

Imperfect Competition in US Ag. Labor Markets

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'A lot of abuse for little pay': how US farming profits from exploitation and brutality - The Guardian, December 2021

FTC, Department of Labor Partner to Protect Workers from Anticompetitive, Unfair, and Deceptive Practices

New agreement establishes formal collaboration between agencies on issues affecting workers

Millions of migrant farm workers exploited in Europe's fields, says Oxfam

Published: 4th June 2024

Introduction

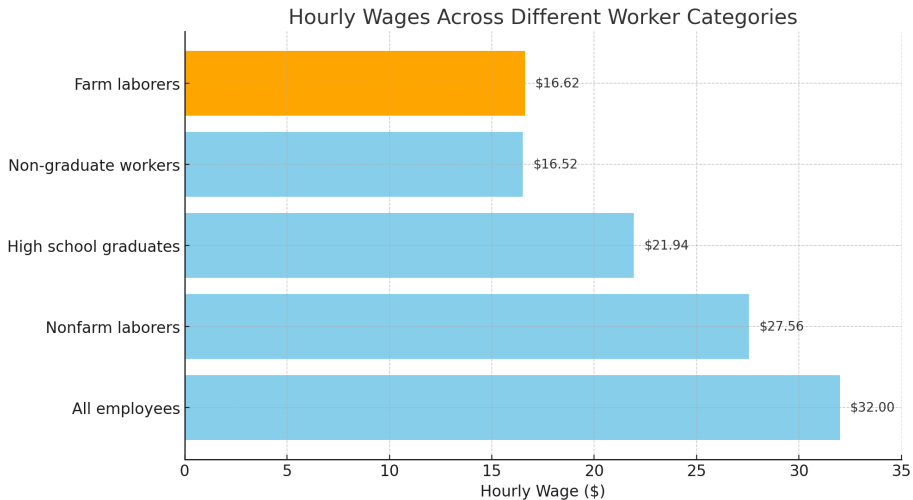


Figure 1: Hourly wages for different worker categories in 2022. Data Sources: USDA Farm Labor Survey, US Bureau of Labor Statistics, & Economic Policy Institute.

Introduction

- US agriculture faces chronic **labor issues**
 - Aging workforce: 40% above age of 47 in 2022 (US DoL)
 - Better outside options, rigid immigration policies, continual labor shortage (Richards '18, '20)
 - 48% unauthorized workers; 72% direct hire by growers; 88% paid hourly from 1989-2022 (US DoL)
 - ⇒ Job differentiation creates variations in job quality and compensation.
- General interest in imperfect competition in labor markets
 - Aggregate economy (De Loecker, Eeckhout, & Unger '20; Autor et al. '20; Berger et al. '22)
 - Industry-specific (Azar et al. '20; Arnold '21; Yeh et al. '22; Azar, Berry & Marinescu '22)
 - Not clear what imperfect competition means for wages of different types of ag. workers.
- Recent US antitrust policies consider monopsony effects on wages (Executive Order '21).
 - Assumes employment surplus implies labor exploitation
 - Is the assumption valid?
- **Goal:** Examine how different factors influence workers' labor market position.

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Preview of Results

- What is **bargaining power** of US crop workers from 1989-2022?
 - Gives “labor market position” of a firm/worker.
 - Informs distribution of employment surplus between workers & employers.
 - Employment surplus = Marginal revenue product *minus* threshold wage
 - Workers get roughly 24% of employment surplus
- How does bargaining power differ across worker characteristics?
 - Higher bargaining power amongst foreign-born and those hired by contractors.

• What is productivity-value of US crop workers?

- \$8.756 per hour, with substantial heterogeneity across groups

• Some workers can have productivity effects **offset** bargaining power effects.

- Understanding of bargaining power as worker *exploitation* can be misleading...
- Whether workers are receiving *fair share* for their productivity is more important.

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Research Strategy

Data from 1989-2022

- **National Ag Workers Survey** from US DoL:
 - Nationally & regionally representative data on US crop workers
 - **Demographics:** Place of birth, race, age, ethnicity, gender, work authorization, marital status, education level.
 - **Job Characteristics:** Crop types, job types, hiring processes, wages, working hours.
 - **Employment History:** Non-crop jobs & recent unemployment status.

