Unionization and plant closure in Canada

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Abstract. This paper examines for the first time the role of unionization as a determinant of plant closings in Canada. Using the 1999 to 2001 Canadian Workplace and Employee Survey, the paper contributes to the North American evidence by showing that the share of a plant's workers covered by collective bargaining has a robust positive partial correlation with the probability of larger plants closing. For smaller plants, the extent of unionization tends to be much lower and its variation plays no role in plant closure. The study highlights the theoretical and statistical importance of examining closure separately for large and small plants.

Syndicalisation et fermeture d'usines au Canada. Ce mémoire examine pour la première fois le rôle de la syndicalisation en tant que déterminant de la fermeture d'usines au Canada. A l'aide des résultats de l'Enquête sur le milieu de travail et les employés de 1999 et de 2001 (EMTE), le texte contribue à enrichir le dossier qui montre qu'il y a corrélation positive partielle robuste entre la portion des travailleurs d'usines couverts par une convention collective et la probabilité de fermeture des grandes usines. Pour les plus petites usines, le degré de syndicalisation tend à être plus faible et sa variation ne joue pas de rôle dans le processus de fermeture d'usines. Cette étude montre l'importance théorique et pratique qu'il y a à étudier séparément les fermetures des grandes et des petites usines.

1. Introduction

This paper investigates the relationship between unionization and plant closure in Canada between 1999 and 2001. In both the United States and Canada it

appears clear that unionization reduces the profitability of firms (see, among others, Hirsch 1991; Becker and Olson 1992; Laporta and Jenkins 1996), deters investment (Hirsh 1991; Bronars and Deere 1993; Odgers and Betts 1997; Fallick and Hassett 1999), deters critical research and development investment (Betts, Odgers, and Wilson 2001; Menezes-Filho and Van Reenen 2003) and reduces growth (Long 1993; Bronars and Deere 1993; Dunne and Macpherson 1994). Despite these adverse outcomes, it remains less clear whether or not unionization increases the chance of plant closure and, ultimately, firm failure. In his Canada centred review of unions, Peter Kuhn claims: 'Like successful viruses, unions are smart enough not to kill their hosts' (1998). Freeman and Kleiner (1999) echo this by pointing out that no rational union raises wages high enough to imperil the existence of its employer.

Despite such claims, the influence of unionization on plant closure represents an under-studied variant on the literature examining unions and firm performance. If unions actually have no influence on plant closings, past studies itemizing the decline in profitability may simply indicate rent seeking that does not impair the joint surplus. Alternatively, if unionization is associated with an increased chance of closure, unions may be neither as farsighted nor as rational as some have suggested. Even if rational, unions may simply make mistakes that cannot be changed quickly enough to stop plant closures.[1] Finally, an optimal strategy of union rent extraction may even be associated with eventual closure. Under the latter circumstances, the influence of unionization on plant closure may help to explain the North American decline in unionization.

The possibility that unions increase plant closure probabilities also raises the spectre that the current evidence on unions and firm performance suffers from selection bias. In essence, the performance comparison between existing union and non-union plants reflects a survivor bias by failing to account for the plants that have failed because of the influence of unionization. Accounting for such a bias would increase the performance gap measured by differences in profitability between otherwise equal union and non-union establishments.

This paper is the first to examine the role of unionization as a determinant of plant closings in Canada. Such an examination takes on added immediacy following the international attention given the closing of a Wal-Mart in Jonquiere, Quebec after a successful unionization drive (Krauss 2005). Using the Canadian Workplace and Employees Survey, this study focuses on a two-year period, 1999 to 2001. The estimation examines the influence of plant level unionization rates on the probability of plant closing over this period. A large and strong positive partial correlation emerges, demonstrating that among larger plants higher rates of unionization are associated with a higher probability of closure. This result is robust to the inclusion of increasingly detailed industry controls and to dividing

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1 The possibility of such mistakes comes to mind in the current bankruptcy case of US Airways, which unsuccessfully sought additional concessions from their unions. The company found relief in a bankruptcy court ruling that allowed the firm to unilaterally lower wages by convincing the court that closure was imminent without the concessions (see Maynard 2004).

the sample of large plants in a variety of ways. The absence of a role for unionization in the closure of small plants reveals the importance of examining the determinants of closure separately for large and small establishments.

2. Theoretical considerations

The theoretical literature revolving around the association between unionization and plant closure includes several contradictory themes. While demand curve models of bargaining can be reconciled with a heightened chance of closure (see Lazear 1983), the efficient bargains models do not always follow suit. In the most extreme versions of these models (those with a vertical contract curve), the union bargains over wages but has no real effect on employment or output. Thus, unions play a distributional role, but would not be expected to influence plant closings. However, most efficient bargains models are static, with capital assumed to be fixed. In the long run, union appropriation of quasi-rents from long-lived specific capital may nonetheless reduce investment and threaten the survival of the firm (Grout 1984). Yet Addison and Chilton (1998) present a long-run efficient bargaining model in which investment and growth need not be affected. In the end, efficient long-run bargaining may simply appear inconsistent with the U.S. and Canadian empirical evidence on investment.

Second, the 'collective voice' theme of unionism argues that unions may actually increase productivity of workplaces (Freeman and Medoff 1984). By aggregating over worker preferences, unions help to solve workplace public good problems by allowing employers to adopt a more efficient mix of working conditions and benefits. Unions improve information flows, as secure workers reveal information that improves the production process. Unions help to create long-term employment relationships, reducing costly turnover and encouraging investment in firm-specific capital. As a result, unionized employers may be able to pay higher wages and still compete successfully with non-union employers. While the monopoly face of unionism may reduce firm performance, the ability of unions to enhance efficiency makes an association with plant closures less likely.

