Remote Work and the Wage Premium

Mitchell Valdes-Bobes and Anna Lukianova

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Research Question

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Agenda for Today

- **Occupation Remote Index:** New a measure of remote work feasibility.
- **Theoretical Model:** Remote work and worker-firm matching dynamics.
- **Model Calibration & Preliminary Results:** Key findings and next steps.

Related Literature

I. **Teleworkability Measurement**

 – **Dingel, Neiman (2020), Mongey, Pilossoph, Weinberg (2021)** Construct teleworkability indices using occupation tasks and requirements based on ad hoc feature selection.

  ◦ **Contribution** Use machine learning on a high-dimensional feature set, rather than relying on manual selection.

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II. **Remote Work and Compensation**
   - **Pabilonia, Vernon (2023), Cullen, Pakzad-Hurson, Perez-Truglia (2024), Barrero, Bloom, Buckman, and Davis (2023)** Workers value remote work document wage premiums associated with remote work.
     - **Contribution** Link wage premiums to occupation teleworkability.

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III. **Amenity Provision and Hedonic Wages**
   - **Morchio, Moser (2024), Hwang, Mortensen, Reed (1998)** Model how workers value job amenities and how these preferences affect wages.
     - **Contribution** Link worker preferences for remote work to job productivity. Allow for heterogeneity in remote work efficiency at the firm and worker level.

Empirical Evidence

Data Sources and Sample Characteristics

- **American Community Survey, 2013-2022**: individual data.
  - Sample civilian wage-employed, respondents between 22 and 70, work more than 30 hours over federal minimum wage.
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- **BLS**: occupation-industry level data.
  - Selected occupation feasibility of remote work.
  - Occupational composition of the workforce. (U.S. and 3-digit industry level).
  - Labor productivity at the 3-digit industry level.
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- **Other**:
  - Business Dynamics Statistics (BDS).
  - WFH Map, **Hansen, et. al. (2023)**: Remote job posting.

Remote vs. Non-Remote Worker Characteristics

	Non-WFH		WFH	
	Mean	Sd	Mean	Sd
Share labor force 2013 - 2019	97%	-	3%	-
Share labor force 2020 - 2023	85%	-	15%	-
Age	44.20	12.43	44.66	11.88
Total income	67,536.4	69,200.87	106,556.2	97,919.89
Hourly wage	27.95	25.81	44.20	37.59
Real hourly wage	26.31	24.10	39.31	33.10
Commuting time	26.81	23.50	-	-
Share of College	39%	-	66%	-
Share of Postgraduate	15%	-	26%	-
Observations	9025857		751654	

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  - **Dingel and Neiman (2020)** classify occupations as teleworkable or not.
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- **Need for a New Index:**
  - Leverage a high-dimensional, data-driven approach.
  - Capture nuanced differences in how tasks and requirements enable remote work.

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    - **Classifier Stage:** Feature importance identifies occupations impossible to telework. (*extensive margin*) ▸ details
    - **Regressor Stage:** Feature importance the level of teleworkability. (*intensive margin*) ▸ details
- Validate results against labeled occupational data.
  - Establishment-level data: Percentage of workers that are **able** to telework at the occupation level.
  - The coverage is incomplete, we use the provided values and the estimated index to predict the teleworkability of the remaining occupations.

Classifier/Regressor Performance and Data Distribution

- **Classification:**
  - Accuracy $= 90.7\%$
  - F1 $=91.9\%$
- **Regression:**
  - MSE $= 0.1$
  - Correlation $= 0.71$

/Users/mitchv34/Work/WFH/figures/telework_index_est

Stylized Fact I: Remote Work Correlates with Higher Wages

Table 1: (log)Wage regressed on Teleworkability index and remote work indicator.

	(1)	(2)	(3)	(4)	(5)	(6)
Teleworkability Index	1.009***	0.860***	0.582***	0.551***	0.484***	0.473***
	(0.00111)	(0.00129)	(0.00256)	(0.00256)	(0.00124)	(0.00124)
WFH Indicator				0.161***		0.0793***
				(0.000970)		(0.000909)
FE: Year & Location	✓	✓	✓	✓	✓	✓
FE: Industry		✓		✓	✓	✓
AgeCat × Educ					✓	✓
N	9708029	9708029	9708029	9708029	9708028	9708028
R^2	0.198	0.279	0.334	0.338	0.420	0.421

Worker level data. All regressions include demographic controls: age, race, education, others.
Standard errors in parentheses: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$.

