Remote Work and the Rise of Performance Pay

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Introduction

- Pay structure—e.g. base *vs* variable—central in several literatures (inequality, labor market dynamics, tax policy)
- Limited empirical work on determinants of pay structure
- Theory: moral hazard, hidden type

- Few estimates of performance pay (Lemieux et al. 2009, Makridis & Gittleman 2022)
- Hard to quantify changes to information environment

This paper

- Measure offered performance pay in $\sim$200m U.S. job ads using LLM-assisted approach
- Increasing reliance on performance pay
- Convergence of occupations traditionally not paying by performance (e.g. administrative, legal, business and computer occupations)

- Widespread adoption of remote work after 2020
- Exploit within-employer-job title-month ad-level variation and control for ad-level characteristics and specific skill requirements
- Distinguish monitoring from sorting using pay types, occupations and worker panels from survey data

Literature

- Pay structure: inequality, risk sharing, taxation and aggregate shocks
  (Lemieux et al. 2009, Guiso et al. 2005, Doligalski et al. 2023, Gertler et al. 2020, Grigsby et al. 2021, Hazell & Taska 2025, Gaur et al. 2025)
- Contract theory: moral hazard, sorting and observable performance
  (Holmström 1979, Lazear 1986, Prendergast 2002)
- Performance pay: productivity and labor-market effects
  (Lazear 2000, Shearer 2004, Cadsby et al. 2007, Dohmen & Falk 2011, Lemieux et al. 2012, Bloom et al. 2015)
- Measurement: realized performance pay in the PSID and NCS
  (Lemieux et al. 2009, Makridis & Gittleman 2022)
- Remote work and job-ad text
  (Barrero et al. 2023, Hansen et al. 2023, Bick et al. 2023, Deming & Kahn 2018, Adams et al. 2026)

Data

- **Lightcast:** U.S. online vacancies, 2015 to 2024
- 192,218,930 non-duplicate ads; 24,564,451 from employers' career sites
- Full text, employer, occupation, title, month, state and skills

- **PSID:** worker-level remote work and bonus or commission income
- **NCS:** external estimates of performance-pay incidence

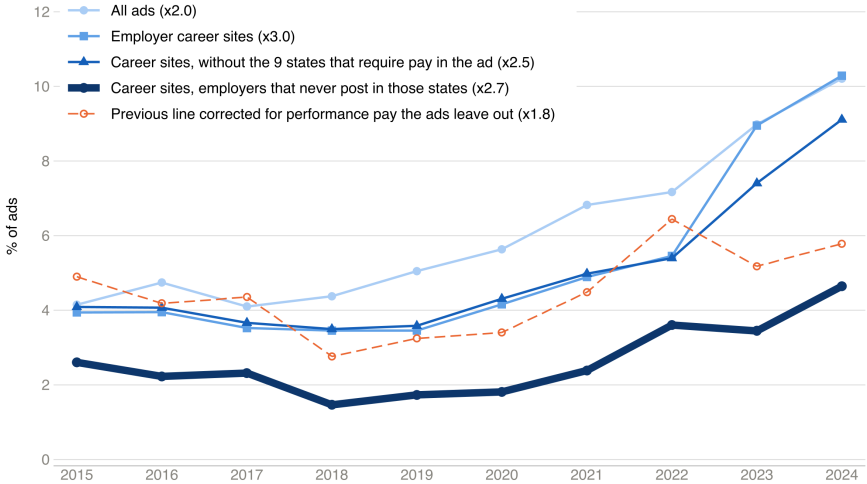
Measuring performance pay I

- **Contextual rules:** include commission, performance bonus and incentive pay tied to results
- Exclude signing bonuses, tips, per-unit pay and non-pay uses of “commission”
- Apply exclusions only to the phrase they touch

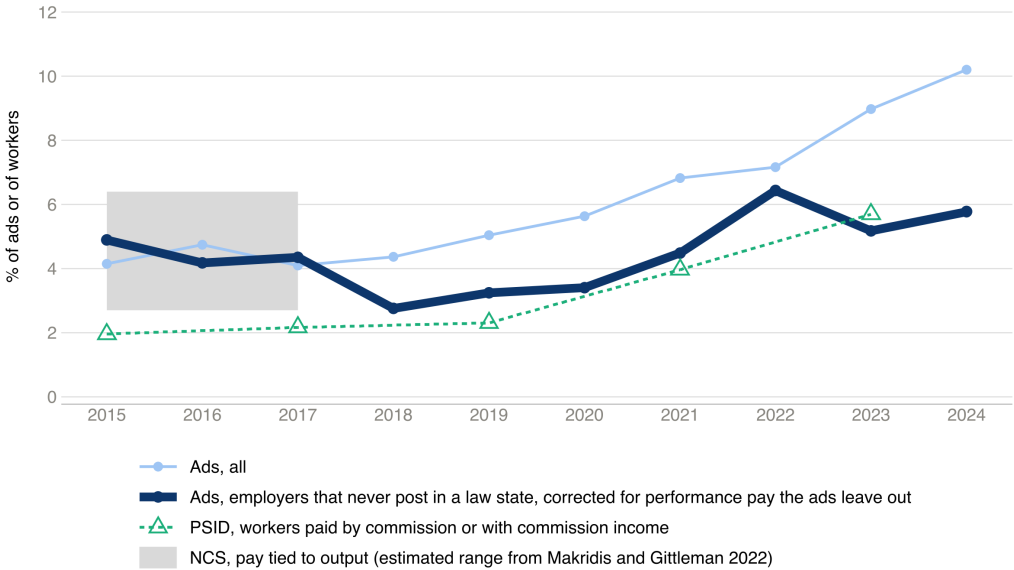
- **Audit:** a language model reads 13,000 full ads without seeing the rules
- Half informs revisions; half measures accuracy
- Authors hand-review 100 ads
- The rules favor precision over recall because false tags add noise to every regression

