

The Development and Use of a Canadian Linked Employer-Employee Survey

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Abstract: The Workplace and Employee Survey (WES) is a new undertaking by Statistics Canada. WES is a dual survey that starts with a sample of establishments and then draws a sample of employees within those establishments. Employers and employees are administered separate questionnaires covering a broad range of workplace issues. Thus, information from both the supply and demand side of the labour market will be available to enrich studies focused on either side of the market. A large-scale pilot of WES was carried out in the winter and spring of 1996. This paper focuses on the challenges identified in a large-scale WES pilot, the plans for a production scale survey, and provides a summary of some research findings based on the pilot data.

I. Introduction

The nineties have witnessed a bumper crop of buzzwords for anyone interested in the economy in general and the labour market in particular. We are working in a *new competitive environment*, making the transition to a *knowledge-based economy*. To thrive in this environment, firms must be *flexible* or *adaptive*; they should develop *high performance workplace practices*. Employees too must be *adaptive*; they can *empower* themselves by adjusting their *skill set*. Otherwise they risk becoming *disposable*.

Annoying as they may be, clichés don't reach that status without some underlying truth. Canadian firms and their employees have always faced a competitive, changing environment. Some types of change -- particularly those related to microprocessor technologies -- have probably quickened pace in recent years. The development of a North American free trade zone has certainly heightened awareness of the competitive environment. And the growing disparity among workers (and would be workers) -- both in terms of earnings and hours -- has been well documented. These trends contribute to a general sense that economic change is increasingly difficult to understand, that the costs of change fall mainly upon less-adaptable workers and that even among the "winners" in the labour market, employment is becoming less stable.

Looking at these and other problems, analysts in Statistics Canada and elsewhere have reached the conclusion that there are two key elements missing in our understanding of firm performance and worker outcomes. The determinants of how well firms respond to change can only be properly studied in a longitudinal setting that covers many of the firm characteristics and behaviours related to performance. Of particular importance are the practices and policies related to employees, since they must be the agents of change in the firm. Conversely, the fortunes of employees are intricately tied to what they do on the job and how they interact with the internal forces of change in a firm. Thus the ideal survey instrument would follow an integrated sample of employers and employees over an indefinite period. Some of these elements exist in other Statistics Canada surveys, but not in an integrated design.

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The Workplace and Employee Survey (WES) is a new Statistics Canada undertaking that is designed to provide an integrated view of the activities of employers and their employees. A large-scale pilot of the WES was conducted in 1996, with a production survey scheduled for 1999. In the remainder of this paper we provide an overview of the objectives of the survey, discuss what was learned from the WES pilot study, look at some of the methodological problems, discuss future plans, and provide a summary of some research findings.

II. Research Objectives: Why have a Linked Workplace and Employee Survey?

Advanced economies are constantly evolving. The key stimuli for this evolution are new technologies (particularly information technologies), increasing international competition and the continued expansion of trans-national enterprises. Firms respond in a number of ways: increasingly embracing new technologies; re-organizing or re-engineering their workforces; or resorting to downsizing or other elements of numerical flexibility². For firms, these trends create challenges in the management and development of human resources. For policy-makers, education and training are central policy prescriptions for increasing prosperity.

In this evolving environment, firms are thought to have undergone dramatic change in the areas of technology adoption, organizational change, training patterns, business strategies, levels of competition, and the manner in which they engage labour. Workers, on the other hand, experience this evolution through changes in job creation rates, job stability, wages and wage inequality, training, the use of advanced technologies, and the type of employment contracts available.

Due to a well-developed set of household (worker) surveys, we in Canada have a good understanding of workers' outcomes regarding wages and wage inequality, job stability and layoffs, training, job creation, and unemployment. What is missing on the employees' side is the ability to link these changes to events taking place in firms. Such a connection is necessary if we hope to understand the association between labour market changes and demand-side pressures, which stem from global competition, technological change, and the drive to improve human capital, among other things. Thus, one primary goal of the WES is to establish a link between events occurring in establishments and the outcomes for workers.

The advantage of a linked survey is depicted in Chart 1. This chart displays the main content blocks in the two surveys. Note that there is reference to establishment and worker outcomes. Analysis of these events can be informed not only by the characteristics of the establishment -- as has been done in other firm surveys -- but also by the characteristics of the workers. Similarly, worker outcomes can be informed not only by data on the workers themselves, as has always been the case, but also by new establishment data.

Such a link would, for example, allow changes in the levels and distributions of wages of workers to be associated with events occurring in establishments, such as the adoption of technology, or competing in international markets. Much of the earnings inequality literature suggest that technology and rising international trade are major contributors to inequality. Research on many other labour market issues would be enhanced by the existence of such a link. Issues that have formerly been considered primarily from the supply side, often within the context of a human

