

Optimal Contract Design in the Wild: Rigidity and Control in Collective Bargaining

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Abstract

We document determinants of incompleteness, rigidity, and delegation in union contracts using a new corpus of 30,000 collective bargaining agreements from Canada from 1986 through 2015. Using ideas and methods from computational linguistics, we extract measures of rigidity and worker control from the text of the contract clauses. We then analyze how rigidity and authority in contracts varies according to firm-level factors and external factors. We document that contracts impose obligations equally on firms and workers but give entitlements mostly to workers. Worker entitlements have increased as a share of contract clauses over the last forty years. An increase in personal income tax rates is associated with an increase in worker entitlements, consistent with a substitution effect away from taxed compensation (income) and toward untaxed compensation (amenities). Control of province government by the labor-supporting New Democratic Party is associated with higher worker authority, consistent with higher

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bargaining power for workers due to political support. We further document a role for contracts as reference points as proposed by Hart and Moore (2008): negative wage shocks due to low COLA adjustments mis-predicting inflation are associated with higher strike rates and strike intensity, consistent with conflict due to frustrated worker expectations relative to a reference point. However, this wage-strike effect is attenuated by contracts with higher worker authority, consistent with a better-managed relationship.

1 Introduction

Economics has produced an extensive body of theory of optimal contract design, where issues such as endogenous contractual incompleteness are considered as the outcome of optimal delegation and rigidity in contracts. These theories generate predictions about quantitative features of contracts. Lawyers, however, traffic in real-world contracts, which are extensive bodies of text, themselves governed by statute (also text) and judicial precedent (again, text). In this paper, we use a large corpus of contracts produced by the relatively homogeneous environment of Canadian collective bargaining to a) use tools from computational linguistics to operationalize ideas from the economic theory of contracts, specifically the degree of specified contingency, the degree of rigidity, and the extent of agent delegation, and b) examine economic and determinants of these contractual features.

Our innovation on this literature is a data-driven analysis of contract language, with the goal of empirically operationalizing long-standing theoretical notions of control rights. We extend natural language processing techniques to extract the contractual obligations to workers and restrictions on managerial prerogatives embedded in union contracts. We unpack the details of “what unions do” by analyzing the text of collective bargaining agreements. The goal is to provide field evidence of some of the predictions of recent models of optimal contract design (Battigalli and Maggi, 2002; Hart and Moore, 2007)

Our empirical setting is nearly all collective bargaining agreements in Canada for the years 1986 through 2015. We use natural language processing tools to extract norms, commitments, and entitlements from the text of contracts. We document that contracts can be understood as bundles of obligations and entitlements. We see about the same number of obligations on employers and employees. For entitlements, almost all of them are granted to workers. Over time, as contracts have become more detailed, we

see an increased number of obligations on both parties. But more strikingly, while the number of firm entitlements has remained constant, the number of worker entitlements in contracts has increased over time.

We link the contracts data to economic and institutional variables such as employment, strikes, political control, NAFTA, and changes to federal and provincial labor laws. Since we have a time series of contracts for each firm, we can explore the relationship between changes in economic and political conditions and changes in the terms of the contract.

First we look at a change in the relative prices between wage compensation and non-wage compensation. We find that an increase in personal income tax rates is associated with an increase in worker entitlements. This is consistent with a substitution effect away from taxed compensation (income) and toward untaxed compensation (amenities).

Second, we look at a change in relative bargaining power of employers and employees. Control of province government by the labor-supporting New Democratic Party is associated with higher worker authority. This is consistent with higher bargaining power for workers due to political support.

Third, we look at the role of worker control in mitigating conflict. We find that negative wage shocks are associated with higher strike rates and intensity, consistent with recent empirical work on union conflict (Mas, 2008) and recent theoretical work on contracts as reference points (Hart and Moore, 2007). In response to a wage that is exogenously beneath the reference point, workers go on strike. But those effects are attenuated by higher worker authority, consistent with reduced conflict in a more well-managed relationship.

The findings attest to the important role of collective bargaining in the labor market. Economic and political conditions have an impact on the text-based measures of worker authority. That authority matters for firm outcomes. Future work in labor economics would benefit from integrating these text-based measures of the granular details of union contracts.

This research adds to a large literature arguing that unions were an important force in compressing the wage (and income) distribution in the twentieth century (DiNardo et al., 1996; Card, 2001). For example, Jaumotte and Osorio (2015) show that union density reduces top income shares in a panel of OECD country-years, instrumenting union density with presence of the Ghent system interacted with past employment

(building on Western, 1999). In ongoing, parallel work Farber, Herbst, Kuziemko, and Naidu (2017) find a similar effect of union density on top income shares across U.S. states, using new micro-data on unions extracted from historical polling data.. More generally, a large amount of recent research has suggested that rent-sharing within the firm is an important component of the wage distribution (Card et al., 2016). Unionization may also be related to historical socioeconomic disparities related to race and gender (Blau and Beller, 1988); indeed, Farber et al. (2017) find that nonwhite workers are more likely to be union members and enjoy larger union premia than comparable white workers.

This previous work invites investigation into how unions managed to capture those rents. What trade-offs were made – in terms of workplace amenities, firm-specific human capital, and worker autonomy? Even though each day, parties enter into countless contracts, very little is known regarding the economic effects of contract design. What is the trade-off that union-firm bargaining pairs make in determining “voice” (Freeman and Medoff, 1984), workplace public goods and amenities, and wage changes? Workplace authority and amenities, such as scheduling, job security, training, and seniority, are embedded in contractual language. By treating each firm as a jurisdiction, and each contract as a workplace constitution, we obtain fine, granular evidence that the “rules of the game” matter for economic outcomes. Even in an era of weakening unions, the lessons from these contracts will help policymakers design labor-market rules to govern workplace amenities, rent-sharing, and control rights within the firm.

The rest of this paper is organized as follows. Section 2 reviews the relevant literature. Section 3 describes the metadata, while Section 4 describes the text data and methods. Section 5 describes the econometric approach. Section 6 reports the results. Section 7 concludes.

2 Literature Background

There is an extensive, abstract theory of contract design in economics. Kornhauser and MacLeod (2012) provide a review of the economics literature on contract writing. Battigalli and Maggi (2002) model contracts “from the ground up,” as a set of statements mapping events to actions. Writing contract statements is costly, so incompleteness arises endogenously. Discretion is the case where an action is not described, so the agent chooses what to do. Rigidity is the case where an action is always performed,

regardless of the event. Battigalli and Maggi (2008) extend this model to multiple periods. Other theory papers on costly contract writing include ?, Schwartz and Watson (2004), and Shavell (2006).

The modern theory of union contracts, building on the work of Grossman and Hart (1986), recognizes that an important function of labor institutions and contracts is the efficient allocation of authority and decision rights within a relationship. Most economists agree that labor law and labor unions affect the relative bargaining power of workers (Svejnar, 1986; Abowd and Lemieux, 1993), but the standard model sees them as merely redistributing rents. On this view, any allocation of bargaining power that results in prices diverging from competitive levels is inherently inefficient. In contrast, the modern contract literature views authority as an instrument for mitigating transaction costs due to asymmetric information and holdup. Because transaction costs are significant, labor protections and labor unions may enhance productive efficiency (Freeman and Medoff, 1984). In a similar vein, collective bargaining by a union can mitigate problems related to employer monopsony power (Manning, 2010). The hysteresis in contract terms documented in Card (1986a) suggests that observed union contracts cannot be viewed as achieving the first best, and hence transaction costs are a necessary ingredient for understanding the observed structure of negotiated employment contracts.

There is a large older literature on unions in labor economics. The empirical literature on unions asks whether unionization of a workforce affects productive efficiency or firm profits. Two recent meta-analyses using a large number of union studies conclude that while unions enhance firm productivity (Doucouliagos and Laroche, 2003), they also reduce firm profits (Doucouliagos and Laroche, 2009). But the evidence is mixed and the effects of unions seem to be sensitive to context. Abowd (1989), among others, shows that an unexpected increase in union wages results in a dollar-for-dollar transfer from shareholders to workers, with little evidence of net loss or net gain. DiNardo and Lee (2004) use union certification elections as an instrument for unionization in a regression discontinuity design (RDD), finding no local average treatment effects on firm stock price of being unionized. Lee and Mas (2012) replicate the zero LATE of unionization at the RD cutoff, but also find a large negative average treatment effect on firm equity value using *diffs-in-diffs*. The decrease in value is delayed, however, occurring over the 18 months following the unionization vote. A relevant detail from Jordan and Bruno (2005) is that only 57 percent of new bargaining units achieve a

first contract within a year, and only 70 percent achieve a first contract at all. Unions with weak support – that is, near the RD cutoff – may be less likely to achieve a contract. Card et al. (2014) provide evidence that increasing profits are shared with union workers, although the sharing does not significantly reduce the return on capital.

Holmes (1998) finds that manufacturing companies located near U.S. state borders will locate factories in the state with Right-to-Work laws, consistent with firms responding to the negative effect of unions on profits. Similarly, the large decline in unionization since 1970 is consistent with the hypothesis of excessive rent extraction by unions, with firms subsequently turning to nonunion alternative investments (Farber and Western, 2001). Machin (2000) documents a similar trend in the United Kingdom.

In Canada, unions have declined much more slowly than in the United States (Kuhn, 1998). This again suggests that the fitness of unionization is sensitive to institutional and economic context. Abowd and Lemieux (1993) analyze the impacts of trade shocks on union wage provisions in Canada. Budd and Wang (2004) analyze the effects of strikes on investment.

MacLeod (2011) discusses the literature on labor unions as part of a broader review of employment contracts. There are a few papers showing that labor/employment contracts matter for firm and work outcomes (e.g., Card and De La Rica, 2006; Garloff and Guertzgen, 2012); these papers focus on wage provisions, although Freeman and Kleiner (1990) argue that unionization affects non-wage employment conditions more than it affects wages. Research that focuses on hand-coded features of union contracts includes Juravich et al. (2006) and Strunk and Grissom (2010). Empirical work on contract terms in other contexts include Masten and Crocker (1985), Joskow (1987), Leffler and Rucker (1991), Allen and Lueck (1992), Akerberg and Botticini (2002), Gulati and Scott (2012), and Matvos (2013).

