

# Asymmetric Information in Labor Contracts: Evidence from an Online Experiment

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# Insuring Labor Product

- Most workers' labor product combines effort and risk
- Would likely value **insurance** against that risk
- What would be the premium for a contract that...
  - Pays restaurant servers when they're stiffed on the tip?
  - Pays lawyers when they lose a case?
  - Pays academics when they're rejected from journals?
- Employers provide *implicit insurance* through **fixed wages**

## Piece-rate Pay

- Paid by unit of output
- Worker sells labor product at market price
- Examples:
  - Rideshare driver paid per mile
  - Self-employed freelance photographer

## Fixed Wages

- Paid by unit of time
- Worker sells *claim* on labor product
- Examples:
  - Limo driver paid per hour
  - Staff photographer with annual salary

← Earnings Risk

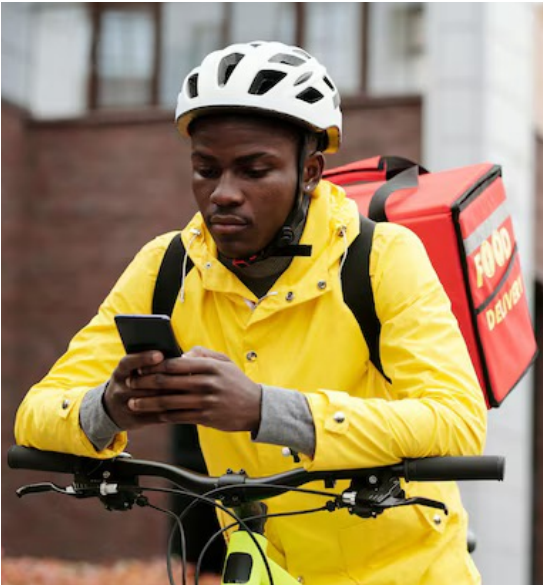
Insurance →

Hourly wage + tips

Annual salary + bonus

Base pay + commission

*Are these contracts socially optimal?*



## Piece-rate Pay

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Earnings Risk

Insurance

Asymmetric information  $\Rightarrow$  market distortions:

- **Moral hazard:** fixed wage induces less effort
- **Adverse selection:** less productive workers sort into fixed wages

$\Rightarrow$  Suboptimal wage contracts

Public policies can mitigate these distortions:

- Hourly wage subsidies
- Employment classification rules
- Portable benefits programs
- Minimum wage

$\Rightarrow$  Promote implicit insurance in wage contracts

*How do moral hazard and adverse selection influence wage contracts?*

# This Paper:

1. Experimentally identify treatment effects and selection into hourly pay
  - Two-stage RCT separates moral hazard, adverse selection, and wage effects
    1. Offer workers a *choice* between randomized hourly wage or piece rate
    2. Randomly increase hourly workers' wages to match highest wage offer
  - Find evidence of both moral hazard and adverse selection into hourly wages
    - MH  $\equiv$  Treatment effect: take-up of hourly contract  $\Rightarrow$  output  $\downarrow$  by 6.3% relative to the mean
    - AS  $\equiv$  Selection into treatment: wage offer  $\uparrow$  by 10%  $\Rightarrow$  marginal worker's productivity  $\uparrow$  by 1.4%

# This Paper:

1. Experimentally identify treatment effects and selection into hourly pay
2. Develop model of fixed-wage labor markets under asymmetric info
  - Clarifies roles of AS and MH in shaping equilibrium, allowing for monitoring costs
  - Equilibrium and efficient shares of hourly work are determined by three curves:
    1.  $\bar{w}(\theta)$ : **reservation wage** for an hourly position at quantile  $\theta$
    2.  $MV(\theta)$ : **marginal value** of output among workers at a given reservation wage
    3.  $AV(\theta)$ : **average value** of output among workers with lower reservation wage

# This Paper:

1. Experimentally identify treatment effects and selection into hourly pay
  2. Develop model of fixed-wage labor markets under asymmetric info
  3. Use MTE framework to estimate equilibrium and efficient hourly wages
    - Let experimental wage offers serve as **instrument** for hourly contract take-up  $\Rightarrow$ 
      - Hourly labor supply at given wage,  $S(w)$  = propensity score
      - Marginal value under hourly pay,  $MV_1(\theta)$  = potential outcome in treated state
      - Marginal value under piece rate,  $MV_0(\theta)$  = potential outcome in untreated state
- $\Rightarrow$  MTE of hourly contracts map directly into model

## This Paper:

1. Experimentally identify treatment effects and selection into hourly pay
2. Develop model of fixed-wage labor markets under asymmetric info
3. Use MTE framework to estimate equilibrium and efficient hourly wages
4. Calculate DWL of inefficient wages and welfare impact of subsidies
  - Welfare loss of \$0.03 to \$0.05 per hour of labor
  - Wage subsidies  $\leq$  \$1.00  $\Rightarrow$  Marginal Value of Public Funds (MVPF)  $\in$  (0.95, 1.15)



# Existing Literature

- Asymmetric Information in Labor Markets
  - Spence (1973), Weiss (1980), Gibbons and Katz (1991), Farber and Gibbons (1996), Shimer (2005), Pallais (2016), Marinescu and Wolthoff (2020)
- Selection and Incentive Effects of Wage Contracts
  - Lazear (2000), Shearer (2006), DellaVigna and Pope (2018), Kantarevic and Kralj (2016), Angrist et al. (2017), Brown and Andrabi (2021), Emanuel and Harrington (2024)
- Measuring Adverse Selection & Moral Hazard
  - Chiappori and Salanie (2000), Karlan and Zinman (2009), Einav, Finkelstein, Cullen (2010), Kowalski (2023), Herbst and Hendren (2024)
- Selection and Marginal Treatment Effects
  - Black et al. (2022), Mogstad et al. (2018), Huber (2013), Carneiro et al. (2011), Heckman and Vyctlacil (2005, 2007), Björklund and Moffitt (1987)

# Outline

- 1 Experimental Design**
- 2 Main Results**
- 3 Model of Asymmetric Information**
- 4 Estimates of Marginal Value and Welfare Loss**
- 5 Optimal Wage Subsidies**

# Detecting Moral Hazard and Adverse Selection

Existing methods of testing for moral hazard and adverse selection:

1. Test for correlation between take-up and realized risk (Chiappori and Salanie 2000)
  - Cannot separate adverse selection from moral hazard
2. Compare take-up and risk across exogenous price changes in existing markets (Einav et al. 2010, Einav et al. 2013; Hackmann et al. 2012)
  - “Under-the-lamppost” problem: Cannot observe *unraveled* contracts, which are unprofitable
3. Construct *hypothetical* contract choices from surveys on subjective beliefs (Herbst and Hendren 2024; Hendren 2013, 2017)
  - Strong parametric assumptions to predict choices across “missing” contracts

My strategy: if I can't observe missing contracts, offer them myself!

- Advantage #1: I can experimentally randomize contract prices (i.e., wages)
- Advantage #2: I can offer unraveled (i.e., unprofitable) contracts

# Detecting Moral Hazard and Adverse Selection

- Suppose worker  $i$  is offered a choice:
  - Remain on piece rate ( $H_i = 0$ )
  - Switch to an hourly wage ( $H_i = 1$ )

- Potential outcomes:

$Y_{1i}$ : Worker  $i$ 's potential output under hourly wage

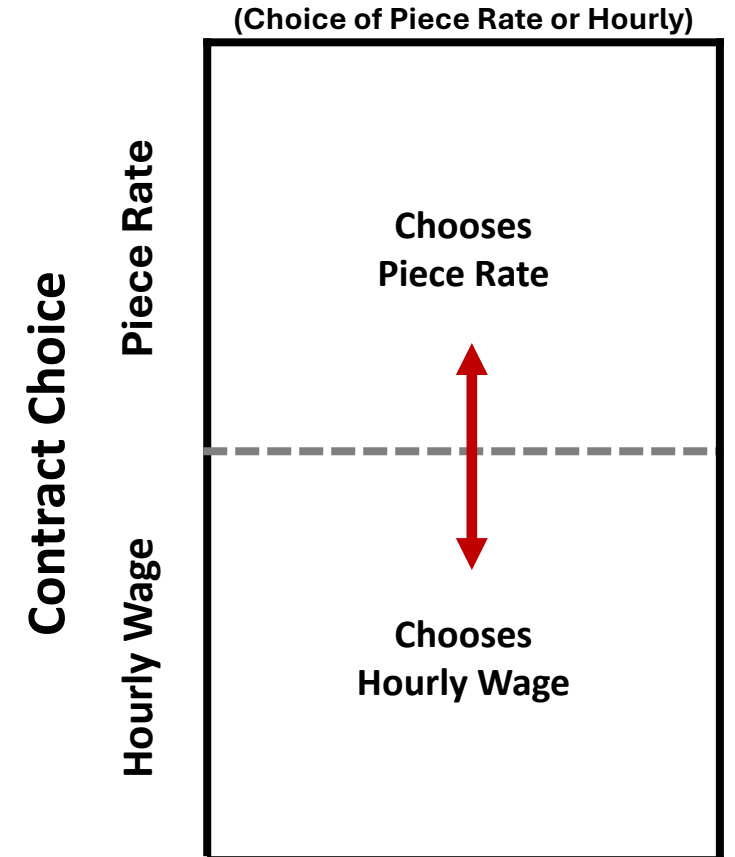
$Y_{0i}$ : Worker  $i$ 's potential output under piece rate

$$Y_i = H_i Y_{1i} + (1 - H_i) Y_{0i}$$

- Comparing across self-selected groups combines treatment and selection:

$$E[Y_i | H_i = 1] - E[Y_i | H_i = 0] =$$

$$\underbrace{E[Y_{1i} - Y_{0i} | H_i = 1]}_{\text{Treatment on the Treated}} + \underbrace{E[Y_{0i} | H_i = 1] - E[Y_{0i} | H_i = 0]}_{\text{Selection on } Y_0}$$

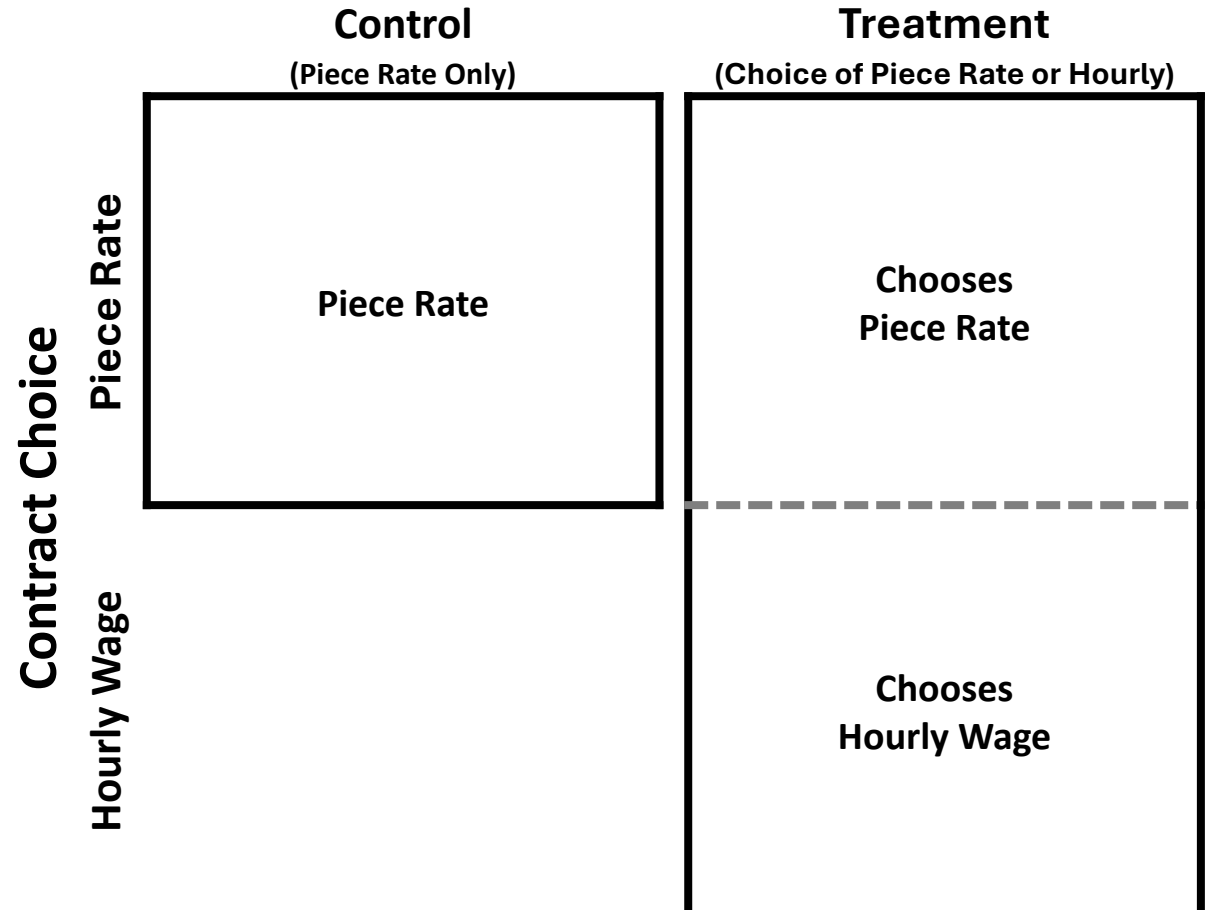


# Experimental Design: Single Wage Offer

## Simplified Experimental Design

Randomize workers into two offer sets:

- **Treated workers ( $W_i = 1$ ):** offered choice
  - Remain on piece rate ( $H_i = 0$ )
  - Switch to an hourly wage ( $H_i = 1$ )
- **Control workers ( $W_i = 0$ ):** no hourly offer
  - Remain on piece rate ( $H_i = 0$ )



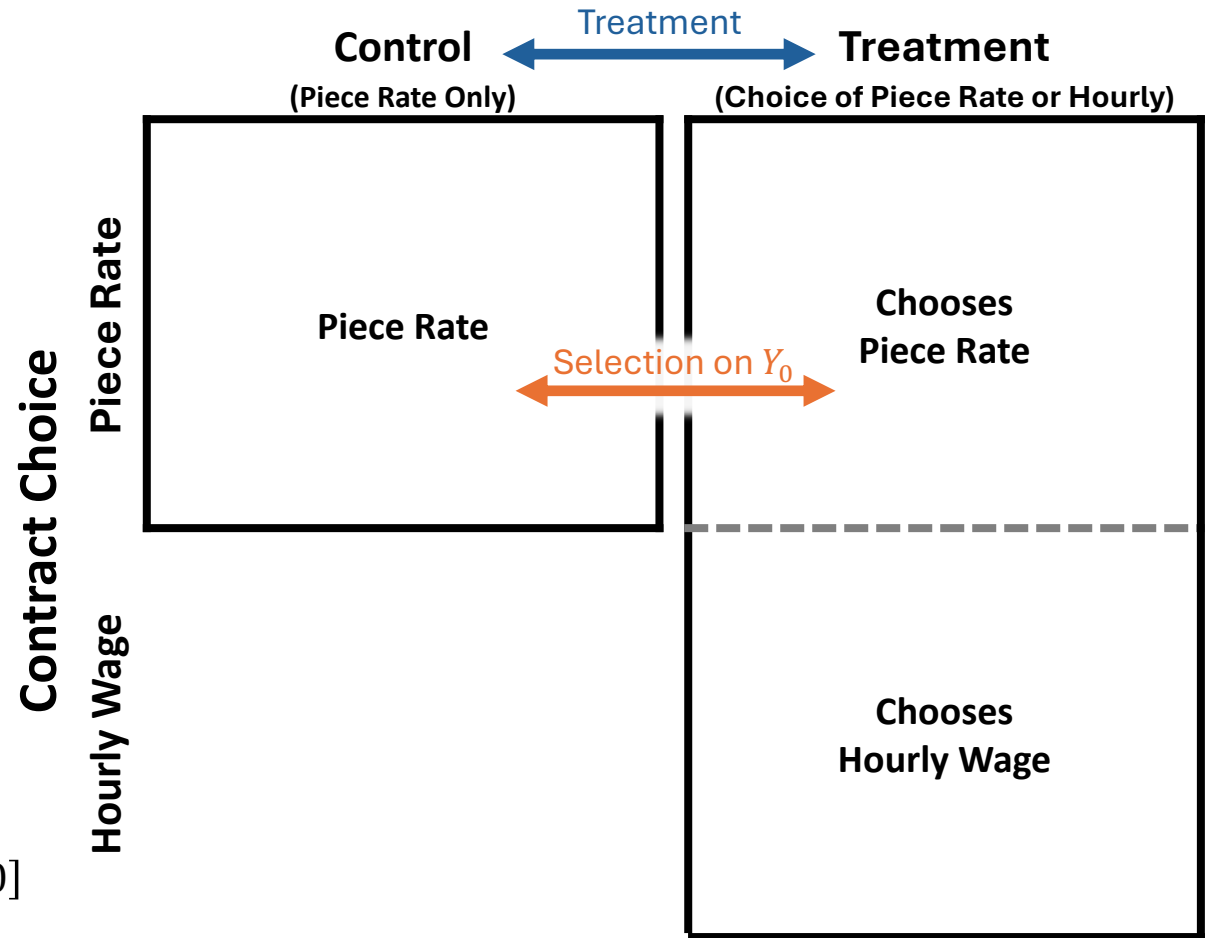
# Experimental Design: Single Wage Offer

