Current research: Ian

INFO/STSCI/ILRST 3900: Causal Inference

28 Nov 2023

Learning goals for today

At the end of class, you will be able to

1. define effects when some potential outcomes do not exist
2. estimate by bounding
3. connect ideas from this class to current research

Non-existent outcomes in research on inequality

A causal approach

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Replication code **here**

Try our (beta) R package!
ilundberg.github.io/pstratreg

The setting

Parenthood reduces hourly wages for women

(Budig & England 2001; Gough & Noonan 2013)

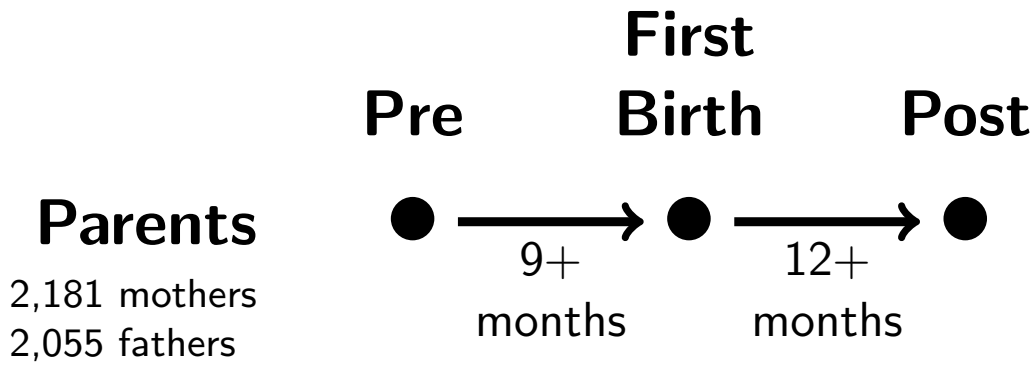
and increases wages for men

(Killewald 2013; Yu & Hara 2021)

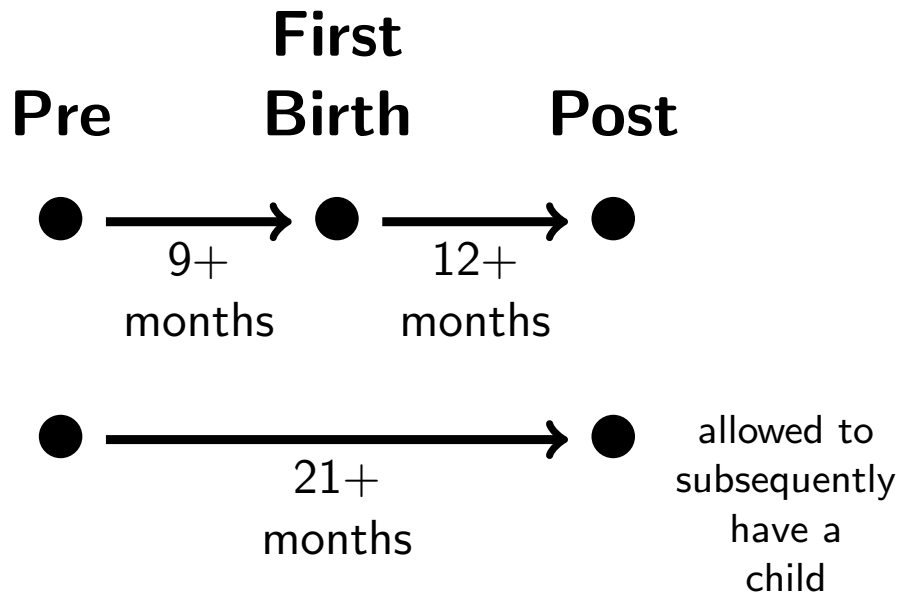
The motherhood wage penalty may be disappearing over time

(Pal & Waldfogel 2016; Buchmann & McDaniel 2016; but see Jee et al. 2019)

Data: NLSY97


First
Pre
Birth
Post
Parents
2,181 mothers
2,055 fathers
9+
months
12+
months

Data: NLSY97



	person-periods	persons
women	20,578	2,796
men	25,921	3,439

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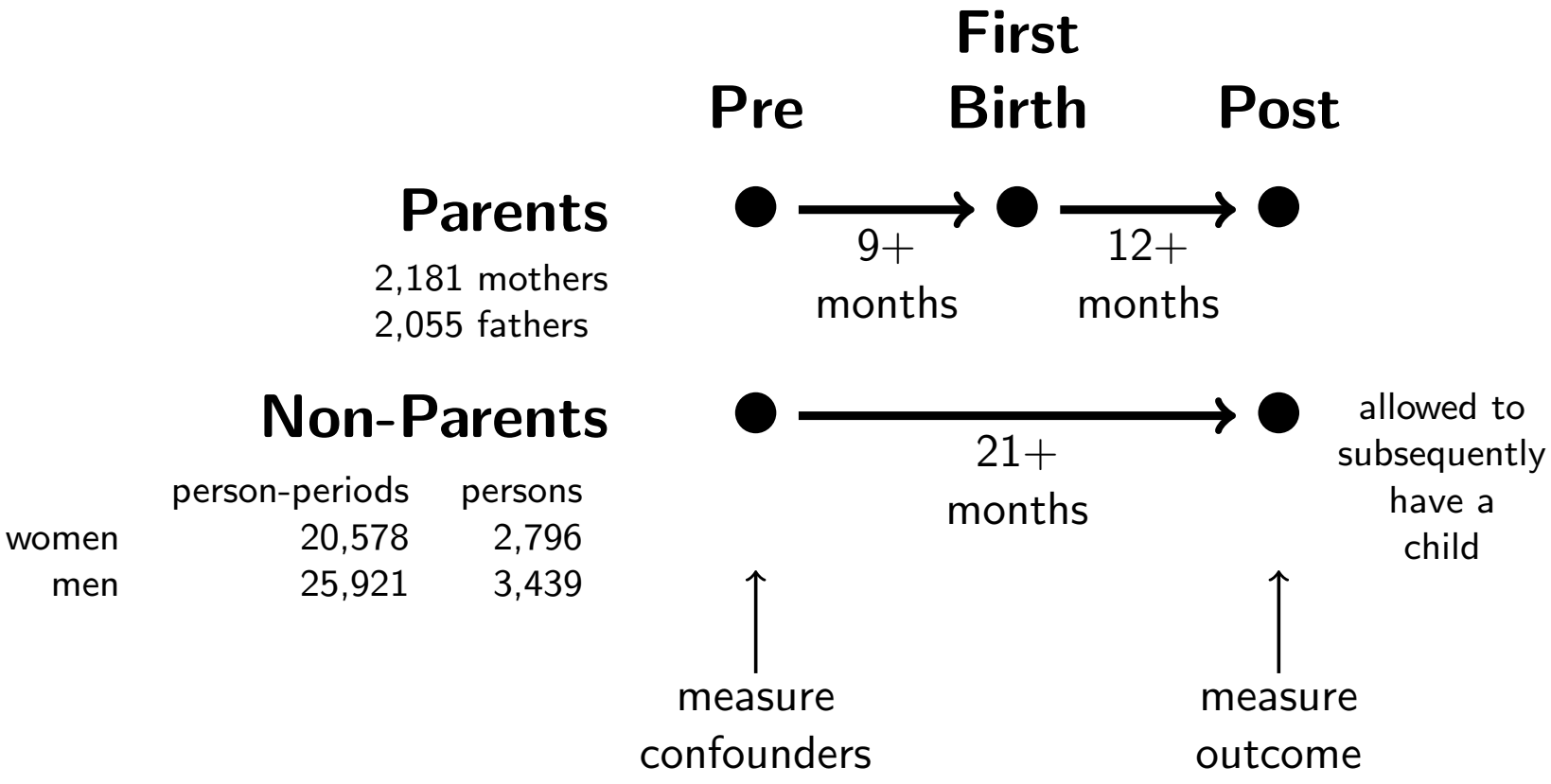

	person-periods	persons
women	20,578	2,796
men	25,921	3,439

$$
\begin{aligned}
\log(\text{Wage}) = \beta_0 &+ \beta_1(\text{Mother}) \\
&+ \beta_2(\text{Age}) \\
&+ \beta_3(\text{Married}) \\
&+ \beta_4(\text{Education}) \\
&+ \beta_5(\text{Work Experience}) \\
&+ \beta_6(\text{Full-Time}) \\
&+ \beta_7(\text{Tenure in Job}) \\
&+ \epsilon
\end{aligned}
$$

