Worker Beliefs About Outside Options

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What Do Workers Know About Their Outside Options?

Starting point:
- Across firms, large differences between wages paid to similar workers
  Slichter (1950); Abowd, Kramarz and Margolis (1999); Card, Heining and Kline (2013); Bonhomme, Holzheu, Lamadon, Manresa, Mogstad and Setzler (2020)

How can these differences persist in equilibrium?
- Compensating differentials
  Rosen (1986)
- Heterogeneity in preferences
  Card, Cardoso, Heining and Kline (2018); Berger, Herkenhoff and Mongey (2019); Lamadon, Mogstad and Setzler (2021)
- Search/switching costs
- Misperceptions
There may be a certain number of workers in the immediate neighbourhood and to attract those from further afield it may be necessary to pay a wage equal to what they can earn near home plus their fares to and fro; or there may be workers attached to the firm by preference or custom and to attract others it may be necessary to pay a higher wage. Or ignorance may prevent workers from moving from one to another in response to differences in the wages offered by the different firms.

⇒ Our goal: measure the extent and form of this ignorance (and potential consequences).
We ask:

1. Do workers, on average, accurately perceive wage differences across firms?
2. How systematic are workers’ biases about outside options with other employers?
3. What are equilibrium consequences of misperceptions about outside options?
Our Paper: Workers’ Subjective vs. Objective Outside Options

- Representative survey of workers’ beliefs about their outside options
  - Integrated into German Socio-Economic Panel (GSOEP)
  - Linked to respondents’ administrative labor market data (IAB)

- Compare subjective beliefs with (proxies for) objective outside options
  - Wage changes of coworkers when they move out of the firm
  - External labor market: wages of workers in the same occupation
Our Paper: Preview of Main Results

• Workers have systematic misperceptions about outside options
  - Workers mistakenly believe outside options are similar to current employment conditions (anchoring)
  - Workers, especially at low-paying firms, underestimate their outside options.

• Analyze equilibrium consequences of worker misperception in very simple labor market model
  Adopt and extend product market framework in Salop and Stiglitz (1977) to labor market and allow for misperceptions (anchoring)
  - Key insight: Misperceptions can be source of monopsony, wage markdowns, and labor market segmentation.
    Formalization of Robinson’s (1933) insight
  - Evaluate model predictions in the data
Related Literature

**Reynolds (1951):** survey of 1,000 manual workers in New Haven labor market (1946-48)
- “Very few [workers] knew [...] how much they could expect to earn [at other plants]”
- Workers at low-paying firms underestimate wages elsewhere

Growing literature on **labor market expectations** (Faberman, Mueller, Şahin and Topa, 2017; DellaVigna, Lindner, Reizer and Schmieder, 2017; DellaVigna, Heining, Schmieder and Trenkle, 2020; Mueller, Spinnewijn and Topa, 2021)
- Survey data covering job-seekers’ beliefs about, e.g., **future wage offers** (Conlon, Pilossof, Wiswall and Zafar, 2018) or **future job finding rates** (Spinnewijn, 2015; Mueller and Spinnewijn, 2021)
- Limited information even about **coworker wages** (Card, Mas, Moretti and Saez, 2012; Cullen and Perez-Truglia, 2018)

**Our paper:** direct measure of beliefs about outside options + comparisons to objective benchmarks in admin data + analysis of equilibrium consequences of misperceptions
Outline

1. Setting and Survey Measurement of Beliefs
2. Biases in Beliefs about Outside Options
3. Equilibrium Consequences
4. Conclusion
Outline

1. Setting and Survey Measurement of Beliefs
2. Biases in Beliefs about Outside Options
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4. Conclusion
German Socio-Economic Panel (GSOEP)

- Representative, probability-based sample of German population
- High quality: face-to-face or computer-aided telephone interviews
- We included our tailored survey module in the 2019 and 2020 waves of the GSOEP Innovation Sample
- 1,604 respondents, with panel structure across the two waves
- Link to administrative matched employer-employee data (SOEP-ADIAB)
  - SOEP respondents asked for consent for linkage
  - Match rate of 87% (based on names, gender, date of birth, and address)

Additional surveys: academic experts & additional survey for robustness checks
Imagine that you were forced to leave your current job and that you had 3 months to find a job at another employer in the same occupation. Do you think that you would find a job that would offer you a higher overall pay, the same pay, or a lower pay?

If previous answer is not “Same pay”: What do you think: how much more/less would you earn in that new job? ⇒ Worker Belief about Outside Option

- Elicit measures of surplus, perceived frictions, and a series of other outside option measures, including:
  - Wage changes of coworkers who left the firm
  - Rank in within-occupation wage distribution
  - Median salary in occupation in external labor market
Validation I: Beliefs are Persistent

Slope: 0.29 (SE 0.03)

Beliefs: Own Wage Change in 2019

Beliefs: Own Wage Change in 2020

In Euros
Validation II: Beliefs Predict Intentions to Search

Prob of Seeking New Job (%)

Belief: Own Wage Change

Uncontrolled, Slope: 51.547 (SE 14.921)
Controlling for Truth, Slope: 53.151 (SE 15.13)

Reservation Wage Cut
Intentions to Bargain
Robustness Checks: Beliefs

- Drop respondents who report "same pay"
- Elicit beliefs without "same pay" option
- Don’t condition on staying in occupation
- Vary time horizon of search
- Vary reason for separation
Outline

1. Setting and Survey Measurement of Beliefs
2. Biases in Beliefs about Outside Options
3. Equilibrium Consequences
4. Conclusion
Research Design: Subjective vs. Objective Outside Options

Subjective Wage Change at Outside Option vs. Actual Wage Change at Outside Option