Measuring performance pay II

	First rules	Revised rules
Precision	66%	**71%**
Tagged ads read as neither	14%	**6%**
Commission tags correct	76%	**91%**
Recall	79%	70%
Agreement with hand review	55 of 96	**70 of 96**

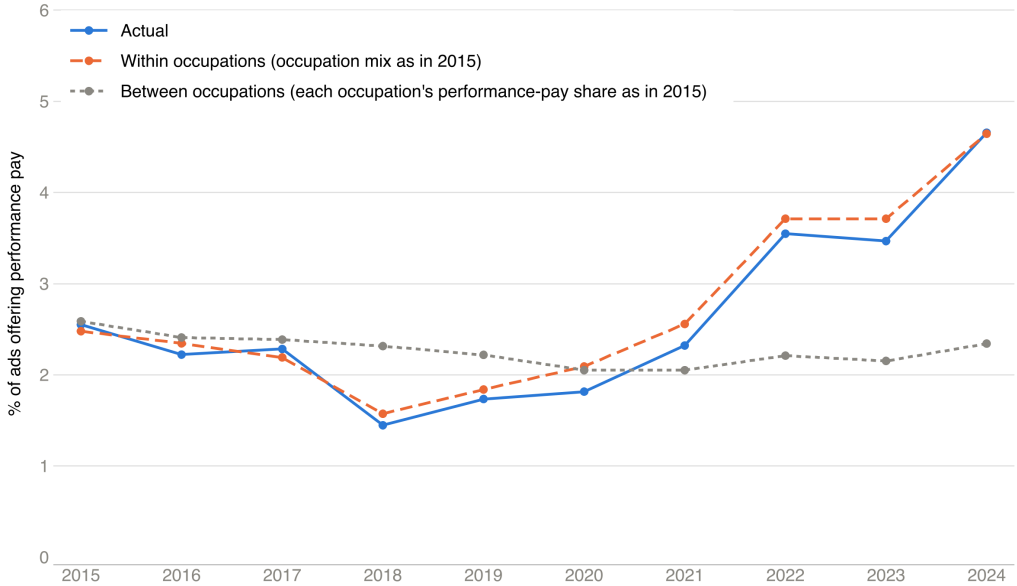


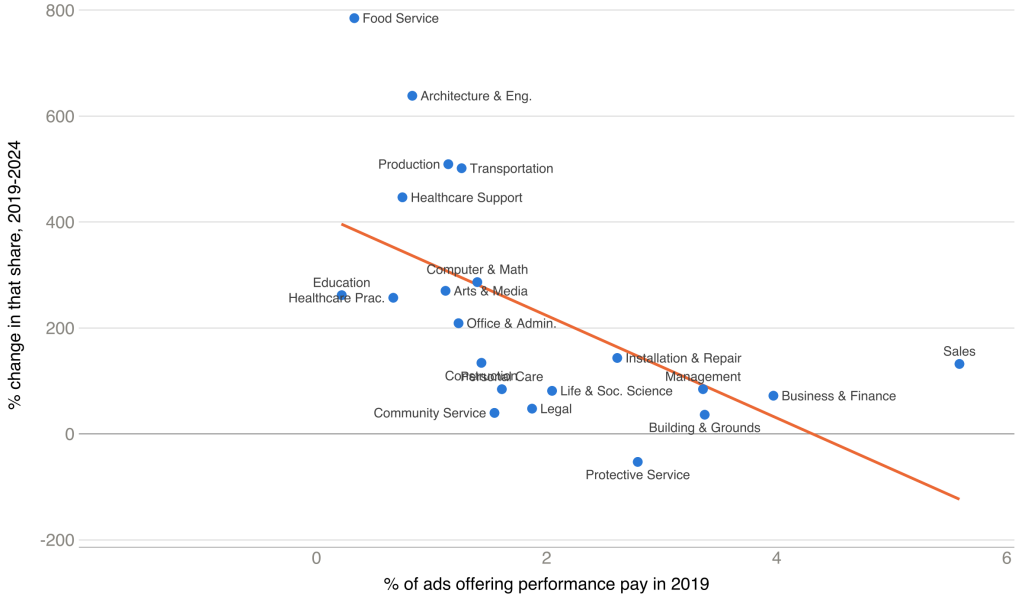
Correction factor: ratio of the share of ads with performance pay in a state that forces disclosure to the share in states without a law, within the same employer, six-digit occupation and month. Colorado in 2021–22, Colorado and Washington in 2023–24, the 2021 ratio before 2021.


