Workplace responses to vacancies and skill shortages in Canada

Tony Fang

*School of Administrative Studies, York University, Toronto, Canada, and
Centre for Industrial Relations and Human Resources,
University of Toronto, Toronto, Canada*

Abstract

Purpose – The purpose of this paper is to analyze employer responses to vacancies and skill shortages by adopting certain workplace practices.

Design/methodology/approach – Making use of the longitudinal nature of the Workplace and Employee Survey, a nationally representative sample of Canadian organizations, the paper applies both linear and probit models to examine incidence of positive vacancies and vacancy rates and subsequent adoptions of various workplace practices in response to such vacancies and skill shortages.

Findings – Employers respond to labour and skill shortages in a number of ways, focusing more on short-term and less costly solutions, such as adoption of flexible working hours and increases in overtime hours, greater reliance on flexible job design and part-time workers, and implementation of self-directed work groups and problem-solving teams. There is no evidence that workplaces would raise employee wages or fringe benefits to alleviate shortages.

Practical implications – In the absence of a well-developed internal market, firms are likely to continue using short-term and less costly solutions. Governments should work with firms, workers and their representatives and act strategically to resolve issues of timely identification of skill shortages in order to make informed decisions and put mechanisms in place to address such shortages.

Originality/value – The results are based on a national longitudinal survey and a number of important practical and policy implications are discussed in the paper

Keywords Labour, Skills shortages, Recruitment, Human resource management, Canada

Paper type Research paper

Introduction

The booming economy in the late 1990s has spurred strong interest in labour and skill shortages and related labour market adjustment in North America (Cappelli, 2003). Substantial growth in employment of knowledge workers in the economy and the increasing number of workplaces reporting difficulties in hiring skilled workers have prompted researchers to examine the determinants and consequences of unfilled

vacancies and skill shortages. These shortages also have implications for a number of key stakeholders, including employers, employees and their representatives, and governments.

Shortages are generally associated with increases in the demand for labour emanating from various sources including technological change, the computer and Internet revolution, international competition and globalization, industrial restructuring, mega projects, and cyclical expansions during which employers are reluctant to expand employment because of the quasi-fixed costs of such expansion. However, the demand expansions will lead to shortages only if there is an insufficient supply response; hence, the focus of this paper is on the barriers that inhibit such a supply response.

There is a wide range of potential responses that stakeholders can make to alleviate such shortages. For example, employers may respond by any combination of the following: Raising wages and/or fringe benefits or altering the working conditions; recruiting youths, delaying retirement of older workers, and facilitating re-entry into the labour force, particularly of women; endeavouring to have immigrants enter the labour market; increasing the hours of work or/and the intensity of work and discretionary effort of existing personnel; improving the quality of the existing labour supply through human capital formation such as education and training; changing internal workplace practices (e.g. broad-based job classes, multi-tasking, multi-skilling, job rotation); and adopting alternative work organization (e.g. problem-solving teams and self-directed work groups) and non-standard employment (e.g. limited-term contracts, subcontracting, part-time employment, temporary help, and telecommuting).

The focus of this study will be on innovative human resource practices that are widely believed to affect skill or labour shortages and for which our dataset also contains rich information. More specifically, the analysis will focus on unfilled and hard-to-fill vacancies and subsequent employer responses/non-responses to such skill and labour shortages. In doing so, the 1999 to 2001 workplace-level data of the Workplace and Employee Survey (WES), conducted by Statistics Canada, are used.

The WES is a linked file consisting of both employer and employee components and covers a broad range of topics from both the demand and supply side of the labour market. Employers are sampled by physical location and employees are then sampled within each location from employer-provided lists. The survey excluded business locations in the Yukon, Nunavut and the Northwest Territories, along with agriculture, fishing, road, bridge and highway maintenance, government services and religious organizations. The initial wave of the WES was conducted during the summer and fall of 1999. Responses were received from 6,322 business locations and 23,540 employees. The WES is ideally suited for this analysis for a number of reasons. In addition to information about the standard establishment characteristics such as establishment size, multiple location status, non-profit status, and foreign ownership, the WES also contains information about various human resource practices and business strategies that are believed to affect labour and skill shortages. These practices and strategies include compensation practices, training and development, flexible management, flexible hours, and flexible employment. It is longitudinal and therefore facilitates tracking those factors that can give rise to shortages and the subsequent responses intended to relieve these shortages. Most importantly, it has good measures of both skill shortages and the barriers and lack of responses on the part of the involved

parties that can foster such skill shortages. The WES asks employers direct questions on vacancies, their occupational dimension (managers, professionals, technical/trades, marketing/sales, clerical/administrative, and production workers), and the reasons for the vacancies.

In what follows, the next section reviews the theory and evidence regarding the labour and skill shortages both in Canada and abroad. It moves on to discuss the data and methodology and the critical associations between vacancies and skill shortages and various workplace practices, and how such practices can be used by employers as potential responses to labour and skill shortages. The third section presents major findings. The final section summarizes practical and policy implications of the findings and suggests future research.

Literature review

There are two major types of skill/labour shortages: cyclical and structural. While cyclical shortages may be short run, the "short-run" can prevail for a considerable time because of uncertainties and adjustment costs. In a dynamic economy, there will always be cyclical shortages. As production and revenues fluctuate during the economic cycle both employers and potential workers will adopt strategies to shift the labour market towards equilibrium. These strategies are usually called "market responses", which are aimed at increasing the availability of workers from an existing labour pool during cyclical labour shortages by sending signals to them that there are jobs available. For example, employers may increase wages or initiate recruitment campaigns in order to attract more workers during a period of rapid economic growth (Skills Canada BC, 2004). Structural shortages may occur due to changes in the nature of the economy when the labour force does not match the skills required for production. Factors that contribute to structural shortages can include significant demographic changes, technological changes and rapid growth of new industries. Structural shortages are more difficult to address through market responses because the available labour pool may not have the skills needed and it can take considerable time to develop these skills.

Two theoretical frameworks exist to explain the causes and consequences of the problem. In the equilibrium-market imperfection model workplaces fail to adjust, or to adjust quickly, their relative wages in the face of supply-demand imbalances. Theories of these types may shed light on the number of vacancies, the number of hard-to-fill vacancies, and the existence of a skill gap (Bosworth *et al.*, 1992). Alternative explanations for skill shortages are offered by the job-matching model. Vacancies can occur in a situation in which a firm must wait longer than usual, or search more actively, to hire a worker. The causes of skill shortages can then be modelled to analyze vacancy duration (Mortensen, 1986; Pissarides, 1990). Causes for the two types of shortages are distinct but can be summarized into two groups:

(1) internal factors that can be adjusted by the employers (e.g. wages and non-wage benefits, training, work organization; and

(2) various innovative workplace practices) and external factors that are beyond the control of the employers (e.g. local unemployment, housing costs).

Although skill shortages are a key issue in labour market analysis because of their significance and relationship to other policy issues, surprisingly, very little has been done to test the above-mentioned hypotheses globally, even less so in Canada. This is

primarily due to lack of quality data for this kind of analysis. Of the studies conducted in the UK, none has been able to use the longitudinal nature of data, and there is no single survey that addresses all major factors (Table I). Recent studies conducted in the UK have used databases such as the Employers' Manpower and Skills Practices Survey (EMSPS), the Employers Skill Survey (ESS), the Workplace Employee Relations Survey (WERS) and its earlier version, the Workplace Industrial Relations Survey (WIRS).