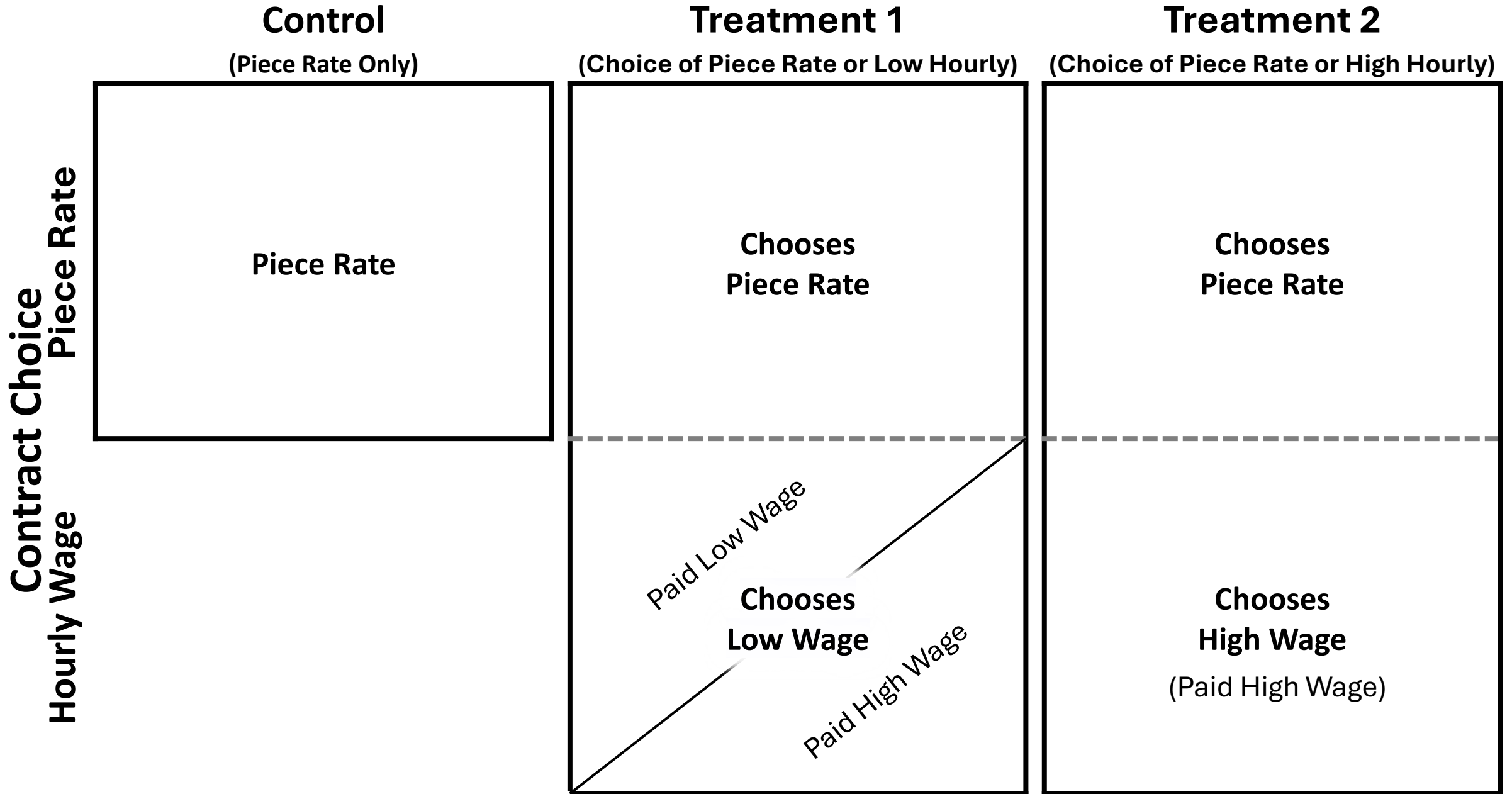
Comparing between workers facing different hourly offers identifies **treatment effect** of hourly wages:

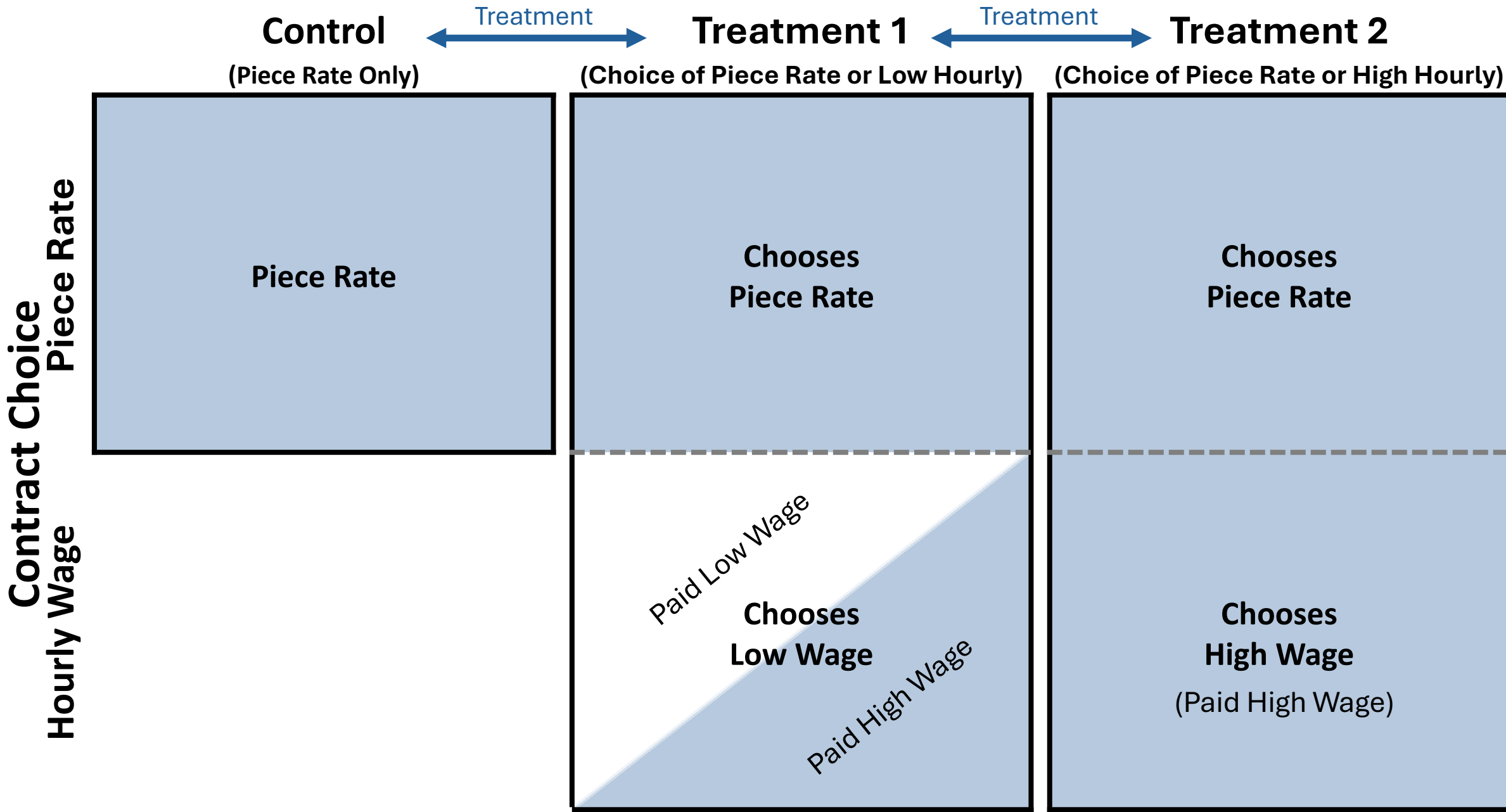
$$\frac{E[Y_i|W_i = 1] - E[Y_i|W_i = 0]}{\Pr(H_i = 1|W_i = 1)} = \underbrace{E[Y_{1i} - Y_{0i}|H_i = 1]}_{\text{Local Average Treatment Effect (LATE)}} + \text{Moral Hazard}$$

Comparing piece-rate workers who faced different offer sets identifies **selection into treatment**:

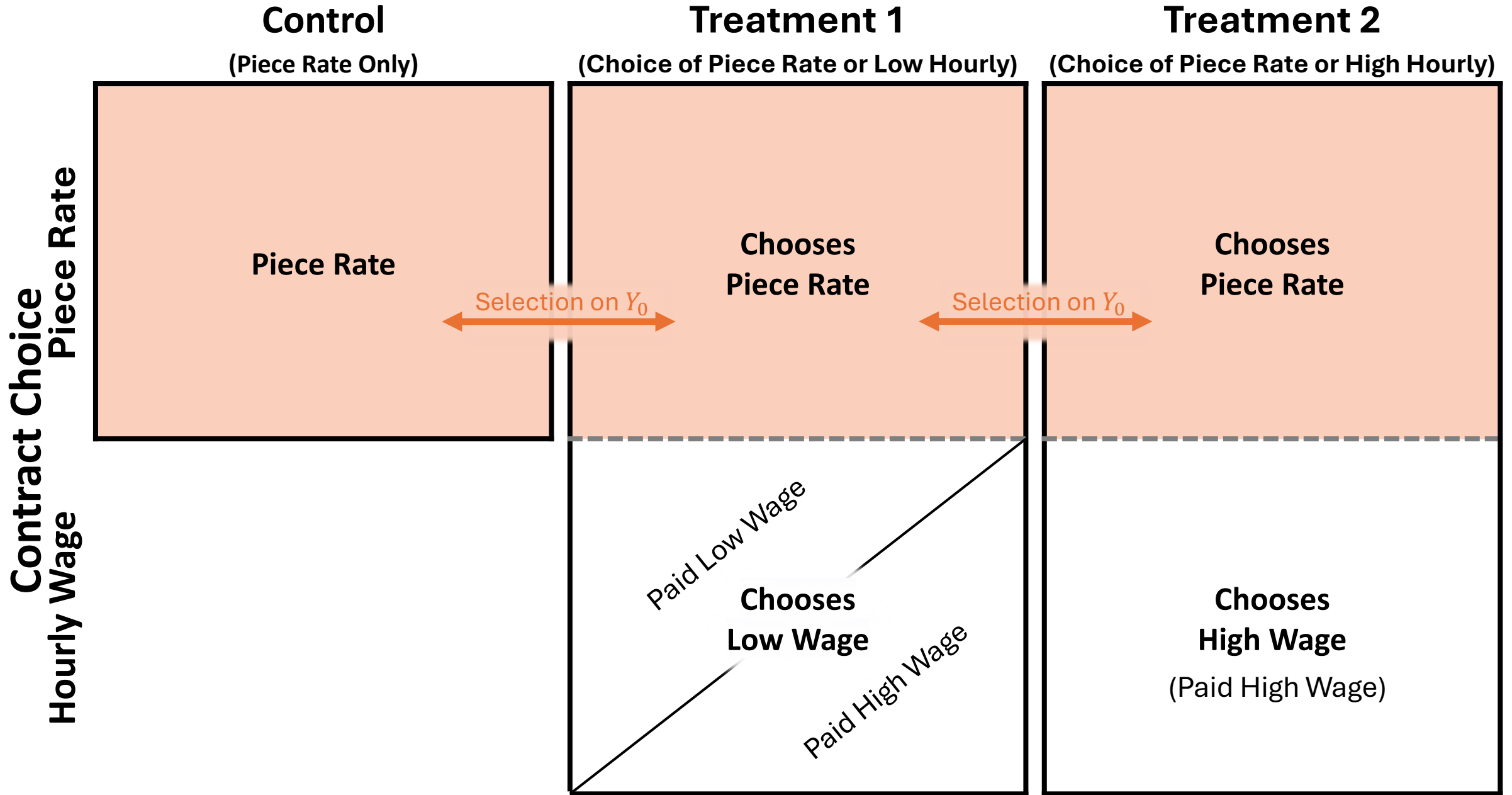
$$\frac{E[Y_i|H_i = 0, W_i = 1] - E[Y_i|W_i = 0]}{\Pr(H_i = 1|W_i = 1)} = \underbrace{E[Y_{0i}|H_i = 1] - E[Y_{0i}|H_i = 0]}_{\text{Selection on } Y_0} + \text{Adverse Selection}$$