Regardless of the influence of collective voice on productivity or the nature of bargaining, the basic contention remains that unions will not imperil their own survival by threatening that of the establishment (Kuhn 1998; Freeman and Kleiner 1999). While initially compelling, this becomes less convincing in a dynamic context. It essentially contends that the monopolist never sets its price high enough to imperil its ability to earn monopoly rents. Yet many models of monopolies derive just such behaviour. The monopolist can set low prices to protect its market power for the future or set a very high price, earning high profits but inviting rapid large-scale entry that dissipates its market power (Gaskins 1971; Milgrom and Roberts 1982). The rate at which the monopolist exploits its power over price depends on weighing the sensitivity of new entry to higher prices and the discount rate, the extent to which the monopolist prefers profits today

compared with profits tomorrow. It need not pay for the monopolist to retain its monopoly power forever.

This discussion is illustrative of the monopoly face of unionism. Higher negotiated wages may well put the establishment at a competitive disadvantage that diminishes the union's ability to extract rents in the future. Yet the optimal pattern of rent extraction may well include this diminution if it is not too great relative to the union's preference for current, as opposed to future, rents. Just as a product monopolist may rationally price itself into a competitive market and eliminate its ability to earn profit, so the union might rationally negotiate away all possibility for future rents, with the closure of the establishment being the end result. Indeed, this process may well happen even more quickly than indicated by dynamic rent maximization, as union members typically do not have full ownership rights to union rents. Membership cannot be transferable upon retirement and so has no equity value. Thus, the median union member has a much stronger desire for current rents as opposed to future rents than does an owner of corporate equity for whom future rents are a capitalized asset (Martin 1980). The result is the 'rationally myopic union,' which Hirsch (1991, 2004) suggests taxes the normal return on long-lived capital, causing reduced investment. This same myopic union may prefer current rents at the cost of an increased chance of future closure.[2] Moreover, when a firm faces multiple unions, each union may extract as much rent as quickly as possible to ensure that other unions do not take the rent. To paraphrase Kuhn, a parasite without property rights over the host has no incentive to ensure survival of the host.[3]

The critical point remains that even a union wishing to retain its market power indefinitely may well make bargaining mistakes, leaving firms vulnerable to unanticipated negative shocks. Thus, the effort to push the firm to the brink may be combined with a negative profit shock that pushes the firm over the brink. Union leaders and members may not always have time to recognize the negative shock, open concession bargaining, reduce premiums, and wait for lower prices to take hold before a plant closure. To the extent such time does not exist, unions might be associated with increased chance of closure. Certainly, airlines in the United States provide an interesting ongoing case study, with major bankruptcies, consolidations and US Airways and others seeking legal intervention to abrogate the bargaining contract in the name of survival.

Finally, beyond the role unions may play in extracting rents from firms, managers may simply prefer to operate without unions. To some extent this may be the

2 Martin (1980) presents evidence on union myopia from the U.S. construction unions in which workers traditionally enjoyed the right to 'transfer' their membership to offspring. Following passage of the anti-discrimination laws in the 1960s, the Department of Labor ended such practices, eliminating a property right and, according to Martin, shortening members' time horizons. The consequence was a 34.1% increase in wages for journeymen-building trade workers between 1968 and 1971, double the increase for union workers in durable goods, and resulting in a decline in the market share of *unionized* construction firms (Martin 1980, 77).

3 For an interesting attempt to actually model trade unions as a biological parasite see Kremer and Olken (2001).

desire to avoid the costs associated with work rules, grievances, co-determination, and the bargaining process. Yet even independent of these costs, managers may simply prefer a free hand to manage without restraint. Unions may be seen both as a failure to manage successfully and as a constraint on the managerial function (Kochan, Katz, and McKersie 1994).[4] This raises the possibility that even if unionization does not render a plant unprofitable, managers may still wish to close it in favour of operating or opening non-union plants that earn higher profit or restore managerial latitude.

As emphasized in the introduction, Canadian and U.S. unions have many of the same influences on performance. Although unionism remains more robust in Canada and labour standards appear higher (Block and Roberts 2000), unions remain associated with reduced performance. At the same time, theory provides somewhat contradictory predictions on the association between unions and plant closure, making apparent the need for empirical testing.

3. The empirical evidence

Eight large econometric studies directly examine unionization as a determinant of plant closings. While this section largely focuses on these studies, it is worth reviewing a couple of points coming from the literatures in industrial economics and regional science.

First, the role of unionization has often been in the background of these other literatures. Bluestone and Harrison (1982) identified the 'runaway shop' (a plant closure motivated by the desire to avoid labour problems) as a feature of industrial change in the United States in the early 1980s. The extent of such closures has been studied by regional economists interested in multi-plant firms that could switch output between plants in response to local differences, including differences in labour relations (Martin, Sunley, and Wills 1996). Indeed, Kirkham, Richbell, and Watts (1999) compared 18 plant closures in Sheffield, England, between 1979 and 1985 with matched plants within the same employer that did not close. Labour relations were significantly worse in the closed plants than in their matched equivalents.[5]

Second, several results emerge from general studies of plant closures that should be incorporated into those studying the role of unionization. Plant closings are more likely in younger and smaller establishments (Reynolds 1988; Dunne, Roberts, and Samuleson 1989; Gibson and Harris 1996). These relationships may reflect a survivor effect in which successful plants are likely both to persist and to grow. As unionized plants are often both larger and older, they might be

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4 Thus, in Australia 90% of managers express a clear preference for dealing with employees directly rather than through a union. (Morehead et al. 1997, 461).

5 Note, however, that a similar methodology used by the authors to explore plant closures in northern England in the 1990s revealed no significant role for labour relations.

anticipated to be less likely to fail; controlling for these well-established results allows a focus on the influence of unionization per se.[6]

Yet beyond these points, smaller establishments may have different determinants of closure. Holmes and Schmitz (1995) stress the greater importance of managerial matches among small, single-plant firms in determining success and survival, while Everett and Watson (1998) demonstrate that small-firm failure rates are much more subject to external risk factors such as changes in interest rates. Chen and Williams (1999) demonstrate that the smaller and younger firms of the high technology sector have a significantly different set of closure determinants than do the larger firms of the low-technology sector. In sum, unionization may have different influences on plant closure among large and small establishments. This possibility informs our testing.