% of ads or of workers
12
10
8
6
4
2
0
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
Ads, all
Ads, employers that never post in a law state, corrected for performance pay the ads leave out
PSID, workers paid by commission or with commission income
NCS, pay tied to output (estimated range from Makridis and Gittleman 2022)

Comparison with existing estimates

- Ads measure openings and promised pay; the surveys measure jobs held or pay received
- PSID level is lower through 2019 because it counts commission but not performance bonuses
- Performance pay falls with employer size in both the ads and the NCS
- Finance ranks highest; real estate also ranks high
- Education, public administration, health care, and accommodation and food rank low

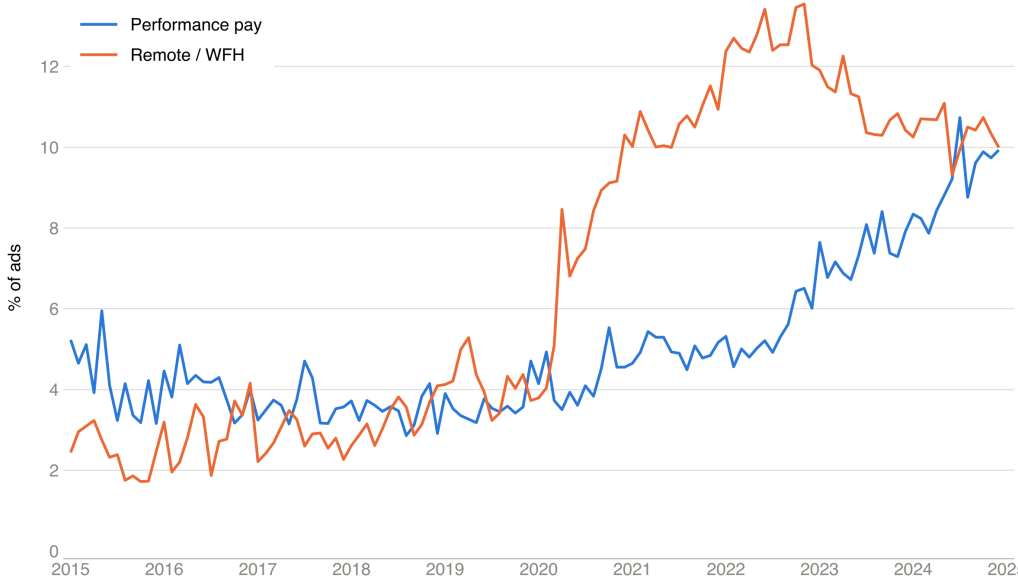

Actual
Within occupations (occupation mix as in 2015)
Between occupations (each occupation's performance-pay share as in 2015)
% of ads offering performance pay
0
1
2
3
4
5
6
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024

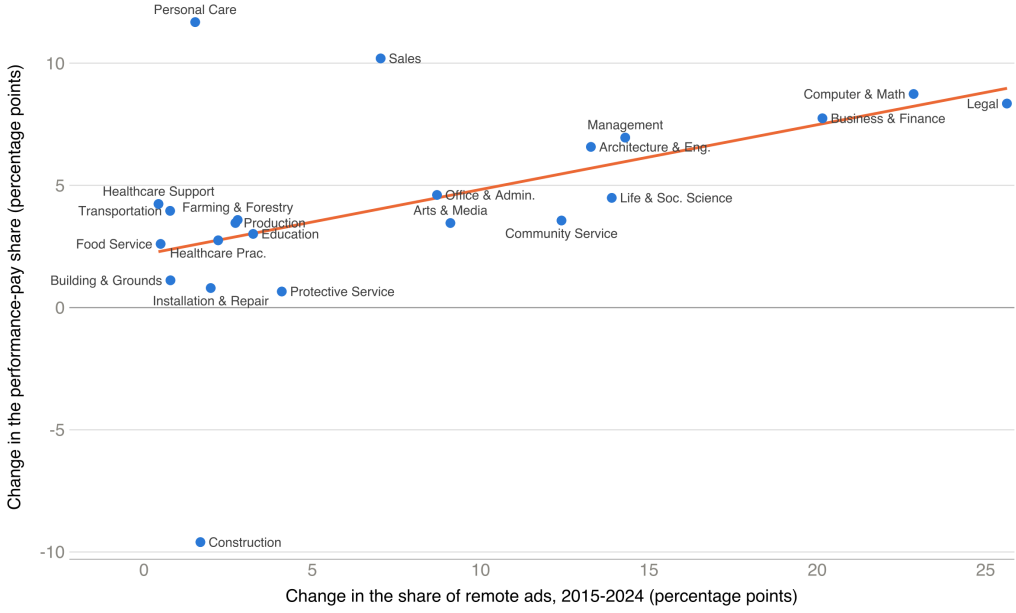

800
600
400
200
0
-200
0
2
4
6
% change in that share, 2019-2024
% of ads offering performance pay in 2019
Food Service
Architecture & Eng.
Production
Transportation
Healthcare Support
Computer & Math
Education
Healthcare Prac.
Arts & Media
Office & Admin.
Installation & Repair
Sales
Management
Life & Soc. Science
Business & Finance
Community Service
Legal
Building & Grounds
Protective Service