Most recently, empirical researchers have begun to apply computational techniques from natural language processing to the text of written contracts (Talley and O’Kane, 2012; Sanga, 2014; Moszoro et al., 2016; Ganglmair and Wardlaw, 2017). This is part of a growing area of empirical research using text data by economists and other social scientists (Gentzkow and Shapiro, 2010; Roberts et al., 2013; Taddy, 2013; Ash, 2016; Ash et al., 2017b,a). Gentzkow et al. (2017) provide a recent survey of this literature.

Besides these papers in economics, there is a large literature in labor and legal history, sociology, and political science concerned with the interaction of labor laws and labor contracts. Stepan-Norris and Zeitlin (2003) argue that certain contract

provisions, such as strong stewards, were a key distinctive demand of particularly politicized unions in the post-war period. McCammon (1990) and Pope (2004), among others, have argued that court interpretations of the Wagner Act have been decisive in weakening the strike provisions in contracts.

3 Theoretical Framework

We begin with a simple framework to capture the correlations between contract length, worker authority, and wages. There are two agents, an owner and a worker.

The owner chooses a contract. First it specifies the wage w . It also specifies a set of contract clauses assigning entitlements to the worker (i.e. the set of actions that the worker chooses rather than the firm). There is a mass N of choices, indexed by i . These are ordered by value to the firm, $\pi(i)$, of the firm choosing the action, where $\pi' > 0$. The size of the choice set N might vary with technology and/or the complexity of the firm. In our empirical analysis we proxy for N with firm size.

The worker chooses whether to accept the contract. Worker utility from acceptance is $(1 - \tau)w - \delta \int v(i)di$, where τ is a tax on labor income (assumed exogenous) and $v(i)$ is the cost to the worker when the firm chooses action i . For simplicity we assume that worker utility decreases as firm profits $\pi(\cdot)$ increase, so $v' > 0$. The parameter δ weights the loss in utility when the firm makes those choice at i rather than the worker choosing i . It is a measure of the degree of “conflict of interest.” Finally, workers have an outside option utility \bar{U} from rejecting the contract. This could be affected by economic conditions or government policies.

The owner’s problem is to choose a wage w , and a threshold for number of clauses \bar{i} , to maximize profits

$$\max_{w, \bar{i}} \int_{\bar{i}}^N \pi(i)di - w$$

subject to the worker’s participation constraint $(1 - \tau)w - \delta \int_{\bar{i}}^N v(i)di \geq \bar{U}$.

Let w^* and i^* represent the optimal choices for w and \bar{i} respectively. At the optimum, we have $\pi(i^*) - \delta v(i^*) = 0$. The wage will satisfy

$$(1 - \tau)w^* - \delta \int_{i^*}^N v(i)di = \bar{U}.$$

The length of the contract, given by i^* , will largely reflect worker control. Simple

Table 1: Summary Tabulations for Contracts Metadata

Province	Freq.	Percent	Industry Group	Freq.	Percent
Alberta	3,541	11.87	Construction	1,645	5.51
British Columbia	3,693	12.38	Educational/health	10,148	34.01
Manitoba	1,658	5.56	Entertainment	782	2.62
Multiprovince	1,461	4.90	Finance / Real estate	829	2.78
New Brunswick	789	2.64	Information / culture	1,216	4.07
Newfoundland / Labrador	552	1.85	Manufacturing	4,979	16.69
Northwest Territories	424	1.42	Primary industries	459	1.54
Nova Scotia	1,140	3.82	Public admin	3,731	12.50
Nunavut	171	0.57	Transportation	4,696	15.74
Ontario	14,414	48.30	Utilities	533	1.79
Prince Edward Island	147	0.49	Wholesale / retail	823	2.76
Quebec	490	1.64	Total	29,841	100.00
Saskatchewan	1,165	3.90			
Yukon Territory	196	0.66			
Total	29,841	100.00			

comparative statics imply

$$\frac{di^*}{dw} < 0$$

$$\frac{di^*}{d\tau} > 0$$

$$\frac{di^*}{dN} > 0$$

$$\frac{di^*}{d\bar{U}} > 0$$

In words, we have that contract length and worker control will decrease with the wage, increase with taxes, increase with firm size, and increase with worker outside options. These predictions will help organize our empirical analysis.

4 Metadata

Our data source for Canadian contracts is Employment and Social Development Canada, from which we obtained 28,848 contracts in the English language for the years 1986 through 2015. This section describes the metadata (that is, non-text numerical data) used in the analysis.

Our data on union contracts is more comprehensive than that used in the previous literature. There are 29,848 contracts, 6,004 companies (~5 contracts per company),

Table 2: Summary Statistics for Contracts Metadata

Variable	Mean	Std. Dev.	Min	Max
Private-Sector	.4860	.499	0	1
Number of Employees	655.87	2721.	0	170000
Effective Year	1999.79	7.89	1986	2015
Duration (Years)	2.584	1.1	0	20
Has COLA	.2731	.445	0	1
Annual Wage Increase (%)	2.61	1.843	-7.560	19.836
Inflation (%)	5.77	3.347	-.8643	31.62
Negative Shock	.362	.4807	0	1

14 provinces, 794 cities, 11 industry groupings, and 551 industry codes. Table 1 reports summary tabulations for the provinces and industry groups. Quebec has relatively few contracts in our sample because most of them are in French.

For each contract, we have the company, union, location, industry, public/private status, and number of employees. We have a set of related dates (signing, effective, and expiry), which allows us to compute contract duration, and match up to short-term changes in economic and political conditions.

For some contracts, we have a wage-adjustment schedule, which gives the planned wage increases over the course of the contract. We matched this data with realized inflation over the course of the contract, with the idea that a COLA clause wage increase, minus the realized inflation, results in an unanticipated real wage shock at the start of bargaining over the subsequent contract (Card, 1986b). In our results we focus on “Negative Shock,” an indicator equaling one when inflation beats the COLA.

Table 2 provides summary statistics on these variables. Figure 1 provides histograms for a selection of the real-valued variables. About half of the firms are in the private sector. The number of employees is widely dispersed. There is significant variation in contract duration, with bunching at 12-month increments. A good number of firms have COLA clauses, with meaningful variation in the gap between COLA and inflation.

Our second data set from Employment and Social Development Canada is the history of strikes among Canadian unions since 1945. We have data on 28,471 strike events, for 22,163 companies. Summary statistics are reported in Table 3. These are

Figure 1: Summary Figures for Contracts Metadata

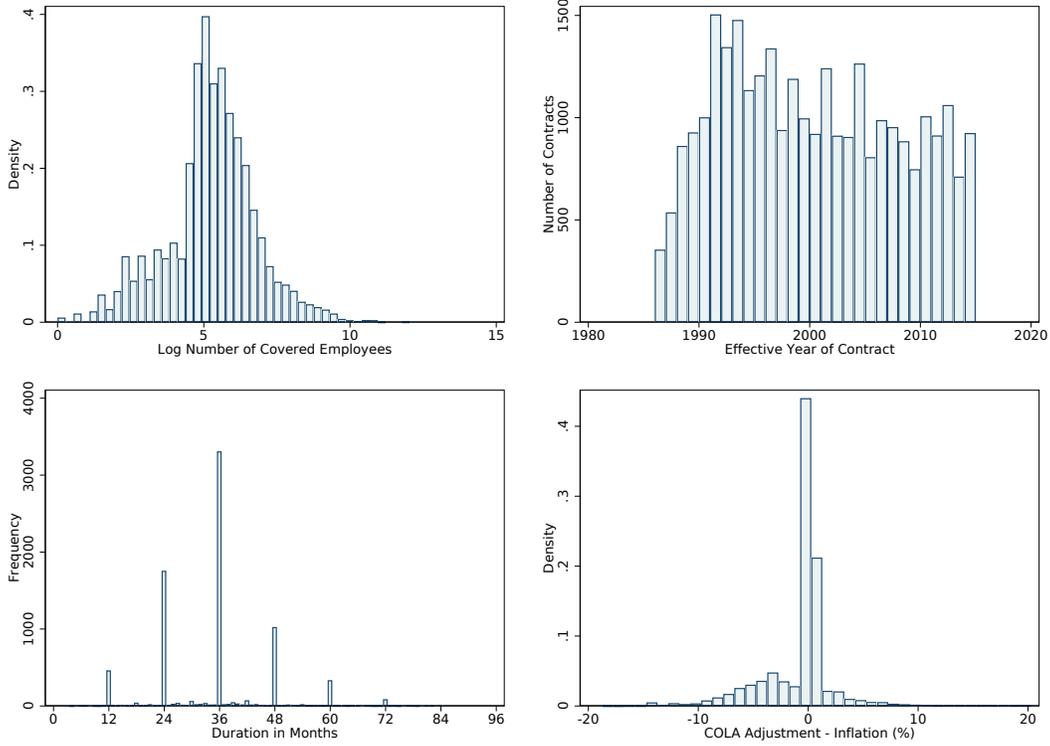


Table 3: Summary Statistics on Strikes

Variable	Mean	Std. Dev.	Min	Max
Workers (Max)	553.95	6452.4	1	830000
Work Days	33.210	75.57	0	2144
Person Days	8445.50	51786.4	0	2156980
Private Sector	.8126	.3901	0	1
Lockout	.0754	.264	0	1
Rotating Strike	.0220	.1469	0	1
Issue: Wages	.595	.49	0	1

Table 4: Summary Statistics on Population and Employment

Variable	Mean	Std. Dev.	Min	Max
Population (1000s)	5795.22	3746.8	96.9	11684
Labor Force (1000s)	266.08	210.57	.2	855.3
Employment (1000s)	254.69	202.75	.2	838.40
Unemployment Rate (%)	5.209	3.729	1.08	49.9
Personal Income Tax Rate (%)	22.3	1.458	16.11	25.62

big events, with over 500 workers on average, and over 8,445 person-days lost. Over 80% are private-sector strikes, and in about 60% of cases, wages are a reported issue over which the workers are striking. Of these cases, the only reported issue in about half of the strikes. In about 70% of strikes, there are non-wage issues reported, including fringe benefits, working conditions, negotiation delays, hours, dismissals, suspensions, job security, and sympathy for other unions.

Next, we have local labor market data. We have numbers by province, sector, and year, for population, labor force, full-time employment, and part-time employment. We use these numbers to compute unemployment rates by province, sector, and year. In addition, we have data on the implicit personal income tax rate, by province and year, from the Center for the Study of Living Standards.¹ Summary statistics for these data are reported in Table 4.

