payroll per Employee			.107e-05	7.65
Technology and Innovation				
Innovation Occurred			.180	49.00
Number of Technological Changes			.034	12.40
Proportion of Workers using Computer			.130	19.82
Training Offered				
Classroom			-.010	-2.26
On-the-Job			-.100	-20.82
Root MSE	4.3042		4.1993	
R-Squared	0.0144		0.0218	
Number of Observations	19454		16379	

Note: Other employee controls included are: Federal Jurisdiction, Years Work Experience Squared, Years Current Employer Squared, Years Job Experience Squared, Age Squared, and Region. Other Establishment controls included are: Number of Variable Pay Practices, Non-Wage Benefits per Employee, Percentage Foreign Assets, Turnover controls, Proportion Full-time, Competition controls, Occupational distribution, and industry.

Table 31
Incidence of Employer-Sponsored Technology-Related Classroom and On-the-Job
Training, 1999

Establishment Sample Probit

Variable	Technical Classroom Training Offered		Technical On-the-Job Training Offered	
	Coefficient dF/dx	t-value	Coefficient dF/dx	t-value
Establishment Size				
0-19*	-.377	-15.90	-.558	-22.32
20-99*	-.086	-6.11	-.183	-9.89
100-499*	-.032	-2.01	-.127	-6.53
Institutional				
Human Resource Unit*	.093	26.05	-.012	-2.70
Unionized*	.098	33.15	.109	30.49
Number of Variable Pay Practices	.054	76.93	.064	76.80
Financial				
Operating Revenue per Employee	-.101e-07	-3.52	-.511e-07	-12.95
Gross Payroll per Employee	.332e-06	5.23	.131e-06	2.46
Non-Wage Benefits per Employee	.148e-04	30.61	.114e-04	24.71
Percentage Foreign Held Assets	-.288e-03	-9.12	-.878e-03	-20.13
Turnover				
Percentage Quits	.020	8.43	.159	37.99
Percentage Layoffs	-.009	-4.72	-.033	-17.68
Percentage New Hires	-.012	-4.90	.032	18.70
Competition				
Compete Local-Owned*	-.043	-18.86	.041	14.49
Compete Canada-Owned*	.048	31.66	.089	45.69
Compete USA-Owned*	.042	23.75	-.070	-32.44
Compete ROW-Owned*	.021	11.40	-.023	-9.59
Compete None*	-.291e-03	-0.10	-.005	-1.37
Technology and Innovation				
Innovation Occurred*	.043	32.56	.102	62.53
Number of Technological Changes	.097	97.21	.129	101.52
Proportion of Workers using Computer	.105	49.50	.264	96.49
Occupational Distribution				
Proportion Sales	.053	16.20	-.011	-2.74
Proportion Technical & Trades	.082	26.25	.019	4.65
Proportion Professional	.135	39.69	-.053	-12.09
Proportion Administrative & Clerical	-.005	-1.77	-.019	-5.48
Proportion Production	-.106	-31.09	-.070	-17.60
Log-Likelihood	-150992		-198220	
Pseudo-R Squared	0.2590		0.1969	
Number of Observations	4107		4107	

Note: * dF/dx is calculated for a discrete change of the dummy variable from 0 to 1. Other establishment controls included: Region, Industry, Federal Jurisdiction, and Proportion Full-Time.

Table 32
Incidence of Employee Participation in Employer-Sponsored Technology-Related Classroom
Training, 1999 Probit