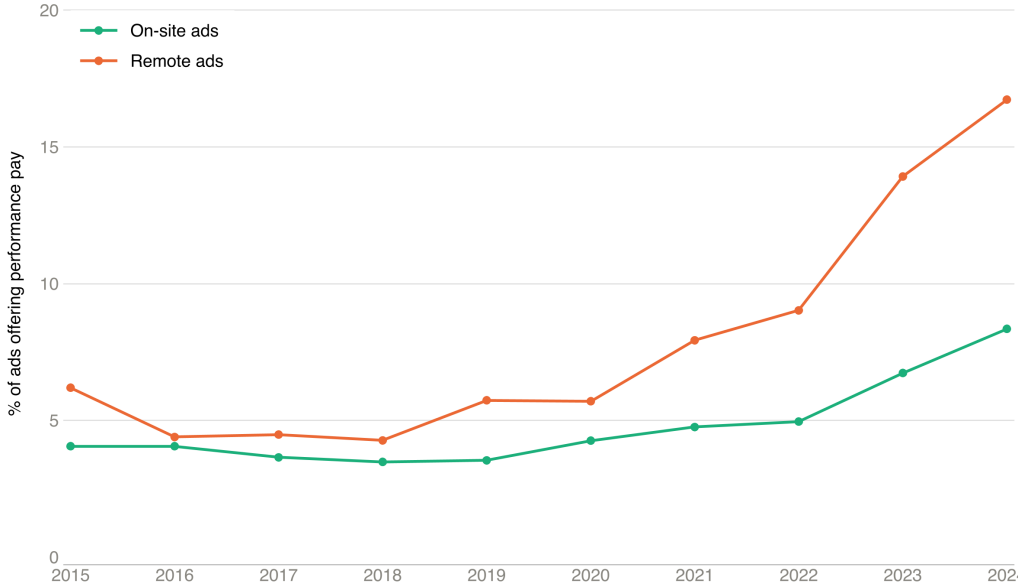
Measuring remote work

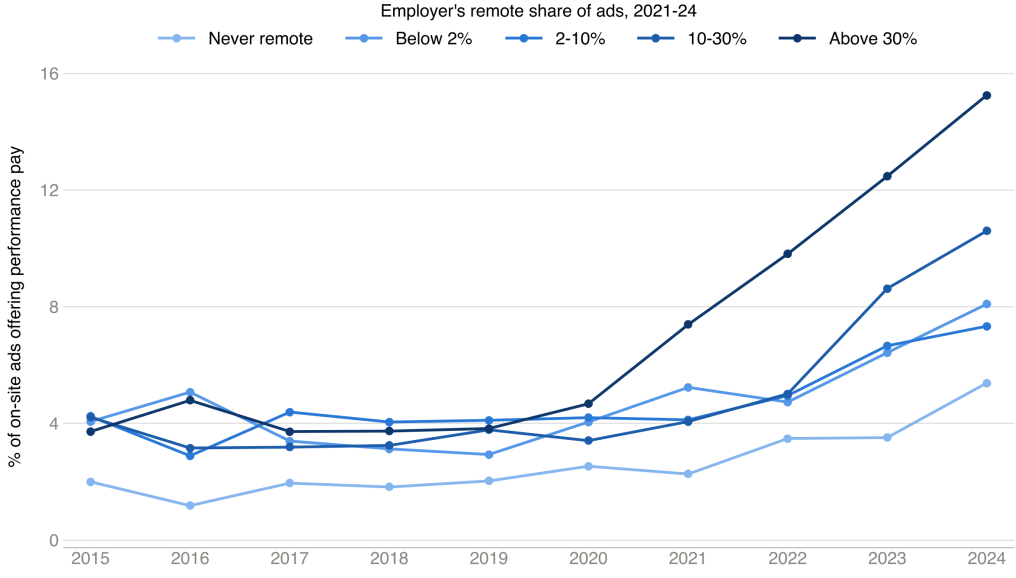
- Classifier: sentence-level language model from Hansen et al. (2023)
- Main analysis: 2019 to 2024

- Public model run on 2013 to 2018 ads
- An ad is remote when its highest sentence score exceeds 0.5
- Validation on 142,500 ads: 95% agreement, 83% precision and 61% recall


Performance pay
Remote / WFH
% of ads
0
2
4
6
8
10
12
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025


Personal Care
Sales
Computer & Math
Legal
Business & Finance
Management
Architecture & Eng.
Healthcare Support
Transportation
Farming & Forestry
Production
Education
Food Service
Healthcare Prac.
Office & Admin.
Arts & Media
Life & Soc. Science
Community Service
Building & Grounds
Installation & Repair
Protective Service
Construction
10
5
0
-5
-10
0
5
10
15
20
25
Change in the performance-pay share (percentage points)
Change in the share of remote ads, 2015-2024 (percentage points)