Another central problem is how to define what the term "skill shortages" actually means. Although there are many technical definitions based on "matching theory," the general consensus and simplest definition of a skill shortage is "when there are not enough people available with the skills needed to do the jobs which need to be done" (Green et al., 1998). More complex models take into account the elastic nature of the labour market since, when the demand exceeds the supply of labour for a given skill, it is expected that time will pass before the market clears. In fact, Haskel and Martin (1993a) define a skill shortage as "a situation in which the firm must wait longer than normal, or search more actively to hire a worker," reducing the problem to a matching game (Haskel and Martin, 1993b), and thus it becomes a question of defining what is considered to be a suitable length of time for a given vacancy.

When defining the job vacancy rate, Green et al. (1998) caution about linking skill shortages to hard-to-fill vacancies since, for example, not all recruitment difficulties pertain to a shortage of workers. A job vacancy is usually characterized by the following three requirements: a job must be vacant for a given indicated period; employers must have taken some form of recruiting action; and the position must be immediately available and open to "outside" persons (Morissette and Zhang, 2001). Green and Owen (2002) go on to further classify "hard-to-fill" vacancies as situations in which salaries or working conditions might not be so attractive and they classify "skill-shortage" vacancies as a subset of the former. In this case, added to the definition

Study	Country	Data	Model/dependent variable
Haskel and Martin (1993b)	UK	WIRS	Probit/vacancy (internal and external factors)
Haskel and Martin (1993a)	UK	Census of Production, Annual and Quarterly Report	Growth in output per head
Bosworth (1993)	UK	WIRS	Probit/prob. and intensity of shortage
Lane and Gohmann (1995)	USA	ARF	Probit, simultaneous 2SLS and "Switching/demand and Supply for F/T equivalent nurses
Green et al. (1998)	UK	EMSPS	Binomial probit model/skill shortages, hard-to-fill vacancies
Gunderson (2001)	Canada	Not applicable	None
Haskel and Martin (2001)	UK	EMSPS, WERS, WIRS	Probit/skill shortages, hard-to-fill vacancies, hiring difficulties
Morissette and Zhang (2001)	Canada	WES	Generalized Tobit model/vacancy
Green and Owen (2002)	UK	ESS	Descriptive, correlations

Table I.
Country, data and models used in previous studies

are problems such as a low number of applicants with the required skills or with the experience the company demands.

Most of the previous studies are conducted in the UK, examining various situations in which vacancies might occur (see Table I). Among the determinants used in the previous studies, unionization, wages, and unemployment/employment rates at both the local and industry level seem to be of some importance and are used in most models. Whether a workplace is part of the high-tech industry or has training programs are of secondary importance but, nonetheless, are common factors, as well as the ratio of skilled to unskilled workers and the size of the organization. One aspect on which most researchers seem to agree is that internal policy decisions at the workplace level play an important role in both increasing and reducing shortages. Since no empirical research to date touches upon this area, considerable time will be spent in the next section to discuss the critical association between vacancies/skill shortages and workplace responses in adopting a number of human resources policies and programs.

Data and methodology
Data
Labour and skill shortages are notoriously difficult to define and measure (Bosworth, 1993). Job vacancies reported by workplaces provide a direct "bottom line" measure of a shortage. They reflect the net effect of the demand side and the supply side, and, in fact, questions could be asked to determine the reasons for the vacancy (e.g. insufficient applicants, high turnover, lack of correct skills). Nevertheless, there are difficulties in interpreting what is meant by a job vacancy since it does not need to be a measure of "effective demand" backed by a willingness and ability to pay. As well, the time period over which a vacancy has to exist before it is considered a true shortage has to be addressed. The number and duration of vacant positions are also contingent on a number of factors, such as the employers' wage offer, the requirement for the quality of match, and the employers' recruitment efforts.

Statistics Canada did conduct a Job Vacancy Survey but it was discontinued in the mid-1970s for budgetary reasons and lack of a clear constituency of users given that unemployment and surpluses rather than shortages of labour were prominent at that time (Meltz, 1976)[1]. While Canada and the United States no longer have job vacancy surveys, they do exist in countries such as Germany, Sweden, the United Kingdom, and the Netherlands (Henson and Newton, 1995; Muysken, 1994). This gap in Canada's vacancy information on the demand side of the labour market can be remedied somewhat by information from the new WES, jointly produced by Human Resources Development Canada (HRDC) and Statistics Canada.

We use the 1999 to 2001 data from the WES. The WES data are consistent across years with the exception that certain questions such as business strategies, work organization, and competition, were only asked in the odd years (e.g. 1999, and 2001). The sample of locations was stratified by region, industry, and size of location. The WES covers business locations of all sizes and industries, excluding all levels of public administration and the primary sector. For each location, a manager answered the employer questionnaire during a personal interview. The survey response rate was 95 percent for locations and 83 percent for workers, as 6,322 locations and 23,540 employees answered the questionnaires in 1999. Since the WES is a longitudinal survey, it repeats for six years with the same business locations.

Methodology

This paper attempts to link the existing theory of shortages with the available measures and explores the extent to which employers respond to labour and skill shortages through various workplace policies and practices and discuss why employers would or would not respond in certain ways.

Dependent variables. Some of the dependent variables are constructed by calculating actual changes in either the level or ratio variables (average real wage rates; pension and group RRSP coverage; training expenditure per employee or proportion of employees trained; proportion of telecommuters) between 1999 and 2001. Most of the workplace practice adoption variables are derived from Question 20 in the workplace survey (increase in overtime hours, adoption of flexible working hours, greater reliance on job rotation, multi-skilling, and implementation of Total Quality Management or TQM). The problem-solving team and self-directed work group variables are derived from Question 18. Details of both questions are provided in Appendix 1.

Compensation and training

Employers can respond to labour and skill shortages in a number of ways, possibly through enhanced compensation, more generous benefit packages, and employer-sponsored training.

- *Average real wages per employee*[2]. The "textbook" response to reduce labour or skill shortages is to raise wages and/or non-wage benefits (such as a pension plan or a group Registered Retirement Savings Plan or RRSP[3]) or alter the working conditions to attract or retain personnel. However, employers may fail to respond to labour and skill shortages through wage and benefit mechanisms because rigidities in wages and fringe benefits coverage can occur as a result of collective bargaining agreements (Simpson, 1985), public policies (Kralj, 2001), or a reluctance to raise wages to attract new recruits to the extent that they would have to raise wages of their internal incumbents for reasons of internal equity[4] (Johansen and Strom, 2001). Haskel and Martin (1993b) further argue that skill shortages can actually reduce productivity because skill shortages tilt the composition of employment away from skilled workers towards the unskilled; they also leave the firm less able to bargain higher levels of effort from their workers.

- *Training expenditure per employee.* Employers can also respond to skill shortages by providing training to those who are otherwise unqualified for the jobs in need. On the other hand, workplaces may be reluctant to provide training because of the "poaching" problem (some workplaces paying a wage premium to attract persons from other workplaces that do train) or the problem of "double pay" (workplaces paying for the specific training and some of generic training, and then having to pay a wage premium to keep their trained workforce, at least for the generic training, from leaving)[5].