Variable	Employee Sample		Establishment-Employee Linked Sample	
	Coefficient dF/dx	t-value	Coefficient dF/dx	t-value
Hours, Weeks & Union Status				
Covered by a CBA*	.033	125.59	.001	5.81
Usual Hours Per Week	.565e-03	57.54	.192e-03	15.43
Weeks Per Year	.972e-03	44.25	.001	58.90
Age & Experience				
Number Years Using Computer	.005	122.26	.002	55.02
Number Years Using Computer Squared	-.175e-03	-99.87	-.105e-03	-57.44
Years Work Experience	.001	45.66	.002	44.94
Years Current Employer	.002	67.85	.946e-04	2.00
Years Job Experience	-.004	-88.89	-.384e-03	-7.50
Age	.246e-03	3.44	-.001	-22.63
Demographic				
Born in Canada*	.011	56.27	.011	50.85
Male*	-.011	-65.68	-.015	-79.05
Married*	.004	25.03	.004	25.56
Language at Work is French*	-.021	-63.28	-.012	-32.49
Language at Work is Other*	-.029	-59.15	-.021	-36.97
Education				
Highest Degree BA or Higher*	.039	135.38	.011	40.18
Completed College or Univ. Certificate*	.030	123.31	.025	92.42
Some College or University*	.017	66.77	.028	94.96
Less Than High School*	-.022	-82.18	-.015	-52.50
Occupation				
Professional*	.043	135.18	.004	14.58
Technical*	.011	45.05	.003	13.57
Trades*	-.867e-03	-2.88	-.023	-69.46
Marketing/Sales*	-.015	-42.92	-.017	-40.47
Clerical/Administrative*	.029	98.12	.017	54.66
Production*	-.048	-109.22	-.054	-123.46
Technology Usage at Work				
Use Computer*	.086	338.60	.060	211.40
Use Computer CAD/CAM*	.004	18.64	.012	44.34
Use Other Devices*	-.008	-46.35	-.004	-20.28
Firm Controls				
Establishment Size				
0-19*			.283e-03	0.64
20-99*			.010	27.53
100-499*			.016	52.33
Institutional				
Human Resource Unit*			.022	73.74
Unionized*			.005	20.82
Financial				
Operating Revenue per Employee			-.250e-08	-11.09
Gross Payroll per Employee			.654e-06	111.86
Technology and Innovation				
Innovation Occurred*			-.002	-13.85
Number of Technological Changes			.117e-03	0.90
Proportion of Workers using Computer			.035	107.94
Log-Likelihood	-2329289		-1832457	
Pseudo-R Squared	0.1594		0.1914	
Number of Observations	19454		16379	

Note: * dF/dx is calculated for a discrete change of the dummy variable from 0 to 1. Other employee controls included are: Federal Jurisdiction, Years Work Experience Squared, Years Squared, and Region. Other Establishment controls included are:

variable from 0 to 1. Other employee controls included are: Current Employer Squared, Years Job Experience Squared, Age Number of Variable Pay Practices, Non-Wage Benefits per

Employee, Percentage Foreign Assets, Turnover controls, Proportion Full-time, Competition controls, Occupational distribution, and industry.

Table 33
Incidence of Employee Participation in Employer-Sponsored Technology-Related On-the-Job Training, 1999 Probit

Variable	Employee Sample		Establishment-Employee Linked Sample	
	Coefficient dF/dx	t-value	Coefficient dF/dx	t-value
Hours, Weeks & Union Status				
Covered by a CBA*	-.070	-178.79	-.039	-70.93
Usual Hours Per Week	.493e-03	30.51	.001	56.47
Weeks Per Year	-.001	-53.92	-.822e-03	-27.27
Age & Experience				
Number Years Using Computer	.002	39.26	.004	55.64
Number Years Using Computer Squared	-.112e-03	-36.45	-.140e-03	-40.39
Years Work Experience	-.001	-30.27	-.003	-50.57
Years Current Employer	.338e-03	4.28	.005	57.20
Years Job Experience	.014	165.03	.009	99.96
Age	.006	57.42	.006	52.03
Demographic				
Born in Canada*	-.054	-150.13	-.055	-135.07
Male*	-.010	-33.09	-.016	-47.38
Married*	.003	11.50	.006	18.35
Language at Work is French*	.052	73.01	.083	115.72
Language at Work is Other*	.017	17.97	.015	14.27
Education				
Highest Degree BA or Higher*	-.017	-36.97	-.008	-16.64
Completed College or Univ. Certificate*	.025	63.18	.040	90.43
Some College or University*	.015	35.89	.033	72.03
Less Than High School*	-.006	-17.15	.001	3.19
Occupation				
Professional*	-.037	-62.27	-.061	-84.12
Technical*	-.029	-59.08	-.036	-63.20
Trades*	-.023	-44.31	-.012	-19.60
Marketing/Sales*	.574e-03	0.89	-.001	-1.91
Clerical/Administrative*	.015	28.13	.006	10.29
Production*	-.065	-96.56	-.057	-72.70
Technology Usage at Work				
Use Computer*	-.041	-104.04	-.034	-74.91
Use Computer CAD/CAM*	-.075	-185.48	-.083	-181.34
Use Other Devices*	-.073	-236.53	-.070	-199.01
Firm Controls				
Establishment Size				
0-19*			-.013	-17.04
20-99*			-.066	-92.63
100-499*			-.032	-53.72
Institutional				
Human Resource Unit*			-.043	-82.40
Unionized*			.014	28.15
Financial				
Operating Revenue per Employee			.124e-08	2.27
Gross Payroll per Employee			.107e-05	88.31
Technology and Innovation				
Innovation Occurred*			-.010	-29.80
Number of Technological Changes			.013	53.23
Proportion of Workers using Computer			-.019	-33.63
Log-Likelihood	-3782141		-2955368	
Pseudo-R Squared	0.0701		0.1111	
Number of Observations	19454		16379	

