Asymmetric Information in Wage Contracts: Evidence from an Online Experiment

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February 2025

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

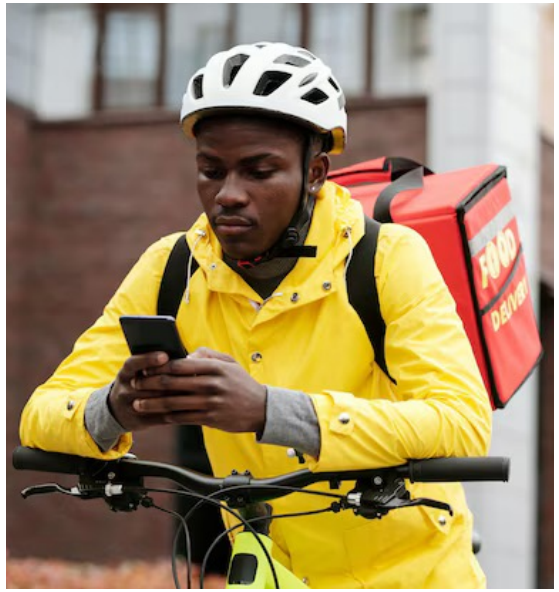
- Paid by unit of time
- Worker sells *claim* on labor product
- Examples:
  - Limo driver paid per hour
  - Staff photographer with annual salary

← Earnings Risk Insurance →

Hourly wage + tips

Base pay + commission

Annual salary + bonus



Are these contracts socially optimal?

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Earnings Risk Insurance

Asymmetric information ⇒ market distortions:

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

⇒ Suboptimal wage contracts

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Earnings Risk — Insurance

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Public policies can mitigate these distortions:

- Taxes tips, commissions, or bonuses
- Hourly wage subsidies
- Employment classification rules
- Portable benefits programs
- Minimum wage

⇒ Promote implicit insurance in wage contracts

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Earnings Risk — **Insurance**

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⇒ 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 ≡ Treatment effect: take-up of hourly contract ⇒ output ↓ by 6.3% relative to the mean
     - AS ≡ Selection into treatment: wage offer ↑ by 10% ⇒ marginal worker's productivity ↑ 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 θ
     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 ⇒
     - 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

   ⇒ MTE of hourly contracts map directly into model

This Paper:

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3. Use MTE framework to estimate equilibrium and efficient hourly wages

4. Calculate DWL of inefficient wages and welfare impact of tax/subsidy
   - Welfare loss of $0.04 per hour of labor
   - Hourly subsidy $\leq$ $1.00 $\Rightarrow$ generates $1.15 of welfare per $1 of govt expenditure
   - Piece-rate tax $\leq$ 15% $\Rightarrow$ raises $1 of govt revenue at social cost of $0.85 or less

Existing Literature

- Asymmetric Information in Labor Markets
  - Spence (1973), Weiss (1980), Gibbons and Katz (1991), Farber and Gibbons (1996), Shimer (2005), Landers et al. (1996), Ales and Maziero (2016), Pallais (2016), Sztutman (2024)
- Selection and Incentive Effects of Wage Contracts
  - Lazear (2000), Nagin et al. (2002), Gaynor et al. (2004), 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 Fixed-Wage Subsidy and Piece-Rate Tax**

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

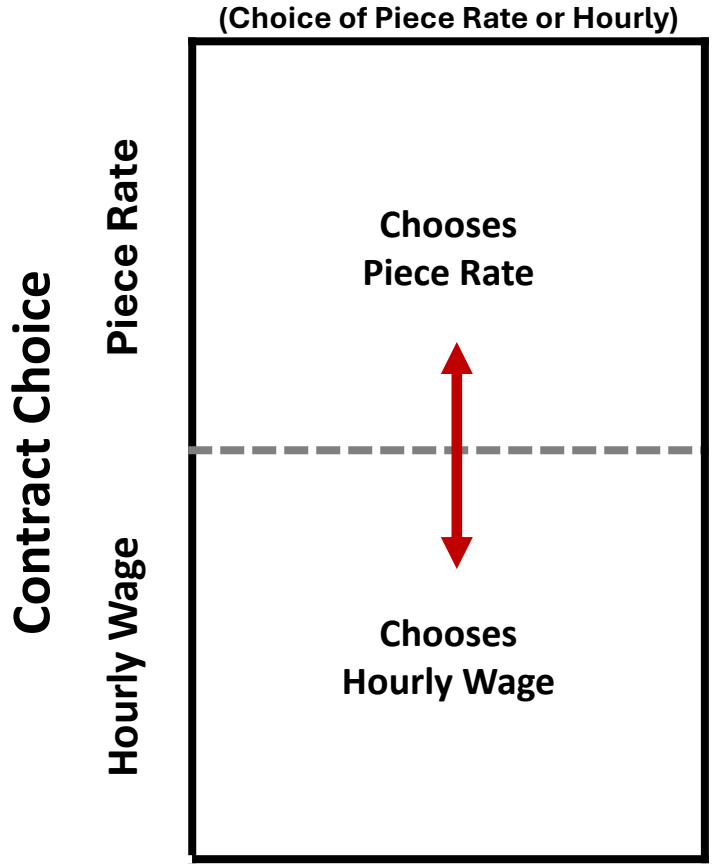
  Y_{0i}: Worker i's potential output under piece rate

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

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

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

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

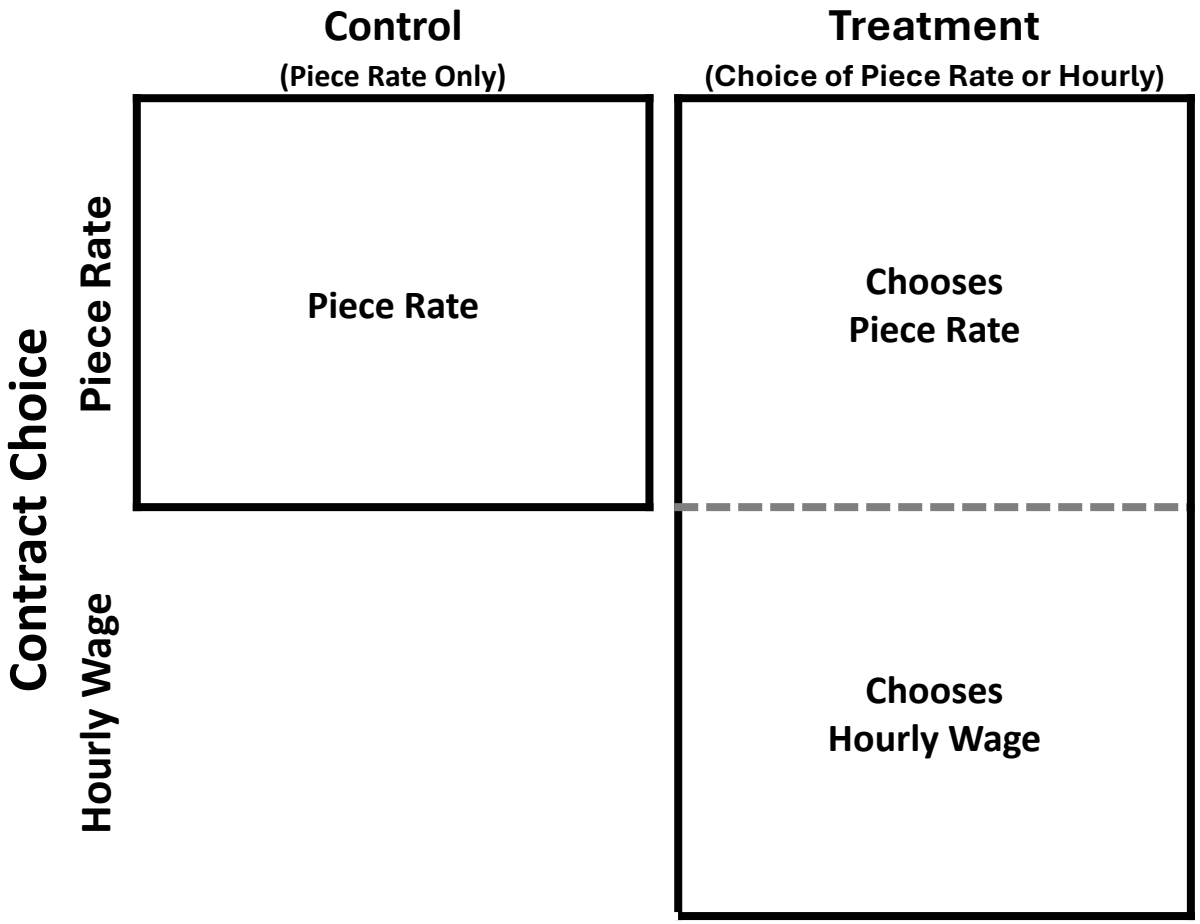


Experimental Design: Single Wage Offer

<u>Simplified Experimental Design</u>

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 ($H_i = 0$)

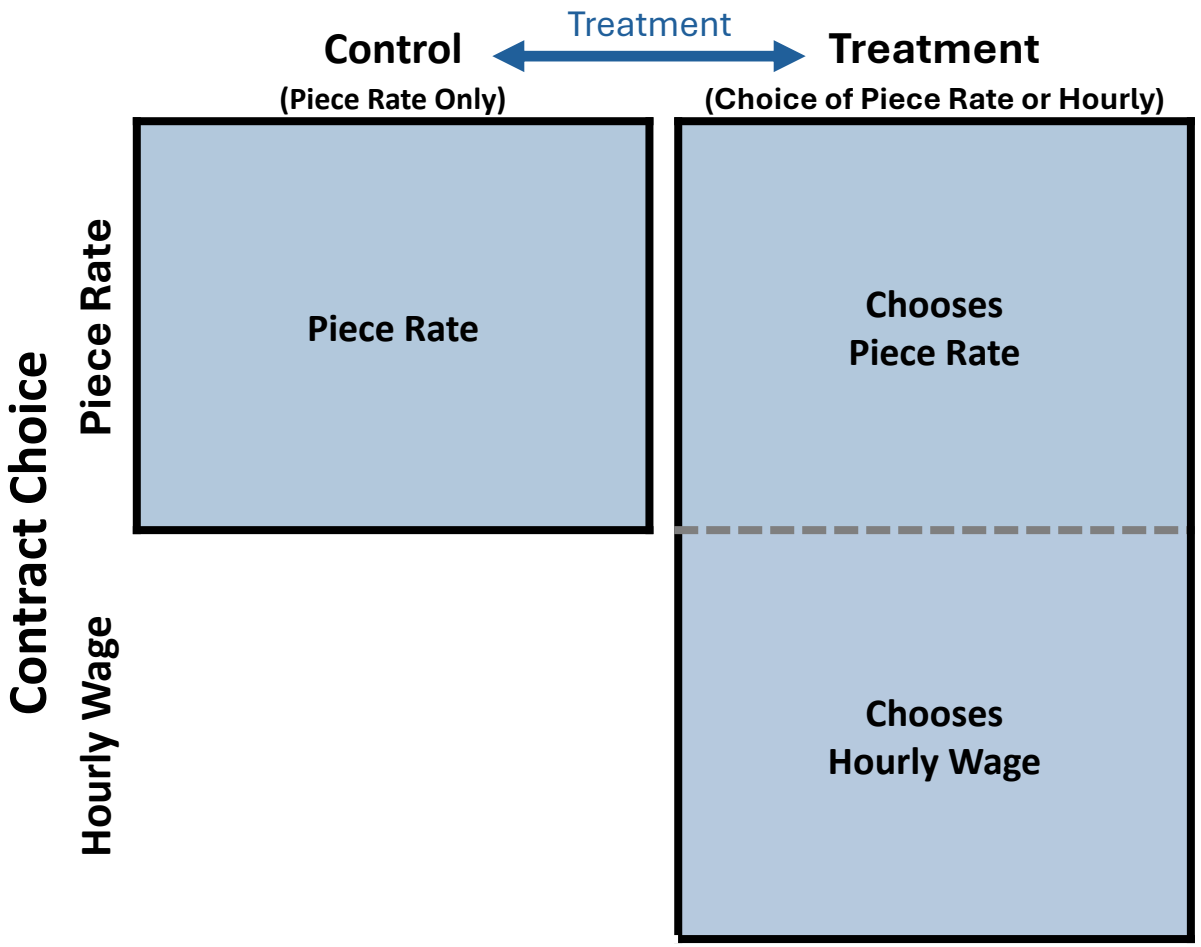


Experimental Design: Single Wage Offer

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

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

Local Average Treatment Effect (LATE)



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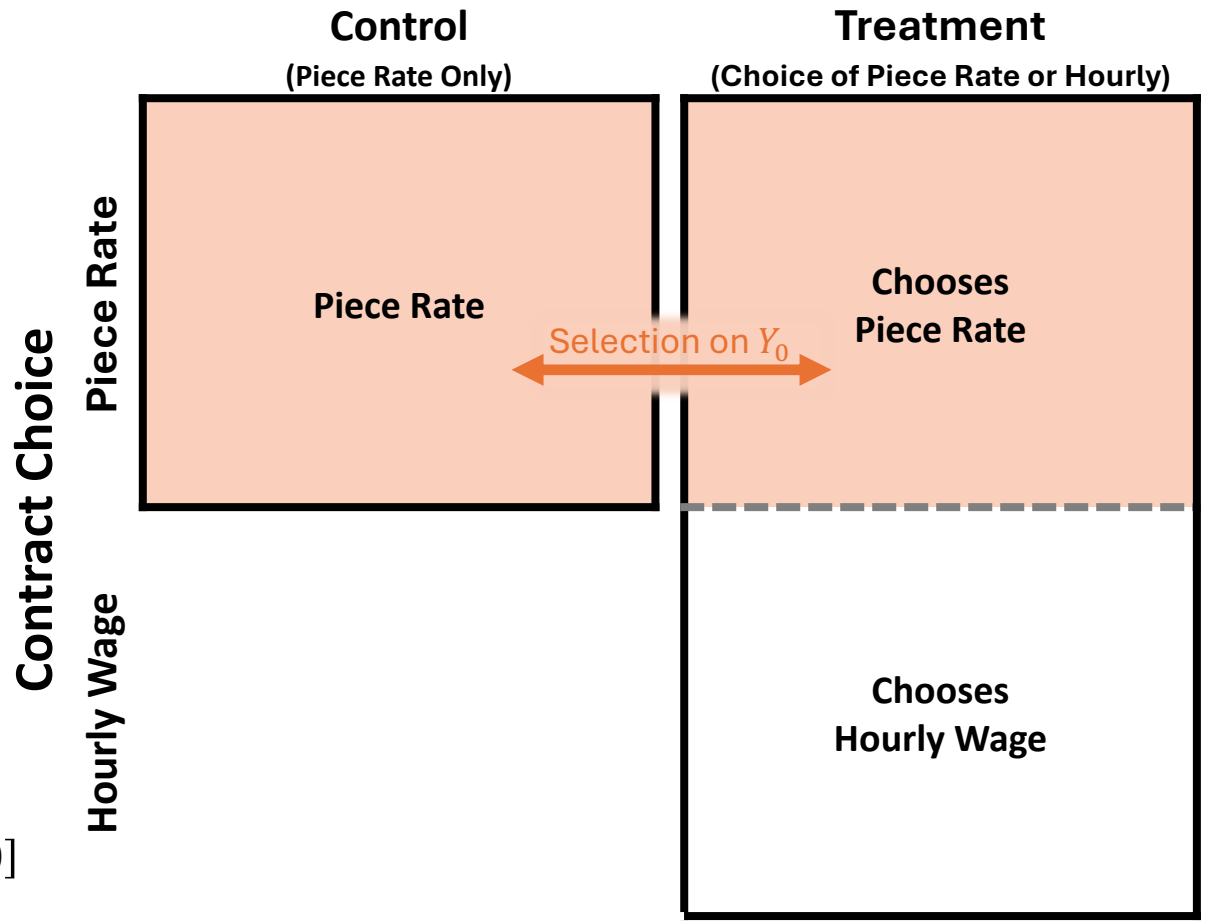

Comparing piece-rate workers who faced different offer sets identifies ***selection into treatment:***

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

Adverse Selection

Details

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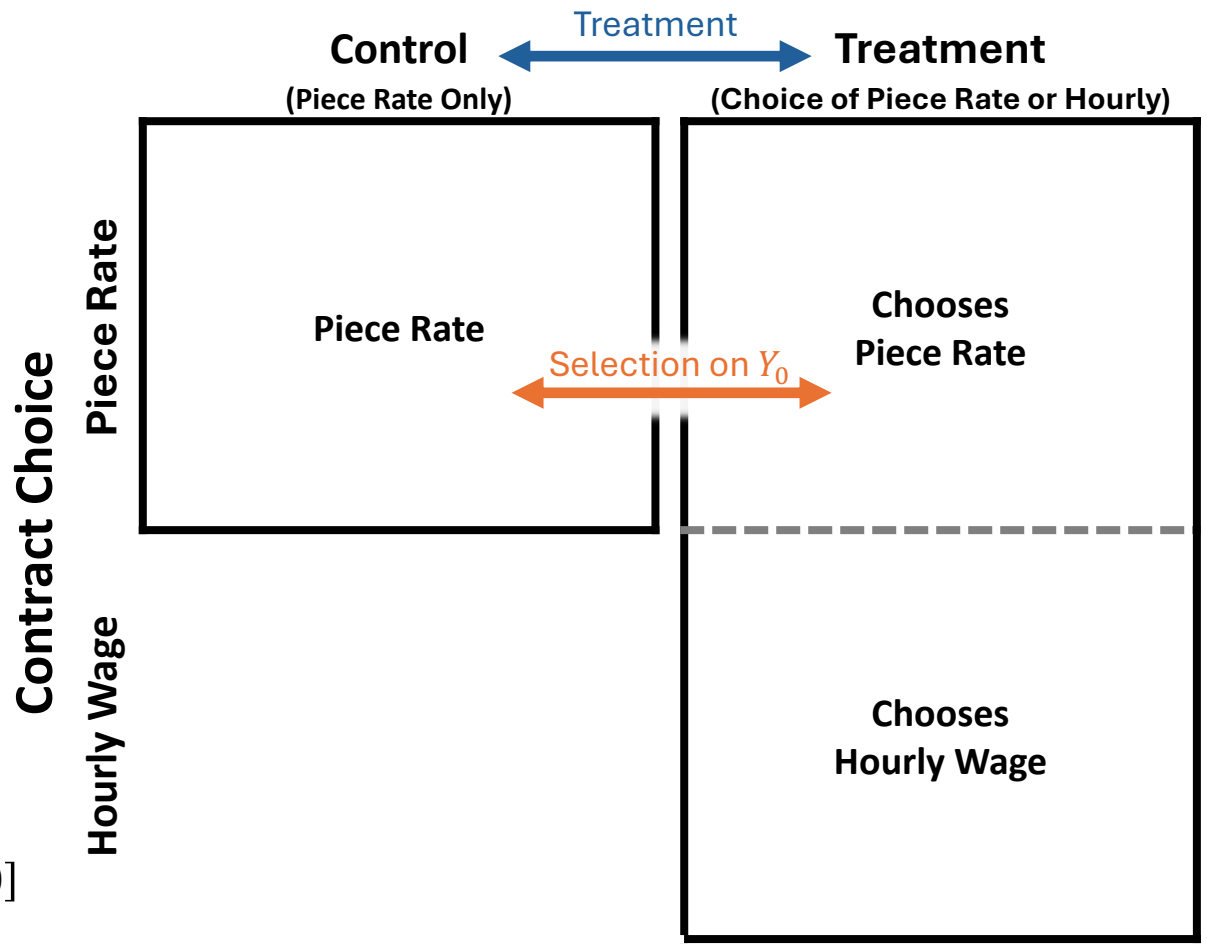
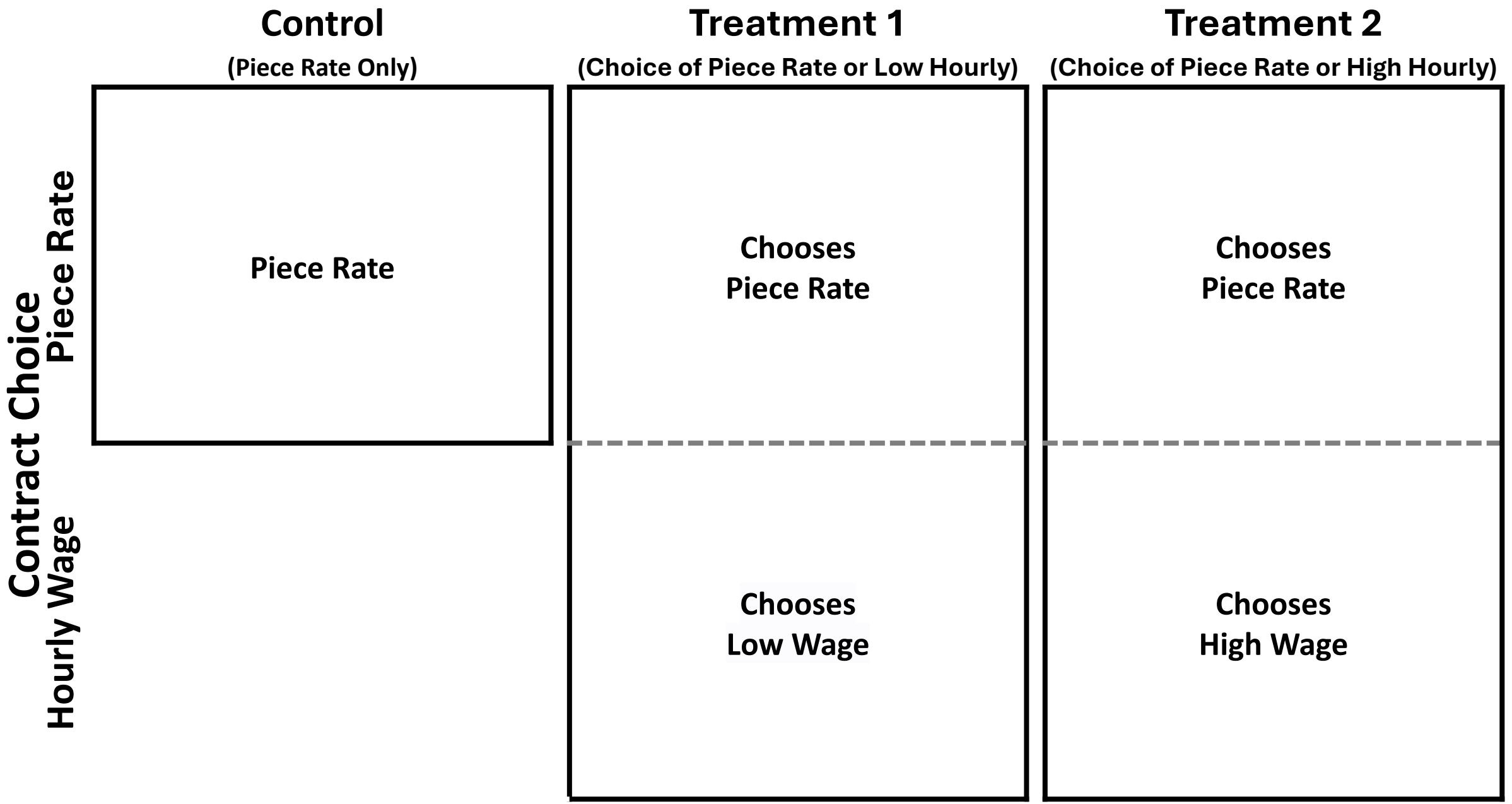
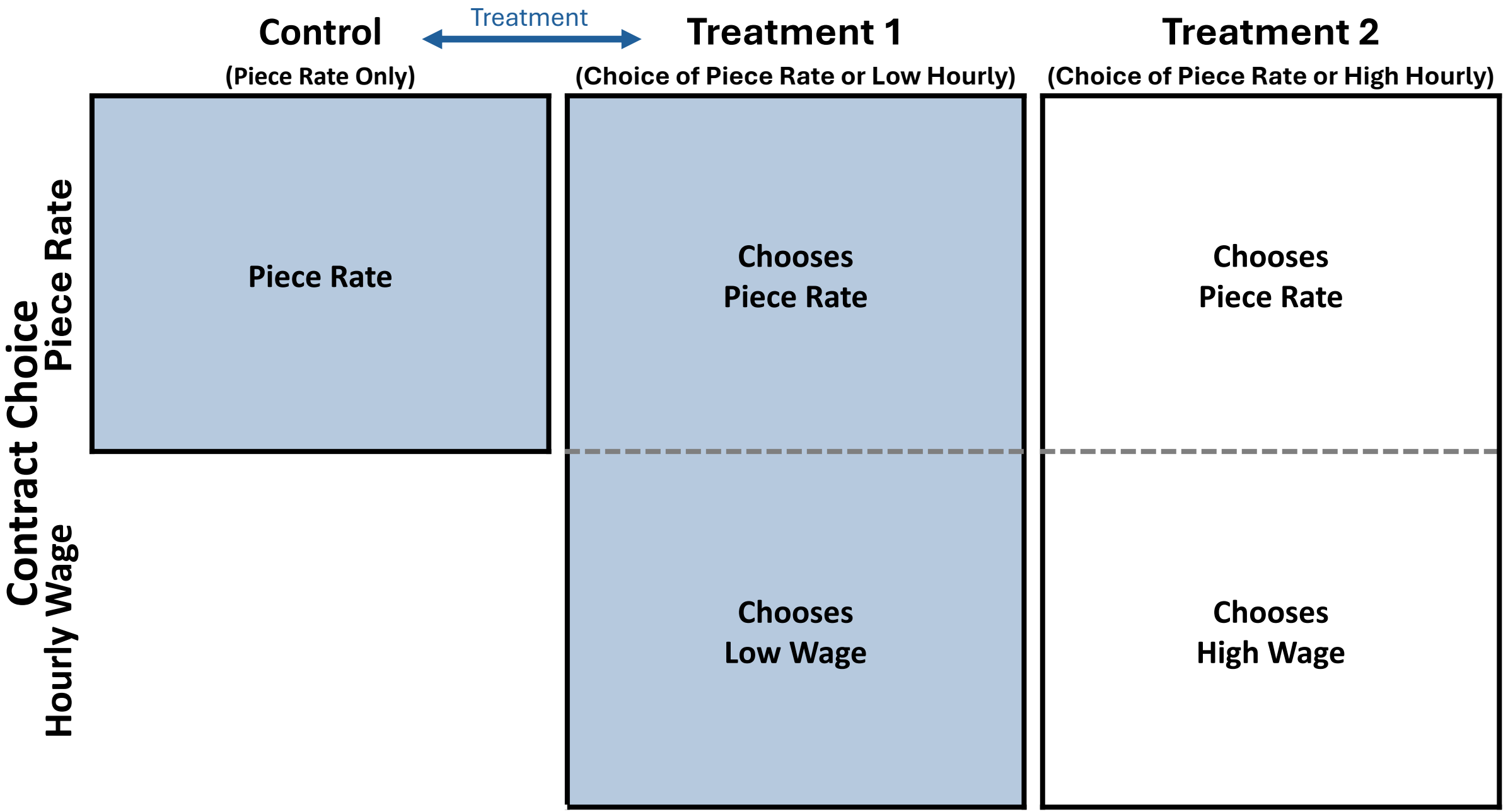
Selection on Y_0





Formal Expression



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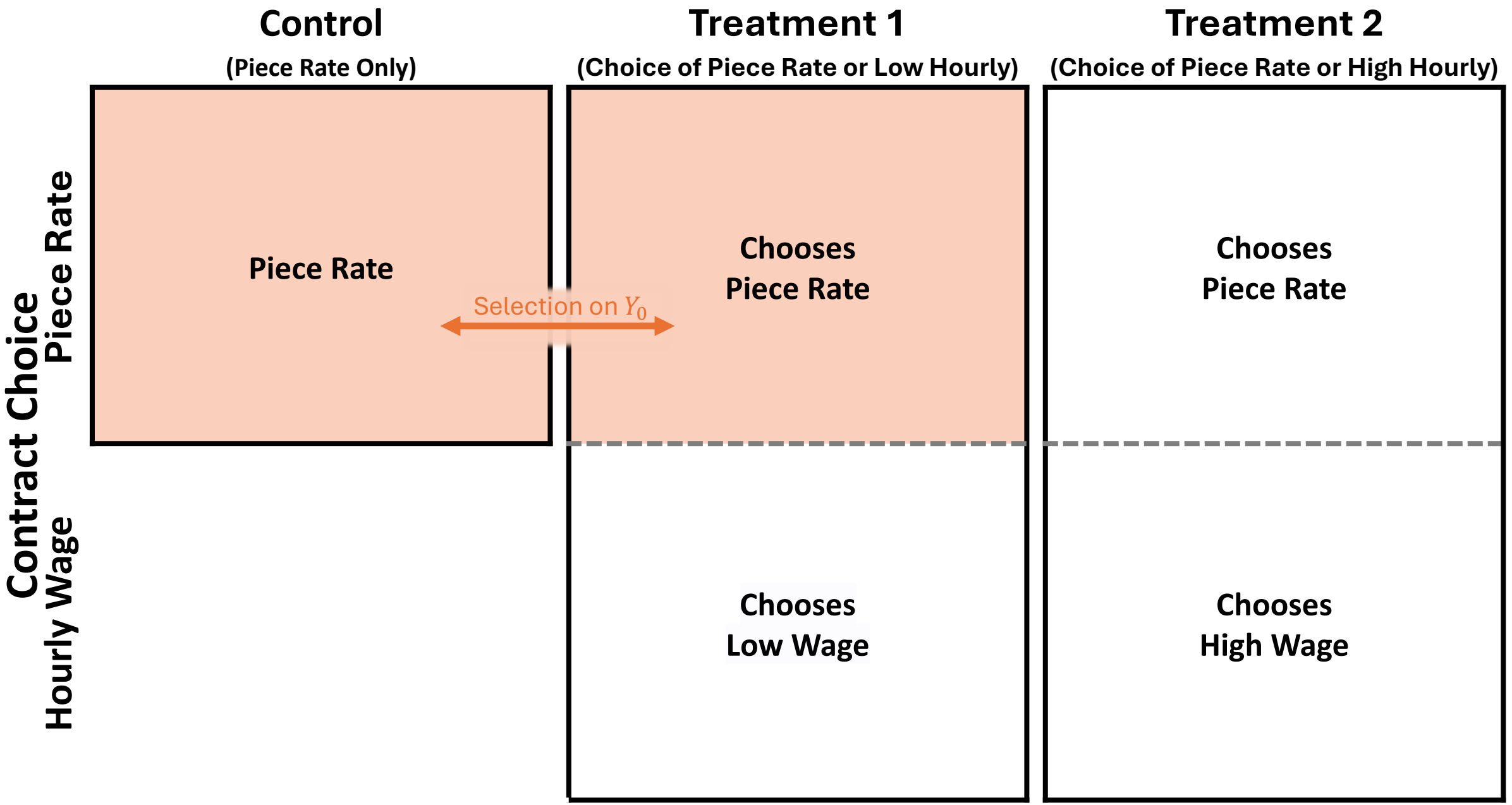