Maya

Maya

	if a mother	−	if not	=	effect
employment		−		=	
wage		−		=	

Maya

	if a mother	—	if not	=	effect
employment		—		=	
wage		—		=	

Maya

	if a mother	—	if not	=	effect
employment		—		=	
wage		—		=	

Maya

	if a mother	—	if not	=	effect
employment		—		=	0
wage		—		=	

Maya

	if a mother	—	if not	=	effect
employment		—		=	0
wage	$30	—		=	

Maya

	if a mother	—	if not	=	effect
employment		—		=	0
wage	$30	—	$40	=	

Maya

	if a mother	−	if not	=	effect
employment		−		=	0
wage	$30	−	$40	=	−$10

Mia

	if a mother	—	if not	=	effect
employment		—		=	
wage		—		=	

Mia

	if a mother	—	if not	=	effect
employment		—		=	
wage		—		=	

Mia

	if a mother	—	if not	=	effect
employment		—		=	
wage		—		=	

Mia

	if a mother	−	if not	=	effect
employment		−		=	-1
wage		−		=	

Mia

	if a mother	−	if not	=	effect
employment		−		=	-1
wage	??	−		=	

Mia

	if a mother	−	if not	=	effect
employment		−		=	-1
wage	??	−	$20	=	

Mia

	if a mother	−	if not	=	effect
employment		−		=	-1
wage	??	−	$20	=	??

Mia

	if a mother		if not		effect
employment		−		=	−1
wage	??	−	$20	=	??

Principal Stratification
Frangakis & Rubin 2002; Zhang & Rubin 2003
For an intro, see Miratrix et al. 2018

Maya

if a mother	−	if not	=	effect
	−		=	0
$30	−	$40	=	−$10

Mia

if a mother	−	if not	=	effect
	−		=	−1
??	−	$20	=	??

Maya

if a mother	−	if not	=	effect
	−		=	0
$30	−	$40	=	−$10

Nancy

if a mother	−	if not	=	effect
	−		=	0
$30	−	$40	=	−$10

Mia

if a mother	−	if not	=	effect
	−		=	−1
??	−	$20	=	??

Nia

if a mother	−	if not	=	effect
	−		=	−1
??	−	$20	=	??

Maya is a Mother

if a mother	−	if not	=	effect
	−		=	0
$30	−	$40	=	−$10

Nancy is a Non-Mother

if a mother	−	if not	=	effect
	−		=	0
$30	−	$40	=	−$10

Mia is a Mother

if a mother	−	if not	=	effect
	−		=	−1
??	−	$20	=	??

Nia is a Non-Mother

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Nancy is a Non-Mother

if a mother	−	if not	=	effect
	−		=	0
$30	−	$40	=	−$10

Mia is a Mother

if a mother	−	if not	=	effect
	−		=	−1
??	−	$20	=	??

DROPPED

Nia is a Non-Mother

if a mother	−	if not	=	effect
	−		=	−1
??	−	$20	=	??

Average Observed

$30

Maya is a Mother

if a mother	−	if not	=	effect
	−		=	0
$30	−	$40	=	−$10

Nancy is a Non-Mother

if a mother	−	if not	=	effect
	−		=	0
$30	−	$40	=	−$10

Mia is a Mother

if a mother	−	if not	=	effect
	−	DROPPED	=	−1
??	−	$20	=	??

Nia is a Non-Mother

if a mother	−	if not	=	effect
	−		=	−1
??	−	$20	=	??

Average Observed

$30

Average Observed

$30

Maya is a Mother

if a mother	−	if not	=	effect
	−		=	0
$30	−	$40	=	−$10

Nancy is a Non-Mother

if a mother	−	if not	=	effect
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$30	−	$40	=	−$10

Mia is a Mother

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	−		=	−1
??	−	$20	=	??

Nia is a Non-Mother

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Maya is a Mother

if a mother	−	if not	=	effect
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	−		=	−1
??	−	$20	=	??

Nia is a Non-Mother

if a mother	−	if not	=	effect
	−		=	−1
??	−	$20	=	??

1) Average effect of motherhood on employment

Maya is a Mother

if a mother	−	if not	=	effect
	−		=	0
$30	−	$40	=	−$10

Nancy is a Non-Mother

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	−		=	0
$30	−	$40	=	−$10

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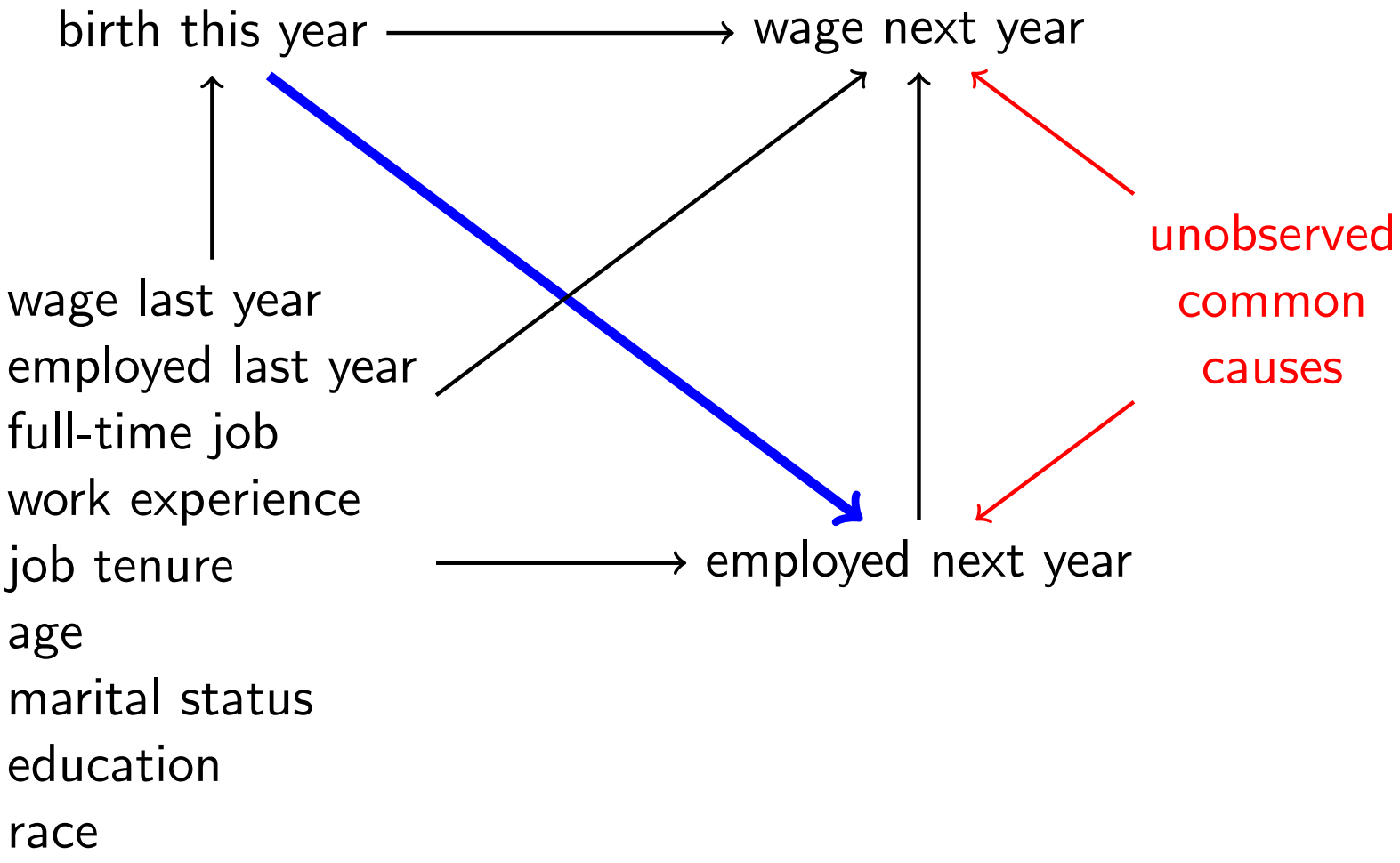
	−		=	−1
??	−	$20	=	??

