Do Words Matter?
The Value of Collective Bargaining Agreements

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"The difference between a one-page teaching contract [South Carolina] and a fifty-page teaching contract [New York] is that one of them has forty-nine extra pages of things that are good for teachers."

Page 47 from "The Hammer" by Hamilton Nolan
Collective Bargaining, for Economists

Collective Bargaining, for Lawyers
What is all this text for?
Simon (1951) introduced the first formal contract model with the following ingredients:

1. The employer does not know in advance their work needs, and thus cannot contract in advance on the commodities to be delivered by the worker.
2. The employment contract solves this by giving the employer the right to direct the worker after the employer learns its needs (this is effectively the first incomplete contracts model).
3. There is a catch. The worker would not agree to do anything the employer requests, and hence the right to manage is constrained by conditions specifying what the firm cannot ask the worker to do.
4. This illustrates the important observation (which we see in our data), that rights are always conditional, and combined with other constraints or obligations.
Williamson, Wachter and Harris (1975) highlight the fact that employment is a form of idiosyncratic exchange. The benefit of a contract is that it can be tailored to the circumstances unique to each employment relationship (Kornhauser and Macleod (2010)). But if each employment relationship is unique, then it is impossible to have a large number of similar units to allow for a causal treatment-control analysis? This explains why the bulk of empirical work on the employment relationship focuses upon wages and employment, rather than contract terms.
Our Solution

- We develop a natural language processing technology that allows us to produce statistics on the number of rights allocated to management and labor.

- New data:
  - Corpus of $\sim 30k$ collective bargaining agreements from Canada, 1986-2015.
    - Much larger and more systematic than US collective agreement collections.
  - Data on province-year economic variables (income tax + LFS microdata).

- We validate these statistics in several ways:
  - Use a large language model to make pairwise comparisons of worker rights clauses.
  - Show that these measures are positively correlated with the Bloom-van Reenan pro-worker rights clauses in the World Management Survey.
  - Show the effect of the 2005 Auto Industry Crises on worker rights clauses.
Main Results

- Unsupervised text algorithm extracts contract agents and associated rights and duties.

Main Results:

- Worker rights and firm obligations are the most common contract features.
- Increases in labor tax rates and outside options that coincide with contract re-negotiation raise worker rights.
- Union wage premium falls with tax rate, and rises with outside option – consistent with interpreting rights as a form of worker amenity.
Related Literature

- **Empirical properties of contracts.**
  - Standard model of contracts – wage/hour bundle (e.g. Simon 1951, MacLeod 2011).
  - Recent interest in non-wage amenities in frictional labor markets (e.g. Sorkin 2019; Dube, Naidu, and Reich 2022; Sockin 2022; Rousille & Scuderi 2023).

- **Unions**
  - Large literature on union effects on wages/firms/inequality (Dinardo and Lee 2004; Lee and Mas 2012; Farber, Herbst, Kuziemko, Naidu 2021), but less on non-wage benefits (Lagos 2020).
  - Corradini, Lagos, and Sharma (2023) show that when unions started prioritizing women’s issues → increase in female-centric amenities.

- **Natural Language Processing**
  - Active literature in economics applying tools from NLP to economic problems (Gentzkow, Shapiro, and Taddy 2017; Ash and Hansen 2023).
  - Recent work moves past bag-of-words representations, uses grammatical structure in text (e.g. Ash, Jacobs, MacLeod, Naidu, Stammbach 2020; Ash, Gauthier, Widmer 2023).
  - Legal documents becoming an important data source for social science (e.g. Ash, Chen, Naidu 2023; Ash, Chen, Ornaghi 2023).
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Canadian collective bargaining shares similarities with the U.S., such as decentralized bargaining at the firm level and common-law foundation.

Persistently higher union density than USA or UK.

Labor regulations partly at provincial level, with diverse rules on union recognition, strike actions, and dispute resolution.

Collective bargaining agreements in Canada are legally binding, but cannot override basic employment rights.

Reserve Rights: CBAs give employers residual control rights but require disputes to be resolved based on the contract’s text. This encourages more detailed contracts to explicitly define workers’ rights.
Union Contract Information

- Canadian union contracts
  - 1986 through 2015
  - restrict attention to English ones for now.
  - From Employment and Social Development Canada NEGOTECH database.
- 32,404 contracts:
  - 7,572 companies (∼4 contracts per company)
  - 13 provinces, 906 cities
  - 11 industry groupings, and 606 industry codes
- Contract Metadata:
  - Company, union, location, industry, public/private status, number of employees, COLA, wage.
  - Timing (signing, effective, and expiry): Compute contract duration, and match economic variables
- Economic Data:
  - Income tax rate, by province and year (Center for the Study of Living Standards)
  - Employment rates by province, sector, and year (Canadian Labor Force Survey)
# Union Contract Example

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### AGREEMENT

This Agreement, dated December 16, 2005 is made and entered into between ST. CLAIR TECHNOLOGIES INC., Woodbridge, Ontario (hereinafter called "the Company") and the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW) (CIO) and its Local No. 251, (hereinafter called "the Union").