Flexible management

To reduce shortages, workplaces may also implement some alternative forms of work organization, such as flexible job design, problem-solving teams, and self-directed teams. Productivity gains can be achieved through synergy and increased efficiency

even with the same number of people and cross-functional training facilitated by such work organization as job rotation, multi-skilling, self-directed work groups and problem-solving teams.

- *Flexible jobs (greater reliance on job rotation, multi-skilling)*. Employers can respond to skill shortages by altering internal workplace practices to increase the skills and responsibilities of the existing workforce.

- *Self-directed work groups*. Semi-autonomous work groups or mini-enterprise work groups are established and these groups may have a high level of responsibility for a wide range of decisions or issues.

- *Problem-solving teams*. Responsibilities for this type of team can be limited to specific areas such as quality or workflow (i.e. narrower range of responsibilities than what self-directed teams have).

Flexible hours

- *Increase in overtime hours*. Most workplaces use overtime as a short-term strategy to deal with labour and skill shortages. However, this may not be an effective long-term strategy as workers become fatigued and stressed, and there may be more accidents, higher scrap rates, lower job satisfaction, and higher turnover rates.

- *Adoption of flexible hours*. The "hours of work" aspect of labour supply can be important for alleviating shortages through such dimensions as shifts from part-time to full-time and increases in the hours of existing personnel.

Flexible employment

Flexibility in staffing can also be obtained through various forms of non-standard employment, including temporary, part-time, and telecommuting workers.

- *Temporary workers*. Temporary workers are typically hired for the life of a particular project that may otherwise create a labour shortage.

- *Part-time workers*. Part-time employment may appeal to people who would otherwise be out of the workforce, or who want to balance work-life demands. Employers may also gain by paying part timers lower wages or benefits.

- *Telecommuting workers*. These people work out of their homes and often connect with their employers via the internet. Workplaces may be able to recruit and retain skilled workers by offering additional flexibility to those who would otherwise not be available.

In addition to a wide range of topics such as business strategies, human resource practices, and technology adoption, the WES also asks workplaces detailed questions about the incidence and number of job vacancies and longer-term vacancies (unfilled for four months or longer), which can be found in Appendix 2.

Main independent variables. Information was drawn from Question 3(b)-(d) to construct the main independent measures of the job vacancy rate and hard-to-fill vacancy rate. First the general job vacancy rate $VRATE_i$ of location i is defined as the number of job vacancies (3(c)) in location *i* divided by location *i*'s labour demand[6]. Next, the hard-to-fill job vacancy rate $HVRATE_{it}$ of location i is constructed as the

number of hard-to-fill job vacancies (those lasting more than four months) in location i divided by location i's longer-term labour demand (equal to the number of workers employed in a location plus the number of job vacancies lasting more than four months).

Control variables. In addition to job vacancy and hard-to-fill vacancy rates, various establishment characteristics may also affect the diffusion or changes of alternative workplace practices as discussed earlier. Using the pooled data of the 1984-1998 Workplace Employment Relations Surveys (WERS), Bryson *et al.* (2007) found that establishment size, size of multi-establishment network, ownership type, set-up date and network effects all play a significant role in predicting adoption of high-commitment human resource management. Based on pooled 1999-2002 WES data, Walsworth and Verma (2007) also revealed some complementarities between high performance workplace practices, internationalization and propensity to innovate.

To control for other internal or external factors that may also affect the diffusion or changes of workplace practices, the following establishment characteristics have been included in the right-hand side of the models:

- workplace size;
- single-/multiple-location indicator;
- union status;
- percentage of skilled workers in a location;
- human resources unit indictors;
- innovation status;
- importance of competition;
- foreign ownership;
- 14 industry groups; and
- six economic regions.

Descriptions of these variables are also provided in Table II and summary statistics are presented in Table III.

Model specification. To answer the above-mentioned research questions, the longitudinal nature of the WES data is used. A set of Probit models that report marginal effects (termed DPROBIT in STATA 9) for dichotomous dependent variables (such as adoption of flexible working hours and greater reliance on part-time workers) and a set of OLS models for continuous dependent variables (such as changes in average real wages and changes in per capita training expenditures) are estimated to examine the effect of the vacancy rates and hard-to-fill vacancy rates at location i in 1999 and 2000 on the probability of adoption of or changes in various workplace practices by the location in 2001.

$$Y_{it+2} = f(\alpha_1 \text{VRATE}_{it} + \alpha_2 \text{VRATE}_{it+1} + \beta Z_{it} + u_{it+2}).$$

$$Y_{it+2} = f(\alpha_1 \text{HVRATE}_{it} + \alpha_2 \text{HVRATE}_{it+1} + \beta Z_{it} + u_{it+2}).$$

where f is a Probit function for a dichotomous dependent variable or a linear function for a continuous dependent variable, $Y_{it+2} = 1$ if plant i adopts a certain type of workplace practice at $t + 2$ (2001), 0 otherwise for the Profit model. The variable

Name	Code name	Description
Dependent variable		
Change in average log real wages	Avlnwage9901	Change in average log real wages (log of total payroll expenditure divided by total number of employees at location adjusted by CPI) between 1999 and 2001
Change in pension plan status	Pension9901	Change in pension plan offering between 1999 and 2001
Change in group RRSP status	Rrsp9900	Change in Group Registered Retirement Savings Plan (RRSP) offering between 1999 and 2001
Change in per capita training expenditure	Training99	Change in per capita training expenditure between 1999 and 2001
(Flexible management)		
Flexible jobs	Flexjob01	Greater reliance on job rotation, multi-skilling
TQM (implementation of TQM)	Tqm01	Implementation of total quality management
(Flexible hours)		
Overtime hours	*Ovetime01*	*Increase in overtime hours*
Flexible hours	*Flexhr01*	*Adoption of flexible working hours*
Part-time workers	Partim01	Greater reliance on part-time workers
(Flexible employment)		
Temporary workers	*Temp9900*	*Greater reliance on temporary workers*
Telecommuters	Home_wk9901	Change in proportion of telecommuters
Independent variables		
1999 Job vacancy rate	Vac_rate99	Workplace job vacancy rate in 1999
2000 Job vacancy rate	Vac_rate00	Workplace job vacancy rate in 2000
1999 Hard-to-fill vacancy rate	Hard_vac_rate99	Workplace hard-to-fill job vacancy rate in 1999
2000 Hard-to-fill vacancy rate	Hard_vac_rate00	Workplace hard-to-fill job vacancy rate in 2000
Number employed at location	Ttl_emp99	Number of employees in a location
Single-location establishment	Single99	Equals 1 if a location is not part of a multiple-location establishment; 0 otherwise
Innovative workplace	Innovat99	Equals 1 if a location has introduced a new product/new process of production or has improved products/processes of production in the past year; 0 otherwise
Unionized	Union99	Equals 1 if at least one employee of the location is unionized; 0 otherwise
Percentage of skilled workers	Skl_pct99	Percentage of managers, professionals, or technical workers in a location
[HR unit with more than one person]		A location has a separate human resources unit employing more than one person
One full-time HR person	Hr_1per99	Equals 1 if a location has 1 full-time person responsible for human resources matters or if human resources matters in the location comprise part of one person's job, such as the owner or manager; 0 otherwise

Table II.
Definition of variables

(*continued*)

