

# 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

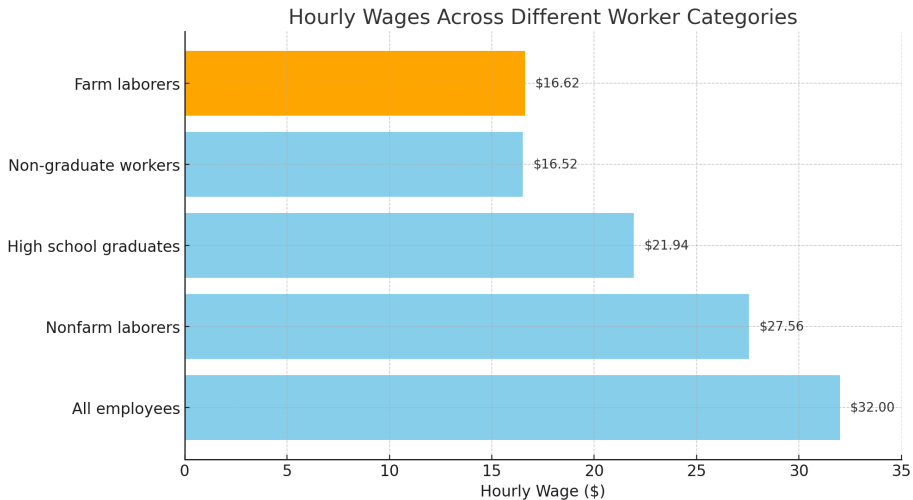
FTC, Department of Labor Partner to Protect Workers from Anticompetitive, Unfair, and Deceptive Practices

New agreement establishes formal collaboration between agencies on issues affecting workers

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

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# 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.

# 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.

# 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

## 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

# Roadmap of Talk

Background

Data and Descriptive Statistics

Model and Empirical Strategy

Results

Conclusion

# 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.
  - $\lambda$ : Workers' share of employment surplus (Marginal Revenue Product of Labor – threshold wage)
  - Perfect competition:  $\lambda = 0$ . No surplus to share. Wage = MRPL.
  - Imperfect competition:  $\lambda > 0$ . Higher value of  $\lambda$  means higher bargaining power.
- Characterize  $\lambda$  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  $\lambda$  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.



# 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

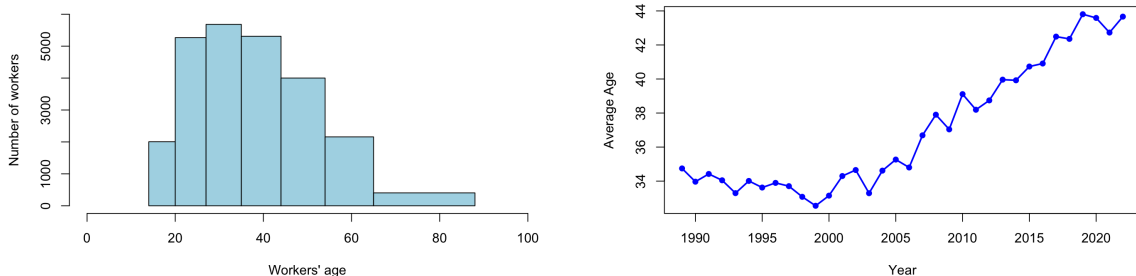


Figure 2:

- **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

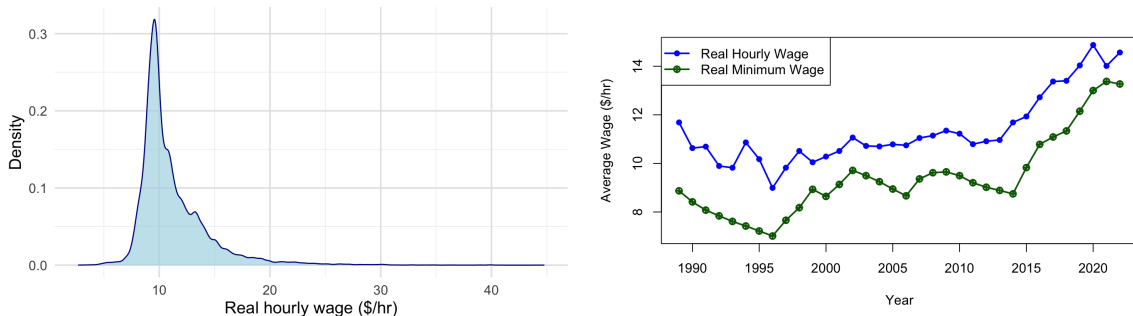


Figure 3:

