Injury Risks Associated with Subcontracting in U.S. Construction

KEVIN CONNER, FREDERICK PURIFOY, KEVIN DUNCAN, PETER PHILIPS, MARK PRUS, JEFF WADDOUPS

NOVEMBER 21ST 2024

Studying Injuries and Subcontracting

AS A **PRACTICE**

- Case and limited statistical studies
- Practitioners experience & perspective
- Injury specifics in relation to subcontracting
- Subcontracting management practices
- Implementing risk management best practices

AS A **SYSTEM**

Statistical studies founded on existing practice literature

Business cycle, unemployment, profit pressures, competitive structure, insurance pressures, allocation of blue and white-collar workers along the subcontracting chain, contractor/subcontractor size,

Risk allocation along the subcontracting chain

Risk elevation in the aggregate

Five Construction Facts

Big
◦ 5% of US Employment and 10% of Male Employment
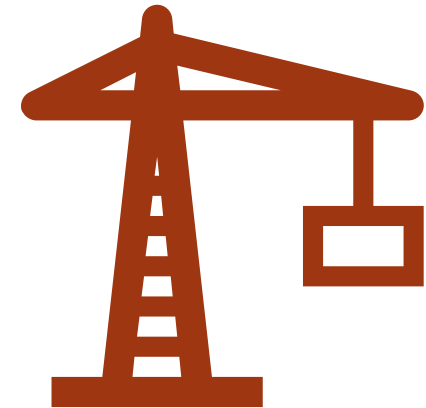
Volatile
◦ Highly exposed to business cycles

Small
◦ Average establishment has fewer than 10 employees

Everywhere
◦ Example: every county in Wyoming reports a construction sector

Dangerous
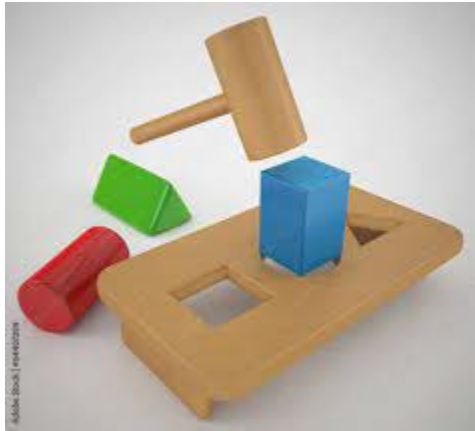◦ More fatal workplace injuries than any other industry

Subcontracting and Injuries: Beneficial and Detrimental Potentials

Right Contractor Right Job

More subcontracting means fewer injuries

Hot Potato

Establishment Phenomenon

More injuries down-chain: reallocation & potentially exacerbation

Too Many Cooks Spoil the Broth

Project Phenomenon

More injuries overall: exacerbation

Subcontracting Injury Literature

◦ Existing work generally concludes that subcontracting endangers workers.
◦ Most are based on case studies
◦ Quantitative analysis limited scope

Our Study

◦ First to view the entire construction industry
  ◦ US 2007, 2012, 2017
◦ Includes self-performing with subcontracting contractors
◦ Controls for economic and construction context (business cycle, industry subsector, injury trends, etc.)

Research Question

Does subcontracting redistribute injury risks away from higher-tier towards lower-tier contractors?

Follow-up Question:

Are lower tier contractors better equipped to manage the risks of the work they receive?

Data

Public Data
- Economic Census of Construction Industries
- Survey of Occupational Injuries and Illnesses

FRDC Data
- Establishment-level Economic Census of Construction Industries
  - Quinquennial, with several hundred thousand construction establishments in each year
- Establishment-level Survey of Occupational Injuries and Illnesses
  - Annual, quarter million establishments drawn from all industries

Linked sample combining business operations and safety data
- Establishments are linked using EIN, NAICS, and location information.