Microfoundation: Bayesian Learning Model
Research Design: Subjective vs. Objective Outside Options

Unbiased beliefs
Slope = 1, intercept = 0

Microfoundation: Bayesian Learning Model
Research Design: Subjective vs. Objective Outside Options

Homogeneous overestimation
Slope = 1, intercept > 0

Subjective Wage Change at Outside Option vs. Actual Wage Change at Outside Option

Microfoundation: Bayesian Learning Model
Research Design: Subjective vs. Objective Outside Options

Homogeneous underestimation
Slope = 1, intercept < 0

Subjective Wage Change at Outside Option
Actual Wage Change at Outside Option

Microfoundation: Bayesian Learning Model
Research Design: Subjective vs. Objective Outside Options

Heterogeneity: bias towards identical OOs
Slope < 1

Subjective Wage Change at Outside Option
Actual Wage Change at Outside Option

Microfoundation: Bayesian Learning Model
Research Design: Subjective vs. Objective Outside Options

Subjective Wage Change at Outside Option

Actual Wage Change at Outside Option

Heterogeneity: bias towards identical OOs
Slope < 1

Underestimation of wage increase
Underestimation of wage decrease

Microfoundation: Bayesian Learning Model
Own Wage Change If Forced to Separate (Beliefs vs Benchmark)

Null: Unbiased Beliefs  
Slope: 1  
Expert Prediction  
Slope: 0.708

Average Bias (Belief - Actual):

Objective Benchmark: Mover Wage Changes
Worker belief about own wage change if forced to separate from current firm
Own Wage Change If Forced to Separate (Beliefs vs Benchmark)

Wage changes of coworkers moving out of firm (mean log wage change, 2015-2019)

Average Bias (Belief - Actual):
Own Wage Change If Forced to Separate (Beliefs vs Benchmark)

Null: Unbiased Beliefs
Slope: 1
Expert Prediction
Slope: .708

Average Bias (Belief - Actual):
Objective Benchmark: Mover Wage Changes
Own Wage Change If Forced to Separate (Beliefs vs Benchmark)

Null: Unbiased Beliefs
Slope: 1

Expert Prediction
Slope: .708
Slope: .089

Belief: Own Wage Change

Objective Benchmark: EB-Adjusted Mover Wage Changes

Average Bias (Belief - Actual): -.023 (SE .011)

Empirical Bayes Methodology
Own Wage Change If Forced to Separate (Beliefs vs Benchmark)

Null: Unbiased Beliefs
Slope: 1
Expert Prediction
Slope: .708

Empirical Bayes Slope: .089 (SE .045)
Split-Sample IV Slope: .049 (SE .061)
Unadjusted Slope: .024 (SE .013)

Average Bias (Belief - Actual): -.023 (SE 0.011)

EB Methodology
IV First Stage
Median
Diff Time Horizon
20+ Moves
Excluding "Same Wage"
Own Wage Change Question
Comparing Subjective and Objective Outside Options

- Two competing hypotheses:
  1. Workers systematically misperceive outside options
  2. Workers have correct beliefs, but objective benchmark (x-axis) is wrong

- Three approaches to address this concern:
  1. Test sensitivity of results to alternative definitions of the relevant sample of coworkers
  2. Alternative benchmark: ML prediction of own wage change based on rich set of covariates
  3. Elicit related beliefs whose accuracy we can directly observe
     a. Wage changes of coworker movers
     b. Salary rank in occupation
     c. Median salary in occupation
1. Alternative Set of Coworkers

(a) Same Education

(b) Same Occupation

- Empirical Bayes Slope: 0.131 (SE 0.071)
- Split-Sample IV Slope: 0.197 (SE 0.101)
- Unadjusted Slope: 0.016 (SE 0.023)

- Empirical Bayes Slope: 0.058 (SE 0.084)
- Split-Sample IV Slope: -0.025 (SE 0.064)
- Unadjusted Slope: -0.009 (SE 0.029)

- Predict GSOEP respondents’ wage changes if they left their current firm, based on a rich set of covariates
- Estimate a Lasso model of log wage change of "involuntary" movers

![Graph showing comparison of beliefs and objective benchmark](image)
3a. Wage Changes of Coworkers Moving Out of Firm (Beliefs vs. Data)

Null: Unbiased Beliefs  
Slope: 1
Expert Prediction  
Slope: .800

Belief: Coworker Wage Change

Objective Benchmark: Mover Wage Changes

Empirical Bayes Slope: .14 (SE .051)
Split-Sample IV Slope: .142 (SE .046)
Unadjusted Slope: .059 (SE .02)
Red bars plot actual pay rank in occupation, calculated using admin ADIAB data and 4-digit occupation codes.
Red bars plot actual pay rank in occupation, calculated using GSOEP data and 4-digit occupation codes.
3b. Histogram of Own Rank in Occupation (Beliefs and Data)

(a) Belief Distribution

(b) Belief vs Actual Rank

Red bars plot actual pay rank in occupation, calculated using GSOEP data and 4-digit occupation codes.
3c. Errors About Median Salary in Occupation

Belief - Actual median salary in occupation using GSOEP data and 4-digit occupation codes.
3c. Errors About Median Salary in Occupation

(a) Errors

Estimation Error (Belief - Actual Wage in Occupation)

Mean: -4.12
Median: -6.98

(b) Errors on AKM Effects

Slope: .222 (SE .078), N=475

Belief - Actual median salary in occupation using GSOEP data and 4-digit occupation codes.
Comparing Subjective and Objective Outside Options

- Systematic misperceptions of own and coworker wage changes: “anchoring” beliefs about OO on current wage.

- Consistent with workers perceiving (relevant) external labor market to be more similar to current employer than it actually is – and using their current employer’s wage as a signal about the overall labor market. 