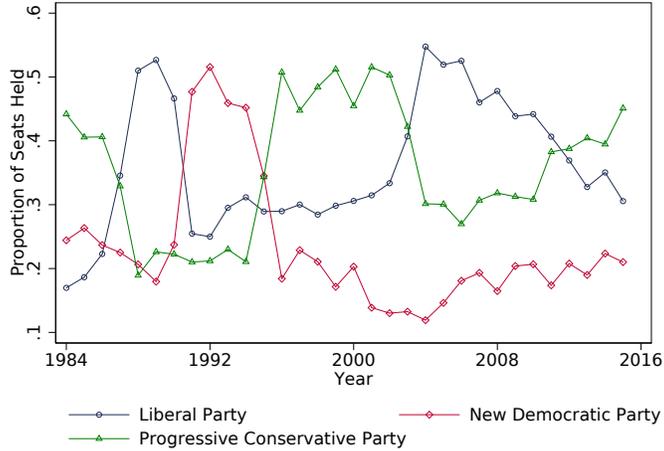
We are interested not just in economic conditions, but also the local political conditions in each province. We collected data on all of the provincial elections in Canada during our time period. This includes the date of these elections, the number of seats to be filled, and the allocation of seats to Liberal, New Democratic, and Progressive Conservative parties.² Figure 2 shows that the relative control of these political parties has changed substantially and repeatedly in our time period of interest. The New Democratic Party is known to favor labor unions politically (Jansen and Young, 2009).

Finally, we have data on trade deals that are relevant to the labor market in Canada. First, we have the Canada-United States Free Trade Agreement (CUSDTA), signed on

¹Available at <http://www.csls.ca/reports/csls2011-17appendixtables.pdf>.

²There are three smaller regional parties: Quebecois, Saskatchewan, and Social Credit.

Figure 2: Provincial Party Control Over Time



January 2, 1988. Second, we have data the North American Free Trade Agreement (NAFTA), which entered into force on January 1, 1994. NAFTA included an ancillary agreement, the North American Agreement on Labor Cooperation (NAALC), which implemented uniform rules on labor contracting.³

5 Extracting Features from Union Contract Text

This section describes our methods for measuring features of union contracts. In addition to the aforementioned metadata by contract, we had access to the full corpus of 29,841 contracts.

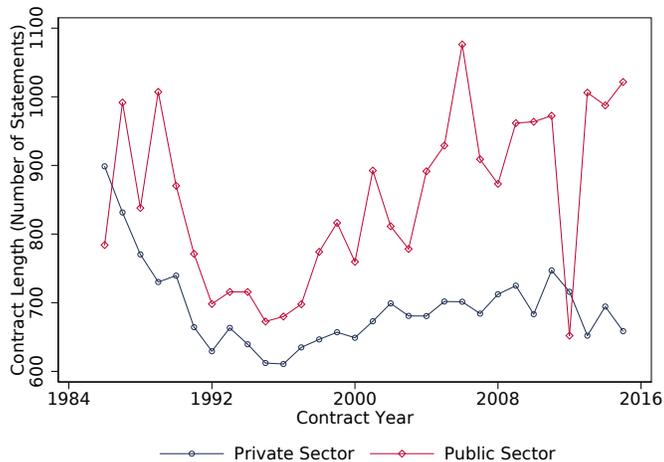
5.1 Pre-Processing

The contracts database arrived as scanned PDFs. The first step was to convert them to machine-readable text using OCR software. We excluded wage schedules, exhibits, appendices, and other miscellaneous materials.

Next, we split the contracts into sections, using the relatively standard legal style to detect and segment section headers. We used a sentence tokenizer to split each section

³Available at <http://govinfo.library.unt.edu/tsrc/hearings/21jan00/aolaborde1.pdf>.

Figure 3: Contract Length Over Time, By Public/Private



into a list of sentences. The resulting corpus consists of 980,909 contract sections (32.9 per contract) and 10.8 million sentences (11.06 per section).

5.2 Measuring Rigidity and Conditionality

Our preferred metric for contract length is to count the number of “statements” in a contract, which we define as a subject-verb structure. This means that compound sentences can count as multiple statements. When counting statements, there are on average 21.98 per section and 722.4 per contract. The shortest contract has 12 statements, and the longest contract has 9,624 statements.

Figures 3, 4, and 5 illustrate some interesting patterns in our data. Public-sector contracts are longer and more detailed than private-sector contracts. Contracts appear to have become less detailed in the early nineties, and then increased in detail again starting in the late nineties. Contracts with a longer effective duration tend to be more detailed. Other measures that can be understood as rigidity, which also correlated with contract length, are whether there is a COLA clause, and the specificity of COLA adjustments (different increases in different years).

We also see that contracts that cover more employees tend to be more detailed. In general, the various measures of rigity are increasing with the number of employees.

Battigalli and Maggi (2002) note that an important feature of complex contracts

Figure 4: Contract Detail and Contract Duration

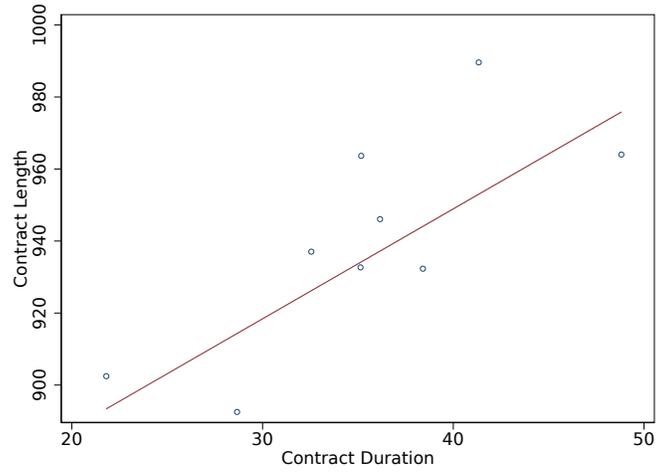


Figure 5: Contract Detail and Firm Size

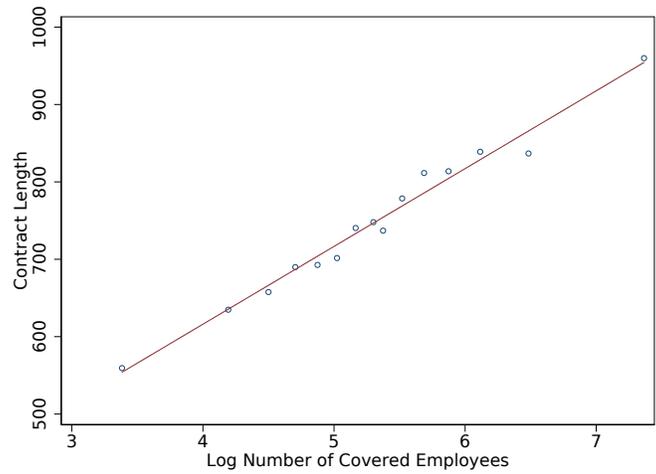
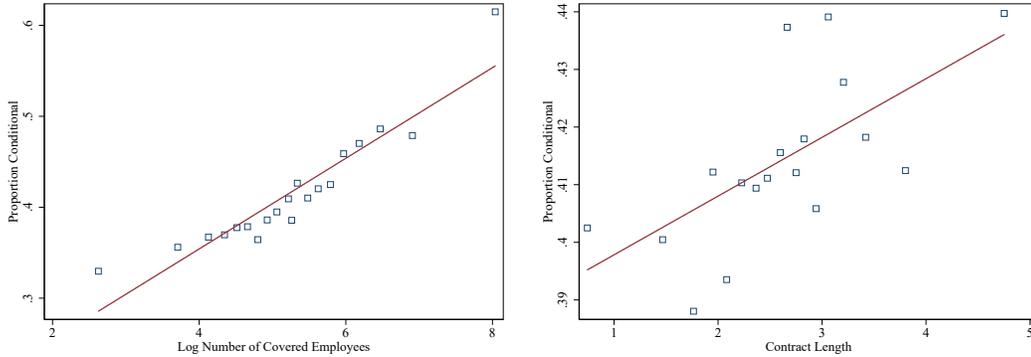


Figure 6: Conditionality, Contract Length, and Employment



is to condition actions on events. In their paper, as contracts become more valuable, there is a greater benefit to state-contingent actions, so the level of conditionality in the contract should increase.

To analyze this idea, we count the proportion of contract statements that have a conditional statement. We use a dictionary of conditional terms, most importantly “if,” “where,” and “unless.” Figure 6 plots this metric against log employment (left side), and log contract length (right hand side). We find that, consistent with Battigalli and Maggi (2002), conditionality is increasing in larger (and presumably higher-value) firms. To the extent that longer contracts are also evidence of a higher-value relationship, we again see that conditionality is increasing.

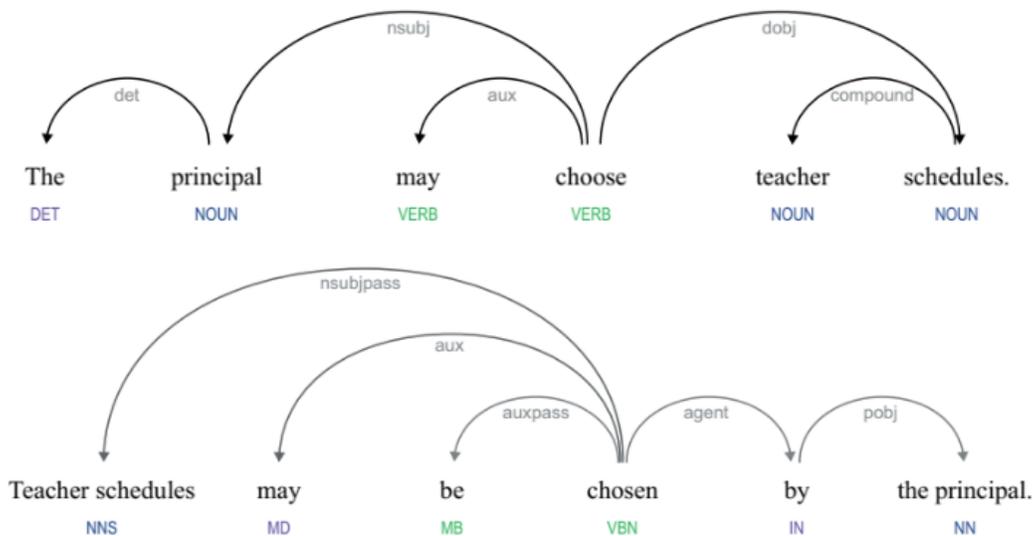
5.3 Measuring the Intent of Union Contract Terms

This section describes our approach for extracting legal provisions from union contracts. We build on recent methods using natural language processing to automate the interpretation of laws and contracts by extracting commitments, entitlements, and the like. This small literature includes Francesconi and Passerini (2007) and Ceci et al. (2011).