- **Min. wage series** (Vaghul & Zipperer '22)

- state level min. wage changes w/ dates

- **Focus on California** for data compatibility

Estimation Approach

- A structural model of search, match, & bargaining in the DMP tradition
 - Integrates search, matching, and bargaining for wages, employment, & productivity.
 - Quantifies workers' bargaining power in agriculture, addressing search frictions & information asymmetry.
 - Explains how workers share employment surplus relative to their productivity

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Roadmap of Talk

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Data and Descriptive Statistics

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Background - Imperfect Competition in Labor Markets

- **New Monopsony Literature** recognizes labor markets as imperfectly competitive
 - Manning '03; Postel-Vinay & Robin '06; Card '22
 - Het. preferences for job attributes, search frictions, monopsony power, market consolidation
- Examine how search frictions can lead to imperfect competition.
- Estimate workers' bargaining power, $\lambda \in (0, 1)$. Search, match, & bargaining model.
 - λ : Workers' share of employment surplus (Marginal Revenue Product of Labor - threshold wage)
 - $1 - \lambda$: Share of surplus to employers
 - Perfect competition: $\lambda = 0$. No surplus to share. Wage = MRPL.
 - Imperfect competition: $\lambda > 0$.
 - Higher value of λ means higher bargaining power.
- Characterize λ and MRPL across worker and employer attributes
 - Worker's age, gender, years of education and experience, foreign status, payment method, hiring process
- Analyzing heterogeneity of λ and MRPL is key to assessing fair surplus distribution.
 - To understand which workers generate more value *relative* to their compensation.
 - Nash bargaining idea: increase both size & share of 'pie', so even those with less bargaining power gain more.

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Contributions

- Extends current **literature on imperfect competition in labor markets**
 - Complements papers on **heterogeneous preferences** (Card et al. '21; Azar et al. '22), **production function approach** (Yeh et al. '22; Rubens '23), **search frictions** (Richards & Rutledge '23; Jarosch et al. '24)
 - We shift focus from exploitation & monopsony to outcomes shaped by heterogeneity & informed negotiations.
- Emphasizes **heterogeneity of MRPL & surplus-share** Vs. 'market power & exploitation'
 - Shifting focus to aligning value creation with compensation gives better insight into labor market inefficiencies.
 - Complements Sexton (AJAE '13)—Modern agricultural markets.
- **Antitrust/policy implications?**
 - Add to discussion on labor antitrust policies for US ag. labor markets (POTUS '21; Naidu & Posner '22)
 - Test the assumption of labor market power in ag. in Biden's 2021 Executive Order on Promoting Competition.
 - Unequal surplus sharing in ag. can stem from bargaining equilibria, not just from exploitation or market concentration.

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Data Sources

- NAWS and minimum wage series for California, 1989-2022
 - **NAWS:** National Agricultural Workers Survey, US Department of Labor.
 - **Minimum wage series:** Changes in CA minimum wages from Vaghul & Zipperer (2022).
- NAWS is nationally representative survey of US crop workers
 - **Demographics:** age, gender, education, experience, immigration status
 - **Job attributes:** weeks worked, hourly wages, & types of tasks, crops, & employers.
- NAWS follows multi-stage random sampling across seasons, regions, counties, employers, and workers.
- Data targets crop production (NAICS 111) and support activities (NAICS 1151).
- **Focus on California**
 - Consistent minimum wage laws within the state simplify the analysis.
 - Uniform industries and markets provide a more controlled study environment.
- California's minimum wage data adjusted to real terms for analysis.

Data – NAWS Summary

Variables	N	Mean	St. Dev.	Min	Max
Hours Per Week	24,827	44.5	11.7	1	120
Age	24,827	36.5	12.7	14	88
Years of Farm Work Experience	24,827	14.1	11.5	0	78
Weeks Worked in Last 52 Weeks	24,827	7.5	9.8	0.0	52.0
Real Hourly Wage	24,827	11.2	3.2	2.7	44.8
Real Minimum Wage	24,827	9.3	1.4	7.0	13.4

Table 1: The table indicates a summary of statistics of crop workers in the NAWS sample period 1989-2022 for demographics and workforce variables. The data source is NAWS, US Department of Labor (<https://www.dol.gov/agencies/eta/national-agricultural-workers-survey>).