### ARTICLE 1 RECOGNITION

1. The provisions of this Agreement shall apply to all employees covered by this Agreement without discrimination on account of race, creed, colour, sex, marital status, religion, ancestry or place of origin.
2. Wherever the male or female is used, it shall also mean the female.
3. The Company recognizes the Union as the collective bargaining agent for all its employees at Woodbridge, Ontario, save and except supervisors, the following: Doctors, registered nurses, nurse practitioners, registered social workers, students, students to not more than twenty-four hours per week and students employed during the summer months to not exceed eighteen hours one week of school year (September 1st). In cases of reduced to less, students will be laid off first. Students will be laid off at a rate of the following: the Company, but will not be less than the Employment Standards Act.
4. The word "employee" or "employees" wherever used in this Agreement shall mean only the employees in the bargaining unit defined above unless the context otherwise provides.
5. The Company will negotiate with the Union for the purpose of adjusting any dispute which may arise concerning sickness and accident, wages, hours and working conditions.

### ARTICLE 2 PRODUCTION

1. Here, provision, delivery, change, transfer, suspect and retire employees, and to disband or discharge for just cause, any employee provided that shall be carried on by employees who has acquired severity that he has been discharged or disciplined without just cause may be the subject of a grievance.
2. Make, unison, and alter, from time to time, rules and regulations to be observed by the employee, such rule not to be inconsistent with the provisions of this Agreement, and the employer agrees to give a copy of this Agreement to each person employed by the Company as Union Chairman prior to posting of some or all boards.
3. Determine the nature and kind of business conducted by the Company, the kind of location of plants, equipment and material to be used, the control of matters and parts, the use of incentive programs, the methods and techniques of work, the content of rates, the schedules of production, the number of employees to be employed, the extension, limitation, or cancellation of agreements or any part thereof, and to determine and exercise all other function and prerogatives which shall remain with the Company without specification limited by the express provisions of this Agreement.

### ARTICLE 3 NO STRIKES-NO LOCKOUTS

1. The Union agrees that during the term of this Agreement, there shall be no strikes, lockouts, or suspension of work, other complete or partial, for any reason, by any employee or employees, or suspension of employment of employees by the Company, for the duration of this Agreement.

### ARTICLE 4 REPRESENTATION

1. The Union shall elect or appoint and the Company shall recognize, from those employees who have completed at least one (1) year service with the Company a plant committee of four (4) people, one of whom will be the chairperson and one of whom will be a vice-chairperson. The committee people shall be employed on the day shift.
2. The Company shall also recognize a steward who will be elected or appointed by the union and work on the afternoon or midnights shift during such periods as the Company agrees. The steward shall be paid the rate of greater than five (5) employees. Stewards will have preferred seniority on the subject of a grievance.
3. The Union will notify the Company in writing of the names of the stewards and members of the Grievance Committee and any subsequent changes to this list shall be in writing.
4. The Union will provide the Company with written acceptance of the Union Chairman prior to posting of the rules or any part thereof.
5. The Company shall not be required to recognize any steward or member of the Grievance Committee unless such acceptance was filed with the Union within thirty (30) days of the date the steward or member was employed.
6. The Union acknowledges that committee-persons and stewards have their regular duties as employees to perform and that such persons will not be deprived of their regular duties without obtaining an agreement from the steward or supervisor. Such permission shall not be unreasonably withheld. In the application of representation language, "such permission shall not be unreasonably withheld" it is understood that a steward will not obtain a Union representative from performing legitimate representation and by the same token the Union representative will understand the occasional need to complete a job in the interest of continuing productive operation before leaving for legitimate union business. In any event, no such Union representative shall be obtained less than thirty (30) minutes to perform their representation duties.

### ARTICLE 5 UNION SECURITY

1. The Company shall schedule a meeting, date and time within the time limits prescribed for any grievance submitted to Step 2 or Step 3 of the grievance procedure. The grievance procedure shall be compensated at the rate for any such regular scheduled work hours time during such meeting with Company representatives. Should the meeting have been requested by the Company then the meeting goes beyond the Union representative scheduled at that.
2. The plant committee referred to in Section 1, shall head the seniority list during their term of office for layoff and recall purposes only. A committee person will be replaced when more than one (1) employee on the duty shift or any one employee are required to work on Saturdays, Sundays and Statutory Holidays.
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Text Pre-Processing Steps

- Contracts arrived as PDFs, along with matched metadata.
- Convert PDFs to machine-readable text (best was ABBBY FineReader)
- Exclude text for wage schedules, exhibits, appendices, etc.
- Co-reference resolution by section: replace pronouns with referent entity
- Split the contracts into sections (RegEx) and sentences (spaCy):
  - 980,909 contract sections (33 per contract), 10.8 million sentences (11 per section)
Pipline

Text Corpus \((N \approx 40k)\)

Fix OCR Errors

Split Contracts Into Articles

spaCy Coreference Resolution

spaCy Dependency Parse Each Article

Derive Salient Info From Parses

Compute Authority Measures

Merge Metadata

More detail: Ash et al. (2020)
Syntactic Parse for Contract Statements

- Dependency parsing (spaCy):
  - Output: Parse tree, giving functional relations between words in a sentence.
  - Identify syntactic subjects, and form statements around each subject
- Pipeline extracts clauses of the form: **Subject, Verb, Object**
“Worker Rights” Examples

1. Employees who retire as well as current retirees and survivors will be provided with Life Insurance in the amount of $6,000.