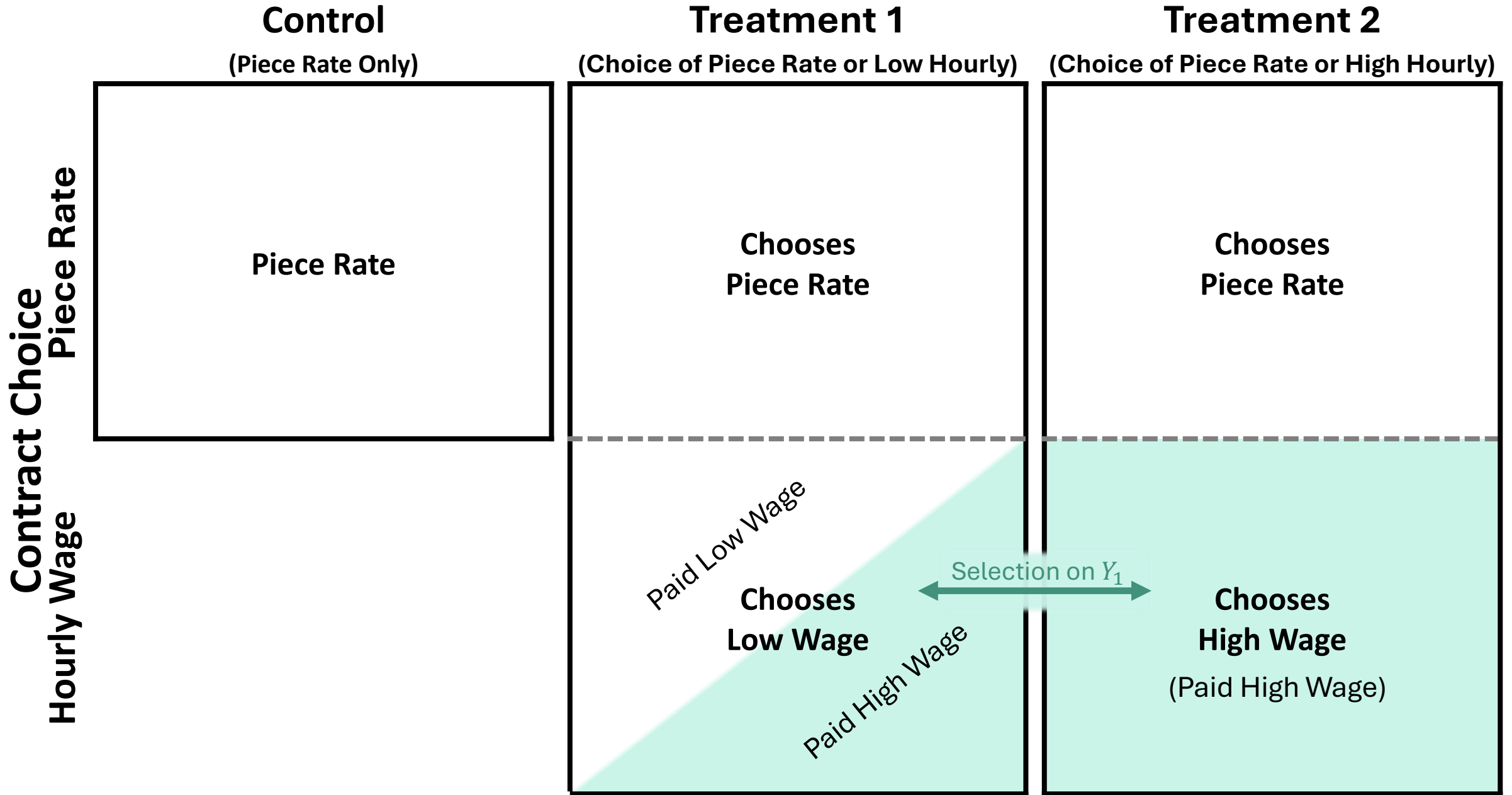


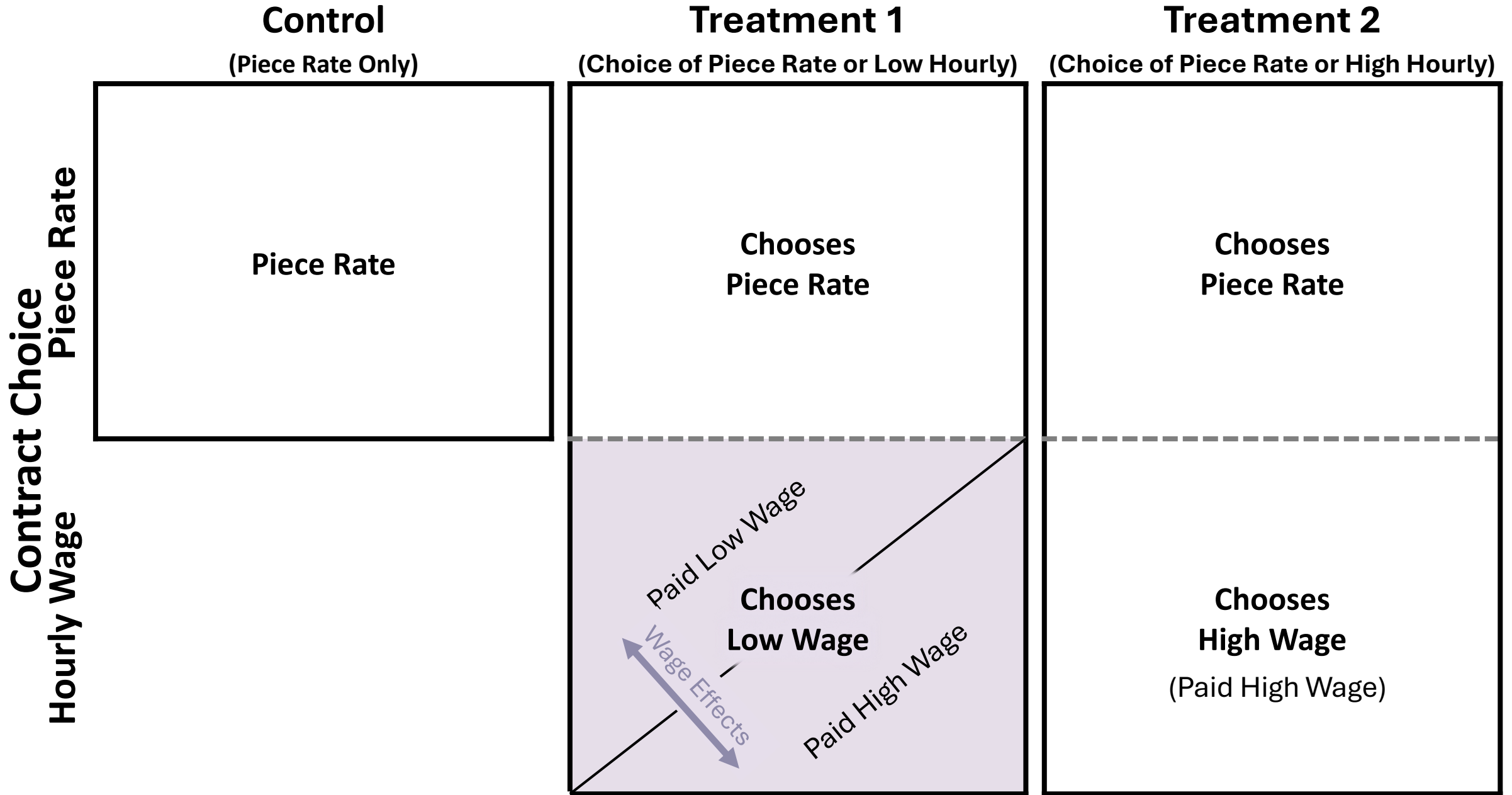


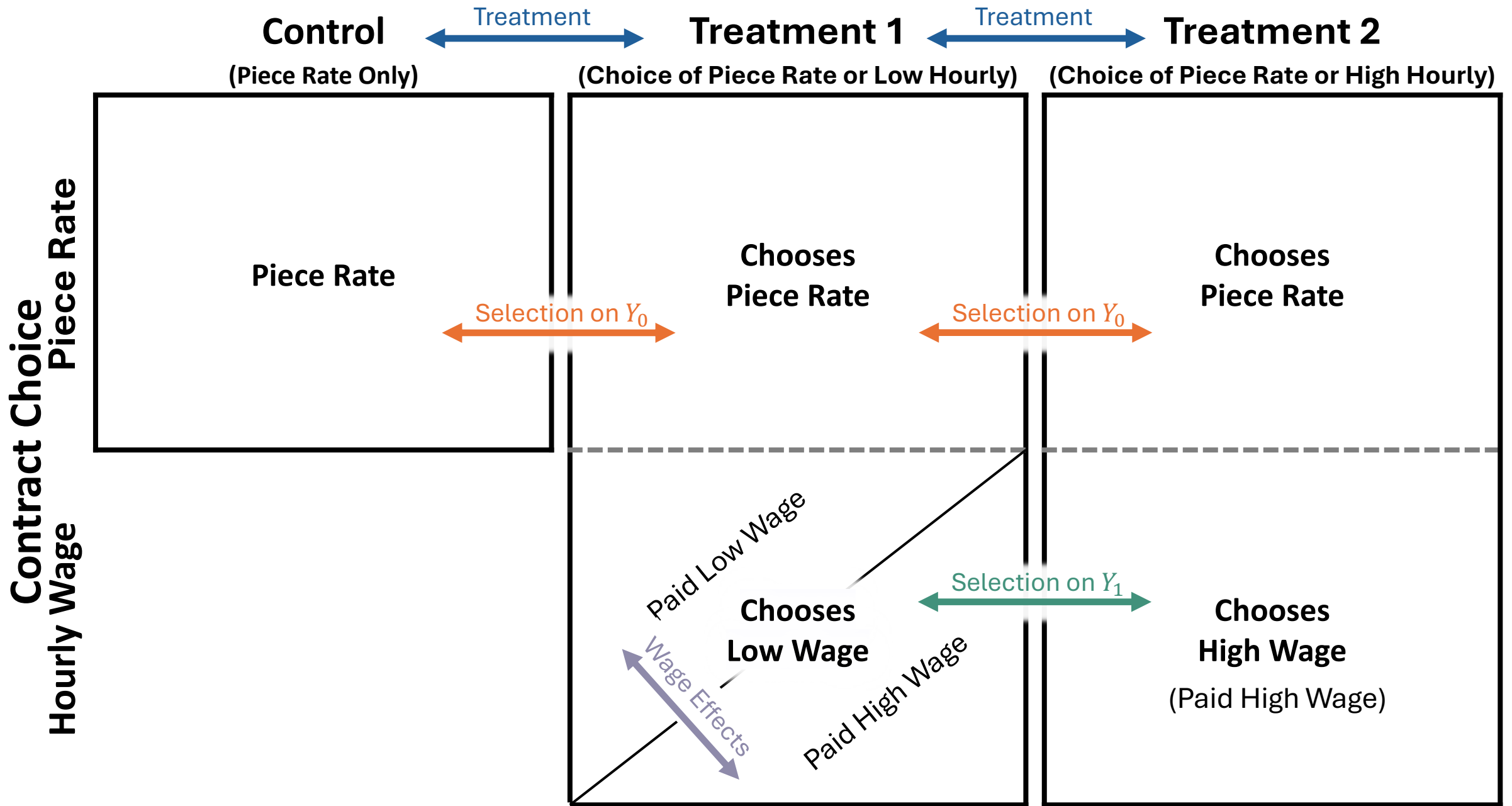




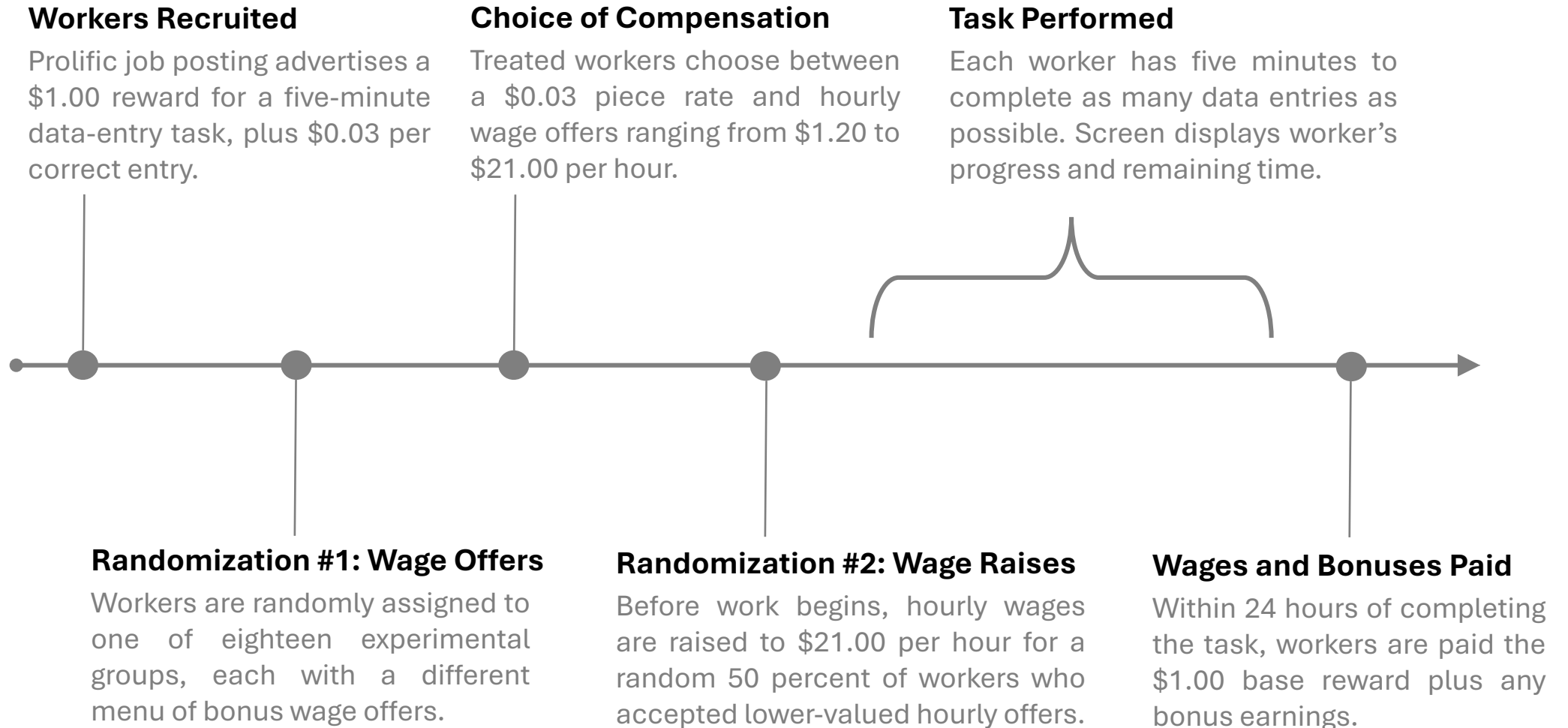








# Experimental Procedure



# Experimental Procedure

## Workers Recruited

Prolific job posting advertises a \$1.00 reward for a five-minute data-entry task, plus \$0.03 per correct entry.

- Posting screens for
  - Approval rating  $\geq 98\%$
  - Number of approved tasks  $\geq 10$
  - Located within US
- In practice, most users who see the posting accept the job.
- Experiment takes place over ten waves of  $\approx 300$  workers

📺 \$1.00 • \$12.00/hr ⌚ 5 mins 👤 300 places 📝 Writing

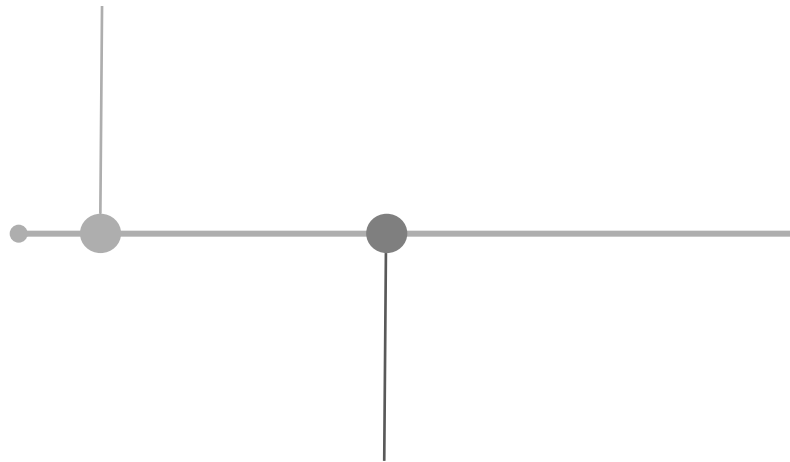
You will be shown a series of handwritten sentences for 5 minutes. Your task is to type each sentence into the corresponding text box.

*You can earn an additional \$0.03 in bonus compensation for each **correctly** typed sentence. Any bonus payments will be deposited within 24 hours of completion. You must reach the end of the 5-minute task to receive credit for your submission.*

# Experimental Procedure

## Workers Recruited

Prolific job posting advertises a \$1.00 reward for a five-minute data-entry task, plus \$0.03 per correct entry.



## Randomization #1: Wage Offers

Workers are randomly assigned to one of eighteen experimental groups, each with a different menu of bonus wage offers.

Hourly Wage Offer	Piece-Rate Offer	Number of Participants
No Hourly Offer	\$0.03 per sentence	302
\$1.20/hr	\$0.03 per sentence	300
\$1.80/hr	\$0.03 per sentence	101
\$2.40/hr	\$0.03 per sentence	103
\$3.00/hr	\$0.03 per sentence	304
\$3.60/hr	\$0.03 per sentence	100
\$4.20/hr	\$0.03 per sentence	99
\$4.80/hr	\$0.03 per sentence	101
\$5.40/hr	\$0.03 per sentence	101
\$6.00/hr	\$0.03 per sentence	305
\$7.20/hr	\$0.03 per sentence	100
\$8.40/hr	\$0.03 per sentence	102
\$9.60/hr	\$0.03 per sentence	101
\$10.80/hr	\$0.03 per sentence	100
\$12.00/hr	\$0.03 per sentence	305
\$15.00/hr	\$0.03 per sentence	100
\$18.00/hr	\$0.03 per sentence	102
\$21.00/hr	\$0.03 per sentence	304

*Total: 3030*

# Experimental Procedure

## Workers Recruited

Prolific job posting advertises a \$1.00 reward for a five-minute data-entry task, plus \$0.03 per correct entry.

## Choice of Compensation

Treated workers choose between a \$0.03 piece rate and hourly wage offers ranging from \$1.20 to \$21.00 per hour.



## Randomization #1: Wage Offers

Workers are randomly assigned to one of eighteen experimental groups, each with a different menu of bonus wage offers.

Before you begin the task, we'd like to offer you a choice of how to receive your bonus payment. Please select your preferred method of compensation from the options below:

Get paid a flat bonus of \$1.00.

Get paid \$0.03 for each sentence you correctly complete.



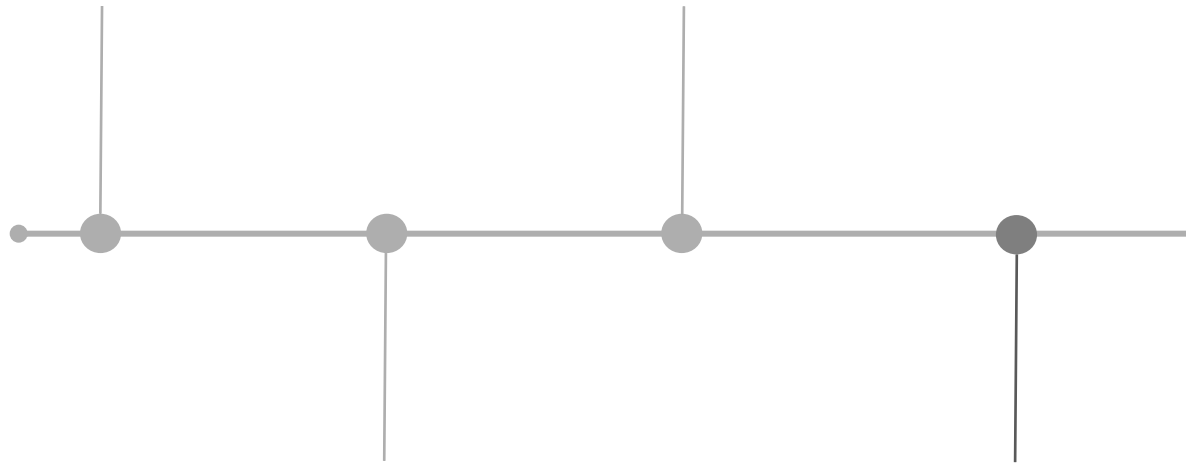
# Experimental Procedure

## Workers Recruited

Prolific job posting advertises a \$1.00 reward for a five-minute data-entry task, plus \$0.03 per correct entry.

## Choice of Compensation

Treated workers choose between a \$0.03 piece rate and hourly wage offers ranging from \$1.20 to \$21.00 per hour.



For performing this task, you will receive **\$1.75**, plus your chosen **flat bonus of \$1.00**.

Your **total compensation will be \$2.75**.