Note: * dF/dx is calculated for a discrete change of the dummy variable from 0 to 1. Other employee controls included are: Federal Jurisdiction, Years Work Experience Squared, Years Squared, and Region. Other Establishment controls included are:

variable from 0 to 1. Other employee controls included are: Current Employer Squared, Years Job Experience Squared, Age Number of Variable Pay Practices, Non-Wage Benefits per

Employee, Percentage Foreign Assets, Turnover controls, Proportion Full-time, Competition controls, Occupational distribution, and industry.

Table 34
Incidence of Technological Change at Establishments, 1999
Establishment Sample Probit

Variable	New Software		New Computer Controlled / Assisted Technology		Other New Devices	
	Coeff. dF/dx	t-value	Coeff. dF/dx	t-value	Coeff. dF/dx	t-value
Establishment Size						
0-19*	-.059	-3.56	-.005	-1.55	-.004	-1.19
20-99*	-.035	-2.19	.002	0.65	-.011	-4.05
100-499*	.059	3.45	.028	6.03	-.010	-4.08
Institutional						
Human Resource Unit*	-.018	-4.63	-.244e-03	-0.24	-.003	-3.69
Unionized*	-.021	-7.13	.030	37.63	.003	4.88
Number of Variable Pay Practices	.003	3.59	.010	58.00	-.011	-20.96
Financial						
Operating Revenue per Employee	.278e-07	7.39	-.125e-07	-13.11	-4.47e-07	-26.38
Gross Payroll per Employee	.106e-05	19.02	.755e-07	6.13	4.01e-07	2.35
Non-Wage Benefits per Employee	-.490e-05	-12.64	-.422e-06	-4.63	-1.23e-05	-12.04
Turnover						
Percentage Quits	.085	22.68	-.017	-23.00	-.006	-11.32
Percentage Layoffs	-.026	-14.19	-.022	-16.64	-.002	-10.46
Percentage New Hires	-.017	-8.18	-.003	-9.48	.004	22.33
Competition						
Compete Local-Owned*	-.007	-2.69	-.001	-2.52	.019	33.83
Compete Canada-Owned*	.054	29.51	.608e-03	1.36	-.001	-3.03
Compete USA-Owned*	.001	0.74	-.007	-16.65	.004	8.23
Compete ROW-Owned*	.023	9.81	.002	4.11	.042	57.07
Compete None*	-.062	-17.69	-.003	-4.02	.043	29.16
Technology and Innovation						
Innovation Occurred*	.130	82.00	.030	70.69	.054	109.52
Proportion of Workers using Computer	.148	56.76	.007	15.08	.002	5.75
Training Offered						
Classroom*	.053	29.71	.001	4.55	.006	16.79
On-the-Job*	.083	47.24	.012	30.30	-.003	-10.75
Occupational Distribution						
Proportion Sales	-.204	-47.72	-.008	-7.36	.021	26.02
Proportion Technical & Trades	-.030	-7.31	-.004	-4.95	.020	23.93
Proportion Professional	.060	13.30	.014	13.33	.011	9.84
Proportion Administrative & Clerical	.041	11.34	.018	19.79	-.018	-18.10
Proportion Production	-.016	-4.11	.005	5.77	.044	53.30
Log-Likelihood	-254165		-91261		-93398	
Pseudo-R Squared	0.0708		0.1321		0.1819	
Number of Observations	4694		5340		5340	

Note: * dF/dx is calculated for a discrete change of the dummy variable from 0 to 1. Other establishment controls included: Region, Industry, Federal Jurisdiction, and Proportion Full-Time.