  Anchoring-and-adjustment heuristic (Kahneman and Tversky, 1974)
Equilibrium Consequences of Biases

- Now: equilibrium model
  - Anchoring gives rise to monopsony power

- Then: empirical evidence
  - Equilibrium sorting consistent with model predictions
  - Biases predict labor market behaviors
  - Calculate share of nonviable jobs if workers had correct beliefs
Outline

1. Setting and Survey Measurement of Beliefs
2. Biases in Beliefs about Outside Options
3. Equilibrium Consequences
4. Conclusion
Equilibrium Consequences of Worker Misperceptions

- Old hypothesis (Robinson, 1933): Workers’ misperceptions may generate employer monopsony, and may help sustain wage markdowns and wage dispersion

- Simple equilibrium model (adopt and extend product market framework of Salop and Stiglitz, 1977, to labor market and misperceptions (anchoring)):
  - Sophisticated and naive workers: experts and amateurs
  - Firms strategically set wages to maximize profits

- Largely graphical intuitions in slides; full paper has Full Model
Standard Competitive Equilibrium

\[ w \] vs. \[ \ell \]

- \( w^* \) and \( \ell^* \)
- MPL curve

Full Model
Competitive Firm Size
Low-Wage Firm Size

\[
\begin{align*}
L & \Rightarrow w \\
W & \Rightarrow MPL
\end{align*}
\]
High-Wage Firm Size

\[ w = \text{MPL} \]

\[ w^* = \left(1 - \alpha \right) \frac{L}{N} \]

\[ \ell^* = \frac{L}{N} \]

\[ \ell_h = \left(1 - \alpha + \frac{\alpha}{\beta} \right) \frac{L}{N} \]

Full Model
Wages in the High-Wage Sector

\[ w = \lambda \left( 1 - \frac{\alpha}{\beta} \right) \left( \frac{L}{N} \right) \]

\[ w^* \]

\[ w_h \]

\[ \ell_i \]

\[ \ell^* \]

\[ \ell_h \]

\[ (1 - \alpha) \left( \frac{L}{N} \right) \]

\[ \left( 1 + \frac{\alpha}{\beta} \right) \left( \frac{L}{N} \right) \]
Wages in the Low-Wage Sector

\[ w = \frac{(1 - \alpha)}{N} \left( \frac{L}{N} \right) \]

\[ w_h = \left( 1 - \alpha + \frac{\alpha}{\beta} \right) \frac{L}{N} \]
Wage Markdowns in the Low-Wage Sector

\[ \frac{w}{(1 - \alpha) \frac{L}{N}} \]

\[ \frac{w}{L/N} (1 - \alpha + \frac{\alpha}{\beta}) \frac{L}{N} \]

\[ w^* \]

\[ w_h \]

\[ w_l \]

\[ l_l \]

\[ l^* \]

\[ l_h \]

\[ MPL \]
Wage-Setting: Worker Beliefs and Reservation Wages

- Simple setup: amateurs’ priors are weighted avg of current wage and true max wage:

\[ \tilde{w}^{\text{max}} = \gamma \cdot w_j + (1 - \gamma) \cdot w^{\text{max}} \]  

(1)

- \( \gamma \in [0, 1] \) guides the degree of anchoring

- Since true max wage is the competitive wage \( w^* \), optimal \( w' \) is:

\[ w_l = w^* - \frac{c_A}{1 - \gamma} \]  

(2)

- Higher search costs or stronger anchoring push down \( w_l \)
Effects of Anchoring on Equilibrium
Effects of Search Costs on Equilibrium

Effects of Search Costs, With and Without Anchoring

- Competitive Equilibrium without Anchoring ($\gamma = 0$)
- Segmented Equilibrium with Anchoring ($\gamma = 0.9$)
- Segmented Equilibrium without Anchoring ($\gamma = 0$)

Wages vs. Search Cost ($c_A$)

- $w^*$
- $w_h (\gamma = 0)$
- $w_l (\gamma = 0)$
- $S_l (\gamma = 0)$

Share of Low-wage Jobs

Full Model
Effects of Search Costs on Equilibrium

- Competitive Equilibrium without Anchoring ($\gamma = 0$)
- Segmented Equilibrium with Anchoring ($\gamma = 0.9$)
- Segmented Equilibrium without Anchoring ($\gamma = 0$)

Graph with axes:
- Wages
- Share of Low-wage Jobs

Search Cost ($c_A$)
How Relevant Are Misperceptions for Labor Market Equilibrium?

• Test model predictions and allocative consequences of misperceptions:
  1. Model predicts sorting: uninformed (amateur) workers concentrated in low-wage sector
Beliefs vs Coworker Wage Changes by AKM Firm Effect

The chart illustrates the relationship between wage changes and beliefs about coworkers compared to the AKM firm effect. The y-axis represents the wage change, with Own (Belief) vs. Coworkers (Data) on the x-axis. The graph shows a negative correlation, with data points clustering around a dashed line that has a slope of -0.474 (SE 0.099).

This indicates that as the AKM firm effect increases, the difference between own beliefs and coworker data decreases, suggesting a shared perception among workers when comparing their personal expectations with actual coworker experiences.
Beliefs vs Coworker Wage Changes by AKM Firm Effect

Beliefs About Coworkers
Errors (Own Wage Change) by AKM Firm Effect

Slope: 0.372 (SE 0.097), N=342

Estimation Error
(Belief - Actual Coworker Wage Change)

AKM Firm Effect

Beliefs About Coworkers
Errors (Rank in Occupation) by AKM Firm Effect

Slope: -38.767 (SE 7.187), N=414

Estimation Error
(Blend - Actual Rank in Occupation)

Slope: -38.767 (SE 7.187), N=414
Errors (Median Salary in Occupation) by AKM Firm Effect

Slope: 0.222 (SE 0.078), N=475

Estimation Error (Belief - Actual Wage in Occupation) vs. AKM Firm Effect

Slope: 0.222 (SE 0.078), N=475
How Relevant Are Misperceptions for Labor Market Equilibrium?