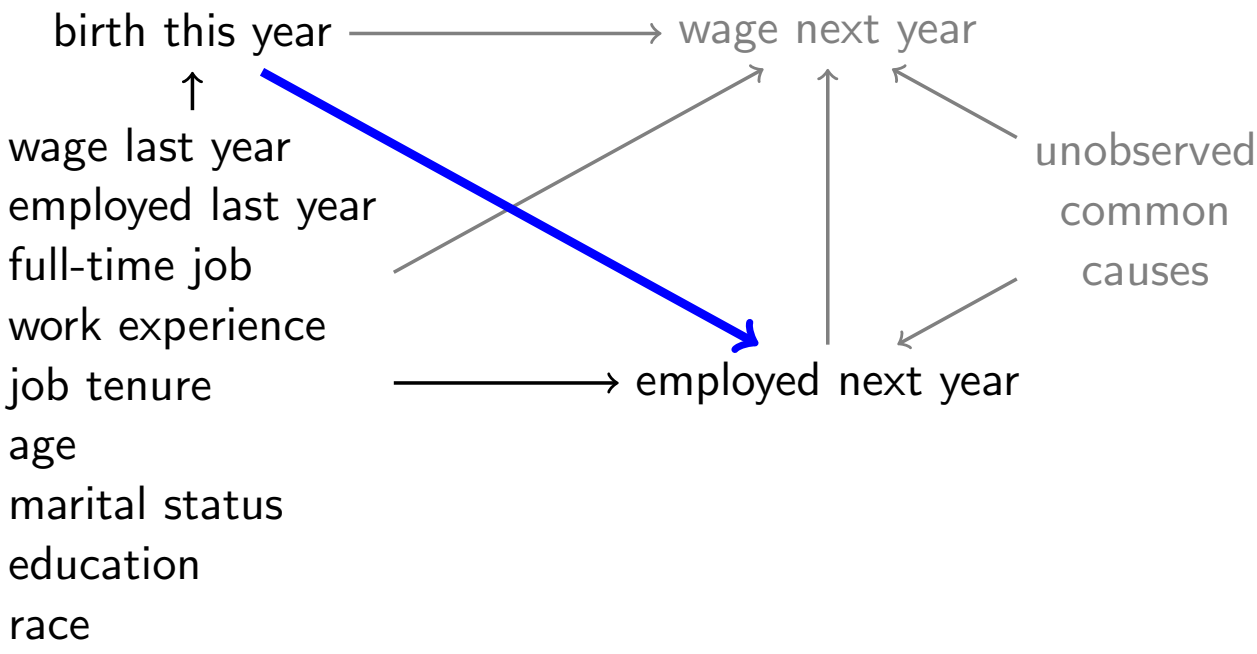
1) Average effect of motherhood on employment

2) Wage effect among those employed regardless

Causal assumptions

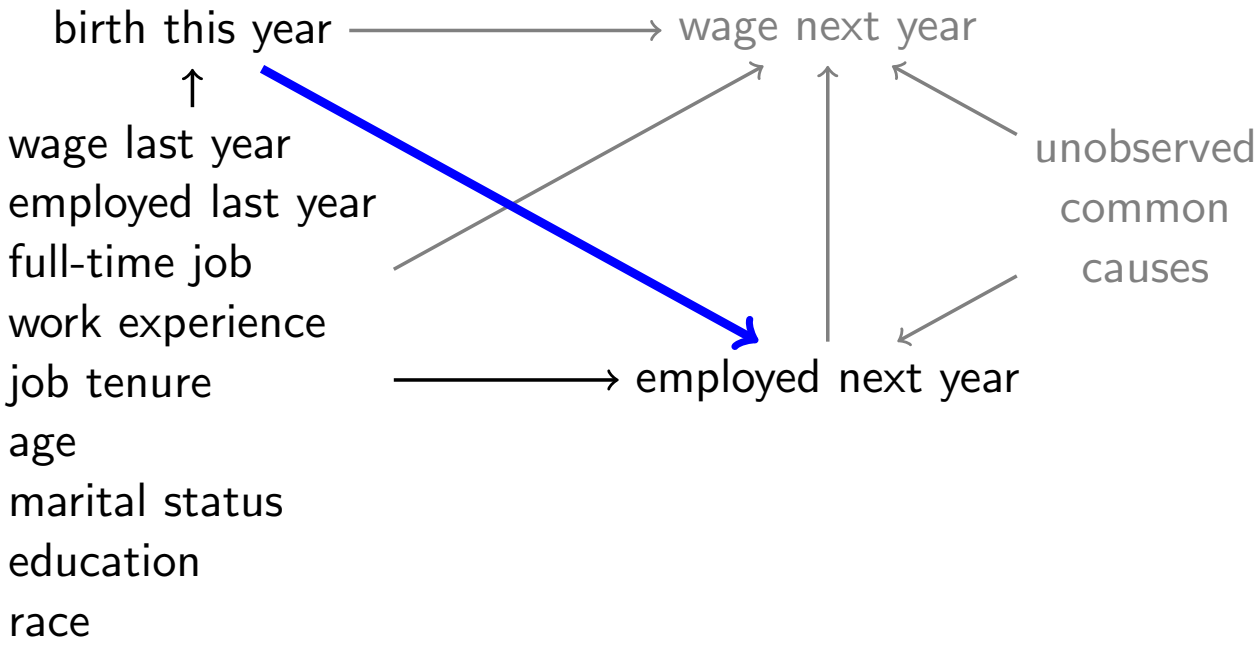


Estimation: Effect on employment



Estimation: Effect on employment

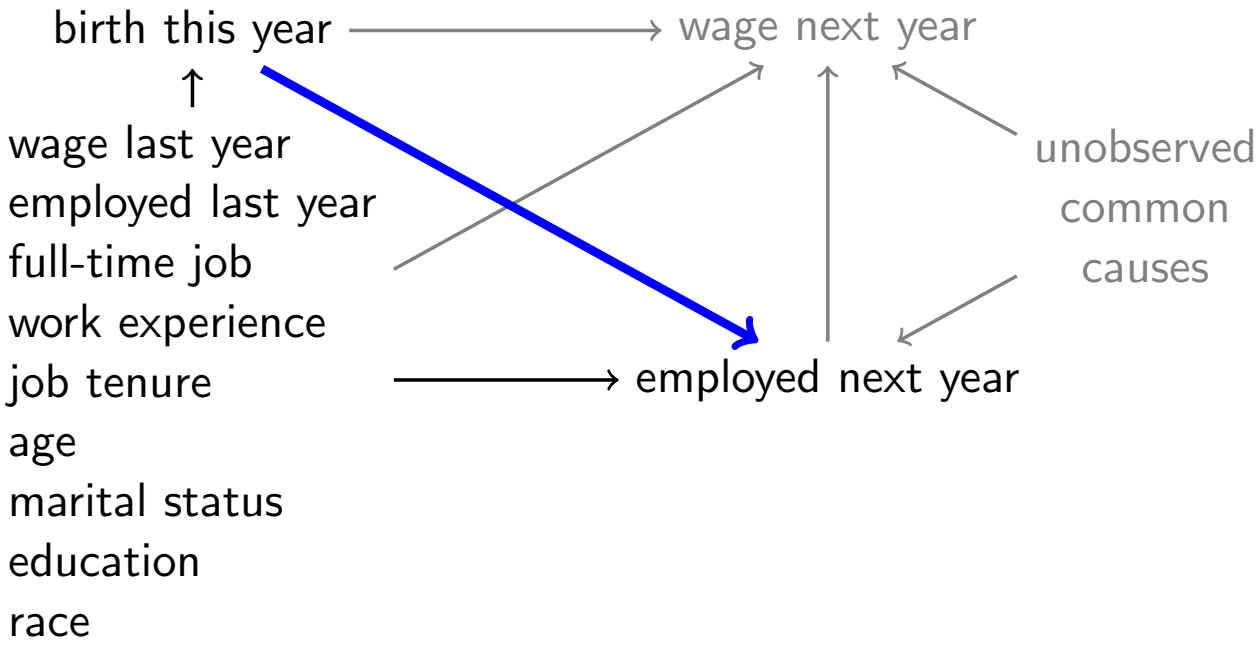
Model employment given birth and confounders