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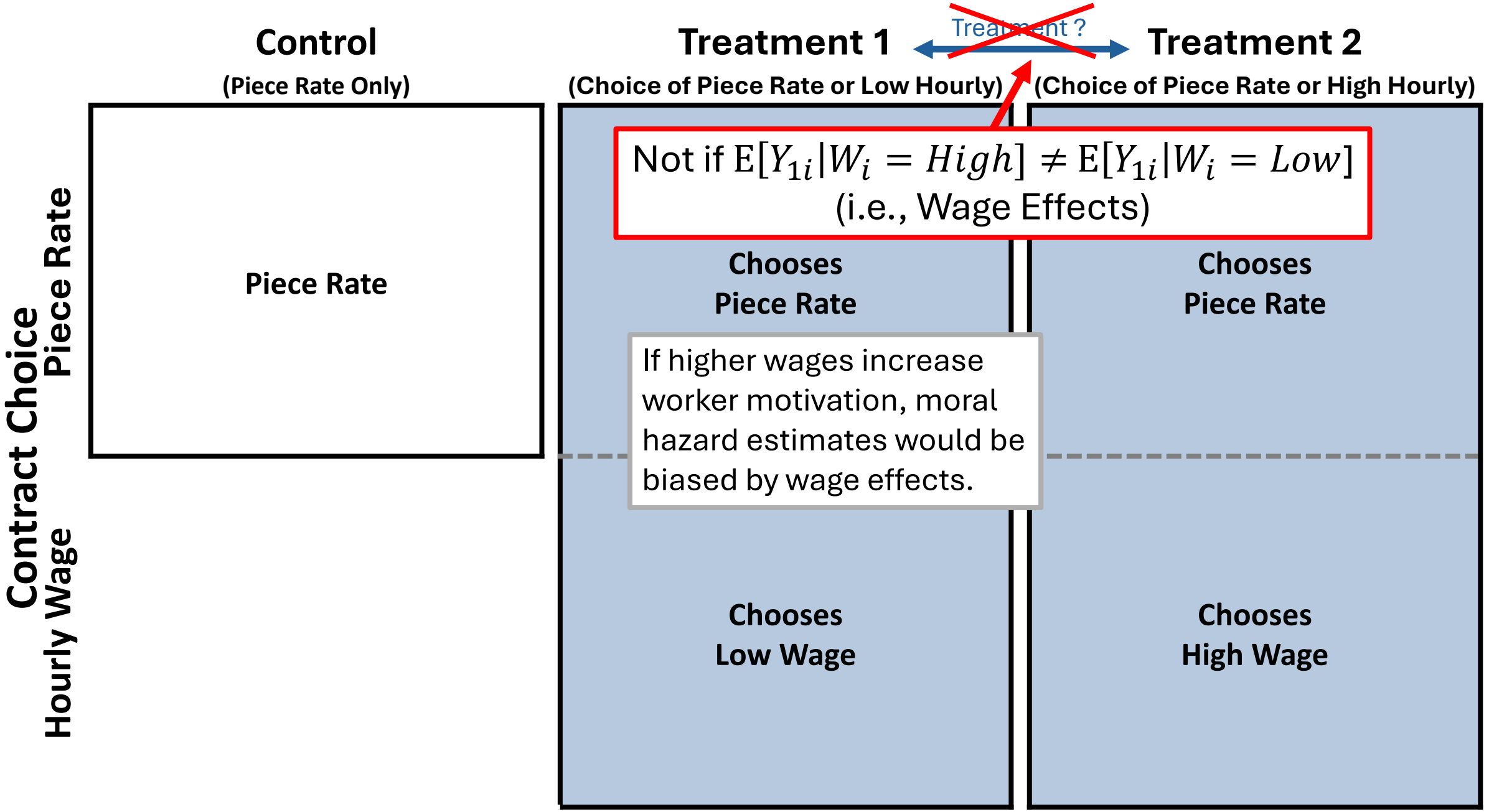

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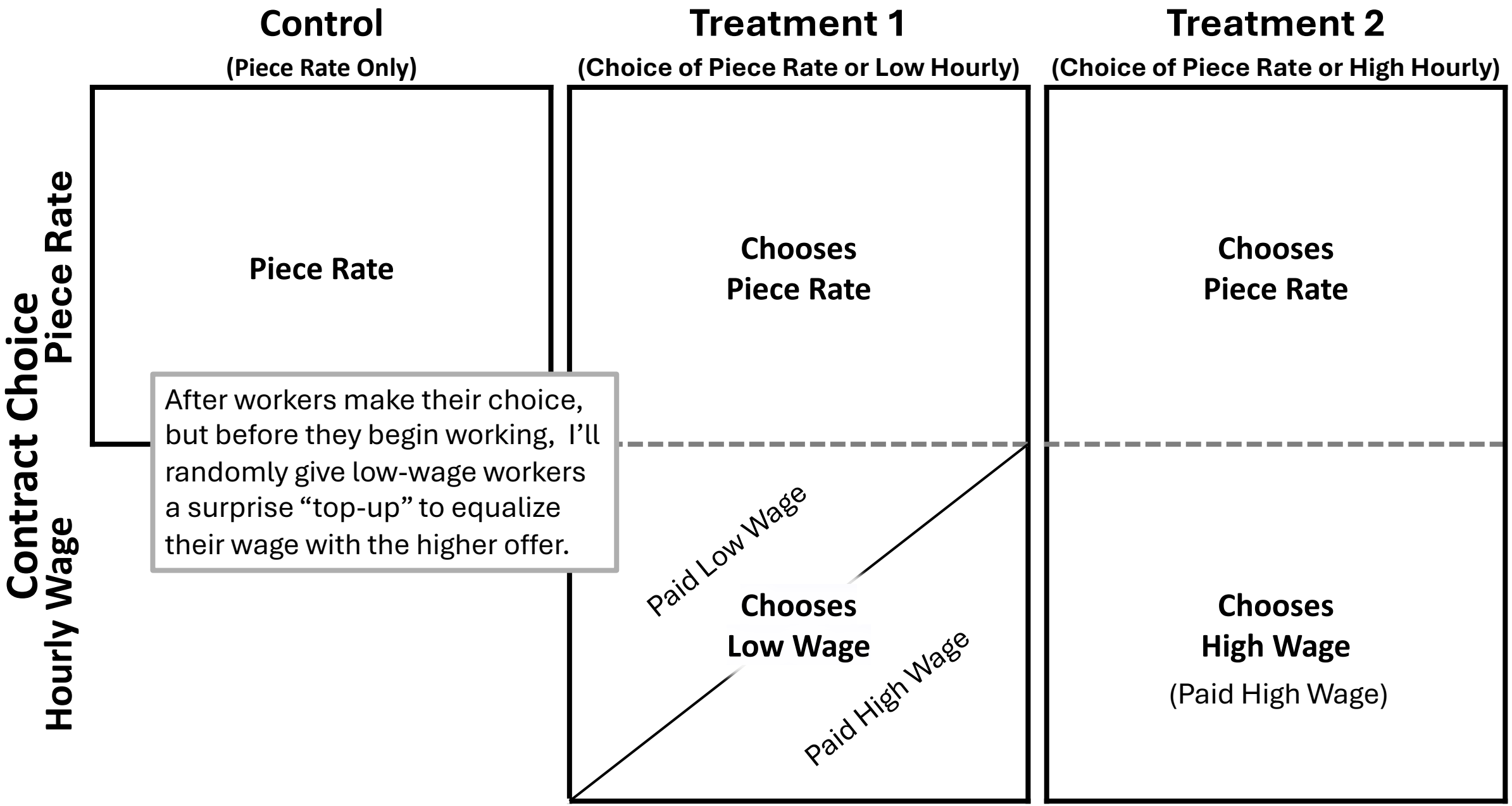

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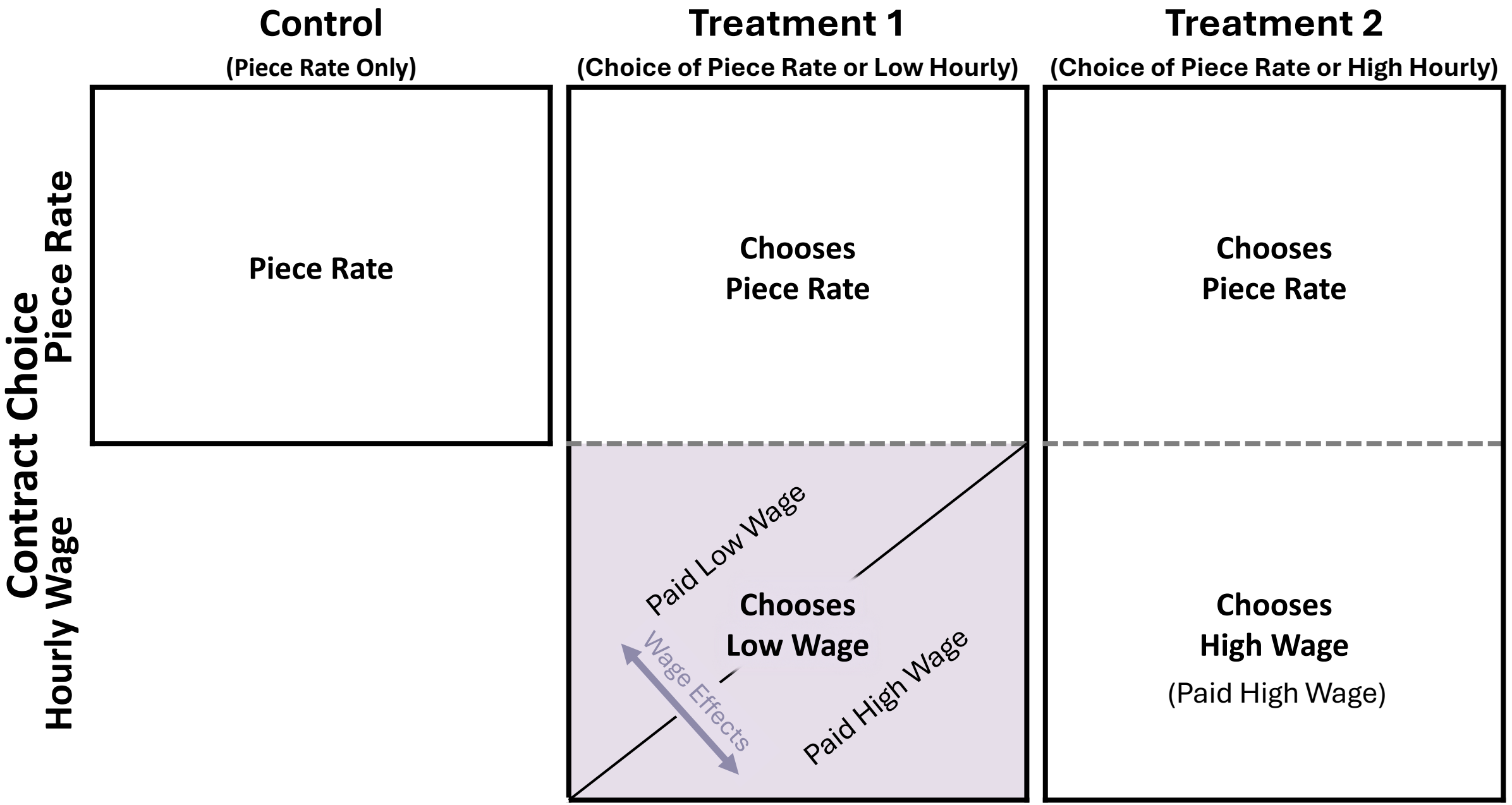

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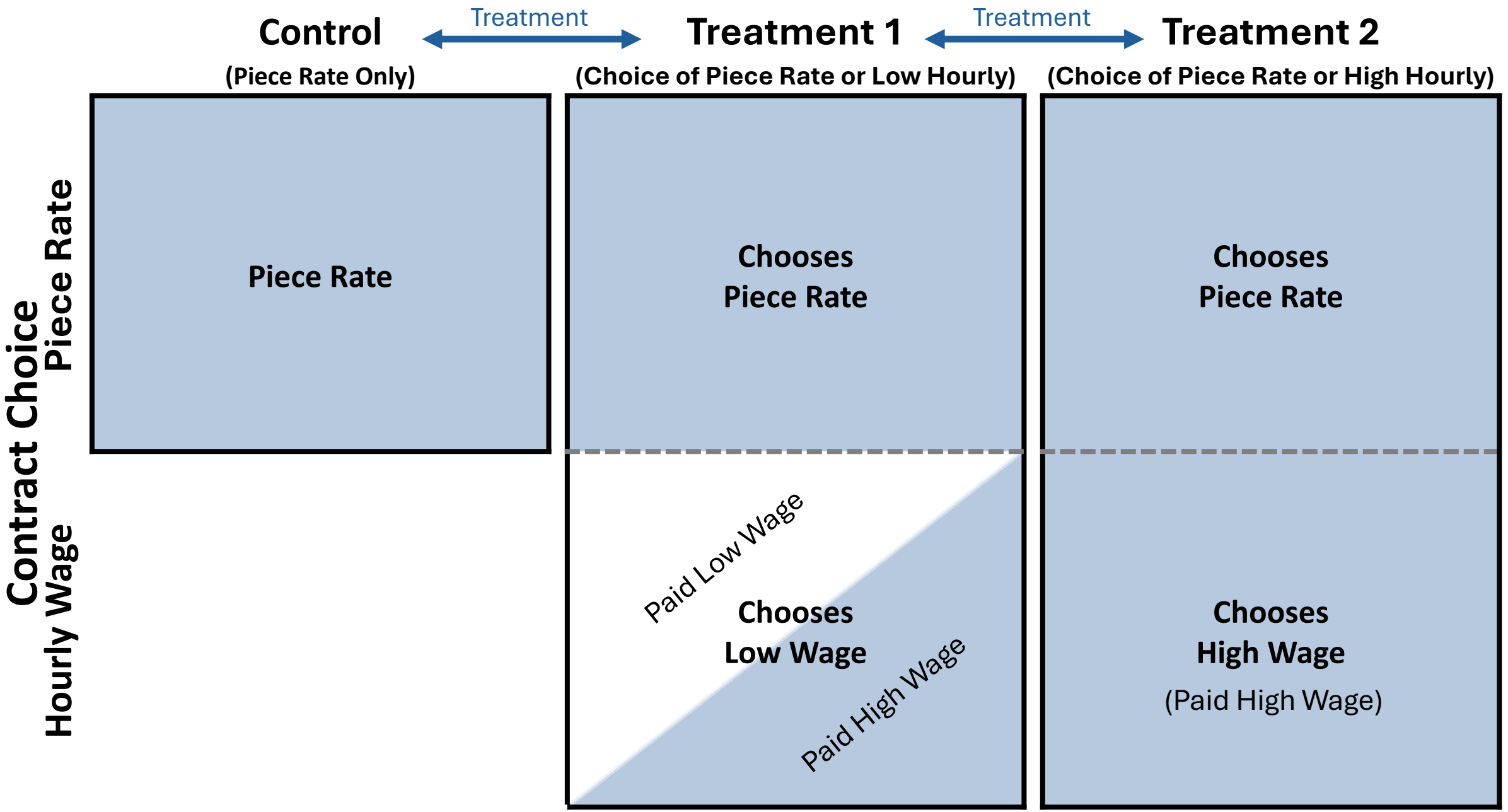

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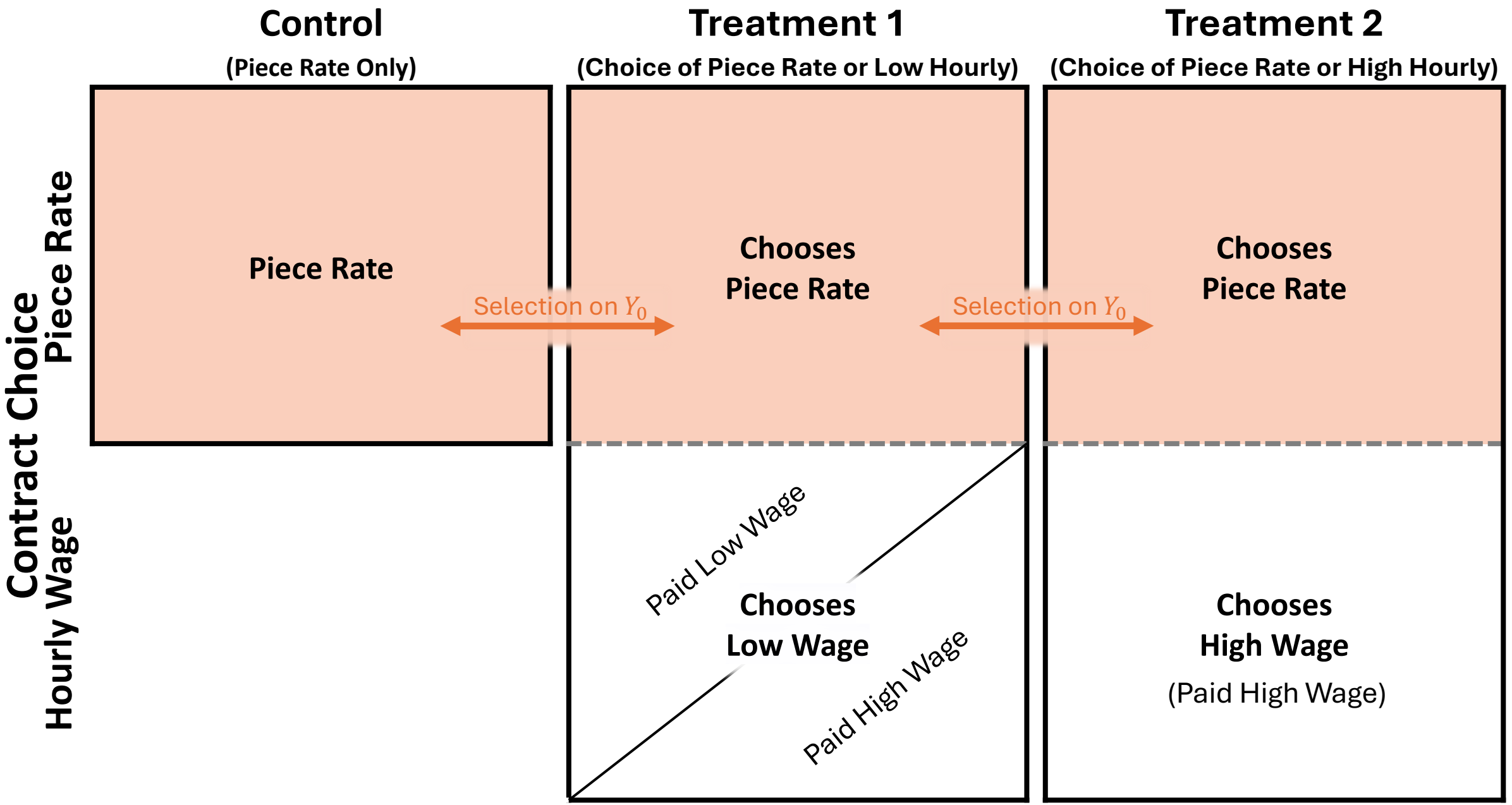

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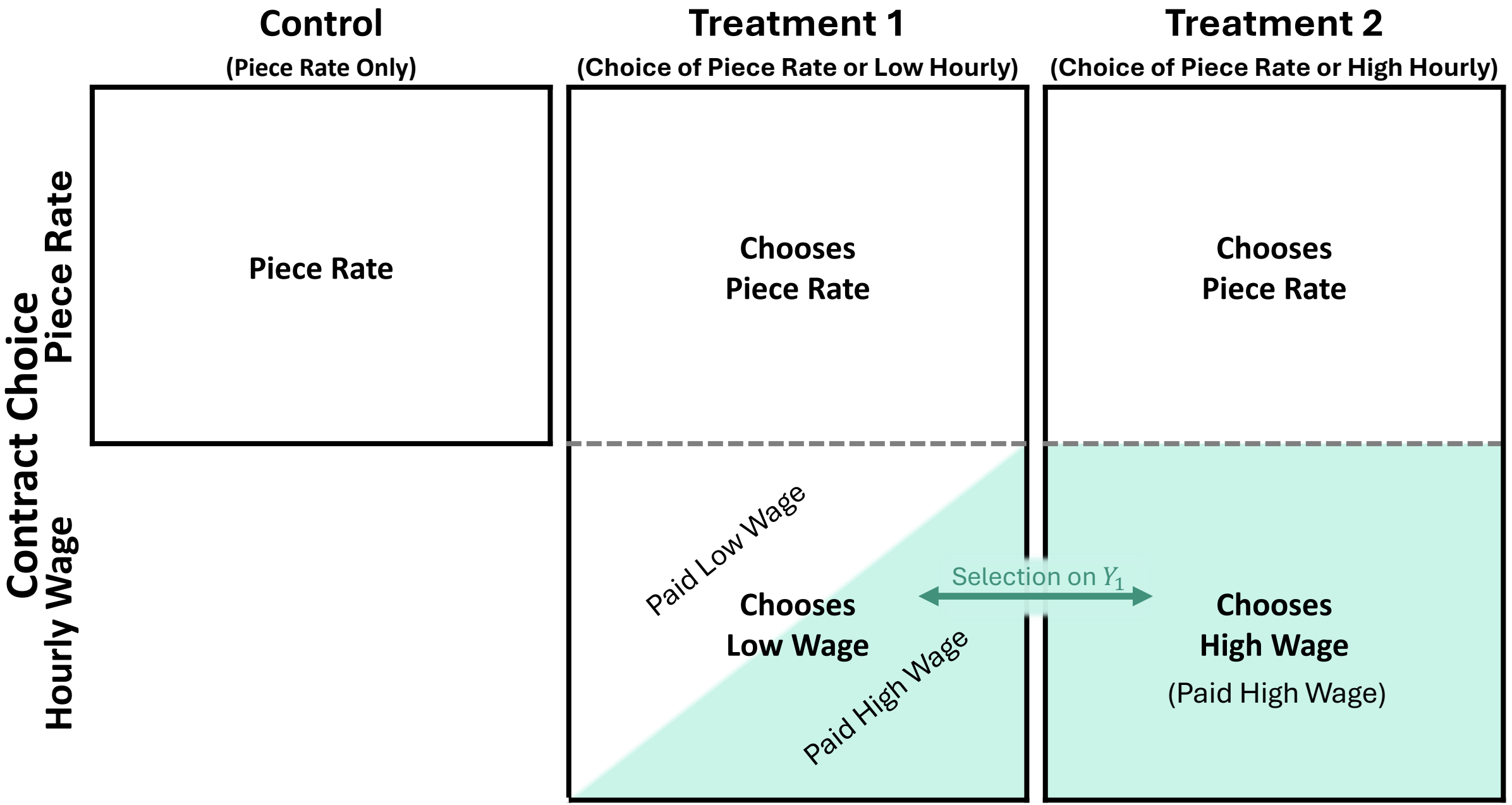

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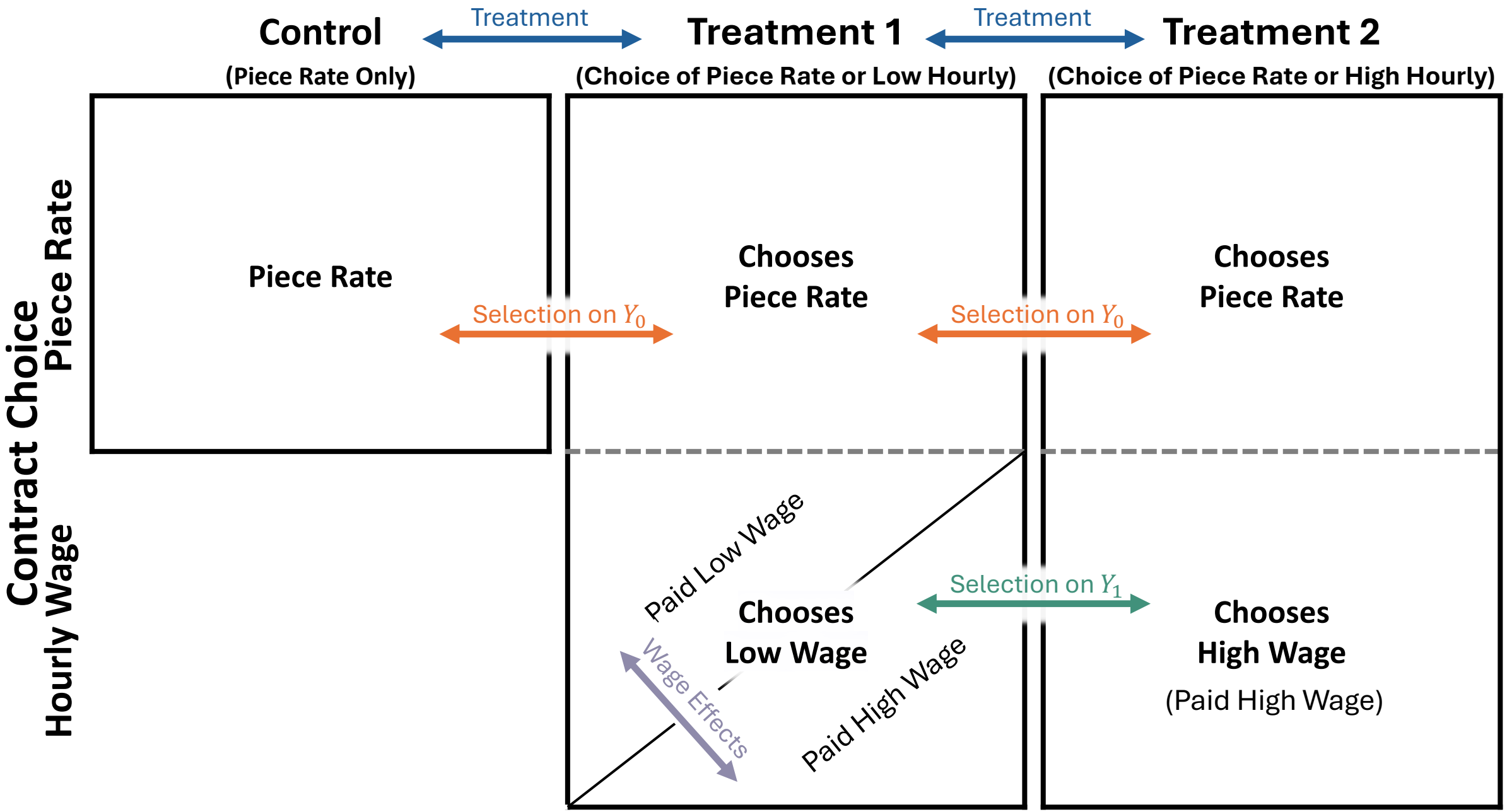


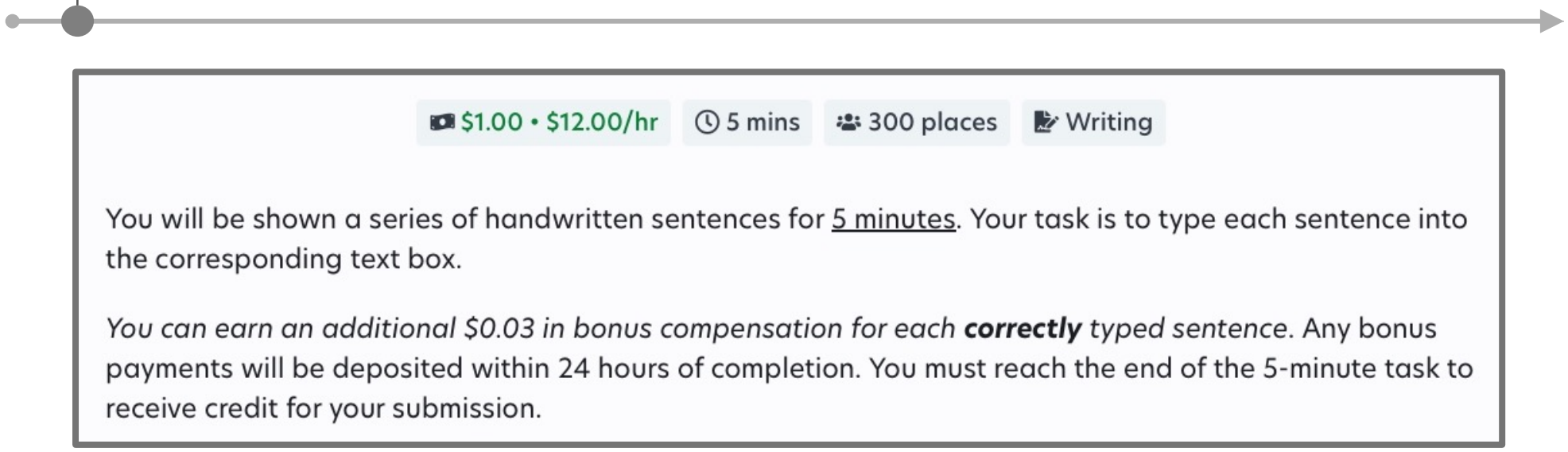
Formal Expression

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 ≥98%
  - Number of approved tasks ≥10
  - Located within US
- In practice, most users who see the posting accept the job.
- Experiment takes place over ten waves of ≈300 workers



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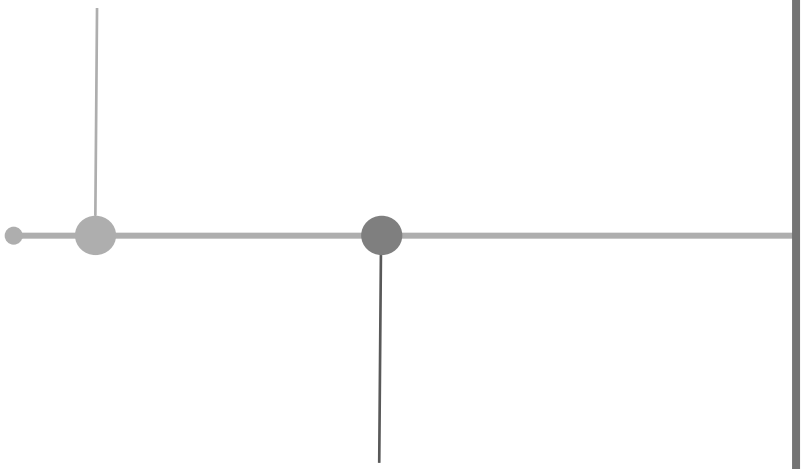

Randomization #1: Wage Offers

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.