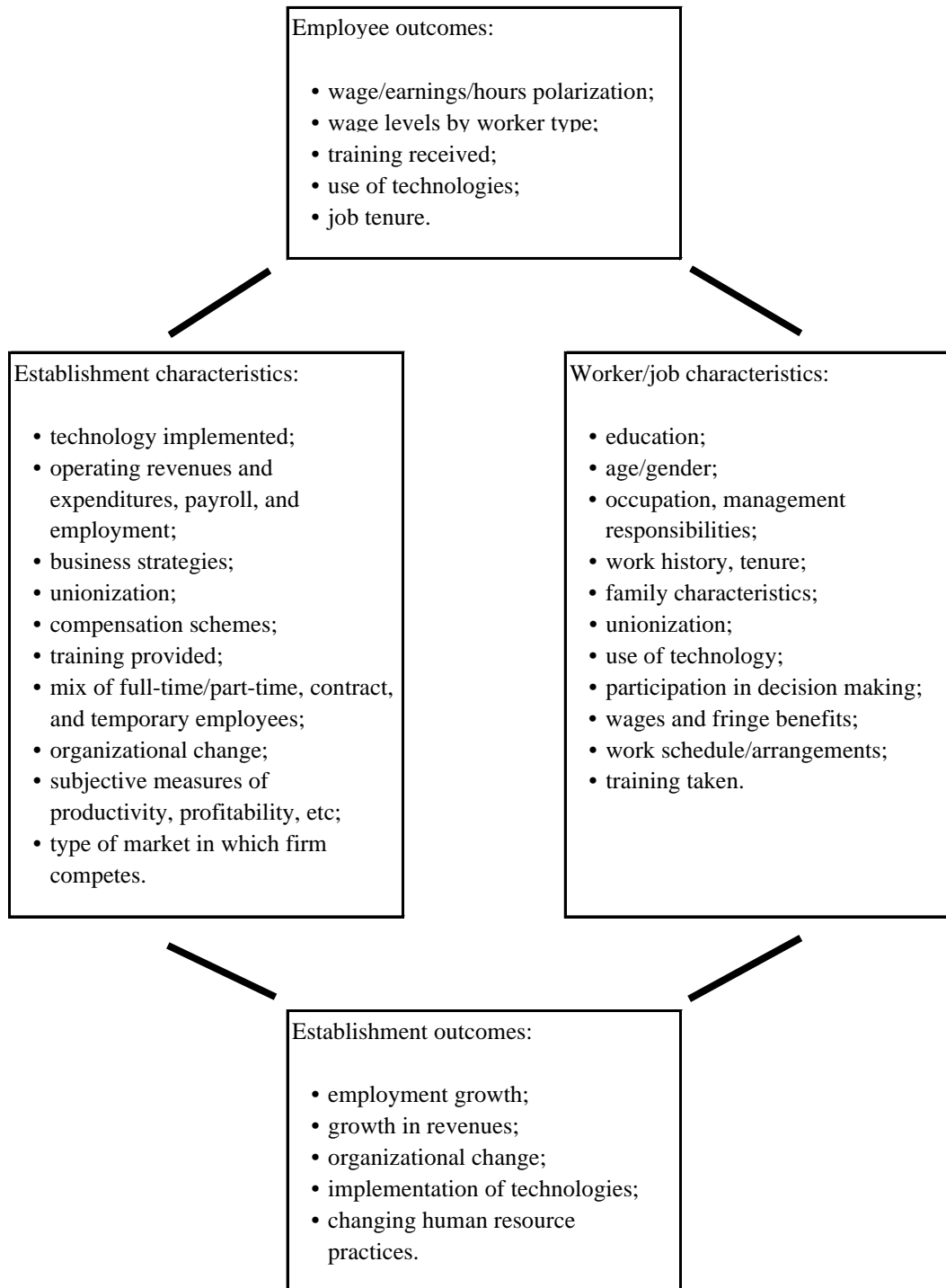
² Numerical flexibility refers to practices whereby firms contract out and make greater use of temporary or part-time workers to improve flexibility in their workforces.

capital model, could be viewed increasingly from the demand side of the labour market. This might include issues such as job stability, the determinants of wages, the creation and destruction of different types of jobs, training levels among different types of workers, etc.

An establishment-worker link would also contribute enormously to improved measurement of a number of establishment –level variables. The characteristics of an establishment’s workforce are often an important determinant of the behavior of a firm. Data on workforce characteristics has been lacking or poorly measured in establishment surveys, however. The link would allow establishment variables -- such as training incidence and intensity, occupational and educational distribution of the workforce, use of technology by the workers, various workplace practices such as quality circles, fringe benefit levels, the distribution of wages, and a host of others -- to be better measured than in the past. Workers can provide more reliable and detailed data on these variables than can establishment level respondents.

Hence, an establishment-worker link at the micro-level would allow the inclusion of demand side factors (events occurring in establishments) in research on labour markets. The reliance on primarily supply side theories and data would be reduced. It would also result in much improved estimates of many establishment-level variables.

Chart 1: The Link Between the Establishment Survey Content, Employee Survey Content, and Outcomes



The second goal of the survey is to develop a better understanding of what is indeed occurring in companies in an era of substantial evolution. Just how many companies have implemented new information technologies? On what scale? What kind of training is associated with this? What type of organizational change is occurring in firms? What types of business strategies are firms relying on to thrive during this period of change, and do they vary dramatically across firms? How important are human resource development activities and strategies, or are they largely ignored by most establishments? Do firms that adopt one set of strategies in fact adopt many (e.g., adoption of technologies, innovation, human resource development, organizational changes)? Is there a set of high-performance workplaces that tend to move on many fronts? These are the kinds of issues addressed in the WES.

While the available household surveys inform us about significant labour market changes, there is not a corresponding set of establishment surveys that deal with new concerns. Some limited survey work has been done. The WES is an attempt to extend this in the context of a general worker–workplace survey.

Finally, the third objective is to extend surveying infrastructure. Given the uncertainty regarding some of the new variables being developed, it is likely that the WES content will change during the early years. To a considerable extent WES is seen as the development of the infrastructure necessary to conduct integrated establishment-household surveys. The content can be altered through time, although some core content is desirable in order to take advantage of the longitudinal nature of the survey.