Table 35
Incidence of Upgrade/Change in Computer CAD/CAM Technologies in Last 12 Months, 1999 Probit

Variable	Employee Sample		Establishment-Employee Linked Sample	
	Coefficient dF/dx	t-value	Coefficient dF/dx	t-value
Hours, Weeks & Union Status				
Covered by a CBA*	.006	4.78	-.029	-14.20
Usual Hours Per Week	-.002	-35.76	-.004	-57.16
Weeks Per Year	.009	70.45	.006	38.11
Age & Experience				
Number Years Using Computer	.032	132.53	.027	92.10
Number Years Using Computer Squared	-.913e-03	-81.25	-.689e-03	-51.42
Years Work Experience	.007	26.45	.009	29.31
Years Current Employer	-.003	-9.84	-.001	-3.84
Years Job Experience	.011	34.25	.014	35.29
Age	-.018	-37.74	-.032	-46.41
Demographic				
Born in Canada*	-.101	-64.61	-.062	-33.23
Male*	.019	15.63	.024	15.70
Married*	.056	50.31	.065	49.23
Language at Work is French*	.091	28.02	.084	18.99
Language at Work is Other*	-.050	-13.40	-.060	-13.47
Education				
Highest Degree BA or Higher*	-.104	-59.90	-.078	-35.94
Completed College or Univ. Certificate*	.040	27.40	.070	38.94
Some College or University*	.066	44.33	.106	58.80
Less Than High School*	-.038	-24.49	.007	3.76
Occupation				
Professional*	.107	48.77	-.002	-0.95
Technical*	.010	6.26	-.024	-12.34
Trades*	.014	8.65	-.059	-26.96
Marketing/Sales*	-.203	-101.22	-.191	-73.61
Clerical/Administrative*	.009	4.31	.056	20.08
Production*	-.117	-47.41	-.031	-9.13
Firm Controls				
Establishment Size				
0-19*			.193	55.03
20-99*			.130	44.64
100-499*			.078	30.62
Institutional				
Human Resource Unit*			.079	36.42
Unionized*			-.008	-4.22
Financial				
Operating Revenue per Employee			.327e-07	16.03
Gross Payroll per Employee			.521e-05	86.92
Technology and Innovation				
Innovation Occurred*			.083	53.04
Number of Technological Changes			.016	18.73
Proportion of Workers using Computer			-.155	-68.80
Training Offered				
Classroom*			.084	51.17
On-the-Job*			.004	2.61
Log-Likelihood	-692837		-529000	
Pseudo-R Squared	0.0971		0.1780	
Number of Observations	2291		1946	

Note: * dF/dx is calculated for a discrete change of the dummy variable from 0 to 1. Other employee controls included are: Federal Jurisdiction, Years Work Experience Squared, Years Current Employer Squared, Years Job Experience Squared, Age Squared, and Region. Other Establishment controls included are: Number of Variable Pay Practices, Non-Wage Benefits per Employee, Percentage

Foreign Assets, Turnover controls, Proportion Full-time, Competition controls, Occupational distribution, and industry.

Table 36
Incidence of Upgrade/Change in Devices or Other Technologies in Last 12 Months, 1999
Probit