- Test model predictions and allocative consequences of misperceptions:
  1. Model predicts sorting: naive workers concentrated in low-wage sector
  2. Pessimism about outside options reduces search
Beliefs About Outside Options Predict Behavior

![](image)

Belief: Own Wage Change

Uncontrolled, Slope: 51.547 (SE 14.921)

Controlling for Truth, Slope: 53.151 (SE 15.13)
Beliefs about Outside Options Predict Behavior

(a) Reservation Wage Cut

(b) Search for New Job

(b) Negotiate for Higher Pay

Intentions on Mover Wage Changes
## Effects of Information Treatment

<table>
<thead>
<tr>
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<th>Beliefs: Own Wage Change</th>
<th>Intended Quit Probability</th>
<th>Intended Negotiation Probability</th>
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<td><strong>Treatment - Underestimate</strong></td>
<td>1.925** (0.858)</td>
<td>2.515 (2.434)</td>
<td>0.333 (2.860)</td>
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<td><strong>Treatment - Overestimate</strong></td>
<td>0.813 (0.986)</td>
<td>0.258 (2.597)</td>
<td>0.813 (3.294)</td>
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<td><strong>Control - Overestimate</strong></td>
<td>1.678 (1.121)</td>
<td>0.547 (2.558)</td>
<td>4.797 (3.440)</td>
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<td><strong>Constant</strong></td>
<td>-1.958*** (0.598)</td>
<td>15.13*** (1.684)</td>
<td>20.55*** (2.149)</td>
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<td><strong>Obs.</strong></td>
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How Relevant Are Misperceptions for Labor Market Equilibrium?

- Test model predictions and allocative consequences of misperceptions:
  1. Model predicts sorting: naive workers concentrated in low-wage sector
  2. Pessimism about outside options reduces search
  3. Rational inattention: wrong beliefs inconsequential among workers who do not search
Biased Beliefs Among All Subgroups

(a) Tenure

(b) Coworker Turnover

(b) Confidence

Split workers by whether above/below median of heterogeneity variable.
How Relevant Are Misperceptions for Labor Market Equilibrium?

- Test model predictions and allocative consequences of misperceptions:
  1. Model predicts sorting: naive workers concentrated in low-wage sector
  2. Pessimism about outside options reduces search
  3. Rational inattention: wrong beliefs inconsequential among workers who do not search
  4. Calculation of share nonviable jobs if workers had correct beliefs
Recalculate surplus: replace subjective wage component with coworker mover wage change (average in AKM ventile) or ML prediction for wage change, keep non-wage component fixed.
Recalculate surplus: replace subjective wage component with coworker mover wage change (average in AKM ventile) or ML prediction for wage change, keep non-wage component fixed.
Outline

1. Setting and Survey Measurement of Beliefs
2. Biases in Beliefs about Outside Options
3. Equilibrium Consequences
4. Conclusion
Conclusion

1. Do workers, on average, accurately perceive wage differences across firms?
   - No: workers underestimate wage differences across firms
   - Workers anchor beliefs about external labor market on current employer

2. How systematic are workers’ biases about outside options with other employers?
   - Workers, especially at low-paying firms, underestimate their outside options.

3. What are equilibrium consequences of misperception about outside options?
   - Monopsony and wage markdowns
   - Labor market segmentation with high- and low-wage sector
Worker Beliefs About Outside Options

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Robinson, Joan, The Economics of Imperfect Competition, Macmillan, 1933.


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## GSOEP-IAB Matched Sample - Summary Statistics

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### Expert Survey - Summary Statistics

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Beliefs About Own Wage Change (Percent)

Mean: -0.26
Median: 0.00
Experts' mean: -0.72
Experts' median: 0

Fraction: -20 0 20 40 60
Beliefs: Own Wage Change

Mean: -0.26
Median: 0.00

Beliefs: Own Wage Change

Fraction: -20 0 20 40 60
Beliefs About Own Wage Change (Euros)

Mean: -525.75
Median: 0.00

Beliefs About Own Wage Change

Mean: -525.75
Median: 0.00
Slope: 0.46 (SE 0.04)
Robustness

In July 2021 we fielded a robustness survey which demonstrates robustness of beliefs to:

- **Elicitation format** (change vs. level elicitation)
- Conditioning on staying in the same occupation
- Different time horizons of search (3 months vs 12 months)
- Different framing of reason for separation (general framing vs. layoff)
- **Prediction incentives** for beliefs about median wage in own occupation
- **Elicitation of min pay raise** at another firm to quit, rather than pay cut at current firm

In May 2021, conducted a survey with **German HR managers** to shed light on the firm-sides.
Imagine you are forced to leave your current job and had [3 / 12 months] to find a job with another employer [in the same occupation].
In the job with another employer, how much would you receive per month as gross employment income in Euro? ___ Euro
[Reminder: Your current gross monthly income is ___ Euro.]
How confident are you in your previous estimate? (very certain, certain, uncertain, very uncertain)
Robustness to Elicitation Format II: No "Same Pay" Option
Robustness to Occupation-Specific Search

- Conditioning on Occupation
- Not Conditioning on Occupation

Belief: Own Wage Change

Back to question in main slides
Robustness to Framing of Reason for Separation

Cumulative Probability

Belief: Own Wage Change

General Framing
Firm Closure Framing

Back to question in main slides
Robustness to Prediction Incentives

The graph illustrates the cumulative probability of biases in beliefs in Euro elicitation with and without incentives. The x-axis represents biases in beliefs in Euro, and the y-axis shows cumulative probability.