One can provide a number of examples of issues for which integrated data sources such as the WES would be useful. Many relate to technology and innovation, processes that play an increasingly important role in the production process. These processes in turn influence the outcomes of firms and their workers. The following list summarizes some of the related research areas:

- (1) the incidence of information technology adoption and innovation in different industries, different size classes, etc,
- (2) training associated with technology adoption,
- (3) the association between technology adoption and downsizing, the use of contingent labour, organizational change, unionization, etc.
- (4) innovation, technology adoption and the outcomes of establishments
- (5) innovation, technology adoption and the outcomes for workers

These examples relate to technology and competition. There are numerous other areas of possible research based on a longitudinal data source such as the WES, including:

- (1) research on employment dynamics,
- (2) extending the human capital model of wage determination to include firm characteristics,
- (3) labour unions and their effects on workers and establishments,
- (4) non-wage compensation,
- (5) training and its impact on firms and workers,
- (6) the incidence and effects (on workers and establishments) of new workplace practices
- (7) the incidence and effects of differential business strategies of firms, and
- (8) job vacancies and skill shortages, job and worker turnover.

Many of these topics would benefit from the use of longitudinal integrated establishment-household data. Dynamics will become a central research focus when longitudinal data become available.

III. Overview of the Workplace and Employee Survey Pilot Survey

To test both the feasibility and efficacy of a dual survey to address some of the issues noted in the introduction, both pre-testing and a large-scale pilot were conducted. Early pre-testing confirmed that employers were able to answer the type of questions proposed and provide lists of employees from which intra-establishment samples could be drawn. Human Resources Development Canada provided funding for a large-scale pilot to test more fully the operational, methodological and analytical feasibility of the project.

The pilot aimed to interview approximately 1000 employers in selected strata from a production-scale sample of 5500 employers. Up to seven employees would then be sampled within each selected establishment. The remainder of this section outlines some basic issues addressed in the development of the WES, the content of each of the surveys, sketches the frame creation and sampling methodology and summarizes the operations.

III.i Some Issues in the Development of Integrated Surveys such as the WES

While administrative (taxation) data have been used in Statistics Canada to link workers and establishments (Picot, 1998), it was decided that such a source would not be capable of addressing the vast majority of the issues of interest to Canadian researchers. Thus the decision to proceed with a pilot survey, or in reality, two surveys –one establishment, the other household - to obtain data on both workers and establishments. This has the tremendous advantage of being able to accommodate the content that the creators feel is necessary, subject of course to response burden constraints. It also has the advantage of being able to collect the data at the most appropriate level in the enterprise structure for the type of research at hand. These are tremendous advantages, but there are also a number of important issues that must be addressed, as there are in any new venture.

(1) Cost

Developing surveys is more costly than developing administrative data. However, if the administrative data are incapable of providing the information needed, then the decision is not between choosing a survey or administrative data approach, but rather whether the information that can be provided from a survey warrants the cost.

(2) Response rates

Achieving high response rates in both the establishment and worker surveys is an issue, perhaps the central one in the conduct of linked surveys. This appears to be true whether the establishment is the first level in the survey, and then workers in the establishments are

sampled, or whether it is done the other way around; workers are the first level, and then the establishments for which the selected workers work are sampled. The response rate issue seems to appear at the interface between the workers and the firm, no matter which way it is done. This issue was encountered in the WES pilot survey; the worker response rate was 55%. This low rate was due primarily to the process used to make the connection between the worker and the interviewer, and steps are being taken to raise this rate to acceptable levels. This is discussed in the next section.

(3) Which to sample first, the worker or the firm

There are substantive reasons for sampling either the worker or the firm first. For example, in developing a longitudinal survey, the unit sampled first (the firm or worker) is likely to become the primary longitudinal unit in the survey, and this has substantive implications. However, there are also cost implications. Suppose one is seeking a sample of, say, 30,000 workers. If establishments are sampled first, this could be achieved by sampling, say, 5000 establishments and picking an average of 6 workers per establishment. If the worker is selected first, the 30,000 workers may work for almost as many establishments, resulting in a very large (and expensive) establishment sample. This outcome is due to the manner in which workers are distributed among establishments. There will be relatively few cases where multiple workers in the sample work for the same establishment.

To test this, we used a linked company-worker administrative data source. Thirty thousand workers were selected at random, and they were found to work in 18,200 different companies. The number of establishment would have been even greater under such a sampling approach. Likely in the order of 20,000 establishments would have to be sampled to achieve a random sample of 30,000 workers. Since an establishment survey is more expensive to conduct than a worker survey (if one uses personal visits to achieve high quality data), having such a large number of establishments in order to achieve a sufficiently large sample of workers can increase costs tremendously.

One could reduce the number of workers and establishments, but for any given amount of money, a smaller sample is possible if workers rather than firms are sampled first. One could cluster the worker sample by establishment to reduce the number of establishment in the sample, but this is in essence the opposite approach, where the establishment is sampled first. Furthermore, the very high worker separation rate (20% per year) means that in a longitudinal survey, a very large number of new establishments would have to be added to the survey each year, as large number of workers move to new establishments. Hence, for both cost and substantive reasons, in the pilot WES establishments were sampled first, and workers selected within establishments.