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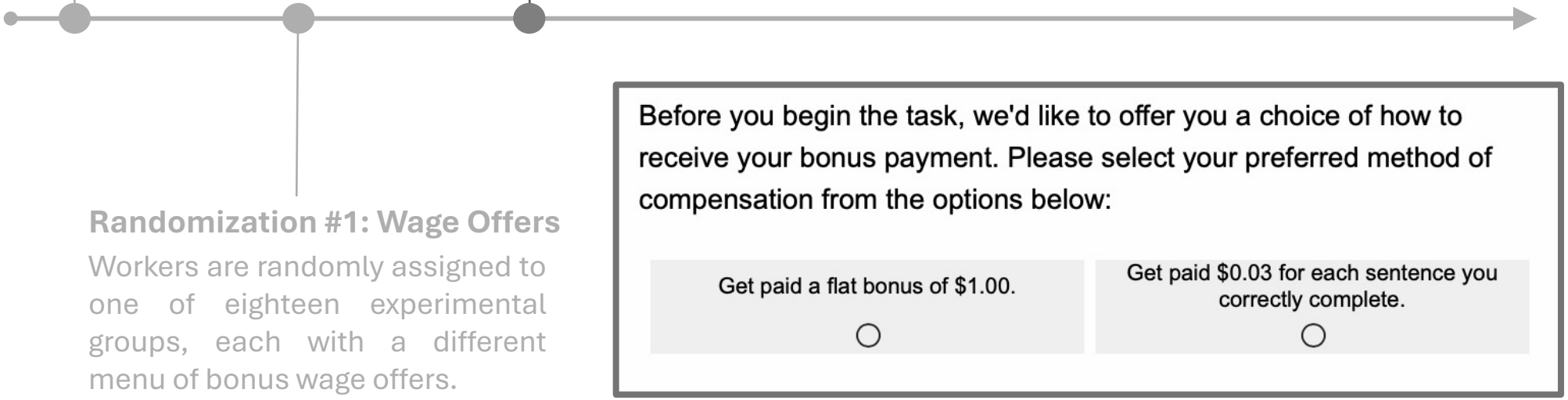

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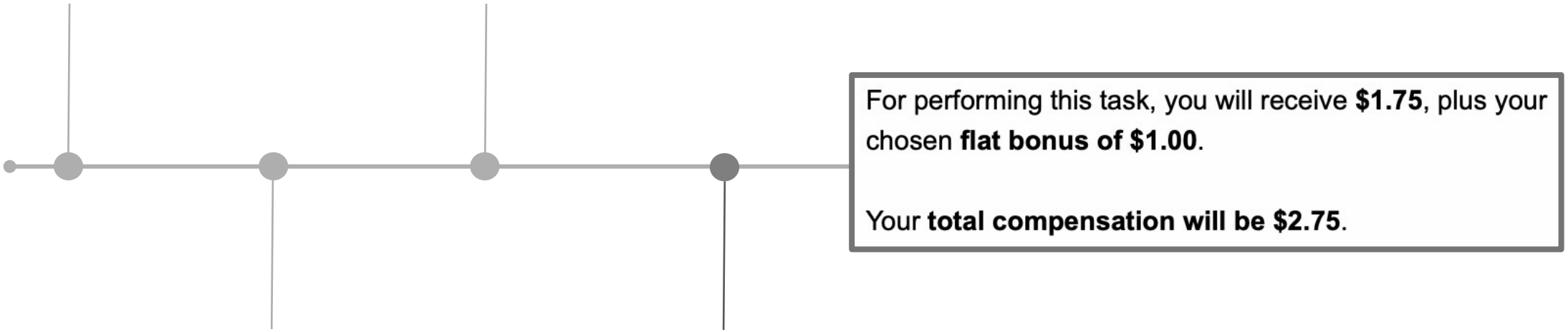


Randomization #1: Wage Offers

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

Workers Recruited

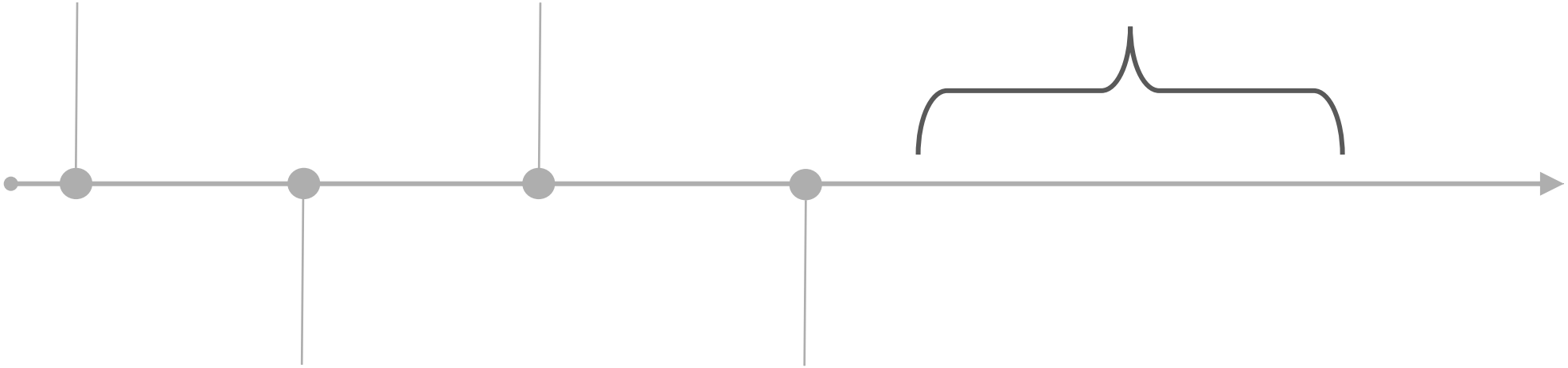
Prolific job posting advertises a $1.00 reward for a five-minute data-entry task, plus $0.03 per correct entry.

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.

Task Performed

Each worker has five minutes to complete as many data entries as possible. Screen displays worker's progress and remaining time.



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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.

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.

→

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

Get paid a $0.03 bonus for each sentence you correctly complete.	Get paid a flat bonus of $1.00.
◉	○

→

Time Remaining: 05:00

For performing this task, you will receive **$1.00**, plus your chosen bonus of **$0.03 per correct sentence**.

Click "Begin Task" to begin your 5-minute typing task.

Once you begin, the timer will start. Do not press the back button or refresh your browser—doing so may invalidate your results!

Begin Task

Score: 0
Earnings: $1.00

Time Remaining: 02:23

The stars twinkled over the silent fore

→

Score: 15
Earnings: $1.45

Time is up.

Thank you for participating!

You completed 31 sentences correctly.

Please click here to receive your $1.93 payment.

Score: 31
Earnings: $1.93

Back

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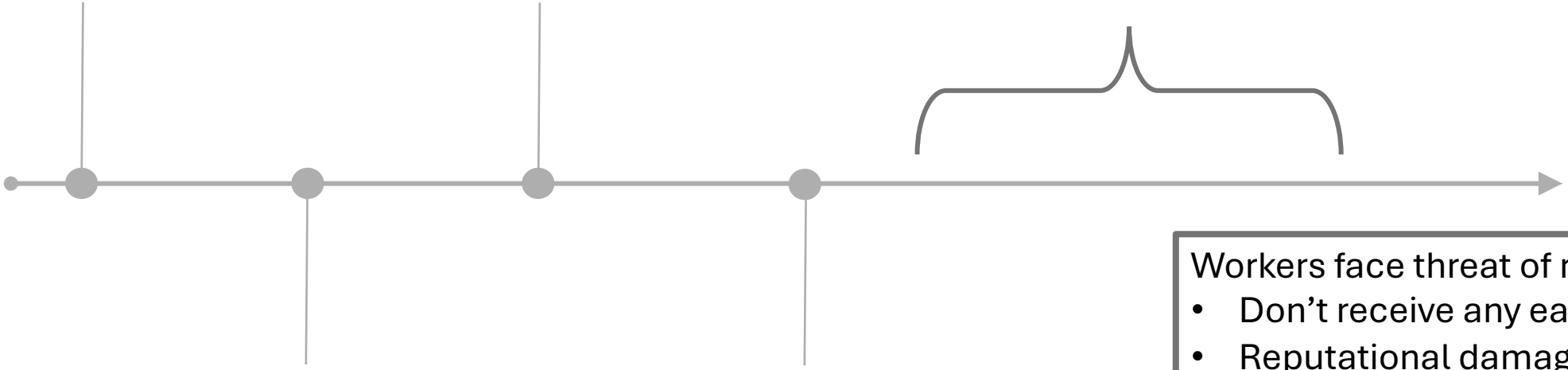

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Workers face threat of rejection ⇒

- Don't receive any earnings
- Reputational damage (approval rate ↓)

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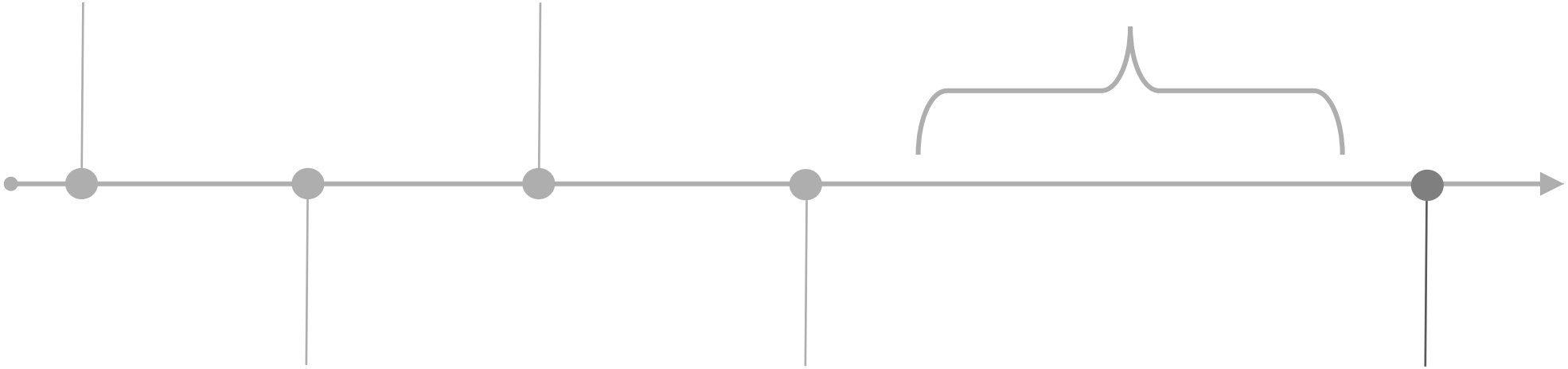

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Wages and Bonuses Paid

Within 24 hours of completing the task, workers are paid the $1.00 base reward plus any bonus earnings.

External Validity

- Results are specific to online workers performing a data-entry task.
- Cannot claim to generalize to the broader labor market
- Do estimates from these settings generalize any better?
  - Rideshare drivers (Angrist et al., 2021; Cook et al., 2021)
  - Agricultural workers (Brune et al., 2022; Bandiera et al., 2010)
  - Cashiers (Mas and Moretti 2009)
  - Windshield repair (Lazear 2000)
  - Call centers (Mas and Pallais 2017; Nagin et al. 2002)
- Division of labor ⇒ applied research on worker incentives usually comes from highly specialized settings
- Even so, I try to make the experimental task as generalizable as possible
  - 66% of US workers type on the job
  - Workers don't know it's an experiment (debriefed afterwards)

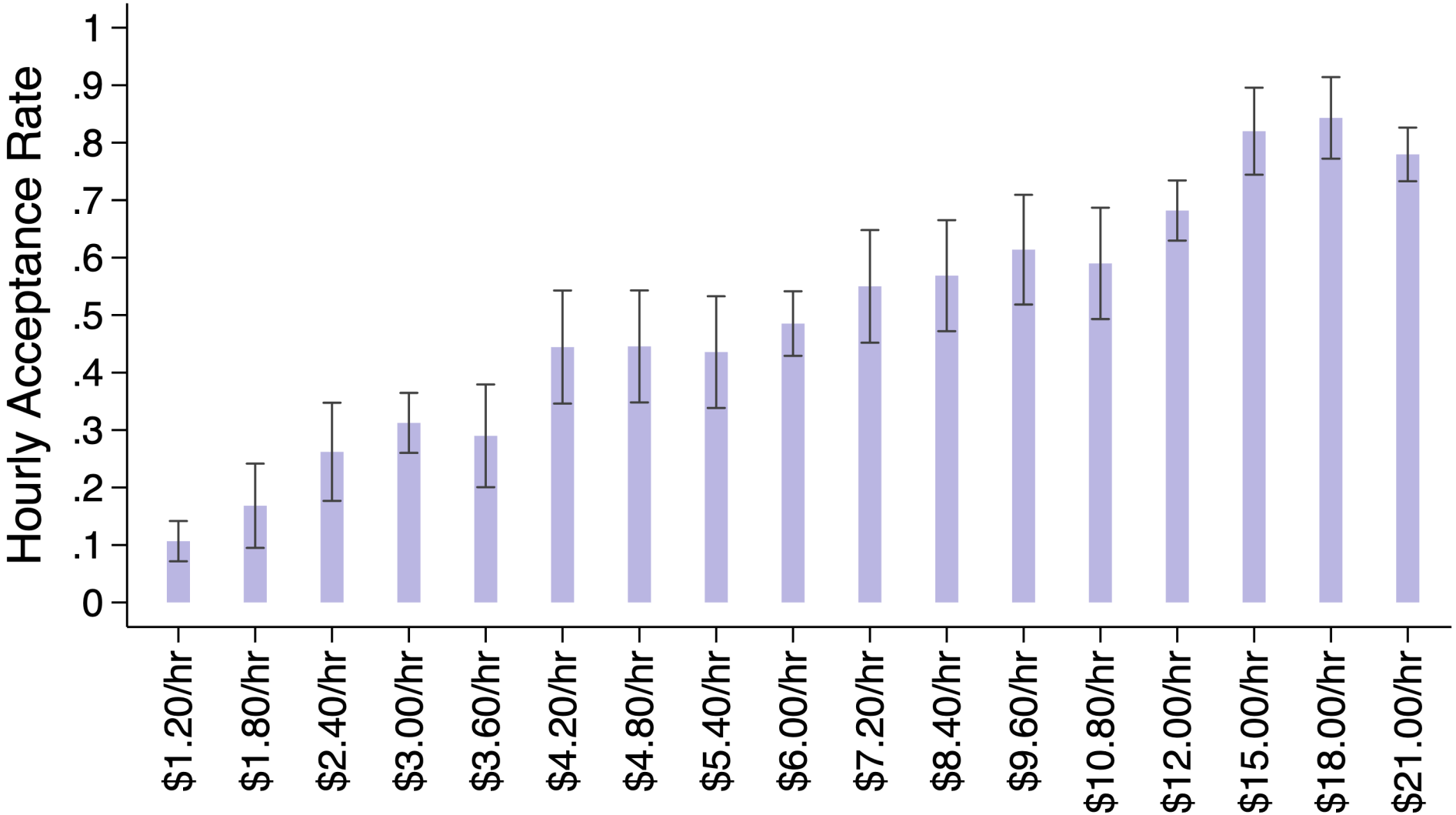
Outline

1. Experimental Design
2. Main Results
3. Model of Asymmetric Information
4. Estimates of Marginal Value and Welfare Loss
5. Optimal Fixed-Wage Subsidy and Piece-Rate Tax

Summary Statistics

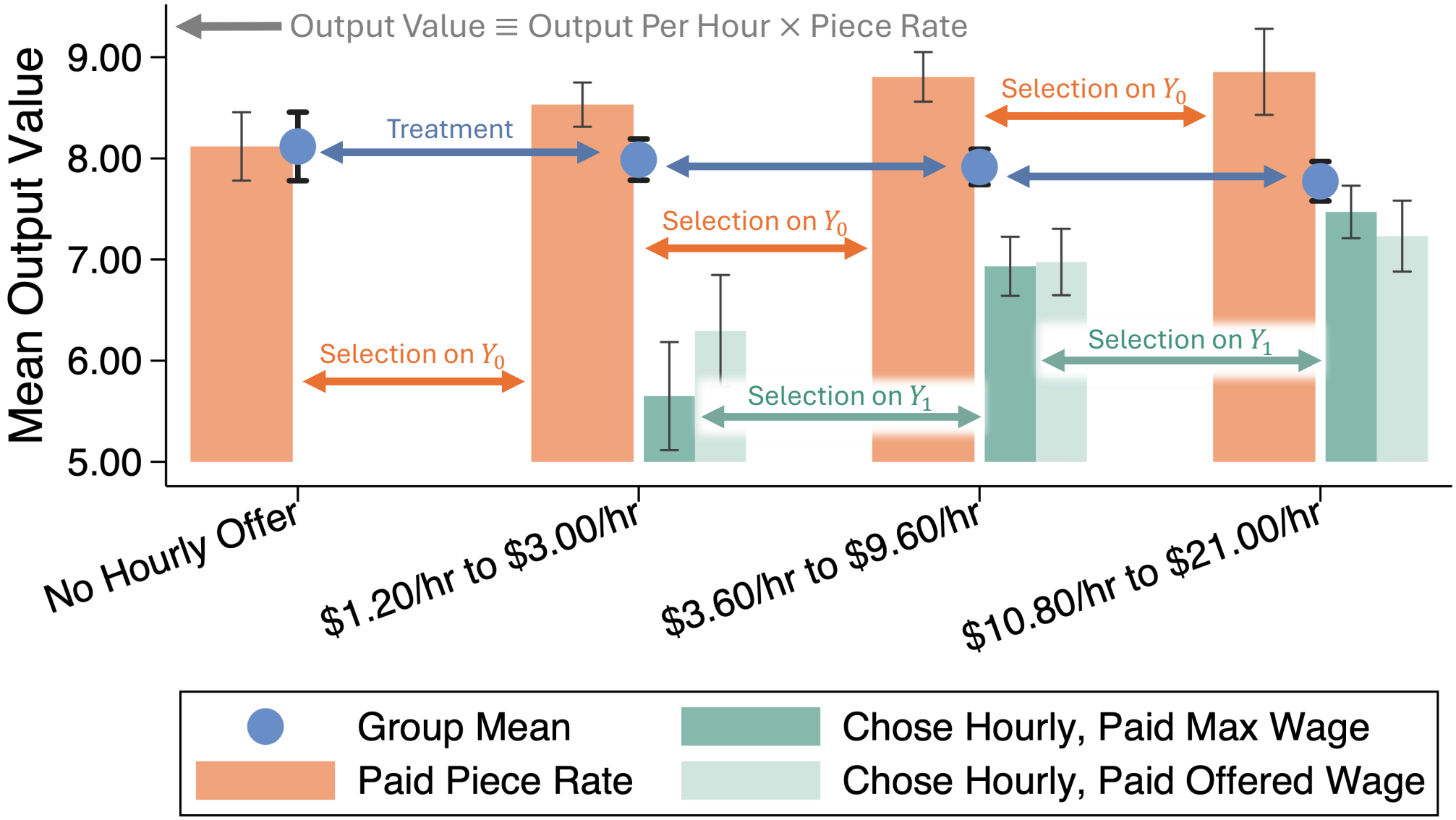
Category	Variable	Mean	SD
Panel A: Task Performance	Accepted Hourly Offer	0.438	0.496
	Completed Sentences	21.98	8.148
	Correct Sentences	17.79	9.360
	Output Value	7.912	2.933
	Finished	0.986	0.118
Panel B: Demographics & Employment	Age	37.23	12.18
	Female	0.643	0.479
	Minority	0.357	0.479
	Employed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

Hourly Wage Take-up



Logit Estimates

Worker Output by Offer & Contract



2SLS Estimates of Treatment Effects

	(1) Output Value	(2) Output Value	(3) Output Value	(4) Output Value
Accepted Hourly Offer	−0.506**	−0.500**	−0.488**	−0.365**
	(0.206)	(0.200)	(0.200)	(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
N	3030	3030	3030	3030

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

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

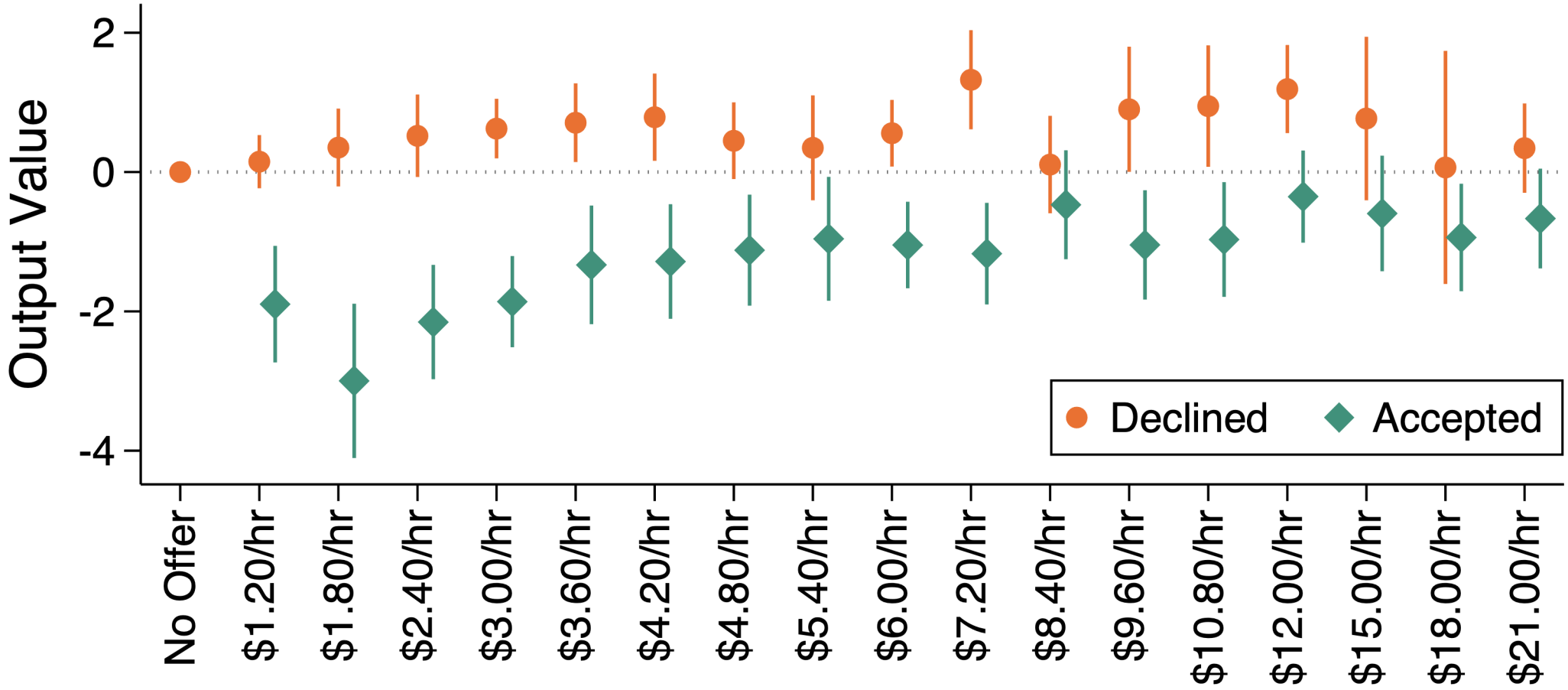
Selection by Log Wage Offer

	(1) Output Value	(2) Output Value	(3) Output Value	(4) Output Value
Accepted Hourly Offer	−2.598***	−2.481***	−2.439***	−2.256***
	(0.329)	(0.319)	(0.320)	(0.300)
Declined × Log Hourly Wage Offer	0.167*	0.193**	0.210**	0.230***
	(0.0960)	(0.0932)	(0.0925)	(0.0855)
Accepted × Log Hourly Wage Offer	0.621***	0.570***	0.568***	0.501***
	(0.116)	(0.112)	(0.113)	(0.104)
Accepted × Log Effective Hourly Wage	−0.0608	−0.0443	−0.0444	−0.0000829
	(0.122)	(0.118)	(0.118)	(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
N	3030	3030	3030	3030

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

Marginal Selection

Selection by Log Wage Offer



$$Y_i = \sum_{w \in \mathbb{W}} [(\beta_0^w (1 - H_i) + \beta_1^w H_i) \times \mathbf{1}\{W_i = w\}] + \gamma H_i \times W_i^P + \boldsymbol{\xi} \boldsymbol{X_i} + \epsilon_i$$

Summary

What have I shown so far?

Evidence of Moral Hazard

Hourly wages reduce average output among workers who accept.

$$\underbrace{E[Y_{1i} - Y_{0i} | H_i = 1, W_i = w] < 0}_{\text{Local Average Treatment Effect}}$$

Evidence of Adverse Selection

Low-productivity workers are more likely to accept low hourly wage offers.

$$\underbrace{\frac{\partial}{\partial w} E[Y_{0i} | H_i = 0, W_i = w] > 0}_{\text{Local Average Selection on } Y_0}$$

$$\underbrace{\frac{\partial}{\partial w} E[Y_{1i} | H_i = 1, W_i = w] > 0}_{\text{Local Average Selection on } Y_1}$$

What are the implications for…

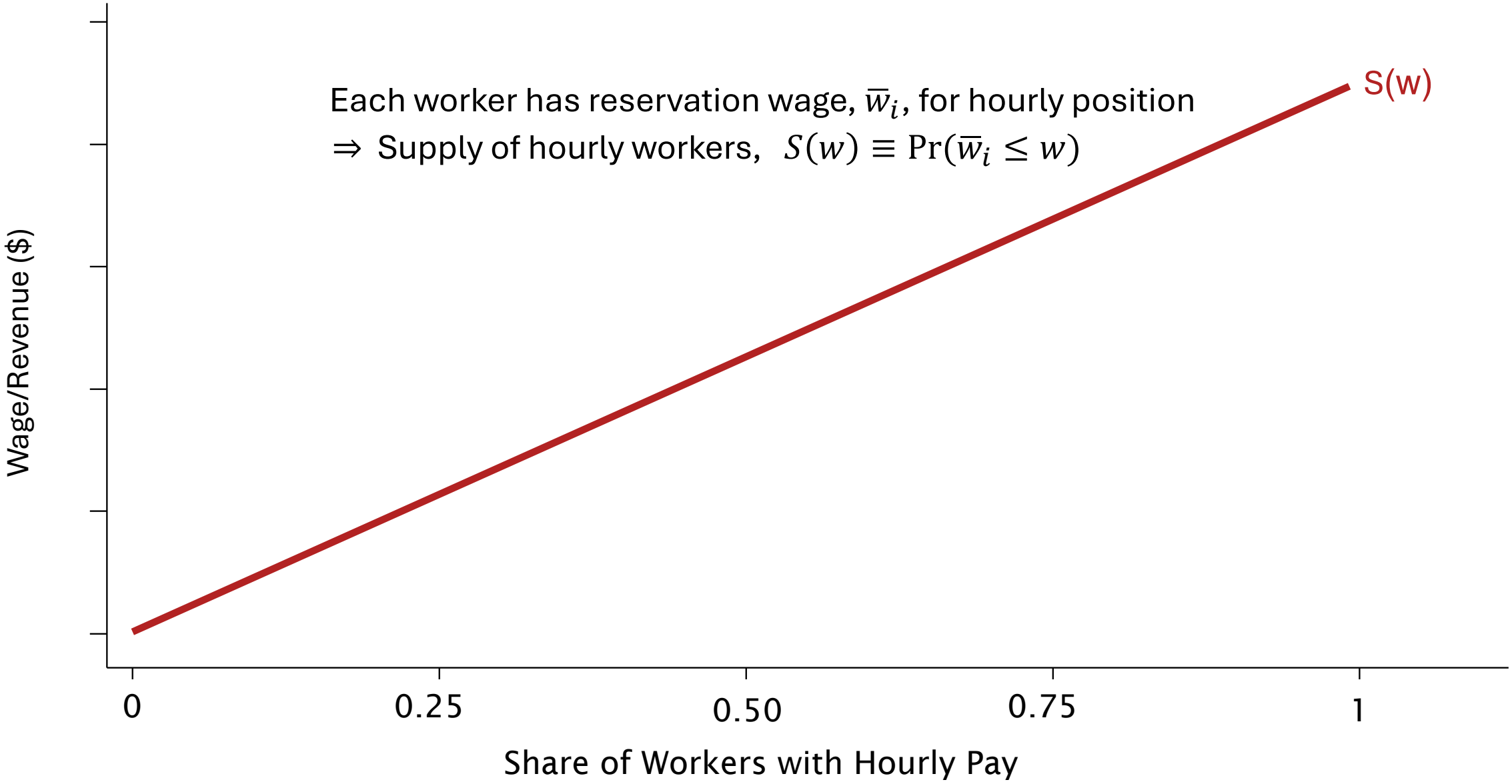
- Market equilibrium?
- Social welfare?
- Policy?