Name	Code name	Description
HR person or unit in another location	Hr_oth99	Equals 1 if human resources matters in the location are the responsibility of a person or unit in another location; 0 otherwise
Ad hoc HR or other arrangement	Hr_unk99	Equals 1 if human resources matters in the location are handled as they arise (i.e. are not assigned to one person in particular) or if there is some other arrangement different from all above; 0 otherwise
Importance of competition	Cmp_int99	The extent to which other establishments (locally owned, Canadian-owned, American-owned, or other internationally owned) offer significant competition to the business is important, very important, or crucial
Foreign ownership	Foreign99	Equals 1 if at least 50 percent of a location's assets are held abroad; 0 otherwise
[Retail trade and consumer services]	Retail99	Industry grouping 9
Forestry or mining	Forest99	Industry grouping 1
Tertiary labour-intensive manufacturing	Manulab99	Industry grouping 2
Primary manufacturing	Manupri99	Industry grouping 3
Secondary manufacturing	Manusec99	Industry grouping 4
Tertiary capital-intensive manufacturing	Manucap99	Industry grouping 5
Construction	Constru99	Industry grouping 6
Transportation, storage, wholesale trade	Transpor99	Industry grouping 7
Communication and other utilities	Commu99	Industry grouping 8
Finance and insurance	Fina99	Industry grouping 10
Real estate, rental, and leasing operation	Real99	Industry grouping 11
Business services	Business99	Industry grouping 12
Education and health care	Eduhlth99	Industry grouping 13
Information and cultural industries	Info99	Industry grouping 14
[Ontario]	Ont99	Region grouping 3
Atlantic	Atl99	Region grouping 1
Québec	Que99	Region grouping 2
Manitoba and Saskatchewan	Pra99	Region grouping 4
Alberta	Alb99	Region grouping 5
British Columbia	Bc99	Region grouping 6

Table II.

$VRATE_{it}$ ($HVRATE_{it}$) and $VRATE_{it+1}$ ($HVRATE_{it+1}$) are the vacancy rate (hard-to-fill vacancy rate) variables for workplace i at time t (1999) and $t + 1$ (2000), respectively. Z_{it} is a vector of controls for other observable workplace characteristics and economic factors for plant i at time t (1999), such as establishment size; single/multiple location indicator; unionization; innovation; percentage of skilled workers (proportion of managers, professionals, and technical workers among total employees in a location); presence of an HR unit employing one person on a full-time or

Variables	Means	Std.
Vacancy rate (1999)	0.025	0.080
Vacancy rate (2000)	0.026	0.077
Vacancy rate (2001)	0.024	0.082
Hard-to-fill vacancy rate (1999)	0.012	0.058
Hard-to-fill vacancy rate (2000)	0.012	0.054
Hard-to-fill vacancy rate (2001)	0.007	0.046
Number employed at location	14.52	59.55
Single-location establishment	0.720	0.449
Innovation	0.452	0.498
Unionized	0.072	0.258
Percentage of skilled workers	0.387	0.340
[HR unit with more than one person]	0.030	0.171
One full-time HR person	0.621	0.485
HR person or unit in another location	0.052	0.223
Ad hoc HR or other arrangement	0.297	0.457
Importance of competition	0.772	0.420
Foreign ownership	0.080	0.272
[Retail trade and consumer services]	0.330	0.470
Forestry or mining	0.016	0.124
Tertiary labour-intensive manufacturing	0.033	0.179
Primary manufacturing	0.012	0.110
Secondary manufacturing	0.021	0.145
Tertiary capital-intensive manufacturing	0.030	0.170
Construction	0.077	0.267
Transportation, storage, wholesale trade	0.132	0.339
Communication and other utilities	0.012	0.109
Finance and insurance	0.057	0.231
Real estate, rental, and leasing operation	0.036	0.186
Business services	0.123	0.328
Education and health care	0.104	0.306
Information and cultural industries	0.017	0.130
(Region)		
Atlantic	0.087	0.281
Québec	0.214	0.410
Ontario	0.381	0.486
Manitoba and Saskatchewan	0.064	0.246
Alberta	0.109	0.312
British Columbia	0.145	0.352
Number of observations	4,548	4,548

Table III.
Descriptive statistics for main independent variables (1999-2001) and control variables (1999), final sample

part-time basis; level of competition; foreign ownership; and standard control variables including 14 industry groups and 6 economic regions, and u_{it+2} is a residual.

Results
Descriptive statistics for incidence and intensity of job vacancies are reported in Table IV. The original WES of 1999 surveyed 6,322 workplaces in Canada. The exclusion of non-profit organizations reduces the sample to 5,501 and 5,414 workplaces in 1999 and 2001, respectively. In 1999, 12.8 percent of the for-profit workplaces reported vacancies with an average job vacancy rate of 2.9 percent. Of the firms, 5.3

Variables	Presence of vacancy (1999)	Job vacancy rate (1999)	Job vacancy rate (2001)
Overall	12.8	2.9	2.4
(Industry)			
Forestry and mining	6.9	0.9	1.9
Labour-intensive tertiary manufacturing	19.6	2.5	2.7
Primary product manufacturing	24.0	1.2	1.3
Secondary product manufacturing	17.6	2.2	1.4
Capital-intensive tertiary manufacturing	30.0	2.4	1.9
Construction	10.8	2.4	1.9
Transportation	12.9	3.1	1.7
Communication and other utilities	11.5	2.6	2.8
Retail trade	13.4	3.8	2.7
Finance and insurance	12.5	4.0	4.2
Real estate, rental, and leasing	3.3	1.9	2.0
Business services	13.5	2.8	2.5
Education and health services	7.0	1.8	2.5
Information and cultural industries	17.5	2.4	1.8
(Region)			
Atlantic	5.0	1.4	3.2
Québec	12.8	2.5	2.1
Ontario	16.4	3.7	2.2
Manitoba and Saskatchewan	10.2	2.2	2.5
Alberta	13.9	3.4	3.1
British Columbia	9.1	1.6	2.0
(Firm size)			
1–19	10.0	3.3	3.1
20–49	30.0	4.3	2.7
50–499	38.1	2.0	1.7
500 +	68.9	1.7	1.7
Number of observations	5,501	5,501	5,414

Table IV.
Presence of vacancy and vacancy rates by industry, region, and workplace size in for-profit establishments (%)

percent reported hard-to-fill vacancies with the longer-term vacancy rate of 1.0 percent (or 47 percent of all vacancies). About the same percentage of firms (13.1 percent) reported vacancies at a lower rate of 2.4 percent in 2001, only 3.6 percent of firms had hard-to-fill vacancies, and the longer-term vacancy rate dropped to 0.7 percent (or 27 percent of all vacancies), suggesting the intensity of job vacancies and longer-term skill shortage problems had eased from 1999 to 2001.

Vacancy rates are relatively high in retail trade, finance and insurance industries while low in forestry and mining, and manufacturing industries. In terms of regional distributions, vacancy rates are higher than national average in Alberta but lower in British Columbia. Finally, although larger establishments (with 50 or more employees) are more likely to report positive vacancies but the vacancy rates are lower than average vacancy rates. This evidence supports the internal labour market hypothesis, a finding that is consistent with previous studies (Bosworth, 1993; Morissette and Zhang, 2001).