(4) Making the Surveys Longitudinal

The real gains from such surveys will be the extent to which they focus on dynamics. What is the association between a change in an establishment practice and the outcomes for the workers or the establishment? Longitudinal data are required to answer such questions. Should the surveys be longitudinal in the establishment, the workers, or both? Complexity in the sample design and increased costs are associated with the latter alternative, and it is likely

unrealistic. Making the worker the primary longitudinal unit of analysis and then sampling the establishment holds the cost implications mentioned above. Making the survey longitudinal in the establishment allows changes in establishment practices to be associated with worker or firm outcomes. This is the practice proposed for the WES. The survey will also track workers for two years and will include retrospective questions for recent hires. This will provide data on one transition, thus making the use of “fixed-effects” models and other similar longitudinal analytical approaches possible.

(5) Introducing New Content

The opportunity to collect a wide range of data on workers and firms leads to the introduction of a number of new variables that been little used in other surveys. Technological change in establishments, the types of technologies employed and workplace practices as they effect workers are all examples of very difficult to measure concepts that are central to many of the research issues that one would like to address using such integrated worker/firm data. Furthermore, traditional measures such as operating revenues and expenditures and training expenditures are also often difficult to measure accurately at the establishment level. Thus, there are difficult challenges in operationalizing the content of the surveys, particularly the establishment survey.

(6) Providing Measures of Establishment Performance

The ultimate goal of the integrated surveys is to focus on the association between worker and establishment characteristics on one hand, and worker and establishment outcomes (performance) on the other. Worker outcome variables such as wages, fringe benefits, training, hours worked, job stability, etc. are measured in a relatively straightforward manner. Establishment performance measures can prove more difficult. Employment related outcome measures could be relatively easily provided at the establishment level. However, financial measures are typically not available at the establishment or location level, but rather at the company or enterprise level. Information on operating revenues and expenditures can be sought, but some establishments have difficulty providing such information. Obtaining quantitative estimates of productivity at the establishment level economy-wide (outside of manufacturing and related industries) can provide difficulties. Some effort is needed to obtain reliable establishment performance measures. Links to administrative data such as corporate taxation data can assist in the production of performance measures, and this approach will be used in the Canadian survey.

III.ii. Survey Content

Two separate questionnaires were developed for the pilot: one for employers and one for employees. The employer questionnaire contains a broad range of information. So broad, in fact, that we anticipated that several respondents may be required to answer it completely, particularly in large establishments. As such, the questionnaire was parceled into blocks – each with a separate cover sheet – so that each block could be directed to the appropriate respondent. A brief description of each block follows.

Workforce Characteristics and Job Organization: Covers the work arrangements of employees (full-time/part-time, permanent, seasonal, on-site/off-site, etc.), recent hiring and separations, and the presence of unfilled vacancies. All questions in this section were broken down into five occupational groups.

Compensation: Covers variable pay plans, gross payroll, non-wage benefits and the distribution of earnings in the company. Most questions captured occupational detail.

Training: Covers the presence of formal training programs, which occupational groups received training in the past year, how training was funded and how much was spent on training.

Human Resource Function: Determines who has responsibility for human resources, the level of employee involvement in decision-making, and the incidence, type, extent and effects of recent organizational change.

Collective Bargaining: Asks about the presence and membership (by occupation) of collective bargaining groups, treatment of “flexibility” issues in contracts, work stoppages and grievances.

Establishment Performance: Covers operating revenues and expenditures, change from the previous year, variability in revenues by quarter and foreign ownership.

Business Strategy: Asks respondent to rate the importance of elements of business strategy, estimate their distribution of sales by market area and specify the number of competitors in their market.

Innovation: Identifies major innovations introduced in the past three years.

Technology Use: Asks about overall computer usage in establishment, looks at specific major technology implementations in the past three years (hardware/software, computer-controlled technologies and other technologies) and the effects of the implementations.

Use of Government Programs: Looks at establishment use of grants and loan, employee-related programs, tax provisions, information services and other ventures with government.

The employee questionnaire was not as clearly blocked as the employer questionnaire, since it only involved a single respondent. The questionnaire covered: job characteristics, requirements when hired, hours of work, pay and benefits, working off-site, leave, promotions, technology, training, participation in decision-making, work stoppages, recent work history, education, family situation and membership in designated employment equity groups. While the questionnaire covers a fairly wide range of topics, the pilot demonstrated that it was not overly burdensome for respondents.³

³ Typically interviews lasted about 25 minutes.

III.iii Survey Frame and Sampling

The WES is based on the notion of a workplace as the microdata unit where labour supply and demand is resolved. Although the responsibility for staffing is included in this concept, it more importantly includes the organization of a group of employees to achieve a common purpose. Our ultimate target population includes workplaces in all industries and geographic areas of the country. Ideally, WES would operate as a two-stage survey. The first stage would involve drawing a sample of workplaces that is large enough to produce estimates for homogenous industries at the provincial level. The second stage would draw a large enough sample of workers within each workplace to permit variance calculations. In conducting a survey, however, our concepts and intentions are tempered by operational constraints and the availability of data.

Statistics Canada's Business Register (BR) -- a registry of all businesses in Canada -- is the primary frame resource for business surveys. The BR organizes business entities into a hierarchy of four statistical levels: enterprises, companies, establishments and locations. Although the location level is conceptually the closest to a workplace, several factors led us to sample from the establishment level for the pilot survey.⁴ An establishment can be thought of as the smallest organizational unit, comprised of at least one physical location, that can provide a complete set of input and output statistics. For most businesses, establishments and locations are one and the same. However, establishments in many larger enterprises -- particularly those in the financial, communications and utilities sectors -- may include separately managed operations in a number of locations⁵. For these complex units, WES sampled smaller units within the establishment using information from the BR, auxiliary files and, in rare cases, from contact with respondents. Thus the employer survey evolved into a two-stage sample and the employee survey a three-stage sample.