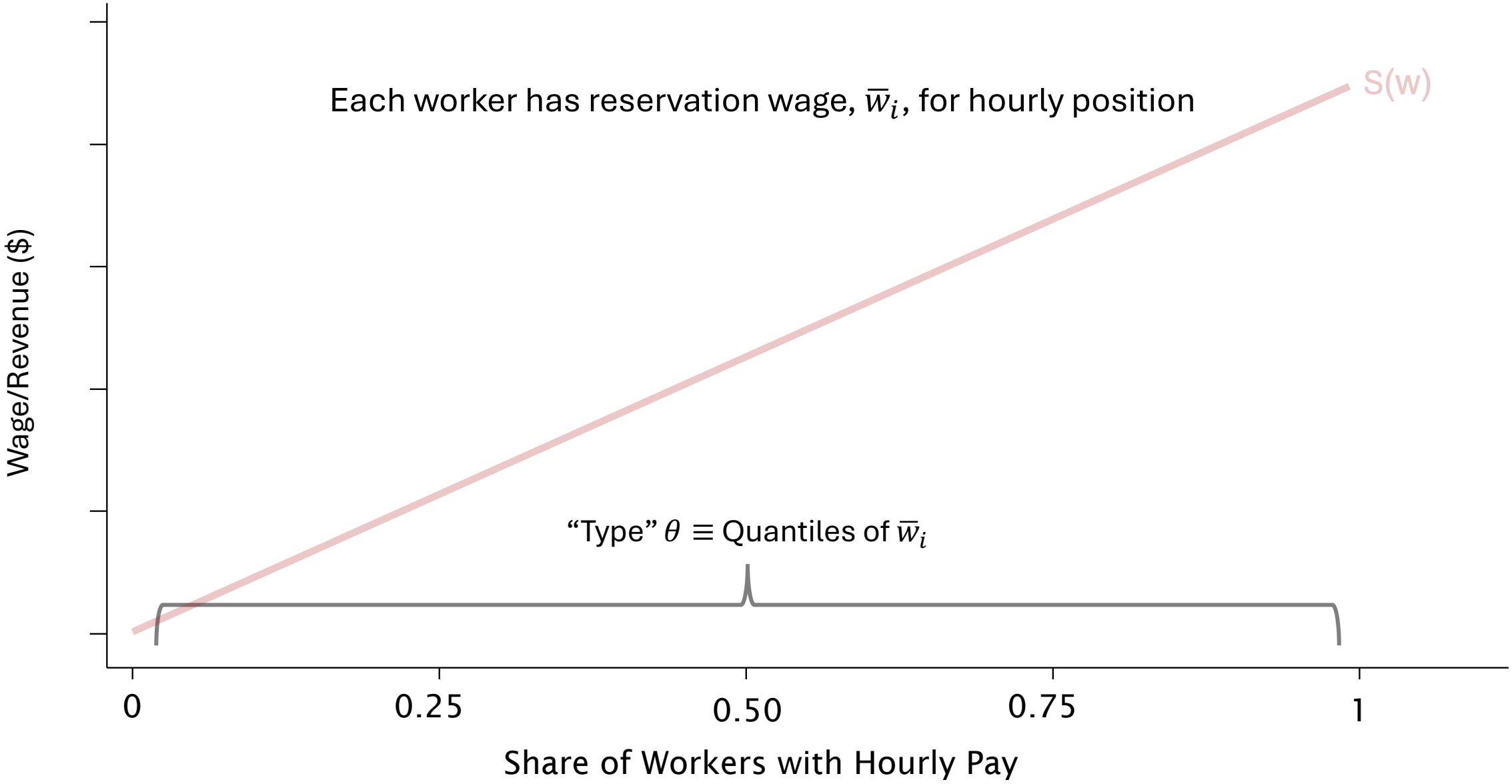
Outline

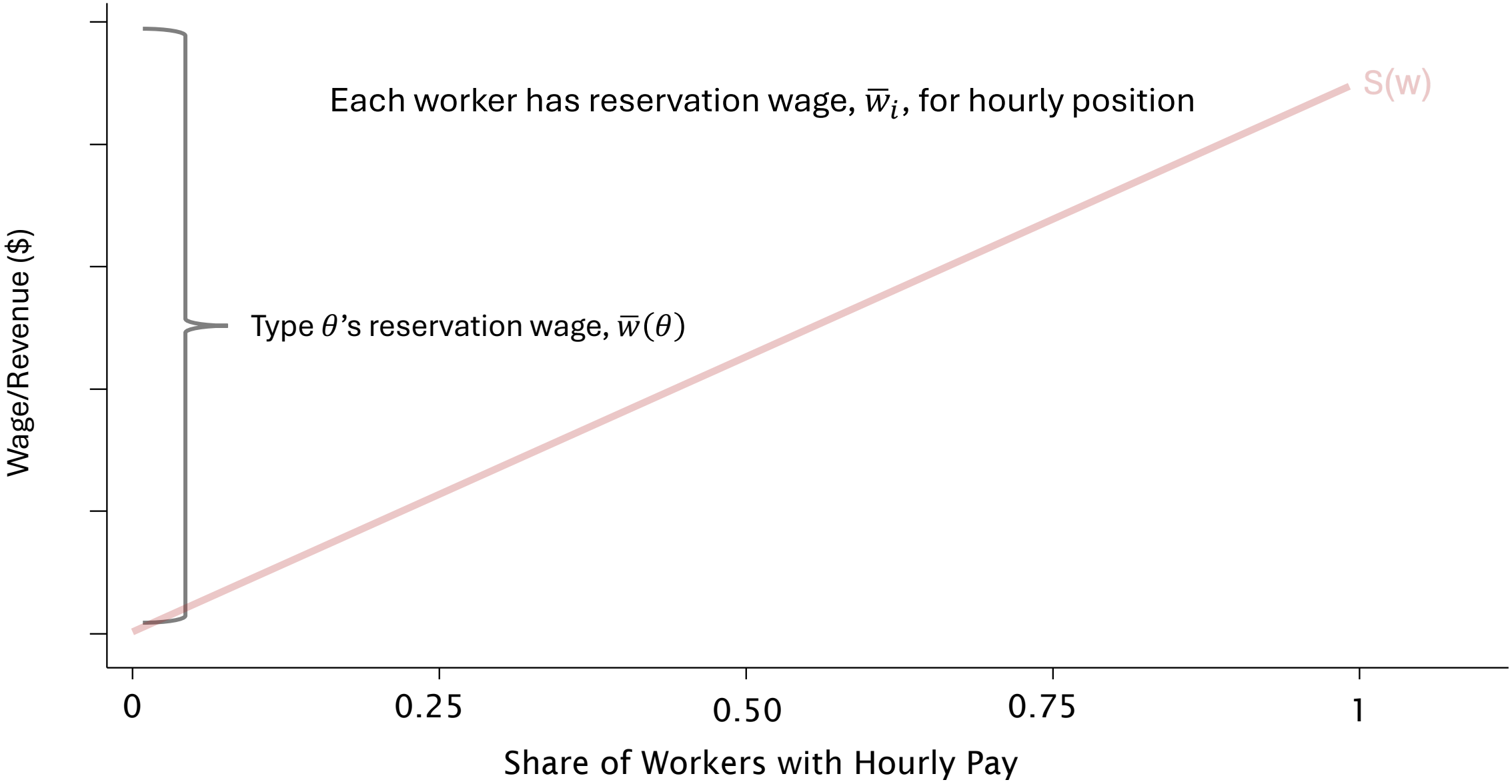
1. Experimental Design
2. Main Results
3. **Model of Asymmetric Information**
4. Estimates of Marginal Value and Welfare Loss
5. Optimal Fixed-Wage Subsidy and Piece-Rate Tax

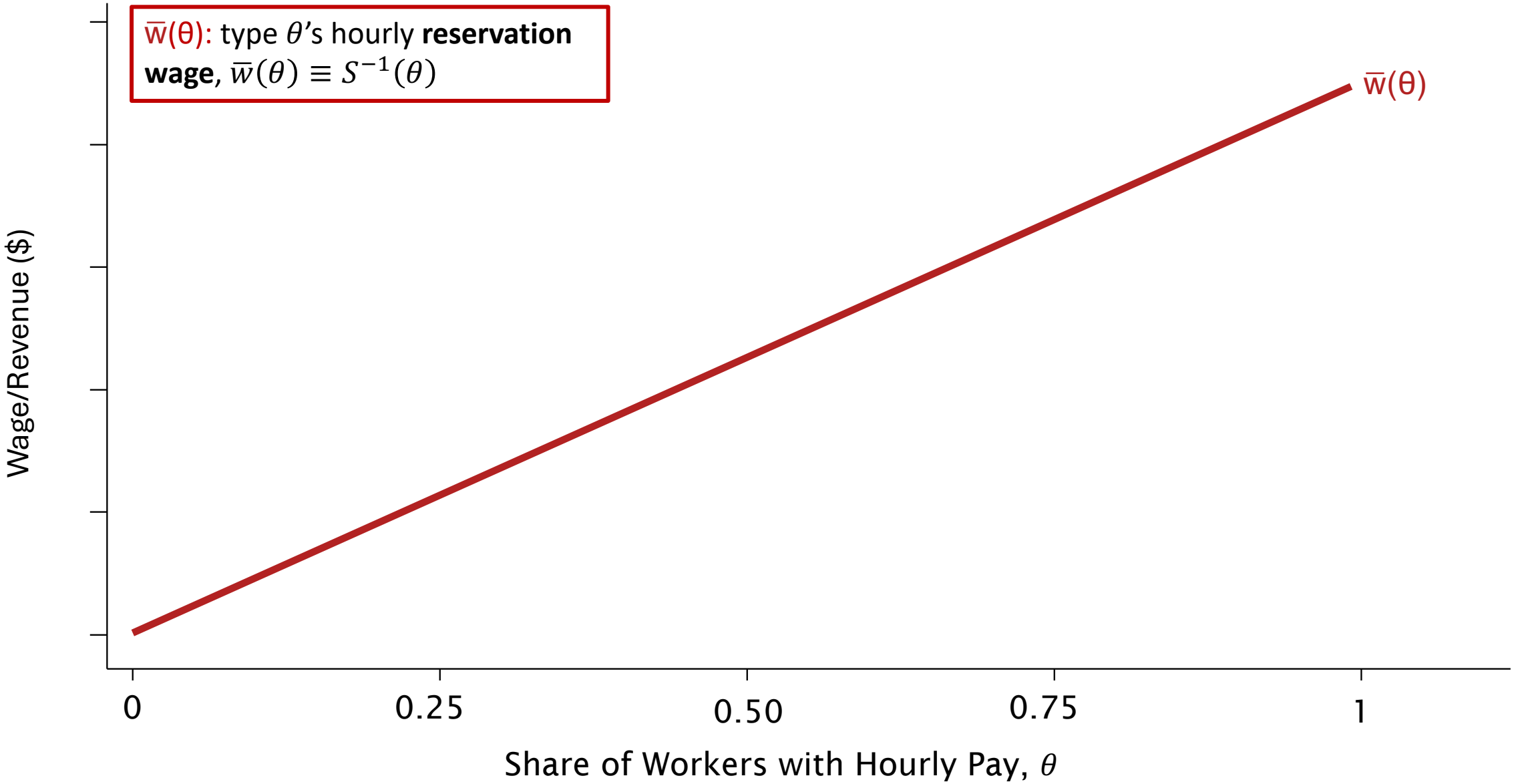
Model

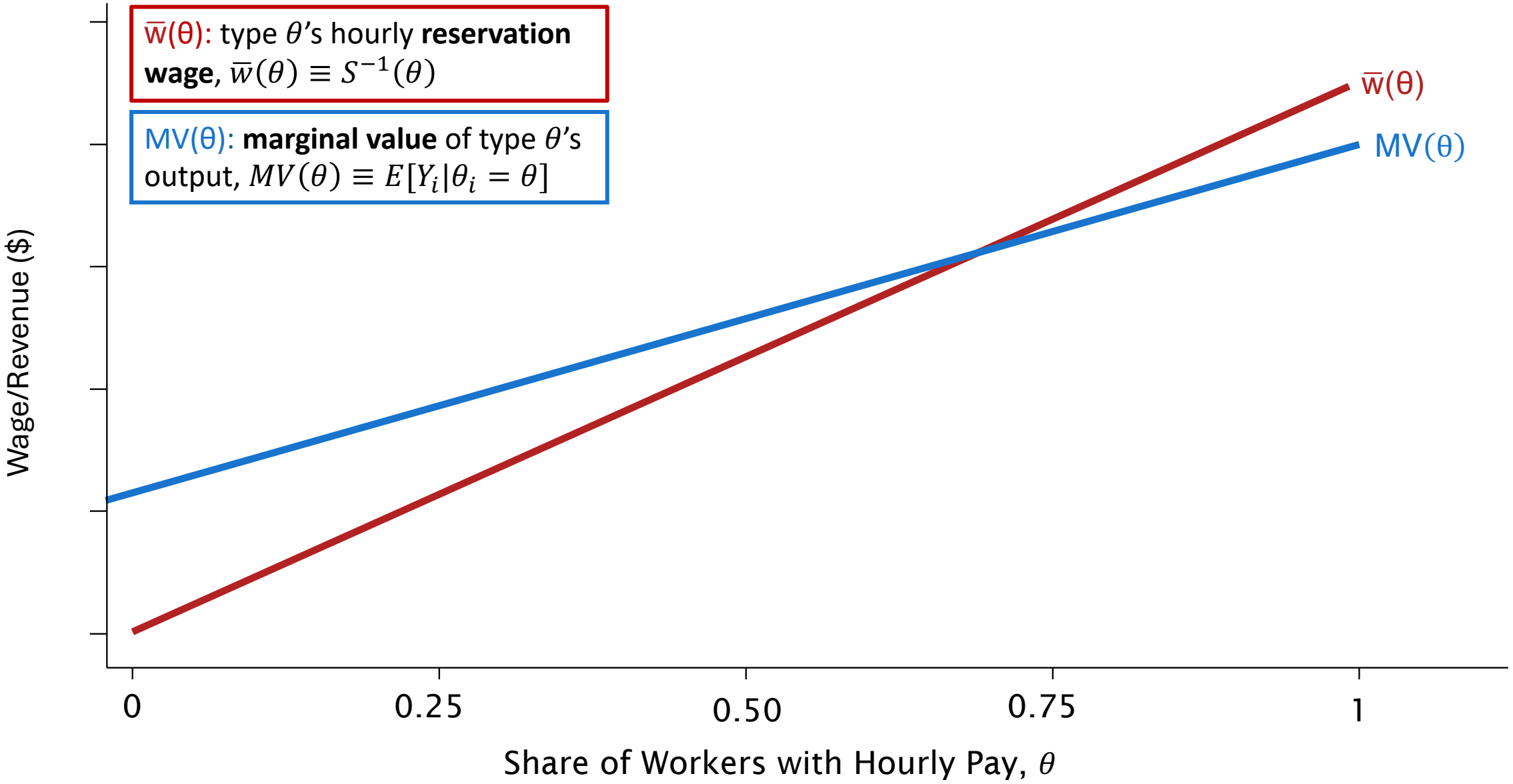
- Population of observationally equivalent (pre-screened) workers
- Each worker produces hourly output $q_i = f(\zeta_i, e_i, \nu_i)$
  - ζ_i: (unobserved) worker characteristics
  - e_i: individual effort, potentially influenced by the contract (moral hazard)
  - ν_i: random noise
- Value of worker 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 *ex-ante* hourly wage, w, in exchange for claim on realized q_i

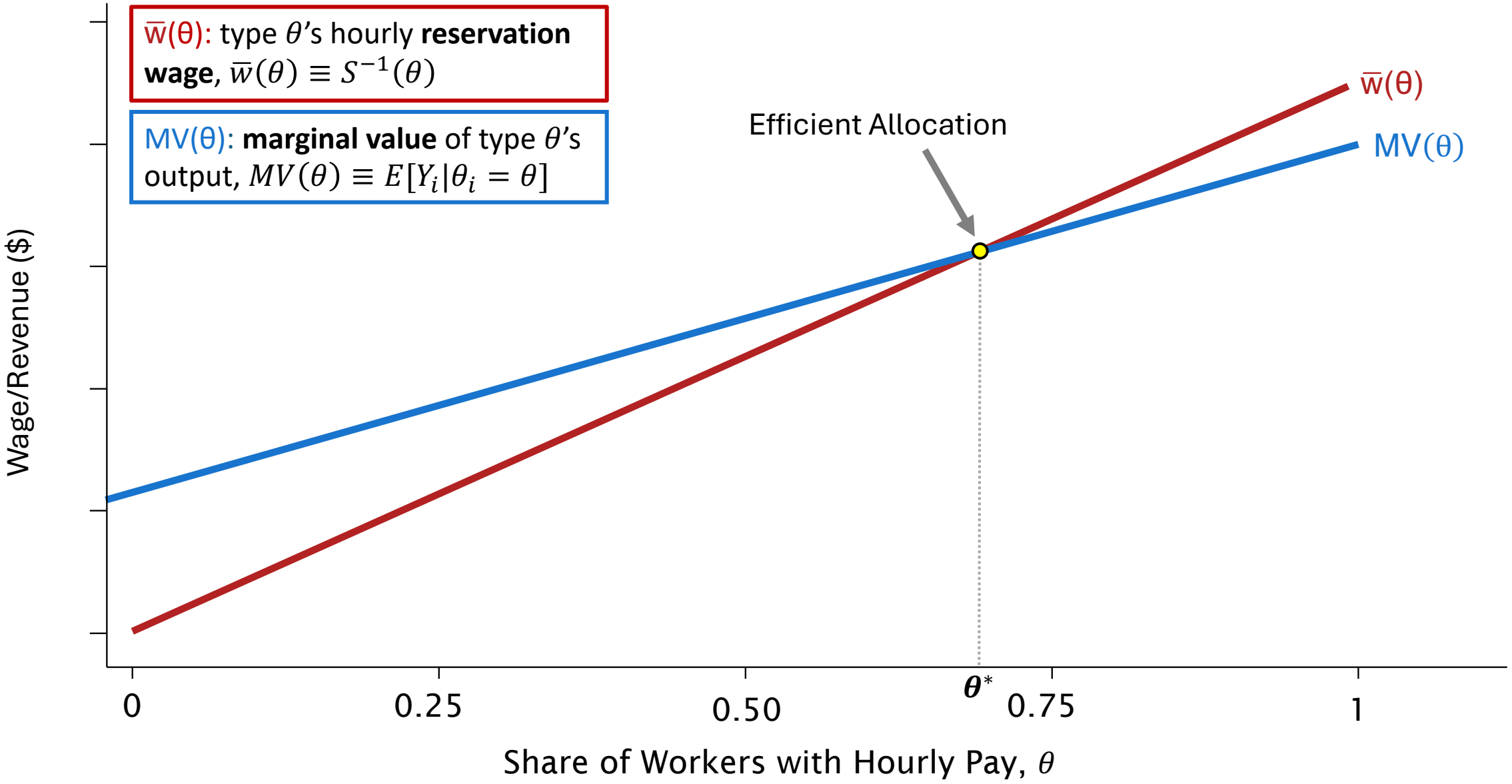

Each worker has reservation wage, $\overline{w}_i$, for hourly position
⇒ Supply of hourly workers, $S(w) \equiv \Pr(\overline{w}_i \leq w)$
S(w)
Wage/Revenue ($)
0
0.25
0.50
0.75
1
Share of Workers with Hourly Pay

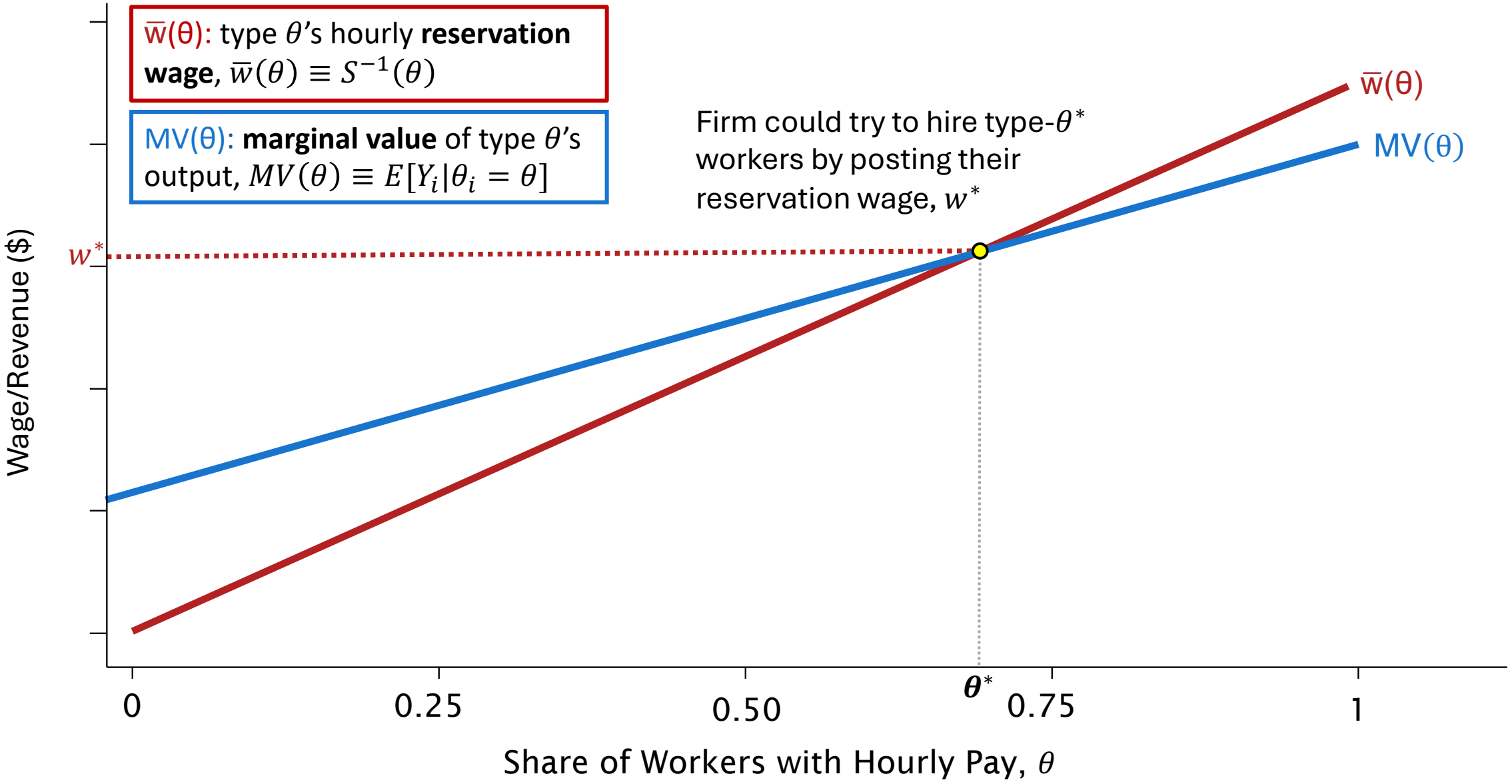

Each worker has reservation wage, $\overline{w}_i$, for hourly position
S(w)
"Type" $\theta \equiv$ Quantiles of $\overline{w}_i$
Wage/Revenue ($)
0
0.25
0.50
0.75
1
Share of Workers with Hourly Pay

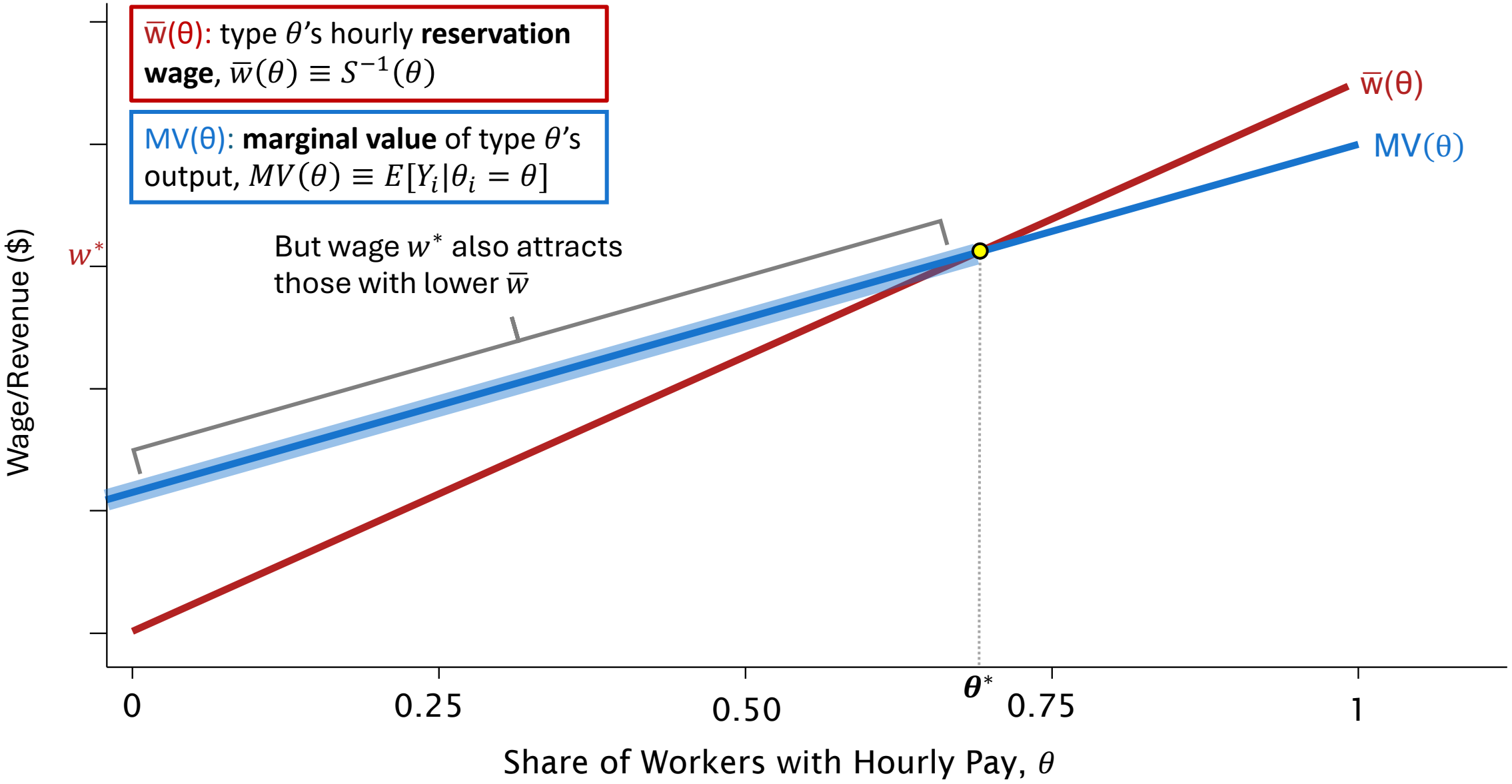

Each worker has reservation wage, $\overline{w}_i$, for hourly position
S(w)
Type θ's reservation wage, $\overline{w}(\theta)$
Wage/Revenue ($)
0
0.25
0.50
0.75
1
Share of Workers with Hourly Pay

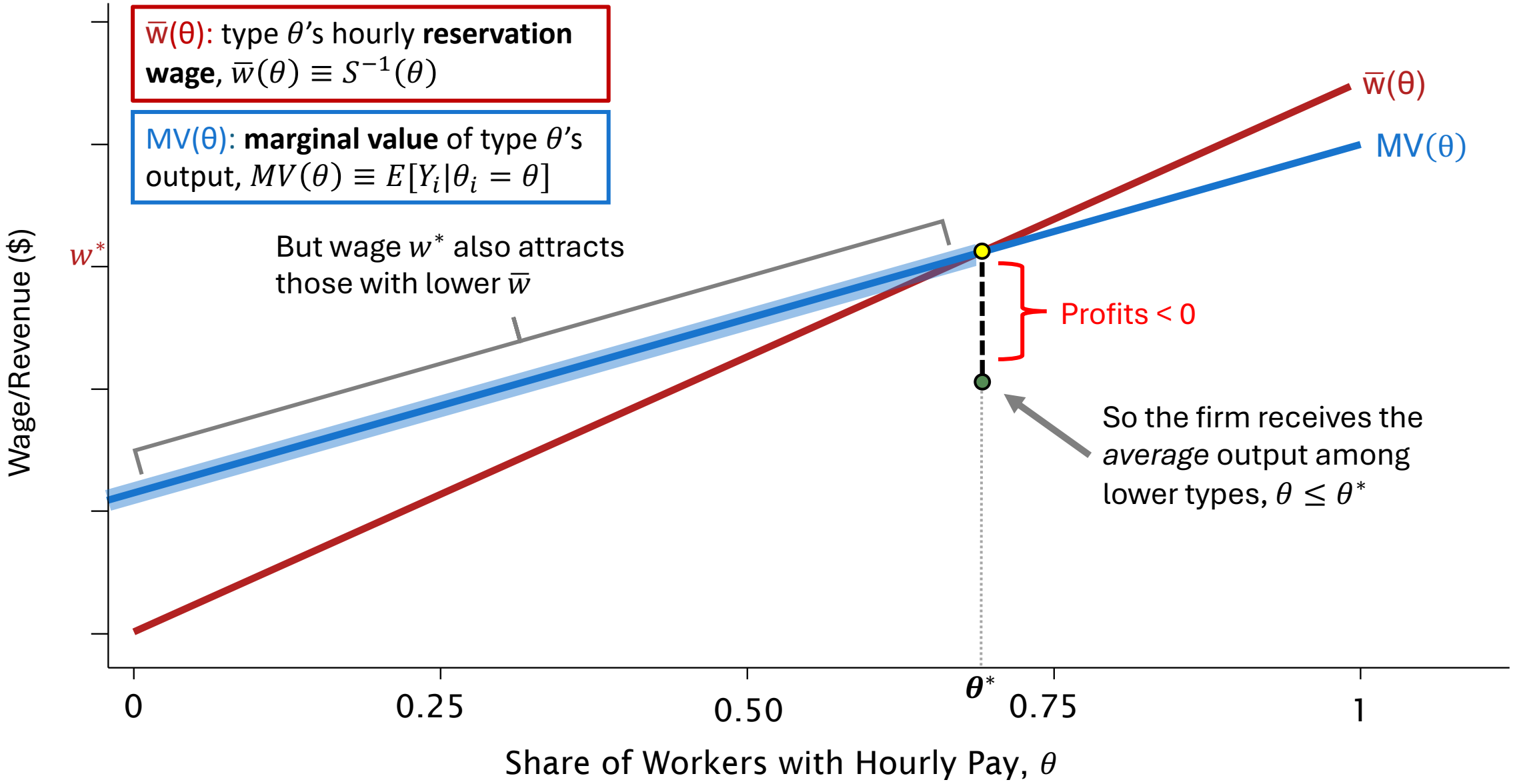

w̄(θ): type θ's hourly **reservation wage**, $\bar{w}(\theta) \equiv S^{-1}(\theta)$
w̄(θ)
Wage/Revenue ($)
0
0.25
0.50
0.75
1
Share of Workers with Hourly Pay, θ

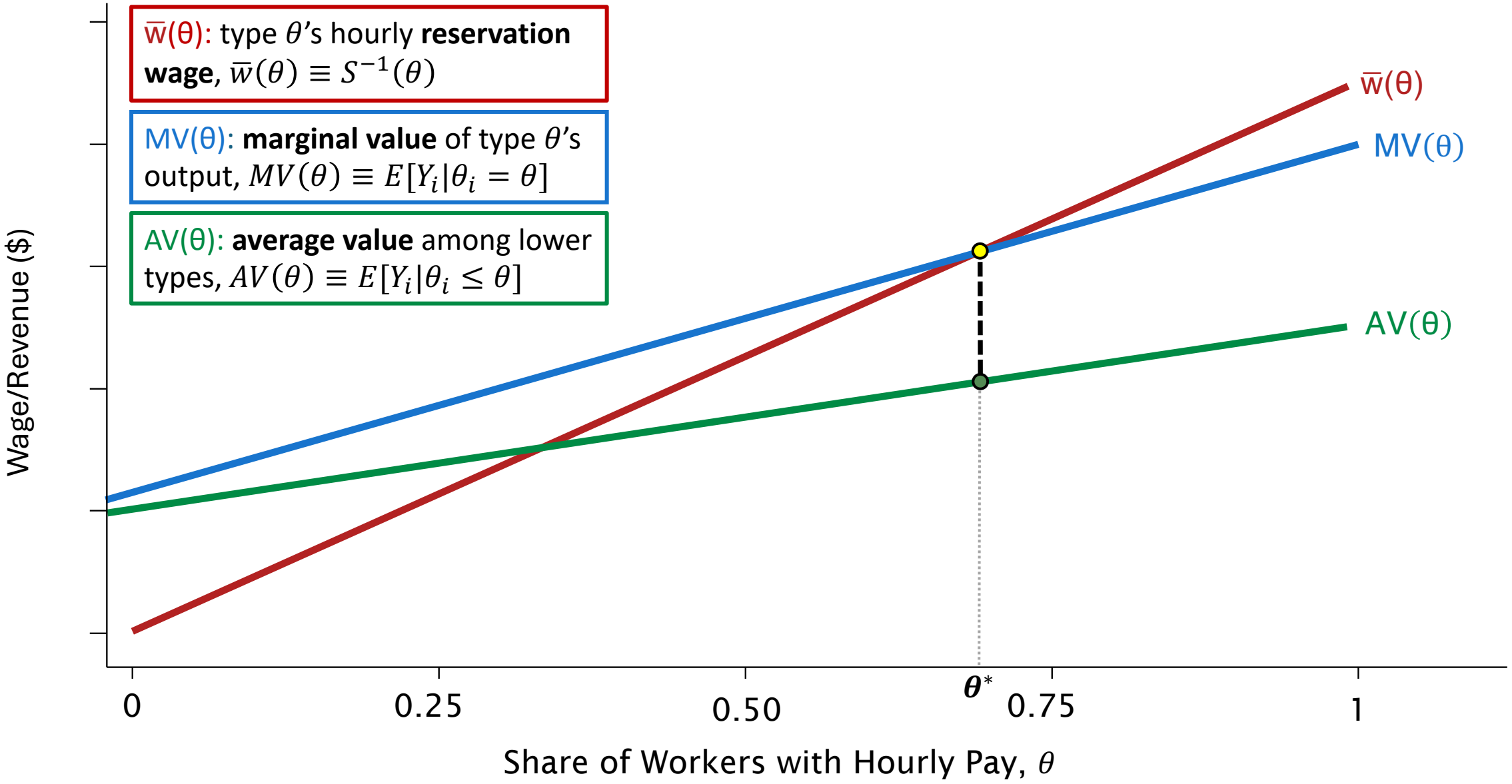

w̄(θ): type θ's hourly **reservation wage**, $\bar{w}(\theta) \equiv S^{-1}(\theta)$
MV(θ): **marginal value** of type θ's output, $MV(\theta) \equiv E[Y_i|\theta_i = \theta]$
w̄(θ)
MV(θ)
Wage/Revenue ($)
0
0.25
0.50
0.75
1
Share of Workers with Hourly Pay, θ