⏩ Wage regression

Stylized Fact II: Within Occupations Remote Workers Earn More

Table 2: (log)Wage regressed on remote work indicator and controls.

	(1)	(2)	(3)	(4)	(5)
WFH Indicator	0.347^{***}	0.216^{***}	0.146^{***}	0.130^{***}	0.0880^{***}
	(0.00108)	(0.00105)	(0.000946)	(0.000942)	(0.000870)
FE: Year & Location	✓	✓	✓	✓	✓
FE: Industry		✓		✓	✓
FE: Occupation			✓	✓	✓
FE: Class of Worker				✓	✓
AgeCat × Educ					✓
N	9712293	9712293	9712293	9712293	9712292
R^2	0.0955	0.227	0.383	0.408	0.485

Worker level data. All regressions include demographic controls: age, race, education, others.
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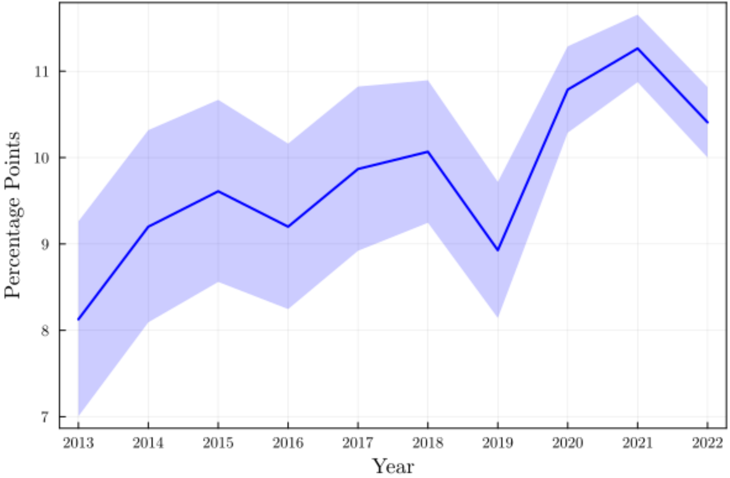
Wage regression

Stylized Fact III: WFH Wage Premium is Increasing



Regression

Model

Model Overview

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- Sources of heterogeneity:
  - **Firms**: Different remote-work efficiencies.
  - **Workers**: Different skill levels.
- **Key Mechanisms**:
  - Workers value the flexibility provided by remote work arrangements.
  - High skilled workers are more productive and better suited for remote work.
  - Firms treat remote and on-site work as substitutable.

Workers

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- Incur disutility from on-site work $(1 - \alpha)$, compensated by wage (w).
  - $x(w, \alpha)$: utility of a worker earning w with remote work $\alpha \in [0, 1]$ of the time.
    - $x_w(w, \alpha) > 0$
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  - $p(\theta(h,x))$ is the job finding rate.
- Choose where to apply based on maximizing expected utility.

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$$Y(\alpha \mid \psi, h) = A(h)\left((1-\alpha) + \alpha g(h, \psi)\right)$$

  - $A'(h) > 0$: Higher-skilled workers (h) contribute more to productivity.
  - $g_\psi(\psi, h) \geq 0$: Remote work efficiency increases with firm type (ψ) due to better technology, better management practices or the nature of the occupation.
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- Firm is uncertain of ψ before posting. The distribution $F(\psi)$ is known by all agents.