On-site ads
Remote ads
% of ads offering performance pay
20
15
10
5
0
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024


Employer's remote share of ads, 2021-24
Never remote
Below 2%
2-10%
10-30%
Above 30%
% of on-site ads offering performance pay
16
12
8
4
0
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024

Two empirical designs

- **Same job over time:** employer $\times$ occupation $\times$ specialized occupation
- E.g. T-Mobile, Sales Representatives, Account Executive
- Job and employer-month effects
- Pre-2020 skill content interacted with month effects

- **Same employer, title and month:** compare remote and on-site ads at one date
- Hold employer, occupation, standardized title and month fixed
- E.g. T-Mobile, Sales Representatives, Government Account Executives
- Robustness: state, ad size, skill factors or exact skill list

Same job over time

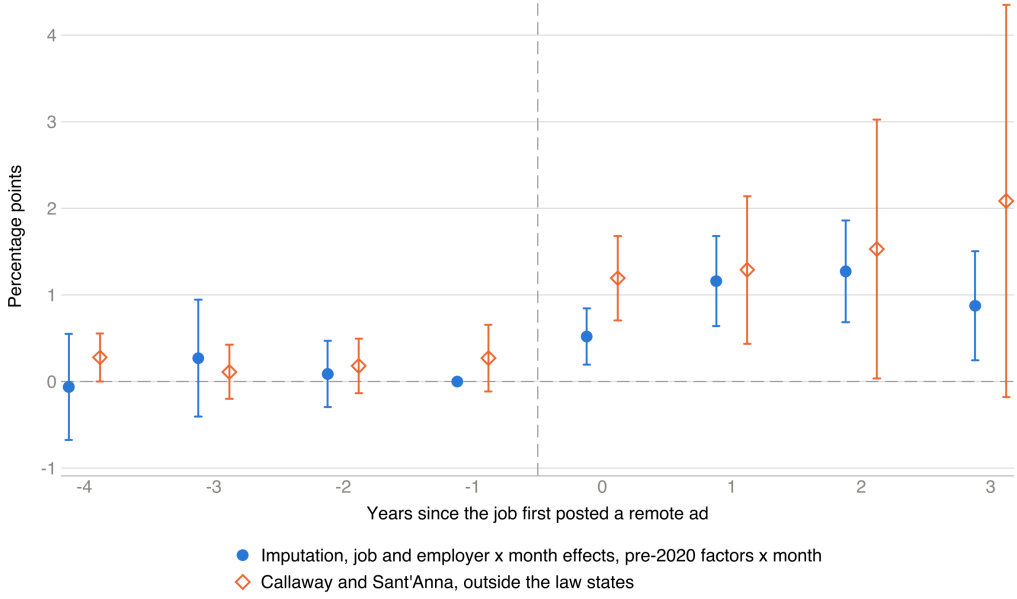
Measuring ad content

- 3,680,536 on-site ads from 2017–2019, 493,579 jobs without performance-pay language
- 14.5 skills per ad; 25,745 distinct skills
- Drop skills listed by fewer than 50 jobs, leaving 11,803
- For each job, count the share of its ads listing each skill, giving more weight to rare skills. Scale each job's vector to length one.
- Truncated singular-value decomposition, 30 factors explain 10% of matrix variance
- Interact each factor with month to allow for differing trends

	(1) Same employer and month	(2) Same job	(3) Skill factors x month	(4) Callaway-Sant'Anna	(5) Imputation
Remote	1.62***	1.84***	1.71***		
	(0.53)	(0.22)	(0.23)		
ATT				1.34***	0.91***
				(0.39)	(0.19)
Observations	10,766,728	10,747,167	10,604,286	413,366	4,211,937
R-squared	0.60	0.75	0.73		
Job effects	No	Yes	Yes	Yes	Yes
Employer x month effects	Yes	Yes	Yes	No	Yes
Pre-2020 skill factors	No	No	x month	Doubly robust	x month
Sample	All states	All states	All states	No law states	All states
On-site ads with PP (%)	5.20	5.21	4.61	3.88	4.61

Standard errors clustered by employer in parentheses.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$


4
3
2
1
0
-1
Percentage points
-4
-3
-2
-1
0
1
2
3
Years since the job first posted a remote ad
Imputation, job and employer x month effects, pre-2020 factors x month
Callaway and Sant'Anna, outside the law states

Same employer, title and month

	(1) Same group	(2) + size of ad	(3) + skill content	(4) Same skill list
Remote	1.24***	0.83***	0.80***	0.53**
	(0.17)	(0.16)	(0.16)	(0.26)
Observations	330,275	330,275	330,275	157,011
R-squared	0.81	0.82	0.82	0.92
Employer x occupation x title x month effects	Yes	Yes	Yes	x skill list
Skills and words of the ad	No	Yes	Yes	No
30 skill factors of the ad	No	No	Yes	No
On-site ads with PP (%)	7.52	7.52	7.52	10.17