Data – Trends in Age of Crop Workers in CA

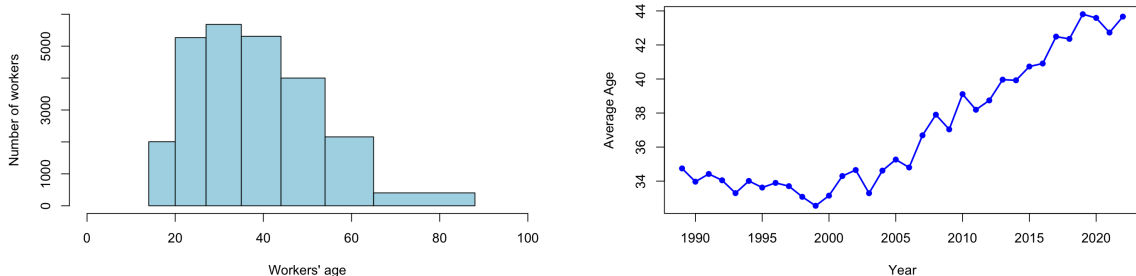


Figure 2:

- **First panel:** Distribution of workers' age. Median = 35, and nearly 40% are above the age of 40.
- **Second panel:** Evolution of average age. Average age in 2022 is 44 years, up from 34 years in 1989.
- **Data source:** NAWS, US Department of Labor, 1989-2022.

Data – Trends in Wage of Crop Workers in CA

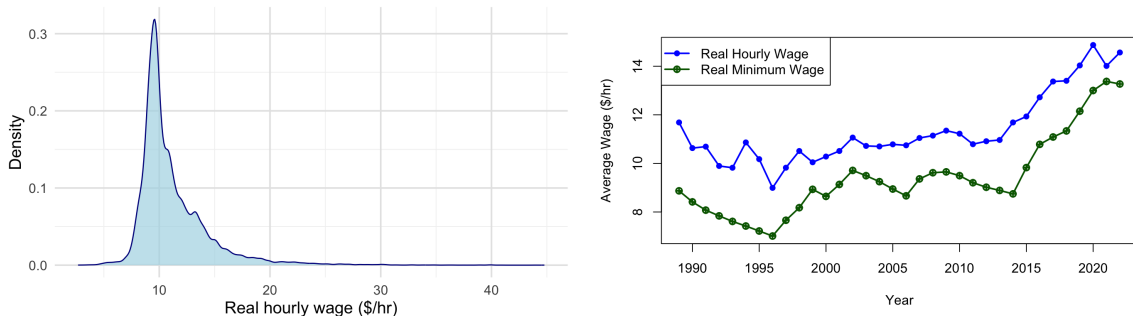


Figure 3:

- **First panel:** Kernel density plot of workers' real hourly wages. Wage concentration at \$9.59/hr.
- **Second panel:** Evolution of CA's min. wage and real hourly wage. Almost parallel and rise after 2013.
- **Data source:** NAWS, US Department of Labor, 1989-2022.

Data – Task and Crop Types of Crop Workers in CA

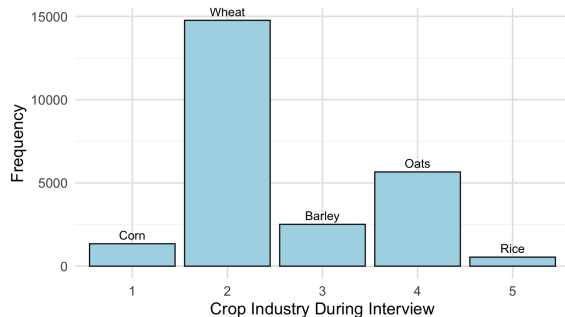
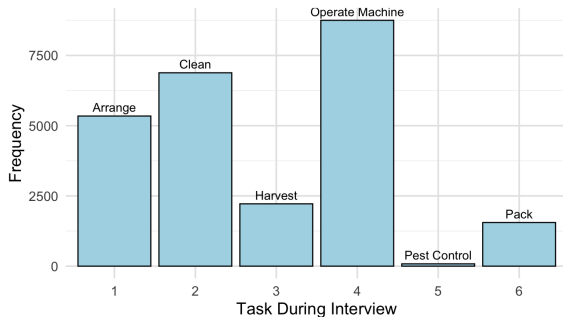


Figure 4:

- **First panel:** Frequencies of types of workers' tasks during interview.
- **Second panel:** Frequencies of types of crop industries they work in during interview.
- **Data source:** NAWS, US Department of Labor, 1989-2022.