- **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

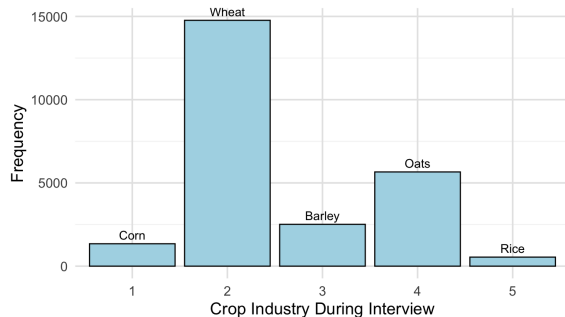
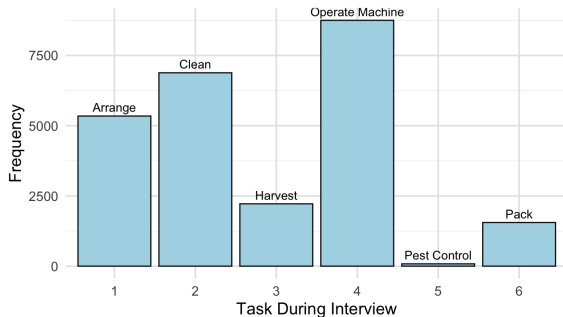


Figure 4:

- **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

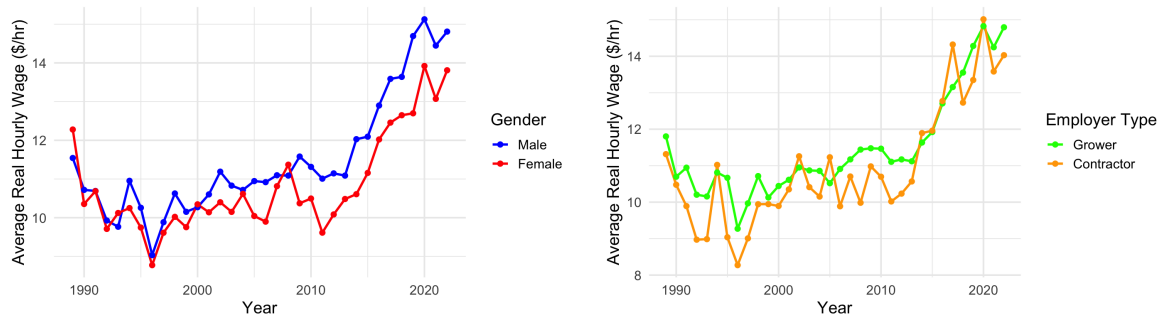


Figure 5:

- **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

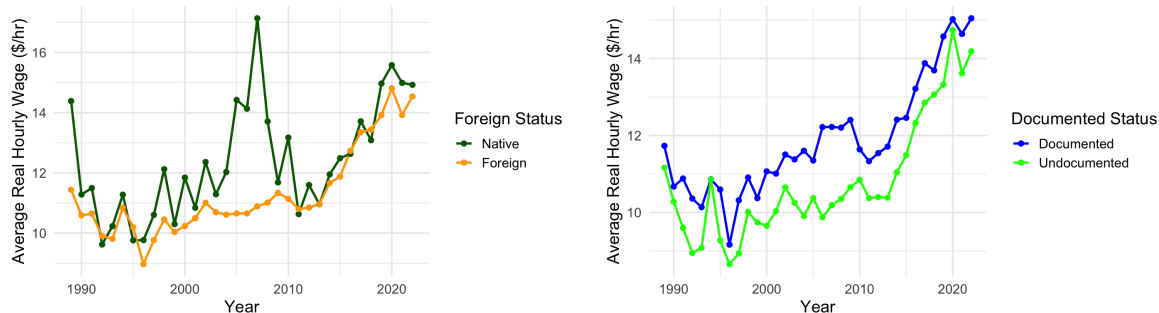


Figure 6:

- **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

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## 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.

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**,  $\phi$  = marginal productivity of labor
  - Both workers and firms observe  $\phi$ , **exogenously**
  - Take distribution  $f(\phi)$  of  $\phi$  to be **log-normal**
- $\delta$  = exogenous rate of job termination
- $\tau$  = exogenous rate of job creation
- $\beta$  = discount rate
- $(0, 1) \ni \lambda$  = exogenous **bargaining power** parameter of workers
  - $1 - \lambda$  = employer's bargaining power parameter
  - determines the distribution of  $\phi$  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,  $\lambda$ , 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  $\lambda$ .