2. Where the Company schedules an employee to work in excess of seventy-seven (77) hours in one pay period, the employee will be paid for the excess hours at the applicable overtime rate.

3. An employee terminated during his probationary period would be entitled to review under the grievance procedure up to and including Step 3.

4. Where an employee is prevented by circumstances beyond his control from returning to work on time, he shall be paid for the holidays.

5. However, where practicable, senior employees in each job shall be given the opportunity to perform any available work in that job, on their shift, within their Department.
Subject categories:
- worker, firm, union, manager

Deontic modal verbs (deontic indicating “duty”) capture necessity/possibility in social freedoms to act:
- strict (shall, will, must) modals express necessity
- permissive (may, can) modals express possibility

Parser indicates negation (“shall not”) and active/passive (“shall provide” vs “shall be provided”)

Special verbs:
- **Obligation Verbs** (have to, ought to, be required, be expected, be compelled, be obliged, be obligated)
- **Prohibition Verbs** (be prohibited, be forbidden, be banned, be barred, be restricted, be proscribed)
- **Permission Verbs** (be allowed, be permitted, be authorized)
- **Rights Verbs** (have, receive, retain)
## Summary Stats: Statement Type Shares

<table>
<thead>
<tr>
<th>Subject</th>
<th>Obligation (%)</th>
<th>Prohibition (%)</th>
<th>Permission (%)</th>
<th>Right (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worker</td>
<td>20.9</td>
<td>3.1</td>
<td>8.4</td>
<td>22.9</td>
<td>55.3</td>
</tr>
<tr>
<td>Firm</td>
<td>24.7</td>
<td>1.5</td>
<td>3.4</td>
<td>0.9</td>
<td>30.5</td>
</tr>
<tr>
<td>Union</td>
<td>7.0</td>
<td>0.6</td>
<td>2.0</td>
<td>2.1</td>
<td>11.7</td>
</tr>
<tr>
<td>Manager</td>
<td>1.7</td>
<td>0.1</td>
<td>0.4</td>
<td>0.2</td>
<td>2.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>54.4</strong></td>
<td><strong>5.3</strong></td>
<td><strong>14.1</strong></td>
<td><strong>26.2</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

- Contracts consist mostly of worker rights (22.9%), worker obligations (20.9%) and firm obligations (24.7%)
- Firm rights are rare (0.9%); makes sense as management reserves rights.
Number of Clauses $\propto \log(\text{Firm Size})$

![Graph showing the relationship between the logarithmized number of clauses and the logarithmized number of covered employees. The graph includes a trend line with a coefficient of 0.128*** (0.013).](image)

**Note:** Binscatter plot of the logarithmized number of clauses in the contract (Y axis) against the logarithmized number of covered employees (X axis). Data source: Employment and Social Development Canada.
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Validation of Worker-Rights Clauses using LLM Annotations

- Quite difficult: Scoring a given clause as “pro-worker” or not.
  - much easier: compare two clauses and say which one is more favorable to workers.

- Dataset:
  - 100 randomly sampled sentences for each of 16 clause types (4 agents × 4 provisions)
  - form across-clause-type pairs: 16 × 15 × 100 clauses = 24,000 pairs

- LLM Annotation (gpt-3.5-turbo-0613):
  - System Prompt: "You are a helpful legal assistant."
  - User Prompt: "Which of these sentences from a union collective bargaining agreement is more likely to be interpreted as an entitlement, benefit, or amenity for workers? Answer 'Definitely 1', 'Probably 1', 'Probably 2', 'Definitely 2', or 'Neither'. 1. [sentence 1]. 2. [sentence 2]."