Data – Wage Heterogeneity by Gender and Employer Type

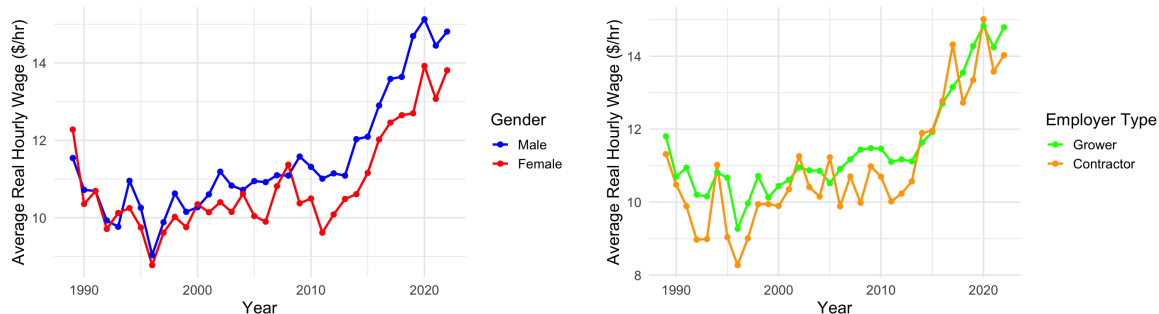


Figure 5:

- **First panel:** Evolution of wages by gender (females = 19.5% of the final sample; males = 80.5%).
- **Second panel:** Evolution of wages by employer type (Farm Labor Contractor, FLC = 28.2%; grower = 71.8%)
- **Data source:** NAWS, US Department of Labor, 1989-2022.

Data – Wage Heterogeneity by Immigration Status

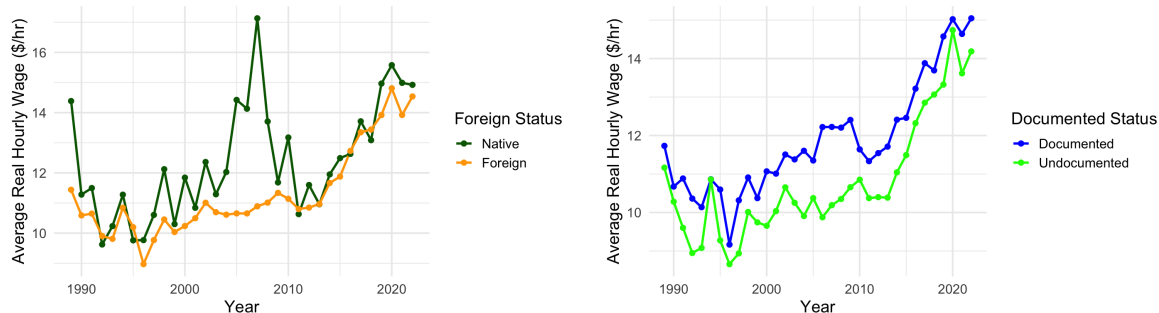


Figure 6:

- **First panel:** Evolution of wages by foreign status (native = 5.4%; foreign = 94.6%).
- **Second panel:** Evolution of wages by documented status (documented = 52.3%).
- **Data source:** NAWS, US Department of Labor, 1989-2022.

Data — Key Takeaways on California Farmworkers

- Getting **older**, suggesting more experience but less mobility & bargaining power.
- Low wages, with few earning significantly more, indicating **wage inequality**.
- **Diverse workforce** with predominantly male, foreign-born workers
 - \Rightarrow heterogeneity in productivity & bargaining power.
- Several tasks are seasonal & labor-intensive.
- **Heterogeneity in wage growth** by worker group.
 - Likely due to het. in productivity & bargaining power?
- Data shows intricate links between employment conditions & wage outcomes, requiring deeper analysis.

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Structural Model

Goals

1. Estimate bargaining power & productivity of CA crop workers.
2. Evaluate how various employment attributes impact bargaining power & productivity.
 - Understand how various worker groups split the employment surplus.