Employer responses to labour and skill shortages – workplace practices
The final sample is constructed by retaining the common units of workplaces for all three years (1999 to 2001). Sample is limited to workplaces with more than 10 employees since questions pertaining to organizational changes were only asked of such establishments. Descriptive statistics for main dependent and independent variables based on this final analysis sample ($N = 4{,}548$) are presented in Table V and Table III, respectively. The summary of estimation results for employer responses to labour and skill shortages can be found in Table VI and complete regression outputs are reported in Table VII and Table VIII.

Compensation and training. There is no evidence that workplaces raise real wages to alleviate skill shortages, at least in the short run. This is also true for pension and group RRSP plans, a finding consistent with almost all available studies based on surveys (Hart and Shipman, 1990; Haskel and Martin, 1993b). The relatively small yet negative correlation coefficients between the average wage in 2001 and vacancy rates in previous years (both the 1999 and 2000 rates at the level of -0.047 and -0.046) confirm the regression results. As another robustness check, a 1999 cross-sectional average wage equation was also estimated with job vacancy and hard-to-fill vacancy rates as main independent variables (the results are available from the author upon request). Vacancy rates in neither equation are significantly associated with average wage rates although most other variables (workplace size, single-location indicator,

Variables	Changes
(Compensation, benefits, and training)	
Changes in average log real wages (1999 constant dollars)	-0.0374
(No changes in pension plan status)	0.915
Change from no pension to pension status	0.043
Change from pension to no pension status	0.042
[No change in group RRSP status]	0.894
Change from no group RRSP to group RRSP status	0.065
Change from group RRSP to no group RRSP status	0.042
Increase in per capital training expenditure	0.097
(Flexible management)	
Flexible jobs (greater reliance on job rotation, multi-skilling)	0.098
Adoption of problem-solving teams	0.058
Adoption of self-directed teams	0.022
TQM (Implementation of TQM)	0.074
(Flexible hours)	
Increase in overtime hours	0.045
Adoption of flexible working hours	0.083
(Flexible employment)	
Great reliance on temporary workers	-0.336
Greater reliance on part – time workers	0.066
Change in proportion of telecommuters	0.102
Number of observations	4,548

Table V.
Changes in or greater reliance on workplace practices: 1999 and 2001, final sample

Variables	1999 job vacancy rate	2000 job vacancy rate	1999/2000 job vacancy rates		1999/2000 hard-to-fill vacancy rates	
			1999	2000	1999	2000
Change in average log real wages	−0.286	0.321	−0.349	0.382	−0.596	0.620
	(−0.94)	(0.86)	(−1.20)	(1.08)	(−1.36)	(1.00)
Change in pension plan status	−0.254	−0.106	−0.249	−0.062	−0.517*	0.367*
	(−1.46)	(−0.67)	(−1.33)	(−0.36)	(−1.83)	(1.67)
Change in group RRSP status	0.092	0.057	0.088	0.042	−0.132	0.102
	(0.58)	(0.71)	(0.54)	(0.47)	(−0.44)	(0.68)
Change in per capita training expenditure	−0.131	0.204	−0.176	0.234	0.023	0.191
	(−0.66)	(1.23)	(−0.85)	(1.35)	(0.07)	(0.71)
(Flexible management)						
Flexible jobs (greater reliance on job rotation, multi-skilling)	0.120	0.193*	0.084	0.177*	0.008	0.346**
	(1.18)	(1.72)	(0.93)	(1.69)	(0.06)	(2.15)
Problem-solving teams	0.064	0.143**	0.041	0.137**	0.051	0.150
	(1.42)	(2.17)	(0.81)	(1.96)	(0.64)	(1.32)
Change in self-directed teams	0.058***	0.044*	0.052**	0.034	0.076**	−0.033
	(2.71)	(1.81)	(2.47)	(1.46)	(2.30)	(−0.65)
TQM (implementation of TQM)	0.093	0.141	0.071	0.127	0.043	0.214
	(1.01)	(1.43)	(0.87)	(1.41)	(0.35)	(1.50)
(Flexible hours)						
Increase in overtime hours	0.098**	0.007	0.100**	−0.009	0.069	−0.089
	(2.05)	(0.17)	(2.03)	(−0.23)	(1.21)	(−1.51)
Adoption of flexible hours	0.253***	0.216**	0.229***	0.167*	0.272**	0.212
	(2.77)	(1.99)	(2.66)	(1.64)	(2.23)	(1.31)
Greater reliance on part − time workers	0.120	0.181*	0.085	0.165	0.080	0.333**
	(1.42)	(1.72)	(1.03)	(1.57)	(0.69)	(2.35)
(Flexible employment)						
Great reliance on temporary workers	−0.022	−0.034	−0.017	−0.031	−0.170**	−0.005
	(−0.54)	(−0.83)	(−0.42)	(−0.74)	(−2.01)	(−0.09)
Change in proportion of telecommuters	−0.027**	0.012	−0.027*	0.017	−0.022*	−0.012
	(−2.05)	(0.36)	(−1.73)	(0.48)	(−1.67)	(−0.83)

Notes: *Significant at 10 percent; **Significant at 5 percent; ***Significant at 1 percent. Absolute values of *t*-statistics based on robust standard errors are in parentheses

Table VI.
Employer responses to labour/skill shortages (the coefficients reported in logit models are marginal effects), final sample

	Change in average log real wages	Change in pension plan status	Change in group RRSP status	Change in per capita training expenditure	Flexible job design	Problem-solving teams	Change in self-directed teams
1999 vacancy rate	−0.348	−0.249	0.088	−0.176	0.084	0.041	0.052**
	(−1.20)	(−1.33)	(0.54)	(−0.85)	(0.93)	(0.81)	(2.47)
2000 vacancy rate	0.382	−0.617	0.042	0.234	0.177*	0.137**	0.034
	(1.08)	(−0.36)	(0.47)	(1.35)	(1.69)	(1.96)	(1.46)
Total number of employment (x100)	0.015	−0.006	0.004	−0.015	0.006**	0.010***	0.003***
	(1.36)	(1.18)	(0.51)	(−0.54)	(2.21)	(5.11)	(3.90)
Single-location establishment	0.0014	−0.012	−0.065**	−0.046	−0.032	−0.078***	−0.017**
	(0.03)	(−0.52)	(−2.40)	(−0.92)	(−1.28)	(−4.99)	(−2.19)
Innovative workplace	−0.064	0.117	−0.025	−0.054	0.076***	0.029**	0.004
	(−1.61)	(0.55)	(−1.15)	(−1.51)	(3.83)	(2.78)	(0.73)
Unionized	−0.015	−0.045	−0.011	0.043	0.018	0.006	−0.008
	(−0.18)	(−1.08)	(−0.23)	(0.69)	(0.64)	(0.49)	(−1.58)
Percentage of skilled workers	0.077	−0.028	−0.007	0.044	−0.013	−0.003	−0.008
	(1.24)	(−1.01)	(−0.32)	(0.71)	(−0.38)	(−0.23)	(−1.04)
[HR unit with more than one person]							
One full-time HR person	0.013	−0.014	0.066	−0.214	0.027	−0.008	−0.020**
	(0.14)	(−0.37)	(1.25)	(−0.69)	(1.08)	(−0.57)	(−2.21)
HR person or unit in another location	0.133	0.008	0.0009	−0.170	−0.025	−0.034***	−0.013***
	(1.16)	(0.15)	(0.01)	(−0.52)	(−0.84)	(−3.95)	(−2.89)
Ad hoc HR or other arrangement	0.038	−0.033	0.063	−0.217	0.004	−0.005	−0.007
	(0.43)	(−0.80)	(1.04)	(−0.71)	(0.15)	(−0.32)	(−0.99)
Importance of competition	0.008	−0.016	−0.024	0.0003	0.040***	0.011	0.001
	(0.17)	(−0.89)	(−0.92)	(0.01)	(2.57)	(0.88)	(0.18)
Foreign ownership	0.139**	0.086*	0.089*	−0.039	0.092***	−0.002	−0.0002
	(2.38)	(1.95)	(1.82)	(−0.66)	(3.25)	(−0.22)	(−0.03)
Industry groups included (13)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional variables included (5)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observation	4,535	4,535	4,535	4,535	4,535	4,535	4,535
R-squared	0.04	0.03	0.03	0.02	0.12	0.17	0.13