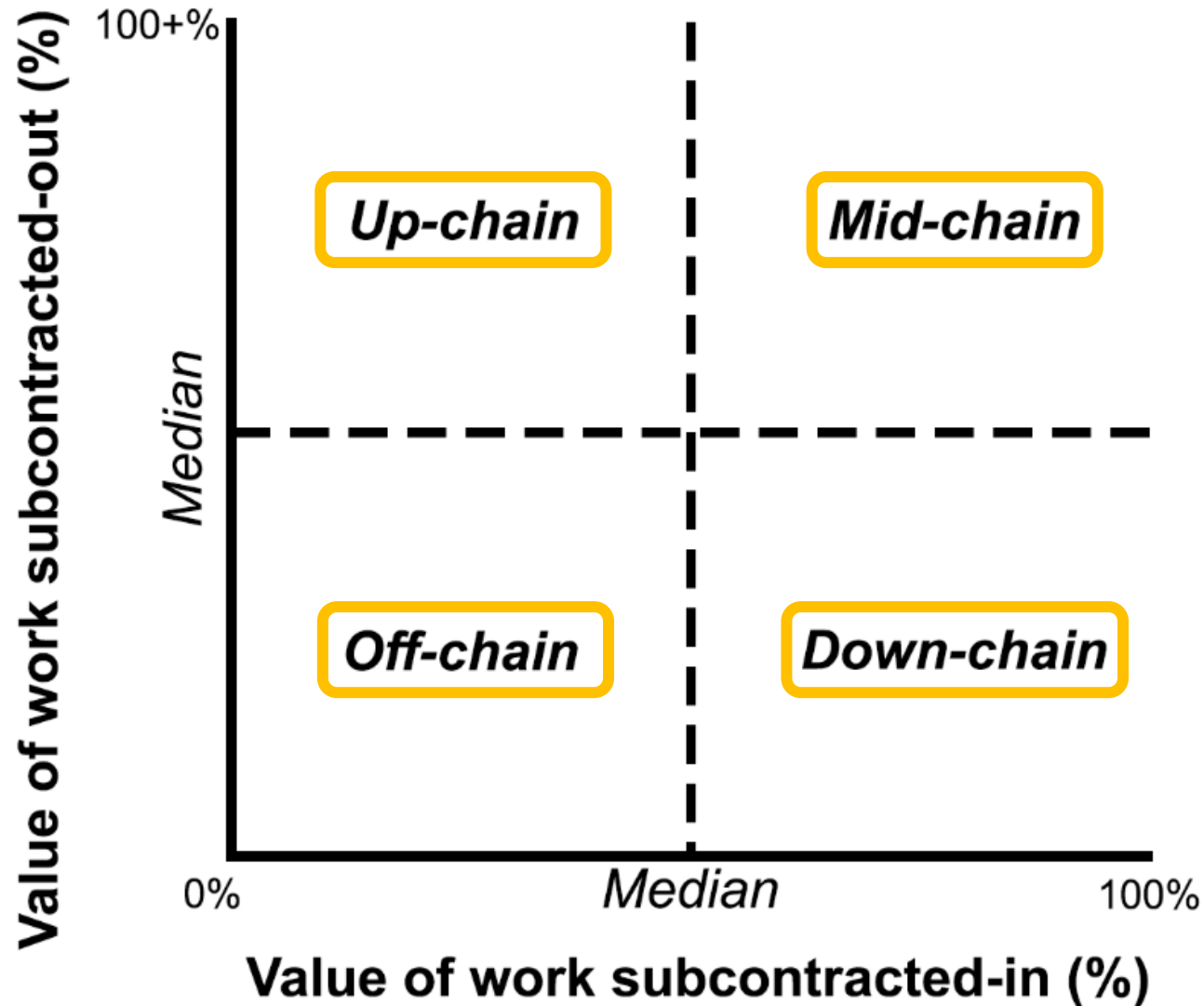## ~18,000 establishments, tending towards larger eststablishments

Contractor Typology

Table 3: Mean Subcontracting as a Percent of Total Receipts by Subcontracting Chain Category

	Subcontracting Out	Subcontracting In
Off-Chain	1.5%	1.4%
Up-Chain	24.9%	2.4%
Mid-Chain	16.9%	74.0%
Down-Chain	1.0%	82.1%

(CBDRB-FY24-P2497-R10966)