# 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](#)

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

- 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  $\phi^*$  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	$\tau$	0.118	0.002	0.116	0.002
Job Separation Rate	$\delta$	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	$\phi^*$	3.232	0.006	3.225	0.005
Workers' Bargaining Power	$\lambda$	0.235	0.001	0.244	0.003
<i>Heterogeneity of <math>\lambda</math>:</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  $\lambda$ . **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

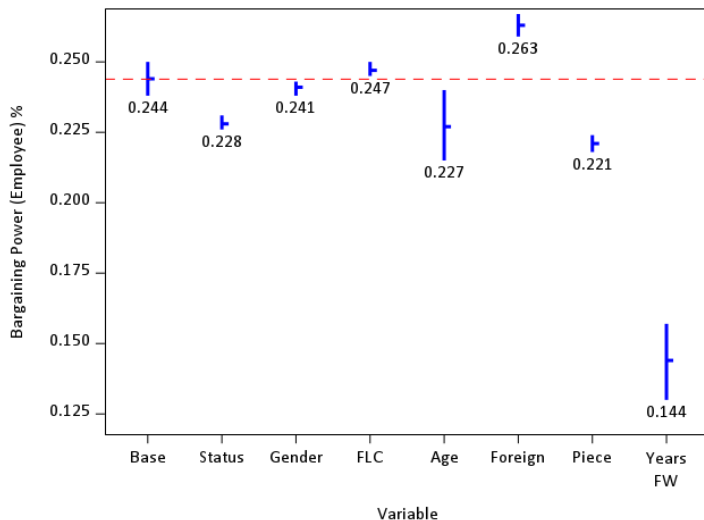


Figure 7: The figure shows how workers' bargaining power differs across worker and employer attributes.

## Model Results — Heterogeneity of Mean Productivity

Parameter/Variable	Notation	Model 1		Model 2	
		Est.	Std. Err.	Est.	Std. Err.
Job Arrival Rate	$\tau$	0.118	0.002	0.138	0.002
Job Separation Rate	$\delta$	0.180	0.004	0.193	0.004
Mean Productivity	$\mu_\phi$	2.027	0.006	2.132	0.019
Std. Dev. Productivity	$\sigma_\phi$	0.192	0.010	0.273	0.012
Reservation Utility	$\phi^*$	3.232	0.006	3.234	0.006
Workers' Bargaining Power	$\lambda$	0.235	0.001	0.234	0.001
<i>Heterogeneity of <math>\mu_\phi</math>:</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  $\mu_\phi$ . **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

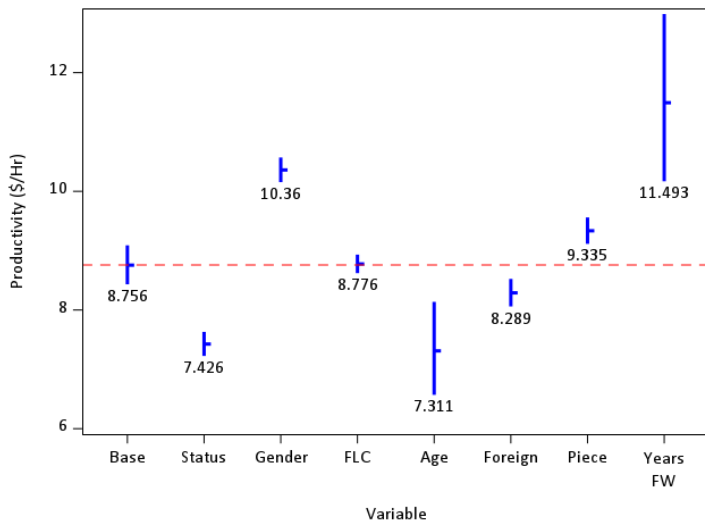


Figure 8: The figure shows how workers' mean productivity differs across worker and employer attributes.

## Model Results — Heterogeneity of $\lambda$ and $\mu_\phi$

Variable/Parameter	Notation	Model 1		Model 1	
		Est.	Std. Err.	Est.	Std. Err.
Job Arrival Rate	$\tau$	0.139	0.002	0.139	0.002
Job Separation Rate	$\delta$	0.193	0.004	0.193	0.004
Mean Productivity	$\mu_\phi$	2.120	0.020	2.120	0.020
Std. Dev. Productivity	$\sigma_\phi$	0.281	0.013	0.281	0.013
Reservation Utility	$\phi^*$	3.226	0.005	3.226	0.005
Workers' Bargaining Power	$\lambda$	0.242	0.003	0.242	0.003
<i>Heterogeneity along:</i>		<i>Heterogeneity of <math>\mu_\phi</math></i>		<i>Heterogeneity of <math>\lambda</math></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  $\lambda$  and  $\mu_\phi$  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 $\lambda$ and $\mu_\phi$ by Attributes

Worker Attributes	Direction of Change	
	Mean Productivity ( $\mu_\phi$ )	Bargaining Power ( $\lambda$ )
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) can 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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## Conclusion

- 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.