Notes: * Significant at 10 percent; ** Significant at 5 percent; *** Significant at 1 percent. Absolute values of *t*-statistics based on robust standard errors are in parentheses

	Implementation of TQM	Increase in overtime	Flexible hours	Part-time workers	Temporary workers	Proportion of telecommuters
1999 vacancy rate	0.071	0.100**	0.229***	0.085	−0.017	−0.027*
	(0.87)	(2.03)	(2.66)	(1.03)	(−0.42)	(−1.73)
2000 vacancy rate	0.127	−0.009	0.167	0.165	−0.031	0.017
	(1.41)	(−0.23)	(1.64)	(1.57)	(−0.74)	(0.48)
Total Number of employment (x100)	0.006***	0.003***	0.005	0.003	0.002***	0.000
	(2.97)	(2.80)	(1.62)	(1.50)	(2.49)	(−0.26)
Single-location establishment	−0.035	−0.047***	0.009	0.009	−0.010	0.008***
	(−1.60)	(−4.34)	(0.56)	(0.56)	(−1.37)	(2.95)
Innovative workplace	0.060***	0.018**	0.030*	0.021	0.015**	−0.006
	(3.67)	(2.24)	(1.81)	(1.37)	(2.19)	(−1.51)
Unionized	−0.136	−0.007	0.190	0.039	0.027	−0.005
	(−0.93)	(−0.79)	(0.60)	(1.46)	(1.44)	(−0.87)
Percentage of skilled workers	0.041	0.009	0.053*	−0.036	0.033***	0.006
	(1.55)	(0.73)	(1.95)	(−1.56)	(3.37)	(0.98)
[HR unit with more than one person]						
One full-time HR person	−0.008	−0.009	−0.008	−0.028	0.001	0.001
	(−0.35)	(−0.77)	(−0.26)	(−1.12)	(0.10)	(0.22)
HR person or unit in another location	−0.040**	−0.010	−0.043	−0.037*	0.020	−0.006
	(−2.17)	(−0.64)	(−1.49)	(−1.70)	(0.84)	(−0.88)
Ad hoc HR or other arrangement	−0.004	0.002	−0.022	0.0004	0.002	0.006
	(−0.18)	(0.14)	(−0.68)	(0.02)	(0.17)	(0.90)
Importance of competition	0.031***	0.012	0.018	0.024	0.002	−0.0003
	(2.64)	(1.32)	(1.05)	(1.30)	(0.23)	(−0.06)
Foreign ownership	0.040*	0.010	0.030	0.030	0.011	−0.001
	(1.90)	(0.88)	(1.29)	(1.51)	(1.00)	(−0.54)
Industry groups included (13)	Yes	Yes	Yes	Yes	Yes	Yes
Regions variables included (5)	Yes	Yes	Yes	Yes	Yes	Yes
Number of observation	4,535	4,535	4,535	4,535	4,535	4,535
R-squared/pseudo R2	0.11	0.12	0.08	0.09	0.11	0.03

Notes: * Significant at 10 percent; ** Significant at 5 percent; *** Significant at 1 percent. Absolute values of *t*-statistics based on robust standard errors are in parentheses

Table VIII.
Employer responses to labour/skill shortages (the coefficients reported in logit models are marginal effects), full results

skill concentration, industry groups, economic regions, etc) are all in the anticipated directions. With regard to training expenditure per employee, the results show that employers who experienced vacancies, higher vacancy rates, or hard-to-fill vacancy rates in 1999 failed to increase training expenditure per employee in 2001, which is possibly caused by "poaching" and/or the "double pay" problems in some industries. On the other hand, high vacancy rates and higher worker turnover might be optimal for establishments that have low or no training costs (e.g. those in retail trade).

Flexible management. Both the vacancy rates and hard-to-fill vacancy rates in 2000 (but not 1999) have significant effects on adoption of flexible job designs in 2001, with a 1 percent rise in the job vacancy rate or hard-to-fill vacancy rate increasing the adoption probability of flexible job design by 0.2 percent and 0.3 percent, respectively. This suggests that flexible job design is a prompt response to alleviate both short-term and longer-term skill shortages. Similarly, workplaces with high vacancy rates (but not hard-to-fill vacancy rates) in 2000 are more likely to introduce problem-solving teams. On the other hand, the implementation of self-directed teams is significantly related to the higher vacancy rates and hard-to-fill vacancy rates in 1999, a higher vacancy rate in 2000 but not the 2000 hard-to-fill vacancy rate, implying that self-directed work groups are more of a structural change of work organization rather than a short-term response to vacancies and skill shortages. However, the adoption probability of TQM is not significantly affected by any measure of job vacancy rates.

Flexible hours. The hours of work aspect of labour supply has proved to be a common workplace response for alleviating shortages. This is particularly the case for the adoption of flexible working hours and, to less extent, the increase in overtime hours. Employers may prefer to implement flexitime or expand hours so as to amortize the fixed costs associated with existing employees rather than hire new recruits and incur such quasi-fixed costs associated with recruiting, hiring, training and expected terminations.

As expected, almost all measures of skill and labour shortages in 1999 and 2000 are significant in predicting the adoption of flexible hours in 2001. On the other hand, use of overtime is prevalent in establishments with higher vacancy rates in 1999 (but not 2000), and it is not significantly related to hard-to-fill vacancy rates in either of the two years. Again, this evidence may indicate that use of overtime is effective if the shortages are temporary or short-term. Certainly, there is a limit to increasing the number of working hours and the intensity of work efforts due to work-life balance issues for dual-earner families. All these results suggest that flexibility within the establishment is very important. Workplaces that must negotiate changes in hours of work and working schedules are more likely to encounter shortages.

Flexible employment. Flexibility in staffing may be obtained through various forms of non-standard employment, including temporary and part-time work and telecommuting. Increased use of non-standard workers can be expected if there is a shortage problem in place. On the other hand, establishments may also choose to shift workers from part-time to full-time or from temporary to permanent work to reduce shortages.

Perhaps somewhat surprising, although all measures of intensity of shortages show positive signs only some are statistically significant. A higher vacancy rate in 1999 and hard-to-fill vacancy rate in 2000 are significantly associated with greater reliance on part-time workers for this period. Similarly, vacancy rates and hard-to-fill vacancy

rates all have expected (positive) signs in the temporary worker equation. However, none of coefficients are significant at the conventional level. It is certainly possible that some employers actually increased working hours for their part-time workers and moved some of their temporary workers into permanent contracts in the face of intense labour and skill shortages.