- The blue line represents elicitation without an incentive.
- The black dashed line represents elicitation with an incentive.

The graph shows a comparison between the two elicitation methods, indicating how robustness to prediction incentives affects the distribution of biases in beliefs.
Robustness to Reservation Wage Elicitation: Cut vs Raise

Slope: .507 (SE .059), N=1,537
Beliefs Predict Reservation Wage Cuts

- **Belief: Own Wage Change**
  - Uncontrolled, Slope: -29.603 (SE 6.414)
  - Controlling for Truth, Slope: -29.352 (SE 6.385)
Beliefs Predict Intentions to Bargain

The graph shows the relationship between beliefs about one's own wage change and the probability of negotiating for a pay rise. The blue line represents the relationship without controlling for truth, with a slope of 77.411 (SE 20.136). The red line, controlling for truth, has a slope of 76.143 (SE 20.087). The graph includes data points that indicate a positive correlation between belief in one's own wage change and the likelihood of negotiating for a pay rise.
Robustness: No "Same Pay" Option

Cumulative Probability

Belief: Coworker Wage Change

Main Elicitation
Alternative Elicitation
Robustness: Don’t Condition on Staying in Occupation

![Graph showing cumulative probability of belief in own wage change with and without conditioning on occupation.](image-url)
Robustness: Vary Reason for Separation

Belief: Own Wage Change

- General Framing
- Firm Closure Framing
Bayesian Model with Normal Learning

- \( N \) firms

- Worker’s prior beliefs about wages are given by

\[
    w_j | \theta \sim N(\theta, 1/\pi) \quad \forall j
\]

\[
    \theta \sim N(\mu, 1/\tau).
\]

- Worker employed at firm \( j \) observes the wage \( w_j \) and updates her beliefs about \( \theta \) according to Bayes rule:

\[
    \theta | w_j \sim N \left( \frac{w_j \pi + \mu \tau}{\pi + \tau}, \pi + \tau \right),
\]

\( \Rightarrow \) Posterior belief about \( \theta \) will be increasing in the current wage \( w_j \) (as long as some uncertainty over \( \theta \) and finite variance of wages)
We use Bayes’ Rule to write the employed worker’s joint posterior:

\[ f(w_k, \theta | w_j) = \frac{f(w_j | w_k, \theta) f(w_k | \theta) f(\theta)}{f(w_j)} \]

\[ = \frac{f(w_j | \theta) f(w_k | \theta) f(\theta)}{f(w_j)} \text{ by cond. ind.} \]  

The marginal posterior for \( \theta \) is given by integrating over the wage \( w_k \):

\[ f(\theta | w_j) \propto \int f(w_j | \theta) f(w_k | \theta) f(\theta) dw_k \]

\[ = f(w_j | \theta) f(\theta) \]

\[ = \phi(\theta; w_j, \pi) \phi(\theta; \mu, \tau) \text{ by sym. of Normal distr.} \]  

Utilizing product characteristics of normal distributions, gives:

\[ \theta | w_j \sim N\left( \frac{w_j \pi + \mu \tau}{\pi + \tau}, \pi + \tau \right) \]
Empirical Bayes Methodology

- Firm $j$'s mean coworker wage change $\hat{\Delta}_j$ is the firm's "true" leaver wage change parameter $\Delta_j$ plus random error:

$$\hat{\Delta}_j = \Delta_j + \varepsilon_j$$  \hspace{1cm} (12)

$$\hat{\Delta}_j | \Delta_j, \sigma^2_j \sim N(\Delta_j, \sigma^2_j)$$  \hspace{1cm} (13)

- Suppose we know underlying distribution of leaver wage change parameters:

$$\Delta_j \sim N(\bar{\Delta}, \sigma^2)$$  \hspace{1cm} (14)

- Idea: shrink $\Delta_j$ towards $\bar{\Delta}$ to reduce influence of $\varepsilon_j$ on regression results

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1Reference: Chandra, Finkelstein, Sacarny, and Syverson (2016), "ebayes.ado" by Adam Sacarny
Empirical Bayes Methodology\textsuperscript{2}

- Posterior distribution of $\Delta_j$ given observed mean $\hat{\Delta}_j$ and population parameters $\bar{\Delta}, \sigma^2$ is:

$$
\Delta_j | \hat{\Delta}_j, \bar{\Delta}, \sigma^2 \sim N(\Delta_{j}^{\text{EB}}, \sigma_j^2(1 - b_j))
$$

(15)

where:

$$
b_j = \sigma_j^2 / (\sigma_j^2 + \sigma^2) \quad (16)
$$

$$
\Delta_{j}^{\text{EB}} = (1 - b_j)\hat{\Delta}_j + b_j\bar{\Delta} \quad (17)
$$

- $\Delta_{j}^{\text{EB}}$ is the posterior expected value of $\Delta_j$, and is a weighted average of the observed mean and true population mean, weighted by relative variances of observed mean and population distribution

\textsuperscript{2}Reference: Chandra, Finkelstein, Sacarny, and Syverson (2016), "ebayes.ado" by Adam Sacarny
Empirical Bayes Methodology

- How to estimate $\Delta_j^{EB}$?
- Estimate $\sigma_j^2$ using within-firm variance of mover wage changes (requires restricting to firms with $\geq 2$ movers)
- Estimate $\bar{\Delta}$ and $\sigma^2$ using an iterative procedure on population distribution of $\hat{\Delta}$
- Details in Appendix C of Chandra, Finkelstein, Sacarny, and Syverson (2016)

Reference: Chandra, Finkelstein, Sacarny, and Syverson (2016), "ebayes.ado" by Adam Sacarny
Lasso Methodology I

- Take universe of transitions between main employment spells, involving an intermediate unemployment spell, in Germany between 2015 and 2019 (excluding GSOEP respondents).