Standard errors clustered by employer in parentheses.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Kinds of pay

	On-site base, %	(1) Same group	(2) + skill content
All performance pay	7.5	1.24***	0.80***
		(0.17)	(0.16)
Commission	2.1	0.41***	0.29***
		(0.11)	(0.09)
Bonus or pay tied to own results	2.0	0.50***	0.35**
		(0.14)	(0.14)
Discretionary or target bonus	0.3	0.05**	0.03*
		(0.02)	(0.02)
Unspecified or firm-level	3.1	0.27***	0.14*
		(0.08)	(0.08)
Tied-only measure	4.6	0.98***	0.67***
		(0.16)	(0.15)
Employer x occupation x title x month effects		Yes	Yes
Skills, words and 30 skill factors of the ad		No	Yes
Observations		330,275	330,275

Measurable output

	(1) Same group	(2) + size of ad	(3) + skill content
Remote	0.98***	0.58***	0.55***
	(0.16)	(0.15)	(0.15)
Remote x output easy to measure	1.67***	1.64***	1.64***
	(0.50)	(0.50)	(0.50)
Remote effect where output is easy to measure	2.66***	2.22***	2.19***
	(0.50)	(0.49)	(0.49)
Employer x occupation x title x month effects	Yes	Yes	Yes
Skills and words of the ad	No	Yes	Yes
30 skill factors of the ad	No	No	Yes
On-site ads with PP, easy to measure (%)	16.3	16.3	16.3
On-site ads with PP, all other occupations (%)	5.8	5.8	5.8
Observations	330,275	330,275	330,275

New *vs* existing jobs (PSID)

	All jobs (1)	Same employer (2)	Changed job (3)
Remote	0.042**	0.065**	-0.015
	(0.020)	(0.027)	(0.029)
Person effects	Yes	Yes	Yes
Year, occupation and industry effects	Yes	Yes	Yes
Observations	10,096	6,284	3,626
On-site share (%)	8.7	9.6	6.7

Conclusion

- Reliance on performance pay more than doubled between 2019 and 2024
- The rise occurred within occupations, and was steepest where performance pay had been rare

- A job offers performance pay more often after adopting remote work
- Remote ads add mostly commission and bonuses tied to the worker's own results
- Effect is stronger when output is easy to measure
- Survey evidence locates the effect within ongoing employment relationships

Appendix

Measurement, disclosure and robustness

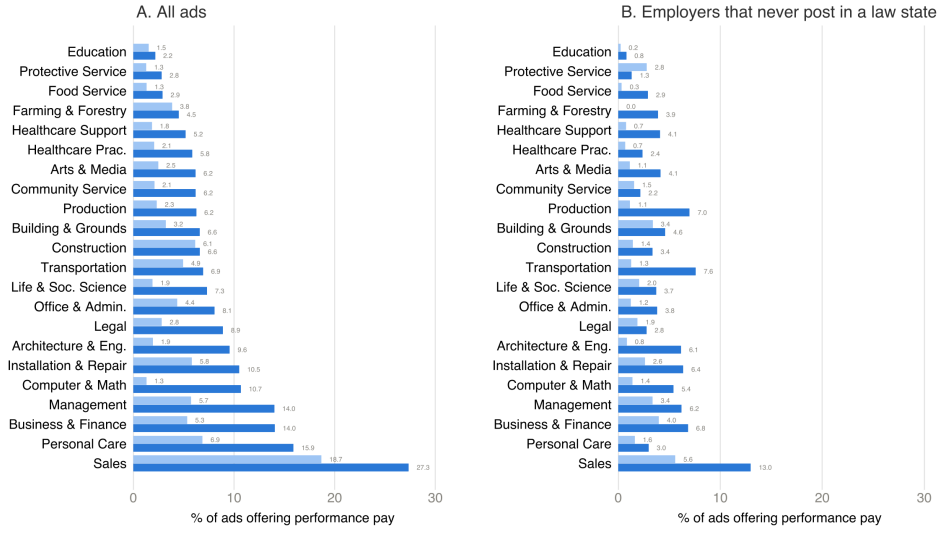
	Job ads
All job ads in the merged panel	192,218,930
Employer career sites only	24,564,451
Descriptive series (Figures 1 to 9)	
without the 9 pay-disclosure states	16,921,758
of which employers that post in one of those states	14,226,923
of which employers that never do	2,090,647
Following the same job over time (Table 5), every state	
2017–2024, identified employers	18,252,352
in a job with an occupation and a specialized occupation	18,252,352
job on-site before 2020 and posting after (columns 1 and 2)	10,927,560
with pre-2020 skill factors (column 3)	10,782,612
the same, without the 9 states (column 4)	5,404,723
Same employer, title and month (Tables 6 to 9), every state	
2020–2024, identified employers	12,778,062
of which remote	1,229,769
in a group with a remote and an on-site ad	330,275
with exactly the same skill list	157,011