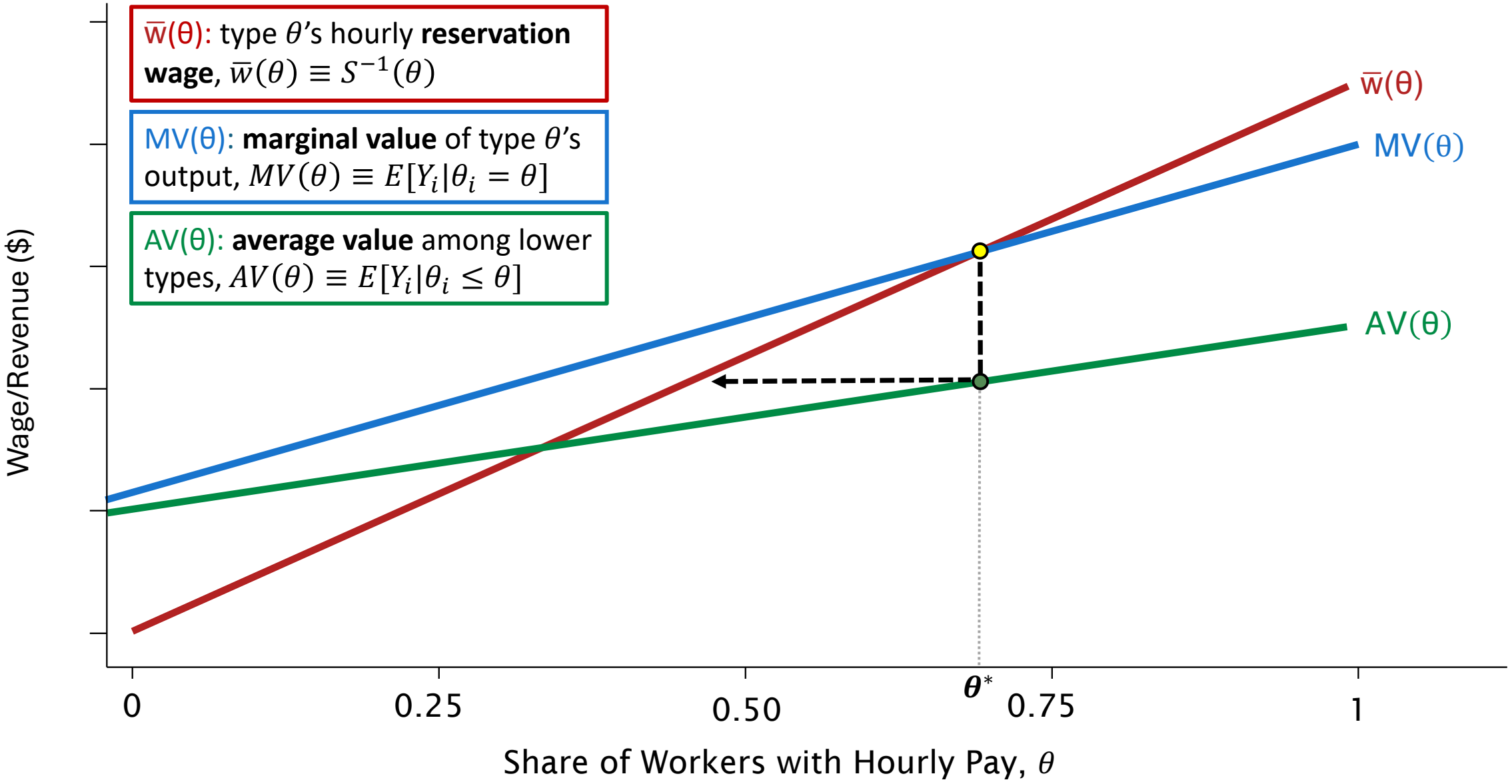

w̄(θ): type θ's hourly **reservation wage**, $\bar{w}(\theta) \equiv S^{-1}(\theta)$
MV(θ): **marginal value** of type θ's output, $MV(\theta) \equiv E[Y_i|\theta_i = \theta]$
w̄(θ)
MV(θ)
Efficient Allocation
Wage/Revenue ($)
0
0.25
0.50
θ^*
0.75
1
Share of Workers with Hourly Pay, θ


w̄(θ): type θ's hourly **reservation wage**, $\bar{w}(\theta) \equiv S^{-1}(\theta)$
MV(θ): **marginal value** of type θ's output, $MV(\theta) \equiv E[Y_i|\theta_i = \theta]$
Firm could try to hire type-θ^* workers by posting their reservation wage, w^*
w̄(θ)
MV(θ)
w^*
Wage/Revenue ($)
0
0.25
0.50
θ^*
0.75
1
Share of Workers with Hourly Pay, θ


w̄(θ): type θ's hourly **reservation wage**, $\bar{w}(\theta) \equiv S^{-1}(\theta)$
MV(θ): **marginal value** of type θ's output, $MV(\theta) \equiv E[Y_i|\theta_i = \theta]$
But wage w^* also attracts those with lower $\bar{w}$
w̄(θ)
MV(θ)
w^*
Wage/Revenue ($)
0
0.25
0.50
θ^*
0.75
1
Share of Workers with Hourly Pay, θ


w̄(θ): type θ's hourly **reservation wage**, $\bar{w}(\theta) \equiv S^{-1}(\theta)$
MV(θ): **marginal value** of type θ's output, $MV(\theta) \equiv E[Y_i|\theta_i = \theta]$
w̄(θ)
MV(θ)
w^*
But wage w^* also attracts those with lower $\bar{w}$
Profits < 0
So the firm receives the *average* output among lower types, $\theta \leq \theta^*$
Wage/Revenue ($)
0
0.25
0.50
θ^*
0.75
1
Share of Workers with Hourly Pay, θ


w̄(θ): type θ's hourly **reservation wage**, $\bar{w}(\theta) \equiv S^{-1}(\theta)$
MV(θ): **marginal value** of type θ's output, $MV(\theta) \equiv E[Y_i|\theta_i = \theta]$
AV(θ): **average value** among lower types, $AV(\theta) \equiv E[Y_i|\theta_i \leq \theta]$
w̄(θ)
MV(θ)
AV(θ)
Wage/Revenue ($)
0
0.25
0.50
θ^*
0.75
1
Share of Workers with Hourly Pay, θ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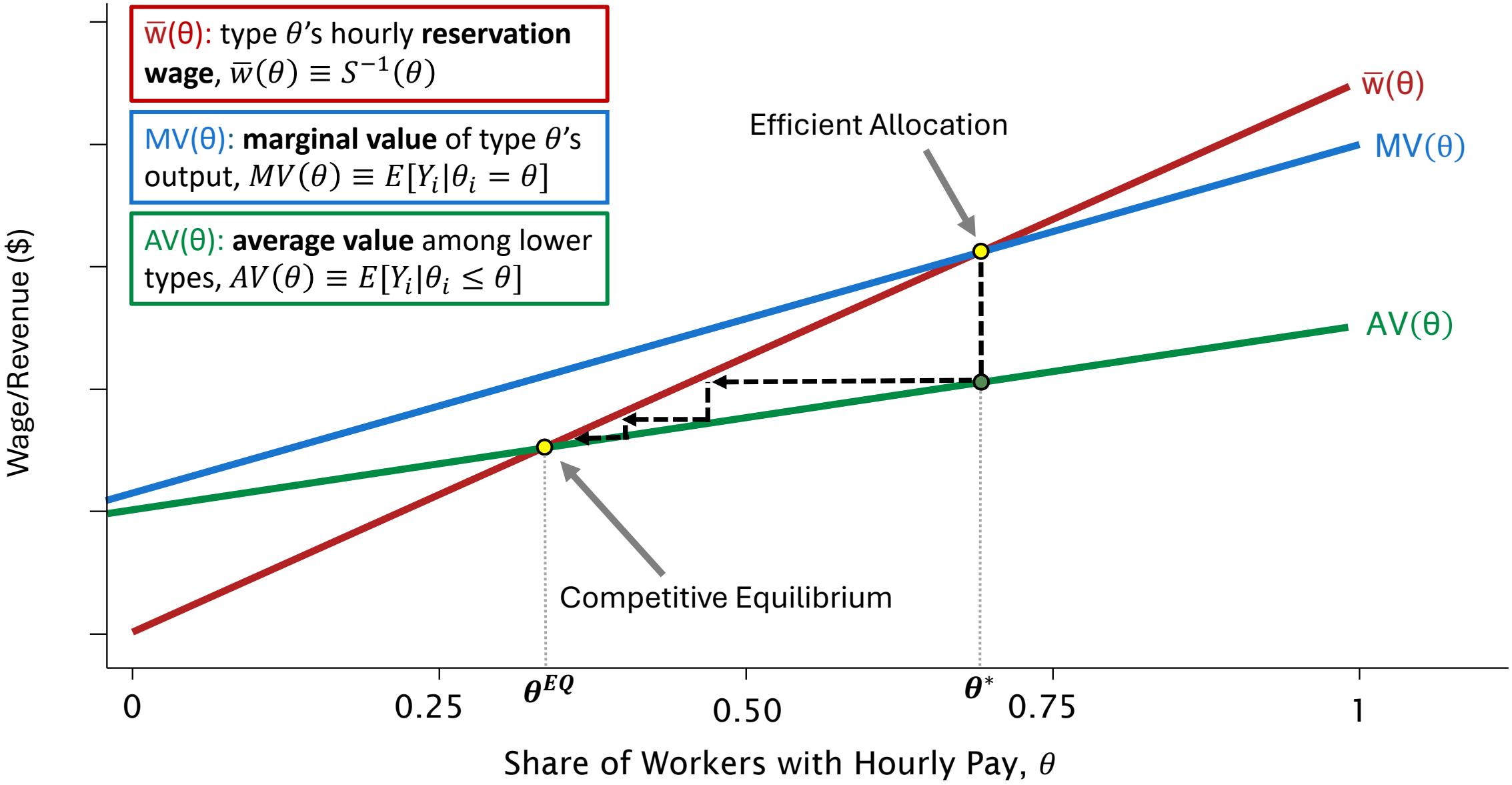
AV(θ): **average value** among lower types, $AV(\theta) \equiv E[Y_i|\theta_i \leq \theta]$
w̄(θ)
MV(θ)
AV(θ)
Wage/Revenue ($)
0
0.25
0.50
θ^*
0.75
1
Share of Workers with Hourly Pay, θ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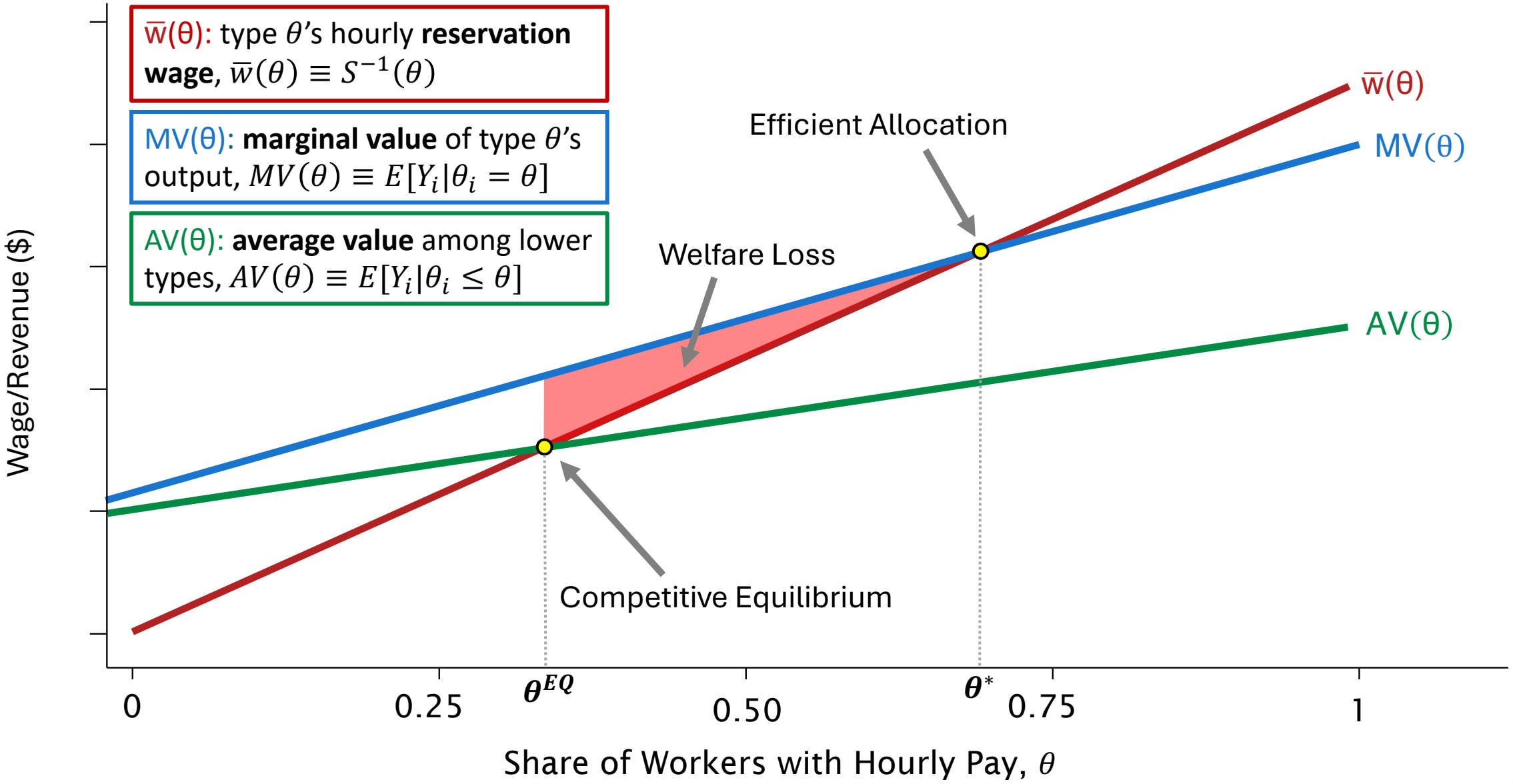
AV(θ): **average value** among lower types, $AV(\theta) \equiv E[Y_i|\theta_i \leq \theta]$
w̄(θ)
MV(θ)
AV(θ)
Efficient Allocation
Competitive Equilibrium
Wage/Revenue ($)
0
0.25
θ^{EQ}
0.50
θ^*
0.75
1
Share of Workers with Hourly Pay, θ



Monitoring Costs

Incorporating Moral Hazard

- Where does moral hazard fit in? Consider potential outputs

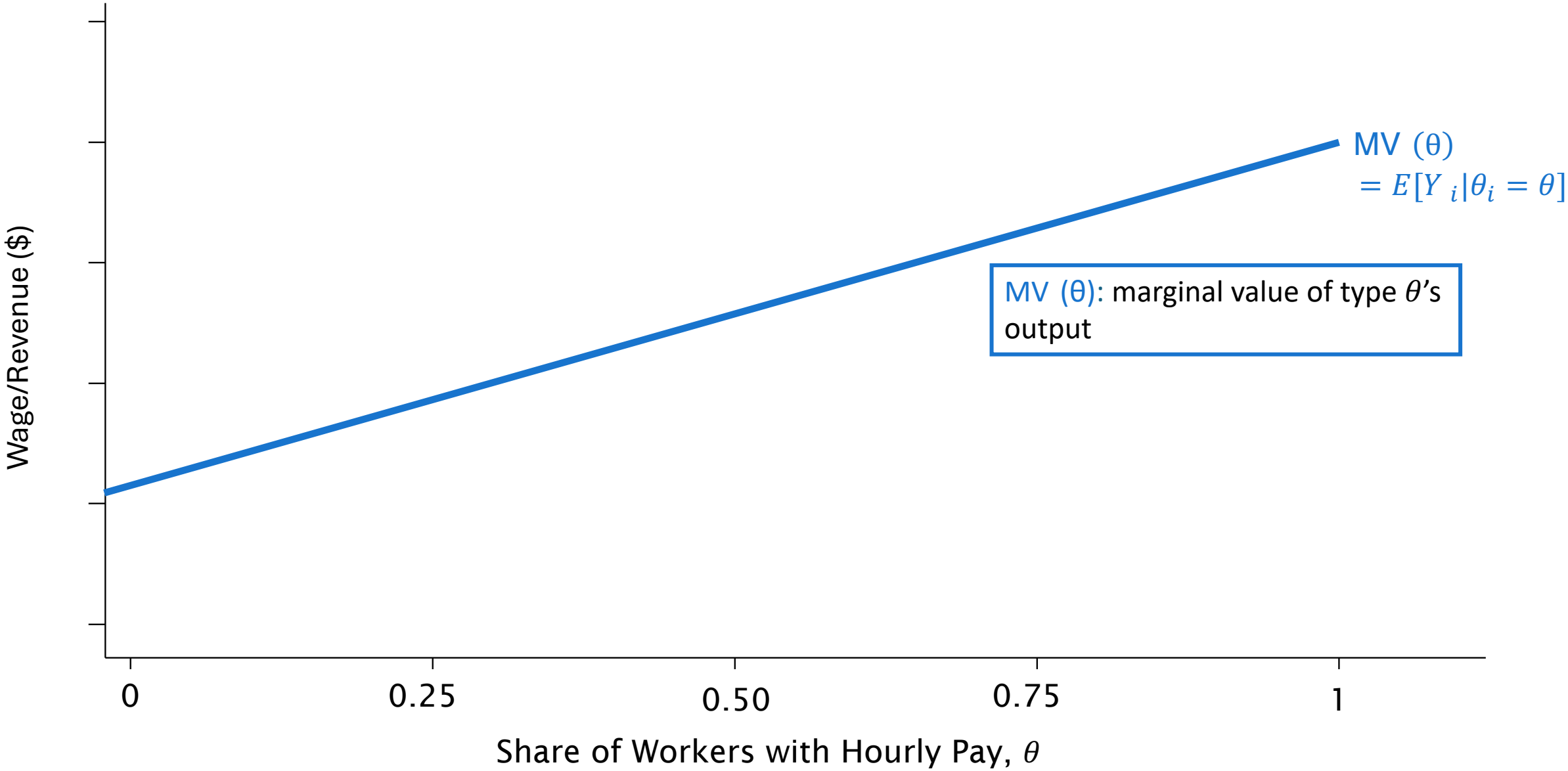
  Y_{1i}: Potential output value under hourly wage
  Y_{0i}: Potential output value under piece rate
  $\Big\}\ Y_{1i} = Y_{0i} + MH_i$

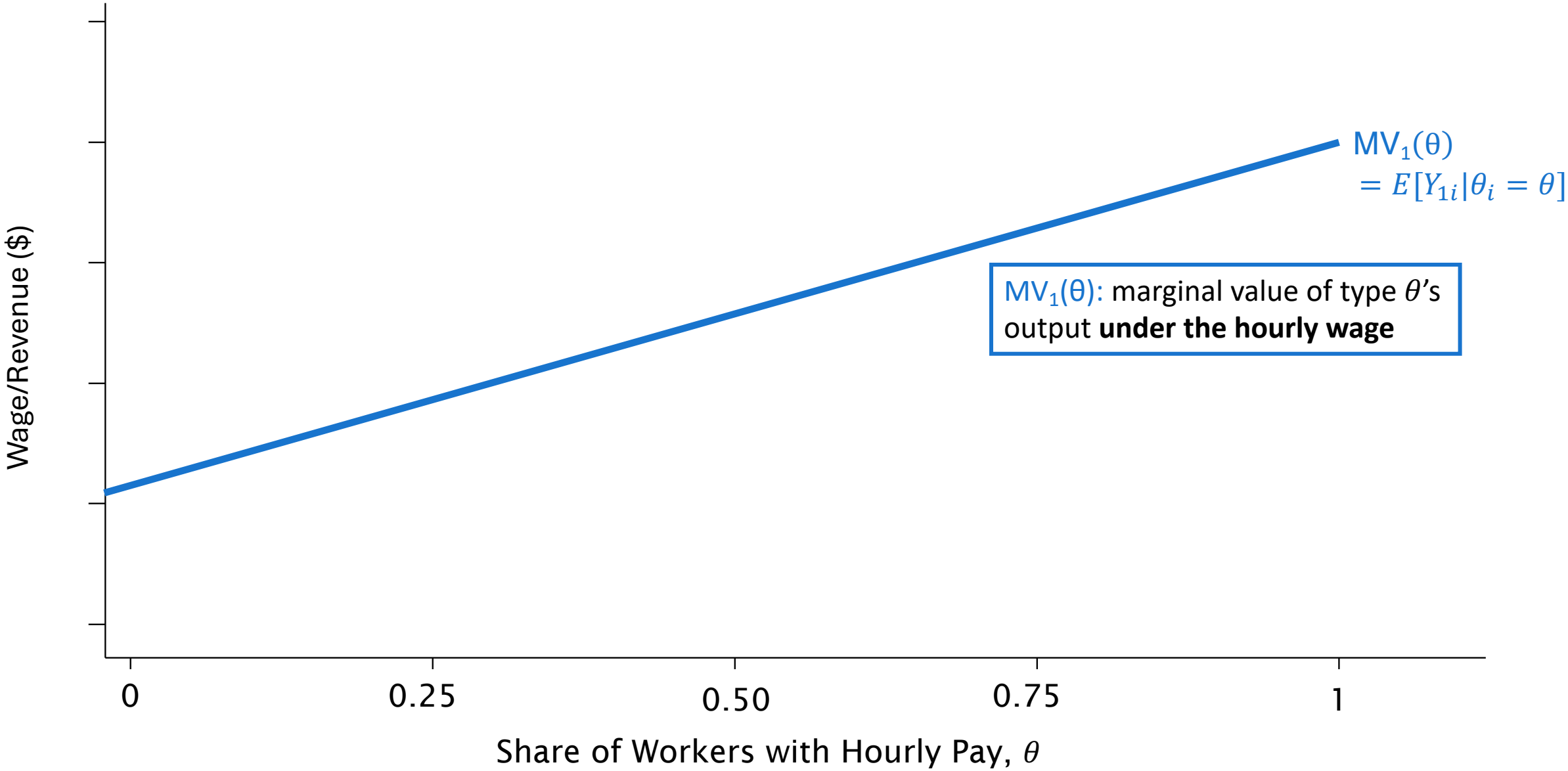
- Firms care about Y_{1i}, but they don't care about Y_{0i}
  - Piece-rate workers sell their output at a constant price per unit, so their productivity has no effect on firm profits
- $MV(\theta)$ & $AV(\theta)$ are defined *conditional* on accepting the hourly wage

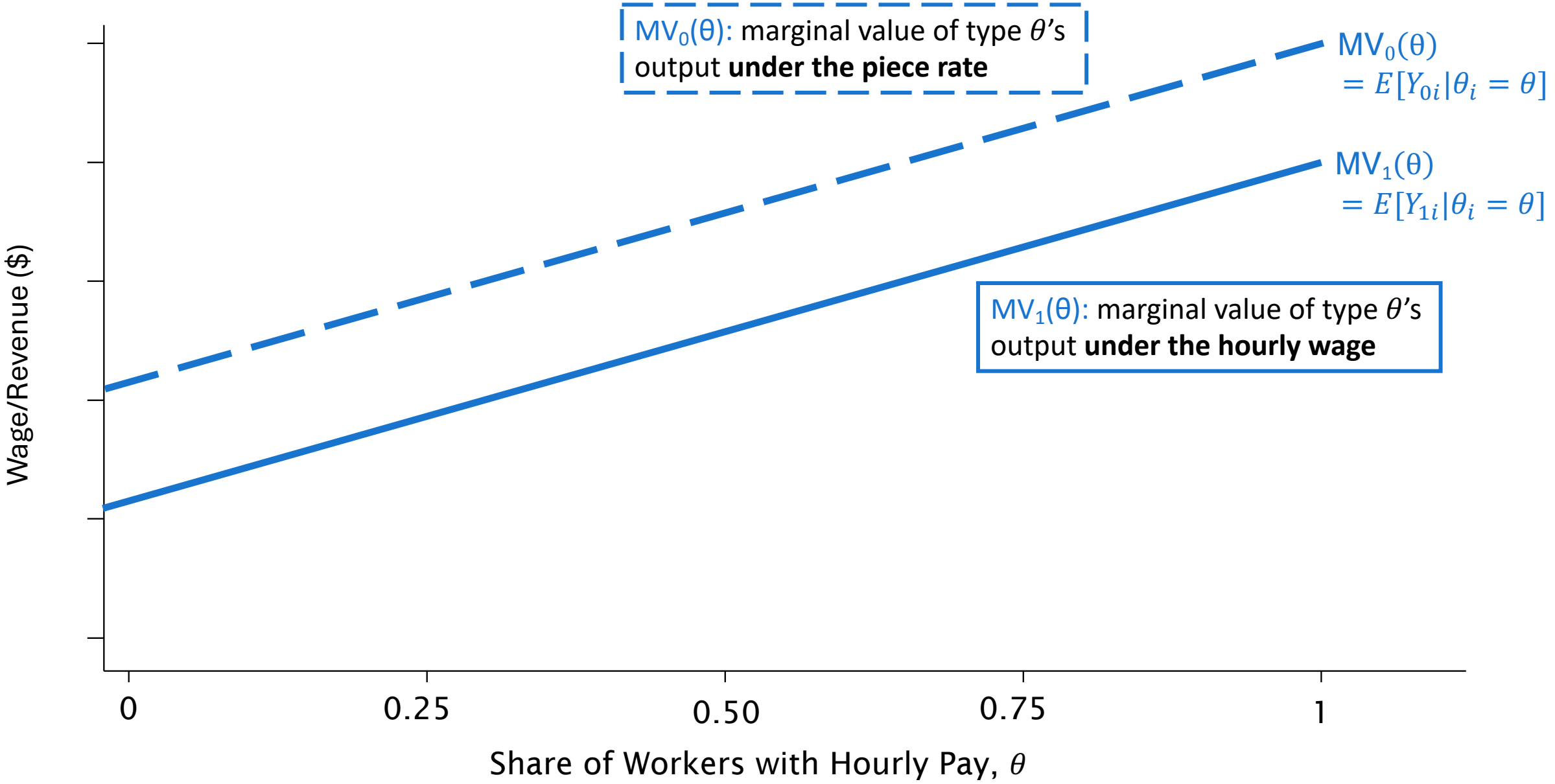
$$MV(\theta) \equiv E[Y_i|\theta_i = \theta] = E[Y_{1i}|\theta_i = \theta]$$
$$AV(\theta) \equiv E[Y_i|\theta_i \leq \theta] = E[Y_{1i}|\theta_i \leq \theta]$$

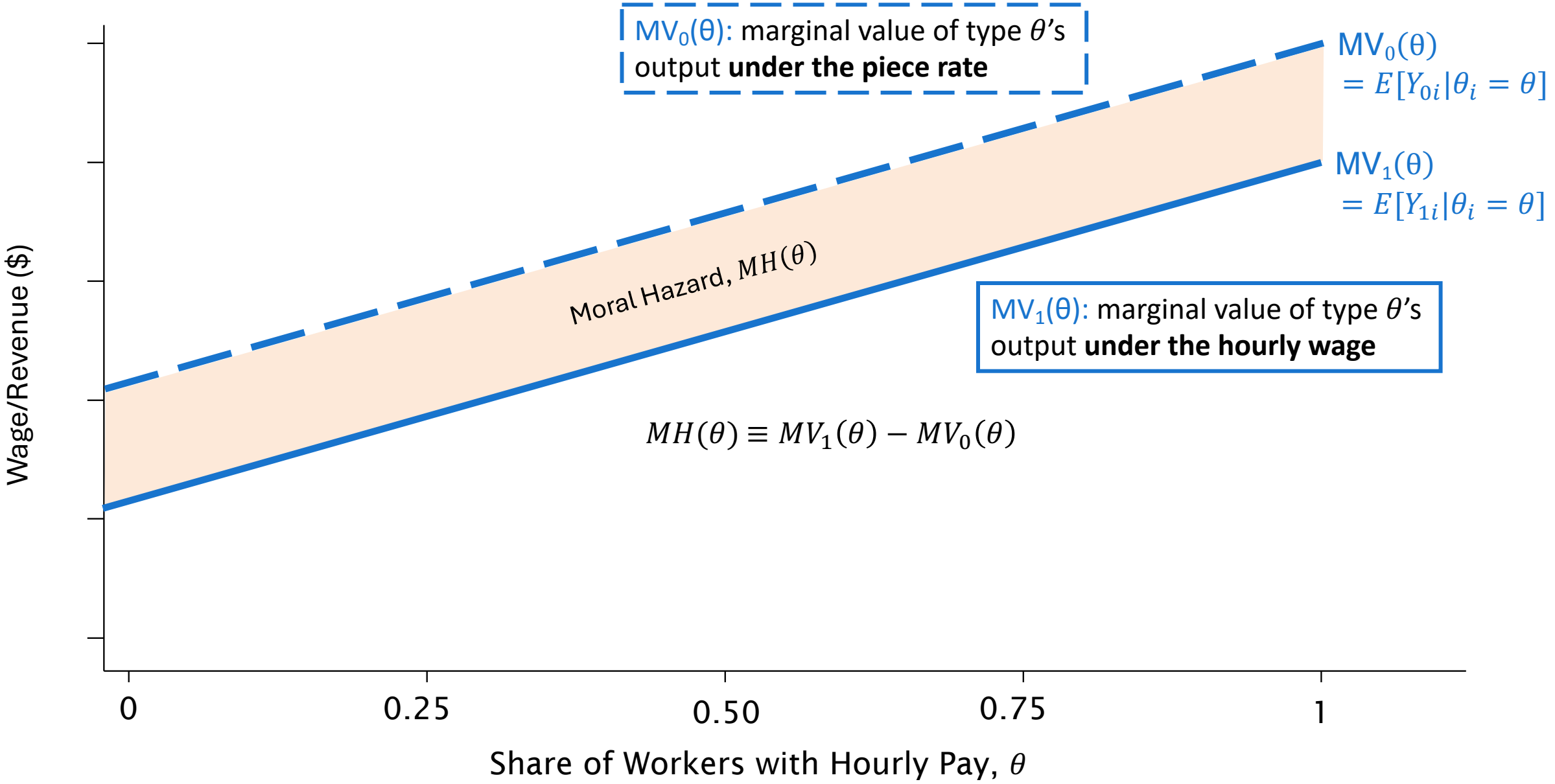
  ⇒ Equilibrium is inclusive of workers' moral hazard response to the hourly wage