Modeling Steps

1. A model of search, match, & bargaining based on Flinn (ECTA, 2006)
2. Estimate a likelihood function to bring the model to data
 - Gives estimates of workers' bargaining power & productivity.
3. Heterogeneity analysis to find which workers earn what portion of surplus, relative to their productivity.

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Step 1:

Search-Match-Bargaining Model

SMB Model — Idea

- Firms search optimally for workers, and workers search optimally for jobs.
- Both search until marginal benefit of search effort equals marginal cost.
- A match generates a marginal productivity of worker.
- Workers and firms bargain over wages or distribution of the surplus in Nash-bargaining framework.
 - Employment surplus = productivity - threshold wage.
 - The framework gives a bargaining power which informs the surplus distribution.
- SMB model accounts for search frictions and information asymmetry.
 - Helps to analyze the relationship of worker attributes and labor market outcomes such as wages and productivity.

SMB Model — Primitives & Assumptions

- We follow Pissarides ('00) & Flinn ('06).
- **Match-value**, ϕ = marginal productivity of labor
 - Both workers and firms observe ϕ , **exogenously**
 - Take distribution $f(\phi)$ of ϕ to be **log-normal**
- δ = exogenous rate of job termination
- τ = exogenous rate of job creation
- β = discount rate
- $(0, 1) \ni \lambda$ = exogenous **bargaining power** parameter of workers
 - $1 - \lambda$ = employer's bargaining power parameter
 - determines the distribution of ϕ between workers and employers

SMB Model – Notation & Assumptions

- Firm's only factor of production is labor
 - implies firm profit is zero under no participation in labor market
- Firm profit from hiring a worker = $\underbrace{\phi}_{\text{match-value}} - \underbrace{w}_{\text{wage}}$
- Worker's bargaining power parameter, λ , depends on **disagreement profit** or value of next best alternative or value of ongoing search efforts while unemployed, W_u .
- Worker accepts job offer only if $\phi \geq \phi^* = \beta W_u$ (**critical match value**)
- $W_e(w)$ = value of employment to the worker (depends on the wage)

SMB Model – Details

- Job-value to a worker: $W_e(w) = \frac{w + \delta W_u}{\beta + \delta}$ = wage plus expected value of reverting to unemployment
- Value of unemployed search:

$$\beta W_u = \underbrace{R}_{\text{Reservation wage}} + \underbrace{\frac{\lambda \tau}{\beta + \delta} \int_{\beta W_u} [\phi - \beta W_u] d f(\phi)}_{\text{Expected present value of surplus from a job with } \phi \geq \phi^*} \quad (1)$$

- Job-value to a firm: $W_f(w) = \frac{\phi - w}{\beta + \delta}$ = match-value minus the wage, discounted
- Firm gets no value if there is no hiring.
- *How is the match-value distributed?*

SMB Model – Nash Bargaining

- After a match, workers and firms bargain for wages with $\phi \geq \phi^*$, and solve generalized Nash-bargaining problem:

$$w(\phi, W_u) = \arg \max_w [W_e(w) - W_u]^\lambda \left[\frac{\phi - w}{\beta + \delta} \right]^{1-\lambda}, \quad (2)$$

- Without a binding minimum wage regulation, equilibrium wage that solves (2) is:

$$w(\phi, W_u) = \lambda \phi + (1 - \lambda) \phi^* \quad (3)$$

- However, about 24% of CA crop workers earn within 1% of minimum wages (NAWS data), so Nash-bargaining equilibrium wages can be different from (3).

SMB Model – Bargaining Under Minimum Wages

- Even if minimum wage w_m may be $> w(\phi, W_u)$, firms can sacrifice some surplus to hire workers with productivity greater than w_m
- Formally, the new critical value is:

$$\hat{\phi}(w_m, W_u(w_m)) = \frac{w_m - (1 - \lambda) W_u(w_m)}{\lambda} \quad (4)$$

- Value of unemployed search $W_u(w_m)$ now depends on minimum wage w_m .
- As w_m impose a discontinuity on wage distribution, value of unemployed search is:

$$\beta W_u(w_m) = R + \frac{\tau}{\beta + \delta} \left\{ \int_{w_m}^{\hat{\phi}} [w_m - \beta W_u(w_m)] df(\phi) + \lambda \int_{\hat{\phi}}^{\infty} [\phi - \beta W_u(w_m)] df(\phi) \right\} \quad (5)$$

- Substituting (5) to Nash-bargaining problem (2), we get new equilibrium wages.