Model

Negative Binomial model for count outcomes
- ◦ Outcome: Injury Count (Total and Days Away from Work Cases)
- ◦ Report incidence rate ratios

$$E(\textit{Establishment Injury Count}_i \mid \boldsymbol{X_i}) = \exp(\beta_0 + \beta_1 \textit{Off-Chain Contractor}_i + \beta_2 \textit{Mid-Chain Contractor}_i +$$

$$\beta_3 \textit{Down-Chain Contractor}_i + \beta_4 \textit{ln(Average Annual Employment}_i) + \beta_5 \text{ State } +$$

$$\beta_6 \textit{State Unemployment Rate}_t + \beta_7 \textit{Year} + \beta_8 \textit{NAICS Code}_i + \boldsymbol{\alpha} \textbf{ \textit{Contractor Characteristics}}_i)$$

Where $\mathbf{X}$ is the vector of explanatory variables, and $\boldsymbol{\alpha}$ is a vector of coefficients associated with a vector of other contractor characteristics.

Injury rates are 9-11% higher at the bottom of subcontracting chains than at the top.

	(1) Total Cases	(2) DAFW Cases
Subcontracting Reference: Up-Chain		
Off-chain	0.958	1.001
Mid-Chain	1.077***	1.058
Down-Chain	1.089***	1.108***
Log of Average Annual Employment	2.617***	2.240***
Construction Worker Percent of Employment	1.002***	1.005***
Expenditure on Temp. Workers as Percent of Labor Costs	1.004	1.003
Seasonality	1.078	1.109
Rental Share of Total Costs	0.992**	0.993
State Unemployment Rate	0.955***	0.940***

Incident rate ratios for states are estimated but not reported.
p<0.1, ** p<0.05, *** p<0.01.
(CBDRB-FY24-P2497-R10966)

	(1) Total Cases	(2) DAFW Cases
Year Reference: 2007		
2012	0.835***	0.913
2017	0.563***	0.607***
NAICS Code		
General Residential (2361)	0.847***	0.903*
General Nonresidential (2362)	0.792***	0.642***
Utility Systems (2371)	0.750***	0.771***
Highway, Street & Bridge (2373)	0.948	0.999
Other Heavy & Civil (2379)	0.674***	0.549***
Foundation, Structure, & Exterior (2381)	REF	REF
Building Equipment (2382)	0.829***	0.718***
Building Finishing (2383)	0.723***	0.784***
Other Specialty Trade (2389)	0.713***	0.748***
Constant	0.065***	0.037***
lnalpha	0.751***	0.882***
~N	18000	18000
pseudo R-sq	0.173	0.154

Economic Characteristics of Down-Chain and Up-Chain Contractors

DOWN-CHAIN

- Smaller
- More Blue-Collar
- Pay Less
- Invest Less in Equipment
- Buy Fewer Materials

UP-CHAIN

- More White-Collar
- Higher Pay
- Invest More in Equipment

Context: Contractor Characteristics

Multinomial Logistic Regression
- Outcome: Subcontracting Category
- Reporting Average Marginal Effects

	Off-Chain	Up-Chain	Mid-Chain	Down-Chain
Log of Average Annual Employment	-0.0341***	0.0043	0.0475***	-0.0177***
Construction Worker Percent of Employment	-0.0003	-0.0010***	0.0002	0.0011***
Rate of Markup	0.0015***	-0.0011***	-0.0013***	0.0009***
Total Profits	-0.0044	0.0183	0.00004	-0.0140
Average Construction Worker Pay	-0.7428***	0.3745**	0.7482***	-0.3799*
Seasonality	0.1692***	0.0454*	-0.1154***	-0.0991***
Capital Expenditure to Labor Ratio	-0.0027***	0.0011***	0.0025***	-0.0009***
Value of Materials Put in Place Per Worker	0.2264***	0.0351	0.0683	-0.3299***
~N		13500		
Adjusted Count R-Sq		0.309		

AMEs for state, year, 4-digit NAICS, percent new construction, percent heavy highway construction, and percent building construction are estimated but not reported.
- $p<0.1$, ** $p<0.05$, *** $p<0.01$
- (CBDRB-FY24-P2497-R10966)

Conclusions

For both total and days away from work injuries, incidence rates are between 9 and 11 percent higher at the bottom of subcontracting chains than at the top.

◦ Consistent with up-chain contractors triaging dangerous work

Regulations and policies promoting safety in construction might focus on contractors further down the subcontracting chain.

Contractor training might include business training to help improve the economic precarity experienced by down-chain contractors