Variable	Employee Sample		Establishment-Employee Linked Sample	
	Coefficient dF/dx	t-value	Coefficient dF/dx	t-value
Hours, Weeks & Union Status				
Covered by a CBA*	.010	13.85	-.028	-23.03
Usual Hours Per Week	-.444e-03	-13.58	-.001	-30.94
Weeks Per Year	.007	118.08	.006	81.65
Age & Experience				
Number Years Using Computer	.002	19.04	-.006	-45.23
Number Years Using Computer Squared	.284e-04	5.00	.357e-03	52.79
Years Work Experience	.004	37.01	-.004	-29.10
Years Current Employer	.003	17.63	.005	23.32
Years Job Experience	-.009	-46.13	-.007	-35.51
Age	.004	22.73	.016	64.66
Demographic				
Born in Canada*	-.044	-55.06	-.043	-46.44
Male*	.028	41.94	.015	19.11
Married*	.004	7.66	.003	4.59
Language at Work is French*	-.115	-72.55	-.149	-90.10
Language at Work is Other*	-.128	-73.22	-.078	-36.87
Education				
Highest Degree BA or Higher*	.031	28.03	-.008	-6.58
Completed College or Univ. Certificate*	.057	67.86	.074	74.12
Some College or University*	.013	15.56	-.018	-17.75
Less Than High School*	-.063	-80.12	-.091	-100.54
Occupation				
Professional*	-.034	-22.75	-.075	-43.54
Technical*	.029	28.12	-.032	-27.00
Trades*	.007	6.87	-.064	-49.70
Marketing/Sales*	.034	27.99	.009	6.64
Clerical/Administrative*	-.021	-17.92	-.070	-51.30
Production*	.007	5.77	-.078	-52.91
Firm Controls				
Establishment Size				
0-19*			.042	22.73
20-99*			-.008	-4.82
100-499*			.041	27.35
Institutional				
Human Resource Unit*			.032	26.66
Unionized*			-.022	-17.86
Financial				
Operating Revenue per Employee			-.757e-07	-42.45
Gross Payroll per Employee			.243e-05	91.05
Technology and Innovation				
Innovation Occurred*			.019	24.38
Number of Technological Changes			.051	97.55
Proportion of Workers using Computer			-.020	-16.44
Training Offered				
Classroom*			-.044	-51.37
On-the-Job*			.062	68.82
Log-Likelihood	-1344275		-1003894	
Pseudo-R Squared	0.0322		0.0872	
Number of Observations	5077		4235	

Note: * dF/dx is calculated for a discrete change of the dummy variable from 0 to 1. Other employee controls included are: Federal Jurisdiction, Years Work Experience Squared, Years Current Employer Squared, Years Job Experience Squared, Age Squared, and Region. Other Establishment controls included are: Number of Variable Pay Practices, Non-Wage Benefits per Employee, Percentage Foreign Assets, Turnover controls, Proportion Full-time, Competition controls, Occupational distribution, and industry.

Table 37
Incidence of Employee Training for Upgrade/Change in Computer CAD/CAM Technologies in Last 12 Months, 1999 Probit

Variable	Employee Sample		Establishment-Employee Linked Sample	
	Coefficient dF/dx	t-value	Coefficient dF/dx	t-value
Hours, Weeks & Union Status				
Covered by a CBA*	-.037	-17.62	-.103	-26.76
Usual Hours Per Week	-.008	-67.52	-.004	-26.32
Weeks Per Year	.008	38.05	.008	29.43
Age & Experience				
Number Years Using Computer	.030	71.73	.033	57.58
Number Years Using Computer Squared	-.001	-94.88	-.001	-69.06
Years Work Experience	.019	43.27	.007	12.30
Years Current Employer	-.009	-18.91	-.020	-30.58
Years Job Experience	-.023	-45.01	-.010	-15.97
Age	-.014	-17.38	.025	22.11
Demographic				
Born in Canada*	.230	99.81	.308	95.21
Male*	-.176	-88.75	-.181	-60.85
Married*	.019	11.03	-.066	-27.85
Language at Work is French*	.174	29.97	.104	14.75
Language at Work is Other*	.286	43.33	.273	35.01
Education				
Highest Degree BA or Higher*	-.209	-69.26	-.224	-52.98
Completed College or Univ. Certificate*	-.018	-7.76	.107	34.83
Some College or University*	-.209	-83.61	-.212	-66.45
Less Than High School*	-.167	-58.84	-.199	-52.82
Occupation				
Professional*	.022	7.18	.196	50.58
Technical*	-.156	-58.66	.008	2.30
Trades*	-.045	-17.31	.180	46.28
Marketing/Sales*	-.171	-46.43	-.261	-48.06
Clerical/Administrative*	-.004	-1.18	.192	46.43
Production*	.112	22.13	.318	58.58
Firm Controls				
Establishment Size				
0-19*			.171	25.71
20-99*			.127	23.08
100-499*			.079	17.85
Institutional				
Human Resource Unit*			.152	37.91
Unionized*			-.053	-14.95
Financial				
Operating Revenue per Employee			.137e-06	29.63
Gross Payroll per Employee			.242e-05	28.76
Technology and Innovation				
Innovation Occurred*			.160	51.50
Number of Technological Changes			.030	19.17
Proportion of Workers using Computer			.117	27.73
Training Offered				
Classroom*			-.088	-30.47
On-the-Job*			.182	54.55
Log-Likelihood	-285264		-190433	
Pseudo-R Squared	0.1356		0.3084	
Number of Observations	986		818	

Note: * dF/dx is calculated for a discrete change of the dummy variable from 0 to 1. Other employee controls included are: Federal Jurisdiction, Years Work Experience Squared, Years Current Employer Squared, Years Job Experience Squared, Age Squared, and Region. Other Establishment controls included are: Number of Variable Pay Practices, Non-Wage Benefits per Employee, Percentage Foreign Assets, Turnover controls, Proportion Full-time, Competition controls, Occupational distribution, and industry.