In fact, higher vacancy rates or hard-to-fill vacancy rates in 1999 reduce the share of employees working at home. Although there is no straightforward explanation for this result, we speculate that workplaces facing skill shortages may find it difficult to delegate managers/supervisors to monitor or communicate with telecommuters.

The impact of other control variables
Across the equations of alternative workplace practice adoptions or changes (flexible jobs, problem-solving teams, self-directed work group, TQM, flexible hours) most of the effects of other control variables are consistent with the literature. As in Bryson *et al.* (2007), establishment size is a strong predictor of all practices. There also appear to be significant complementarities between technological innovations and workplace practice innovations as evidenced in Walsworth and Verma (2007). This is the case for TQM, flexible job design, problem-solving teams, overtime hours, and flexible hours. Being a part of a multi-unit firm also plays an important role in predicting adoptions of problem-solving teams, self-directed teams, overtime, and TQM (Bryson *et al.*, 2007). Competition and foreign ownership are important determinants for adoptions of TQM and flexible jobs but not for the others.

Conclusions and discussion
Labour and skill shortages are likely to be central issues in labour market analysis as the baby boomers continue to move into their retirement years. The problem of vacancies and skill shortages is of particular importance also because of the potential consequences to the key stakeholders, particularly the relevant employers, as well as its relationship to many key policy issues. Governments need to act strategically to resolve issues of timely identification of skill shortages in order to make informed decisions and put mechanisms in place to address such shortages.

Previous studies on skill shortages are subject to a number of criticisms. Many are based on surveys confined to certain areas or industries and so it is difficult to draw generalized conclusions. As well, cross-sectional analysis of skill shortages may encounter reverse causation problems. This paper uses a nationally representative sample from a longitudinal survey of Canadian workplaces (excluding those in the primary sector and all levels of government). The rich information in the WES on the number of unfilled and hard-to-fill vacancies allows us to construct reliable measures of skill and labour shortages.

In terms of employer responses to shortages, evidence shows that adoption of flexible hours and greater reliance on flexible jobs are among the most prevalent employer responses in the face of labour and skill shortages. To relieve shortages, workplaces also rely on increases in overtime hours as a short-term solution. In terms of work organization, workplaces are also likely to introduce self-directed work groups and, to a lesser extent, problem-solving teams, to extract synergy and economic efficiency.

Since flexibility in hours of work can be an important aspect of labour supply to reduce shortages, governments, employers, employees, and labour unions should work

together and find common grounds that facilitate flexibility of working hours through such mechanisms as labour standards legislation. Flexibility in workplace practices can also be crucial for using the existing labour supply to fill shortages within an organization. Employers may develop such flexibility through means such as broader job classifications, multi-tasking, multi-skilling, job rotation, and various forms of work organization (e.g. problem-solving teams, self-directed work groups etc). Difficult trade-offs amongst the stakeholders can be involved here, however, since many of these practices threaten unions in that they can be viewed as getting around labour regulations. In dealing with these trade-offs, unions and governments should consider that many of the practices are complementary to the wishes of an increasingly heterogeneous workforce (especially multiple-earner families) and they may be necessary to the joint survival of employers and employees in the information economy and increased globalization.

After many rounds of robustness checks, no evidence, however, has been found that workplaces increase wages or fringe benefits to reduce shortages, at least in the short run, likely because they are constrained by collective bargaining agreements, public policies, and internal equity concerns. Vacancies and shortages may induce skill mismatch that reduces labour productivity. Unions should also realize that wage compression could diminish the incentives for skill acquisition.

Surprisingly, there is also no evidence that employers would increase the percentage of training expenditures per employee in the face of shortages. Employers may be reluctant to provide training because of the "poaching" and/or "double pay" problems. The poaching problems imply that employees are gaining higher wages from training and therefore should have an incentive to acquire more human capital – subject to the inability of individuals to finance training by using human capital as collateral to a loan. Governments should consider training incentives as a way to help finance such "public goods," perhaps with rebates given to those who train or guaranteed loans to finance individuals who wish to invest in human capital acquisition.

Another subtle problem may also exist that discourages workplaces from adopting innovative workplace practices that could yield positive benefits. This occurs because individual establishments that innovate bear the full cost, but are unable to reap the full benefits of their innovations because successful innovations are likely to be emulated by competitors, but the failures will not be (Gunderson, 1986, p. 127). There may be a role for governments to innovate in their own human resources and workplace practices, since any spillover benefits can be thought of as a service they provide to the public. However, this can also be a risky practice because governments are not subject to market checks with respect to bad innovations.

Despite many interesting findings from this study, certain limitations exist. First, the period of study (1999–2001) for which our data are available was a time when the Canadian economy experienced substantial expansion. Therefore, what was observed might capture some effect of cyclical labour and skill shortages while employers may have responded to this particular type of shortage accordingly. Future research should test the sensitivity of the findings against the economic cycle and over a longer period of time. Furthermore, specific measures of skill-related shortages should also be employed to examine this more serious type of shortage that may hamper productivity advancement and economic growth the most.

Notes

1. The job vacancy series was used in the early years to estimate the unemployment-vacancy (UV) relationship. An inverse relationship generally prevailed, highlighting that when labour markets become tight and vacancies increase, aggregate unemployment generally falls. An outward shift in the UV relationship – more vacancies at every given level of unemployment – was generally interpreted as evidence of greater structural and frictional unemployment in the aggregate labour market.

2. The average real wage was derived as the total payroll expenditure divided by total number of employees at location and was adjusted by inflation (the CPI information is available at Bank of Canada web site: available at: www.bankofcanada.ca/en/rates/inflation_calc.html).

3. Group RRSP is a defined-contribution type of retirement savings plan sponsored by the employers. The counterpart in the United States is the 401(k) plan.

4. Johansen and Strom (2001) suggest that comparison effects both within and between firms play a key role in the determination of relative wages and unemployment. They further argue that wage comparison within firms induces wage compression.

5. Loewenstein and Spletzer (1999) used the National Longitudinal Survey of Youth Data and found that most of the skills learned in training are useful elsewhere and employers will extract some of the returns to the general training they provide.

6. Labour demand equals the number of workers employed in a location plus the number of job vacancies.

References

Bosworth, D. (1993), "Skill shortages in Britain", *Scottish Journal of Political Economy*, Vol. 40, pp. 241-71.

Bosworth, D., Dutton, P. and Lewis, J. (Eds.) (1992), *Skill Shortages: Causes and Consequences*, Ashgate Publishing, London.

Bryson, A., Gomez, R., Kretschmer, T. and Willman, P. (2007), "The diffusion of workplace voice and high-commitment human resource management practices in Britain, 1984-1998", *Industrial and Corporate Change*, Vol. 16, pp. 395-426.

Cappelli, P. (2003), "Will there really be a labour shortage?", *Organizational Dynamics*, Vol. 323, pp. 221-33.

Green, A.E. and Owen, D. (2002), "Skill shortages: local perspectives from England", *Regional Studies*, Vol. 372, pp. 123-34.

Green, F., Machin, S. and Wilkinson, D. (1998), "The meaning and determination of skill shortages", *Oxford Bulletin of Economics and Statistics*, Vol. 60, pp. 165-87.