Optimal Remote Work Policy

- Type ψ firms posting vacancies in a sub-market (x, h) faces the maximization problem:
$$\max_{\alpha}\{Y(\alpha \mid \psi, h) - w(x, \alpha)\} \quad \text{s.t.} \quad x(w(x, \alpha), \alpha) = x$$

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    - $\phi \in \mathbb{R}$: Captures how worker skill affects the productivity of remote work.
  - **Worker utility:** $x(w,\alpha) = w - c(1-\alpha)^{\chi}$ with $c > 0$ and $\chi > 1$

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- First order conditions of the firm problem give us interior solution if and only if:

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Proposition Optimal Remote Work Policy Properties

Consider a firm's optimal remote work policy where a worker's skill level h influences their arrangement. If the worker's skill satisfies:

$$h > \frac{c\chi}{A\phi}$$

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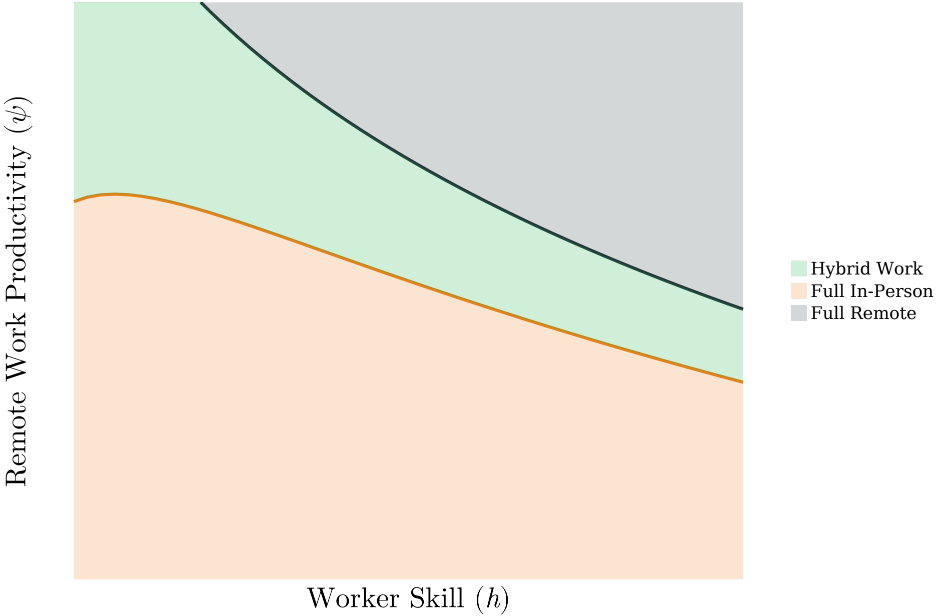
Optimal Remote Work



Value Functions

- Firms:
  - Value of posting:

$$V(h,x) = -\kappa + \int J(\psi,h,x)dF(\psi)$$

  - Value of an ongoing match:

$$J(\psi,h,x) = Y(\alpha^*(\psi,h) \mid \psi,h) - w(x,\alpha^*(\psi,h)) + \beta\left[(1-\delta)J(\psi,h,x) + \delta V(h,x)\right]$$

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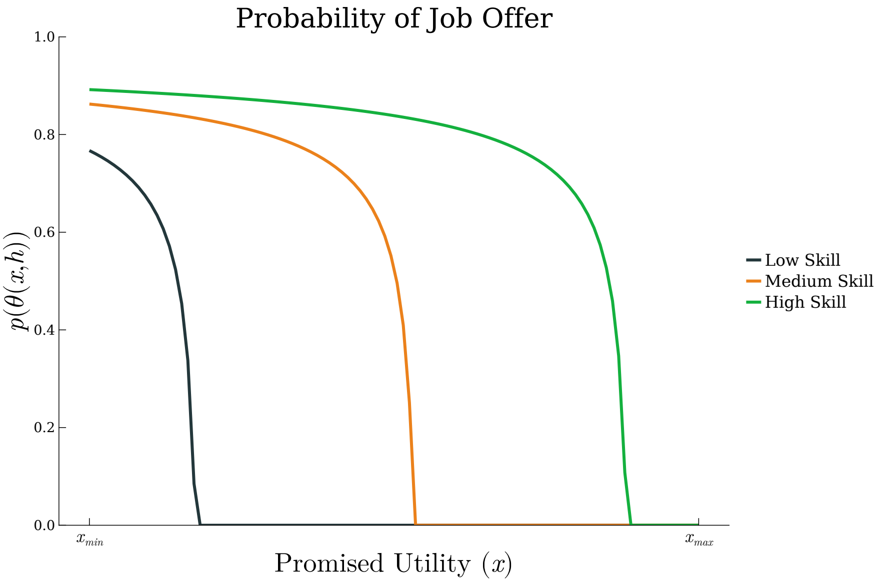
- Workers:
  - Value of unemployed worker:

$$U(h) = b + \max_x \left\{ p(\theta(h,x)) \int W(\psi,h,x)dF(\psi) + (1-p(\theta(h,x)))U(h) \right\}$$