Table 38
Incidence of Employee Training for Upgrade/Change in Devices or Other Technologies in Last 12
Months, 1999 Probit

Variable	Employee Sample		Establishment-Employee Linked Sample	
	Coefficient dF/dx	t-value	Coefficient dF/dx	t-value
Hours, Weeks & Union Status				
Covered by a CBA*	.021	11.16	-.036	-11.06
Usual Hours Per Week	-.001	-15.90	.003	27.60
Weeks Per Year	.015	69.95	.012	41.58
Age & Experience				
Number Years Using Computer	.027	86.33	.029	66.68
Number Years Using Computer Squared	-.001	-90.63	-.858e-03	-48.17
Years Work Experience	.021	64.18	.023	52.03
Years Current Employer	-.019	-46.14	-.030	-53.10
Years Job Experience	.025	56.86	.045	72.78
Age	-.010	-18.72	-.352e-03	-0.46
Demographic				
Born in Canada*	.043	23.12	-.017	-7.40
Male*	-.087	-54.80	.086	38.78
Married*	-.104	-68.50	-.070	-35.01
Language at Work is French*	.062	17.91	.080	16.58
Language at Work is Other*	.191	37.95	.237	41.76
Education				
Highest Degree BA or Higher*	-.093	-38.80	-.034	-10.89
Completed College or Univ. Certificate*	-.054	-29.26	.065	27.67
Some College or University*	-.078	-34.95	.051	18.37
Less Than High School*	-.012	-5.68	.077	28.05
Occupation				
Professional*	.153	48.81	.183	43.66
Technical*	.024	10.65	.071	22.50
Trades*	.134	59.01	.272	85.55
Marketing/Sales*	.332	148.36	.355	114.79
Clerical/Administrative*	.127	44.92	.242	68.95
Production*	.119	41.96	.257	69.13
Firm Controls				
Establishment Size				
0-19*			.075	14.50
20-99*			.191	43.77
100-499*			.226	62.70
Institutional				
Human Resource Unit*			.120	35.59
Unionized*			.155	50.53
Financial				
Operating Revenue per Employee			-.131e-06	-26.62
Gross Payroll per Employee			-.966e-06	-12.96
Technology and Innovation				
Innovation Occurred*			-.006	-3.19
Number of Technological Changes			.118	88.41
Proportion of Workers using Computer			-.012	-3.53
Training Offered				
Classroom*			-.166	-68.03
On-the-Job*			.062	23.61
Log-Likelihood	-374134		-263151	
Pseudo-R Squared	0.1081		0.2278	
Number of Observations	1261		1062	

Note: * dF/dx is calculated for a discrete change of the dummy variable from 0 to 1. Other employee controls included are: Federal Jurisdiction, Years Work Experience Squared, Years Current Employer Squared, Years Job Experience Squared, Age Squared, and Region. Other Establishment controls included are: Number of Variable Pay Practices, Non-Wage Benefits per Employee, Percentage Foreign Assets, Turnover controls, Proportion Full-time, Competition controls, Occupational distribution, and industry.

Table 39
Number of Days of Employee Training for Upgrade/Change in Computer CAD/CAM Technology in
Last 12 Months, 1999 OLS