Estimation: Effect on employment

Model employment given birth and confounders

1) recode birth as `TRUE`. Predict for everyone

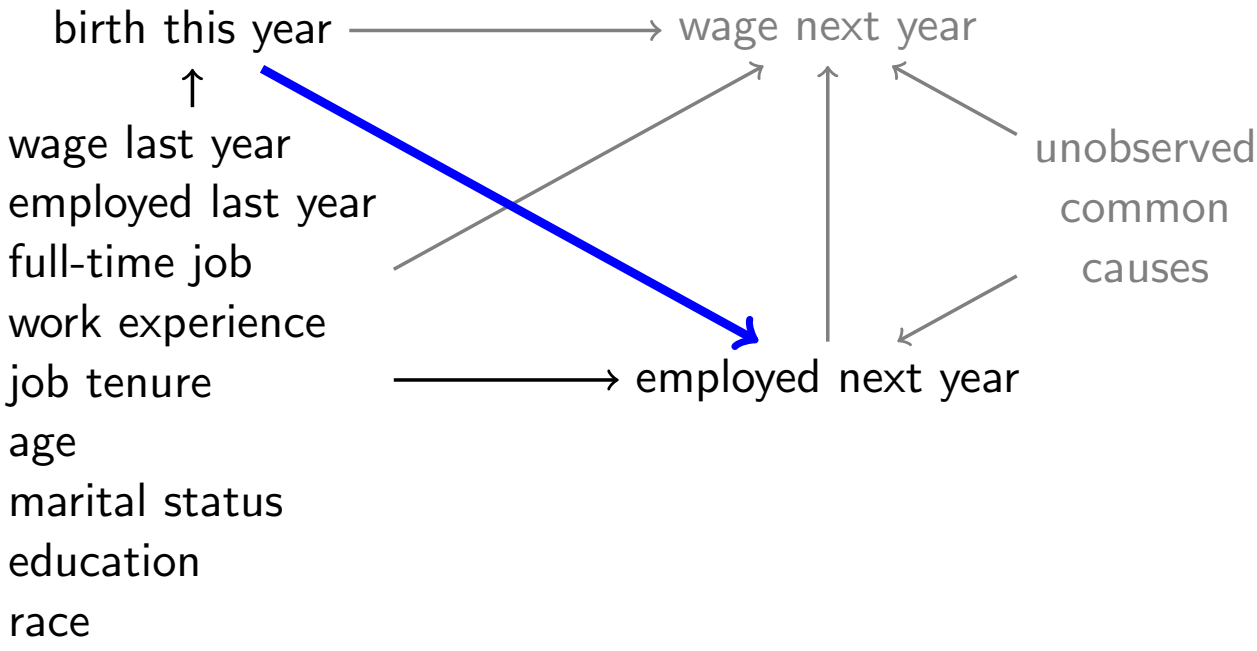


Estimation: Effect on employment

Model employment given birth and confounders

1) recode birth as `TRUE`. Predict for everyone

2) recode birth as `FALSE`. Predict for everyone



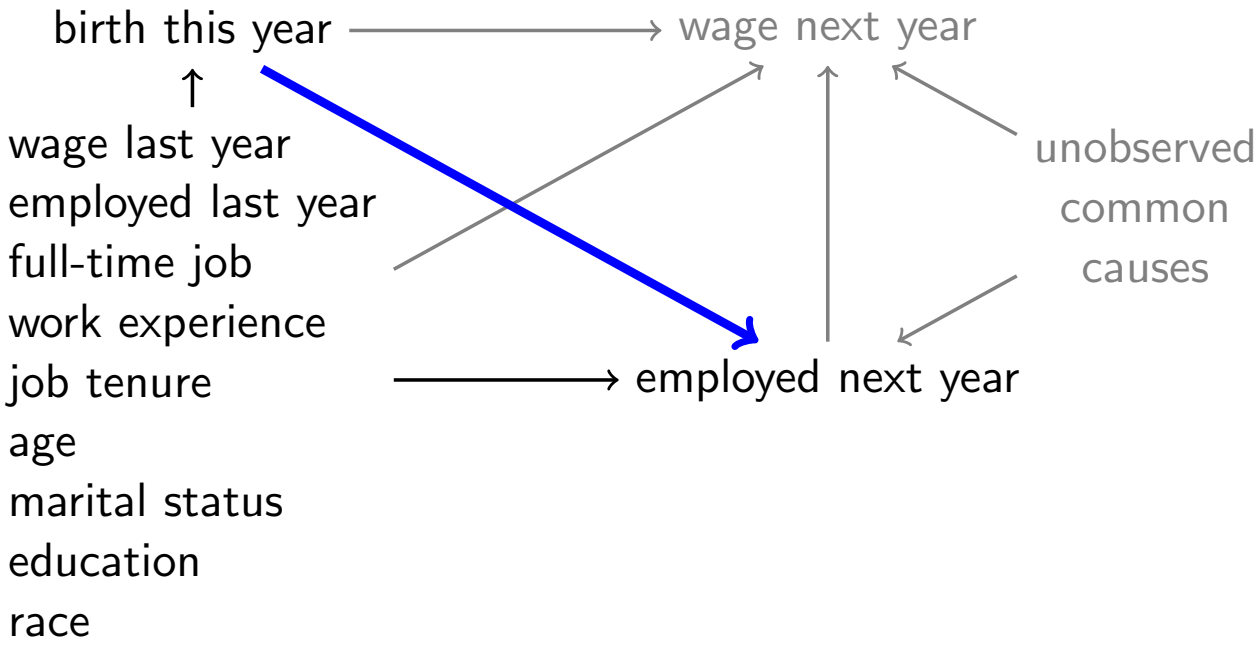
Estimation: Effect on employment

Model employment given birth and confounders

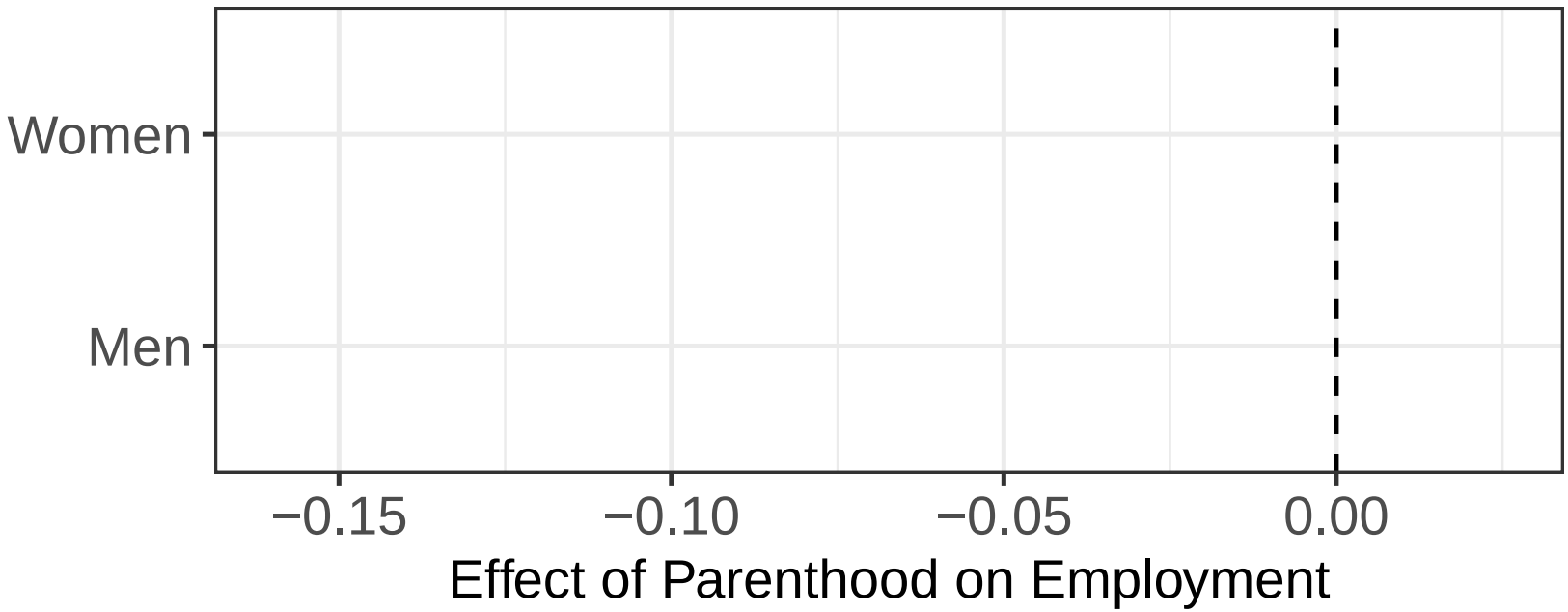
1) recode birth as `TRUE`. Predict for everyone