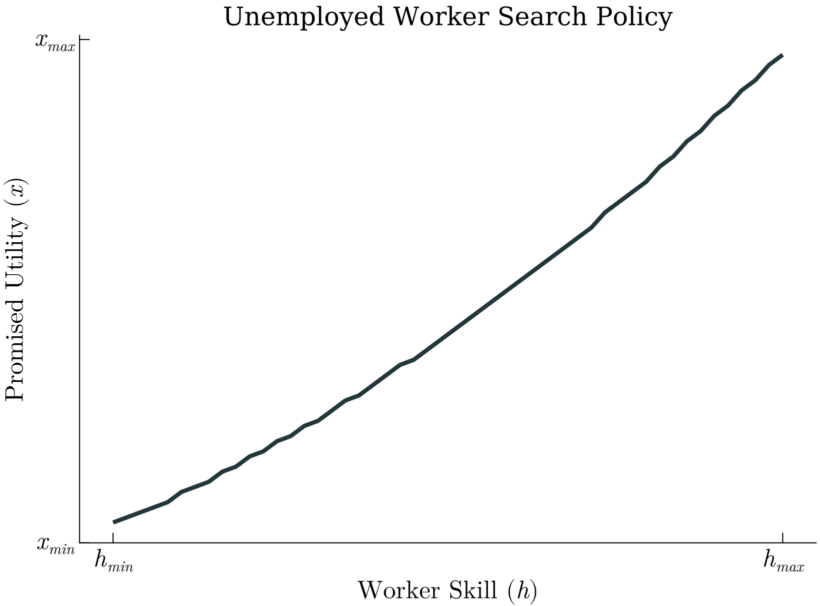
  - Value of employed worker:

$$W(\psi,h,x) = x + \beta\left[(1-\delta)W(\psi,h,x) + \delta U(h)\right]$$

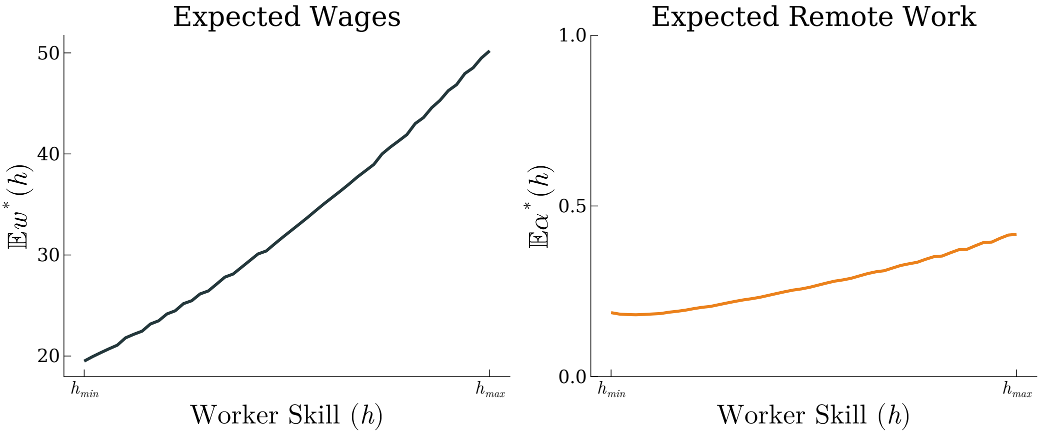
Better Jobs are Harder to Find (but better workers find them)