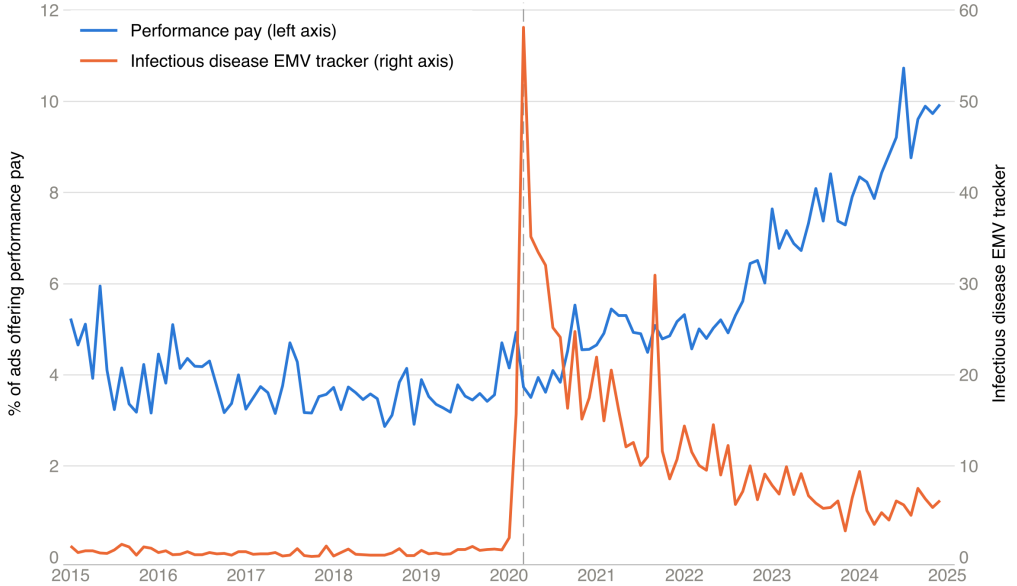
	First rules	Revised rules
Language model, second half not used in revision		
Ads tagged	1,973	1,591
Precision	66%	71%
Bonus with no stated condition	18%	22%
Neither	14%	6%
Commission tags correct	76%	91%
Recall	79%	70%
Hand review: 100 ads, 96 judged		
Agreement with reader	55	70
Revised-rule tagged ads offering performance pay		41 of 45
Dropped tags offering performance pay		10 of 35
New commission rule correct		18 of 20
Bonus-tied-to-results rule correct		23 of 23

	Share of ads offering performance pay, 2019, %		
	All ads	Employers never in a law state	Position in the two studies
A. Employer size			
Fewer than 50 ads in the year	7.2	2.7	6.4 (under 50 employees)
50 to 499	5.2	1.9	5.4 (50 to 99), 4.6 (100 to 499)
500 to 4,999	4.6	1.4	2.7 (500 or more)
5,000 or more	3.7	too few employers	
B. Industry, five highest and five lowest of 20 groups			
Information	10.2	6.0	
Real estate	10.1	3.3	high in Lemieux et al.
Finance and insurance	9.6	9.3	highest in both studies
Other services	8.9	4.6	
Transportation and warehousing	8.5	6.7	
…			
Accommodation and food	3.0	0.7	lowest in Makridis and Gittleman
Mining	2.8	1.1	
Health care	1.7	0.9	low in Makridis and Gittleman
Public administration	1.5	1.1	low in Makridis and Gittleman
Education	0.9	0.3	low in Makridis and Gittleman

	Exposed minus never-exposed employers, pp	
Employers exposed to	Colorado	CA, WA, NY
Law in force from	2021	2023
2019	base	base
2020	0.07 (0.40)	-0.49 (0.39)
2021	1.16** (0.58)	-0.04 (0.49)
2022	1.28* (0.74)	-0.13 (0.64)
2023	3.44*** (0.91)	1.39* (0.73)
2024	5.07*** (0.93)	1.97** (0.89)
Employer effects	Yes	Yes
Occupation x month effects	Yes	Yes
Exposed employers	3,753	4,269
Never-exposed employers	27,326	27,326

	Ads in the law state offering performance pay, %	Gap to the same employer's ads elsewhere, pp	Not disclosed, % of jobs offering it
Colorado: all compensation required from January 2021			
Before the law, 2019–2020	5.3	0.08 (0.11)	
2021	15.1	7.09*** (2.20)	47
2022	12.7	5.59*** (1.32)	44
2023	17.8	5.95*** (1.32)	34
2024	15.5	2.62*** (0.58)	17
Washington: all compensation required from January 2023			
Before the law, 2019–2022	4.7	0.05 (0.09)	
2023	15.4	5.13*** (0.82)	33
2024	12.0	2.68*** (0.53)	22
Both states, years under the law	14.6	4.77*** (0.80)	33
Employer x occupation x month effects		Yes	