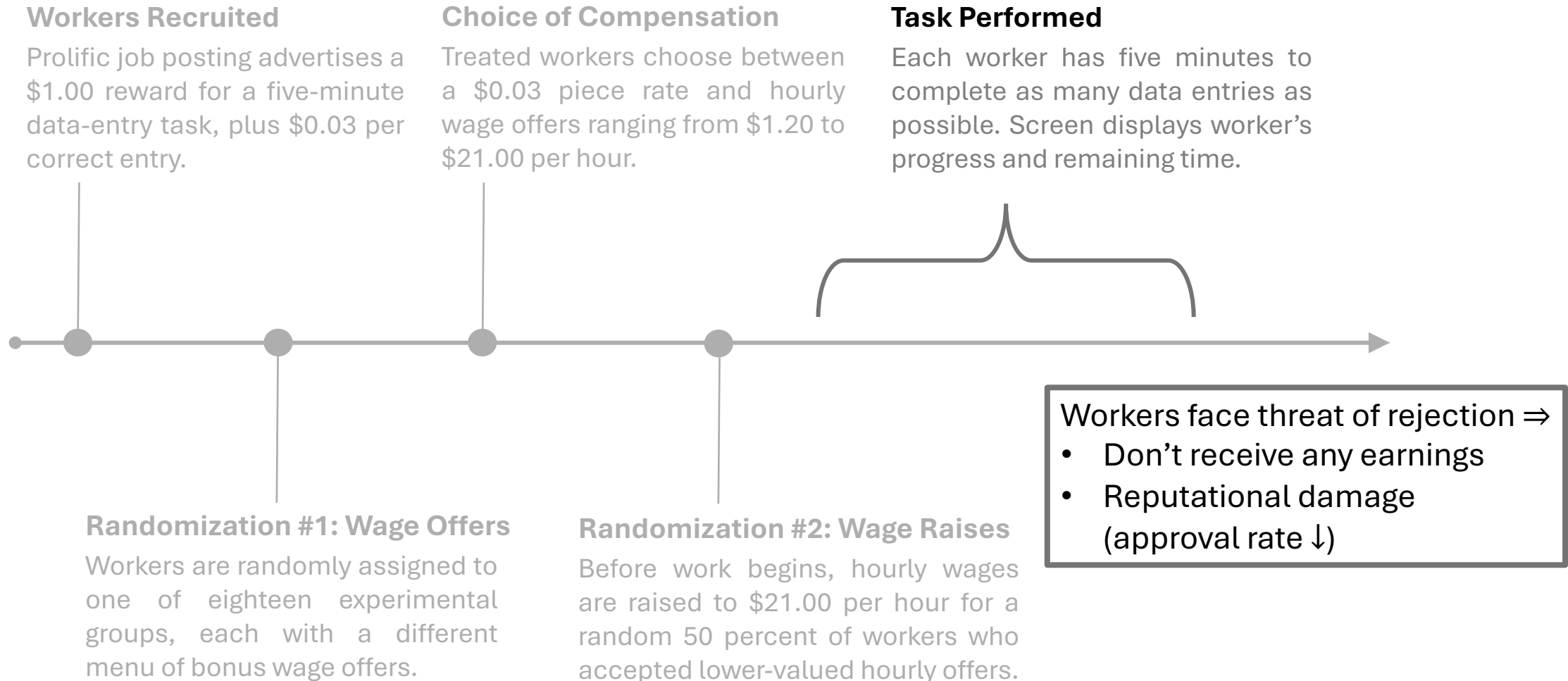
## Randomization #1: Wage Offers

Workers are randomly assigned to one of eighteen experimental groups, each with a different menu of bonus wage offers.

## Randomization #2: Wage Raises

Before work begins, hourly wages are raised to \$21.00 per hour for a random 50 percent of workers who accepted lower-valued hourly offers.

# Experimental Procedure



You will be shown a series of handwritten sentences. On each page, your task is to type the sentence into the text box below.

Here is one example of a completed sentence:

*The quick brown fox jumps over the lazy dog.*

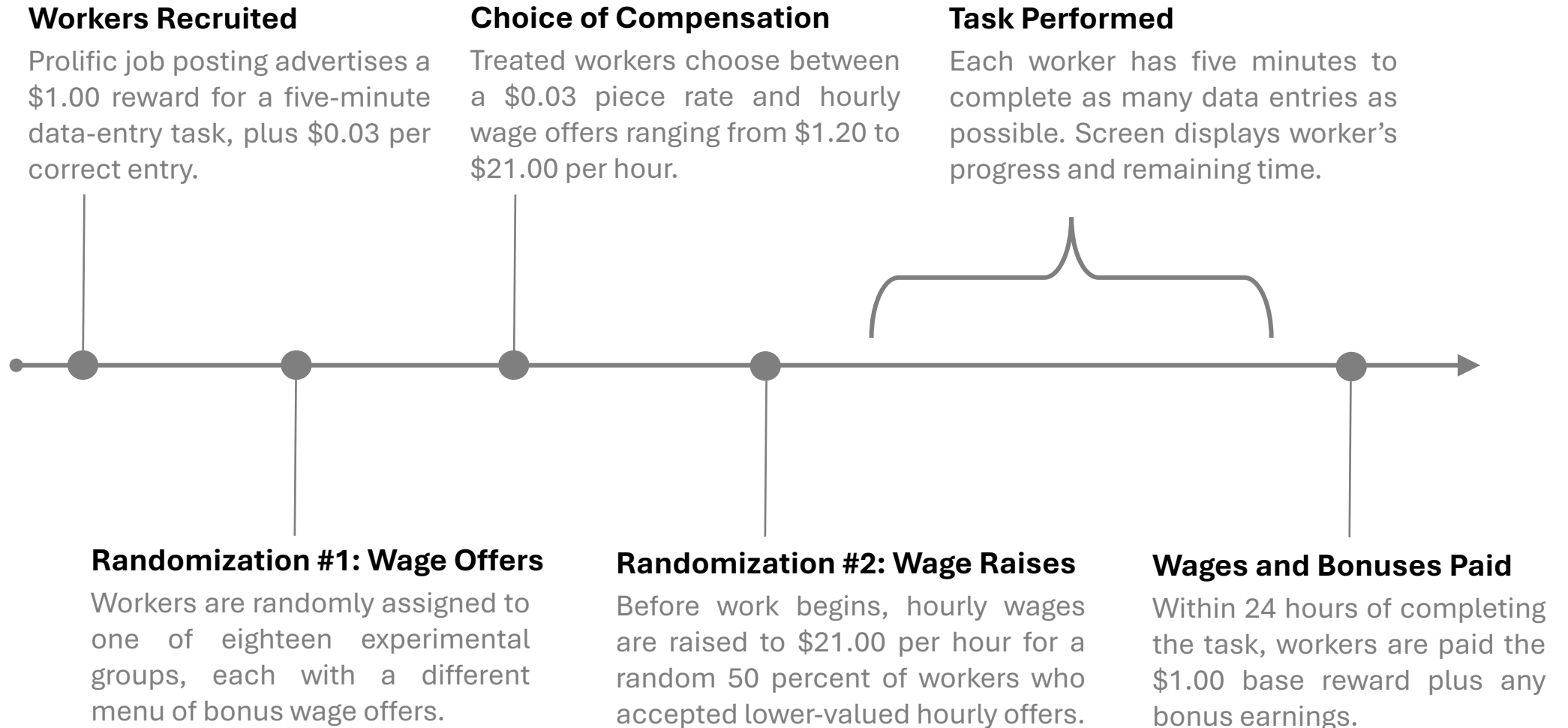
The quick brown fox jumps over the lazy dog.

Your answers should be as accurate as possible. Please be mindful of capitalization, spacing, and punctuation. When you've completed a sentence, click the "→" button to move on.

**You will have 5 minutes to complete as many sentences as you can. You cannot start over, and you can only perform this task once.**



# Experimental Procedure



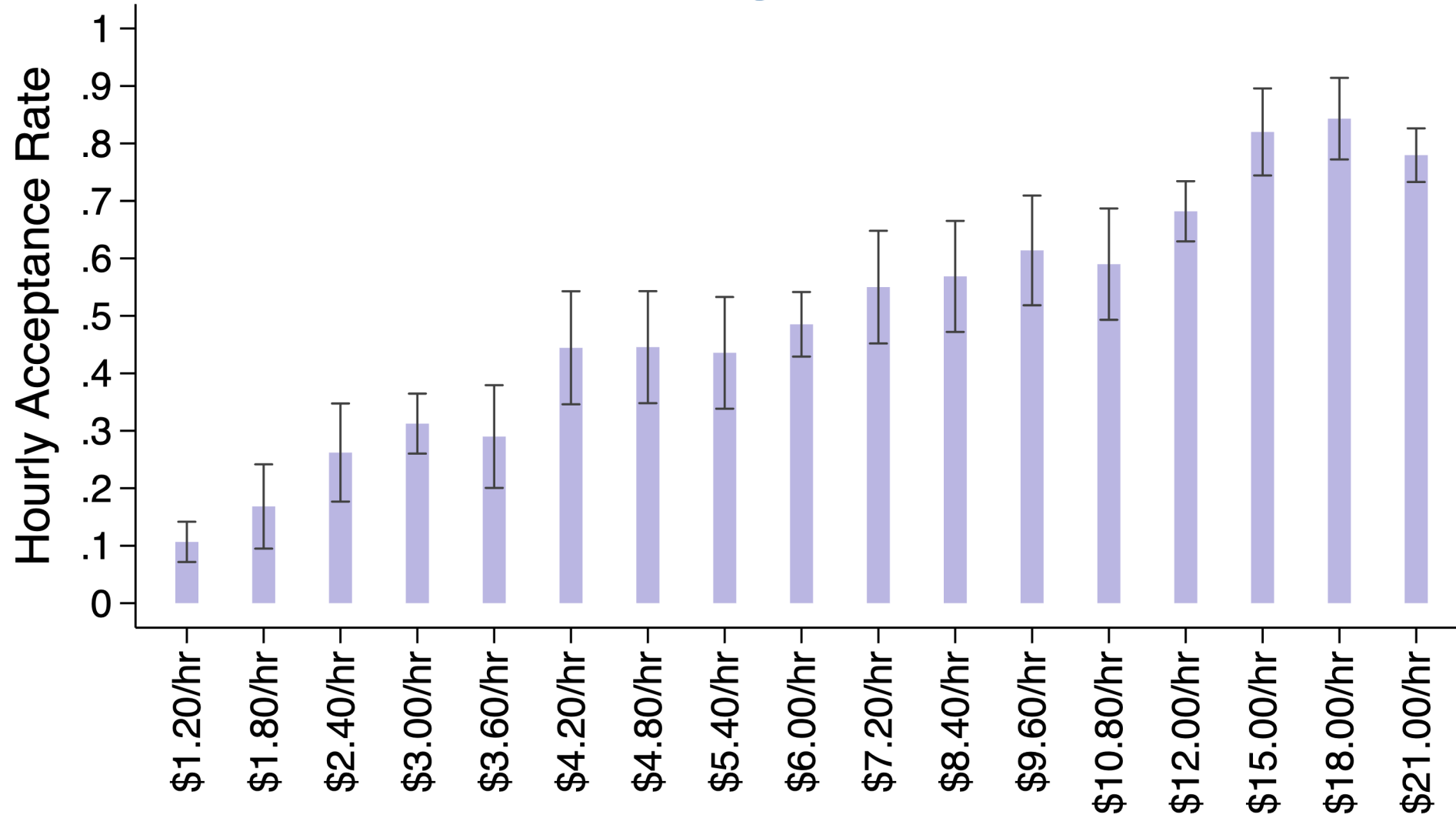
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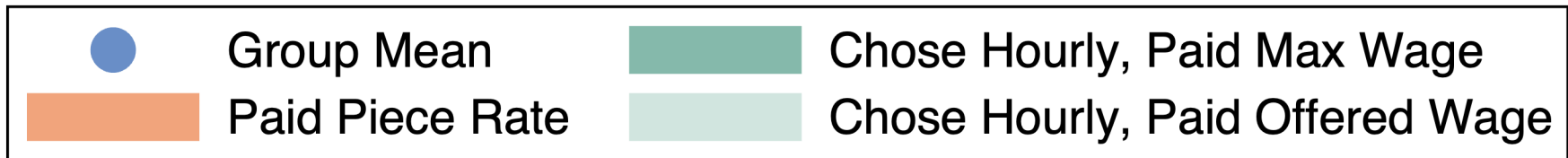
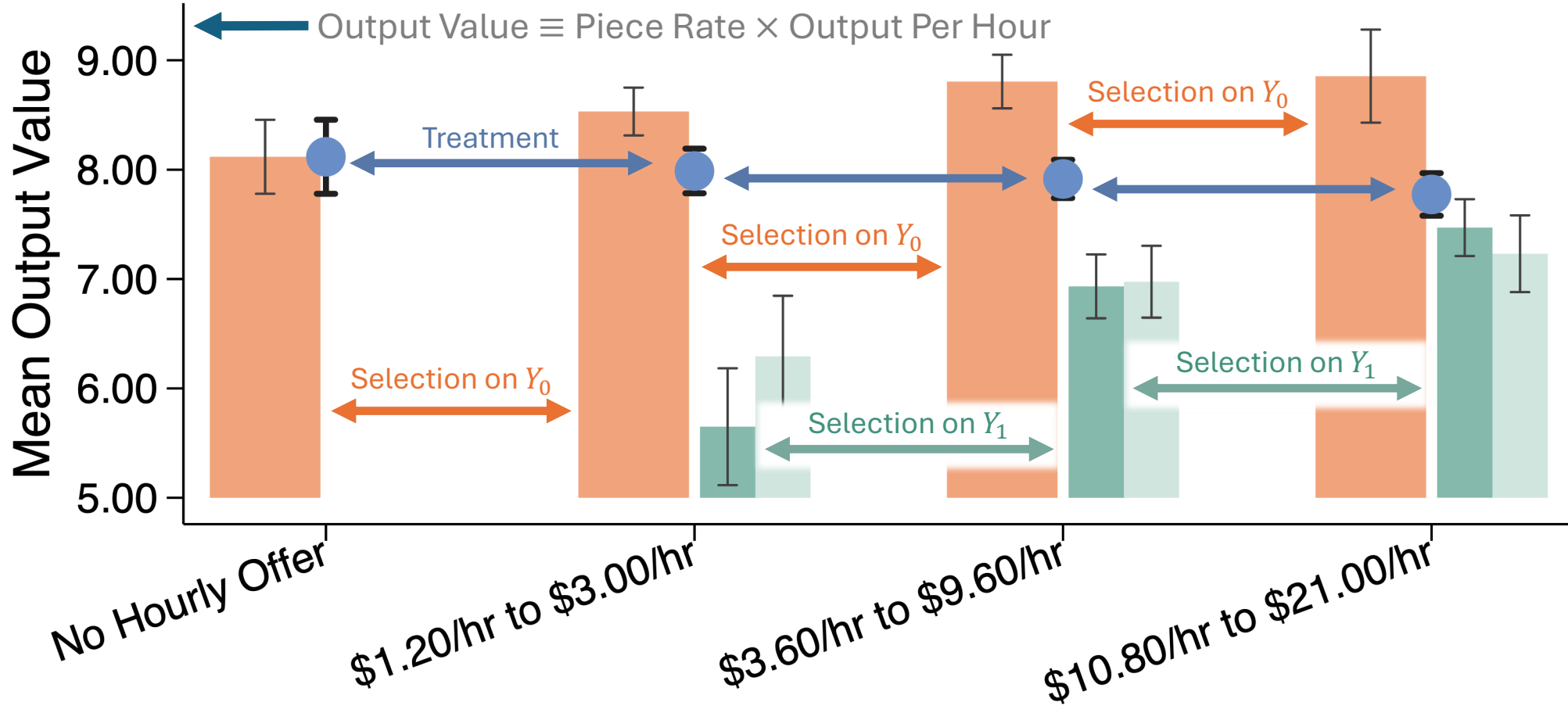
# Summary Statistics

Category	Variable	Mean	SD
<i>Panel A: Task Performance</i>	Accepted Hourly Offer	0.438	0.496
	Completed Sentences	21.98	8.148
	Correct Sentences	17.79	9.360
	Output Value	7.912	2.933
	Finished	0.986	0.118
<i>Panel B: Demographics &amp; Employment</i>	Age	37.23	12.18
	Female	0.643	0.479
	Minority	0.357	0.479
	Employed	0.685	0.465
	Student	0.187	0.390
	Number of Previous Tasks	1281.6	1746.4

# Hourly Wage Take-up



# Worker Output by Offer & Contract





# 2SLS Estimates of Treatment Effects

	(1)	(2)	(3)	(4)
	Output Value	Output Value	Output Value	Output Value
Accepted Hourly Offer	−0.506** (0.206)	−0.500** (0.200)	−0.488** (0.200)	−0.365** (0.185)
Task Controls	No	Yes	Yes	Yes
Employment Controls	No	No	Yes	Yes
Demographic Controls	No	No	No	Yes
R-squared	0.037	0.080	0.096	0.232
<i>N</i>	3030	3030	3030	3030

$$\tilde{Y}_i = \delta H_i + \boldsymbol{\eta} \mathbf{X}_i + \epsilon_i$$

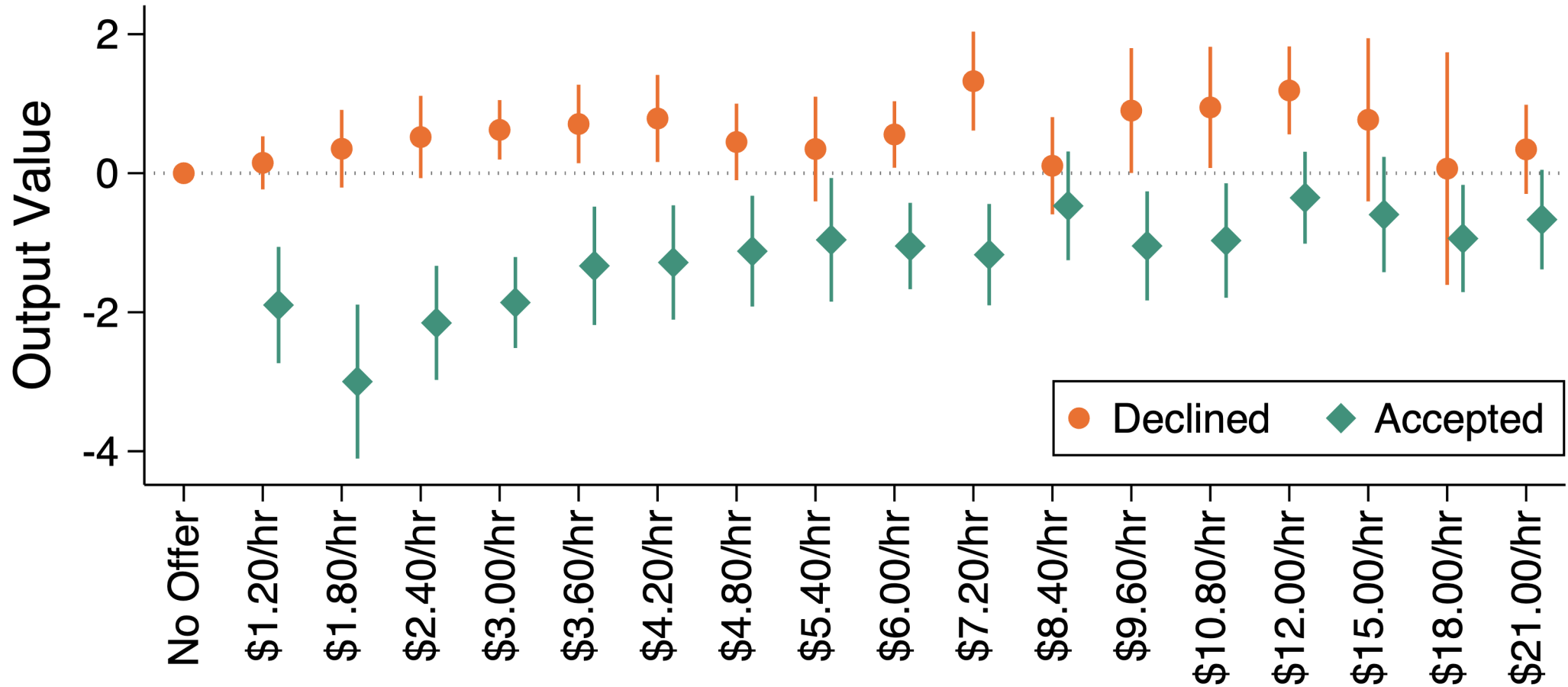
$$\tilde{Y}_i \equiv Y_i - \gamma H_i \times W_i^P$$