Higher Skill Workers search for Better Jobs



Higher-Skilled Workers Earn More and Access More Remote Opportunities



Calibration

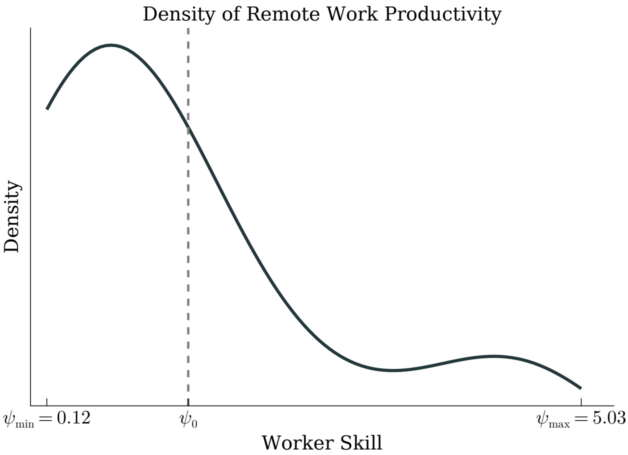
Calibration Overview

- **Worker Skill Distribution**:
  - Skill index at the occupation level constructed from *Abilities* and *Skills* datasets from ONET. ▸ details
- **Remote Work Efficiency Distribution**($F(\psi)$):
  - No productivity data at the occupation level.
  - Labor productivity at the 3-digit industry level from BLS.
  - Combined with the teleworkability index estimated at the occupation level with the occupation composition of each industry, obtain the remote work feasibility at the industry level.
  - Use the observed fraction of remote workers in each industry (ACS).
  - Regress productivity data on remote work indicators to estimate ψ as a function of observables. ▸ details
  - Use a kernel density estimator to calibrate the distribution of teleworkability (ψ).

Calibrated Parameters and Density Function

Parameter	Estimate
A	25.55
ψ_0	1.46
ϕ	2.66

details



Future Work

- Incorporate additional sources of heterogeneity, firm productivity, and worker preferences.
- Test alternative functional forms for productivity and utility in the theoretical model.
- Examine how the overall technological environment and digital infrastructure influence remote work feasibility and wage differentials.
- Explore dynamic aspects such as on-the-job search and career mobility in remote work settings.
- Evaluate counterfactual scenarios—such as a complete shutdown of remote work—to measure their impact on wage differentials.

Appendix

Occupation Remote Index: Details

- **Data:** Occupation-level features (tasks, skill requirements, etc.)
- **Models:** SVC (RBF) for classification, SVR (RBF) for teleworkability level.
- **Hyperparameters:** (tuned via cross-validation)
- **Validation:** Boostrap validation (1000 samples) per parameter set.

Back

Occupation Remote Index: Performance

/Users/mitchv34/Work/WFH/figures/telework_index_estimation/permutation_imp

Occupation Remote Index: Performance

/Users/mitchv34/Work/WFH/figures/telework_index_estimation/permutation_imp

Calibration of Remote Work Efficiency Distribution

- Consider the production function:

$$Y(\alpha, h, \psi) = Ah((1-\alpha) + \alpha(\psi - \psi_0 + \phi \log(h))$$

- We make the following assumption:

$$\psi_i = \psi_1 \text{Tele}_i$$

- This implies the following specification:

$$Y_{it} = \beta_0 + \beta_1 h_i + \beta_2 \alpha_{it} h_i + \beta_3 \text{Tele}_i \alpha_{it} + \beta_4 h_i \log(h_i)$$

- This identifies the coefficients:

$$A = \beta_1, \quad \psi_0 = \frac{\beta_2 + 1}{A}, \quad \psi_1 = \frac{\beta_3}{A}, \quad \phi = \frac{\beta_4}{A}$$

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Calibration of Remote Work Efficiency Distribution: Results

$$Y_{it} = \beta_0 + \beta_1 h_i + \beta_2 \alpha_{it} h_i + \beta_3 \text{Tele}_i \alpha_{it} + \beta_4 h_i \log(h_i)$$

	Y
β_0	16.739***
	(6.151)
β_1	25.708***
	(4.345)
β_2	-37.564**
	(17.131)
β_3	315.199***
	(73.476)
β_4	64.152***
	(20.580)
N	418
R^2	0.263