- Lasso regression
  - Dependent variable: log wage change associated with transition
  - Independent variables: worker and origin-firm covariates

- Use selected variables and estimated coefficients to generate predicted wage changes for GSOEP respondents.
Lasso Methodology II

Included covariates, in descending order of partial R-squared values:

- Wage at initial firm
- Age $\times$ education dummies
- Occupation (1-digit) at initial firm
- Industry $\times$ region dummies
- Gender
- Initial firm’s AKM effect
- Age, tenure, education, and firm size, turnover, employment growth, wage dispersion, region, industry

No covariates end up excluded
Coworker Moves: Split-Sample First-Stage

Slope: .5 (SE .05), N=105

Actual Wage Change of Movers

(50% Random Sample A)

(50% Random Sample B)

Slope: .5 (SE .05), N=105
Subjective Outside Options: Median Coworker Wage Change

Belief: Own Wage Change

Objective Benchmark: Mover Wage Changes

Split-Sample IV Slope: 0.088 (SE 0.061)

Unadjusted Slope: 0.025 (SE 0.013)
Subjective Outside Options: Different Time Horizon (2017-2019)

Belief: Own Wage Change

Objective Benchmark: Mover Wage Changes

Empirical Bayes Slope: .089 (SE .045)
Split-Sample IV Slope:  .037 (SE .058)
Unadjusted Slope:         .021 (SE .016)
Belief: Own Wage Change

Objective Benchmark: Mover Wage Changes

Empirical Bayes Slope: .021 (SE .051)
Split-Sample IV Slope:  .002 (SE .032)
Unadjusted Slope:         .008 (SE .029)
20+ Coworker Moves (Coworker Wage Change)

Belief: Coworker Wage Change

Objective Benchmark: Mover Wage Changes

Empirical Bayes Slope: 0.108 (SE 0.061)
Split-Sample IV Slope: 0.08 (SE 0.042)
Unadjusted Slope: 0.067 (SE 0.038)

Back to Mover Beliefs
Excluding "Same Wage" Responses (Own Wage Change)

- Belief: Own Wage Change

- Objective Benchmark: Mover Wage Changes

- Empirical Bayes Slope: .075 (SE .044)
- Split-Sample IV Slope: .03 (SE .051)
- Unadjusted Slope: .029 (SE .018)
Excluding "Same Wage" Responses (Own Wage Change)

Belief: Own Wage Change

Objective Benchmark: Mover Wage Changes

Empirical Bayes Slope: .075 (SE .044)
Split-Sample IV Slope: .03 (SE .051)
Unadjusted Slope: .029 (SE .018)
Excluding "Same Wage" Responses (Mover Wage Change)

Belief: Coworker Wage Change

Objective Benchmark: Mover Wage Changes

Empirical Bayes Slope: .182 (SE .057)
Split-Sample IV Slope:  .157 (SE .069)
Unadjusted Slope:         .075 (SE .022)
Own Wage Change Question

Imagine that you were forced to leave your current job and that you had 3 months to find a job at another employer in the same occupation. Do you think that you would find a job that would offer you a higher overall pay, the same pay or a lower pay?

- Higher pay
- Same pay
- Lower pay

[Asked only if previous answer is not "Same pay"] What do you think: how much more/less would you earn in that new job?

- Between 0 and 50 Euros
- Between 50 and 100 Euros
- Between 100 and 200 Euros
- ...
- Between 2000 and 3000 Euros
- More than 3000 Euros
Alternative Set of Coworkers II

(a) Same Age

- Belief: Own Wage Change
- Objective Benchmark: Mover Wage Changes

Empirical Bayes Slope: 0.178 (SE 0.077)
Split-Sample IV Slope: 0.147 (SE 0.118)
Unadjusted Slope: 0.033 (SE 0.032)

(b) Same Income

- Belief: Own Wage Change
- Objective Benchmark: Mover Wage Changes

Empirical Bayes Slope: 0.263 (SE 0.059)
Split-Sample IV Slope: 0.351 (SE 0.234)
Unadjusted Slope: 0.056 (SE 0.024)
Involunt. Move Wage Changes By AKM Firm Effect (Beliefs and Data)

Belief, Slope: -.136 (SE .03)
Data, Slope: -.474 (SE .099)
Beliefs About Coworkers: Median Coworker Wage Change

Belief: Coworker Wage Change

Objective Benchmark: Mover Wage Changes

Split-Sample IV Slope: 0.183 (SE 0.047)

Unadjusted Slope: 0.092 (SE 0.019)
Beliefs About Coworkers: Different Time Horizon (2017-2019)

- **Belief: Coworker Wage Change**
  - Objective Benchmark: Mover Wage Changes
  - Empirical Bayes Slope: 0.14 (SE 0.051)
  - Split-Sample IV Slope: 0.127 (SE 0.052)
  - Unadjusted Slope: 0.043 (SE 0.019)
Own Wage Rank Question

Think of all employees in Germany that work in the same occupation as you, but work at a different employer. What do you think: what percent of those employees receive a...

- Lower pay _ %
- Same pay _ %
- Higher pay _ %

(Please note: these numbers need to add up to 100%)
Median Salary Question

- Think of all employees in Germany that are full-time employed and work in the same occupation as you. What do you think is the typical monthly pay of those employees before taxes (in Euro)?