Each contract sentence is parsed using a syntactic dependency parser called spaCy (spacy.io). This package uses the ClearNLP dependency schema and has proven accuracy and efficiency relative to other parsers.⁴ The parser transforms sentences into

⁴See <http://www.mathcs.emory.edu/~choi/doc/clear-dependency-2012.pdf>.

Figure 7: Syntactic Dependency Parse for Deontic Modal Verb Structures



parse trees, which represent the relations between words in a recursive hierarchical structure. Figure 7 shows the dependency parse for two example sentences.

We are most interested in deontic modal verb structures. Formally speaking, modal-ity prescribes a favored action within a possible world (Kratzer, 1991). In contracts, these statements create legal obligations and entitlements, featuring the modal verbs shall, will, may, must, and can. We begin by extracting the subject, modal, and associated (action) verb. Table 5 provides tabulations for the most frequent subjects, modals, and verbs encountered in our data set. In the bottom panel, we have listed the most frequent subject-model-verb tuples (starting with msot frequent). We can see in the first column a focus on obligations for the company. In the second and third columns, we see a focus on entitlements for the worker.

The subject is assigned using a dictionary of synonyms to one of four agent categories: worker, union, owner, and manager (or other). The modal verb is distinguished as strict (*shall, will, must*) or permissive (*may, can*). Statements are tagged as negative (“shall not” rather than “shall”), and tagged as active (“shall hire”) or passive (“shall be hired”).

We identify a handful of special verbs that appear often in the contracts and delineate obligations and entitlements: Obligation Verbs (be required, be expected, be

Table 5: Summary Tabulations: Subjects, Modals, and Verbs

Subject	Freq.		Verb	Freq.
employee	32465		be	35265
who	12633		have	6212
it	7198		agree	5900
employer	6431		be_pay	5400
company	5666		receive	4236
which	5404		work	4035
he	5101		be_require	3656
party	4044		apply	3468
they	3997		provide	3045
there	3081		be_make	2955
union	2735		be_entitle	2694
that	2649	Modal	be_grant	2663
teacher	2598	shall	continue	2355
member	2501	will	be_give	2301
leave	2303	may	pay	2237
board	2247	must	be_consider	1945
grievance	2092	should	include	1639
dans	1960	would	make	1570
nurse	1809	can	become	1553
hour	1690	could	mean	1518
hospital	1626	might	be_provide	1495
rate	1612	ought	occur	1486
time	1596	need	complete	1420
period	1572		be_understand	1402
he/she	1485		leave	1301
she	1460		require	1293
committee	1350		take	1224
day	1346		be_agree	1212
work	1301		recognize	1202
agreement	1299		be_deem	1188
provision	1278		meet	1142
seniority	1267		give	1102
notice	1233		notify	1092
position	1224		commence	1063

Most Frequent Subject-Modal-Verb Tuples

Subject - Modal - Verb	Subject - Modal - Verb	Subject - Modal - Verb
agreement_shall_be	employee_shall_be	employee_shall_receive
arbitrator_shall_have	employee_shall_be_allow	employee_shall_retain
board_shall_have	employee_shall_be_consider	employee_will_be
case_may_be	employee_shall_be_entitle	employee_will_be_allow
committee_shall_meet	employee_shall_be_give	employee_will_be_entitle
company_shall_pay	employee_shall_be_grant	employee_will_be_give
company_shall_provide	employee_shall_be_lay_off	employee_will_be_grant
company_will_pay	employee_shall_be_pay	employee_will_be_pay
company_will_provide	employee_shall_be_require	employee_will_be_require
decision_shall_be	employee_shall_continue	employee_will_have
employee_may_request	employee_shall_lose	employer_shall_grant

Table 6: Contract Statement Typology

Categorization Logic	Examples
<u>Obligations</u>	
Positive, Strict Modal, Active Verb	shall be, shall provide, shall include, shall notify, shall continue
Positive, Strict Modal, Obligation Verb	shall be required, shall be expected, shall be obliged
Positive, Non-Modal, Obligation Verb	is required, is expected
<u>Prohibitions</u>	
Negative, Any Modal, Active Verb	shall not exceed, shall not use, shall not apply, shall not discriminate
Negative, Permission Verb	shall not be allowed, is not permitted
Positive, Strict Modal, Constraint Verb	shall be prohibited, shall be restricted
<u>Permissions</u>	
Positive, Non-Modal, Permission Verb	is allowed, is permitted, is authorized
Positive, Strict Modal, Permission Verb	shall be allowed, shall be permitted
Positive, Permissive Modal, Active Verb	may be, may request, may use, may require, may apply
Negative, Any Modal, Constraint Verb	shall not be restricted, shall not be prohibited
<u>Entitlements</u>	
Strict Modal, Passive Verb	shall be paid, shall be given, shall not be discharged
Positive, Strict Modal, Entitlement Verb	shall have, shall receive, shall retain
Negative, Any Modal, Obligation Verb	may not be required

compelled, be obliged, be obligated, have to, ought to), Prohibition Verbs (be prohibited, be forbidden, be banned, be barred, be restricted, be proscribed), Permission Verbs (be allowed, be permitted, be authorized), and Entitlement Verbs (have, receive, retain). We define Action Verbs as all non-special active-tense words, including “be” by itself. Passive Verbs are all non-special passive-tense verbs.

Now, we use these grammatical features to assign statements to one of four types of contract statements (or “other”). The formal requirements, plus some examples, are included in Table 6. An *Obligation* requires that the subject perform an action or set of actions. A *Prohibition* requires that the subject not perform an action or set of actions. A *Permission* gives the subject permission or authority over an action or set of actions. An *Entitlement* gives the subject an entitlement.

We calculate frequency counts for each statement type and each agent. Table 7 reports summary statistics on these frequencies. As can be seen in the bottom set of variables, contracts in the main can be understood as a bundle of obligations and enti-

Table 7: Summary Statistics: Statements Per Contract

Variable	Mean	Std. Dev.	Min	Max
Active Verbs	441.01	374.07	0.00	8501.00
Passive Verbs	221.88	156.74	0.00	2053.00
Modal Verbs	332.49	229.33	0.00	2797.00
Special Verbs	72.11	50.06	0.00	820.00
Obligation Verbs	11.55	10.38	0.00	190.00
Constraint Verbs	0.27	0.66	0.00	14.00
Permission Verbs	4.45	4.94	0.00	96.00
Entitlement Verbs	32.88	24.01	0.00	412.00
Promise Verbs	22.97	18.92	0.00	381.00
Obligations	427.77	367.22	0.00	8443.00
Constraints	23.48	18.35	0.00	235.00
Permissions	4.09	4.53	0.00	83.00
Entitlements	241.24	168.49	0.00	2248.00
Total Statements	718.73	519.15	1.00	9626.00

tlements. We understand obligations and prohibitions as reducing an agent’s authority. We understand permissions and entitlements as expanding an agent’s authority.

Table 8 provides a first look into the legal content of these union contracts. We plot the average number of obligations per agent by contract for each year (top panel), as well as the average number of entitlements per agent by contract for each year (bottom panel). In the top panel, we can see that obligation statements are allocated to firms and workers (rather than managers and unions). Obligations have increased over time for both agents. In the bottom panel, we see that there are few entitlements for unions, managers, and firms. Entitlements are concentrated among workers, and the average number of worker entitlements per contract has increased over our time period. In addition, as contract length increases, the share of statements concerning workers (rather than the firm) goes up.

To better understand these descriptive statistics, we also classified each statement by topic using LDA (Latent Dirichlet Allocation (see e.g. Blei, 2012)). We used the “action” segment of the clause, which includes the other pieces of the parse tree besides the subject, modal, special verbs, and stopwords. To train the model, we treated each contract section as a document. We obtained interpretable results with 20 topics.

Table 8 provides a list of LDA topics, with the associated words. A handful of junk