Gunderson, M. (2001), *Skill Shortages in the Residential Construction Industry*, Canada Mortgage and Housing Corporation, Ottawa.

Gunderson, M. (1986), "Alternative mechanisms for dealing with permanent layoffs, dismissals and plant closings", in Riddell, C. (Ed.), *Adapting to Change: Labour Market Adjustment in Canada*, University of Toronto Press, Toronto, pp. 111-62.

Hart, P. and Shipman, E. (1990), "Skill shortages in the United Kingdom: the lessons from case studies", Discussion Paper 185, National Institute of Economic and Social Research, London.

Haskel, J. and Martin, C. (1993a), "Do skill shortages reduce productivity? Theory and evidence from the United Kingdom", *Economic Journal*, Vol. 103, pp. 386-94.

Haskel, J. and Martin, C. (1993b), "The causes of skill shortages in Britain", *Oxford Economic Papers*, Vol. 45, pp. 573-88.

Haskel, J. and Martin, C. (2001), "Technology, wages, and skill shortages: evidence from UK micro data", *Oxford Economic Papers*, Vol. 534, pp. 642-58.

Henson, H. and Newton, C. (1995), *Tools and Methods for Identifying Skill Shortages: A Cross-Country Comparison*, Human Resources Development Canada, Ottawa.

Johansen, K. and Strom, B. (2001), "Efficiency wages, interfirm comparison, and unemployment", *Southern Economic Journal*, Vol. 68, pp. 387-402.

Kralj, B. (2001), "Physician distribution and physician shortage intensity in Ontario", *Canadian Public Policy*, Vol. XXVII No. 2.

Lane, J. and Gohmann, S. (1995), "Shortage or surplus: economic and non-economic approaches to the analysis of nursing markets", *Southern Economic Journal*, Vol. 61, pp. 644-53.

Loewenstein, M.A. and Spletzer, J.R. (1999), "General and specific training – evidence and implications", *Journal of Human Resources*, Vol. 34, pp. 710-33.

Meltz, N. (1976), "Identifying sources of imbalance in individual labour markets for purposes of manpower and employment policy", *Relations Industrielles*, Vol. 31, pp. 224-46.

Mortensen, D. (1986), "Job search and labour market analysis", in Ashenfelter, O. and Layard, R. (Eds), *Handbook of Labour Economics*, Vol. II, North-Holland, Amsterdam.

Morissette, R. and Zhang, X.L. (2001), "Which firms have high job vacancy rates in Canada?" Research Paper 11F0019MIE2001176 176, Analytical Studies Branch, Statistics Canada, Ottawa.

Muysken, J. (1994), *Measurement and Analysis of Job Vacancies*, Avebury Publishers, London.

Pissarides, C. (1990), *Equilibrium Unemployment Theory*, Basil Blackwell, Oxford.

Simpson, W. (1985), "The impact of unions on the structure of Canadian wages", *Canadian Journal of Economics*, Vol. 18, pp. 164-81.

Skills Canada BC (2004), *Skill Shortages in BC, Ministry of Skills Development and Labour*, Government of British Columbia, Victoria.

Walsworth, S. and Verma, A. (2007), "Globalization, human resource practices and innovation: recent evidence from the Canadian Workplace and Employee Survey", *Industrial Relations*, Vol. 46, pp. 222-40.

Further reading

Dwayne, B., Gunderson, M. and Riddell, C. (2002), *Labour Market Economics*, 5th ed., McGraw-Hill Ryerson, Toronto.

Black, D.A., Noel, B.J. and Wang, Z. (1999), "On-the-job training, establishment size, and firm size: evidence for economies of scale in the production of human capital", *Southern Economic Journal*, Vol. 66, pp. 82-100.

Brown, C., Hamilton, J. and Medoff, J. (1990), *Employers: Large and Small*, Harvard University Press, Cambridge, MA.

Burdett, K. and Cunningham, E.J. (1998), "Toward a theory of vacancies", *Journal of Labor Economics*, Vol. 16, pp. 445-78.

Fang, T. and Verma, A. (2002), "Union wage premium", *Perspectives on Labour and Income Autumn*, Vol. 14 No. 4, pp. 17-23.

Krueger, A.B. and Summers, L.H. (1988), "Efficiency wages and the inter-industry wage structure", *Econometrica*, Vol. 56, pp. 259-93.

Morissette, R. (1993), "Canadian jobs and firm size: do smaller firms pay less?", *Canadian Journal of Economics*, Vol. 26, pp. 159-74.

Appendix 1. Questions pertaining to various organizational changes and workplace practices (2001)

Question 20. Has your workplace experienced any of the following forms of organization change between April 1, 2000 and March 31, 2001? (Organizational change refers to a change in the way in which work is organized within your workplace or between your workplace and others)

(a) Greater integration among different functional areas;

(b) Increases in the degree of centralization;

(c) Downsizing (reducing the number of employees on payroll to reduce expenses; it is part of a reorganization in the workplace and not simply a response to a drop in demand);

(d) Decrease in the degree of centralization;

(e) Greater reliance on temporary workers;

(f) Greater reliance on part-time workers;

(g) Re-engineering (redesigning processes to improve performance and cost);

(h) Increase in overtime hours;

(i) Adoption of flexible working hours;

(j) Reduction in the number of managerial levels (delaying);

(k) Greater reliance on job rotation, multi-skilling;

(l) Implementation of total quality management;

(m) Greater reliance on external suppliers of products/services (outsourcing);

(n) Greater inter-firm collaboration in R&D, production or marketing;

(o) Other, specify.

Question 18. For non-managerial employees, which of the following practices exist on a formal basis in your workplace?

(a) Employee suggestion program;

(b) Flexible job design;

(c) Information sharing with employees;

(d) Problem-solving teams;

(e) Joint labour-management committees;

(f) F) Self-directed work groups.

Appendix 2. Questions pertaining to incidences and number of vacancies and longer-term vacancies

Question 3(a) How are vacant positions usually staffed? For all applicable categories, check only the most frequently used method.

- From within the workplace;
- From another workplace within the same legal company or business enterprise;
- From outside the company.

Question 3(b) At this location, are there any vacant positions that you are currently trying to fill?

Yes

No ... Go to Question 4(a)

Question 3(c) In total, how many vacant positions are currently unfilled at this location?

Question 3(d) Of those, how many positions have remained vacant for four months or longer in the following categories:

(a) Managers;
(b) Professionals;
(c) Technical/trades;
(d) Marketing/sales;
(e) Clerical/administrative;
(f) Production workers with no trade/certification;
(g) Other.

For each group with having vacant positions for four months or longer, identify the reason(s) for the vacancies. (Check all that apply):

- Too few applicants;
- Most applicants lacked educational requirements;
- Most applicants lacked job experience;
- Most applicants declined job offer.

About the author
Tony Fang is Assistant Professor at the School of Administrative Studies, York University, and a research associate at the Centre for Industrial Relations and Human Resources, University of Toronto. He received a PhD in Industrial Relations and Human Resource Management from the University of Toronto (2004) and was an economist with Statistics Canada (2001-2004). His current research areas are labour and skill shortages, compensation and benefits, public and HRM policy, pension, retirement and ageing workforce, labour union, firm growth, and immigration issues. Tony Fang can be contacted at: tonyfang@yorku.ca