- Here, we refer to the "typical" monthly earnings as the median monthly earnings, i.e. the earnings that the average full-time employee earns in their job, so that half of the full-time employees earn more in their job and the other half less than this earnings in the occupation according to the 2010 occupation classification.
Errors (Coworker Wage Change) by AKM Firm Effect

Slope: .249 (SE .06), N=513

Estimation Error (Belief - Actual Coworker Wage Change)

AKM Firm Effect

Slope: .25 (SE .06), N=513
Survey Measure of Worker Surplus

- **Definition**: the worker surplus is the percent wage cut that makes the worker indifferent between her current firm and her second best option.

- **Measure Worker Rent** $c_i^*$ as follows:

  Imagine that your current employer were to permanently cut wages. This wage cut results from a change of the CEO in the company and is independent of the economic conditions in your industry. At which wage cut would you quit your job within one year?

  *I would quit my job if my current employer cut wages by more than $c_i^*$.*

Cf. Mui and Schoefer (2021) reservation wage change to/from nonemployment.
Intentions on Mover Wage Changes

(a) Reservation Wage Cut

(b) Search for New Job

(b) Negotiate for Higher Pay
Worker Surplus (Euros)

- Mean: 6068.52
- Median: 3840.00

![Histogram showing the distribution of worker surplus with mean 6068.52 and median 3840.00.](image-url)
Persistence of Worker Surplus

Worker Surplus in 2020 (Flow, as % of Salary)

Worker Surplus in 2019 (Flow, as % of Salary)

slope: 0.3590 (0.0545)
Worker Surplus Predict Lower Actual Separations

```
slope: -0.0014 (0.0006)
```

![Graph showing the relationship between worker rent (flow, as % of salary) and the number of employers switched over the last 12 months, with a negative slope indicating a predictive relationship.]
Reasons for Not Switching Employers

- Job Security
- Atmosphere
- Schedule
- Colleagues
- Location

- Dislike Change
- Obligation
- Fear New Job
- Difficulty to Find New Job
- Other Reasons
Coworker Wage Change Question

Think of the typical employee with work experience that switches from your current employer to another employer. Would this employee receive a lower, higher or the same pay compared to his previous employer?

- Higher pay
- Same pay
- Lower pay

[Asked only if previous answer is not “Same pay”] How much lower/higher would the monthly pay before taxes of this employee be (in percent) after the switch compared to his/her prior employer?

- Between 0% and 2%
- Between 2% and 5%
- Between 5% and 10%
- ...
- Between 50% and 75%
- More than 75%
Setting

- $N$ firms, each initially endowed with $\frac{L}{N}$ workers
- Produce a homogeneous good with DRS production function:
  \[ f(\ell) = \ell^\eta \quad (\eta \in (0, 1]) \]
- Normal competitive equilibrium:
  - Wages equal MPL
    \[ w^* = \eta \left( \frac{L}{N} \right)^{\eta-1} \]
  - Firms earn positive profits (no free entry)
Timing

1. Firms enter labor market endowed with their workers, post a wage

2. Workers learn their firm’s wage, choose whether to search (costly) and move to higher (highest) paying firm
   - Share $\alpha$ of experts: costless search and accurate beliefs
   - Share $(1 - \alpha)$ of amateurs: search costs $c_A$ and anchored prior beliefs

3. Production occurs
Wage-Setting: Temptation to Deviate?

- Suppose a competitive equilibrium.
- A firm has two options:
  - Pay competitive wage $w^*$, retain all workers, earn profits:
    \[
    \pi_j = \left( \frac{L}{N} \right)^\eta - w^* \frac{L}{N}
    \]  
    \[\text{(19)}\]
  - Deviate: pay lower wage $w' < w^*$, retain only amateurs, earn profits:
    \[
    \pi_j = \left( (1 - \alpha) \frac{L}{N} \right)^\eta - w'(1 - \alpha) \frac{L}{N}
    \]  
    \[\text{(20)}\]
- Tradeoff: paying lower wage leads to
  - $\pi \uparrow$ due to reduced wages ($w' < w^*$)
  - $\pi \downarrow$ due to reduced scale ($1 - \alpha$)
Wage-Setting: Reservation Wages

• What is the optimal choice of lower wage $w'$, conditional on deviating from competitive wage?

• Optimal $w'$ is the lowest wage that still retains amateur workers

• Amateurs search (and hence leave) if perceived benefits of search exceed costs:

$$\tilde{w}^\text{max}(w_j, w_{-j}) - w_j > c_A$$  \hspace{1cm} (21)

⇒ Optimal $w' = w_l$ pushes amateur workers to reservation wage:

$$\tilde{w}^\text{max}(w_l, w_{-j}) - w_l = c_A$$  \hspace{1cm} (22)
Simple setup: amateurs’ priors are weighted avg of current wage and true max wage:

\[ \tilde{w}^{\text{max}} = \gamma \cdot w_j + (1 - \gamma) \cdot w^{\text{max}} \]  \hspace{1cm} (23)

\( \gamma \in [0, 1] \) guides the degree of anchoring

Since true max wage is the competitive wage \( w^* \), optimal \( w' \) is:

\[ w_l = w^* - \frac{c_A}{1 - \gamma} \]  \hspace{1cm} (24)

Higher search costs or stronger anchoring push down \( w_l \)
Solving for the Equilibrium

- Profits in the competitive equilibrium:
  \[
  \pi^\text{competitive} = \left( \frac{L}{N} \right)^\eta - \eta \left( \frac{L}{N} \right)^\eta
  \]

- Profits when deviating:
  \[
  \pi^\text{deviating} = \left( (1 - \alpha) \frac{L}{N} \right)^\eta - \left( \eta \left( \frac{L}{N} \right)^{\eta-1} - \frac{c_A}{1 - \gamma} \right)(1 - \alpha) \frac{L}{N}
  \]
Equilibrium Consequences of Worker Misperceptions