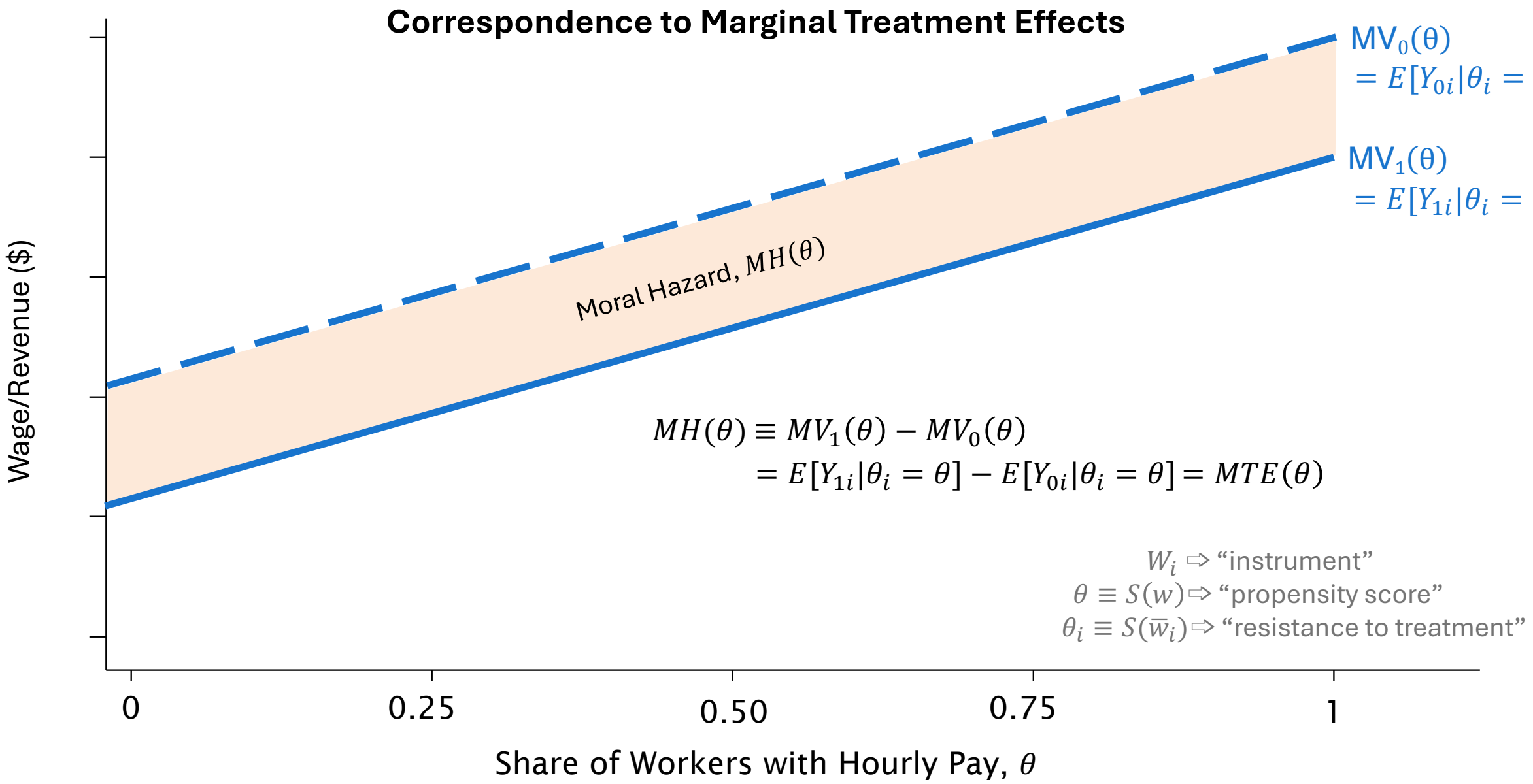
- Still want to separately identify moral hazard
  - Firms might mitigate MH with "partial insurance" (e.g., sales commission, tips)
  - Account for fiscal costs policies promoting fixed wages (MH ⇒ tax revenue ↓)

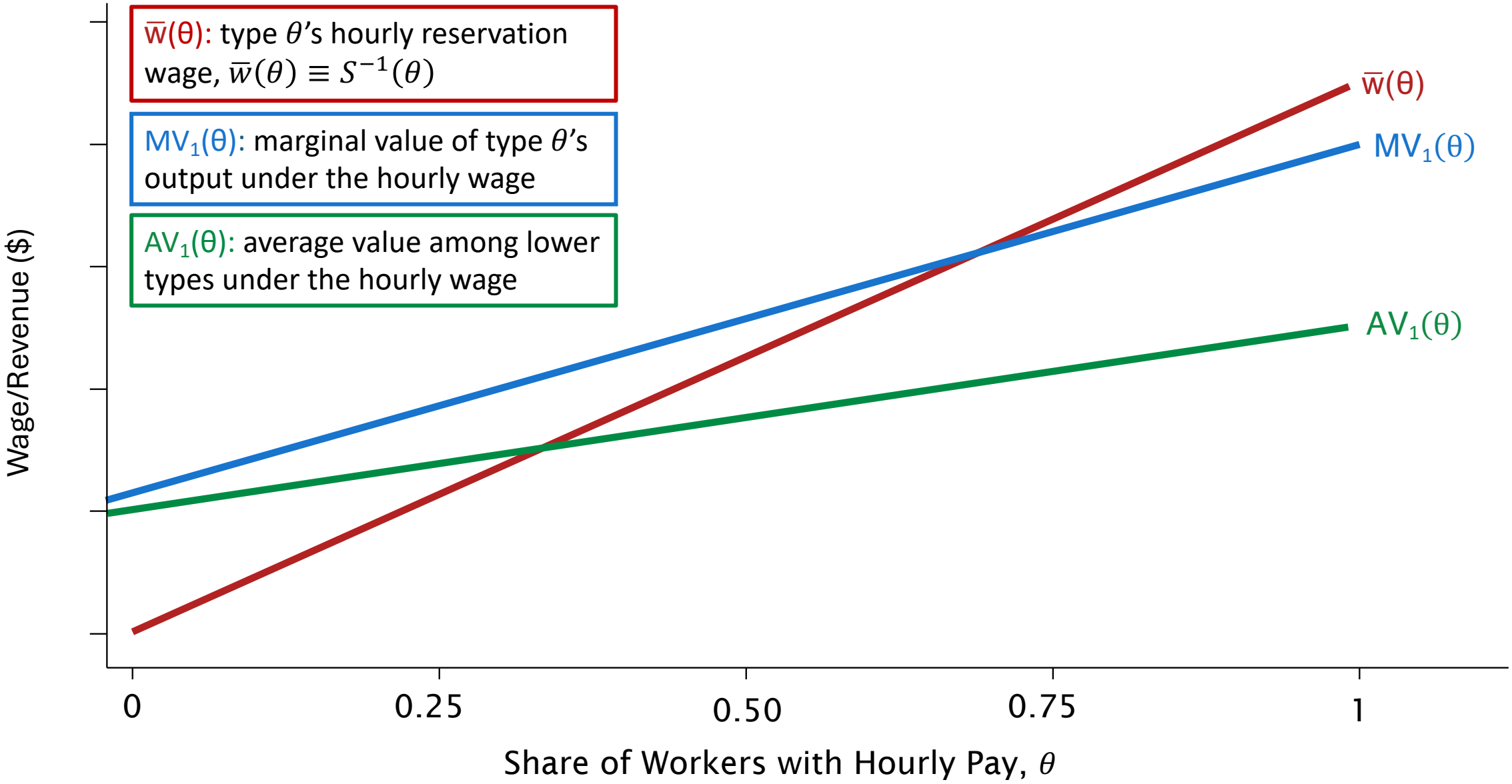

Wage/Revenue ($)
MV (θ)
$= E[Y_i|\theta_i = \theta]$
MV (θ): marginal value of type θ's output
0
0.25
0.50
0.75
1
Share of Workers with Hourly Pay, θ

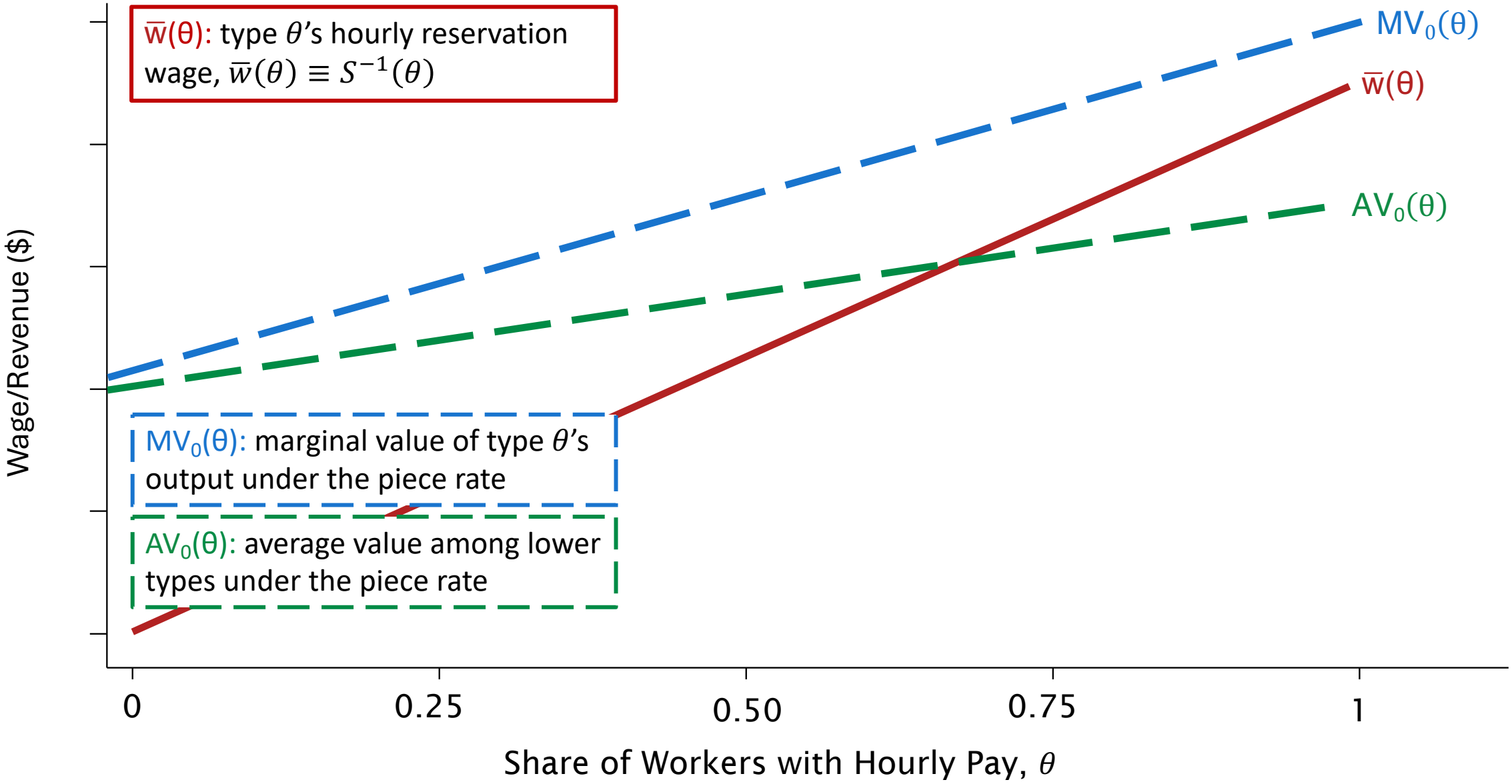

Wage/Revenue ($)
$MV_1(\theta) = E[Y_{1i}|\theta_i = \theta]$
$MV_1(\theta)$: marginal value of type θ's output **under the hourly wage**
0
0.25
0.50
0.75
1
Share of Workers with Hourly Pay, θ


MV$_0$(θ): marginal value of type θ's output **under the piece rate**
MV$_0$(θ) $= E[Y_{0i}|\theta_i = \theta]$
MV$_1$(θ) $= E[Y_{1i}|\theta_i = \theta]$
MV$_1$(θ): marginal value of type θ's output **under the hourly wage**
Wage/Revenue ($)
0
0.25
0.50
0.75
1
Share of Workers with Hourly Pay, θ


MV$_0$(θ): marginal value of type θ's output **under the piece rate**
MV$_0$(θ) $= E[Y_{0i}|\theta_i = \theta]$
MV$_1$(θ) $= E[Y_{1i}|\theta_i = \theta]$
Moral Hazard, MH(θ)
MV$_1$(θ): marginal value of type θ's output **under the hourly wage**
$MH(\theta) \equiv MV_1(\theta) - MV_0(\theta)$
Wage/Revenue ($)
0
0.25
0.50
0.75
1
Share of Workers with Hourly Pay, θ


Correspondence to Marginal Treatment Effects
$MV_0(\theta) = E[Y_{0i}|\theta_i = \theta]$
$MV_1(\theta) = E[Y_{1i}|\theta_i = \theta]$
Moral Hazard, $MH(\theta)$
$MH(\theta) \equiv MV_1(\theta) - MV_0(\theta)$
$= E[Y_{1i}|\theta_i = \theta] - E[Y_{0i}|\theta_i = \theta] = MTE(\theta)$
W_i ⇨ "instrument"
$\theta \equiv S(w)$ ⇨ "propensity score"
$\theta_i \equiv S(\overline{w}_i)$ ⇨ "resistance to treatment"
Wage/Revenue ($)
0
0.25
0.50
0.75
1
Share of Workers with Hourly Pay, θ


$\bar{w}(\theta)$: type θ's hourly reservation wage, $\bar{w}(\theta) \equiv S^{-1}(\theta)$
$MV_1(\theta)$: marginal value of type θ's output under the hourly wage
$AV_1(\theta)$: average value among lower types under the hourly wage
$\bar{w}(\theta)$
$MV_1(\theta)$
$AV_1(\theta)$
Wage/Revenue ($)
0
0.25
0.50
0.75
1
Share of Workers with Hourly Pay, θ


w̄(θ): type θ's hourly reservation wage, $\bar{w}(\theta) \equiv S^{-1}(\theta)$
MV₀(θ)
w̄(θ)
AV₀(θ)
MV₀(θ): marginal value of type θ's output under the piece rate
AV₀(θ): average value among lower types under the piece rate
Wage/Revenue ($)
0
0.25
0.50
0.75
1
Share of Workers with Hourly Pay, θ

Outline

1. Experimental Design
2. Main Results
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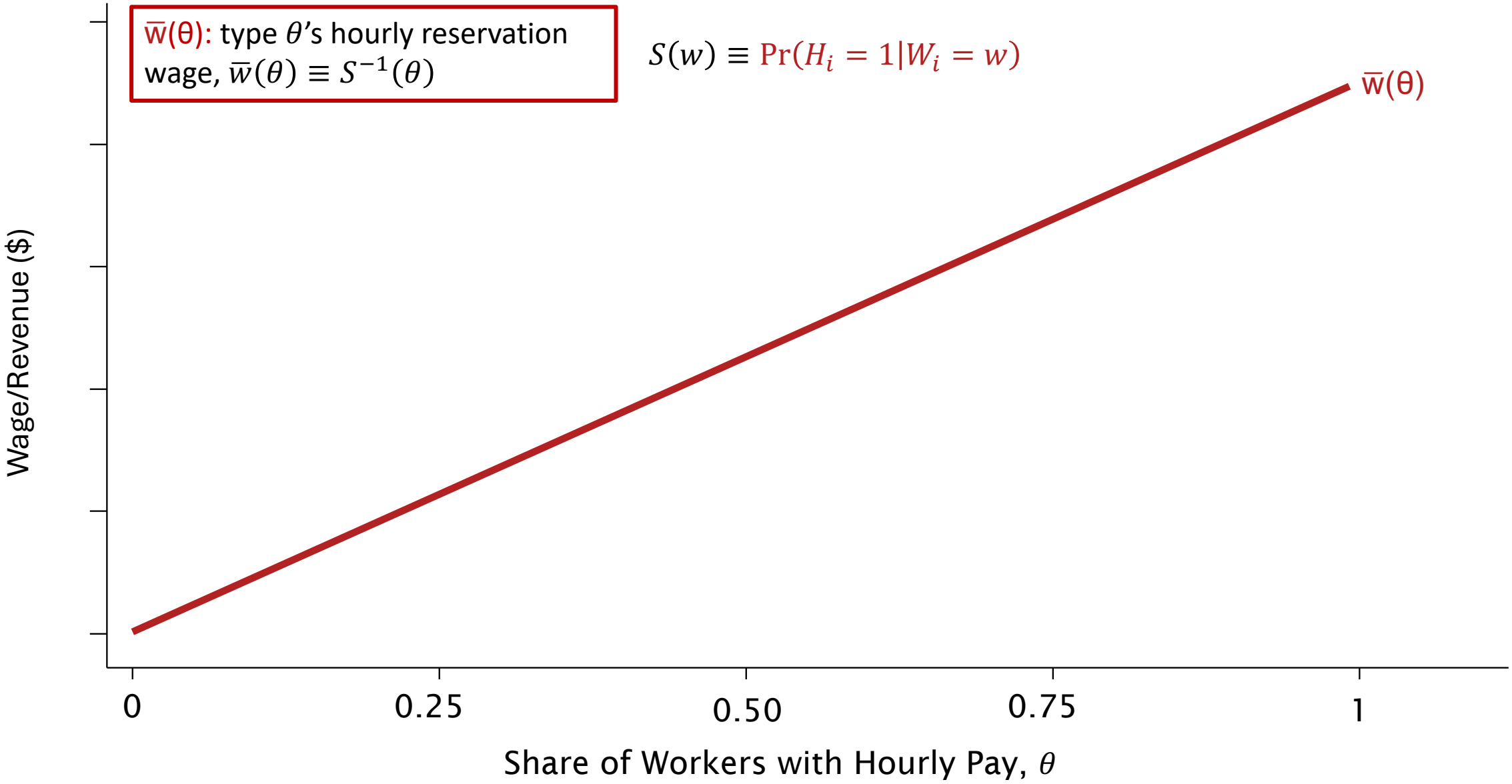
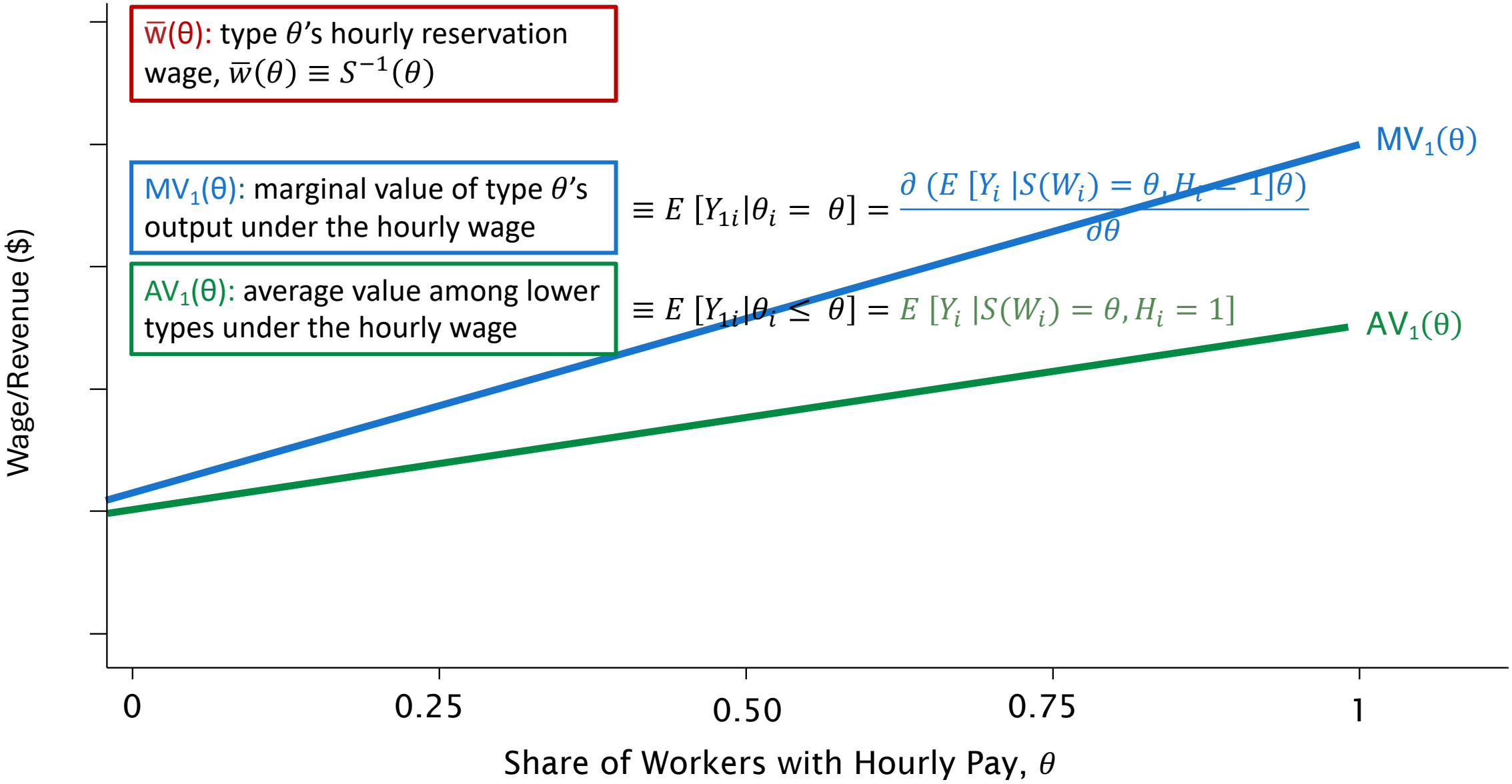
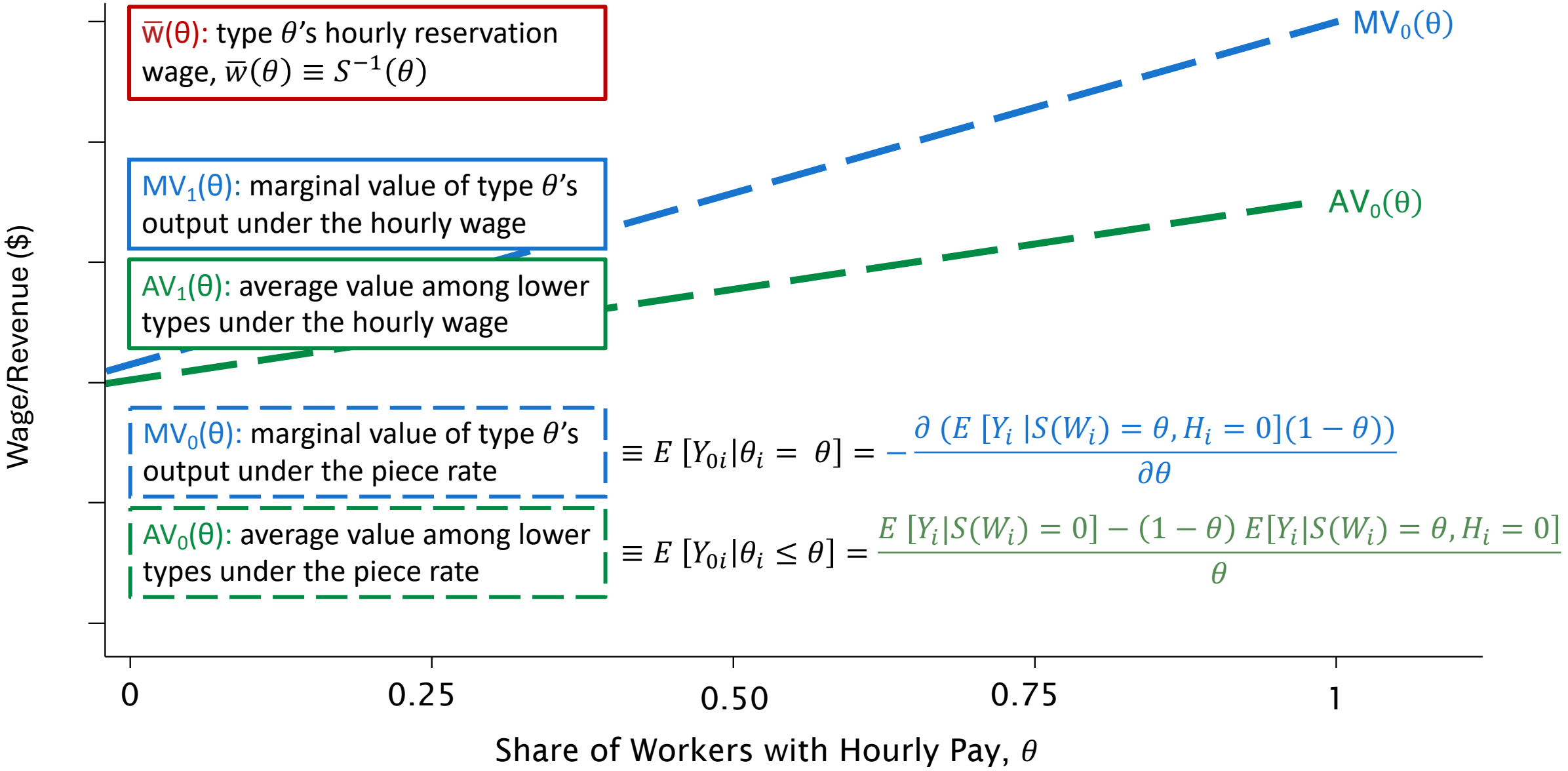
4. Estimates of Marginal Value and Welfare Loss
5. Optimal Wage Subsidies


w̄(θ): type θ's hourly reservation wage, $\bar{w}(\theta) \equiv S^{-1}(\theta)$
$S(w) \equiv \Pr(H_i = 1 | W_i = w)$
w̄(θ)
Wage/Revenue ($)
0
0.25
0.50
0.75
1
Share of Workers with Hourly Pay, θ


$\bar{w}(\theta)$: type θ's hourly reservation wage, $\bar{w}(\theta) \equiv S^{-1}(\theta)$
$MV_1(\theta)$: marginal value of type θ's output under the hourly wage
$AV_1(\theta)$: average value among lower types under the hourly wage
$\equiv E\,[Y_{1i}|\theta_i = \theta] = \frac{\partial\,(E\,[Y_i\,|S(W_i) = \theta, H_i = 1]\theta)}{\partial\theta}$
$\equiv E\,[Y_{1i}|\theta_i \leq \theta] = E\,[Y_i\,|S(W_i) = \theta, H_i = 1]$
$MV_1(\theta)$
$AV_1(\theta)$
Wage/Revenue ($)
0
0.25
0.50
0.75
1
Share of Workers with Hourly Pay, θ


$\bar{w}(\theta)$: type θ's hourly reservation wage, $\bar{w}(\theta) \equiv S^{-1}(\theta)$
$MV_1(\theta)$: marginal value of type θ's output under the hourly wage
$AV_1(\theta)$: average value among lower types under the hourly wage
$MV_0(\theta)$: marginal value of type θ's output under the piece rate
$AV_0(\theta)$: average value among lower types under the piece rate
$MV_0(\theta)$
$AV_0(\theta)$
$\equiv E\,[Y_{0i}|\theta_i = \theta] = -\frac{\partial\,(E\,[Y_i\,|S(W_i) = \theta, H_i = 0](1-\theta))}{\partial\theta}$
$\equiv E\,[Y_{0i}|\theta_i \leq \theta] = \frac{E\,[Y_i|S(W_i) = 0] - (1-\theta)\,E[Y_i|S(W_i) = \theta, H_i = 0]}{\theta}$
Wage/Revenue ($)
0
0.25
0.50
0.75
1
Share of Workers with Hourly Pay, θ

AV Details

$\bar{w}(\theta)$: type θ'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 θ's output under the hourly wage

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

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

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

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

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

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

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

Estimation

(Carneiro et al. 2011)

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

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

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

2. Separately estimate

$$E[Y_i | S(W_i) = \theta, H_i = 1]$$
$$\&$$
$$E[Y_i | S(W_i) = \theta, H_i = 0]$$

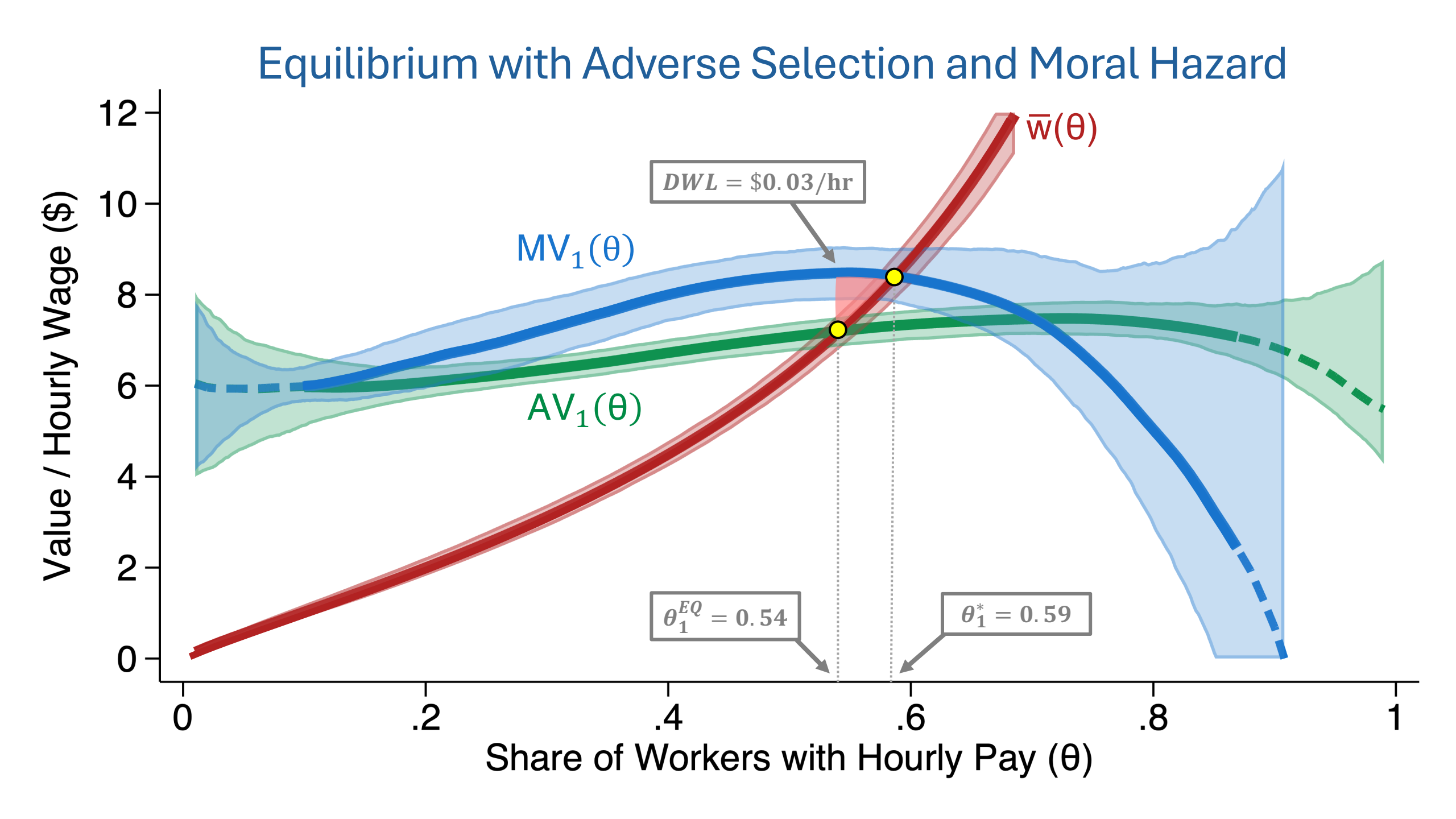
(local polynomial regression)