Figure 8: Obligations and Entitlements Over Time, By Agent

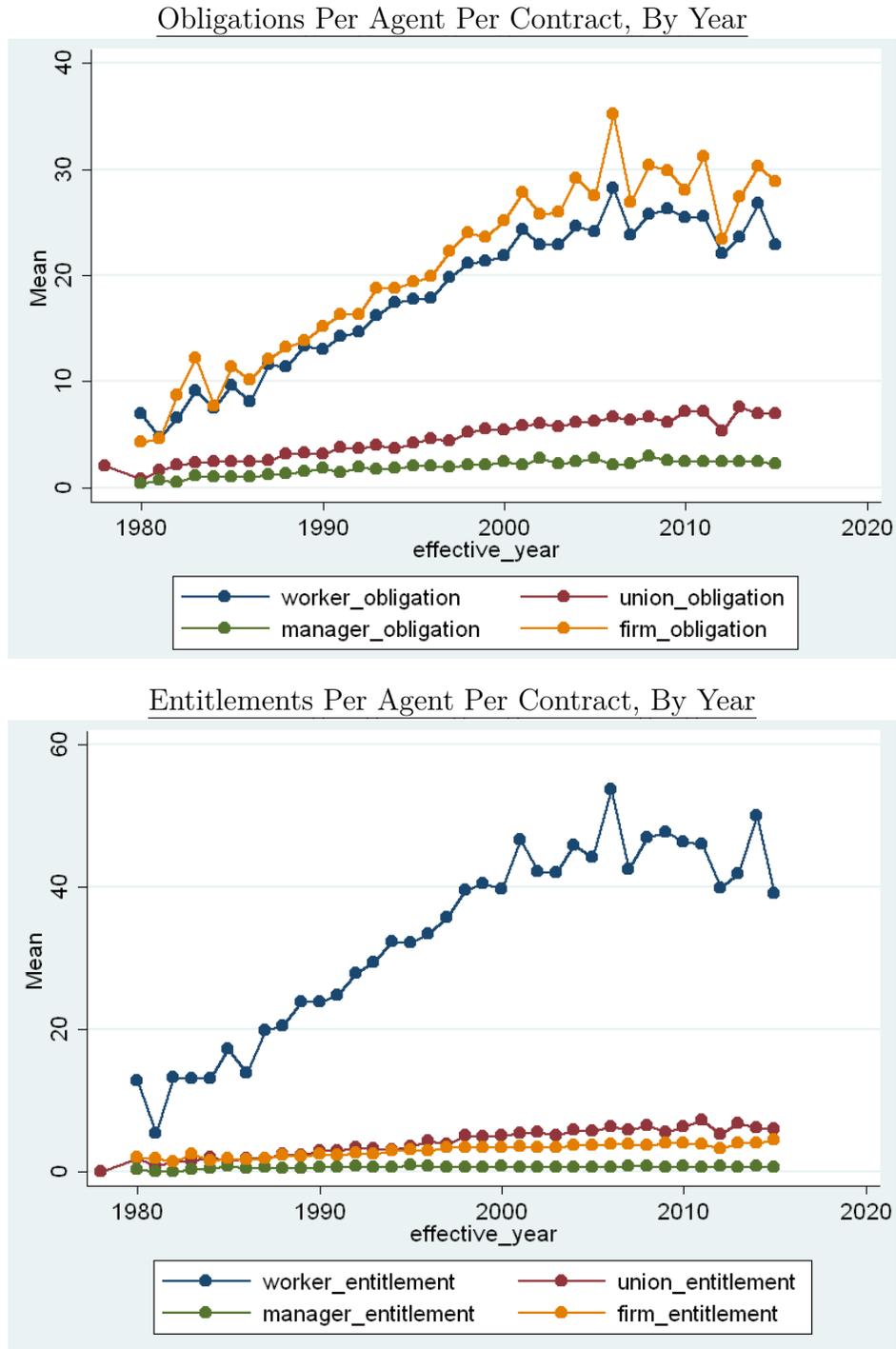


Table 8: LDA Topic Words in Collective Bargaining Agreement Clauses

1 -- **"Sick Leave"** -- period month sick leave six probationary credit three complete employment twelve absent completion accumulate date exceed consecutive professional

2 -- **"Parental Leave"** -- leave absence pay request date grant prior week parental commencement pregnancy write maternity duty witness advance approve notice

4 -- **"Payroll"** -- change due result deduction amount status deduct monthly payroll reduction affect cheque technological fee employment orientation statement

5 -- **"Bargaining Unit"** -- unit bargaining person appointment appoint employ outside activity membership represent agent terminal sole select exercise ontario bargain behalf

7 -- **"Overtime"** -- hour shift work schedule overtime period call rest meal half minute start end break duty sunday weekend saturday two friday

8 -- **"Grievances"** -- grievance party procedure arbitration writing decision write step matter arbitrator committee complaint submit final dispute request name process

9 -- **"Job Training"** -- requirement operation training require equipment individual meet service responsibility provide program area manner performance" business duty operational

10 -- **"Vacation Leave"** -- year vacation service pay date employment week continuous effective two annual entitlement percent january salary earn termination period follow

14 **"Medical Leave/Injuries"** medical reasonable illness reason certificate unable duty injury course require due provide information circumstance accident personal condition examination reasonably

15 -- **"Discipline/Firing"** -- school act safety committee health action discharge labour cause discipline disciplinary file application canada public relations suspension regulation authority accordance

16 -- **"Seniority"** -- seniority lay position list layoff vacancy recall transfer post temporary qualification permanent job hire fill date provide ability copy basis

17 -- **"Work-Related Deaths"** -- article accordance law child spouse pursuant family death include immediate parent purpose require city office paragraph funeral

18 -- **"Insurance/Benefits"** -- benefit plan insurance payment cost premium eligible provide receive compensation disability pay coverage pension receipt term amount

19 -- **"Scheduling"** -- work hour day week schedule two return perform normal regular report normally excess regularly require notice eight teaching available emergency

Table 9: Summary Statistics on Topic Proportions

Variable	Mean	Std. Dev.	Min	Max
Topic 0	.0434	.0248	0	.6100
Topic 1	.0309	.0192	0	.6833
Topic 2	.0465	.0325	0	.6620
Topic 3	.024	.0279	0	.8403
Topic 4	.0547	.0308	0	.6387
Topic 5	.0423	.0268	0	.6833
Topic 6	.0730	.0440	0	.8943
Topic 7	.0329	.0276	0	.8522
Topic 8	.0719	.0509	0	1
Topic 9	.0689	.0407	0	.794
Topic 10	.0429	.0338	0	.81
Topic 11	.0415	.0267	0	.668
Topic 12	.0488	.0297	0	.593
Topic 13	.0423	.0251	0	.847
Topic 14	.0562	.0318	0	.670
Topic 15	.059	.0332	0	1
Topic 16	.0624	.0369	0	.7625
Topic 17	.0405	.0259	0	.525
Topic 18	.0714	.0545	0	1
Topic 19	.0446	.0290	0	.683

topics (0, 3, 6, 11, 12, and 13) have been excluded, leaving 14 interpretable topics to help us understand the content of collective bargaining agreements.

Table 9 gives the distribution across topics in our data set. There is a relatively even distribution over topics across contracts. The most frequent topics are Topic 8 (Grievances) and Topic 18 (Insurance/Benefits). These topics get the most text dedicated to them in our sample of contracts. We looked at the topic shares over time and did not see any notable changes in our sample period.

Figure 9 plots our authority measures by topic, and by agent group. The top panel includes statements for worker and union, and the bottom panel includes statements for firm and manager. Employees receive entitlements and permissions – which can be understood as amenities and authorities. In turn, firms have obligations and prohibitions imposed, but do not receive entitlements/permissions. This is consistent with these contracts being designed to protect employees from unemployment risk, from work-related disutility, and potential abuse by managers. These types of protections could be efficiency-enhancing in labor markets characterized by monopsony, asymmetric information, or holdup.