- For each clause type, compute % probability of being more pro-worker than other clause types.
<table>
<thead>
<tr>
<th>Pair-Wise Comparisons: Which is more Pro-Worker?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The Employer and the Union will not tolerate, ignore or condone workplace harassment.</td>
</tr>
<tr>
<td>2. The principal should be specific in his/her comments and should base comments on personal observation.</td>
</tr>
</tbody>
</table>

**GPT Annotation:** Neither.

| 1. Employees who retire as well as current retirees and survivors will be provided with Life Insurance in the amount of $6,000. |
| 2. If the parties mutually agree, the Company may hire temporary employees for short term periods not longer than 30 work days for non-routine work or special projects. |

**GPT Annotation:** Clause 1.

- Validation of GPT-3.5 annotations: compare to 102 human-labeled pairs
  - overall agreement: **62.7%**
  - agreement when one clause is a worker right: **83.3%**
  - GPT-4 even better.
## Ranking of Clause Types by Pair-Wise Pro-Worker Frequency

<table>
<thead>
<tr>
<th>Clause Type</th>
<th>Clause Frequency (%)</th>
<th>Pro-Worker Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worker Right</td>
<td>22.9</td>
<td>80.9</td>
</tr>
<tr>
<td>Union Right</td>
<td>2.1</td>
<td>67.8</td>
</tr>
<tr>
<td>Worker Permission</td>
<td>8.4</td>
<td>63.08</td>
</tr>
<tr>
<td>Manager Right</td>
<td>0.2</td>
<td>59.85</td>
</tr>
<tr>
<td>Firm Obligation</td>
<td>24.7</td>
<td>55.63</td>
</tr>
<tr>
<td>Worker Prohibition</td>
<td>3.1</td>
<td>55.51</td>
</tr>
<tr>
<td>Worker Obligation</td>
<td>20.9</td>
<td>55.33</td>
</tr>
<tr>
<td>Union Permission</td>
<td>2</td>
<td>46.33</td>
</tr>
<tr>
<td>Manager Prohibition</td>
<td>0.1</td>
<td>44.36</td>
</tr>
<tr>
<td>Firm Right</td>
<td>0.9</td>
<td>39.0</td>
</tr>
<tr>
<td>Union Obligation</td>
<td>7</td>
<td>38.74</td>
</tr>
<tr>
<td>Union Prohibition</td>
<td>0.6</td>
<td>38.73</td>
</tr>
<tr>
<td>Manager Obligation</td>
<td>1.7</td>
<td>38.5</td>
</tr>
<tr>
<td>Manager Permission</td>
<td>0.4</td>
<td>37.43</td>
</tr>
<tr>
<td>Firm Prohibition</td>
<td>1.5</td>
<td>36.17</td>
</tr>
<tr>
<td>Firm Permission</td>
<td>3.4</td>
<td>35.56</td>
</tr>
</tbody>
</table>

**Note:** Statistics from pairwise comparisons of clause types with GPT-3.5, as described in the text. Rows indicate clause types. Second column gives the frequency of that clause in the corpus; third column gives the proportion of pairwise comparisons where that category’s clause is annotated as more beneficial to workers than the paired clause from another category. Sorted by third column.
Validation Against Pro-Worker HR Index

- Pro-Worker HR Index based on World Management Survey (Bloom et al, 2012)
  - Increases in “managers care about workers”, “promotes good workers”, “employees are valued”, and decreases in “focus on top talent”, “incentives”, “fire poor performers”
  - Matched to 127 contracts by firm name and time.

![OLS Relationship of Contract Clause Type with Pro-Worker HR Practices]

Note: Figure presents coefficients and 95% confidence intervals of regression of contract clause types on index for Pro-Worker HR Practices. Outcome: Clause type, defined as share of clauses of given type (number of clauses of type in question over the number of all clauses). Treatment: Standardized index of Pro-Worker HR Practices, defined as sum of approval rates to six statements about worker practices. Controls: None. Heteroscedasticity-robust standard errors.
Pro-Worker HR Practices vs. Worker-Rights Clauses

Coef. = 12.03***

(3.50)
Effect of 2000’s Oil Price Shock on Canadian Auto Workers.

Canadian Auto Workers president Buzz Hargrove on the 2005 concession agreement:

➤ "totally unprecedented....there was ’no business as usual’ in this round of bargaining”
➤ "The companies started bargaining by demanding big concessions: like replacing wage increases with lump sums, abandoning COLA (even for pensioners), 10% co-pays on prescriptions, and giving up a week of paid time off per year.”
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Theory Predictions

- Stylized model extending Gruber-Poterba (1994), Dube, Naidu, & Reich (2022):
  - contract specifies pre-tax wage and rights (amenities), which are costly to draft.
  - workers maximize utility, firm maximize profit and offer contract with wage and amenities

- Predictions:
  - rights increase with firm size
  - rights increase with taxes (pre-tax wages decrease)
  - rights increase with outside option (so do wages)
Identification

Baseline Fixed Effects Model:

\[ y_{sit} = \rho z_{sit} + \alpha_{sit} + X_{sit}' \beta + \epsilon_{sit}, \]  

(1)

- **y_{sit}**: Contract feature (i.e. share of worker rights) of contract adopted in province \( s \), firm \( i \), and becoming effective in year \( t \)
- **z_{sit}**: Economic variable of interest (i.e. labour income tax rate or employment rate)
- **\( \alpha_{sit} \)**: Year-by-sector and province-by-sector fixed effects (and further FE in robustness)
  - Conduct event-studies using largest change in each province in 1990s and Callaway-Sant’Anna estimator.
- **X_{sit}**: Time-varying controls in robustness checks
- **\( \epsilon_{sit} \)**: Error term. Standard errors clustered at province-sector level (robustness: province level)