SMB Model – Bargaining Under Minimum Wages & Estimation

- New equilibrium wage distribution under binding minimum wage w_m is:

$$g(w; W_u(w_m)) = \left\{ \begin{array}{ll} [f'(\hat{\phi}(w, W_u(w_m)))] / \lambda f(w_m), & w > w_m \\ [f(w_m) - f(\hat{\phi}(w, W_u(w_m)))] / f(w_m), & w = w_m \\ 0, & w < w_m \end{array} \right\}, \quad (6)$$

- for workers that are paid above w_m , at w_m , or who are not hired.
- Estimate the model with data on observed wages w_i & time spent unemployed during past year (t_i) for $N = 25k$ worker-year observations.
- Derive a **log-likelihood function** to estimate parameters of (6) and λ .

Step 2:

Empirical Strategy

SMB Model – Estimation

- **Idea** is to break log-likelihood function into three parts.
- **Part 1: Probability that a worker is unemployed for t weeks:**
 - Assume unemployment duration follows negative exponential distribution.
 - Prob. of observing a spell of t weeks given worker is unemployed:

$$pr(t|u) = \tau f(w_m) \exp(-\tau f(w_m)t). \quad (7)$$

- Prob. of being unemployed last year is:

$$pr(u) = \frac{\delta}{\delta + \tau f(w_m)}. \quad (8)$$

- Multiplying (7) with (8), we get **prob. of a worker being unemployed for t weeks:**

$$pr(t, u) = \frac{\delta \tau f(w_m) \exp(-\tau f(w_m)t)}{\delta + \tau f(w_m)}. \quad (9)$$

SMB Model – Estimation

- **Part 2: Probability that a worker is employed & earns w_m :**

$$pr(w = w_m, e) = \frac{\tau \left[f(w_m) - f\left(\frac{w_m - (1-\lambda)\beta W_u(w_m)}{\lambda}\right) \right]}{\delta + \tau f(w_m)}. \quad (10)$$

- Binding w_m makes equilibrium match-values lie above w_m
- Firm gives up some surplus to hire workers with productivity greater than w_m
- **Part 3: Probability that a worker is employed & is paid above w_m :**

$$pr(w, w > w_m, e) = \frac{\frac{\tau}{\lambda} f' \left(\frac{w - (1-\lambda)\beta W_u(w_m)}{\lambda} \right)}{\delta + \tau f(w_m)}. \quad (11)$$

- We combine parts 1, 2 & 3.

SMB Model – Estimation

- Combining 3 parts by taking logs & summing over all individuals gives LLF: [▶ Results](#)

$$\begin{aligned}
 LLF = & \underbrace{[\ln(\tau) - \ln(\delta + \tau f(w_m))]}_{\text{Total Contribution}} + \underbrace{d_U [\ln(\delta) + (w_m)]}_{\text{Unemp. Workers' Contribution}} \quad (12) \\
 & - \underbrace{\tau f(w_m) d_U t_i}_{\text{Penalty for Unemp. Duration}} + \underbrace{d_M \ln \left(f(w_m) - f \left(\frac{w_m - (1 - \lambda)\phi^*}{\lambda} \right) \right)}_{\text{Minimum Wage Earners' Contribution}} \\
 & - \underbrace{d_H \ln(\lambda) + d_H \ln \left(f' \left(\frac{w_i - (1 - \lambda)\phi^*}{\lambda} \right) \right)}_{\text{Above Minimum Wage Earners' Contribution}},
 \end{aligned}$$

- Worker is employed if $d_U = 1$, and unemployed if $d_U = 0$.
- d_M & d_H are binary indicators whether worker is paid at & above minimum wage, resp.
- Maximize the LLF to estimate $\tau, \delta, \lambda, \mu_\phi, \sigma_\phi$, and ϕ^* that best fit the observed data.