At the first stage of sampling, the frame is stratified by region, industry and employment size. Sampling fractions vary by size group so that larger employers have a greater probability of being included in the sample. In the second stage, complex establishments drawn in the first stage are subdivided into smaller units and a sample of these units is drawn. In the third stage, a sample of workers is drawn from employer-provided lists in each workplace.

III.iv Operations

The unique content and methodology of WES placed unusual demands on survey operations. Many of the required operations had no recent precedents at Statistics Canada. What we provide here is a thumbnail sketch of the survey operations without too much detail on the logistical permutations involved.

⁴ For more details, see "Frame Allocation for the Workplace and Employee Survey", Sharon Wirth, Business Surveys Methods Division.

⁵ The sub-establishment units sampled were not necessarily statistical locations. Please see the section on Workplace Reporting Units for more details.

Preparation for fieldwork began with the examination of the sample (primary sampling units – PSUs) for potentially complex establishments, that is, those with multiple workplace locations. Complex establishments were sub-divided into secondary sampling units (SSUs). In the sample the SSUs were selected at a rate of one per stratum. This process was necessary to overcome the problem of having “establishments” in the sample that had multiple workplace locations.

Interviewers in the regions contacted employer respondents to schedule on-site interviews. Interviewers had a number tasks to perform in these visits.

- Complete all possible sections of the employer questionnaire with the available respondents. Document any problems regarding survey content or procedures.

Leave appropriate sections of the questionnaire behind when required respondents are not available.

- Take sample of employees from employer list according to methodology’s instructions. Record names of and, at interviewer’s discretion, other information about sampled employees.

- Transmit sampled employees’ names to Winnipeg RO.

Sampled employees were to fill out the contact/consent forms – which asked for information on convenient times and numbers for a telephone interview – and return them by fax or pre-paid mail. About two-thirds returned the forms and about 85 percent of those agreed to participate. Employees were then interviewed by phone.

IV. Methodological Problems and Responses

IV.i. Primary and Secondary Sampling Units

The employer portion of WES was originally conceived as a stratified single stage design with establishment as the primary sampling unit (PSU). It became apparent that, for approximately ten percent of the sample, the target unit of interest –Secondary Sampling Unit - corresponding to a physical location, was different from the PSU. This came about as a result of many larger establishments having multiple workplaces (locations on the Business Register).

Collecting data from every location of a complex establishment was not feasible due to sample size constraints imposed on the pilot survey. A second stage was added to the survey design to facilitate the sub-sampling of PSUs. Each in-sample complex establishment was stratified by type of SSU (eg. Head Office, typical bank branch, etc.). For the pilot one location was selected from each SSU stratum.

The employee portion of WES added a second/third stage to the employer survey. After a WRU had been sampled, a list of employees was obtained from the employer followed by the selection of a systematic sample of six (or seven) employees. SSUs with fewer than seven employees were sampled exhaustively. The pilot sample consisted of approximately 3,500 employees, of which 1,960 responded to the survey, representing 544 SSUs.

Thus, the response rates in the pilot survey were approximately 80 percent among establishments, and 55 percent among the workers. The establishment response rate was acceptable, but many linked surveys appear to have low response rates at the second stage of the survey. In this case, the low worker response rate was due to the process used to contact the workers (through the establishments), rather than the content of the survey itself. Other Canadian surveys have used similar content and registered response rates in the 80 to 95 percent range. In the pilot, employers forwarded an information slip on to the workers, and the employees were asked to contact Statistics Canada so that a telephone survey could be conducted. This is asking a lot of respondents, and the low response rate is not surprising.

Other approaches are being tested currently. In one case, workers are asked to complete a small questionnaire (of perhaps five questions) and return it to Statistics Canada, along with their phone number. They are then contacted and a larger telephone interview conducted. It has been found in testing that asking for workers active participation through the completion of a small survey could raise response rates to the 70% range. Other approaches are also being tested. Employers will be asked to provide the employees' work telephone number. Statistics Canada interviewers could then actively seek an interview, rather than passively waiting for potential respondents to contact them. The possibility that the interviewer will speak to the employees while conducting the personal interview at the establishment to obtain the employees consent and telephone number is also being considered. It is believed that these approaches, possibly taken together, will bring the worker response rates to an acceptable level, matching that of the establishments.

IV.ii. Multi-Stage Estimation

In a typical multi-stage survey the total estimated variance can be decomposed into components computed individually for each stage of sampling, provided that at least two units have been selected in each stratum at each stage. Failing to satisfy this criterion (WES sampled one unit per stratum in the second stage of selection) forced us to find an alternative to estimating proper multi-stage variances. To that end, we made the simplifying assumption that the first stage units had been selected with replacement and proceeded to compute the corresponding variances.

The Statistics Canada Generalized Estimation System (GES) was used to compute the design weights for the sampled locations (SSU) of complex establishments. Locations of simple establishments were assigned a weight of one. Second stage estimates were produced using the combined ratio estimator. The auxiliary variable, establishment employment, was not collected directly; it was derived either from the information available on the Business Register or data collected by SEPH.

A second run of GES produced the first stage design weights for the sampled establishments. The parameters of interest were computed using the combined ratio estimator. The auxiliary variable was once again employment. It was first computed using data carried by the BR and later adjusted to agree with SEPH estimates deemed to be more current and sufficiently reliable. Auxiliary information was applied at the industry/region level with an exception discussed in Section IV.iii.