→ Identification assumption: Economic variables affect contract features, without confounding variables influencing both.
(consistent with that, treatment variables are unrelated to firm exits, the number of employees, and whether the employees have a COLA clause).
## Effect of Income Tax Rate Change

<table>
<thead>
<tr>
<th>Worker-Rights Clauses</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
<th>(10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log Income Tax Rate</td>
<td>0.060***</td>
<td>0.037***</td>
<td>0.060***</td>
<td>0.058***</td>
<td>0.060***</td>
<td>0.059***</td>
<td>0.060***</td>
<td>0.046***</td>
<td>0.035***</td>
<td>0.041***</td>
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<tr>
<td></td>
<td>(0.014)</td>
<td>(0.011)</td>
<td>(0.015)</td>
<td>(0.015)</td>
<td>(0.015)</td>
<td>(0.015)</td>
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<td>(0.014)</td>
<td>(0.011)</td>
<td>(0.012)</td>
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<td>R-Squared</td>
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<td>24,549</td>
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<tr>
<td>Province-Sector FEs</td>
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<td>X</td>
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**Note:** Coefficients and standard errors of effect of labor tax rate on worker rights clauses, for different specifications as indicated in table footer. Outcome: Share of worker rights clauses, defined as number of worker rights clauses over the number of all clauses. Treatment: Labor tax rate is defined as logarithmized implicit personal income tax rate. Controls: Pro-Union (Anti-Union) Law Controls includes set of separate indicator variables for whether a given law favorable (unfavorable) to unions is in place. Inference: Standard errors clustered at the province-by-sector level, unless noted otherwise. Single, double, and triple asterisks indicate statistical significance at the 10%, 5%, and 1% levels, respectively.
Effect of Income Tax Rates on Worker Rights, by Topic Group

OLS Relationship of Worker-Rights Clause Groups with Income Tax Rate

- Family issues
- Vacations
- Seniority
- Health & Well-being
- Payments
- Work termination
- Scheduling

Assigning Clauses to Topics
Effect of Income Tax Rates and Union Status on Wages (LFS)

Note: Figure presents coefficients and 95% confidence intervals of effect of labor tax rate, union status, and the interaction of labor tax rate and union status on individual wages. Outcome: Individual wages, defined as worker’s logarithmized hourly wage (before taxes and other deductions, but including tips, commission and bonuses). Treatments: Labor tax rate, defined as logarithmized implicit personal income tax rate; union status, defined as indicator variable that equals one if worker is member of a union, and zero otherwise. Controls: Province-by-sector fixed effects, and year-by-sector fixed effects. Standard errors clustered at the province level. Sample: 1999-2006 (excludes years from the financial crisis 2007 onward).
Labor Demand Shock

- Employment rate in sector X province X year is a measure of workers’ outside option:
  - costliness of strike to employers – more difficult to hire replacements.
  - also a measure of labor demand.
- Predicts more pro-worker contracts during high labour demand.
- Use leave-one-out sectoral employment rate (X province by year) as Bartik instrument.
  - Isolate outside option component.
- Positive labor demand shock improves bargaining position of unions relative to firms: We expect an increase in worker rights and wages
Effect of Outside Option on CBA Clauses

Note: Figure presents coefficients and 95% confidence intervals of effect of Bartik-style leave-one-out employment rate on contract clause types. Outcome: Clause type, defined as share of clauses of given type (number of clauses of type in question over the number of all clauses). Treatment: Bartik-style leave-one-out employment rate in a given sector, defined as the logarithmized average over the employment rates in other sectors. Controls: Province-by-sector fixed effects and year-by-sector fixed effects. Inference: Standard errors clustered at the province-by-sector level.
## Robustness: Effect of Outside Options

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**Note:** Coefficients and standard errors of effect of Bartik-style leave-one-out employment rate on worker rights clauses, for different specifications as indicated in table footer. Outcome: Share of worker rights clauses, defined as number of worker rights clauses over the number of all clauses. Treatment: Bartik-style leave-one-out employment rate in a given sector, defined as the logarithmized average over the employment rates in other sectors. Controls: Pro-Union (Anti-Union) Law Controls includes set of separate indicator variables for whether a given law favorable (unfavorable) to unions is in place. Employment control controls for logarithmized employment rate (own sector). Inference: Standard errors clustered at the province-by-sector level, unless noted otherwise. Single, double, and triple asterisks indicate statistical significance at the 10%, 5%, and 1% levels, respectively.
Note: Figure presents coefficients and 95% confidence intervals of effect of log tax rate (panel A) and Bartik-style leave-one-out log employment rate (Panel B) on worker right topics. Outcome: Worker-rights topic, defined as share of worker rights clauses that belong to given topic (number of clauses of topic in question over the number of all clauses). Controls: Province-by-sector fixed effects and year-by-sector fixed effects. Standard errors clustered at the province-by-sector level.
Outline