Our preferred measure of authority is the proportion of statements for an agent

Figure 9: Permissions and Entitlements by Agent and Topic

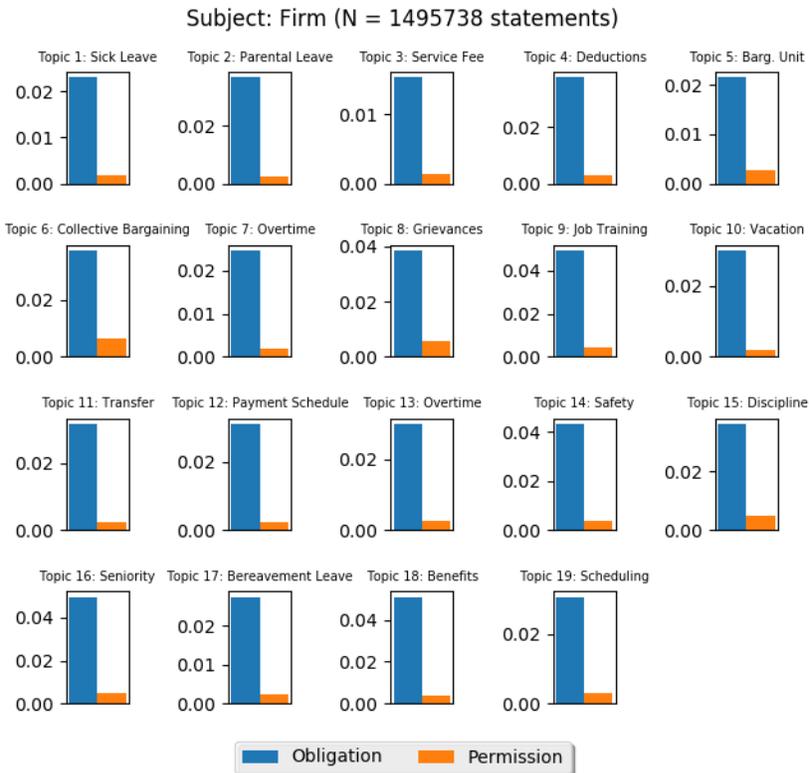


Figure 10: Distribution of Entitlement Shares for Workers and Employers

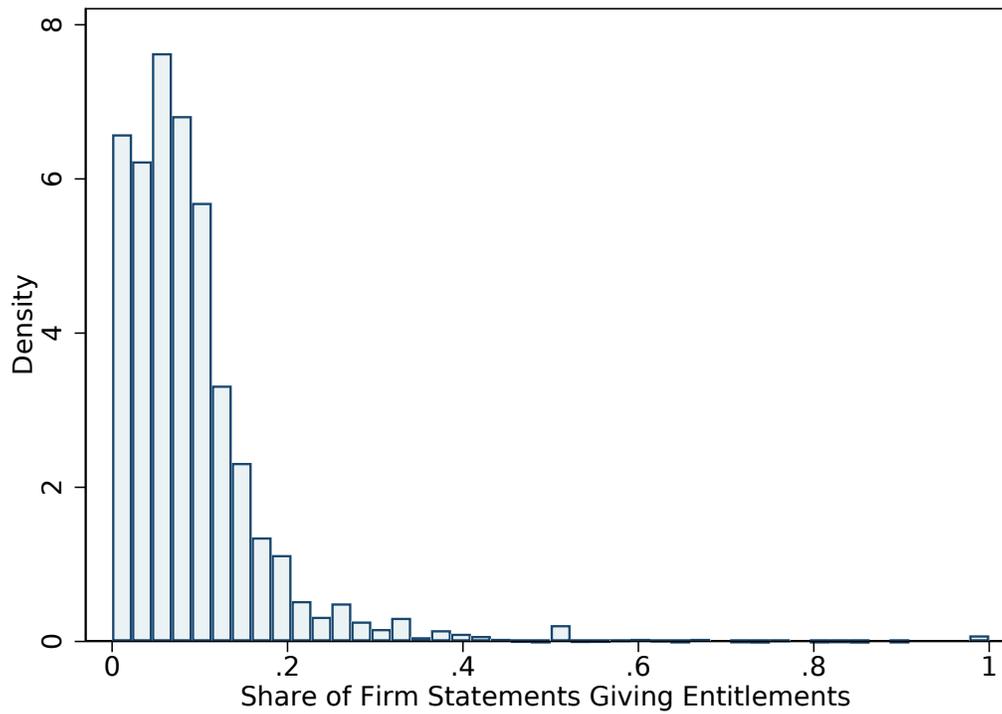
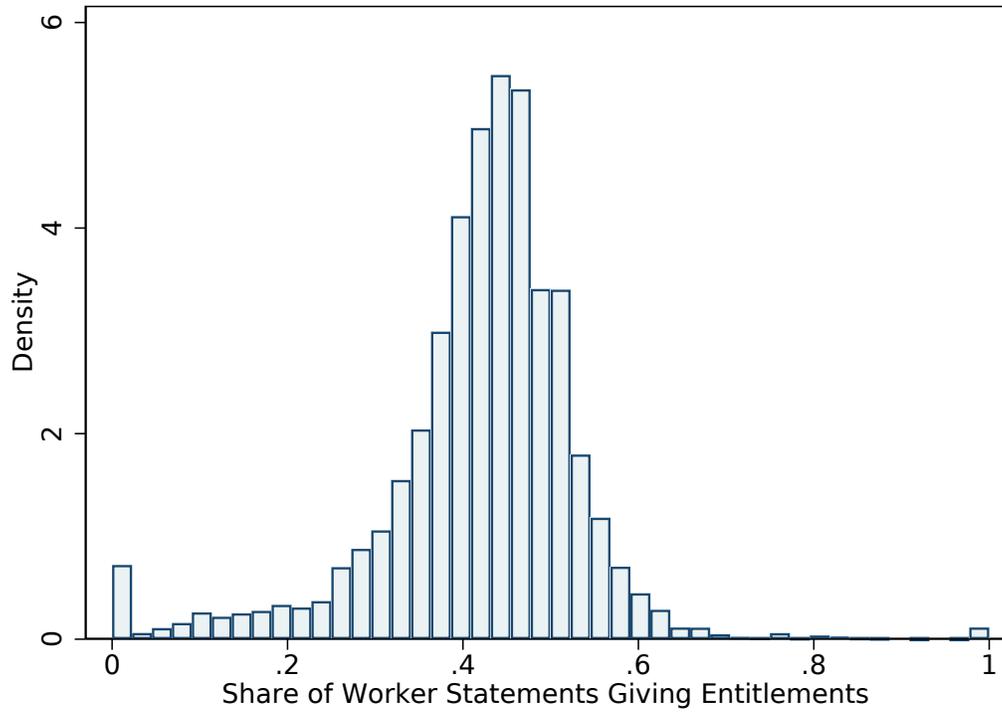


Table 10: Relative Worker Control, By Industry Grouping

Industry Grouping	Relative Worker Control	
	<i>Mean</i>	<i>Standard Error</i>
Construction	-.627	.028
Educational, Health	-.071	.014
Entertainment/Hospitality	-.124	.062
Finance, real estate	-.001	.044
Information and culture	.152	.039
Manufacturing	.148	.015
Primary industries	.112	.049
Public administration	.228	.022
Transportation	-.013	.02
Utilities	.341	.044
Wholesale/Retail Trade	-.092	.052

that serve as entitlements (rather than obligations). We compute this for workers and employers. We then look at how these values change in response to a range of explanatory variables. The distribution of entitlement shares is depicted in Figure 10. One can see that it is approximately normal and has a higher mean for workers.

In order to make relative comparisons, we look at relative worker control, the employee entitlement share minus the employer entitlement share. Figure 11 (top panel) shows in a single line what we saw previously in the by-agent graphs. Relative worker control increased in the first half of our data period. Figure 11 (bottom panel) shows that relative worker control is strongly related to the length of the contract (values residualized on company fixed effects and sector-year fixed effects). This again reflects the idea that the primary function of contracts is to protect workers; longer contracts provide more protections. This also means that the length of the contract Table 10 reports the mean relative worker control by major industry grouping. Workers have relatively more control in Utilities and Public Administration. They have relatively less control in Construction and Entertainment/Hospitality (restaurants).⁵ These ideas are echoed in the ranking in Table 11, which gives the unions with the highest relative

⁵In parallel work we are exploring a more principled measure, motivated by the idea that relative agent authority would generate a correlation between agent type and modal verb type at the statement level. To summarize, worker authority in a contract could be given by the within-topic correlation coefficient (or OLS coefficient) across statements between agent indicators and indicators for a permissive vs, restrictive modal verb. More generally, there are promising avenues for structural modeling of the contract drafting process.

Table 11: Relative Worker Control, By Union

Union	# of Contracts		Relative Worker Control
	Private-Sector	Public-Sector	
Alberta Union of Provincial Employees	64	323	0.3770774
Unifor	141	27	0.3714532
Communications, Energy and Paperworke..	1160	84	0.3710064
Industrial Wood and Allied Workers of..	109	0	0.3707015
Public Service Alliance of Canada	323	898	0.3706359
Ontario Nurses' Association	27	1295	0.3657097
Nova Scotia Government and General Em..	9	93	0.362997
British Columbia Government and Servi..	61	66	0.360454
Canadian Union of Public Employees	282	3655	0.3599985
Ontario Public Service Employees Union	12	430	0.3575886
Office and Professional Employees Int..	71	56	0.3561289
United Food and Commercial Workers Ca..	315	26	0.3537522
National Automobile, Aerospace, Trans..	1402	262	0.3537032
International Association of Machinis..	482	11	0.3528805
International Brotherhood of Boilerma..	99	0	0.3511368
Elementary Teachers' Federation of On..	0	149	0.3488342
United Steel, Paper and Forestry, Rub..	443	28	0.3464268
Professional Institute of the Public ..	7	176	0.3461352
British Columbia Teachers' Federation	0	173	0.343406
United Steelworkers of America	929	39	0.3419327
Teamsters Canada	611	30	0.3405123
International Brotherhood of Electric..	303	206	0.3354559
National Automobile, Aerospace and Ag..	229	6	0.3311382
Canadian Merchant Service Guild	259	51	0.3291438
United Food and Commercial Workers In..	659	104	0.3290809
International Union of Operating Engi..	277	95	0.3277051
International Brotherhood of Teamsters	949	52	0.3269495
Seafarers' International Union of Can..	187	0	0.3222763
Service Employees International Union	167	1031	0.321059
Canadian Paperworkers Union	119	0	0.320908
International Association of Fire Fig..	6	328	0.3115588
Hotel Employees and Restaurant Employ..	101	12	0.3109177
Ontario Secondary School Teachers' Fe..	7	615	0.3090633
Ontario Public School Teachers' Feder..	0	102	0.3064964
Ontario English Catholic Teachers' As..	0	316	0.3001441

worker control.

6 Regression Approach

We are interested in measuring how observed worker authority in Canadian collective bargaining agreements responds to changes in economic, legal, and political conditions. Here we describe our econometric analysis in more detail.

In our data an observation is a contract, indexed by province s , firm i , and effective year t . For each contract we have a set of outcomes, represented by y_{sit} . We use a linear model

$$y_{sit} = \rho z_{sit} + \alpha_{sit} + X'_{sit} \beta + \epsilon_{sit},$$

with the components described as follows. First, z_{sit} is the explanatory variable of interest, with ρ giving the corresponding OLS coefficient. Depending on the specification and associated assumptions, $\hat{\rho}$ may or may not estimate a causal relationship. Second, α_{sit} includes a set of fixed effects, which may include indicators for year, province, sector, or company. It may also include interacted fixed effects. Third, X_{sit} includes a set of time-varying controls, for use in assessing robustness of $\hat{\rho}$. Finally, ϵ_{sit} is an error term. In all regression results, we cluster standard errors by province (e.g. Bertrand et al., 2004).

Our outcome variables and treatment variables, as labeled in the tables, are listed in Table 12. We provide a description as well.

7 Results

This section reports our results. We report two sets of results. First, we look at how contract features respond to local economic and political conditions that affect outside options, relative pricing of amenities, and worker bargaining power. Second, we look at the strike response to unexpected wage cuts, and how that varies according to contract features.

Table 12: List of Variables Used in Regression Analysis

Variable Label	Description
<i>Contract Feature Outcome Variables</i>	
Log Total Clauses	Log of the total statements in contract
Relative Control	Employee Entitlement Share minus Employer Entitlement Share
<i>Endogenous Descriptive Variables</i>	
Log Employees	Log number of employees covered by contract
Log Duration	Log of expiry month minus effective motnh
Has COLA Clause	Indicator equaling one if contract has COLA
COLA Amount	Conditional on having COLA, average annualized change
<i>Exogenous Treatment Variables</i>	
Negative Wage Shock	Indicator equaling one if inflation beats COLA during previous contract
Unemployment Rate	Province-sector-year unemployment rate
Log Tax Rate	Log of the province-year- implicit personal income tax rate
NDP Control	Indicator: New Democratic Party controls provincial government

7.1 Effects of Economics and Political Conditions on Contract features

This section looks at external influences of contract features. We look at a set of factors that, conditional on the fixed effects, are exogenous to the features of the contract.

The first economic variable that we look at is the unemployment rate at the time of contract negotiation. This can be seen as a negative shock to worker outside options. These coefficients are reported in Table 13. A higher unemployment rate does not have any consistent effects on contract features in the private sector. In the public sector, it is associated with increased relative worker control (Column 12), which could be due to political factors resulting from unemployment.

Next we look at province-wide shocks to wages due to tax policy. In Table 14, we look at whether changes to the within-province tax rate are associated with changes to tax features. We find that a higher income tax is associated with higher worker authority, both in the private sector and public sector. This is consistent with a substitution away from the taxed income (wages) toward untaxed income (amenities).