The existing econometric evidence on unions and plant closure comes from four countries, as summarized in table 1. We emphasize the studies from the United States. Dunne and Macpherson (1994) show that sectors in the United States with high union membership did not experience significantly greater employment loss due to plant closings than their less unionized counterparts. Nevertheless, they do show that highly unionized sectors do downsize more and have lower growth rates, other things being equal.

Freeman and Kleiner (1999) undertake a series of investigations. They examine 633 COMPUSTAT business units of which 126 became insolvent (67 firms and 59 terminated business lines) between 1983 and 1990. They show offsetting influences for a union presence dummy and a union density variable. The former is negatively associated with the likelihood of closure, while the latter is positively associated with the likelihood of closure. Across a variety of specifications, closures in the union regime are more likely than in the non-union regime only when density is 60% or greater, a level more than twice the average unionization rate of the sample. In a second investigation, Freeman and Kleiner use data from the Federal Mediation and Conciliation Service to show that the newly unionized firms close no less frequently than other firms. Finally, they also examine displaced workers, showing that the probability that a worker will be displaced by plant closure is not associated with the worker's union status. On the basis of these investigations, Freeman and Kleiner conclude that there is little or no influence of unionization on plant closure.

Two of the three investigations by Freeman and Kleiner have no controls for establishment size. Thus, in the CPS data it is not known whether the worker was displaced from a large or small establishment. Similarly, in the election and FMCS data, the size of the establishment is unknown. As is clear from our earlier discussion, unionization is negatively associated with small firms, the firms most

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6 Interestingly, while the closure of high cost plants might be anticipated, this is not always confirmed (Reynolds 1988; Whinston 1988). As Gibson and Harris (1996, 527) make clear, a multi-plant firm may retain the higher cost plants if it has sufficiently large offsetting benefits. Taking this insight to the role of unions seems critical, as unions seem associated with higher costs and the issue is whether there exist offsetting benefits.

TABLE 1
International evidence on union/representation effects on plant closings

Study	Country	Data	Union/representation variable	Results
Dunne and Macpherson (1994)	USA	Sectoral closure rates from the 1982 and 1987 Census of Manufactures	Sectoral union density form the CPS	Insignificant
Freeman and Kleiner (1999)		Primary analysis uses firms/lines from 1983–90 COMPUSTAT	Unionization dummy and unionization density	Negative coefficient on the dummy and positive coefficient on density with the net effect positive only above a density of 60%
Machin (1995) Stewart (1995)	UK	1984 and 1990 WIRS 1984 and 1990 WIRS	Union recognition Predicted union wage differential	Insignificant Insignificant
Addison, Heywood and Wei (2003)		1990 WIRS and 1998 WERS	Union recognition and union coverage	Positive effect of each measure but driven by a strong results for multi-establishment plants
Bryson (2004)		1990 WIRS and 1998 WERS	Union recognition and various measures of union strength	Generally positive union effects but strongest where unions are weak
Addison, Bellmann and Kolling (2004)	Germany	IAB Panel	Union coverage and presence of works council	Positive effect of works councils not moderated by union coverage
Brown and Heywood (2006)	Australia	1990 AWIRS and 1995 AWIRS	Union coverage, extent of union activity and union climate	Generally positive union effects with the influence being stronger among large plants

NOTE: A positive effect indicates a greater rate of plant closure and a negative effect indicates a smaller rate of plant closure.

likely to close. Failure to account for this may introduce downward bias in the observed role of unionization on plant closure. In the case of observations from COMPUSTAT, the chances of insolvency (which may or may not mean a plant closure) and line closure are not estimated separately for larger and smaller establishments. While size is controlled for, it may be associated with broader differences in the regime of determinants. Indeed, Brown and Heywood (2006) confirm that the influence of unionization on closure is significantly greater among larger establishments than among smaller establishments in their Australian study. We will investigate the role of size in the Canadian data and, in particular, whether the treatment of size alters the estimated role of unionization on closure.

The econometric evidence is growing but contains variations in results across countries and time periods. The two studies from the United States suggest no association between unions and plant closure, with the study by Freeman and Kleiner being the more recent and complete. This conclusion is matched by the two early U.K. studies described in table 1. The two later U.K. studies, the Australian study, and the German study suggest a positive association, but the emphases and institutions being studied obviously vary. It is against this backdrop that we provide the first Canadian evidence.

4. Data and methodology

We draw our data from the 1999 to 2001 Workplace and Employee Survey (WES) conducted by Statistics Canada. The sample of establishments is stratified by region, industry, and size. The WES covers business establishments of all sizes and industries, excluding all levels of public administration and the primary sector.[7] For each establishment, a manager answered the employer questionnaire during a personal interview. A sample of workers selected randomly from a list provided by the establishment answered the employee questionnaire by telephone. The survey response rate was 95% for locations and 83% 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 establishments and for two years with the same workers. In every third wave of the survey, the workplace sample is topped up with longitudinal births and the employee sample is completely refreshed.