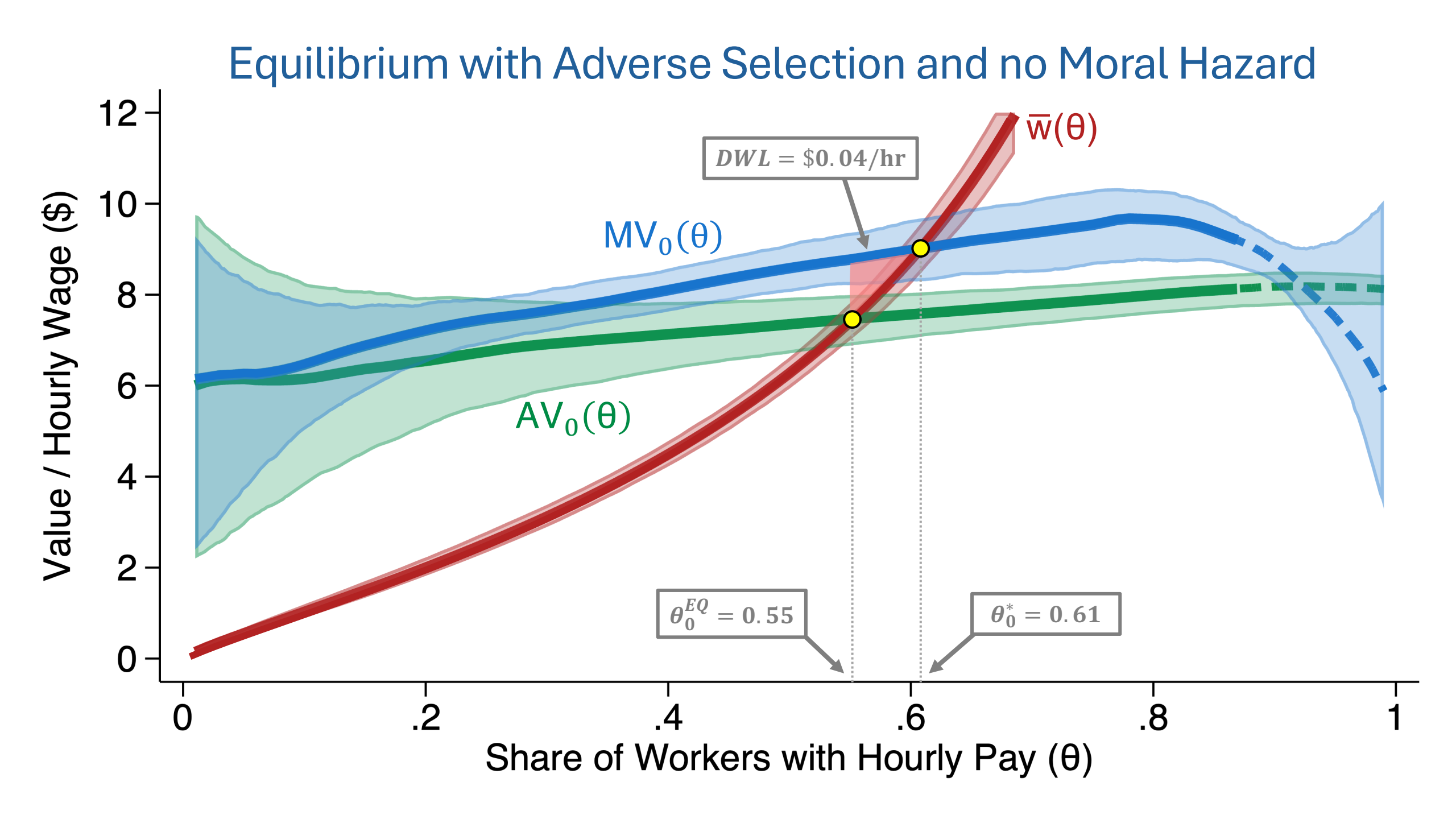
$$AV_1(\theta) \equiv E\left[Y_{1i} | \theta_i \leq \theta\right] = E\left[Y_i | S(W_i) = \theta, H_i = 1\right]$$

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

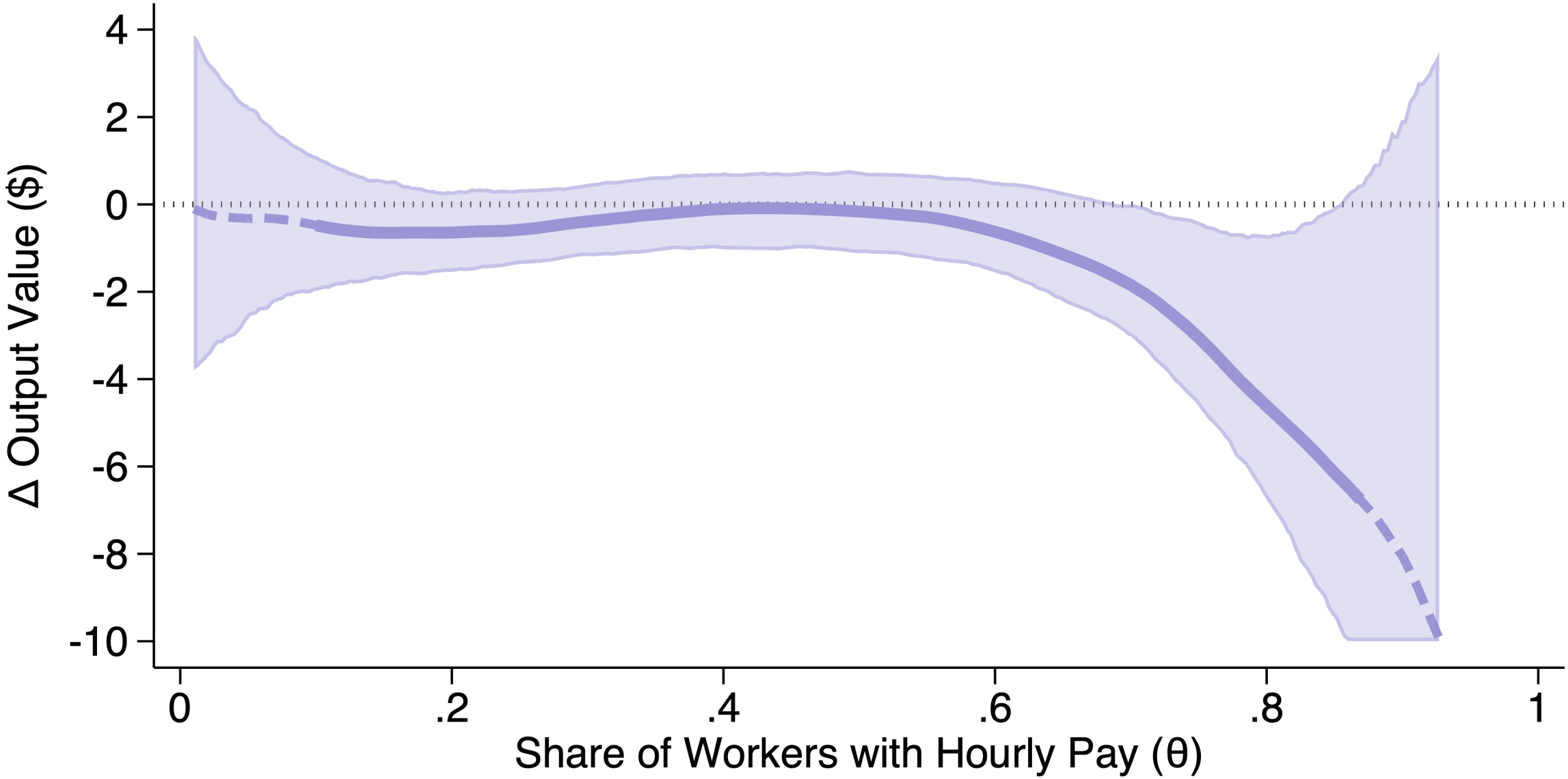
3. Differentiate with respect to θ

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


Equilibrium with Adverse Selection and Moral Hazard
12
10
8
6
4
2
0
Value / Hourly Wage ($)
$\bar{w}(\theta)$
$DWL = \$0.03/hr$
$MV_1(\theta)$
$AV_1(\theta)$
$\theta_1^{EQ} = 0.54$
$\theta_1^* = 0.59$
0
.2
.4
.6
.8
1
Share of Workers with Hourly Pay (θ)


Equilibrium with Adverse Selection and no Moral Hazard
Value / Hourly Wage ($)
12
10
8
6
4
2
0
0
.2
.4
.6
.8
1
Share of Workers with Hourly Pay (θ)
$\bar{w}(\theta)$
$DWL = \$0.04/\text{hr}$
$MV_0(\theta)$
$AV_0(\theta)$
$\theta_0^{EQ} = 0.55$
$\theta_0^* = 0.61$

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 Fixed-Wage Subsidy and Piece-Rate Tax

Policy Solutions

- Welfare loss from adverse selection suggests role for government: promote insurance-like provisions in labor contracts.

- I calculate the **Marginal Value of Public Funds (MVPF)** for two policies

  1. Fixed-wage subsidies
     - e.g., deductions for portion of hourly payments
  2. Piece-rate tax
     - e.g., eliminate tax credits on tipped earnings

$$MVPF = \frac{Welfare\ Benefit}{Net\ Govt\ Expenditure}$$

- Results may inform broad set of labor policies, even if estimates are specific to data-entry setting

GE Effects

Policy #1: Fixed-wage Subsidy

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

$$MVPF_{subsidy} = \frac{Welfare\ Benefit}{Net\ Govt\ Expenditure}$$

$Welfare\ Benefit$: The aggregate amount workers are willing to pay for subsidy

$Net\ Govt\ Expenditure$: The aggregate amount spent including fiscal externalities

Policy #1: Fixed-wage Subsidy

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

$$MVPF_{subsidy} = \frac{Transfer + Insurance\ Value}{Net\ Govt\ Expenditure}$$

$Welfare\ Benefit$: The aggregate amount workers are willing to pay for subsidy

- $Transfer$ from government to hourly workers
- $Insurance\ Value$ to workers who move from piece-rate to hourly pay

$Net\ Govt\ Expenditure$: The aggregate amount spent including fiscal externalities

Policy #1: Fixed-wage Subsidy

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

$$MVPF_{subsidy} = \frac{Transfer + Insurance\ Value}{Transfer + Tax\ Loss\ from\ MH}$$

$Welfare\ Benefit$: The aggregate amount workers are willing to pay for subsidy

- $Transfer$ from government to hourly workers
- $Insurance\ Value$ to workers who move from piece-rate to hourly pay

$Net\ Govt\ Expenditure$: The aggregate amount spent including fiscal externalities

- $Transfer$ from government to hourly workers
- $Tax\ Loss\ from\ MH$ when hourly workers shirk and pay less income tax

GE Effects

Policy #1: Fixed-wage Subsidy

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

$$MVPF_{subsidy} = \frac{\delta\theta^{\delta} + \int_{\theta^{EQ}}^{\theta^{\delta}} \left(MV_1(\theta) - \overline{w}(\theta)\right) d\theta}{\delta\theta^{\delta} - \int_{\theta^{EQ}}^{\theta^{\delta}} \tau MH(\theta) d\theta}$$

$Welfare\ Benefit$: The aggregate amount workers are willing to pay for subsidy

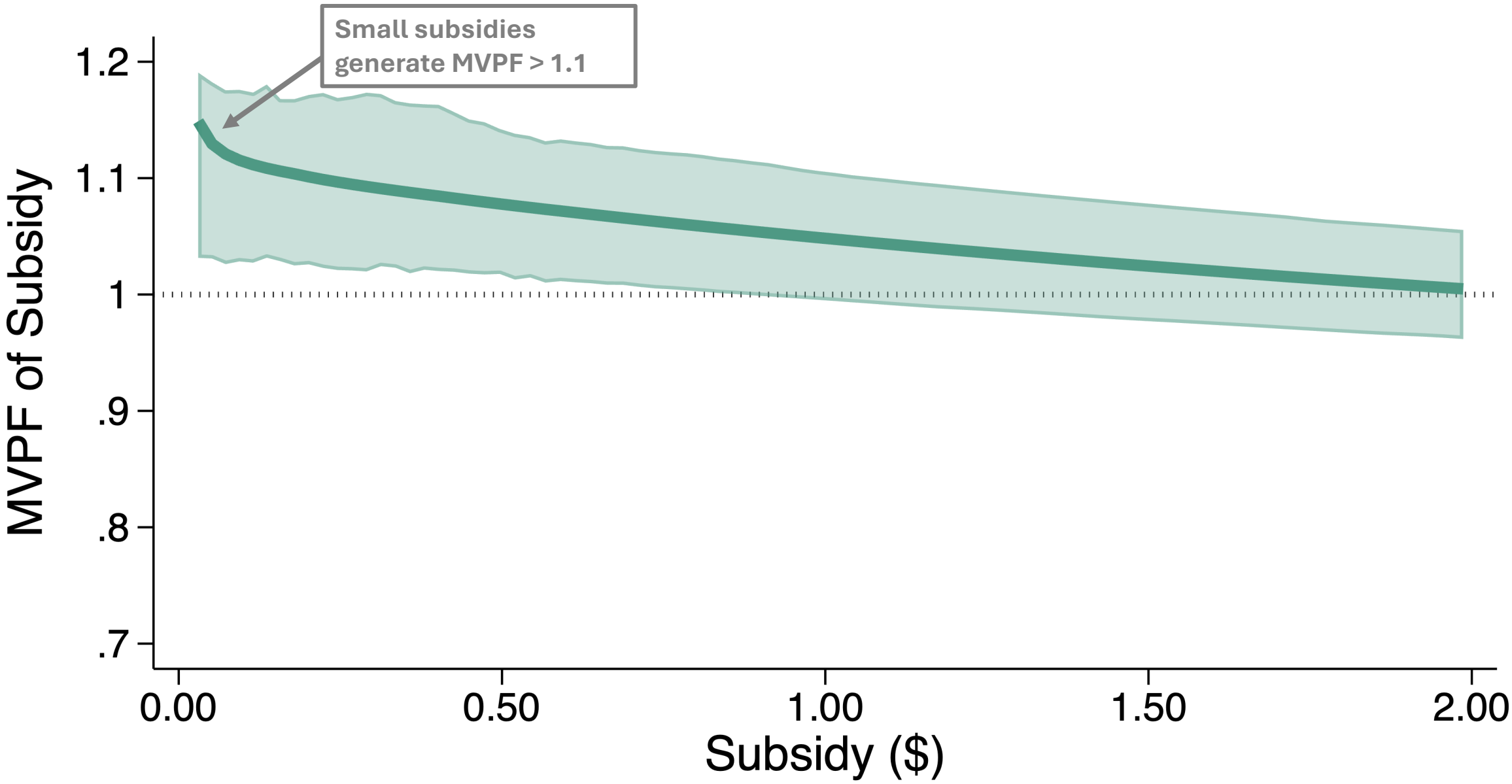
- $Transfer$ from government to hourly workers
- $Insurance\ Value$ to workers who move from piece-rate to hourly pay

$Net\ Govt\ Expenditure$: The aggregate amount spent including fiscal externalities

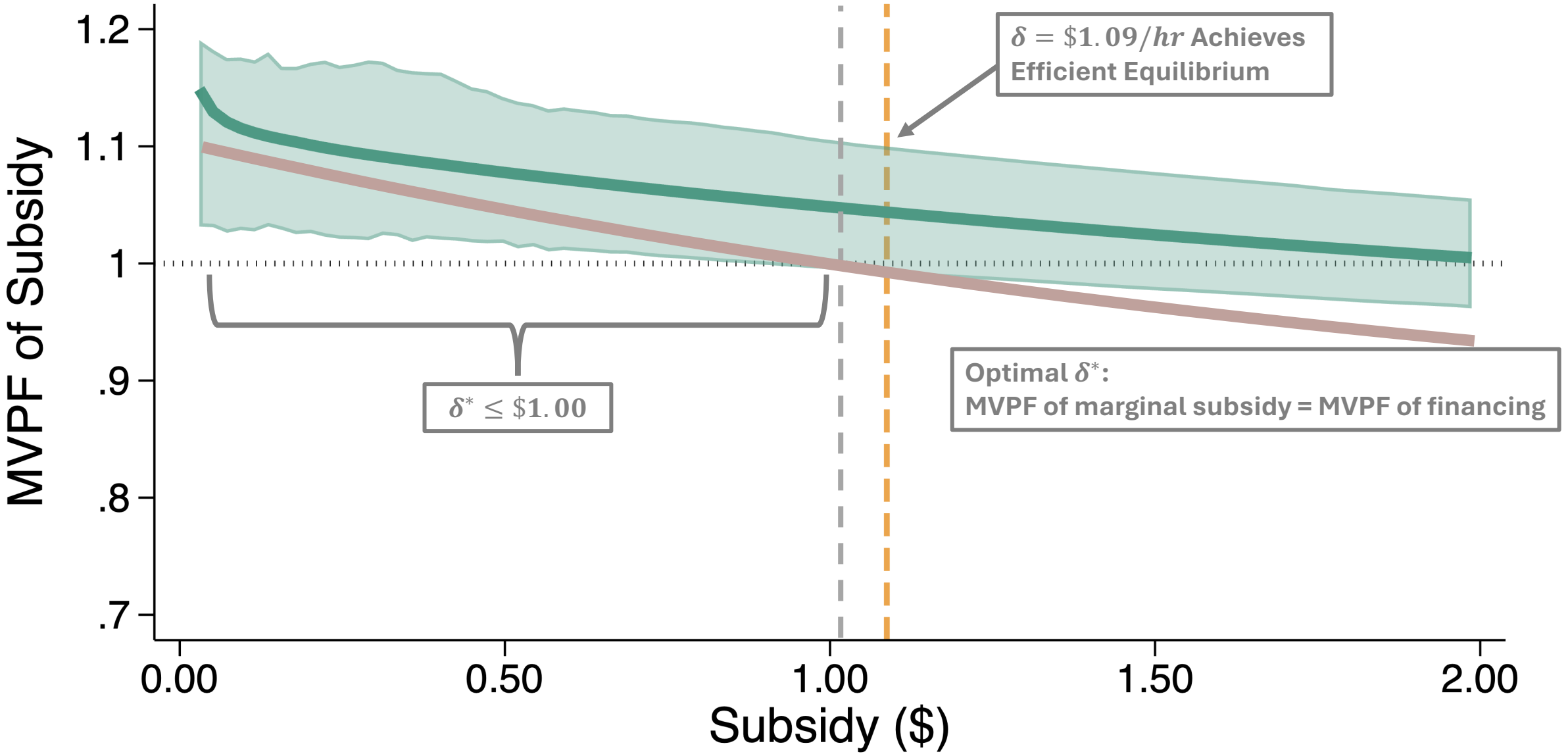
- $Transfer$ from government to hourly workers
- $Tax\ Loss\ from\ MH$ when hourly workers shirk and pay less income tax

GE Effects

MVPF of Hourly Wage Subsidy



MVPF of Hourly Wage Subsidy



Policy #2: Piece-rate Tax

Marginal Value of Public Funds (MVPF) for a piece-rate tax:

$$MVPF_{tax} = \frac{Welfare\ Loss}{Net\ Govt\ Revenue}$$

$Welfare\ Loss$: The aggregate amount workers would pay to avoid the tax

$Net\ Govt\ Revenue$: The aggregate revenue raised including fiscal externalities

Socially efficient tax ⇒ ***lower*** MVPF

Policy #2: Piece-rate Tax

Marginal Value of Public Funds (MVPF) for a piece-rate tax:

$$MVPF_{tax} = \frac{Transfer - Insurance\ Value}{Net\ Govt\ Revenue}$$

$Welfare\ Loss$: The aggregate amount workers would pay to avoid the tax

- $Transfer$ from piece-rate workers to government
- $Insurance\ Value$ to workers who move from piece-rate to hourly pay

$Net\ Govt\ Revenue$: The aggregate revenue raised including fiscal externalities

Socially efficient tax ⇒ ***lower*** MVPF

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Socially efficient tax ⇒ ***lower*** MVPF

Policy #2: Piece-rate Tax

Marginal Value of Public Funds (MVPF) for a piece-rate tax:

$$MVPF_{tax} = \frac{\int_{\theta^\rho}^{1} \rho MV_0(\theta)d\theta - \int_{\theta^{EQ}}^{\theta^\rho} \left(MV_1(\theta) - \overline{w}(\theta)\right)d\theta}{\int_{\theta^\rho}^{1} \rho MV_0(\theta)d\theta + \int_{\theta^{EQ}}^{\theta^\rho} \tau MH(\theta)d\theta}$$

$Welfare\ Loss$: The aggregate amount workers would pay to avoid the tax

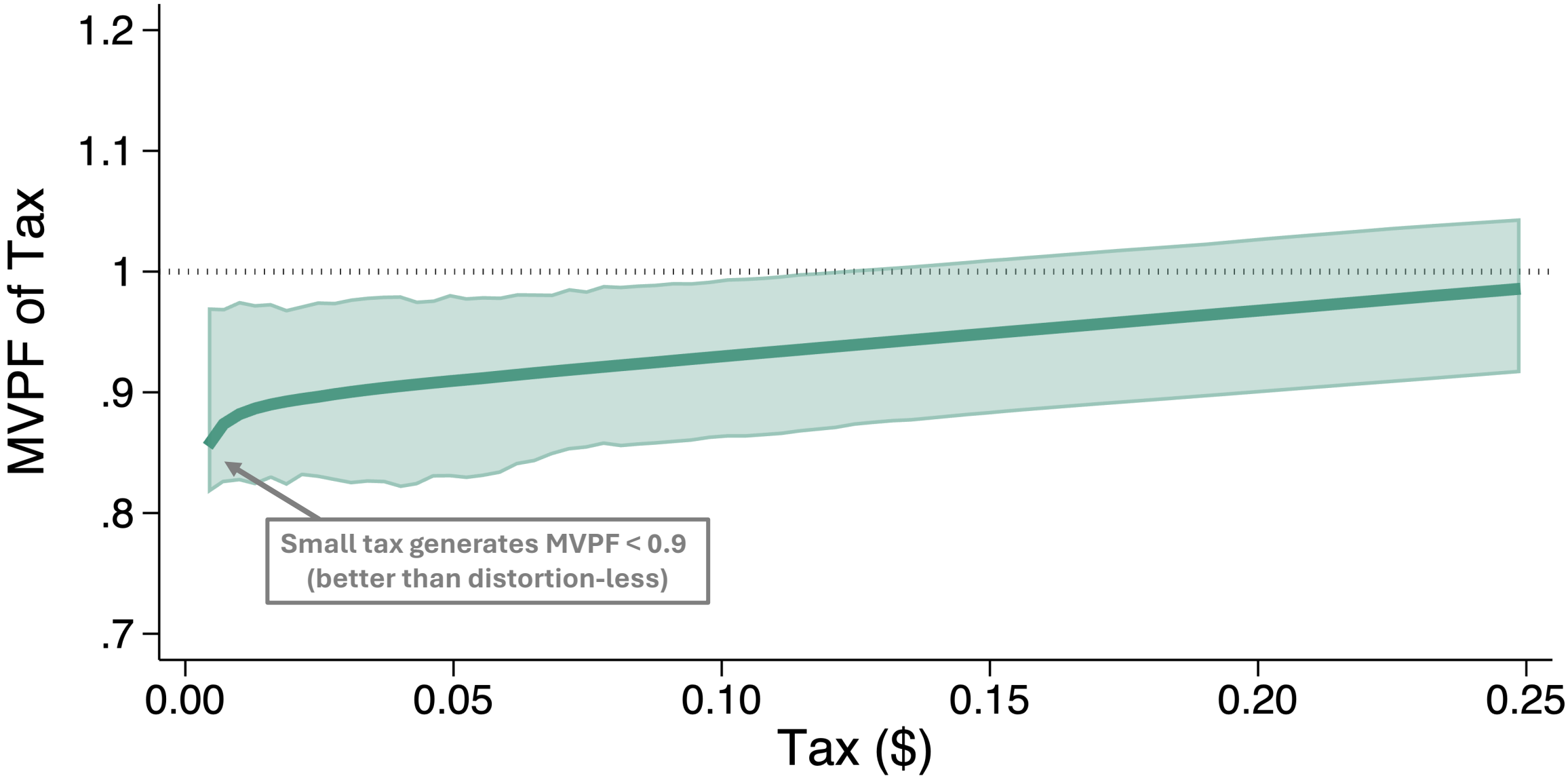
- $Transfer$ from piece-rate workers to government
- $Insurance\ Value$ to workers who move from piece-rate to hourly pay

$Net\ Govt\ Revenue$: The aggregate revenue raised including fiscal externalities

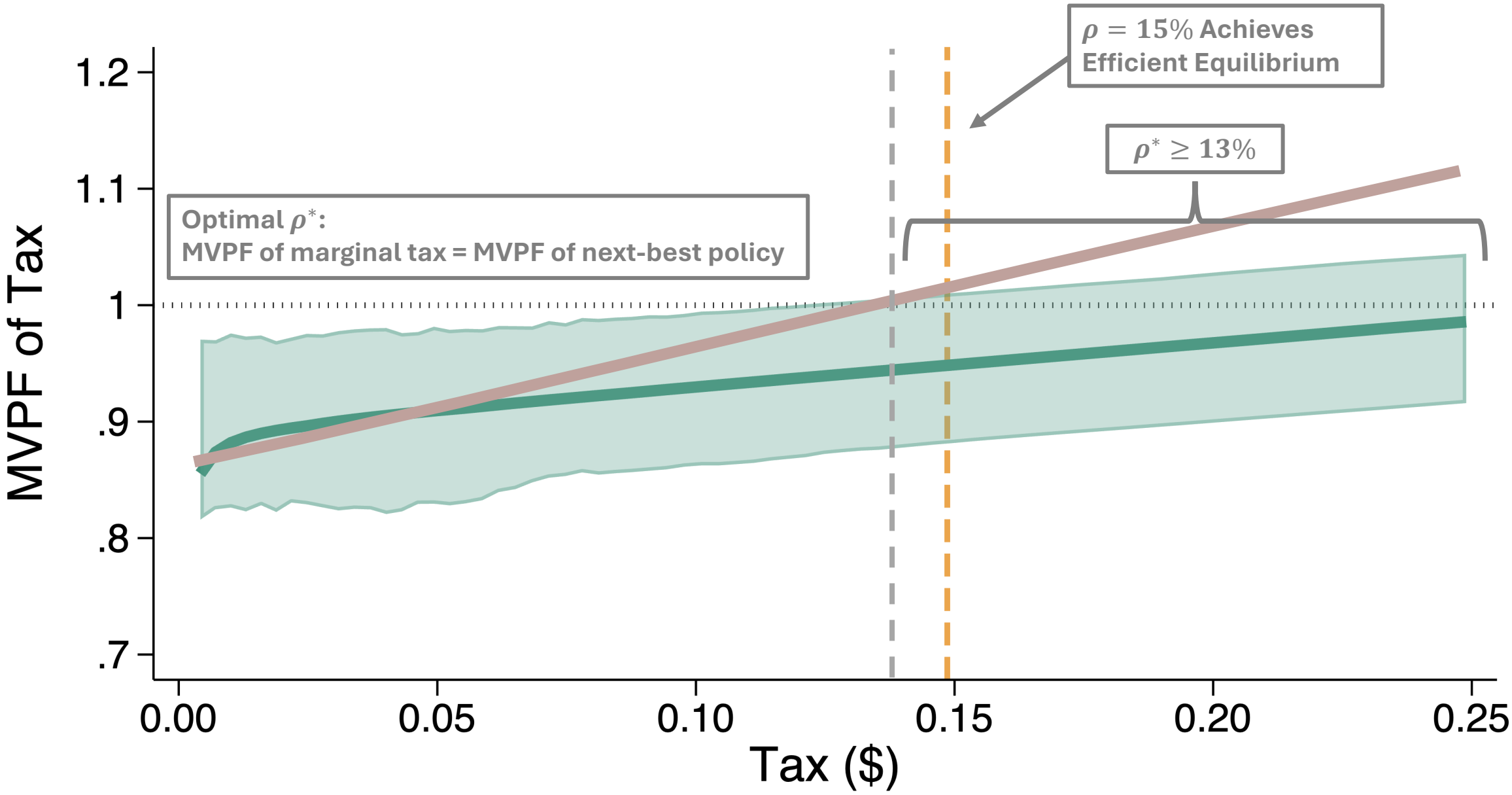
- $Transfer$ from piece-rate workers to government
- $Tax\ Loss\ from\ MH$ when hourly workers shirk and pay less income tax

Socially efficient tax ⇒ ***lower*** MVPF

MVPF of Piece Rate Tax



MVPF of Piece Rate Tax



Conclusion

- Develop insurance model of wage 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
- Policy prescription: increase taxes on piece-rate compensation
  - Tax on commissions, bonuses, or tips can encourage fixed wages and mitigate welfare loss
  - $\tau \approx 13\%$ raises $1 of government revenue at an estimated social cost of $0.90 or less
- Future research and extensions
  - Employer learning: screening on past performance
  - Separating contracts: randomize *menu* of offers
  - Alternative approach to measure adverse selection in other settings or contract dimensions
    1. Solicit reservation wage: “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
- π^W: Take-up of wage offer $W \in \{L, H\}$

Selection on Y_0 into offer H among those who would reject offer L:

$$E\left[Y_{0i} \middle| H_i^H = 1, H_i^L = 0\right] - E\left[Y_{0i} \middle| H_i^H = 0\right]$$

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

Selection on Y_1 into offer L among those who would accept offer H:

$$E\left[Y_{1i} \middle| H_i^L = 1\right] - E[Y_{1i} | H_i^H = 1, H_i^L = 0]$$

$$= \frac{\pi^H}{\pi^H - \pi^L} E[Y_i | H_i = 1, W_i = L] - E[Y_i | H_i = 1, W_i = H]$$

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Balance Test

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

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Hourly Wage Take-up

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

$$\Pr(H_i = 1) = \text{inv logit}\left(\alpha \ln W_i + \boldsymbol{\nu X_i}\right)$$

Main Results MTE

Suppose supply and average value are linear in the wage offer:

$$Y_i = \xi_0 + \alpha H_i + \beta_0(1 - H_i)\times W_i + \beta_1 H_i \times W_i + \gamma H_i \times W_i^P + \epsilon_i$$
$$H_i = \gamma + \delta w + \nu_i$$

Let $\overline{w}_i$ be worker i's hourly reservation wage ⇒ CEFs of hourly take-up and output value:

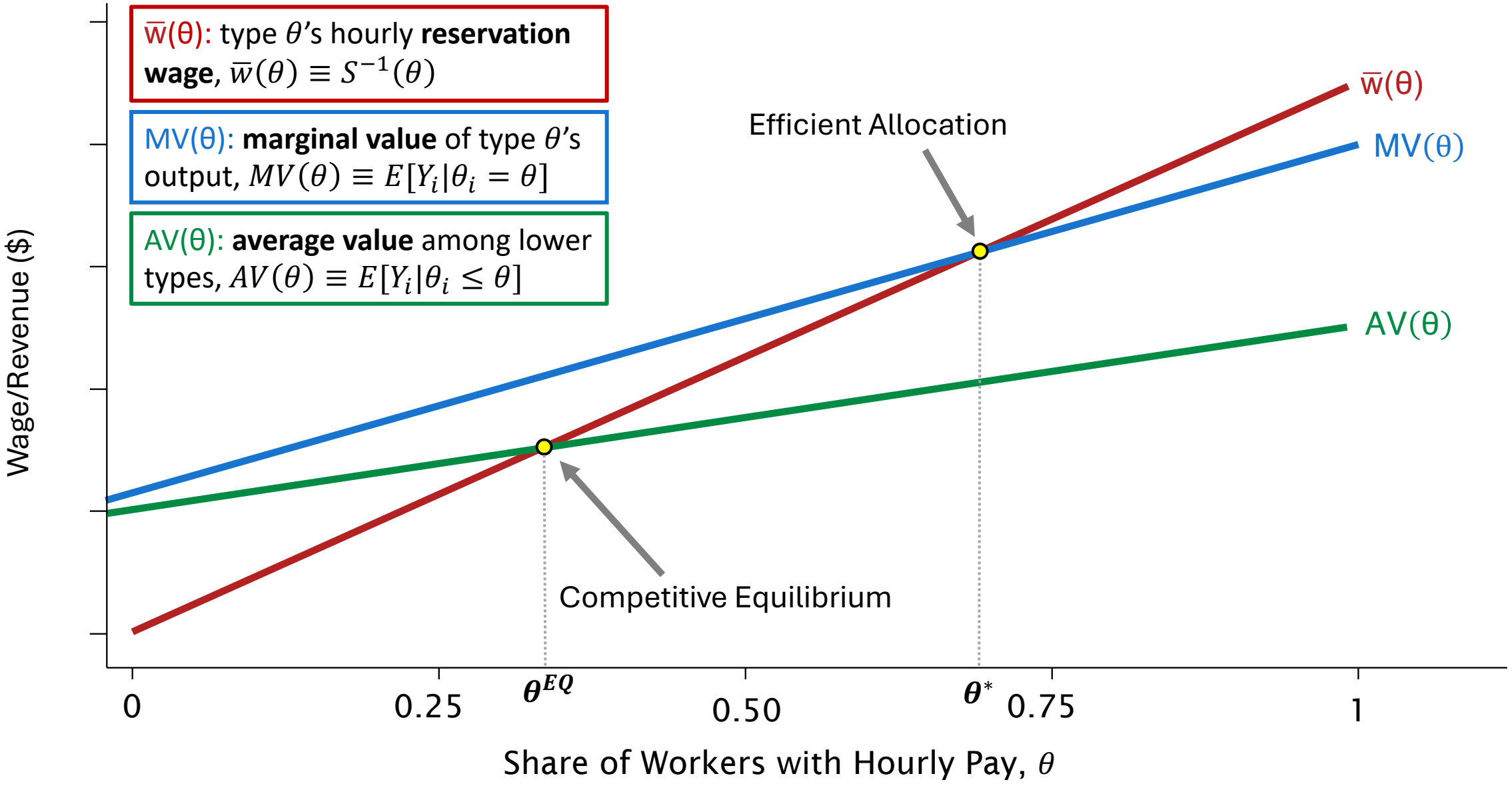
$$\mathrm{E}[H_i|\overline{w}_i \le w] = \gamma + \delta w$$
$$\mathrm{E}[Y_i|\overline{w}_i \le w] = \xi_0 + \alpha + \beta_1 H_i \times w$$
$$\mathrm{E}[Y_i|\overline{w}_i > w] = \xi_0 + \beta_0(1 - H_i)\times w$$