GES was also used to compute the design weights for employee records. Each selected individual was given a weight, ignoring non-response, equal to the number of employees in an SSU divided by the number of employees in the corresponding sample. This was also the calibrated weight, since the number of employees in the SSU was taken directly from the employer questionnaire. The reported SSU employment could, conceivably, be different from the number of employees on the list used by the interviewers for sample selection. Unfortunately, this number was not recorded; it could have provided a measure of non-sampling error.

IV.iii. Pilot Meta Results

The employer sample consisted of 1,006 live, 53 dead, 54 inactive, 1 receivership, 11 holding company and 169 out-of-scope PSUs. Estimates of totals for some 897 variables were computed using 1,025 establishments (all except “live/complete refusal”). At the national level, the coefficients of variation (CV) for *Gross Operating Revenue*, *Gross Expenditures* and *Total Gross Payroll* were 0.0887, 0.0654 and 0.0201 indicating good reliability. Overall, still at the national level, two thirds of the estimates had a CV between 0 and 0.33.

On the employee side 1,960 persons provided either partial or complete responses. As an example of reliability of the totals computed from the employee portion, the CVs, at the national level, for *Family Income* and *Salary* were 0.0236 and 0.0230. Overall, still at the national level, three quarters of the estimates had a CV between 0 and 0.33.

V. Future Plans

Cross-sectional surveys of workplace practices and outcomes – the WES pilot included – suffer from some common methodological problems that hamper workplace research. First, in a cross-section it is quite difficult to establish the timing of the introduction of workplace practices, their dissemination throughout the workplace and the lag time necessary to have an impact on workplace performance. Thus it is hard to infer the causal direction between performance and practice, even though the relationship may appear very strong. Secondly, the estimates of cross-sectional relationships may be affected by a survival bias. In effect, the cross-section represents a truncated distribution of workplace performance: failed businesses are not observed. It is entirely probable that a number of practices will increase both the probability of improved performance and the probability of workplace death. Without being able to account for past deaths, cross-sectional surveys will tend to over-estimate the returns to relatively risky practices, such as product innovation, reorganizations and technological investment.

These methodological issues can be overcome by true panel data – a starting cohort of workplaces that is followed over time. Re-interviewing the panel at regular intervals would allow researchers to follow the introduction of workplace policies and practices and infer their effect on workplace outcomes, while properly accounting for the effects of deaths within the cohort. Current plans are for WES to treat its first cross section in April 1999 as the starting cohort of an ongoing workplace panel. The remainder of this section outlines in more detail our plans for the survey.

V.i. Inaugural Cross-sectional Survey

The initial production survey is scheduled to be in the field in April 1999. The planned usable sample for this survey will be about 6,000 workplaces and about 25,000 employees. Unlike the pilot survey strategy of sampling establishments and then sub-sampling locations within complex establishments, the production sample will be drawn from the location level of the Business Register. This more efficient sampling design has been enabled by increased Register profiling efforts in the banking and insurance sectors. While many locations remain to be profiled in the communications and utilities sectors, the Register is undertaking to profile units in these sectors selected in a pre-sample. The final sample will be selected in January 1999, maximizing overlap with the pre-sample.

The target population for the survey is all employers operating in Canada having paid employees, with some exceptions.

There will be no minimum employer size cutoff, however so-called “own account” businesses – where a working owner is the only paid employee – will be screened out in the initial contact. The Yukon and Northwest Territories were excluded due to the small population of businesses and the expense of surveying them. Farming, fishing and trapping are excluded due to the preponderance of own account businesses in these sectors. Government administration and related services were dropped due to the lack of location information on the Register.

The target population for the Employee component is all employees working in the selected workplaces who receive a Revenue Canada T-4 Supplementary form. In order to improve coverage of occupations and reduce overall sampling variance relative to the pilot survey, up to 12 workers will be selected in the larger workplaces.

V.i. Basic Elements of the WES Longitudinal Design

V.i.a. Workplace

Our working assumption is to follow locations for a minimum of five years from their selection into the sample. One of the reasons we chose to sample at the location level is the stability of the statistical unit at this level. While ownership changes can trigger deaths and re-births at higher levels (enterprise, company and establishment), location deaths can only be triggered by the location actually closing up shop or through a major change in the products or services produced at the location. This cleans up a number of longitudinal weighting issues associated with the two-stage sample design used in the pilot.

No matter how stable the statistical unit, there will still be sample attrition over time – due to both location deaths and refusals. In the third year and in each subsequent odd year sample attrition by death will be handled by selecting new entrants from a pool of births using the Business Register. This pool will be comprised of all locations born on the Register since the last sampling date. Increasing the sampling fraction for existing firms (i.e. those not in the pool of new births) may be necessary after several occasions if attrition by refusal begins to erode the quality of cross-sectional estimates. The sampling fraction may also be increased in cells in danger of depletion.

This design yields a cross-sectionally representative sample in odd years. In addition, these cross-sections form the basis of overlapping panels: locations active in year 1, locations active in year 3, etc. Each subsequent panel could, in principle, run indefinitely. In practice, we will monitor response burden and refusal attrition carefully after year 3 to determine our sampling strategy for year 5 and beyond. The sample will not be cross-sectionally representative in even years due to the lack of information on new births

V.i.b. Employee

An “ideal” employer-employee survey would follow employees for long periods of time, as well as employers. Employees, however, change employers with some frequency; an average of 20% of employees leave their employer each year. To follow them from employer to employer and collect data from each subsequent employer would result in an explosion of our employer sample size. Accordingly, our original plan was to follow employees for as long as they were with the establishment they were originally sampled in and for one period thereafter. Similar to the establishment sample, sample attrition would be handled by selecting new employees from a pool of new hires since the first sample. However, a follow-up to our pilot showed that not all employers could put together lists of new employees. Rather than continue with an asymmetrical sample, a different strategy was developed.