Variable	Employee Sample		Establishment-Employee Linked Sample	
	Coefficient	t-value	Coefficient	t-value
Hours, Weeks & Union Status				
Covered by a CBA	1.494	49.53	.315	7.91
Usual Hours Per Week	.007	5.55	-.008	-6.04
Weeks Per Year	-.149	-24.92	.027	6.63
Age & Experience				
Number Years Using Computer	-.105	-18.97	-.119	-17.48
Number Years Using Computer Squared	.220e-03	0.91	.007	23.30
Years Work Experience	.126	23.86	.297	51.52
Years Current Employer	.216	33.67	.085	11.11
Years Job Experience	-.258	-38.05	-.209	-23.57
Age	-.508	-38.32	-.851	-58.83
Demographic				
Born in Canada	-1.202	-44.45	-.192	-4.78
Male	-1.462	-50.11	-.573	-15.89
Married	.372	14.51	.914	34.27
Language at Work is French	-2.094	-14.13	-1.834	-12.83
Language at Work is Other	.395	6.47	-1.616	-20.95
Education				
Highest Degree BA or Higher	1.876	52.28	.413	8.34
Completed College or Univ. Certificate	.625	22.30	-.123	-3.58
Some College or University	.622	22.01	1.024	29.59
Less Than High School	-1.809	-46.33	-1.361	-28.80
Occupation				
Professional	2.439	63.46	2.599	54.35
Technical	-1.211	-53.19	.604	16.05
Trades	1.295	38.89	1.940	42.06
Marketing/Sales	-2.667	-90.20	-.286	-6.20
Clerical/Administrative	-.050	-1.11	2.498	46.79
Production	-.854	-14.07	-1.625	-26.54
Constant	18.362	52.05	11.399	34.54
Firm Controls				
Establishment Size				
0-19			1.757	23.21
20-99			.329	4.93
100-499			1.051	17.26
Institutional				
Human Resource Unit			1.473	33.32
Unionized			-1.489	-47.69
Financial				
Operating Revenue per Employee			.107e-05	28.61
Gross Payroll per Employee			.192e-04	16.75
Technology and Innovation				
Innovation Occurred			-.117	-3.75
Number of Technological Changes			.137	6.39
Proportion of Workers using Computer			-1.836	-42.36
Training Offered				
Classroom			-.221	-9.39
On-the-Job			1.014	27.22
Root MSE	4.248		3.3934	
R-Squared	0.2810		0.4756	
Number of Observations	564		466	

Note: Other employee controls included are: Federal Jurisdiction, Squared, Years Job Experience Squared, Age Squared, and

Years Work Experience Squared, Years Current Employer Region. Other Establishment controls included are: Number of

Variable Pay Practices, Non-Wage Benefits per Employee, Percentage Foreign Assets, Turnover controls, Proportion Full-time, Competition controls, Occupational distribution, and industry.

Table 40
Number of Days of Employee Training for Upgrade/Change in Devices or Other Technologies in
Last 12 Months, 1999 OLS

Variable	Employee Sample		Establishment-Employee Linked Sample	
	Coefficient	t-value	Coefficient	t-value
Hours, Weeks & Union Status				
Covered by a CBA	-.565	-13.11	.506	6.56
Usual Hours Per Week	-.045	-42.25	.058	18.61
Weeks Per Year	.082	10.53	.065	14.20
Age & Experience				
Number Years Using Computer	-.244	-52.09	-.046	-6.39
Number Years Using Computer Squared	.008	41.99	.002	10.43
Years Work Experience	.188	36.02	.275	26.91
Years Current Employer	-.471	-43.51	-.490	-43.05
Years Job Experience	.145	17.50	.006	0.75
Age	.023	3.85	-.628	-63.72
Demographic				
Born in Canada	-.359	-19.38	-.427	-11.61
Male	.637	15.78	-.049	-0.65
Married	-.687	-20.34	.685	15.06
Language at Work is French	3.277	60.02	2.653	35.35
Language at Work is Other	1.780	44.09	2.179	35.95
Education				
Highest Degree BA or Higher	.348	14.50	-.587	-10.12
Completed College or Univ. Certificate	1.308	24.45	1.588	30.20
Some College or University	.516	13.17	-.332	-6.09
Less Than High School	.030	1.02	-.067	-1.56
Occupation				
Professional	2.292	55.33	2.994	39.06
Technical	2.087	48.82	3.381	39.64
Trades	2.459	54.37	2.946	31.68
Marketing/Sales	.410	13.42	2.415	25.28
Clerical/Administrative	1.019	34.07	1.173	22.65
Production	-.848	-18.70	-.092	-1.08
Constant	-1.557	-3.91	4.051	10.23
Firm Controls				
Establishment Size				
0-19			2.017	25.83
20-99			2.657	37.65
100-499			1.618	30.26
Institutional				
Human Resource Unit			.449	8.55
Unionized			-1.108	-21.25
Financial				
Operating Revenue per Employee			.223e-05	24.78
Gross Payroll per Employee			.196e-04	16.72
Technology and Innovation				
Innovation Occurred			1.513	23.24
Number of Technological Changes			-.020	-1.07
Proportion of Workers using Computer			1.483	13.22
Training Offered				
Classroom			-1.318	-13.96
On-the-Job			.291	3.75
Root MSE	6.8545		6.734	
R-Squared	0.0712		0.1664	
Number of Observations	690		571	