2) recode birth as `FALSE`. Predict for everyone

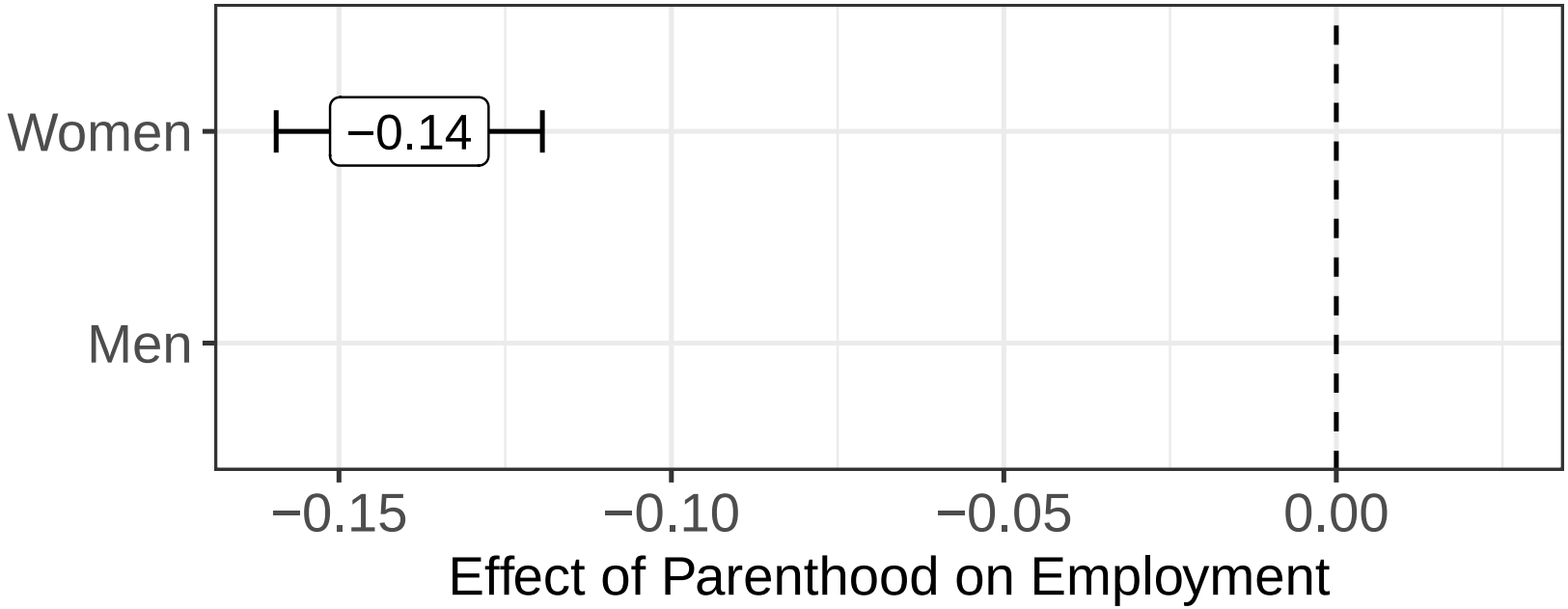
average (1) − (2) among the mothers



Results: Effect on employment



Results: Effect on employment