Every year after the first, the WES includes detailed codes that identify the operating status of the establishment. These include 'refusal,' 'unable to contact,' 'unable to locate,' 'out of scope,' 'out of business,' and 'receivership.' These are used to construct the dependent variable in our analysis (plant closure). The full set of codes and explanations are provided in table A1. Our dependent variable

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7 The primary sector is crop and animal production, fishing, hunting, and trapping. Public administration includes the federal, provincial and local governments but excludes broad education and health services.

takes the value of one if the establishment went out of business in the second year of a two-year period. Out of the firm status codes, we consider only 'out of business' (60) as a plant closure. 'Seasonal operation' (30) and 'temporarily inactive' (31) meant that the establishment did not operate during the reporting period, but was expected to resume activity in the future. Plants that were 'out of scope' (33) should not have been included in the sample in the first place and so were excluded from our sample. 'Refusal' (40), 'unable to contact' (51), and 'data not available within survey timeframe' (53) occurred when the interviewer had been unable to make contact or obtain valid information with the appropriate respondents, but otherwise the businesses were presumed to be operational. 'Unable to locate' (61) was assigned by the supervisor when the business was believed to exist, but it was not possible to locate the business within the survey timeframe. 'Receivership' (73) is a legal proceeding in which a court appoints a trustee to administer the affairs of a firm unable to meet its debts. The company in receivership can be operating or not operating. However, for the WES, if a company is operating, it is not coded as receivership and the data are collected. If the company is not operating, the unit is coded as receivership. Thus, receivership is the only category that appears questionable as to whether or not it should be identified as a closure. While our estimates assume firms in receivership are not yet closed, the results are virtually unchanged by including receivership as a closure.[8]

The WES gathers information on a wide variety of workplace characteristics and practices from both employers and a small number of employees from each workplace. Employers identify the total number of workers at each establishment and the number of workers at the establishment who are covered by a collective bargaining agreement. Our major independent variable, the unionization rate, is the proportion of workers covered by a collective bargaining agreement among the total employees in the establishment. In addition to information about the standard firm characteristics such as firm age, multiple location status, non-profit status, establishment size, and foreign ownership, the WES also contains information about various human resource practices and business strategies that are believed to affect firm survival and growth. These practices and strategies include compensation practices, the presence of joint labour-management committees, information-sharing programs, use of new technology, flexible management, flexible hours, and flexible employment. Thus, this dataset is well suited to an examination of unionization and other factors that correlate with plant closure probabilities.

The analysis uses pooled data from adjoining two-year panels (1999–2000, and 2000–1). There are 5,358 *smaller* establishments (fewer than 50 workers) and 4,521 *larger* establishments (50 or more workers) that contain valid information for all our main variables of interest in the sum of 1999–2000 and 2000–1 panels. We estimate the impact of unionization on plant closure within these two

8 There are very few establishments – only three – coded as 'receivership.'

sub-samples. Of the *smaller* establishments, 4.9% closed over a one-year period. Only 1.2% of *larger* establishments closed over a one-year period. The overall closure rate of 2.9% per year is slightly higher than a rate of 2.6% per year in the German data (Addison, Bellmann, and Kolling 2004) and a total rate of 11.0% over the longer U.K. panel (Addison, Heywood, and Wei 2003).

The sample split by establishment size was adopted for two main reasons. First, smaller establishments are very unlikely to be unionized. The union coverage rate is about 4% for the sample of smaller establishments but over 30% for larger establishments. Thus, using the combined sample runs the risk that the estimates may reflect unmeasured characteristics associated both with whether or not the establishment is larger or smaller and with unionization. Second, and related to the first point, unionized plants are usually larger and older. The full 'survivor effect' may not be captured when larger unionized firms are compared with smaller non-unionized firms. By comparing the union effect among plants of more nearly similar size and age, the true influence of unionization on plant closures can be better isolated.[9] To identify the consequences of splitting the sample, we return at the end of the estimations to present the influence of unionization in a combined size sample. This presentation confirms the statistical importance of examining small and large plants separately.

Our empirical strategy utilizes the longitudinal data to examine the effect of the unionization rate on plant closure probabilities.

$$\Pr(C_{it} = 1) = f(\alpha \text{URATE}_{it-1} + \beta Z_{it-1} + u_{it}), \tag{1}$$

where $C_{it} = 1$ if plant i closed down in the second year of the two-year period ($t = 2$), 0 otherwise. The variable URATE_{it-1} is the unionization rate of plant i at time $t = 1$. Z_{it-1} is a vector of controls for other observable characteristics and workplace practices for plant i at time $t = 1$, and u_{it} is a residual.

The coefficient α captures the effects of the unionization rate of plant i at time $t = 1$ on firm i's plant closure probability at time $t = 2$. If unionization increases the probability of closure, then the estimates of α will be positive. For each probit estimate we present the marginal effects evaluated at the mean value of the dependent variable. These effects isolate the influence on the probability of closure from a one-unit change in the independent variable.

In addition to the unionization rate, a series of other independent variables (Z_{it-1}) control for differences across establishments. These include whether or not the establishment is part of a multi-plant firm, plant size, industrial controls, a proxy for firm age, foreign ownership, non-profit status, and the workforce composition of the establishment. We also include a particularly wide range of variables designed to control for industrial relations factors. 'Poor IR climate' is measured as managerial ratings of industrial relations climate at firm (1 = good;

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9 It would also be valuable to know the age of the bargaining relationship, as this could be critical for testing theories of myopic unions, but unfortunately, this is not available in the WES.

2 = fair; 3 = poor). Also included are indicators of the use of compulsory redundancy, the use of formal grievance procedure, and various employee involvement schemes such as joint labour-management committees, problem-solving teams, information sharing programs, and performance-related pay schemes such as individual incentive systems and stock option plans. We also incorporate various business strategies and practices believed to affect firm survival and growth, including use of new technology, proportion of computer users, and various flexible work organization systems, such as flexible management and flexible hours. The full set of variables and their descriptive statistics are shown in table 2a and table 2b. The descriptive statistics are for a sample size of 9,879, the set of establishments for which there was no missing data.

5. Results

Table 3 presents an initial parsimonious specification divided by establishment size. This specification includes the unionization rate and a short set of structural characteristics including size, broad occupational controls, whether or not the plant is foreign owned, whether or not the plant is a single establishment firm, and our proxy for establishment age. The results in the first column show that only two significant determinants emerge for the small plants. Among the plants with fewer than 50 workers, the larger plants have a reduced chance of failure. Also, older establishments have a reduced chance of failure. Unionization plays no role. In general, the estimation holds low explanatory power, as indicated by the chi-squared and low pseudo r-squared. These results contrast with those for the large plants shown in the second column. Total employment size retains a negative coefficient but is small and far from statistical significance. Instead, the significant controls include the share of blue-collar workers and whether the plant is foreign owned. Each of these is associated with a greater chance of closure. Most important, the strongest statistical relationship, as measured by the t-tests, is that with the unionization rate. When the rate is higher, the chance of failure is significantly greater. The coefficient indicates that a 10 percentage point (0.10) increase in the unionization rate (far less than the standard deviation in the rate of 0.385) is associated with an increase of 0.0018 or 0.18 percentage points in the closure rate. As the mean closure rate is 1.1 percentage points, this represents about a 16% increase in the closure rate. Such projections indicate that the influence of unionization is of economic as well as statistical significance.