# Selection by Log Wage Offer

	(1) Output Value	(2) Output Value	(3) Output Value	(4) Output Value
Accepted Hourly Offer	-2.598*** (0.329)	-2.481*** (0.319)	-2.439*** (0.320)	-2.256*** (0.300)
Declined × Log Hourly Wage Offer	0.167* (0.0960)	0.193** (0.0932)	0.210** (0.0925)	0.230*** (0.0855)
Accepted × Log Hourly Wage Offer	0.621*** (0.116)	0.570*** (0.112)	0.568*** (0.113)	0.501*** (0.104)
Accepted × Log Effective Hourly Wage	-0.0608 (0.122)	-0.0443 (0.118)	-0.0444 (0.118)	-0.0000829 (0.110)
Task Controls	No	Yes	Yes	Yes
Employment Controls	No	No	Yes	Yes
Demographic Controls	No	No	No	Yes
R-squared	0.082	0.123	0.139	0.273
<i>N</i>	3030	3030	3030	3030

$$Y_i = \alpha H_i + \beta_0(1 - H_i) \times W_i + \beta_1 H_i \times W_i + \gamma H_i \times W_i^P + \xi X_i + \epsilon_i$$

# Selection by Log Wage Offer



$$Y_i = \sum_{w \in W} [(\beta_{w0}(1 - H_i) + \beta_{w1}H_i) \times \mathbf{1}\{W_i = w\}] + \gamma H_i \times W_i^P + \xi \mathbf{X}_i + \epsilon_i$$

# Summary

What have I shown so far?

- Consider two hourly wage offers,  $W' > W$
- Let  $\bar{w}_i \equiv$  **hourly reservation wage** (the lowest hourly wage worker  $i$  would accept)

## Evidence of Moral Hazard

$$E[Y_{1i} - Y_{0i} | W < \bar{w}_i \leq W'] < 0$$

Local Average Treatment Effect

## Evidence of Adverse Selection

$$E[Y_{0i} | \bar{w}_i > W] < E[Y_{0i} | \bar{w}_i > W']$$

Local Average Selection on  $Y_0$

$$E[Y_{1i} | \bar{w}_i \leq W] < E[Y_{1i} | \bar{w}_i \leq W']$$

Local Average Selection on  $Y_1$

What are the implications for...

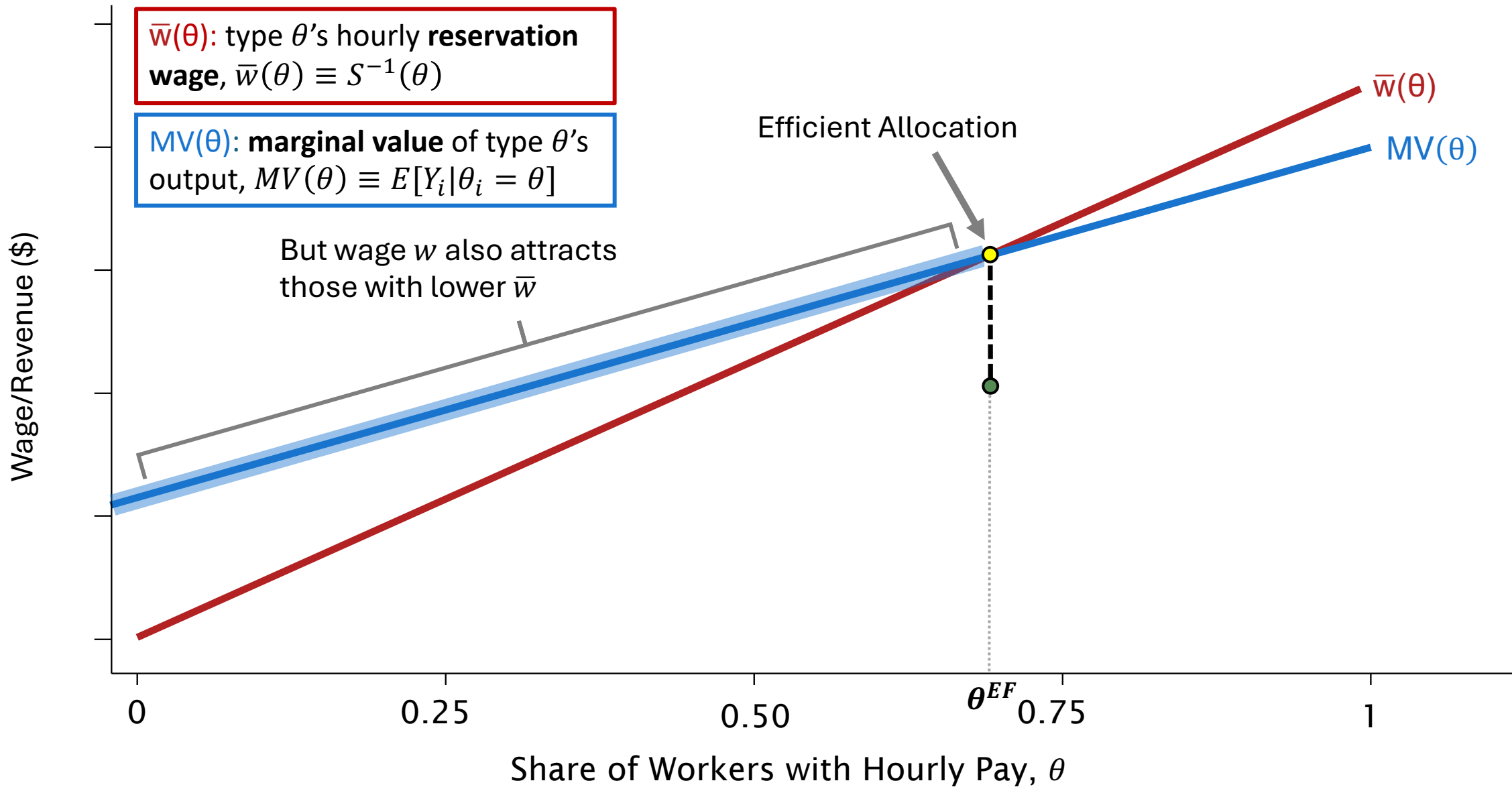
- Market equilibrium?
- Social welfare?
- Policy?

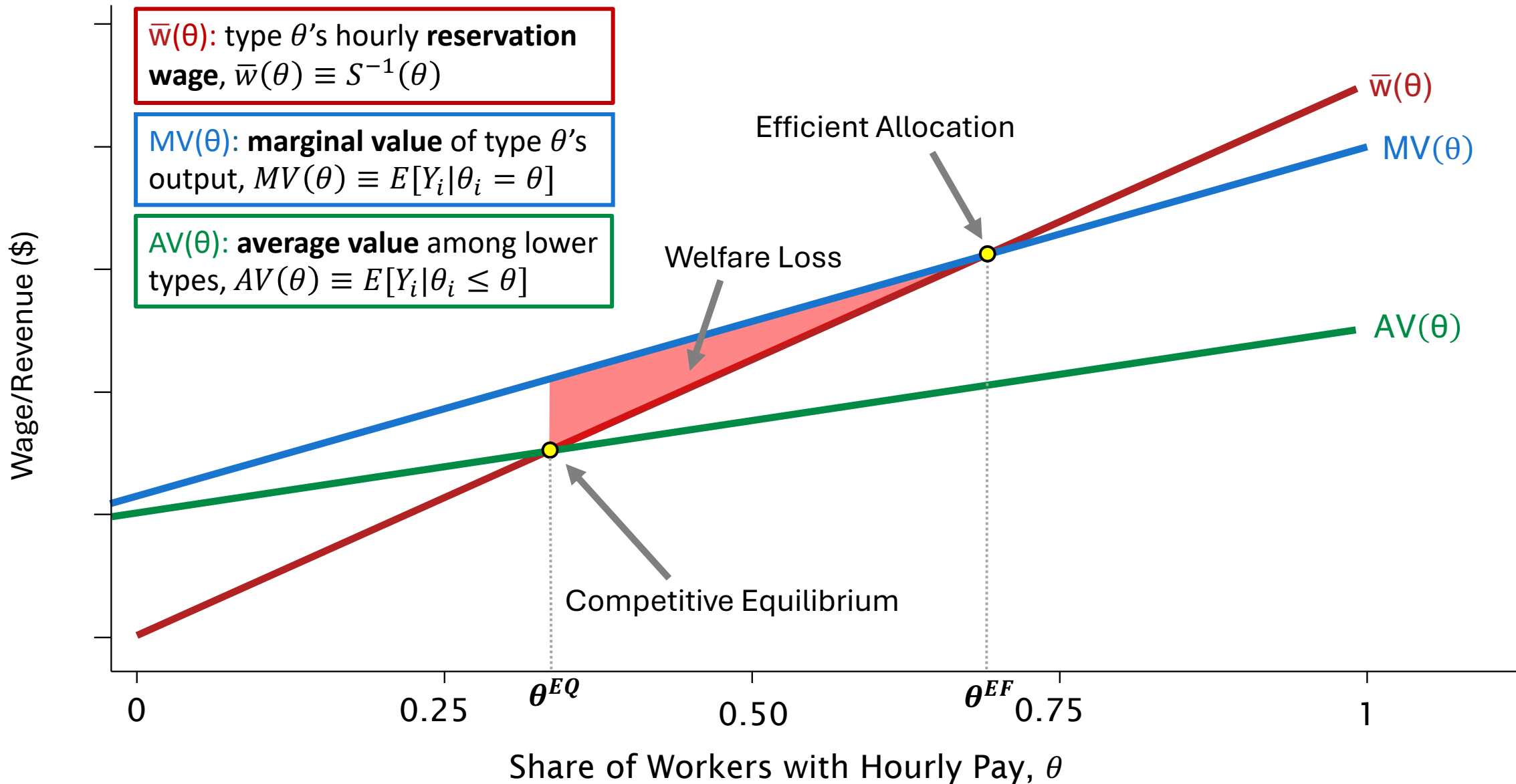
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# Model

- Population of observationally equivalent (pre-screened) workers
- Each worker produces hourly output  $q_i = f(\zeta_i, e_i, v_i)$ 
  - $\zeta_i$ : (unobserved) worker characteristics
  - $e_i$ : individual effort
  - $v_i$ : random noise
- Value of worker  $i$ 's output is  $Y_i \equiv pq_i$ , where  $p \equiv$  price per unit  $q$
- Firms have two options:
  1. Buy output at per-unit market price  $p$  (e.g., piece rate, freelance hire)
  2. Offer worker a flat hourly wage,  $w$ , for whatever they produce