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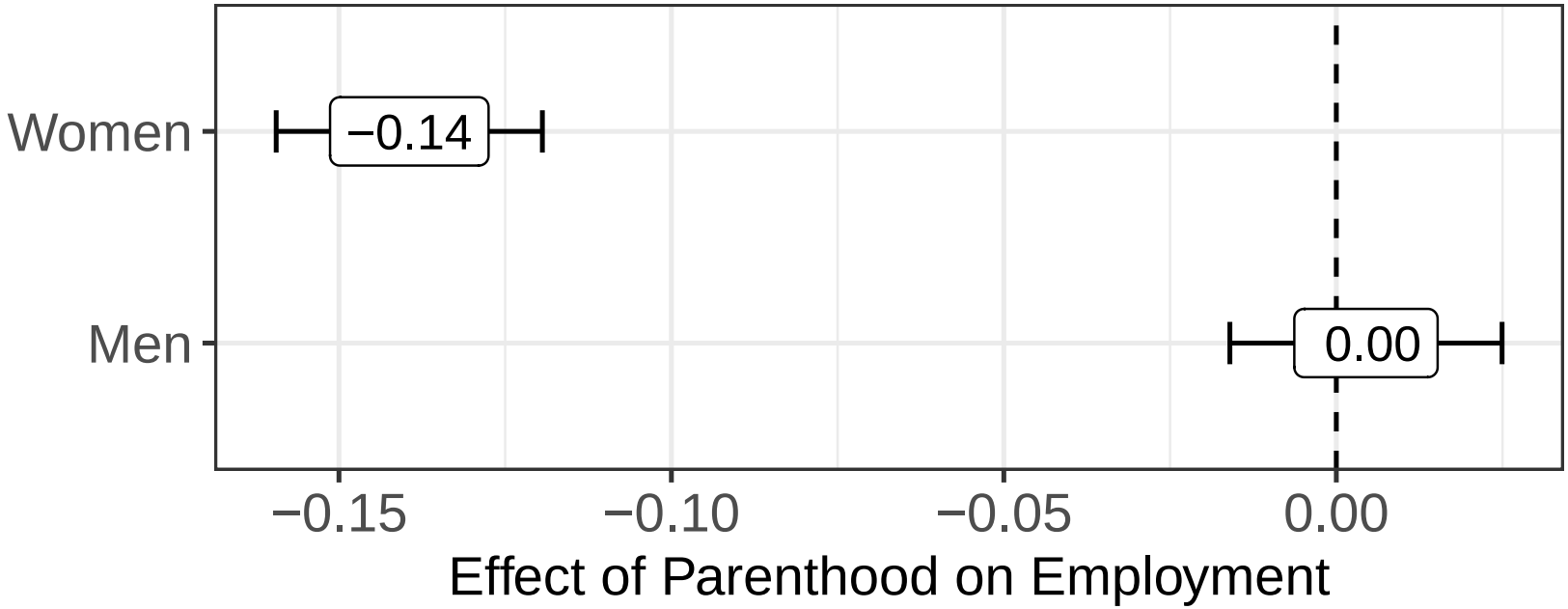
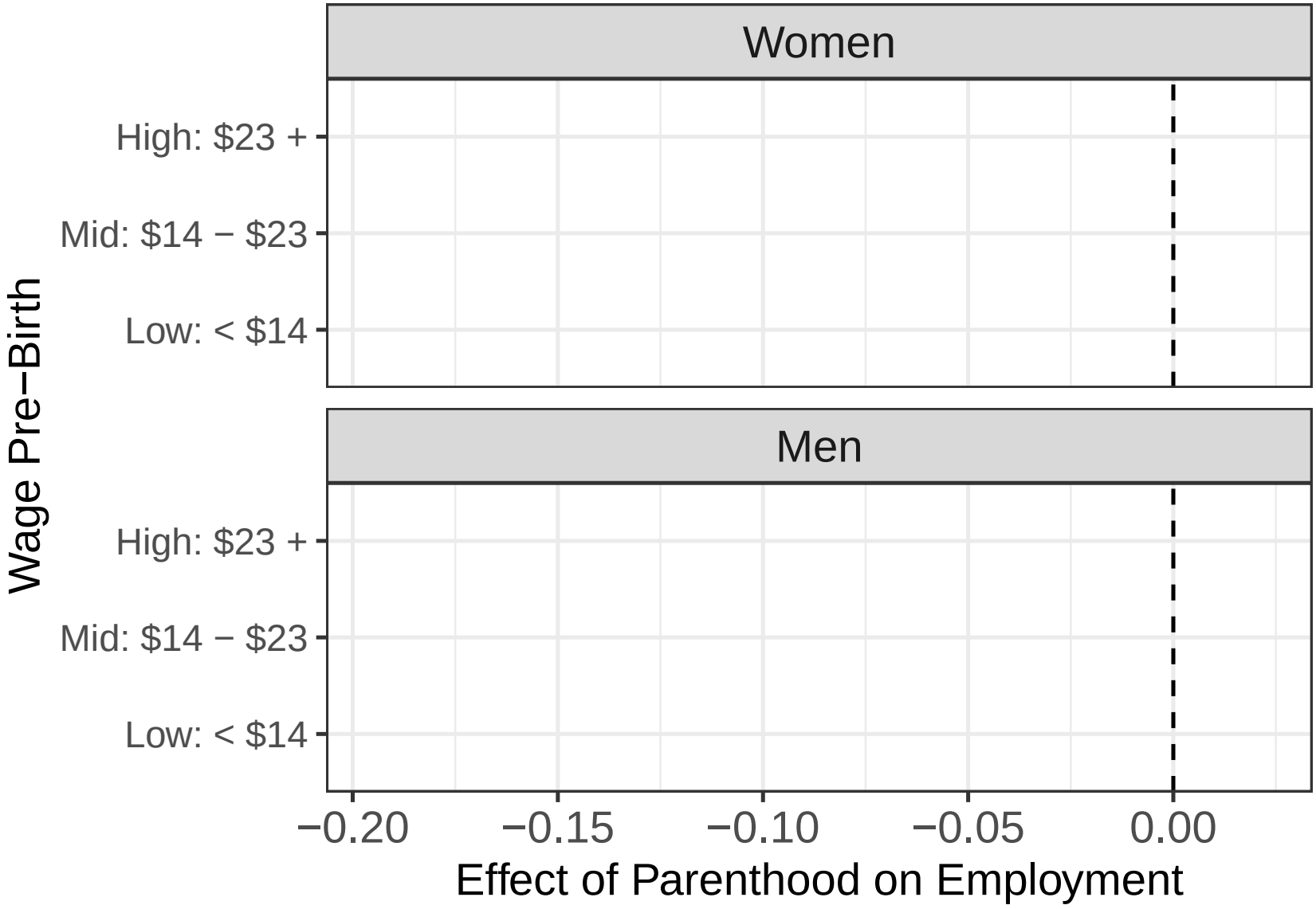


Results: Effect on employment



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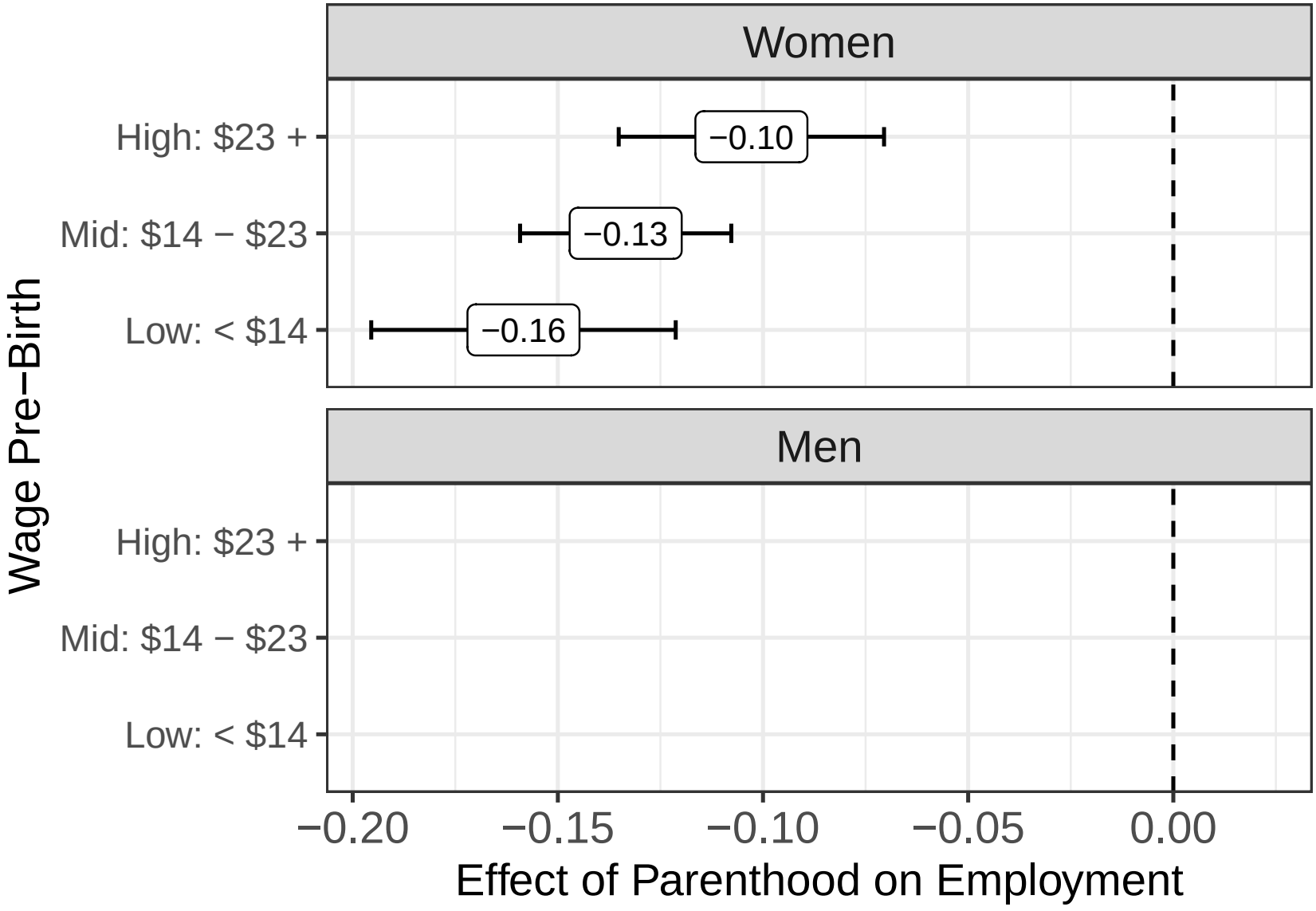