WFH premium over years

Dependent variable	Log of real hourly wage
WFH (1 if works from home)	0.0781*** (0.005)
WFH#2014	0.0099 (0.0074)
WFH#2015	0.0136* (0.0072)
WFH#2016	0.0134* (0.0069)
WFH#2017	0.0160** (0.0069)
WFH#2018	0.0178*** (0.0065)
WFH#2019	0.00737 (0.0065)
WFH#2020	0.0243*** (0.0058)
WFH#2021	0.0286*** (0.0056)
WFH#2022	0.0209*** (0.0056)
Observations	8,410,229
R-squared	0.438

Fixed effects: Age and age squared, education controls, race controls, year FE, place of residence FE, industry FE, occupation FE. Robust standard errors are in parentheses.

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Stylized Fact I: Remote Work Correlates with Higher Wages

Table 3: Wage regressed on Teleworkability index and remote work indicator.

	(1)	(2)	(3)	(4)	(5)	(6)
Teleworkability Index	33.58***	27.68***	20.89***	19.70***	15.36***	14.90***
	(0.0522)	(0.0580)	(0.115)	(0.115)	(0.0569)	(0.0570)
WFH Indicator				6.365***		3.203***
				(0.0506)		(0.0487)
FE: Year & Location	✓	✓	✓	✓	✓	✓
FE: Industry		✓		✓	✓	✓
AgeCat × Educ					✓	✓
N	9708029	9708029	9708029	9708029	9708028	9708028
R^2	0.141	0.186	0.227	0.230	0.292	0.293

Worker level data. All regressions include demographic controls: age, race, education, others. Standard errors in parentheses: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$.

Wage regression

Stylized Fact II: Within Occupations Remote Workers Earn More

Table 4: Wage regressed on remote work indicator and controls.

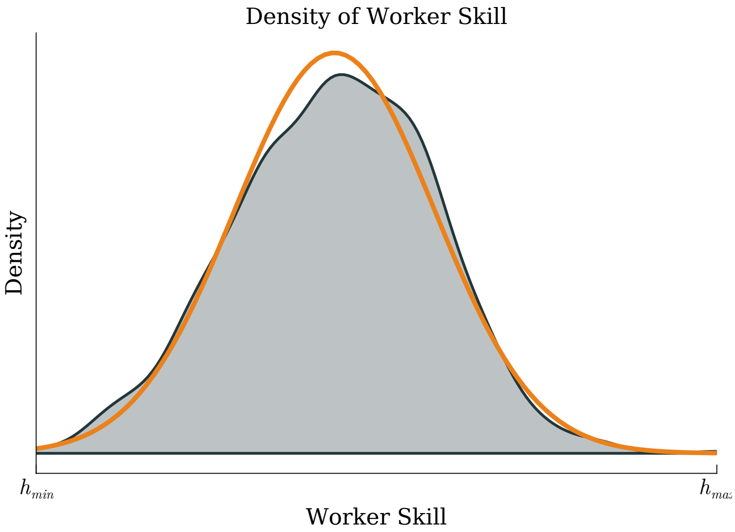
	(1)	(2)	(3)	(4)	(5)
WFH Indicator	12.44***	7.702***	5.834***	5.031***	3.603***
	(0.0530)	(0.0525)	(0.0494)	(0.0493)	(0.0471)
FE: Year & Location	✓	✓	✓	✓	✓
FE: Industry		✓		✓	✓
FE: Occupation			✓	✓	✓
FE: Class of Worker				✓	✓
AgeCat × Educ					✓
N	9712293	9712293	9712293	9712293	9712292
R^2	0.0711	0.153	0.289	0.307	0.364

Worker level data. All regressions include demographic controls: age, race, education, others.
Standard errors in parentheses: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$.

Wage regression

Worker's Skill Distribution

- The skill distribution is constructed from ONET data.
- Simple average of Skills and Abilities weighted by importance to the occupation.
- We fit a Normal distribution to the skill index.
  - **Mean:** 0.41
  - **Standard Deviation:** 0.17



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