Our thirs set of results looks at how contracts respond to political conditions (Table

Table 13: Cross-Sectional and Panel Differences: Local Sectoral Unemployment Rate

Private Sector Firms				
	(1)	(2)	(3)	(4)
	<u>Log Total Clauses</u>		<u>Relative Control</u>	
Unemp. Rate	-0.000329	0.00210	0.00103	0.001
	(0.00367)	(0.00680)	(0.000679)	(0.00123)
Public Sector Firms				
	(1)	(2)	(3)	(4)
	<u>Log Total Clauses</u>		<u>Relative Control</u>	
Unemp. Rate	-0.0324**	-0.00338	-0.000465	0.007*
	(0.0104)	(0.0197)	(0.00179)	(0.0032)
Province FEs	X		X	
Sector-Year FEs	X	X	X	X
Firm FE's		X		X

Table 14: Cross-Sectional and Panel Differences: Personal Income Tax Rate

Private Sector Firms				
	(1)	(2)	(3)	(4)
	<u>Log Total Clauses</u>		<u>Relative Control</u>	
Log Tax Rate	0.917**	0.354	0.0531	0.139*
	(0.333)	(0.360)	(0.0614)	(0.0657)
Public Sector Firms				
	(1)	(2)	(3)	(4)
	<u>Log Total Clauses</u>		<u>Relative Control</u>	
Log Tax Rate	1.988**	1.125**	0.107	0.140*
	(0.385)	(0.407)	(0.0666)	(0.0673)
Province-Sector FEs	X	X	X	X
Sector-Year FEs	X	X	X	X
Firm FE's		X		X

Table 15: Cross-Sectional and Panel Differences: New Democratic Party Control

Private Sector Firms				
	(1)	(2)	(3)	(4)
	<u>Log Total Clauses</u>		<u>Relative Control</u>	
NDP Control	0.0872**	0.0988**	0.00603	0.00951*
	(0.0204)	(0.0212)	(0.00378)	(0.00385)
Public Sector Firms				
	(1)	(2)	(3)	(4)
	<u>Log Total Clauses</u>		<u>Relative Control</u>	
NDP Control	0.0378	-0.0127	-0.00928*	0.00152
	(0.0238)	(0.0250)	(0.00407)	(0.00410)
Province-Sector FEs	X		X	
Sector-Year FEs	X	X	X	X
Firm FE's		X		X

15). We find that relative to other parties, control of province government by NDP (New Democratic Party, which is known to support the labor movement) has empowering effects on labor unions in the private sector. NDP control is associated with longer, more detailed contracts that give more authority to employees. This is consistent with stronger worker bargaining power due to political support

7.2 Worker Authority and Strike Responses to a Wage Cut

This section looks at the impacts of an unexpected wage cut on strike rates.

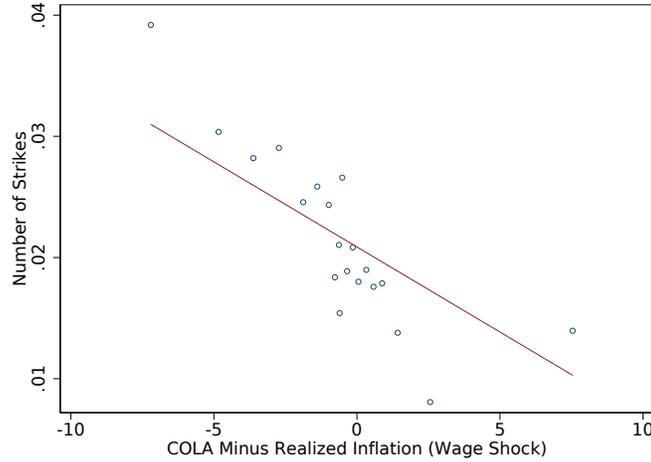
Figure 12 shows how our metadata on strikes are related to the wage shocks variable computed by subtracting realized inflation from the specified COLA wage adjustment. In this bin-scatter, the variables have been residualize on province-sector-year fixed effects. We find that strikes are less likely when COLA does better than inflation; that is, negative wage shocks increase the probability of a strike. In a regression, this coefficient is significant with $p = .022$.

Table 16 reports a set of regressions with the number of strikes and the number of work days on strike as outcome variables. As treatment variables, these regres-

Table 16: COLA-Inflation Wage Shock, Worker Control, and Strike Intensity

Private Sector Firms				
	(1)	(2)	(3)	(4)
	<u>Has Strike</u>		<u>Work Days on Strike</u>	
High Worker Control	0.00206 (0.00272)	0.00410 (0.00551)	0.153 (0.105)	0.0405 (0.249)
Negative Wage Shock	0.0179** (0.00371)	0.0151* (0.00684)	0.808** (0.182)	0.655 (0.529)
High Control * Negative Shock	-0.00883* (0.00403)	-0.0200* (0.00861)	-0.785** (0.218)	-1.273* (0.425)
Public Sector Firms				
	(1)	(2)	(3)	(4)
	<u>Has Strike</u>		<u>Work Days on Strike</u>	
High Worker Control	0.00138 (0.00257)	-0.0205 (0.0904)	0.00689+ (0.00323)	0.120 (0.0945)
Negative Wage Shock	0.0178* (0.00742)	0.337+ (0.177)	0.0140** (0.00450)	0.325+ (0.172)
High Control * Negative Shock	-0.00323 (0.00507)	-0.0955 (0.109)	-0.00643 (0.00533)	-0.224 (0.168)
Province-Sector-Year FEs	X	X	X	X
Firm FE's		X		X

Figure 12: Effect of COLA-Inflation Wage Shock on Strike Intensity



sions include High Worker Control (an indicator for above-median worker control in a province-sector-year), Negative Wage Shock (an indicator for a COLA clause not keeping up with inflation in the previous contract), and the interaction between the two. We report results with province-sector-year fixed effects, and with these fixed effects plus firm fixed effects.

The regressions show the following. While there is no real difference in strike rates or intensity according to the level of worker control, there is an increase in strikes due to negative wage shocks. However, with high worker control, there is a significantly smaller effect of the negative wage shock on strikes. This interaction effect is only seen in the private sector. Note that we ran the same regression with contract length (rather than relative worker control) and found no effect.

This result can be understood by looking to the literature on contracts as reference points. Hart and Moore (2007) provide a model where workers punish the employer for providing beneath the contracted compensation; here, the negative wage shock can be seen as causing the wage to go beneath the reference point. The workers reciprocate by striking. This is related to the findings in Mas (2006) and Mas (2008) on labor conflict and product quality. However, the effect is reduced when workers have greater control over the firm power structure. This is related to the discussion by Hart and Moore (2007) that a contract that gives workers more entitlements would reduce conflict.

8 Conclusion

This paper has provided empirical evidence of how labor union contracts respond to changes in the economic and political environment. We showed that in the main, labor contracts impose obligations on both workers and firms, and give entitlements to workers. The strength of those worker entitlements varies across firms and over time in response to a range of factors.

In addition to uncovering “what unions do,” this research aims to uncover “what unions want” – and inform what future collective bargaining institutions might look like. By comparing contracts with strong unions to contracts with weak unions, we can produce statistical evidence on what types of clauses – amenities, obligations, entitlements, and protections – unions tend to bargain for. These dimensions of workplace autonomy are difficult to measure with traditional datasets, but may be an important component of well-being on the job. Indeed, while unions almost certainly compressed the income distribution, our project aims to document their further effects on workplace control rights and amenities. The lessons from these contracts will help policymakers design labor-market rules that efficiently govern workplace amenities, rent-sharing, and control rights within the firm. Given the recent emphasis on heterogeneity in firms as a source of wage inequality, understanding the firm-specific institutions that govern pay practices is important for unpacking the income distribution.

In the domain of law, while there is extensive theorizing about contract language, there is little credible empirical evidence. A fundamental identification problem is that the terms used in contracts are rarely tested in court, so it is difficult to decide what is boilerplate and what is probative. Our measurement and identification approach provides one way to gain some traction on this problem. Further, for practitioners of labor law, having an annotated database of the kinds of clauses unions have demanded in the past will likely be of some value in designing and negotiating future collective bargaining agreements.

In addition, we can provide evidence on what clauses increase the quality of the firm-employee relationship and increase efficiency. While a now considerable literature has measured firm productivity, comparatively little has gone into measuring firm amenities. Collective bargaining agreements might provide one way to get a sense of historical variation in quality of the workplace.

These findings will be relevant to ongoing debates within the labor movement, both public and private, about what unions have to offer workers in the 21st century. It

might be that many of the contractual provisions that unions offered are no longer demanded by workers because they are now protected by law.

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A Labor Law in Canada

Canadian labor law is generally protective of workers' rights. "Unlike the United States, the labour relations jurisdiction of the Canadian federal government is much more extensive than that of the state governments" (L.M. Farrell and G.F. Marcil, *Collective Bargaining in Canada*, National Center for the Study of Collective Bargaining 1 (April 2008).). In *Health Services and Support – Facilities Subsector Bargaining Assn. v. British Columbia*, 2007 SCC 27 (Supreme Court of Canada), the Canadian Supreme Court extended the definition of freedom of association to include protection for employees to engage in collective bargaining.

In addition, "[a]rbitration is available in the major jurisdictions upon a showing that an impasse has occurred because bargaining has become dysfunctional" (Id.). Unlike collective agreement arbitration in the United States, collective agreement arbitration in Canada has both public and private elements (Id. (citing Mitchnick & Etherington, *Labour Arbitration in Canada* (Lancaster House, 2006), pp. 3, 76.). "Arbitrators can and, where relevant, must consider and apply external statutes" (Id.).⁶

B Similarity Metrics

An alternative approach that we use for analyzing union contracts is to measure the stability of contract terms within a firm-union bargaining pair over time. We do this by computing distance measures between consecutive negotiated contracts. We have three specifications for contract similarity, each of which is well established in previous works from natural language processing and information extraction. Each of our metrics is based on cosine similarity, which gives the cosine of the angle between the vectorized documents. First, we use the standard cosine similarity between the word frequencies (Jurafsky and Martin, 2014). Second, we have GloVe similarity, which gives the cosine similarity between the contract vectors in a word embeddings space (Pennington et al., 2014). Third, we have LDA similarity, which gives the similarity between the LDA topics of the contracts (Blei, 2012). These variables are highly correlated, so for the main analysis we use the average of the three metrics.

⁶For introductions and overviews to Canadian labor law, see https://www.americanbar.org/content/dam/aba/administrative/labor_law/meetings/2009/ac2009/125.authcheckdam.pdf and <http://irc.queensu.ca/sites/default/files/articles/adams-overview-of-labour-law-in-canada.pdf>.