A. All ads
Education 1.5 2.2
Protective Service 1.3 2.8
Food Service 1.3 2.9
Farming & Forestry 3.8 4.5
Healthcare Support 1.8 5.2
Healthcare Prac. 2.1 5.8
Arts & Media 2.5 6.2
Community Service 2.1 6.2
Production 2.3 6.2
Building & Grounds 3.2 6.6
Construction 6.1 6.6
Transportation 4.9 6.9
Life & Soc. Science 1.9 7.3
Office & Admin. 4.4 8.1
Legal 2.8 8.9
Architecture & Eng. 1.9 9.6
Installation & Repair 5.8 10.5
Computer & Math 1.3 10.7
Management 5.7 14.0
Business & Finance 5.3 14.0
Personal Care 6.9 15.9
Sales 18.7 27.3
0 10 20 30
% of ads offering performance pay
B. Employers that never post in a law state
Education 0.2 0.8
Protective Service 2.8 1.3
Food Service 0.3 2.9
Farming & Forestry 0.0 3.9
Healthcare Support 0.7 4.1
Healthcare Prac. 0.7 2.4
Arts & Media 1.1 4.1
Community Service 1.5 2.2
Production 1.1 7.0
Building & Grounds 3.4 4.6
Construction 1.4 3.4
Transportation 1.3 7.6
Life & Soc. Science 2.0 3.7
Office & Admin. 1.2 3.8
Legal 1.9 2.8
Architecture & Eng. 0.8 6.1
Installation & Repair 2.6 6.4
Computer & Math 1.4 5.4
Management 3.4 6.2
Business & Finance 4.0 6.8
Personal Care 1.6 3.0
Sales 5.6 13.0
0 10 20 30
% of ads offering performance pay
2019
2024


Performance pay (left axis)
Infectious disease EMV tracker (right axis)
% of ads offering performance pay
Infectious disease EMV tracker
0
2
4
6
8
10
12
0
10
20
30
40
50
60
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025

	(1) words	(2) skills	(3) ln words	(4) ln skills
Remote	53.376***	1.170***	0.105***	0.076***
	(2.448)	(0.084)	(0.006)	(0.006)
Observations	10,604,286	10,604,286	10,604,286	10,604,286
R-squared	0.856	0.799	0.863	0.837
Job effects	Yes	Yes	Yes	Yes
Employer x month effects	Yes	Yes	Yes	Yes
Pre-2020 skill factors	x month	x month	x month	x month
On-site mean	536.37	14.68	6.10	2.51

Standard errors clustered by employer in parentheses.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

	(1) Same group and state	(2) + size of ad	(3) + skill content	(4) Same skill list
Remote	1.21***	0.91***	0.89***	0.78**
	(0.22)	(0.21)	(0.20)	(0.37)
Observations	213,582	213,582	213,582	90,788
R-squared	0.88	0.88	0.88	0.96
Employer x occupation x title x month x state effects	Yes	Yes	Yes	x skill list
Skills and words of the ad	No	Yes	Yes	No
30 skill factors of the ad	No	No	Yes	No
On-site ads with PP (%)	6.29	6.29	6.29	8.79

Standard errors clustered by employer in parentheses.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

	(1) Same group	(2) + skill content
Remote	1.36***	0.97***
	(0.22)	(0.20)
Remote x employer over 30% remote	-0.35	-0.50
	(0.35)	(0.36)
Remote effect at employers over 30% remote	1.01***	0.47*
	(0.27)	(0.27)
Employer x occupation x title x month effects	Yes	Yes
Skills and words of the ad	No	Yes
30 skill factors of the ad	No	Yes
On-site ads with PP, up to 30% (%)	5.63	5.63
On-site ads with PP, over 30% (%)	14.51	14.51
p-value, equal effects	0.32	0.16
Observations	330,167	330,167
R-squared	0.81	0.82

	Job and employer × month		+ pre-2020 factors × month	
Years since the first remote ad	TWFE	BJS	TWFE	BJS
-4	-0.18 (0.24)	-0.20 (0.30)	-0.12 (0.24)	-0.06 (0.31)
-3	0.52 (0.35)	0.15 (0.34)	0.58 (0.36)	0.27 (0.34)
-2	0.12 (0.19)	0.00 (0.19)	0.21 (0.19)	0.09 (0.20)
-1	0	0	0	0
0	0.52*** (0.19)	0.70*** (0.17)	0.40** (0.18)	0.52*** (0.17)
$+1$	0.72** (0.30)	1.30*** (0.28)	0.53* (0.30)	1.16*** (0.27)
$+2$	0.86*** (0.32)	1.37*** (0.33)	0.60* (0.32)	1.27*** (0.30)
$+3$ and later	1.75*** (0.46)	1.21*** (0.34)	1.23*** (0.45)	0.88*** (0.32)
Post-period average		1.09*** (0.20)		0.91*** (0.19)
Job effects	Yes	Yes	Yes	Yes
Employer x month effects	Yes	Yes	Yes	Yes
Pre-2020 skill factors	No	No	x month	x month
Pre-trend test [p]	[0.17]	[0.68]	[0.19]	[0.76]
Treated cells		468,596		461,819
Untreated cells		3,807,558		3,750,118
Treated cells not imputable		119,654		117,613
Ads	10,747,167		10,604,286	

References I

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