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Model Results — Heterogeneity of Bargaining Power

Parameter/Variable	Notation	Model 1		Model 2	
		Est.	Std. Err.	Est.	Std. Err.
Job Arrival Rate	τ	0.118	0.002	0.116	0.002
Job Separation Rate	δ	0.180	0.004	0.180	0.004
Mean Productivity	$\mu\phi$	2.027	0.006	2.021	0.006
Std. Dev. Productivity	$\sigma\phi$	0.192	0.010	0.187	0.010
Reservation Utility	ϕ^*	3.232	0.006	3.225	0.005
Workers' Bargaining Power	λ	0.235	0.001	0.244	0.003
<i>Heterogeneity of λ:</i>					
Citizenship Status				-0.016	0.001
Gender				-0.003	0.001
FLC				0.003	0.001
Age				-0.016	0.007
Foreign Born				0.019	0.002
Piece Rate				-0.023	0.001
Years Farm Work				-0.100	0.007

Table 2: **Model 1** is baseline with no heterogeneity in λ . **Model 2** includes worker & employer attributes—citizenship status, gender, Farm Labor Contractor (FLC), age, foreign, piece-rate, and years of farm work experience. Both Models 1 & 2 include year, crop, & task fixed effects, & control for following worker attributes: age, age-squared, gender, education, years of farm work, foreign-born, and citizenship status. [► Empirical Model](#)

Results — Heterogeneity in Bargaining Power

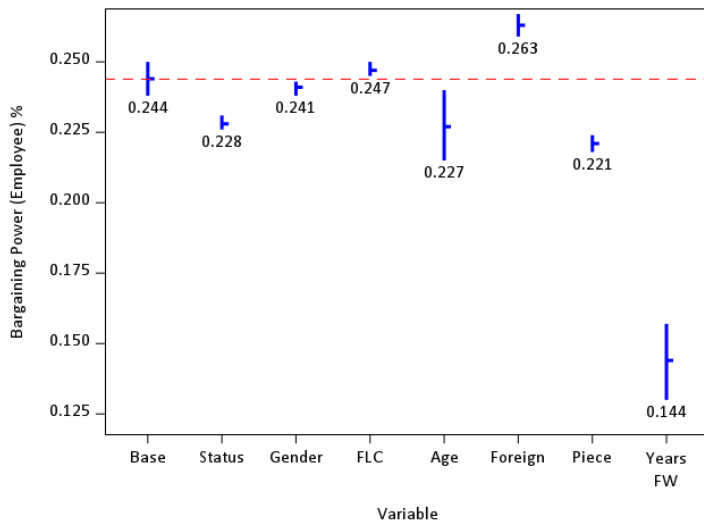


Figure 7: The figure shows how workers' bargaining power differs across worker and employer attributes.

Model Results — Heterogeneity of Mean Productivity

Parameter/Variable	Notation	Model 1		Model 2	
		Est.	Std. Err.	Est.	Std. Err.
Job Arrival Rate	τ	0.118	0.002	0.138	0.002
Job Separation Rate	δ	0.180	0.004	0.193	0.004
Mean Productivity	μ_ϕ	2.027	0.006	2.132	0.019
Std. Dev. Productivity	σ_ϕ	0.192	0.010	0.273	0.012
Reservation Utility	ϕ^*	3.232	0.006	3.234	0.006
Workers' Bargaining Power	λ	0.235	0.001	0.234	0.001
<i>Heterogeneity of μ_ϕ:</i>					
Citizenship Status				-0.165	0.014
Gender				0.168	0.010
FLC				0.002	0.009
Age				-0.180	0.055
Foreign Born				-0.055	0.014
Piece Rate				0.064	0.012
Years Farm Work				0.272	0.062

Table 3: **Model 1** is baseline with no heterogeneity in μ_ϕ . **Model 2** includes worker & employer attributes—citizenship status, gender, Farm Labor Contractor (FLC), age, foreign, piece-rate, and years of farm work experience. Both Models 1 & 2 include year, crop, & task fixed effects, & control for following worker attributes: age, age-squared, gender, education, years of farm work, foreign-born, and citizenship status. ▶ Empirical Model