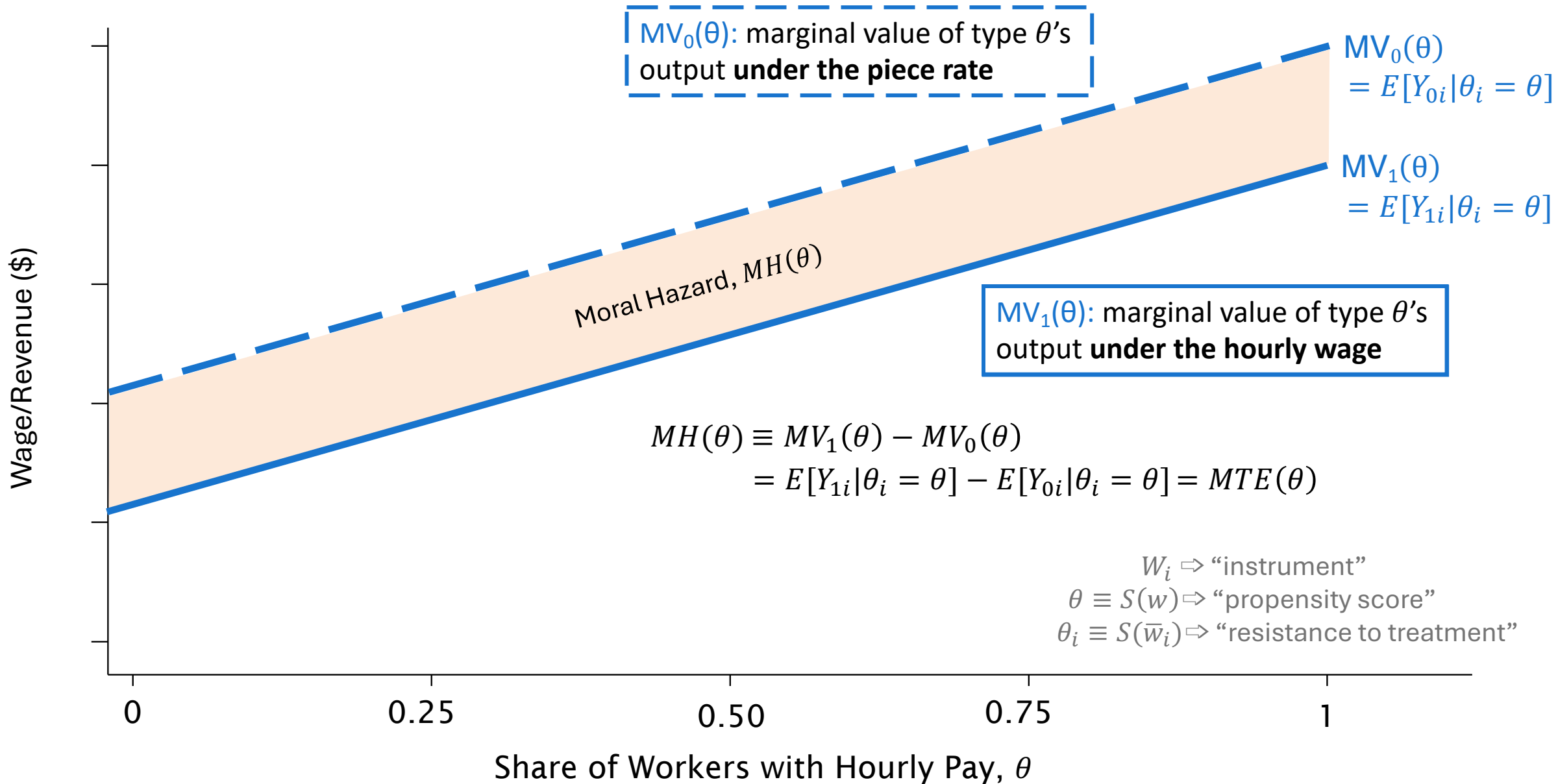


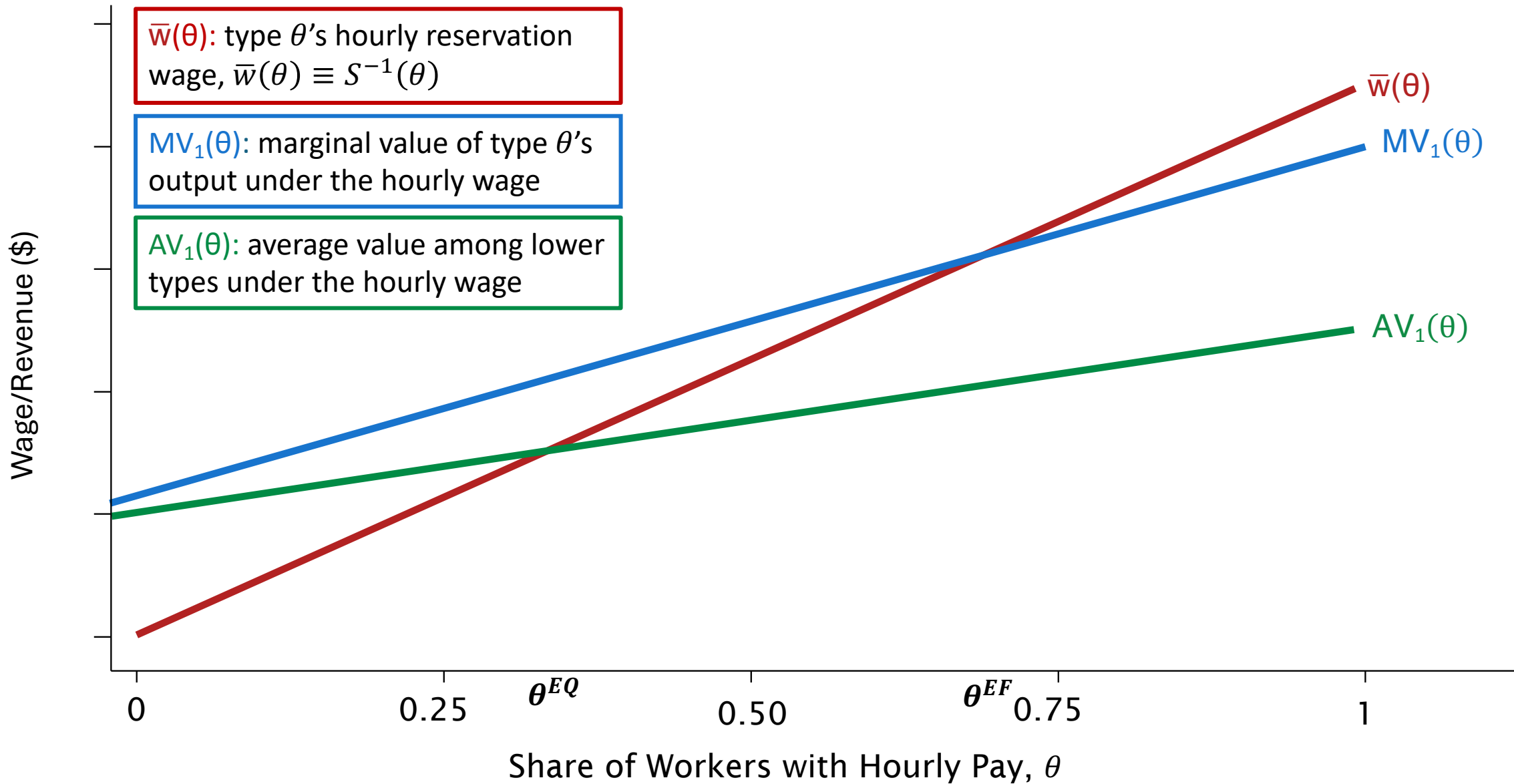


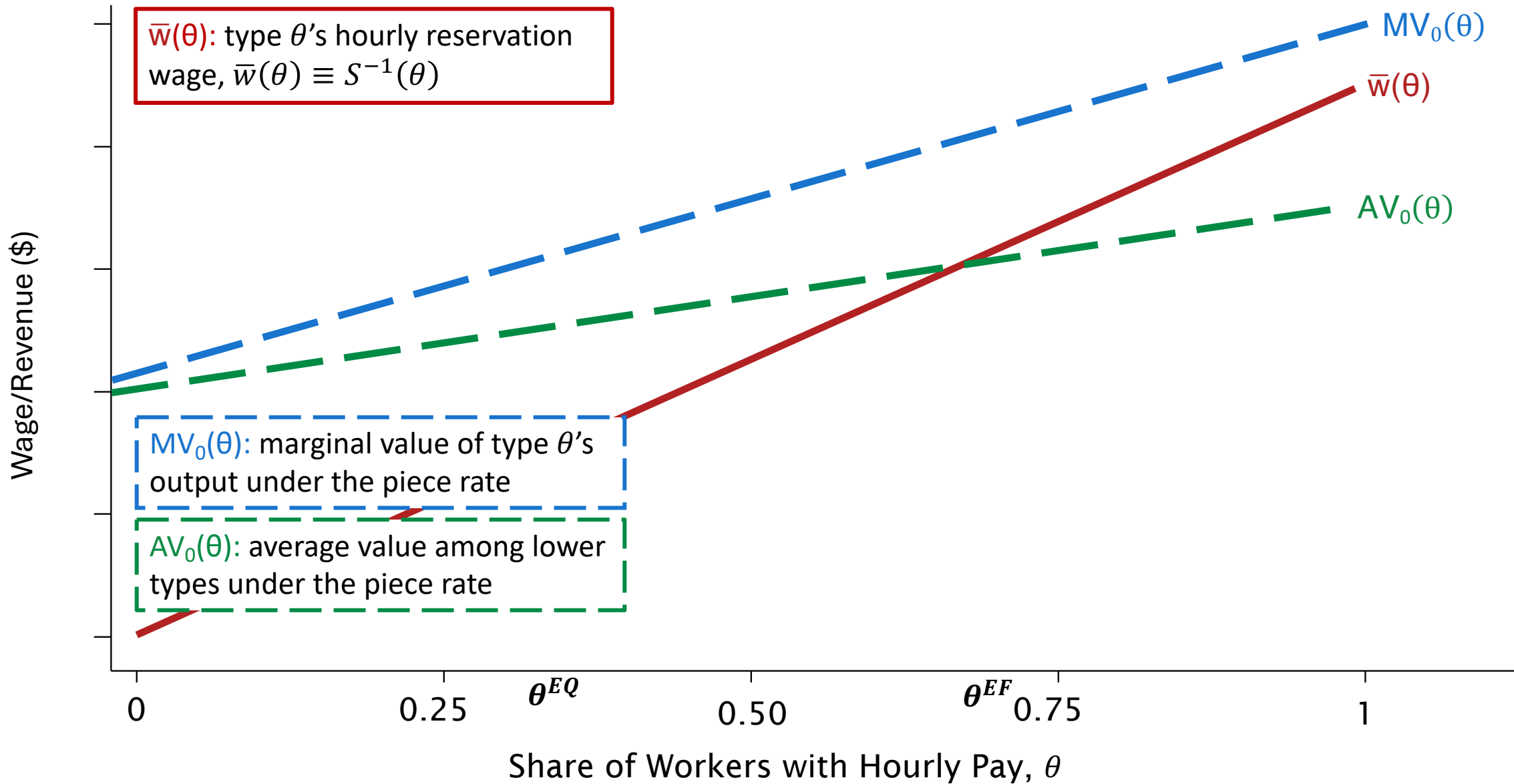
# Incorporating Moral Hazard

- Where does moral hazard fit in? Consider potential outputs
  - $Y_{1i}$ : Potential output value under hourly wage
  - $Y_{0i}$ : Potential output value under piece rate
- Firms care about  $Y_{1i}$ , but they don't care about  $Y_{0i}$ 
  - Piece-rate workers sell their output at a constant price per unit, so their productivity has no effect on firm profits
- $MV(\theta)$  &  $AV(\theta)$  are defined *conditional* on accepting the hourly wage
$$MV(\theta) \equiv E[Y_i | \theta_i = \theta] = E[Y_{1i} | \theta_i = \theta]$$
$$AV(\theta) \equiv E[Y_i | \theta_i \leq \theta] = E[Y_{1i} | \theta_i \leq \theta]$$

⇒ Equilibrium is inclusive of workers' moral hazard response to the hourly wage
- Still want to separately identify moral hazard
  - Firms might mitigate MH with “partial insurance” (e.g., sales commission, tips)
  - Account for fiscal effects of decreased earnings under hourly wage subsidies

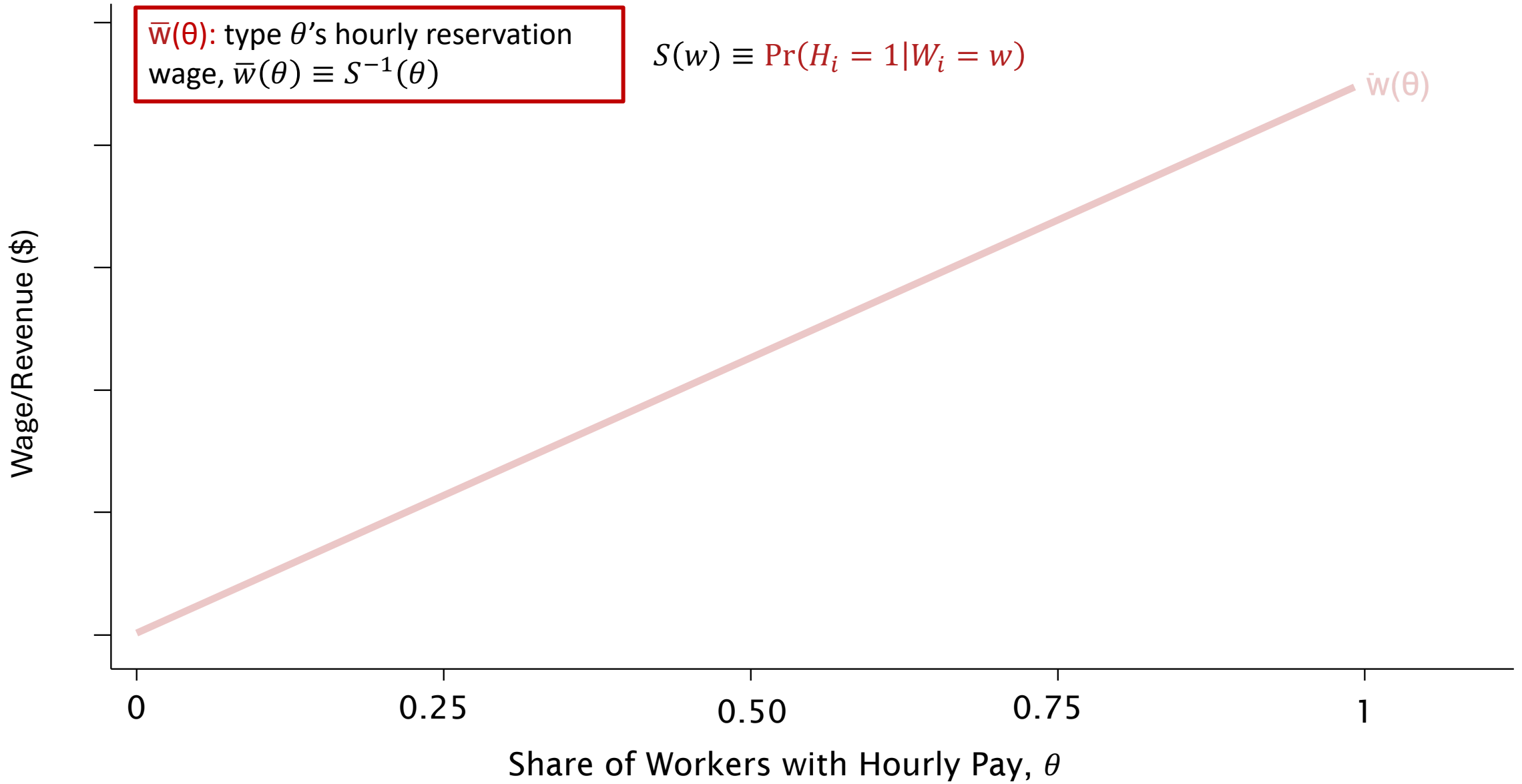


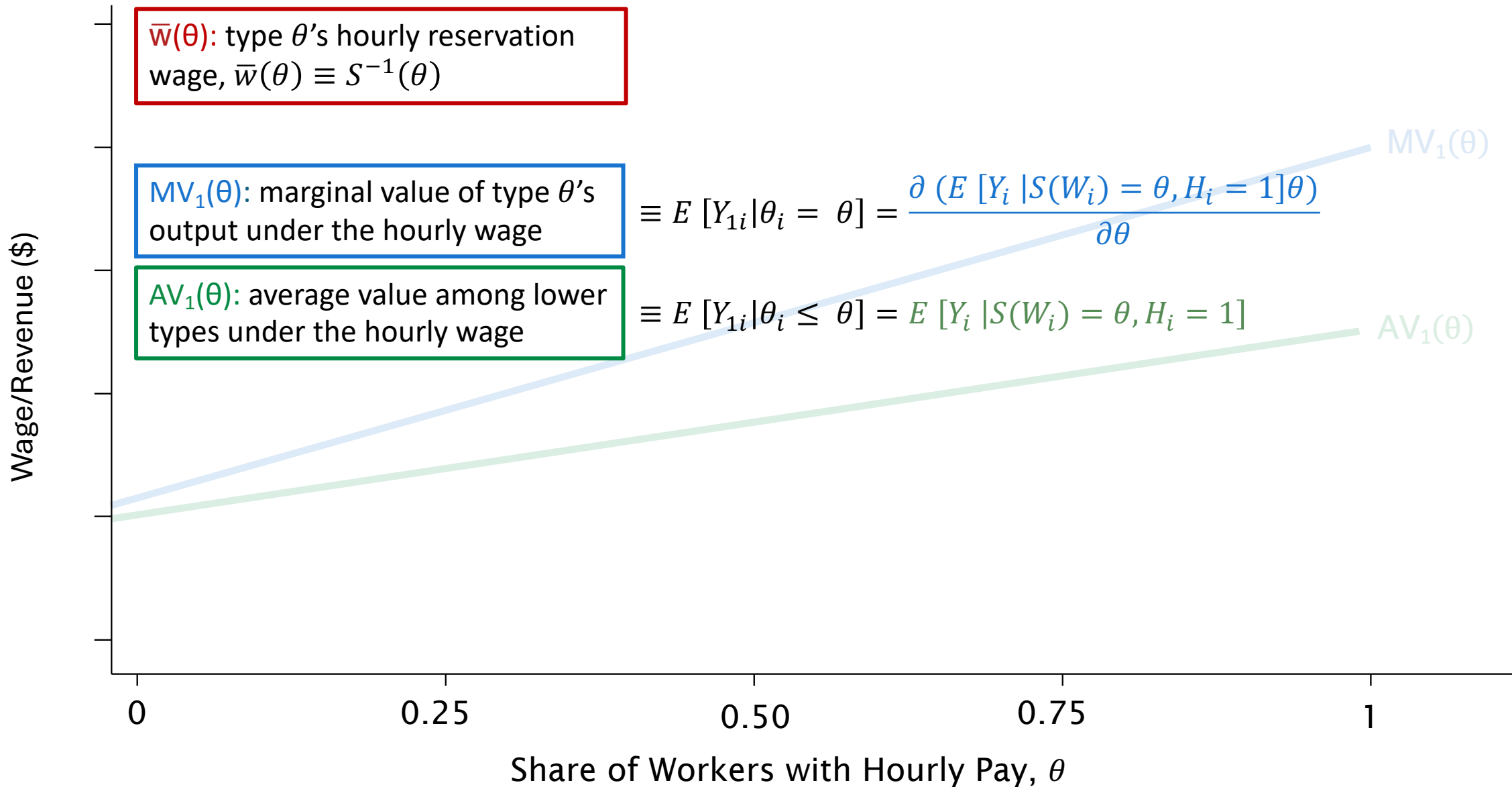


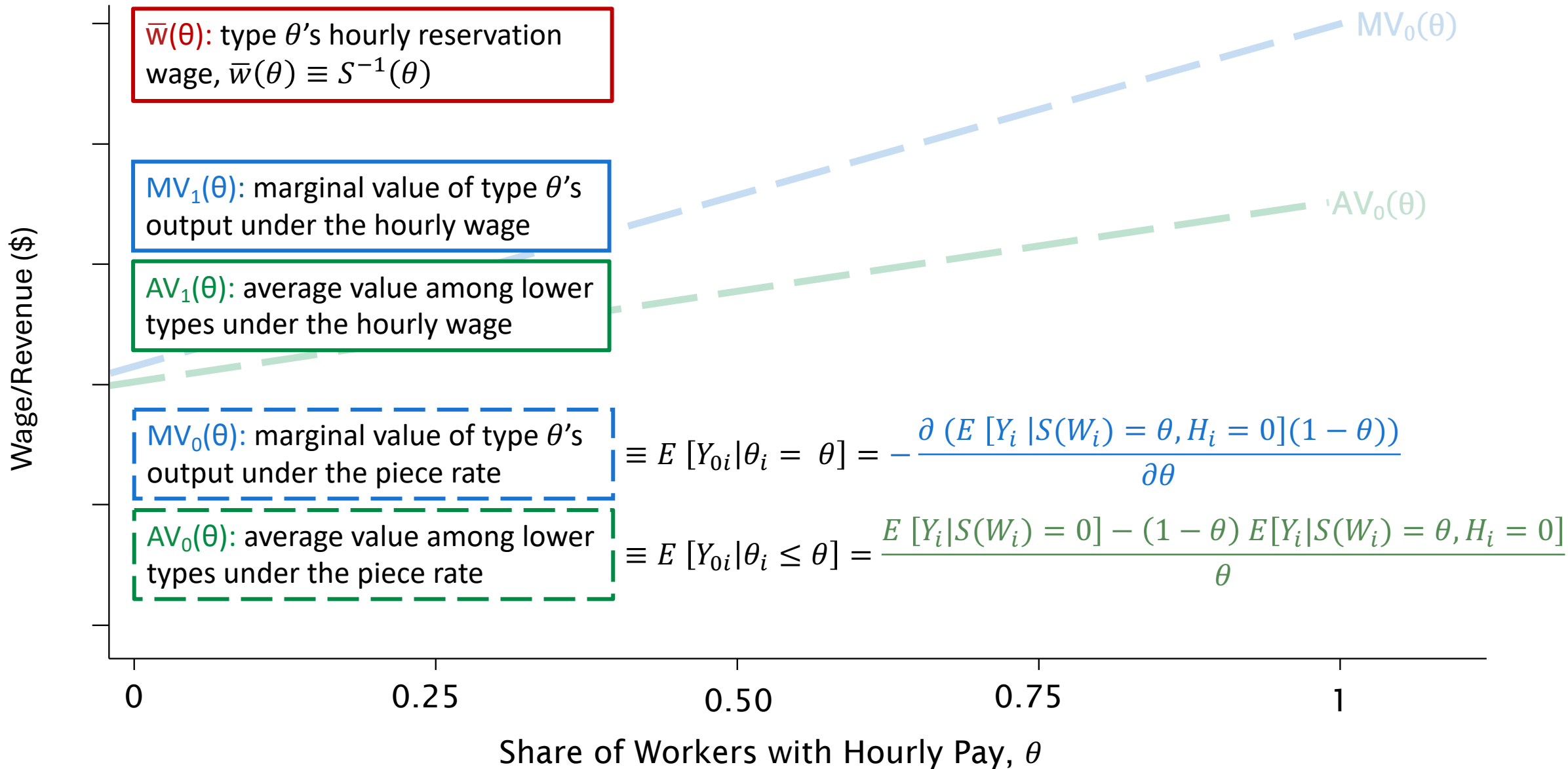


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$\bar{w}(\theta)$ : type  $\theta$ 's hourly reservation wage,  $\bar{w}(\theta) \equiv S^{-1}(\theta)$

$$S(w) \equiv \Pr(H_i = 1 | W_i = w)$$

$MV_1(\theta)$ : marginal value of type  $\theta$ 's output under the hourly wage

$$\equiv E [Y_{1i} | \theta_i = \theta] = \frac{\partial (E [Y_i | S(W_i) = \theta, H_i = 1] \theta)}{\partial \theta}$$