Employees sampled in the first year will be interviewed for two consecutive years. An “exit” questionnaire will be administered to those employees no longer with the same employer in the second year regardless of the reason for exit. The employee sample will be redrawn in the third year using a pool of all current employees yielding a new cohort of employees. The two-year cycle would then be repeated for the selected employees in the third year. Under this design, a set of retrospective questions for recently hired employees had to be added to the first cycle questionnaire so that transitions into and out of the employer would be covered by the survey.

V.ii. *Operational Features and Cost*

As a result of the workplace and employee plans outlined above, WES collection will alternate between relatively easier and relatively more difficult years. In odd numbered years all the operations outlined above will be carried out: pre-contact with newly sampled establishments; location visits to sample employees, distribute employee questionnaires, collect workplace information and print off sections of the questionnaire for secondary respondents; conduct telephone follow-ups with employees; re-integrate workplace information from

secondary respondents into the CAPI (computer assisted interviewing) application and transmit all this information from regional offices to headquarters. In even numbered years, we are not sampling any new locations or employees so there is no need to send interviewers into the field. All the information will be collected by telephone using contact information captured the previous year.

Most of the development costs of the WES have been covered by Human Resources Development Canada (Canada's umbrella ministry for employment insurance, labour relations, labour research and immigration) on an ad hoc basis. Starting in the current fiscal year, WES is being funded directly from the government's main accounts as part of a package of new survey initiatives. The WES program, including in-house analysis, will cost an average of \$3.2 million (approximately \$2.2 million US) per year over the first full cycle. Costs will fall somewhat in subsequent cycles as methodology research and systems development subside.

VI A Summary of Some Preliminary Findings From the Pilot Survey

In order to assess the quality and relevance of the pilot WES data, a number of research projects were undertaken. This section provides a summary of the findings from one such project: the association between training, computer use, and international competition. Because of space considerations the details of the research, including the econometrics, cannot be reported. Such details are available in a separate paper (Picot, 1998b).

VI.i Why focus on Training, Computer Use and International Competition?

The extensive adoption of information technologies and the increase in international competition has focused attention on training as a means of increasing the skills of workers in this more technological and competitive environment. There is particular concern regarding the level of training in Canada because of this country's low incidence of employer-provided training, by international standards (Lynch, 1994). This paper uses the new linked pilot employee-employer database to address issues in two areas: (1) the use of computers, training and the acquisition of skills related to their use, and (2) the type of market in which firms compete and its association with computer technology use and training.

Technology use and human resource development are increasingly seen as interrelated. It has been argued by Mincer (1989) that technological change and the demand for human capital are complementary. Firms that have as a business strategy the adoption of higher level technologies will demand higher skilled workforces. Associated with the higher technology and more skilled workers is a higher level of training. Using primarily industry level data, the association between higher rates of technological change and increased training levels has been noted in a number of studies (McMullen, 1996; Betcherman, Leckie and McMullen, 1997; Lillard and Tan, 1986; Bartel, 1989, 1995, Baldwin; Grey and Johnston, 1995). More generally, Lynch and Black (1995) find that employers who have made large investments in physical capital (relative to employment) are more likely to train their workers.

This study differs from many of the earlier ones in a number of ways. We focus on computers and computer-based technologies (CBTs) exclusively, not technology in a more general sense. We can also control for worker and establishment characteristics, something that is possible because of the linked nature of the data. Such data have not previously been available in Canada. Furthermore, information on training is provided by the worker, not the establishments. This is generally a more reliable measure; many firms know little about the training taken by their workers, whereas workers are more likely to be able to provide an accurate picture of both incidence and intensity of training. Finally, the analysis is conducted at the micro-level, not at the industry level, as is the case in some earlier work. Industries consist of a very heterogeneous set of firms, with some adopting technologies, others not; some with high levels of training, and others not (Baldwin 1998). It is more appropriate to test the notion that technology use and a firm's training patterns are complementary at the level of the establishment rather than the industry.

The introduction and use of computers and CBTs may lead to higher training levels for two reasons. First, firms adopting technologies generally have more highly skilled and educated workers, and earlier studies have indicated that there is a strong association between education level and training (Picot, 1987, Simpson et al., 1993, Lynch, 1995, de Broucker, 1997). Second, the adoption and use of a new technology is likely to lead to increased training requirements if companies wish to maximize the benefits of the technology. This training requirement would likely exist no matter what the education level of the employees. This latter point is of particular interest in this paper. We want to know whether, after controlling for the educational and other characteristics of workers, establishments that adopt computer-based technologies and workers that use computers train at higher levels than other workers.

VI.ii Computer Use on the Job: General and Specialized Applications

While more than half of the workers in the sample used computers, they are employed for many different applications. Among users, about 85% focused on short-time or general applications, 15% on specialized applications. Women are much more likely to be "general" users than men. There is a general consensus that technology is skill-biased. In this work, the probability of using a computer rises with educational attainment. However, users employing "general" applications were found at all education levels (above some high school). This is because clerks use computer for general applications as well as managers. Specialized applications are concentrated among the post-secondary educated, so that increased use of these applications would lead to higher (relative) demand for the more highly educated.