Note: Other employee controls included are: Federal Jurisdiction, Years Work Experience Squared, Years Current Employer Squared, Years Job Experience Squared, Age Squared, and Region. Other Establishment controls included are: Number of Variable Pay Practices, Non-Wage Benefits per Employee, Percentage Foreign Assets, Turnover controls, Proportion Full-time, Competition controls, Occupational distribution, and industry.

Appendix Table 1
Establishment Characteristics by Employee Union Status in 1999

Variable	Covered by CBA	Not Covered by CBA	All
	Mean	Mean	Mean
Establishment Size			
0-19	.1118	.4241	.3631
20-99	.2655	.3180	.3077
100-499	.3335	.1738	.2050
500+	.2890	.0839	.1240
Institutional			
Human Resource Unit	.4718	.1850	.2411
Number of Variable Pay Practices	1.2537	1.2090	1.2177
Financial			
Operating Revenue per Employee	213503.90	197034.30	200253.50
Gross Payroll per Employee	36308.75	31040.29	32070.07
Non-Wage Benefits per Employee	4801.15	1967.14	2521.08
Percentage Foreign Held Assets	17.23	10.34	11.67
Turnover			
Percentage Quits	.1011	.1682	.1550
Percentage Layoffs	.0474	.0603	.0578
Percentage New Hires	.2294	.2971	.2839
Competition			
Compete Local-Owned	.6690	.7899	.7663
Compete Canada-Owned	.6531	.5852	.5985
Compete USA-Owned	.5457	.4345	.4562
Compete ROW-Owned	.3469	.2729	.2873
Compete None	.0990	.0801	.0838
Workforce Characteristics			
Proportion Full-Time	.7752	.7631	.7655
Technology and Innovation			
Innovation Occurred	.6749	.6468	.6523
Number of Technological Changes	.6528	.5692	.5868
Proportion of Workers using Computer	.3650	.4794	.4570
Technology Introduced			
New Software	.3830	.3981	.3949
New Computer Controlled Technology	.1784	.0853	.1035
New Other Devices	.0818	.0699	.0722

Occupational Distribution			
Proportion Managers	.0886	.1607	.1465
Proportion Sales	.0701	.1415	.1274
Proportion Technical & Trades	.2153	.1508	.1635
Proportion Professional	.0713	.0882	.0849
Proportion Administrative & Clerical	.1215	.1619	.1539
Proportion Production	.4329	.2966	.3234
Industry			
Forestry/Mining	.0289	.0196	.0214
Labour Intensive Tertiary Manu.	.1001	.0485	.0586
Primary Manufacturing	.1163	.0287	.0459
Secondary Manufacturing	.0455	.0435	.0439
Capital Intensive Tertiary Manu.	.1022	.0618	.0697
Construction	.0563	.0456	.0477
Transport/Storage/Wholesale	.0726	.1397	.1266
Communications/Utilities	.0559	.0133	.0216
Retail / Commercial	.1938	.3098	.2872
Finance/Insurance	.0262	.0601	.0535
Real Estate	.0173	.0195	.0191
Business Services	.0446	.1320	.1149
Education/Health Care	.0770	.0490	.0545
Information/Cultural	.0626	.0280	.0348
Classroom Training			
Classroom Training Offered	.8272	.5741	.6236
Occupational Courses Offered	.7418	.4704	.5235
Organizational Courses Offered	.6890	.3873	.4463
Technology Courses Offered	.6506	.4070	.4546
Basic Courses Offered	.5782	.3599	.4025
Proportion Workers Received Training	.5107	.5420	.5339
On-the-Job Training			
On-the-Job Training Offered	.8659	.7063	.7375
Occupational Courses Offered	.6944	.4785	.5207
Organizational Courses Offered	.6278	.3688	.4194
Technology Courses Offered	.6603	.4425	.4851
Basic Courses Offered	.6870	.5524	.5787
Proportion Workers Received Training	.5383	.5550	.5512
Number of Observations	4924	14567	19491