$AV_1(\theta)$ : average value among lower types under the hourly wage

$$\equiv E [Y_{1i} | \theta_i \leq \theta] = E [Y_i | S(W_i) = \theta, H_i = 1]$$

$MV_0(\theta)$ : marginal value of type  $\theta$ 's output under the piece rate

$$\equiv E [Y_{0i} | \theta_i = \theta] = - \frac{\partial (E [Y_i | S(W_i) = \theta, H_i = 0] (1 - \theta))}{\partial \theta}$$

$AV_0(\theta)$ : average value among lower types under the piece rate

$$\equiv E [Y_{0i} | \theta_i \leq \theta] = \frac{E [Y_i | S(W_i) = 0] - (1 - \theta) E [Y_i | S(W_i) = \theta, H_i = 0]}{\theta}$$

## Estimation

1. Estimate  $\Pr(H_i = 1|W_i = w)$   
(logit regression)

2. Separately estimate

$$E[Y_i | S(W_i) = \theta, H_i = 1]$$

&

$$E[Y_i | S(W_i) = \theta, H_i = 0]$$

(local polynomial regression)

3. Differentiate with respect to  $\theta$

$$S(w) \equiv \Pr(H_i = 1|W_i = w)$$

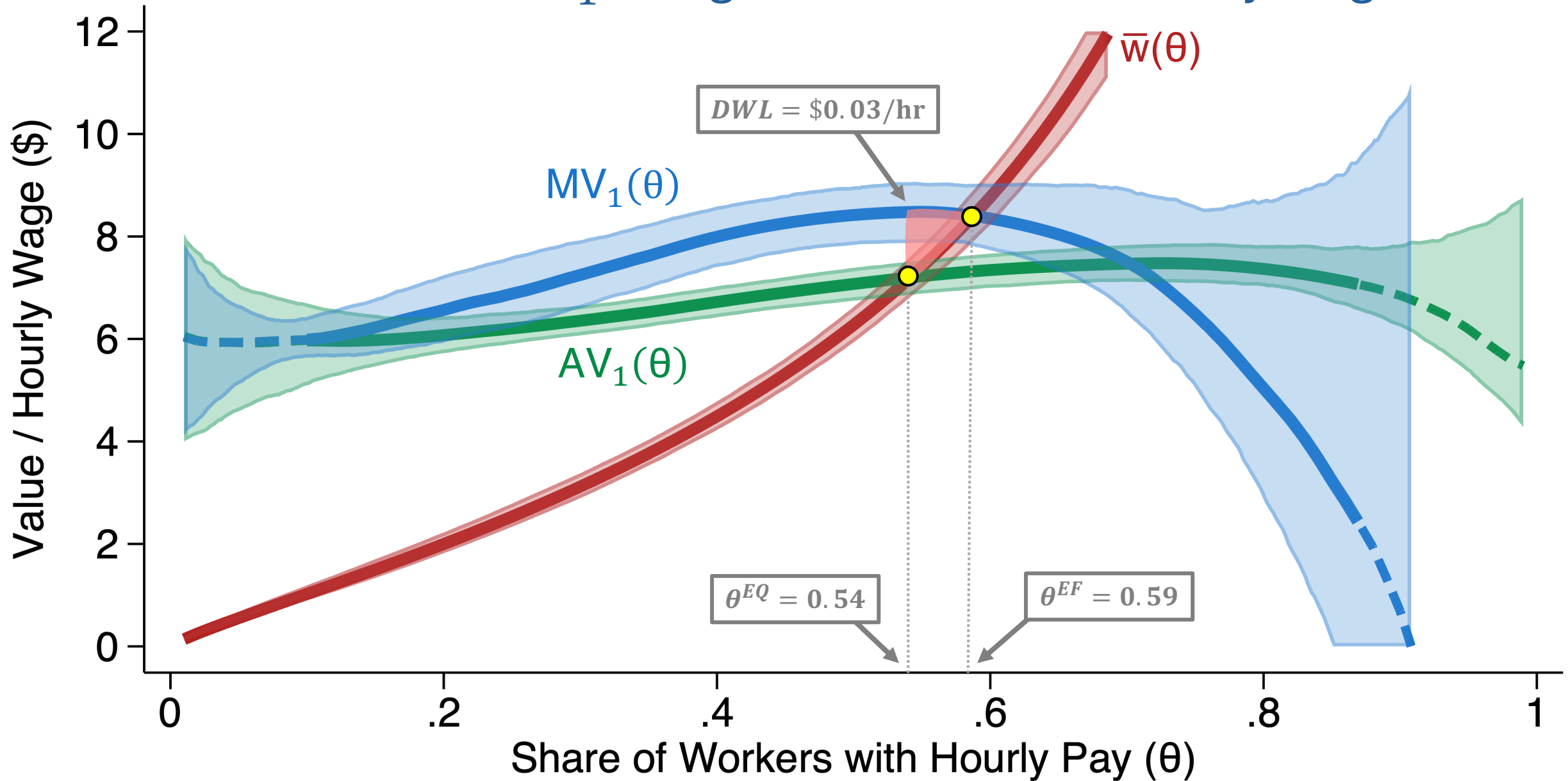
$$MV_1(\theta) \equiv E [Y_{1i} | \theta_i = \theta] = \frac{\partial (E [Y_i | S(W_i) = \theta, H_i = 1]) \theta}{\partial \theta}$$

$$AV_1(\theta) \equiv E [Y_{1i} | \theta_i \leq \theta] = E [Y_i | S(W_i) = \theta, H_i = 1]$$

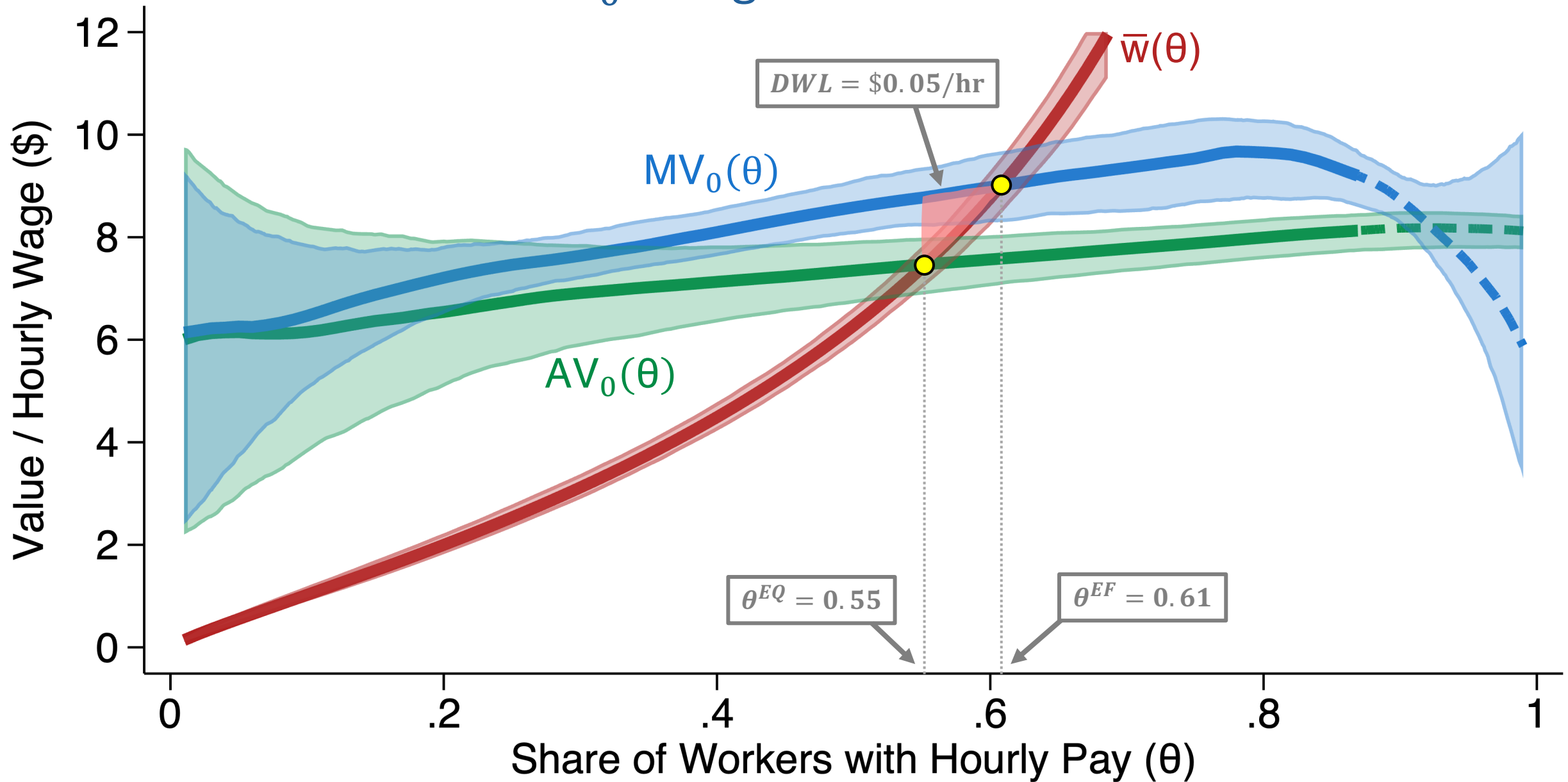
$$MV_0(\theta) \equiv E [Y_{0i} | \theta_i = \theta] = - \frac{\partial (E [Y_i | S(W_i) = \theta, H_i = 0]) (1 - \theta)}{\partial \theta}$$

$$AV_0(\theta) \equiv E [Y_{0i} | \theta_i \leq \theta] = \frac{E [Y_i | S(W_i) = 0] - (1 - \theta) E [Y_i | S(W_i) = \theta, H_i = 0]}{\theta}$$

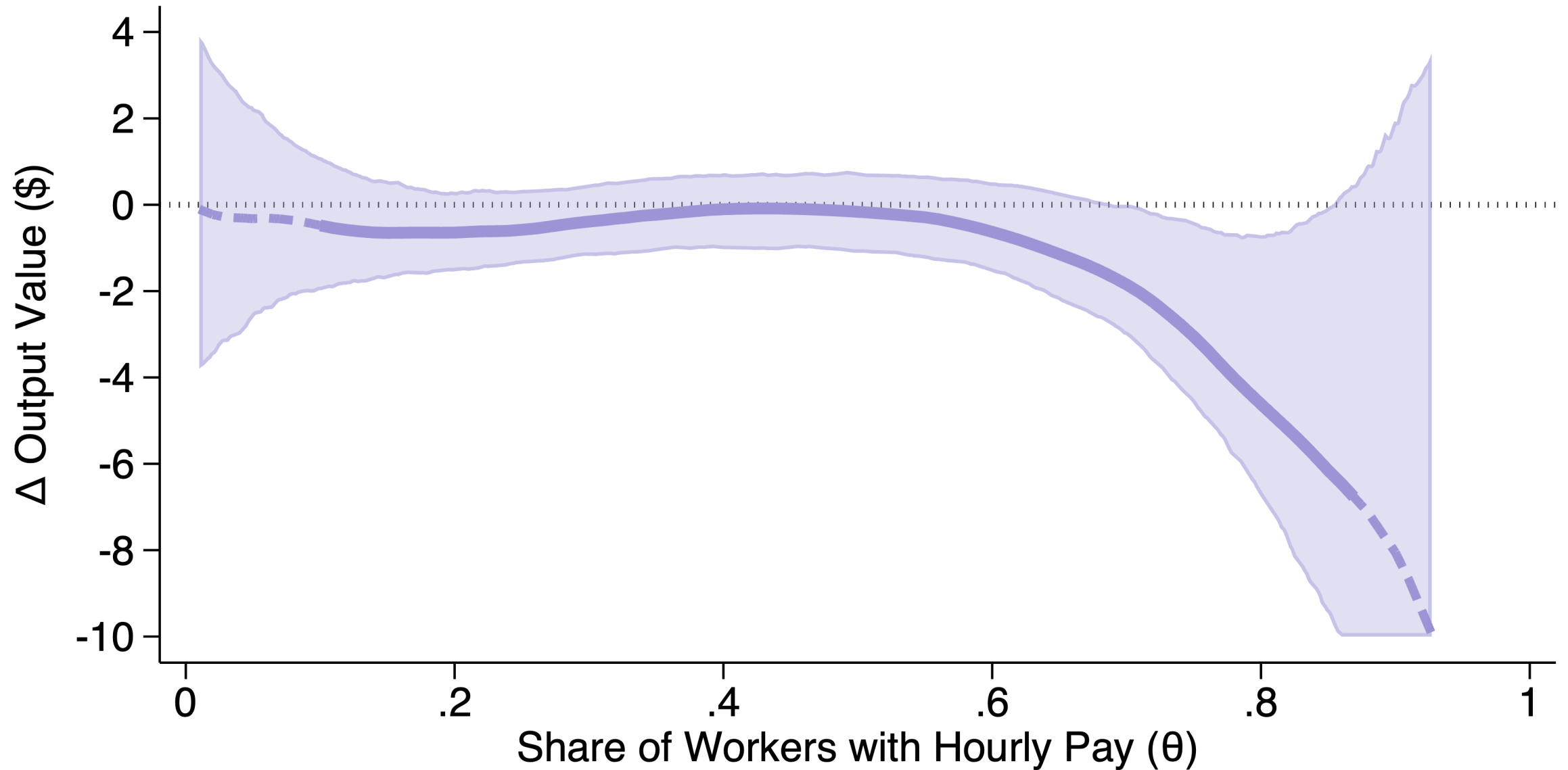
# Selection on $Y_1$ : Marginal Values under Hourly Wage



# Selection on $Y_0$ : Marginal Values under Piece Rate



# Moral Hazard: Estimates of Marginal Treatment Effects



# Outline

- 1 **Experimental Design**
- 2 **Main Results**
- 3 **Model of Asymmetric Information**
- 4 **Estimates of Marginal Value and Welfare Loss**
- 5 **Optimal Wage Subsidies**

# Policy Solutions?

**Marginal Value of Public Funds (MVPF)** for an hourly wage subsidy:

$$MVPF = \frac{Benefits}{Net\ Cost\ to\ Govt}$$

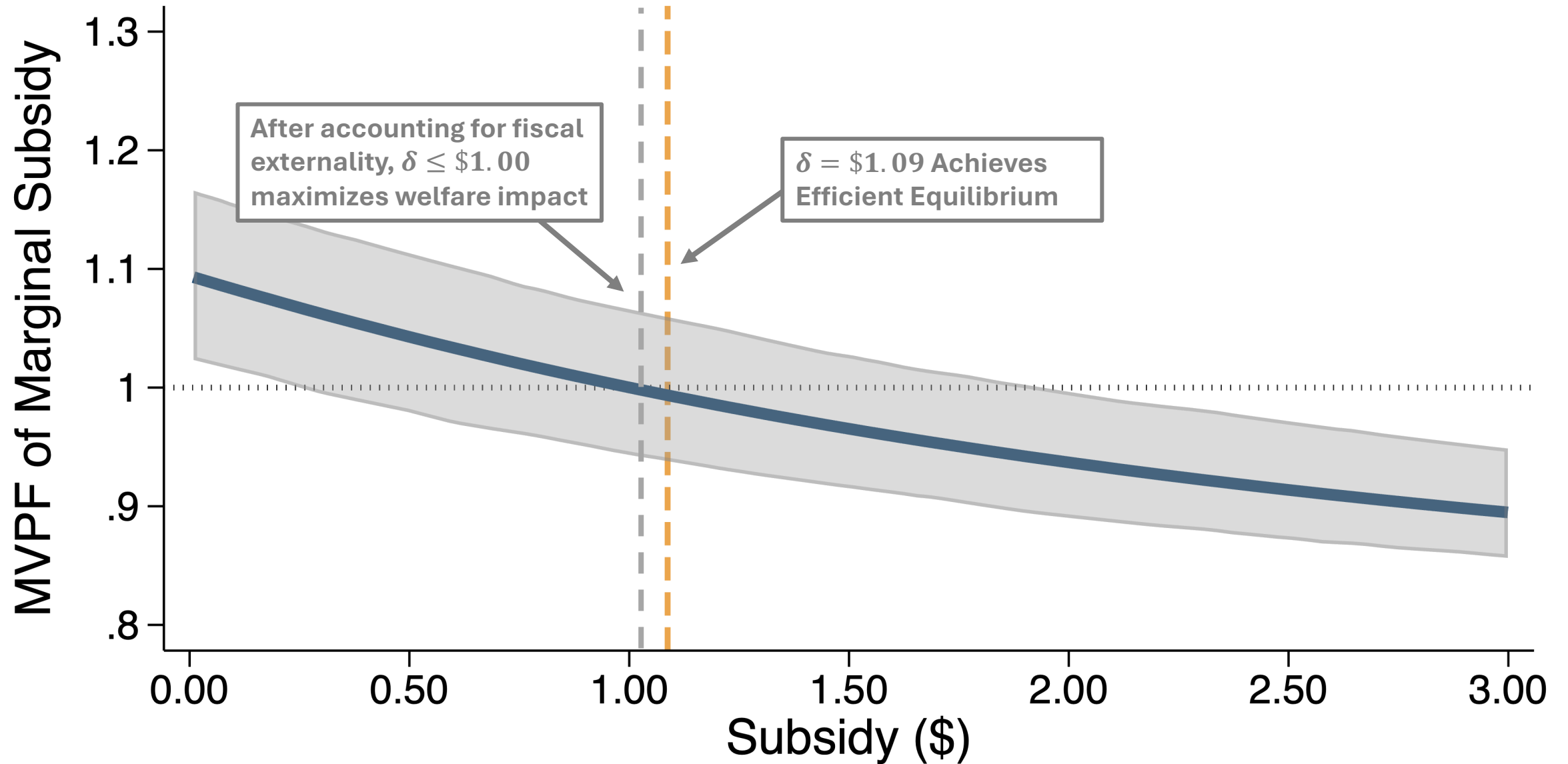
*Benefits*: The aggregate amount workers would be willing to pay for an hourly contract at the subsidized wage.