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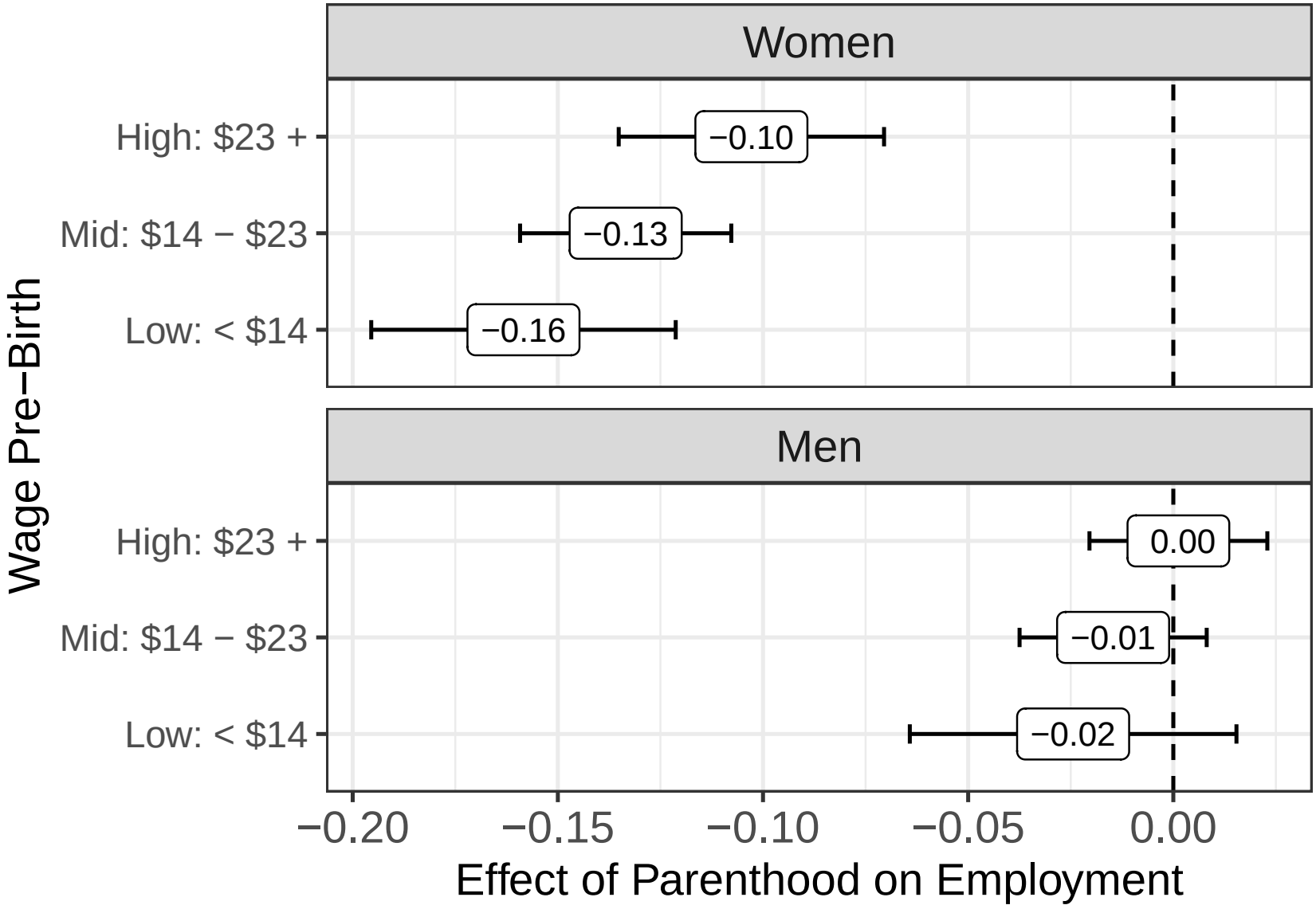

Maya is a Mother

if a mother	−	if not	=	effect
	−		=	0
$30	−	$40	=	−$10

Nancy is a Non-Mother

if a mother	−	if not	=	effect
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Mia is a Mother

if a mother	−	if not	=	effect
	−		=	−1
??	−	$20	=	??

Nia is a Non-Mother

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1) Average effect of motherhood on employment