Introduction

Background & Data

Measuring Worker Rights in CBAs

Validating Worker Rights

Empirical Analysis

Discussion and Conclusion
CBAs and Tax Avoidance

In response to a 10% income tax increase:
- share of worker-rights clauses in contracts increase by roughly 0.6 p.p. (0.23 standard deviations).
- union wages fall by 1.25%

CBAs offer additional tax avoidance margin:
- Unionized firms can bargain around untaxed amenities in addition to wages.
- In response to a tax increase, there is more movement among unions on rights clauses rather than wages.

Estimates of taxable income elasticity may be biased if amenities are endogenous (eg Chetty 2009; Chetty et al 2011).
In response to a 10% income tax increase:
- share of worker-rights clauses in contracts increase by roughly 0.6 p.p. (0.23 standard deviations).
- union wages fall by 1.25%

One std deviation increase in share of worker-rights clauses is worth about 5.4% of wages.

Compare to:
- Dube, Naidu, Reich (2021): one s.d. of “workplace dignity” worth 6% of wages.
- Anelli and Koenig (2023): reducing workplace fatality risk by 1 in 100,000 is worth 9% of wages.
- Roussille and Scuderi (2023): a one S.D. increase in amenities (in job posts) worth about 12% of wages.
Conclusion

▶ NLP is opening up new dimensions of language for empirical social science research
  ▶ in particular, NLP lets economists study high-stakes legal agreements at scale.
  ▶ detailed parsing of language particularly important in rarely litigated legal documents like collective bargaining agreements.
▶ We find that economic conditions determine legal content of union contracts.
▶ In particular, worker rights clauses behave as a contracted amenity:
  ▶ Personal Income Tax + Outside Option ↑: Increase in worker rights clauses
  ▶ Substitution of wage and non-wage compensation
  ▶ Allows valuation of contract language in empirical economics.
▶ Thank you!
Appendix Slides
Model Ingredients (based on Dube, Naidu, & Reich 2022)

- Worker CES Utility with $\rho < 1$:

$$V\left(\{a\}, w\right) = \left(\left(\int_0^1 a_i di\right)^\rho + ((1 - \tau) w)^\rho\right)^{1/\rho}$$

  - wage $w$, tax rate $\tau$
  - mass of potential rights (to amenities) $a_i \in [0, 1]$, $\forall i \in [0, 1]$. 

$F$ is cumulative distribution function for probability of no strike, increasing and concave.
Model Ingredients (based on Dube, Naidu, & Reich 2022)

- Worker CES Utility with $\rho < 1$:
  \[ V(\{a\}, w) = \left( (\int_0^1 a_i di)^\rho + ((1 - \tau)w)^\rho \right)^{1/\rho} \]
  - wage $w$, tax rate $\tau$
  - mass of potential rights (to amenities) $a_i \in [0, 1]$, $\forall i \in [0, 1]$.

- Firm offers wage $w$ and CBA with length $T \in [0, 1]$ describing rights $\{a_i^*\}$.
  - workers have right to each contracted amenity: $a_i = a_i^*$ for $i \in [0, T]$
  - management reserves rights for non-contracted amenities: $a_i = 0$ for $i \in (T, 1]$. 

- Workers can strike if $V(\cdot) + \epsilon > V_0$.
  - $V_0$ = outside option, increases with local sectoral labor demand.
  - $\epsilon \sim 1 - F(V - V_0)$, $F(\cdot)$ = cdf for probability of no strike, increasing and concave.

- Firm profit $\Pi(\{a\}, w, T) = (p - w - (\int_0^1 a_i di)\rho + (1 - \tau)w)^{1/\rho}$
  - $p$ = worker marginal product,
  - $c$ = firm amenity cost
  - $C(T)$ = drafting cost of CBA, $C(\cdot)$ is increasing and convex, with $C'(0) = 0$ and $C'(1) = \infty$. 

Model Ingredients (based on Dube, Naidu, & Reich 2022)

- Worker CES Utility with $\rho < 1$:

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- Workers can strike if $V(\cdot) + \epsilon > V^0$.
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Model Ingredients (based on Dube, Naidu, & Reich 2022)

▶ Worker CES Utility with $\rho < 1$:

$$
V(\{a\}, w) = \left( (\int_0^1 a_i di)^\rho + ((1 - \tau)w)^\rho \right)^{1/\rho}
$$

▶ wage $w$, tax rate $\tau$

▶ mass of potential rights (to amenities) $a_i \in [0, 1], \forall i \in [0, 1]$.

▶ Firm offers wage $w$ and CBA with length $T \in [0, 1]$ describing rights $\{a^*_i\}$.