Results – Heterogeneity in Mean Productivity

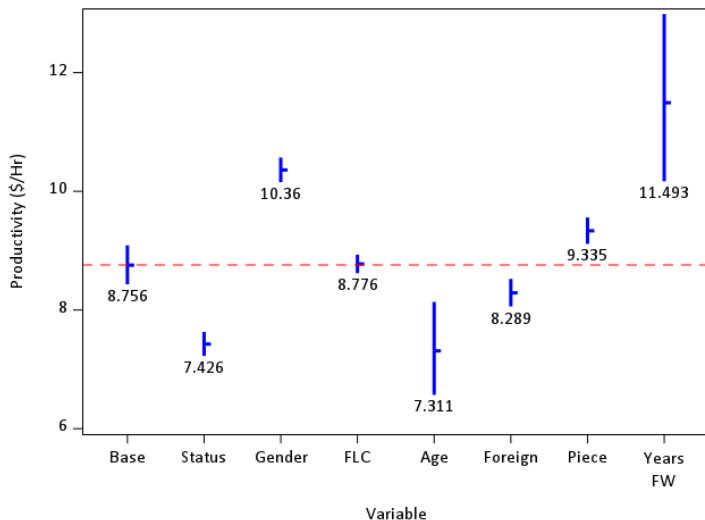


Figure 8: The figure shows how workers' mean productivity differs across worker and employer attributes.

Model Results — Heterogeneity of λ and μ_ϕ

Variable/Parameter	Notation	Model 1		Model 1	
		Est.	Std. Err.	Est.	Std. Err.
Job Arrival Rate	τ	0.139	0.002	0.139	0.002
Job Separation Rate	δ	0.193	0.004	0.193	0.004
Mean Productivity	μ_ϕ	2.120	0.020	2.120	0.020
Std. Dev. Productivity	σ_ϕ	0.281	0.013	0.281	0.013
Reservation Utility	ϕ^*	3.226	0.005	3.226	0.005
Workers' Bargaining Power	λ	0.242	0.003	0.242	0.003
<i>Heterogeneity along:</i>		<i>Heterogeneity of μ_ϕ</i>		<i>Heterogeneity of λ</i>	
Citizenship Status		-0.155	0.014	-0.013	0.001
Gender		0.178	0.011	-0.007	0.001
FLC		0.000	0.009	0.002	0.001
Age		-0.169	0.057	-0.015	0.007
Foreign Born		-0.066	0.015	0.020	0.002
Piece Rate		0.081	0.013	-0.022	0.001
Years Farm Work		0.366	0.064	-0.099	0.007

Table 4: Represents the heterogeneity of bargaining power and mean productivity in a same specification. That is, we interact both λ and μ_ϕ with worker and employer attributes simultaneously, unlike in the prior tables. The model includes year, crop, & task fixed effects, & control for following worker attributes: age, age-squared, gender, education, years of farm work, foreign-born, and citizenship status. [► Empirical Model](#)

Model Results – Changes in λ and μ_ϕ by Attributes

Worker Attributes	Direction of Change	
	Mean Productivity (μ_ϕ)	Bargaining Power (λ)
Undocumented	↓	↓
Male	↑	↓
Under FLC	No Change	↑
Older	↓	↑
Foreign Born	↓	↑
Piece Rate	↑	↓
More Farm Experience	↑	↓

Table 5: The table shows how workers' mean productivity and bargaining power vary across different worker attributes. Arrows indicate the increase (↑) or decrease (↓) in the respective attribute, while "No Change" signifies no significant change, relative to the corresponding counterparts of worker attributes. [► Empirical Model](#)

Model Results — Summary

- Workers capture 24% of surplus; moderate job arrival (14%) & separation (19%) rates.
- Higher bargaining power for foreign-born, older, & contractor-hired; lower for undocumented, males, piece-rate, & experienced.
- Productivity higher for males, piece-rate earners, & experienced; lower for undocumented, older, & foreign-born.
- Some workers (males, piece-rate, experienced) benefit more from productivity than bargaining.
- Results challenge “zero-sum game” views; both productivity & bargaining shape outcomes.
- High productivity can compensate for low bargaining power in some groups.
 - More research needed to fully answer this.

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- US ag. faces labor shortages, aging, foreign, & undocumented workforce, and heterogeneity in wage outcomes.
- Imperfect competition in CA crop labor markets using 1989-2022 data.
- A structural model to assess bargaining power and productivity.
- Workers' bargaining power is low ($\approx 24\%$), employers capture remaining share.
- Some workers have higher productivity, likely offsetting their bargaining effects, and can still be better-off.
- Understanding if there's an alignment between workers' productivity & their surplus-share, instead of interpreting bargaining effects as 'exploitation'.
- Whether workers are paid fairly for their productivity is more important than bargaining effects alone.