VI.iii The Association Between Computer Use and Training

The use of a computer increased significantly (by up to a factor of 2) the likelihood a worker will train, even after controlling for differences in education, age, etc. Furthermore, the more intense or specialized the computer use, the higher the probability of training and the longer the duration of training. There was also a positive association between training and many workplace practices, such as the use of quality circles, self-directed work groups, and total quality management. This supports the notion that establishments implement a series of H.R. practices in the drive for increased productivity, not training alone.

Most establishments that implement a computer-based technology provide some training to the workers affected. However, formal employer-based training is by no means the primary method by which users of computer technologies acquire the skills necessary to use particular applications. Informal and on-the-job training play a much larger role. This held for both general and specialized applications. It is clear that when considering the process whereby workers acquire the skills necessary to use computer technology, on-the-job training and self-learning have to be central, and one cannot focus only on employer based formal training, or any type of formal training. It is not clear whether the importance of informal training is due to the lack of formal training being provided by the employer, or because this is the most efficient way of acquiring the skills.

It is evident, however, that the use of a computer or the adoption of a computer based technology does lead to increased training levels. This is consistent with earlier work. These increased levels are not only due to the characteristics of workers that use computer based technology, or the types of establishments that implement them. There is an additional kick to training levels even after controlling for such characteristics. One would expect such an increase to raise productivity levels associated with the implementation and use of the technologies.

VI.iv The Association Between the Type of Market in Which an Establishment Competes and (1) Computer Use, and (2) Training

It is often argued that technologies are more likely to be implemented in more competitive markets. This is because such technologies are intended to increase productivity and competitiveness of the establishment. An establishment operating in a very competitive market with competitors from other countries may be pressured to be at the forefront of technology adoption, or risk failing. The operation of a firm in an international market or one with many competitors may drive a firm to adopt technologies. Training levels may also be higher in firms competing in international or in more competitive markets. This may be because of the (potentially) increased reliance on technology, or because training itself may be seen as a means of increasing the companies' competitive advantage in such markets. If firms believe that training results in higher productivity and competitiveness, then those in international markets, or those with many competitors, may introduce higher levels of training, as well as the higher levels of the use of technologies. This section asks whether the pilot data from the Workplace and Employee Survey supports such hypotheses.

Two variables defining the market in which the establishment competes were created: (1) the regions (local, provincial, national, international) that offer significant competition in the market in which most of the establishment's output is sold, and (2) the number of firms that offer products or services that directly compete with the establishment in its most important market.

The results regarding computer use and market type were mixed. Workers in establishments that compete internationally were more likely to employ computers than those working in other establishments, after accounting for differences in establishment size, industry, and worker characteristics such as education and age. This supports the notion that technological change and increasing international competition (trade, foreign direct investment) are linked.

However, the association between computer use and number of competitors was if anything negative. These mixed results could reflect a number of possibilities. One has to first ask whether the variables we have used to proxy levels of competition are valid. Is competition necessarily greater among firms that compete internationally than those that compete locally? And is the number of competitors a good measure of market competition? It may be that a market with five large competitors is as competitive as one with more than twenty smaller competitors. If one assumes that these are indeed reasonable measures, then there are other possibilities for the mixed results. Whether establishments that compete in more competitive markets would turn to a higher incidence of computer use depends on whether they see this as productivity enhancing. There is some question as to the extent to which some computer applications are in fact productivity enhancing. Firms in very competitive markets may be more reluctant to “over-use” computer applications, especially for general applications, if productivity benefits are not commensurate with the investment. They may be forced to focus on this issue more than users in less competitive markets, leading potentially to lower, not higher rates of computer usage and investment. This may be particularly true among smaller establishments. This could potentially explain the results observed here, but the pilot data do not allow us to rigorously assess these competing hypotheses.

There was not a strong association between market type and training intensity. If anything, establishments operating in international markets were less likely to train their workers than other establishments, controlling for worker and establishment characteristics. The same questions arise as noted above.

VI.v Does Analysis Based on Establishment and Worker-Based Training Data Produce the Same Result?

Results can differ depending upon whether one uses establishment-based or worker-based measures of training incidence. In some cases both the direction and magnitude of an association differed, depending upon the measure used. Training as defined by the question “does the establishment train” at times produced different results than training as defined by a question posed to employees “did you (in the same establishments) receive training”. There are a number of reasons why such a difference might exist. These are not the same measures and could produce different results. The former measure indicates the share of establishments that train, the latter the share of workers within establishments that receive training. However, both are commonly used measures (although different), and the results indicate that some care must be taken, even when measuring incidence. The two different training measures did provide different answers to some questions of association, particularly between the implementation of a technology and training, and between the market type and training levels. We generally relied on the worker responses, as they were deemed more reliable.

The goal here was to provide demonstrative, not definitive, research. All of these findings are preliminary for a number of reasons. The sample size in the pilot is quite small (750 establishments and 2,000 workers). This prevented more detailed analysis that could be used to strengthen these findings. For example, one might want to test many of these hypotheses on particular industries. The sample used here was not sufficient to ask such questions. Furthermore, the sample is not representative of the Canadian economy. It consists of a number of industry-

region combinations that can be thought of as case-study in scale. Finally, some of the new measures – such as “market type” could be improved upon. The pilot data did provide the opportunity, however, to control for both worker and establishment characteristics when addressing these issues, something that is quite important for the reasons discussed in the text, and not previously possible in Canada. When the production version of this survey is run in early 1999 the research necessary to validate and extend these results will be possible.

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