- + Net transfer from subsidy
- + Smoothing benefit from mitigating risk

*Net Cost to Govt*: The aggregate amount spent, less program revenue or increased tax receipts

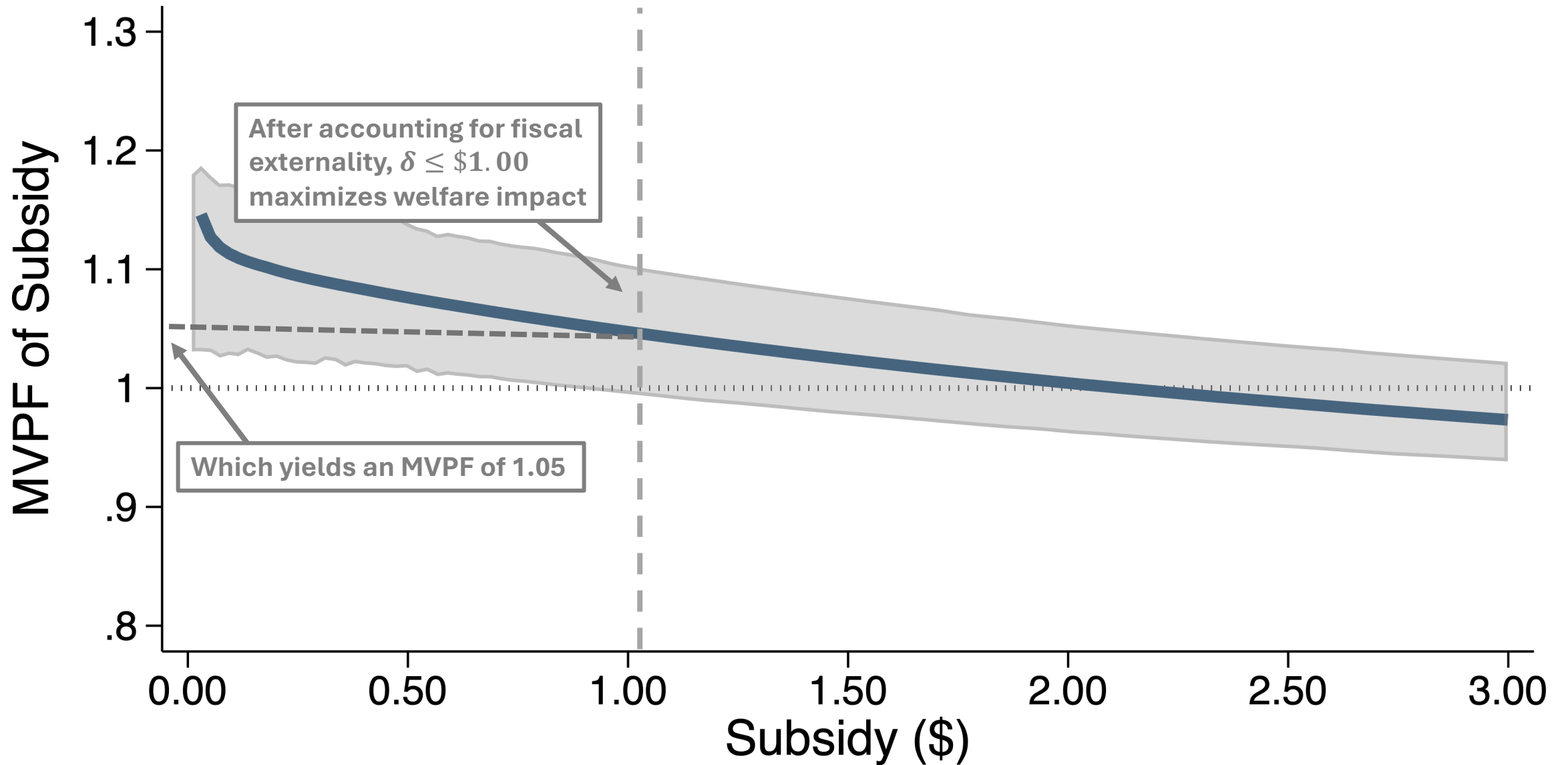
- Net transfer from subsidy
- Fiscal Externality: Reduced tax revenue from shirking workers

# MVPF of Marginal Increase in Hourly Wage Subsidy





# MVPF of Hourly Wage Subsidy



# Conclusion

- Insurance model of labor contracts under asymmetric information
  - Shows how moral hazard and adverse selection affect market equilibrium
  - Parameters map into an MTE framework
- RCT estimates (marginal) selection and treatment effects of hourly pay
  - Separately identifies moral hazard and adverse selection
- Estimate welfare loss of \$0.05/hour from inefficient contracts
  - Hourly wage subsidies of \$1.00 or less can mitigate welfare loss
- Potential for distortions in whenever labor product is ex-ante unknown
- Future research and extensions
  - Employer Learning: screening on past performance
  - Soliciting preferences to estimate MH & AS in other settings or contract dimensions
    1. “What’s the minimum pay raise you would accept to forego your bonus?”
    2. Measure worker productivity by stated willingness-to-accept

# Appendix

# Identifying Selection Across Multiple Wage Offers

$W_i$ : Randomized treatment-offer group

- $W_i = L$ : Offered a choice between low hourly wage and piece rate
- $W_i = H$ : Offered a choice between high hourly wage and piece rate
- $\pi^W$ : Take-up of wage offer  $W \in \{L, H\}$

Selection on  $Y_0$ :

$$\begin{aligned} E[Y_{0i} | H_i^H = 1, H_i^L = 0] - E[Y_{0i} | H_i^H = 0] \\ = \frac{1 - \pi^L}{\pi^H - \pi^L} E[Y_i | H_i = 0, W_i = L] - E[Y_i | H_i = 0, W_i = H] \end{aligned}$$

Selection on  $Y_1$ :

$$\begin{aligned} E[Y_{1i} | H_i^L = 1] - E[Y_{1i} | H_i^H = 1, H_i^L = 0] \\ = \frac{\pi^H}{\pi^H - \pi^L} E[Y_i | H_i = 1, W_i = L] - E[Y_i | H_i = 1, W_i = H] \end{aligned}$$

# Balance Test

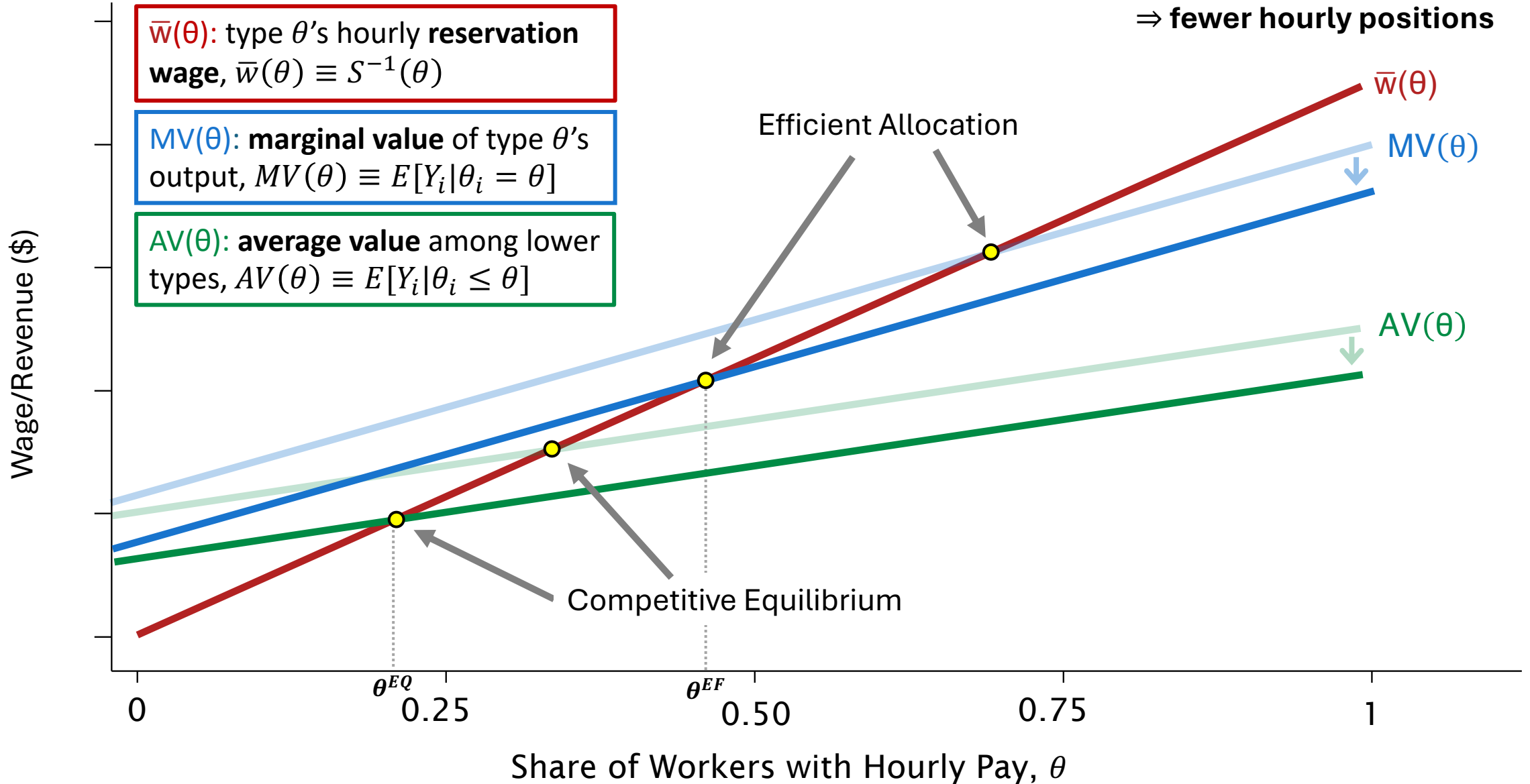
	(1)	(2)
	Experimental Wage Offer	Output Value
Number of Previous Tasks/1000	-0.0478 (0.0343)	0.191*** (0.0305)
Age	0.00141 (0.00529)	-0.0683*** (0.00453)
Female	0.0909 (0.124)	0.366*** (0.108)
Minority	-0.0528 (0.125)	-0.896*** (0.109)
Employed	-0.202 (0.138)	0.142 (0.121)
Student	0.0685 (0.169)	-0.474*** (0.149)
F-statistic	1.019	36.492
p-value	0.426	0.000
<i>N</i>	3030	3030

# Hourly Wage Take-up

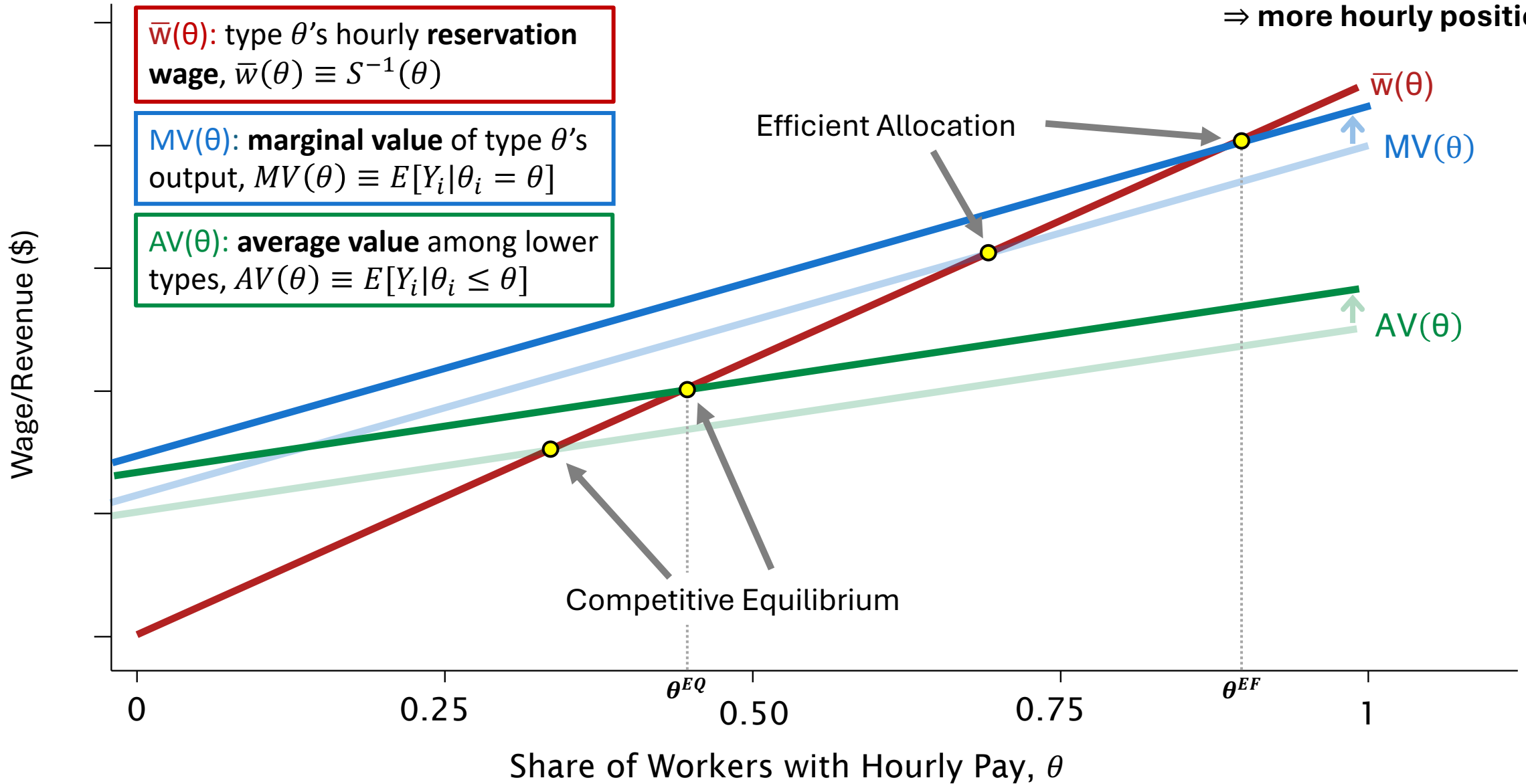
	(1) Accepted Offer	(2) Accepted Offer	(3) Accepted Offer	(4) Accepted Offer
Log Hourly Wage Offer	1.198*** (0.0554)	1.202*** (0.0554)	1.212*** (0.0560)	1.245*** (0.0578)
Task Controls	No	Yes	Yes	Yes
Employment Controls	No	No	Yes	Yes
Demographic Controls	No	No	No	Yes
<i>N</i>	2728	2728	2728	2728

$$\Pr(H_i = 1) = \text{inv logit}(\alpha \ln W_i + \boldsymbol{\nu} \mathbf{X}_i)$$

**Input monitoring costs** reduce firm's value of fixed-wage hire  
⇒ **fewer hourly positions**



Output monitoring costs increase the firm's value of fixed-wage hire  
⇒ more hourly positions





# Estimation Details

Estimation Follows Carneiro et al. (2012):

1. Estimate  $S(w) \equiv \Pr(H_i = 1 | W_i = w)$  using [logit regression](#)
2. Condition on  $X$  using double-residual regression (Robinson 1988)
  - $X$ : Controls for number of previous tasks, task start time, and employment status
  - Assumes additive separability of  $X$ :  $E[Y_{ji} | X_i = x, \theta_i = \theta] = \xi_j \tilde{X}_i + MV_j(\theta)$
3. Separately estimate  $E[Y_i | S(W_i) = \theta, H_i = 1]$  and  $E[Y_i | S(W_i) = \theta, H_i = 0]$ 
  - Local polynomial regressions of  $\tilde{Y}$  on  $S(W_i)$  for hourly and piece-rate workers ( $bw=0.2$ )
4. Differentiate with respect to  $\theta$