We now augment our parsimonious specification with a series of potential determinants. These include a wide variety of technological and managerial practice variables and regional controls. For both large and small plants, the hypothesis that the additional controls do not improve the fit (likelihood ratio test) can be rejected. The third column of table 3 shows that their addition does not change the irrelevance of unionization in the determinants of closure for small plants. Total employment continues to be a negative determinant, as does our age proxy.

TABLE 2a
Variable descriptions

Name	Description
Dependent variable	
Plant closure	Workplace out of business from 1999 to 2000 or from 2000 to 2001 equals 1; 0 otherwise
Independent variables	
Unionization rate	Proportion of total employees covered by a collective bargaining agreement
Poor industrial relations climate	Ratings of labour-management relations (1 = good; 2 = fair; 3 = poor)
Number employed	Total number of employment at location
Proportion of blue collar workers	Proportion of all workers who are blue collar workers
Proportion of managerial workers	Proportion of all workers who are managers
Establishment age	Years at the same firm location
Single establishment	The workplace is the only one in the organization equals 1; 0 otherwise
Foreign ownership	Owned by foreign interest (as defined by percentage of the assets of this workplace that are held by foreign interests greater than or equal to 51%) equals 1; 0 otherwise
Redundancy	Proportion of number of employees downsized among total employees
Joint committee	Existence of joint labour-management committees on a formal basis in workplace equals 1; 0 otherwise
Quality circle	Existence of problem solving teams on a formal basis in the workplace equals 1; 0 otherwise
Information share	Existence of information sharing with employees on a formal basis in the workplace equals 1; 0 otherwise
Stock ownership plan	Presence of a stock purchase or other savings plan in the workplace to which any employees can belong equals 1; 0 otherwise
Ind. performance pay	Presence of individual incentive systems such as bonuses, piece rate, and commissions in the workplace equals 1; 0 otherwise
Casual	Proportion of all workers that are non-permanent workers
New technology	Introduction of a major new software application and/or hardware installation in the last fiscal year equals 1; 0 otherwise
Formal grievance	Existence of dispute, complaint or grievance systems for employees on a formal basis in the workplace equals 1; 0 otherwise
Flexible management	WQ20: Organizational changes: A, B, G, K, L, M, N
Flexible hours	WQ20: Organizational changes: E, F, H, I
Flexible employment	WQ20: Organizational changes: C, D, J
Non-profit organization	The workplace is a non-profit operation equals 1; 0 otherwise
Proportion of computer users	Proportion of all workers that are computer users
Year 2000	Dummy equals 1 if observation is from 2000
Year 2001	Dummy equals 1 if observation is from 2001

The use of redundancy is positively associated with closure perhaps simply as precursor to eventual failure. The use of employment relations tools shows a mixed pattern, with joint committees being positively associated with closure, but quality circles, information-sharing schemes, and performance pay all being

TABLE 2b
Descriptive statistics by plant size

Variable	Plants with 1–49 workers		Plants with 50+ workers	
	Mean	Std.	Mean	Std.
Plant closure	0.049	0.217	0.012	0.107
Unionization rate	0.041	0.171	0.304	0.385
Number employed	8.3	8.825	182.7	399.502
Single establishment	0.734	0.442	0.116	0.320
Firm age	12.346	13.585	20.244	20.624
Proportion of blue collar workers	0.189	0.320	0.326	0.356
Proportion of managerial workers	0.179	0.226	0.088	0.089
Foreign ownership	0.030	0.170	0.151	0.358
Redundancy	0.033	0.263	0.013	0.336
Joint committee	0.017	0.131	0.170	0.376
Quality circle	0.024	0.154	0.154	0.361
Information share	0.049	0.215	0.225	0.418
Ind. performance pay	0.126	0.332	0.176	0.381
Stock ownership plan	0.048	0.214	0.189	0.391
Formal grievance	0.059	0.235	0.245	0.430
Poor industrial relations	1.100	0.324	1.193	0.414
Causal	0.093	0.228	0.110	0.225
New technology	0.222	0.416	0.357	0.479
Flexible management	0.311	0.463	0.647	0.478
Flexible hours	0.241	0.428	0.377	0.485
Flexible employment	0.123	0.328	0.303	0.459
Proportion of computer users	0.491	0.425	0.469	1.524
Non-profit organization	0.093	0.290	0.168	0.374
Year 2000	0.674	0.469	0.607	0.488
Year 2001	0.326	0.469	0.393	0.488
Observations	5,358	5,358	4,521	4,521

NOTES: Plant closure is measured by the proportion of workplaces that were out of business from 1999 to 2000, and from 2000 to 2001. Also used are dummy variables identifying 6 regions and 14 industries or more detailed 3-digit NAICS codes. Means are available from the authors.

negatively associated with closure. Interestingly, only one of the regional controls emerges as a significant determinant. The pseudo r-squared increased to 0.08 with the additional variables.