Figure 13: Sequential Contract Similarity Over Time

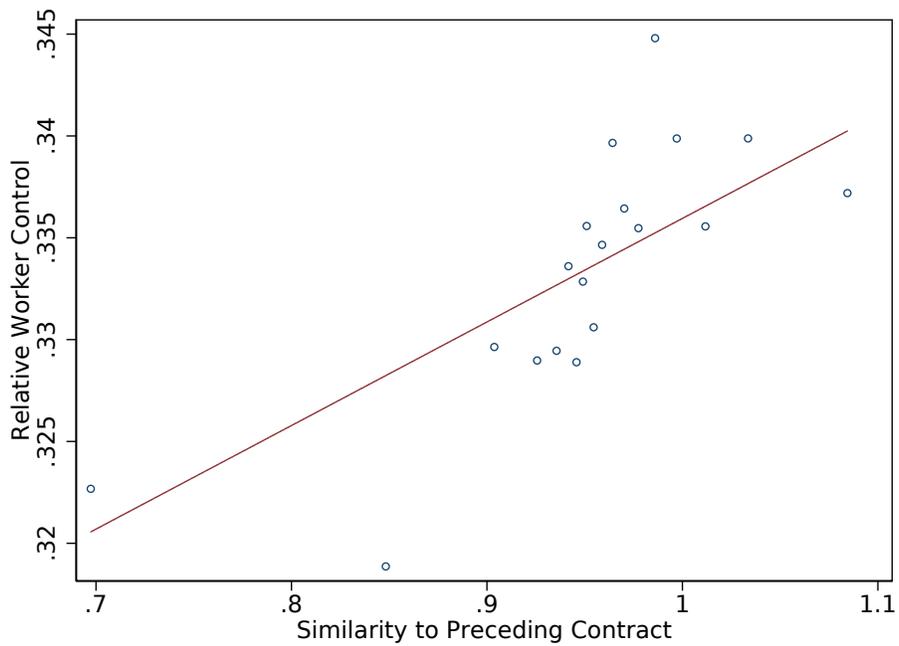
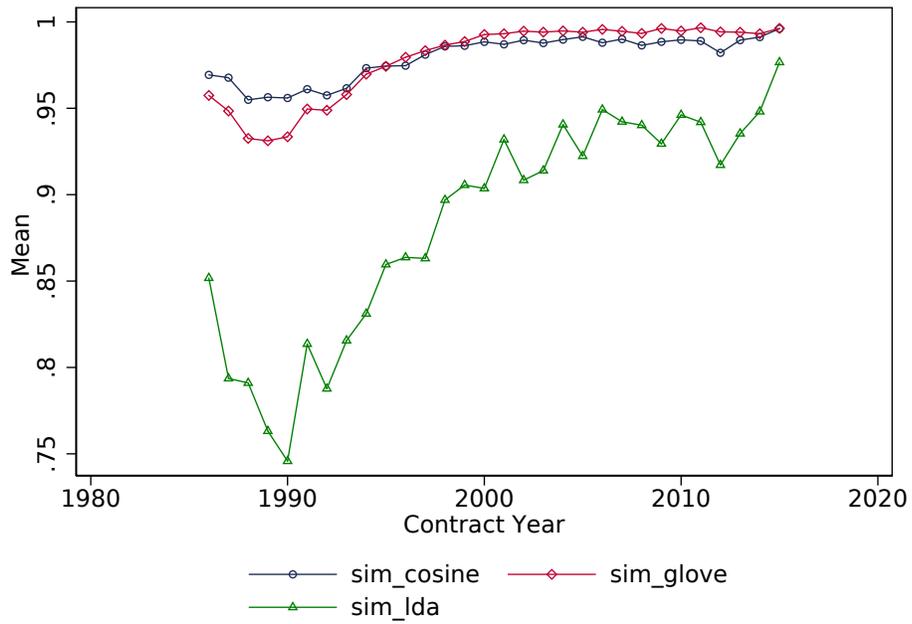


Table 17: Cross-Sectional and Panel Effects of Larger Work Force

Private Sector Firms						
	(1)	(2)	(3)	(4)	(5)	(6)
	<u>Log Total Clauses</u>			<u>Relative Control</u>		
Log Employees	0.0986** (0.00467)	0.102** (0.00508)	0.0986** (0.00859)	-0.00156+ (0.000872)	-0.000968 (0.000948)	0.00348* (0.00153)
Public Sector Firms						
	(1)	(2)	(3)	(4)	(5)	(6)
	<u>Log Total Clauses</u>			<u>Relative Control</u>		
Log Employees	0.126** (0.00555)	0.117** (0.00588)	0.124** (0.00908)	-0.00219* (0.000996)	-0.00594** (0.00108)	-0.0135** (0.00163)
Province FEs	X			X		
Sector-Year FEs	X			X		
Prov.-Sect.-Year FE's		X	X		X	X
Firm FE's			X			X

Figure 13 (top panel) shows the time trend for this metric (similarity between current contract and previous contract) across the time period in our data set. Contract terms appear to have become more stable in recent years. Figure 13 (bottom panel) shows that more contracts with higher similarity to the preceding contract also tend to have higher worker control (values residualized on company fixed effects and sector-year fixed effects). This is consistent with workers putting value on higher contract-term stability.

C Firm-Level Determinants of Contract Features

This appendix looks at how a set of firm-level variables are related to features of the contract. These are endogenous, and these regressions should be understood as descriptive statistics rather than causal estimates.

We begin by looking at variation in contracts by firm size, measured by the number of employees. Table 17 reports these coefficients for private-sector and public-sector firms. We see that in both sectors, firms with more employees have longer contracts.

Table 18: Cross-Sectional and Panel Differences: COLA-Inflation Wage Shock

Private Sector Firms						
	(1)	(2)	(3)	(4)	(5)	(6)
	<u>Log Total Clauses</u>			<u>Relative Control</u>		
Negative Shock	0.0250 (0.0176)	0.0153 (0.0196)	-0.0381+ (0.0229)	0.000845 (0.00323)	0.00483 (0.00358)	0.00336 (0.00403)
Public Sector Firms						
	(1)	(2)	(3)	(4)	(5)	(6)
	<u>Log Total Clauses</u>			<u>Relative Control</u>		
Negative Shock	-0.0132 (0.0178)	-0.0294 (0.0185)	-0.0364+ (0.0190)	0.0119** (0.00300)	0.00832** (0.00320)	0.00667* (0.00318)
Province FEs	X			X		
Sector-Year FEs	X			X		
Prov.-Sect.-Year FE's		X	X		X	X
Firm FE's			X			X

We see divergent effects in terms of relative control. In the private sector, a larger workforce is associated with a lower employee entitlement share, and there a higher relative wortker control. There is an opposite effect for the public sector, where larger workforces are associated with lower worker entitlements, higher employer entitlements, and lower relative worker control.

This appendix reports some additional regression results.

We begin with exogenous variation in wages due to COLA clauses mis-predicting inflation, reported in Table 18. These firm-level wage shocks do not appear to have large effects. There may be an associated decrease in contract detail. In the public sector, there is an increase in relative worker control.

Next we look at descriptive evidence of differences between contracts that are longer or shorter in duration (Table 19). Longer-duration contracts are more detailed. In the public sector, longer-term contracts are associated with greater worker control.

Table 20 provides descriptive statistics on how contracts differ depending on whether or not they have a schedule for cost-of-living adjustments to wages. First, we see that contracts with COLAs tend to be longer in both the public and private sectors. In

Table 19: Cross-Sectional and Panel Differences: Contract Duration

Private Sector Firms						
	(1)	(2)	(3)	(4)	(5)	(6)
	<u>Log Total Clauses</u>			<u>Relative Control</u>		
Log Duration	0.202** (0.0163)	0.205** (0.0185)	0.179** (0.0234)	-0.00848** (0.00302)	-0.00849* (0.00343)	0.000599 (0.00418)
Public Sector Firms						
	(1)	(2)	(3)	(4)	(5)	(6)
	<u>Log Total Clauses</u>			<u>Relative Control</u>		
Log Duration	0.175** (0.0182)	0.111** (0.0199)	0.0729** (0.0214)	0.0163** (0.00310)	0.0132** (0.00348)	0.00608+ (0.00360)
Province FEs	X			X		
Sector-Year FEs	X			X		
Prov.-Sect.-Year FE's		X	X		X	X
Firm FE's			X			X

the private sector, we see an increase in employee entitlements and control for COLA contracts. In the public sector, we see the opposite; when public firms add a COLA clause, that is associated with reduced authority. This is consistent with a tradeoff in the public sector, and stronger bargaining power in the private sector where strong unions get both types of compensation.

If we zoom in on the contracts that have COLA clauses, we can see if there is variation in contract features according to the size of the COLA (average annualized change over the course of the next contract). These regressions are reported in Table 21. There are no effects.

Table 20: Cross-Sectional and Panel Differences: Has COLA Adjustment

Private Sector Firms						
	(1)	(2)	(3)	(4)	(5)	(6)
	<u>Log Total Clauses</u>			<u>Relative Control</u>		
Has COLA Clause	0.282** (0.0147)	0.270** (0.0160)	0.159** (0.0221)	0.0112** (0.00275)	0.0115** (0.00299)	0.00522 (0.00396)
Public Sector Firms						
	(1)	(2)	(3)	(4)	(5)	(6)
	<u>Log Total Clauses</u>			<u>Relative Control</u>		
Has COLA Clause	0.319** (0.0163)	0.290** (0.0171)	0.167** (0.0232)	-0.00314 (0.00281)	-0.0122** (0.00302)	-0.0207** (0.00392)
Province FEs	X			X		
Sector-Year FEs	X			X		
Prov.-Sect.-Year FE's		X	X		X	X
Firm FE's			X			X

Table 21: Cross-Sectional and Panel Differences: Higher COLA Adjustment

Private Sector Firms						
	(1)	(2)	(3)	(4)	(5)	(6)
	<u>Log Total Clauses</u>			<u>Relative Control</u>		
COLA Amount	-0.0159 (0.00979)	-0.0245+ (0.0129)	0.00535 (0.0170)	0.00176 (0.00155)	0.000115 (0.00203)	0.000320 (0.00252)
Public Sector Firms						
	(1)	(2)	(3)	(4)	(5)	(6)
	<u>Log Total Clauses</u>			<u>Relative Control</u>		
COLA Amount	0.0623** (0.0114)	0.00869 (0.0151)	0.0163 (0.0142)	-0.00253 (0.00185)	-0.00440+ (0.00255)	-0.00352 (0.00244)
Province FEs	X			X		
Sector-Year FEs	X			X		
Prov.-Sect.-Year FE's		X	X		X	X
Firm FE's			X			X