- Presence of amateur workers with anchored beliefs can lead to shift from competitive equilibrium to segmented labor market with high- and low-wage sector
  - Search costs and anchoring amplify each other
- Comparative statics: more anchoring leads to
  - Lower wages in low-wage sector
  - Larger low-wage sector
First Possibility: Competitive (One-Wage) Equilibrium

- If \( \pi^{\text{competitive}} > \pi^{\text{deviating}} \), deviating is unprofitable and we get a normal competitive-wage equilibrium

- This occurs if:

\[
\frac{c_A}{1 - \gamma} < \frac{1 - \alpha \eta - (1 - \alpha)\eta}{1 - \alpha} \left( \frac{N}{L} \right)^{1-\eta}
\]  

(27)

- i.e., if search costs \( c_A \) are low, anchoring \( \gamma \) is weak, or the share of experts \( \alpha \) is high
Second Possibility: Segmented Equilibrium

- Either competitive equilibrium or a segmented, two-wage equilibrium

- If $\pi^{\text{competitive}} < \pi^{\text{deviating}}$, some firms deviate and pay low wage $w_l$

- Deviating firms increase their profits (by assumption)

- Non-deviating pay high wage $w_h$, and firms absorb the experts from deviating firms, increasing their size and hence their profits

- Deviations continue until profits in deviating and non-deviating firms are equal:

$$
\left( (1 - \alpha) \frac{L}{N} \right)^{\eta} - w_l (1 - \alpha) \frac{L}{N} = \left( (1 - \alpha + \frac{\alpha}{\beta}) \frac{L}{N} \right)^{\eta} - w_h \left( 1 - \alpha + \frac{\alpha}{\beta} \right) \frac{L}{N}
$$

where $\beta$ is the share of high-wage (non-deviating) firms
Employment Levels in the Segmented Equilibrium

- High-wage sector employs all experts and all "lucky" amateurs
- High-wage firms are large:
  \[ \ell_h = (1 - \alpha + \frac{\alpha}{\beta}) \frac{L}{N} \]  

- Low-wage sector employers all "unlucky" amateurs
- Low-wage firms are small:
  \[ \ell_l = (1 - \alpha) \frac{L}{N} \]

- Turnover in the low-wage sector is higher (experts leave low-wage firms), consistent with reality
Wage Levels in the Segmented Equilibrium

- High-wage firms pay wages equal to MPL at $\ell_h$

$$w_h = \eta \left( \left( 1 - \alpha + \frac{\alpha}{\beta} \right) \frac{L}{N} \right)^{\eta-1}$$  \hspace{1cm} (31)

- Low-wage firms pay the reservation wage preventing amateurs from searching

$$w_l = w_h - \frac{c_A}{1 - \gamma}$$  \hspace{1cm} (32)
The Size of the Low-Wage Sector

• Low-wage sector employs all amateurs born into low-wage firms

⇒ # of workers in low-wage sector depends on share of firms, $1 - \beta$, that are low-wage, and share of workers, $1 - \alpha$, that are amateurs

• $\beta$ pinned down by equal-profit condition

$$
\left( (1 - \alpha) \frac{L}{N} \right)^\eta - w_l (1 - \alpha) \frac{L}{N} = \left( \left( 1 - \alpha + \frac{\alpha}{\beta} \right) \frac{L}{N} \right)^\eta - w_h \left( 1 - \alpha + \frac{\alpha}{\beta} \right) \frac{L}{N}
$$

deviant profits

non-deviant profits

(33)

• Given $\beta$, share of jobs that are low-wage is

$$
S_l = \frac{1 - \beta}{\alpha/(1 - \alpha) + \beta}
$$

(34)
Share of Nonviable Jobs if Workers Had Correct Beliefs

• How consequential are these misperceptions?

• Back-of-the-envelope calculation: calculate share of jobs that would not be viable if workers had accurate beliefs
Share of Nonviable Jobs with Corrected Beliefs

- How many jobs would not be viable at current wages if workers had correct beliefs?

- Draw on survey measure of subjective overall worker surplus:

  *Imagine that your current employer permanently cut wages. This wage cut results from a change of the CEO in the company and is independent of the economic conditions in your industry. At which wage cut would you quit your job within one year?*

  *I would quit my job if my current employer cut wages by more than X%.*

- Decompose overall subjective surplus into subjective wage component and nonwage component:

  \[
  \tilde{S}_i = \tilde{W}_i + \tilde{A}_i.
  \]

  *Worker Surplus = Wage Component from OO Question + Residual "Amenity" Component*
Subjective Worker Surplus (Flow, as % of Salary)

- Mean: 14.23
- Median: 10.00
Share of Nonviable Jobs with Corrected Beliefs

- Decompose overall subjective surplus into nonwage component and subjective wage component:

\[
\tilde{S}_i = \tilde{W}_i + \tilde{A}_i.
\]

- Worker Surplus: \(\tilde{S}_i\)
  - Wage Component from OO Question: \(\tilde{W}_i\)
  - Residual "Amenity" Component: \(\tilde{A}_i\)

- Calculate corrected surplus by replacing subjective wage component with objective OO proxy:

\[
S_i = \tilde{S}_i + \left(\hat{W}_i - \tilde{W}_i\right)
\]

- Worker Surplus: Corrected: \(S_i\)
  - Worker Surplus: Belief: \(\tilde{S}_i\)
  - Wage Change: Objective Benchmark: \(\hat{W}_i\)
  - Wage Change: Belief: \(\tilde{W}_i\)

- OO proxy: mean coworker wage change in AKM ventile, or machine learning prediction