The pseudo r-squared for the large-plant estimate in column 4 increases substantially to 0.27 and three of the regional dummies emerge as significant. The importance of the unionization rate is strengthened, with both the coefficient and the t-statistic becoming larger. Redundancy is, again, a positive determinant of closure, but the employment relations tools show less influence, and those that emerge as important are not the same as among the small plants. The increasing use of casual workers emerges as a significant negative determinant. This could follow if the greater use of casual (contingent) workers provides flexibility and reduces cost and thus reduces the chance of closure. Interestingly, the use of a formal grievance system also reduces the chance of closure. It may be that such a

TABLE 3
Probit estimates of the probability of closure

	1 Small plants	2 Large plants	3 Small plants	4 Large plants	5 Small plants	6 Large plants
Constant	−0.130**	−0.076**	−0.124**	−0.068**	−0.151**	−0.058**
	(−6.61)	(−11.75)	(−3.47)	(−5.67)	(−3.45)	(−3.05)
Unionization rate	0.004	0.018**	0.011	0.026**	0.017	0.029**
	(0.13)	(2.51)	(0.31)	(3.11)	(0.44)	(3.75)
Number employed[†]	−0.016**	−0.0001	−.0186**	−0.00005	−0.0184**	−0.00002
	(−2.19)	(−0.69)	(−2.29)	(−0.69)	(−2.26)	(−0.39)
Single	−0.023	0.002	−0.025	−0.002	−0.021	−0.006
	(−1.49)	(0.22)	(−1.53)	(−0.27)	(−1.26)	(−0.67)
Firm age[†]	−0.0084*	−0.0015	−.0099**	−0.0021	−0.0099**	−0.0029
	(−1.77)	(−0.68)	(−2.11)	(−0.96)	(−2.07)	(−1.30)
Proportion blue collar	0.017	0.011*	0.008	0.012	0.006	0.004
	(0.98)	(1.77)	(0.40)	(1.32)	(0.30)	(0.50)
Proportion management	−0.023	−0.047	−0.030	−0.068*	−0.038	−0.060
	(−0.49)	(−1.42)	(−0.75)	(−1.96)	(−0.95)	(−1.32)
Foreign ownership	−0.017	0.010*	−0.020	0.009*	−0.012	0.005
	(−0.62)	(1.64)	(−0.63)	(1.69)	(−0.38)	(0.91)
Redundancy			0.017*	0.004**	0.017*	0.005**
			(1.65)	(2.69)	(1.70)	(2.89)
Joint committee			0.081**	−0.006	0.089**	−0.003
			(1.99)	(−0.58)	(2.16)	(−0.38)
Quality circle			−0.178**	−0.017	−0.172**	−0.012
			(−3.71)	(−1.40)	(−3.44)	(−0.98)
Information share			−0.045*	−0.011	−0.052**	−0.014
			(−1.84)	(−0.78)	(−2.03)	(−0.92)
Ind. performance pay			−0.060**	−0.026	−0.062**	−0.027
			(−2.95)	(−1.46)	(−2.95)	(−1.51)
Stock ownership plan			0.034	0.007	0.039	0.005
			(1.40)	(0.83)	(1.56)	(0.67)
Formal grievance			−0.064	−0.037**	−0.068	−0.039**
			(−1.57)	(−4.06)	(−1.62)	(−4.05)
Poor industrial relations			0.018	0.000	0.018	−0.005
			(1.01)	(0.07)	(0.99)	(−0.83)
Casual			−0.028	−0.045**	−0.028	−0.031**
			(−1.03)	(−2.27)	(−1.00)	(−1.97)
New technology			−0.002	−0.008	−0.002	−0.011**
			(−0.10)	(−1.34)	(−0.10)	(−2.08)
Flexible management			0.021	−0.002	0.022	−0.002
			(1.29)	(−0.35)	(1.39)	(−0.31)
Flexible hours			−0.013	−0.000	−0.013	−0.001
			(−0.88)	(−0.05)	(−0.86)	(−0.20)
Flexible employment			0.027	0.007	0.028*	0.010*
			(1.60)	(1.19)	(1.64)	(1.84)
Computer users			−0.030*	−0.001	−0.023	−0.006
			(−1.71)	(−0.27)	(−1.36)	(−0.65)
Non-profit organization			−0.026	0.002	−0.018	0.022
			(−1.39)	(0.15)	(−0.92)	(1.55)

Continued

TABLE 3 (*Concluded*)

	1 Small plants	2 Large plants	3 Small plants	4 Large plants	5 Small plants	6 Large plants
Regional dummies	No	No	Yes	Yes	Yes	Yes
2-digit industrial dummies	No	No	No	No	Yes	Yes
Chi-squared	9.64	17.88**	89.11**	85.78**	93.75**	194.20**
Pseudo r-squared	.016	.070	.077	.268	0.086	0.343
Added controls are significant at 5% level			Yes	Yes	No	Yes
N	5358	4521	5358	4521	5358	4521

NOTES: Asymptotic t-statistics are in parentheses. All estimates are marginal effects and use the sample weights.
*significant at 10%
**significant at 5 %
†The variables 'number employed' and 'firm age' are rescaled to provide no zero estimates (number of workers employed/10 and firm age in years/10).

system improves employment relations, morale and so efficiency. The coefficient is approximately the same size and of the opposite sign as that on the union variable, a point that we will consider in more detail. Poor industrial relations play no role in closure in either the small or the large establishment estimates. This is at variance with the Australian evidence suggesting that a poor industrial relations climate plays an independent role in closure.

We recognize that unionization may itself influence some of the added controls in columns 3 and 4. As an illustration, if formal grievance systems are synonymous with high rates of unionization, the total influence of unionization may vanish as the coefficients on unionization and grievance systems offset each other. We undertook a variety of examinations to determine to what extent this was the case. First, we note that, while highly associated, formal grievance systems and unions are not synonymous. The mean unionization rate is 0.222 for large establishments without grievance systems and 0.515 percent for large establishments with grievance systems. Moreover, there remains substantial variation in the extent of unions independent of the presence of grievance systems. The standard deviation in unionization is 0.353 for large establishments without grievance systems and is a nearly identical 0.384 for large establishments with grievance systems. Second, we augmented the estimations in table 3 by adding an interaction of unionization and the presence of a grievance system. The coefficient on the interaction is not significant and does not diminish the role of unionization in the large-establishment estimation. Finally, we re-estimated the first two columns of table 3, dividing the samples into those with and without grievance systems. Unionization emerged as a statistically significant positive determinant in both estimations (available from the authors).