▶ workers have right to each contracted amenity: $a_i = a^*_i$ for $i \in [0, T]$

▶ management reserves rights for non-contracted amenities: $a_i = 0$ for $i \in (T, 1]$.

▶ Workers can strike if $V(\cdot) + \epsilon > V^0$.

▶ $V^0 =$ outside option, increases with local sectoral labor demand.

▶ $\epsilon \sim 1 - F(V - V^0), F(\cdot) =$ cdf for probability of no strike, increasing and concave.

▶ Firm profit

$$
\Pi(\{a\}, w, T) = (p - w - \int_0^1 c a_i di) F(V(\{a\}, w) - V^0) - C(T)
$$

▶ $p = \text{worker marginal product}, c = \text{firm amenity cost}$

▶ $C(T) =$ drafting cost of CBA, $C(\cdot)$ is increasing and convex, with $C'(0) = 0$ and $C'(1) = \infty$. 

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Equilibrium

Firm problem:

\[
\max_{a^*, T, w} \left( p - w - cT a^* \right) F(V(T a^*, w) - V^0) - C(T)
\]

In equilibrium, worker MRS is equal to firm MRT (net of tax):

\[
\left( \frac{w}{T a^*} \right)^{\rho - 1} = \frac{1}{c(1 - \tau)^\rho}
\]

Other results:

- Amenities and wages increase with the outside option \(V^0\) or with firm productivity \(p\).
Equilibrium

- Firm problem:

\[
\max_{a^*, T, w} \left( p - w - cT a^* \right) F(V(T a^*, w) - V^0) - C(T)
\]

- In equilibrium, worker MRS is equal to firm MRT (net of tax):

\[
\left( \frac{w}{T a^*} \right)^{\rho - 1} = \frac{1}{c(1 - \tau)^{\rho}}
\]

- Taking logs and re-arranging, we have

\[
\log\left( \frac{w}{T a^*} \right) = c_0 - \sigma \log(1 - \tau)
\]

- where \( \sigma = \frac{\rho}{\rho - 1} \) is the MRS and \( c_0 = \frac{\log c}{\rho - 1} \) is a constant.

- i.e., an increase in the tax rate (decrease in net-of-tax rate) increases the ratio of amenities to wages.

- Other results:

- amenities and wages increase with the outside option \( V^0 \) or with firm productivity \( p \).
Equilibrium

- Firm problem:
  \[
  \max_{a^*, T, w} (p - w - cTa^*)F(V(Ta^*, w) - V^0) - C(T)
  \]

- In equilibrium, worker MRS is equal to firm MRT (net of tax):
  \[
  \left( \frac{w}{Ta^*} \right)^{\rho-1} = \frac{1}{c(1 - \tau)^\rho}
  \]

- Taking logs and re-arranging, we have
  \[
  \log\left( \frac{w}{Ta^*} \right) = c_0 - \sigma \log(1 - \tau)
  \]

  where \( \sigma = \frac{\rho}{\rho - 1} \) is the MRS and \( c_0 = \frac{\log c}{\rho - 1} \) is a constant.

  i.e., an increase in the tax rate (decrease in net-of-tax rate) increases the ratio of amenities to wages.

- Other results:
  - amenities and wages increase with the outside option \( V^0 \) or with firm productivity \( p \).
NLP in Legal Contexts: Text corpora

- Legislation
  - The statutes enacted by legislators, which are then added to a compiled code
  - Hierarchical structure, extensively cross-referenced

- Regulations
  - The more specific rules to implement legislation, decided by more technocratic agencies.
  - E.g., tax agency should decide whether a gift counts as income

- Judicial opinions
  - When a dispute arises over the meaning of a statute or regulation, a judge decides
  - Judge will write an opinion, citing statutes and previous caselaw, explaining the interpretation
NLP in Legal Contexts: Potentials (Robot clerk)

▶ In general: Legal documents tend to have more structure, legal language tends to be more precise than other corpora

▶ Annotation tasks
  ▶ Categorize documents into topics (Osnabruegge, Ash, and Morelli 2021), tag slant/sentiment in opinions (Ash, Chen, and Galletta 2021)

▶ Document Comparison and Retrieval
  ▶ Finding similar precedents to a given case (Ostendorff, Ash, et al 2021)
  ▶ Compare international tax treaties to understand influential tax systems (Ash and Marian 2020).