The *marginal* potential output values $E[Y_{1i}|\overline{w}_i = w]$ & $E[Y_{0i}|\overline{w}_i = w]$ are given by

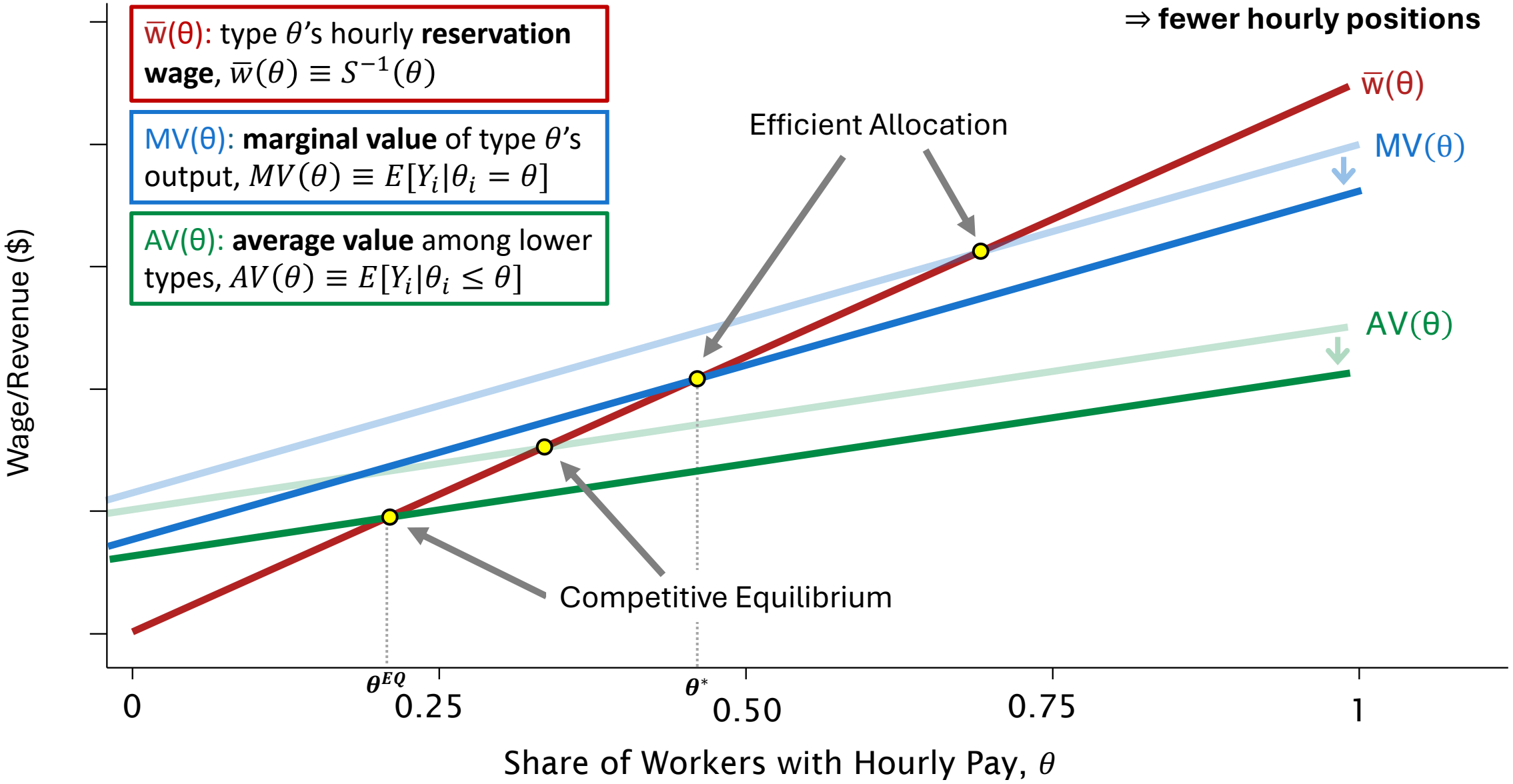
$$E[Y_{1i}|\overline{w}_i = w] = \frac{\partial(\mathrm{E}[Y_i|\overline{w}_i \le w]S(w))}{\partial S(w)} = \xi_0 + \alpha + \frac{\gamma\beta_1}{\delta} + 2\beta_1 w$$

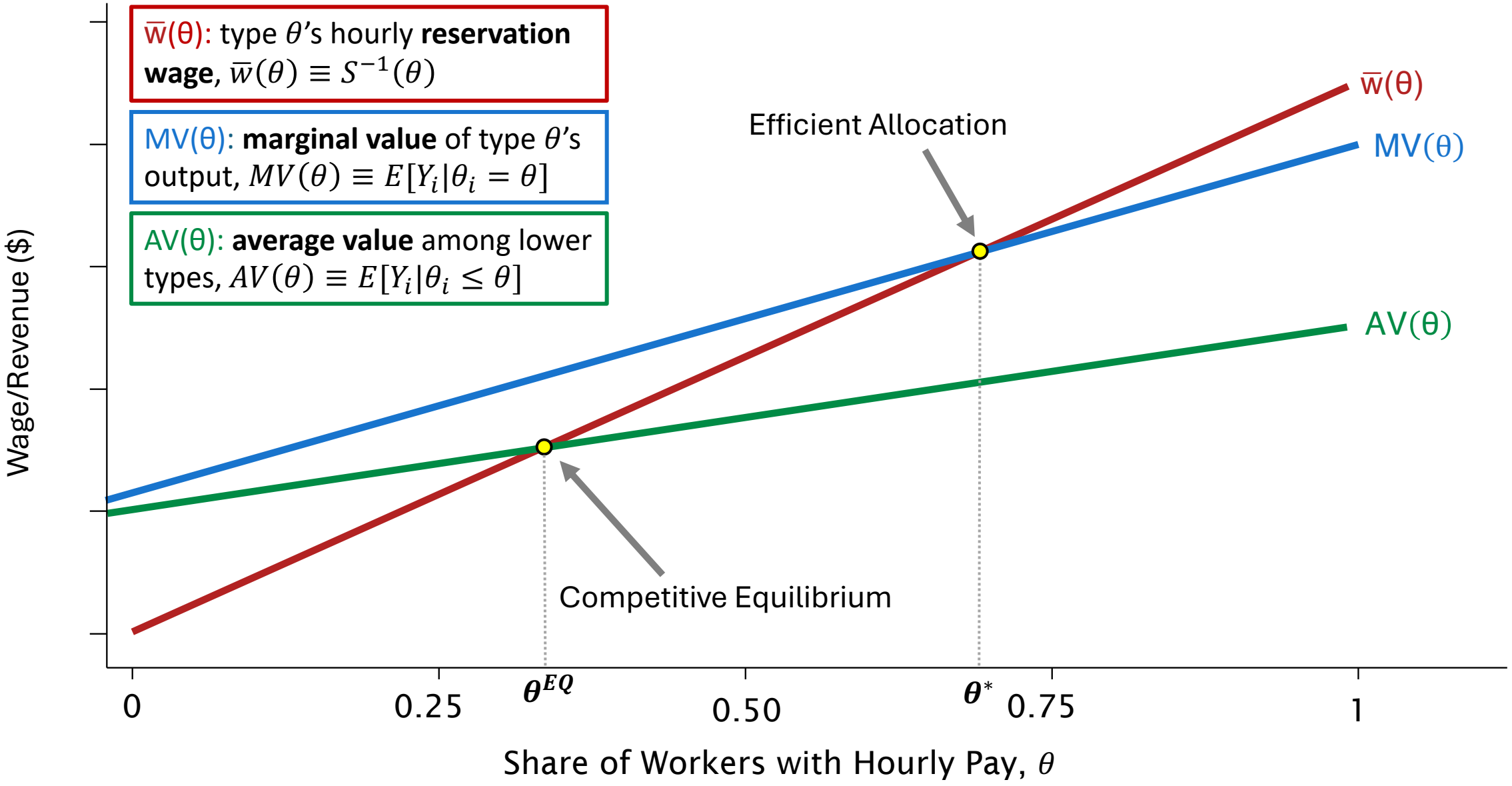
$$E[Y_{0i}|\overline{w}_i = w] = -\frac{\partial\left(\mathrm{E}[Y_i|\overline{w}_i > w]\big(1 - S(w)\big)\right)}{\partial S(w)} = \xi_0 + \frac{(\gamma - 1)\beta_0}{\delta} + 2\beta_0 w$$

Back


w̄(θ): type θ's hourly **reservation wage**, $\bar{w}(\theta) \equiv S^{-1}(\theta)$
MV(θ): **marginal value** of type θ's output, $MV(\theta) \equiv E[Y_i|\theta_i = \theta]$
AV(θ): **average value** among lower types, $AV(\theta) \equiv E[Y_i|\theta_i \leq \theta]$
w̄(θ)
MV(θ)
AV(θ)
Efficient Allocation
Competitive Equilibrium
Wage/Revenue ($)
0
0.25
θ^{EQ}
0.50
θ^*
0.75
1
Share of Workers with Hourly Pay, θ

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

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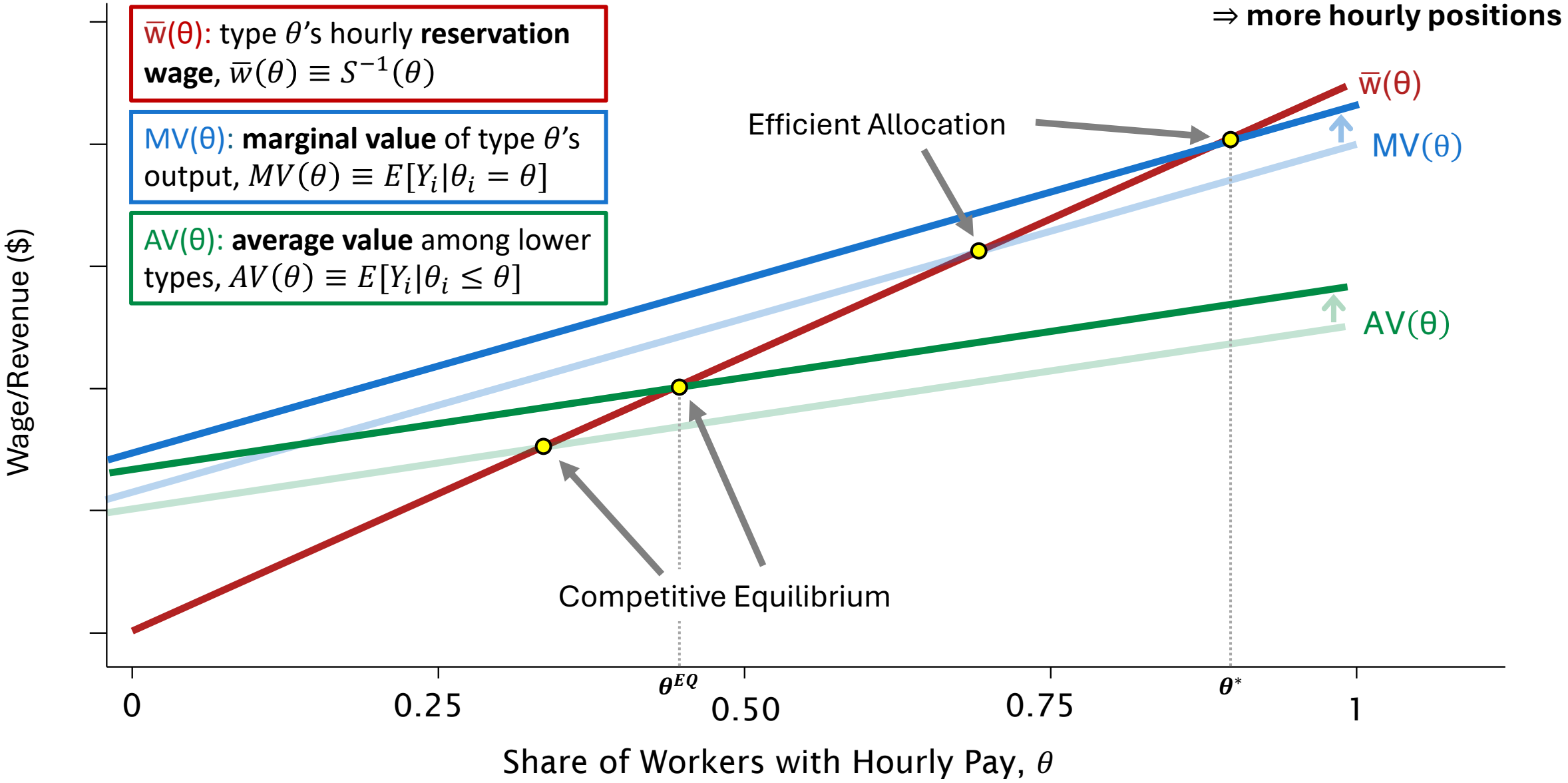
w̄(θ)
MV(θ)
AV(θ)
Efficient Allocation
Competitive Equilibrium
Wage/Revenue ($)
0
0.25
θ^{EQ}
0.50
θ^*
0.75
1
Share of Workers with Hourly Pay, θ

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



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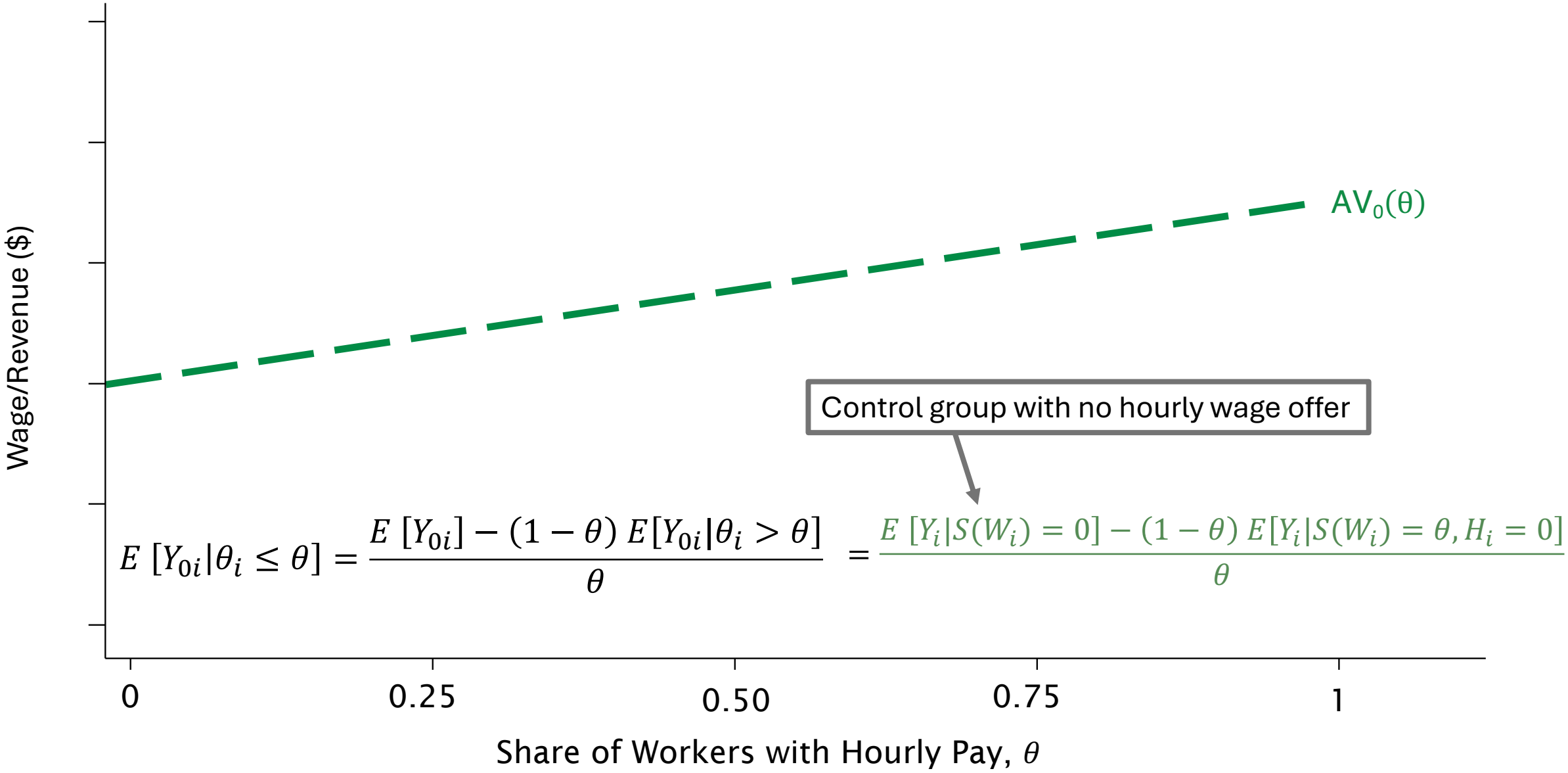

Wage/Revenue ($)
$AV_0(\theta)$
Control group with no hourly wage offer
$E\ [Y_{0i}|\theta_i \leq \theta] = \frac{E\ [Y_{0i}] - (1-\theta)\ E[Y_{0i}|\theta_i > \theta]}{\theta} = \frac{E\ [Y_i|S(W_i) = 0] - (1-\theta)\ E[Y_i|S(W_i) = \theta, H_i = 0]}{\theta}$
0
0.25
0.50
0.75
1
Share of Workers with Hourly Pay, θ

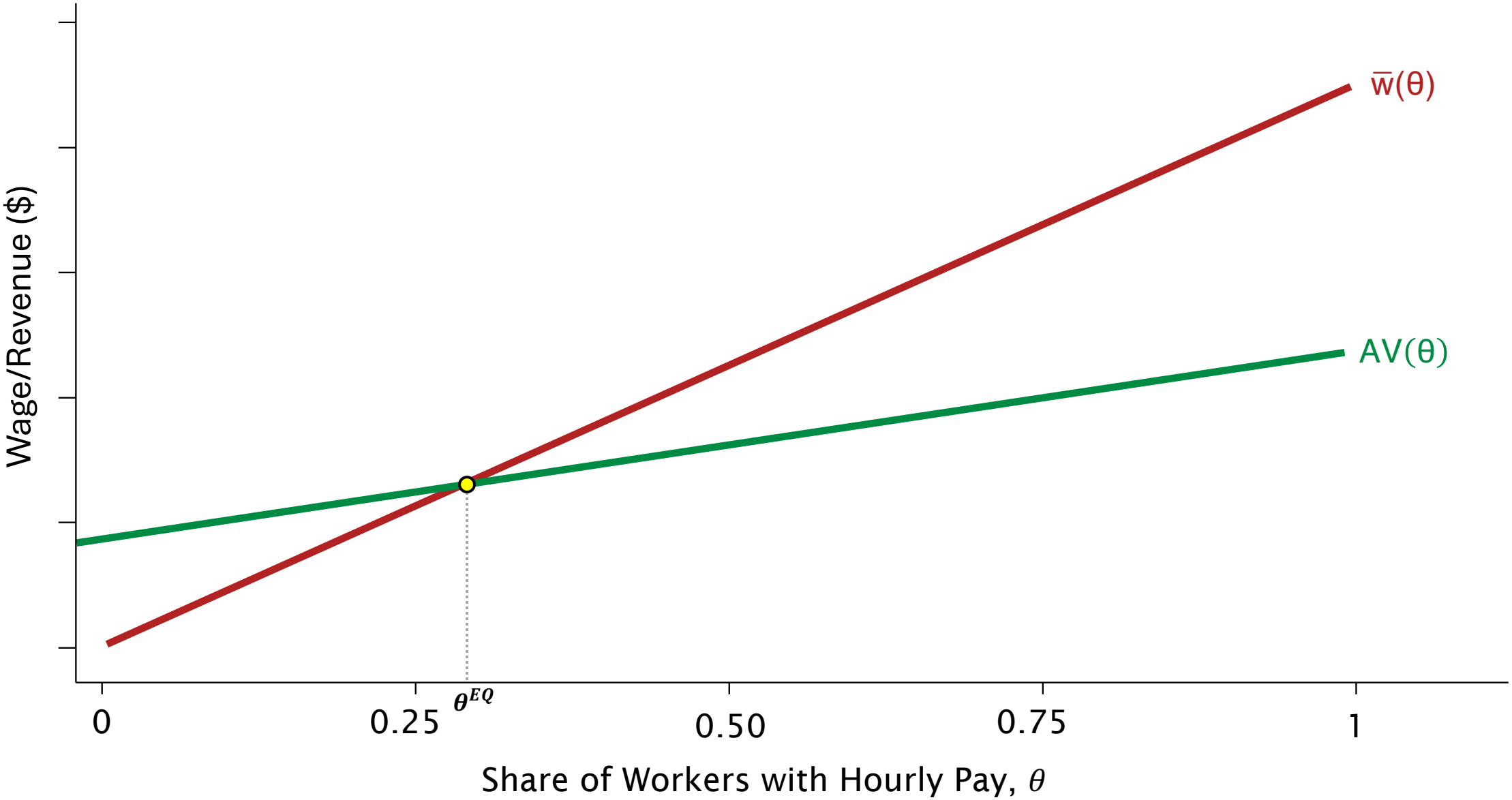
Back

Estimation Details

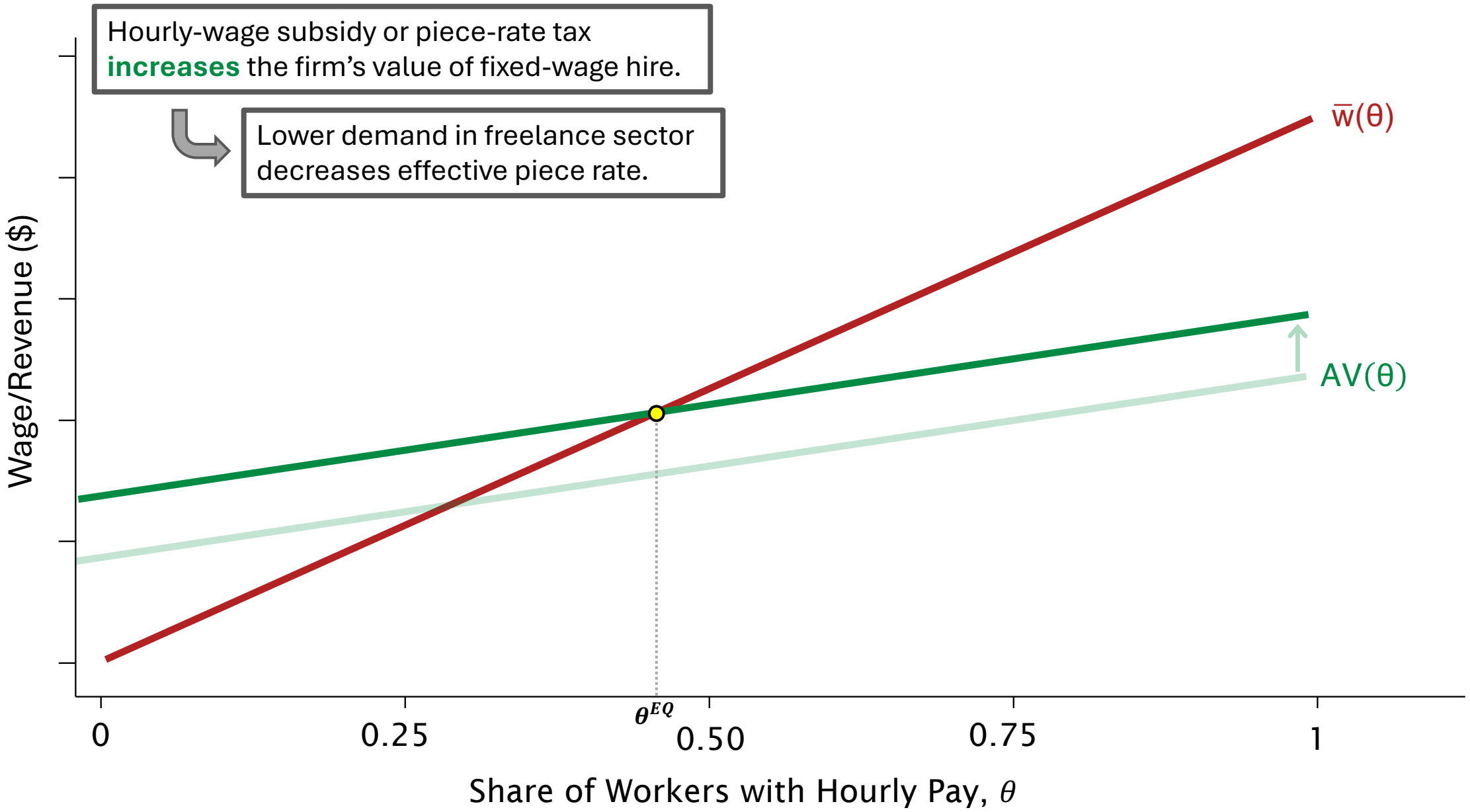
Estimation Follows Carneiro et al. (2011):

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 quadratic regressions of $\tilde{Y}$ on $S(W_i)$ for hourly and piece-rate workers (bw=0.2)
4. Differentiate with respect to θ

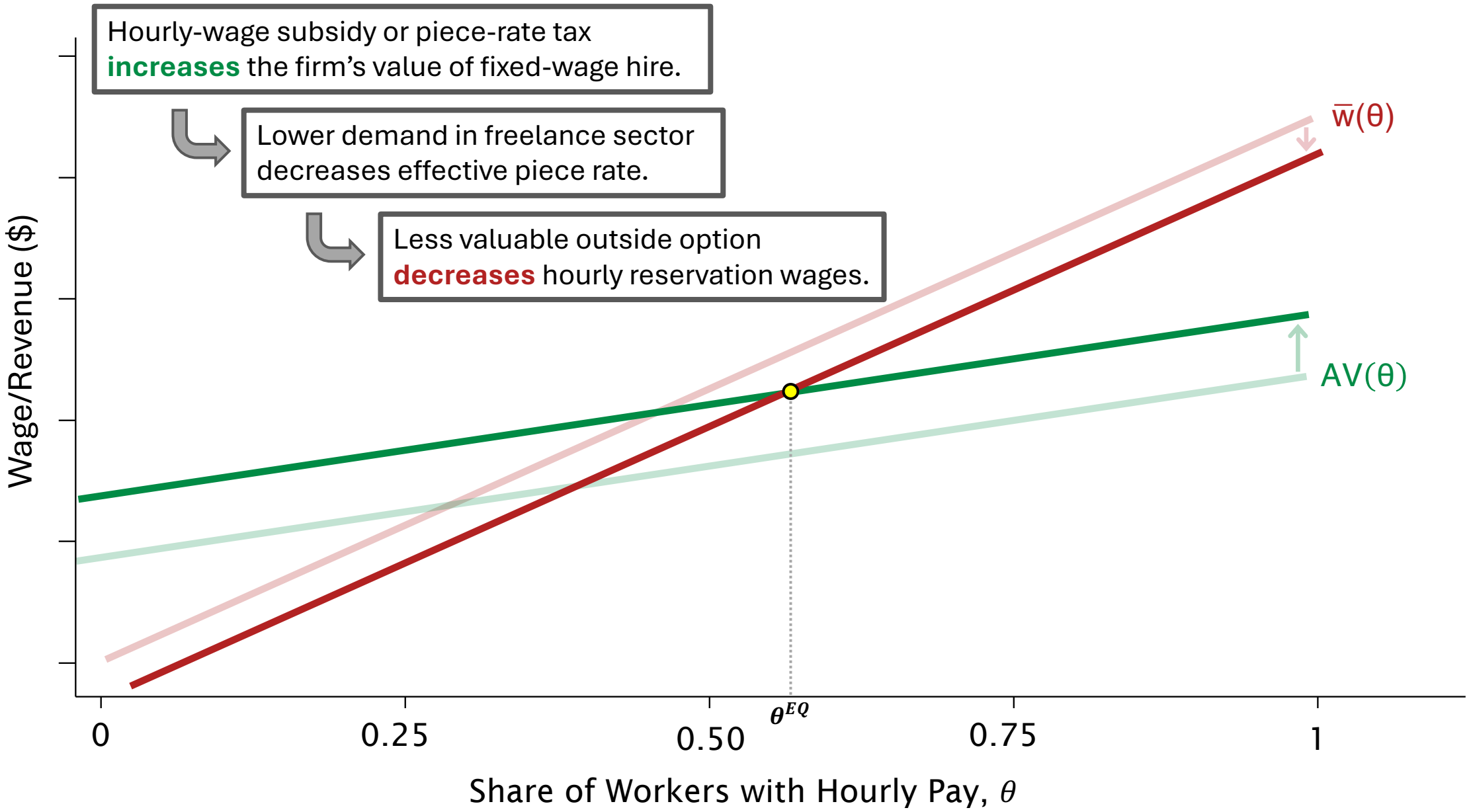
Back


Wage/Revenue ($)
$\bar{w}(\theta)$
AV(θ)
0
0.25
θ^{EQ}
0.50
0.75
1
Share of Workers with Hourly Pay, θ

Back


Hourly-wage subsidy or piece-rate tax
increases the firm's value of fixed-wage hire.
Lower demand in freelance sector
decreases effective piece rate.
$\bar{w}(\theta)$
AV(θ)
Wage/Revenue ($)
θ^{EQ}
0
0.25
0.50
0.75
1
Share of Workers with Hourly Pay, θ

Back


Hourly-wage subsidy or piece-rate tax increases the firm's value of fixed-wage hire.
Lower demand in freelance sector decreases effective piece rate.
Less valuable outside option decreases hourly reservation wages.
$\bar{w}(\theta)$
AV(θ)
Wage/Revenue ($)
0
0.25
0.50
0.75
1
θ^{EQ}
Share of Workers with Hourly Pay, θ

Back