This examination of grievance systems might be part of a more general problem that part of the influence of unionization is its indirect effect on other important

variables. Three variables that are likely suspects for such indirect effects are formal grievance systems, poor industrial relations climate, and redundancy. Thus, we know that each of these variables has a positive correlation with unionization and that, theoretically, unionization may help determine the values of these variables. The total of the direct and indirect effect of unionization includes its influence through these variables. When we remove these three variables from the estimation in column 4 of table 3, the marginal effect decreases only slightly from 0.0026 to 0.0023, suggesting that the indirect effect is minimal. Indeed, repeating this exercise for the other estimations in the paper results in similarly small changes in the marginal effects. Thus, there seems to exist only a small role for the indirect effects of unionization through these three variables.

We next undertook two sets of estimates designed to add industrial controls to the specifications. Many influences on the chance of closure may be industry specific, including demand shocks, the rise of low price imports, or increasing input costs. Controlling for industry becomes crucial if unionization is concentrated in particular industries that, independent of any union influence, have establishments that are more likely to close because of these influences. The first set of estimates adds 13 industry dummies and is presented in columns 5 and 6 of table 3. While the hypothesis that the industrial controls add nothing to the estimation can be rejected for the sample of large plants, it cannot be rejected for the sample of small plants. Thus, the primary changes are in the large-plant sample. For instance, the presence of new technology becomes a negative determinant of closure among large establishments and several regional controls lose significance. Nonetheless, most of the controls retain similar coefficients and the overall pattern remains very similar. Importantly, the role of unionization remains largely unchanged by the additional controls. Indeed, if anything, there may be a slight increase in the size of the marginal effect.

Table 4 is associated with adding the full set of 3-digit industrial controls. Many of the 3-digit industries have few enough observations that no closures are observed. This absence of variation in the dependent variable causes the observations associated with such industries to be dropped. Nonetheless, the vast majority of the sample remains and 69 3-digit controls do have variation in the dependent variable and so enter the estimations. As the lost observations are those in industries that had no plant closures, the mean value of the dependent variable in the remaining sample increases. The closure rate among the remaining small plants is 0.056 and among large plants is 0.020. The unionization rates remains largely unchanged in the remaining sample: 0.044 for small plants and 0.289 for large plants. The resulting estimations identify the influence of unionization on closure for the sample of establishments that had at least one closure within their three-digit industry.

The estimation proceeds in two steps. The first step limits the sample to those establishments in 3-digit industries with at least one closure but continues to use only the broader industrial controls. The second step uses the sample identified

TABLE 4
Adding detailed industrial controls to the probit estimates of plant closure

	1 Small plants	2 Large plants	3 Small plants	4 Large plants
Constant	−0.146**	−0.104**	−0.176**	−0.360**
	(−3.05)	(−4.34)	(−3.38)	(−6.14)
Unionization rate	0.010	0.061**	0.020	0.079**
	(0.24)	(4.34)	(0.51)	(5.05)
Regional dummies	Yes	Yes	Yes	Yes
Industrial controls	2-digit	2-digit	3-digit	3-digit
Chi-squared	85.01**	138.17**	235.80***	220.23**
Pseudo r-squared	0.099	0.349	0.155	0.4260
Added controls are significant at 5% level			Yes	Yes
N	4942	2877	4942	2877

NOTES: All estimations include the full set of explanatory variables, as shown in columns 3 and 4 of table 3. Asymptotic t-statistics are in parentheses. All estimates are marginal effects and use the sample weights.
*significant at 10%
**significant at 5%

in the first step but replaces the broader industrial controls with the narrower 3-digit controls. The results for the first step are presented in the columns 1 and 2 of table 4. Despite the change in sample, there remains no role for unionization among the smaller plants. Among the larger plants, the marginal effect for unionization continues to be positive and significant. Indeed, it is substantially larger than that in the final column of table 3, which has an identical specification but the larger sample. The marginal effect from the probit is evaluated at the mean level of the dependent variable and is the product of the estimated coefficient on unionization times the mean closure rate. The larger marginal effect reflects, in part, the fact that closure is more likely in this smaller sample.

Columns 3 and 4 present the second step of controlling for the detailed industries. The hypothesis that the extra detail adds nothing can be rejected for both sub-samples. In the large-establishment estimation approximately 30 industry controls have statistically significant coefficients. Despite the addition of these controls, the basic portrayal does not change. There is no role for unions among the small establishments. Among the large establishments, the extent of unionization remains a significant positive determinant of the chance of closure. Indeed, controlling for detailed industry serves to further increase the marginal effect of unionization. This influence of detailed industrial controls mimics the U.K. results of Addison, Heywood, and Wei (2003, 831) that finer industrial controls actually increase the estimated effect of unionization. In total, the estimations using the 3-digit controls convince us that the significant positive

TABLE 5
Combining both plant sizes in probit estimates of closure

	1	2	3	4
Constant	−0.145**	−0.159**	−0.161**	−0.189**
	(−8.07)	(−11.99)	(−3.76)	(−3.75)
Unionization rate	0.003	0.017	0.018*	0.020
	(0.15)	(0.54)	(1.74)	(0.62)
Full set of control variables	No	Yes	Yes	Yes
Regional dummies	No	Yes	Yes	Yes
Industrial controls	No	No	2-digit	3-digit
Chi-squared	14.46**	117.45**	217.30***	275.04**
Pseudo r-squared	0.014	0.083	0.093	0.1488
Hypothesis that the combined estimate fits the data as well as the separate estimates by size+	Reject	Reject	Reject	Reject
N	9879	9879	9879	7819