▶ Legal Summarization and Drafting (powered up by neural nets and language models)
  ▶ Generate coherent legal language (Peric, Mijic, Stammbach and Ash 2020), extractive summarization: highlight the relevant portions of long texts (Gu, Ash, and Hahnloser 2022; Bauer, Stammbach, Gu, and Ash 2023)
NLP in Legal Contexts: Issues and Limitations

► Text complexity:
  ► Definitions are often specified elsewhere in the document
  ► Extensive and pivotal references to other documents

► Text ambiguity
  ► bounded cognition and time; strategic ambiguity
  ► failed efforts to put law on a formal-logic basis, or to say “law is code”

► Context
  ► Legal texts are embedded in a complex social system, e.g. parliamentary debates, proposed bills etc.
Labor Demand Shock

- Employment rate in sector X province X year measure of outside option of workers and costliness of strike to employers.
  - E.g. more difficult to hire replacement workers.
- But also a measure of labor demand.
  - Also predicts more pro-worker contracts during high labor demand.
- Use leave-one-out sectoral employment rate (X province by year) as Bartik instrument.
  - Isolate outside option component.
Event-Study: Outside Employment Rate Decrease

- p-val (pre) = 0.935
- p-val (post) = 0.001

Worker-Rights Clauses Share

Years relative to event (two-year bins)

- Back

Pre-treatment

Post-treatment
Event-Study: Outside Employment Rate Increase

p-val (pre) = 0.257
p-val (post) = 0.169

Worker-Rights Clauses Share

Years relative to event (two-year bins)

Pre-treatment

Post-treatment
Note: Effect of Bartik employment rate on contract clause types. Bartik employment calculated as leave-one-out specification, where employment in a given province, year, and sector equals the average employment in this province and year for all other sectors besides the one of the contract.
Event-Study: Own Employment Rate Decrease

Worker Entitlements Share

Years relative to event (two-year bins)

-9,-5  -4,-3  -2,-1  [0,1]  [2,3]  [4,6]

Pre-treatment  Post-treatment
Event-Study: Own Employment Rate Increase

-0.01
0
0.01
0.02
0.03
0.04

Worker Entitlements Share

[-8,-5] [-4,-3] [-2,-1] [0,1] [2,3] [4,5]

Years relative to event (two-year bins)

Pre-treatment Post-treatment

Pre-treatment
Post-treatment

Back
Employment Rate Results

OLS Relationship of Contract Clause Type with Employment Rate

- Worker Constraints
- Manager Permission
- Manager Entitlements
- Manager Obligations
- Manager Constraints
- Firm Entitlements
- Firm Permissions
- Worker Permissions
- Union Entitlements
- Union Permissions
- Firm Constraints
- Non Worker Entitlements (Average)
- Union Constraints
- Worker Obligations
- Union Obligations
- Firm Obligations
- Worker Entitlements

Bartik

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Effect of Employment Rate on Worker Rights by Topic Group

OLS Relationship of Worker-Right Clause Groups with Bartik Employment
Effect of Employment Rates and Union Status on Wages

Event-Study: Employment Decrease
## Appendix: Summary Statistics for Contracts Metadata

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</tr>
<tr>
<td>Income Tax Rate (%)</td>
<td>24910</td>
<td>22.38973</td>
<td>1.447889</td>
<td>16.11</td>
<td>25.62</td>
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<td>Unemployment Rate (%)</td>
<td>29200</td>
<td>5.086423</td>
<td>3.544908</td>
<td>1.08</td>
<td>49.92</td>
</tr>
<tr>
<td>NDP Province Govt Control</td>
<td>32402</td>
<td>.2127338</td>
<td>.4092472</td>
<td>0</td>
<td>1</td>
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</table>
Appendix: Text Pre-Processing Steps

- Contracts arrived as PDFs, along with matched metadata

- Convert PDFs to machine-readable text:
  - Compared three different OCR engines. Best was ABBYY FineReader (by misspelling rate), followed by Adobe's and then Tesseract

- Exclude text for wage schedules, exhibits, appendices, etc.

- Split the contracts into sections and sentences:
  - Use custom-built splitter (based on regular expression), and Spacy tokenizer

- 980,909 contract sections (33 per contract), 10.8 million sentences (11 per section)
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Appendix: Event-Study: Employment Rate Decrease

Year relative to event (two-year bins)

Pre-treatment

Post-treatment
Assigning Clauses to Topics

- Use pretrained S(entence)-BERT encoder to represent clauses as 768-dim vectors.
  - Uses context of sentences tuned to capture similar meanings (rather than word counts like LDA).
- Apply k-means clustering within clause type (e.g. within set of worker-rights sentences) to produce $k = 32$ topics.
- Aggregate clusters into 7 more interpretable topics: Scheduling, work termination, health & well-being, vacations, family issues, payments, and seniority.
Summary Statistics on Topic Clusters of Worker Rights

<table>
<thead>
<tr>
<th>Label</th>
<th>Frequency</th>
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<tbody>
<tr>
<td>Scheduling</td>
<td>0.182</td>
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<tr>
<td>Work Termination</td>
<td>0.069</td>
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<tr>
<td>Health &amp; Wellbeing</td>
<td>0.051</td>
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<tr>
<td>Vacation</td>
<td>0.117</td>
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<tr>
<td>Family Issues</td>
<td>0.068</td>
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<tr>
<td>Payments</td>
<td>0.079</td>
</tr>
<tr>
<td>Seniority</td>
<td>0.089</td>
</tr>
</tbody>
</table>

Note: Cluster topics from “Other” category not reported.