NOTES: Asymptotic t-statistics are in parentheses. All estimates are marginal effects and use the sample weights.
*significant at 10%
**significant at 5%
+The test statistic is the sum of the chi-squared for the separated samples minus the chi-squared for the combined sample and is distributed chi-squared itself. The degrees of freedom equal the number of restricted coefficients, the explanatory variables in any single estimation. All tests are at the 5% level of significance.

coefficient on the unionization variable does not reflect omitted industry specific effects.[10]

Recall that our sample put together two years of closure data in order to examine the probability of closure. All of the estimates have been redone to include a dummy for the year in which the plant was initially observed. This dummy usually, but not always, indicates that there were significantly more closures in the second year. Yet the inclusion of this dummy alters none of the critical results and certainly does not change the portrayal of the role of unionization at all. Indeed, despite many attempts to dislodge the association, the positive statistical relationship between closure and unionization among large plants, remains.[11]

We now return to the decision to separate the estimations by plant size. To examine the consequences we re-estimated the series of four probits with the

10 An alternative approach to including additional industrial detail is to combine 3-digit industries without any closures into adjoining industries that do have closure. This creates a degree of detail somewhat less narrow than 3-digit and, we stress, there is no single appropriate way in which to make such a combination. We undertook one experiment making such a combination that allowed us to retain the original 9,879 observations. The coefficient for unionization remained insignificant in the small plant sample but significant at the 1% level in the large plant sample and with a marginal effect of 0.037.
11 We replaced the union variable with the log of the unionization rate and experimented with adding a squared term; we found no evidence of non-linearity in the influence of the union variable.

combined sample of both plant sizes. We continued to use the weights provided by the WES. The results are striking. In three of the four estimations, including that with the greatest set of controls, there is no evidence of a union influence on plant closure. In the one estimation that provides evidence, the coefficient is significant at only the 10% level and is smaller than that seen in the large-plant sample alone. Moreover, comparisons of the summary statistics between the split sample estimations and the combined sample estimations (again, a likelihood ratio test) reject the hypothesis that the combined sample estimations fit the data as well. Finally, if we remove the weights, inflating the importance of the large plants, three of the four estimates show a weak (significant at the 10% level) role for unionization in determining plant closure.

Thus, both the theoretical and statistical rationales for separately examining small and large plants seem strong. Moreover, the failure to do so leads to the inappropriate result that unionization has little or no influence on closure. Such a demonstration argues that any future work on closure determinants should test for the interaction of unionization and plant size.

6. Conclusions

Studies using evidence from other industrial democracies question whether or not trade unions influence plant closures. The evidence is mixed, with the question being answered differently depending on the country and the time of analysis. We examine this issue in Canada, arguing that its system of industrial relations is sufficiently similar to that of the United States to inform North American enquiry.

Using the WES, we identify from the 1999 to 2001 waves those establishments that survive and those that close. We use extent of unionization within the establishment and a large list of establishment features as explanatory variables in estimation of the probability of establishment closure. Many controls behave as anticipated and as they have in other studies. Thus, plant size and single-plant status (not being part of a multi-plant firm) are often associated with a reduced probability of closure, while management activities associated with increased flexibility and reduced cost often reduce the probability of closure.

In a series of ever more complete specifications, a clear pattern emerges. Unionization plays no role in the determination of closure among smaller establishments. Yet unionization is routinely associated with a higher chance of closure among larger establishments. Moreover, these coefficients suggest a large economic influence. Yet, our combined sample of both large and small plants reveals little role for unions. Small plants have low levels of unionization and high failure rates and the statistical tests confirm that they should be examined separately.

Several caveats are in order. First, despite our best attempts, it remains possible that omitted variables could be driving both the union measures and closure probability. Thus, establishments most likely to close in any event may also have

high values of the union measures. While we cannot rule this out, we emphasize the many controls including firm size, age, occupational mix, and detailed industrial controls. Second, we cannot fully distinguish between two alternative interpretations of the results. On the one hand, the results might show that firms with unions are simply more likely to close, and we are picking that up with the establishment data. On the other hand, it might be the case that firms remain open but choose to close heavily unionized establishments in an effort to reduce the role of unions within the firm. Certainly, the finding that single plants are less likely to close provides oblique support for the latter view, but as the data do not allow us to link establishments to firms, it remains an open question.

TABLE A1
Firm status codes and explanations

Codes	Definitions
Complete (10)	Assigned by the system when all the relational edits have been resolved
Combined (11)	Assigned by the supervisor when the data has not been reported for this unit because it has been reported as part of a "combined report" for another unit.
Partial (20)	Assigned by the interviewer when some data has been supplied, however, information is missing and it is not expected that this information will be provided.
Seasonal operation (30)	Assigned by the interviewer when there were no paid employees or employees on paid leave during the last pay period of March of the reference year because the company is a seasonal operation that does not operate at this time.
Temporarily inactive (31)	Assigned by the interviewer when the company did not operate during the reporting period, but expects to resume activity in the future.
Out of scope – no employees (33)	Assigned by the interviewer if the company has no employees for which the employer must complete a T4.
Refusal (40)	Assigned by the supervisor when the respondent expressly refuses to supply any data for the survey.
Unable to contact (51)	Assigned by the supervisor when the interviewer is unable to contact anyone who can provide the required survey data by the deadline.
Data not available within survey timeframe (53)	Assigned by the interviewer when some sections of the questionnaire have not been completed and the data is not available within the survey timeframe.
Out of business (60)	Assigned by the supervisor when a business becomes permanently inactive. This occurs when the owner(s) has(have) liquidated all of the assets of the business.
Unable to locate (61)	Assigned by the supervisor when the business is believed to exist, but it is not possible to locate the business within the survey timeframe.
Void (duplicate) (70)	Assigned by the interviewer if a unit is a duplicate record, a dormant, shell or paper company.
Out of scope – nature of business activity (71)	Assigned by the interviewer if the main business activity in all levels of public administration or primary sector.
Receivership (73)	Receivership is a legal proceeding involving the appointment, by the court of a trustee to administer the affairs of a person or firm unable to meet its debts as they mature.

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