2) Wage effect among those employed regardless

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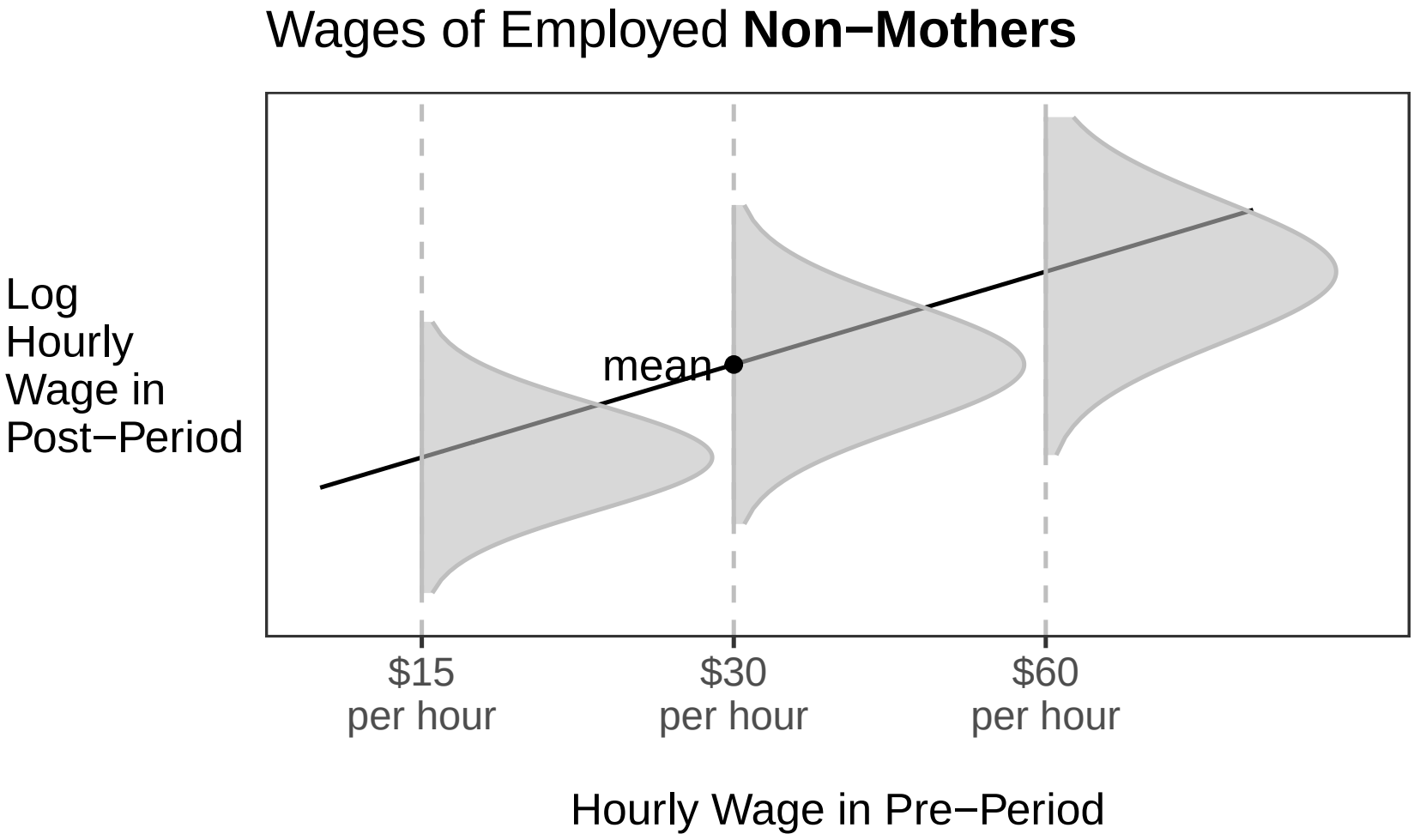
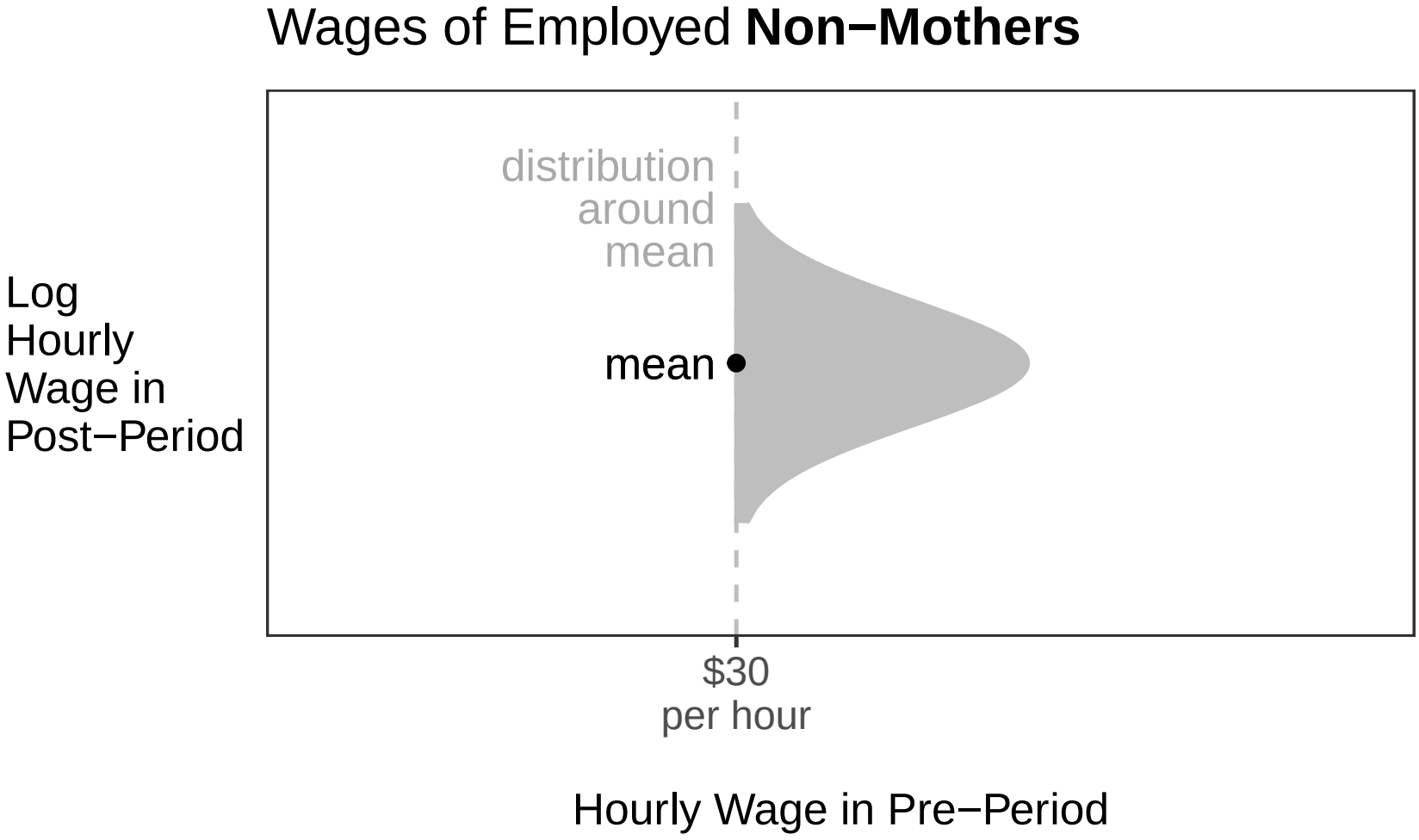
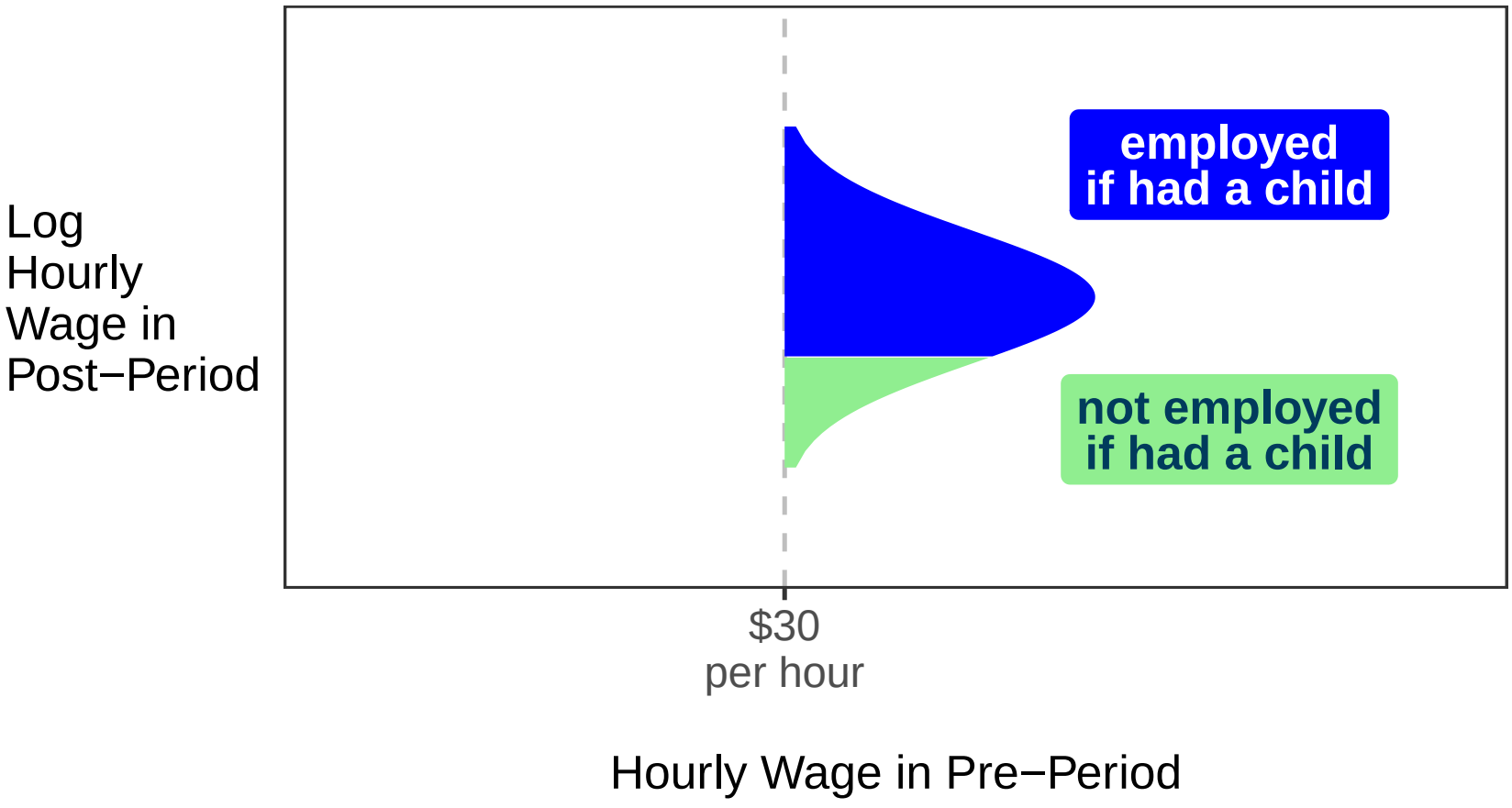
1) Average effect of motherhood on employment

2) Wage effect among those employed regardless

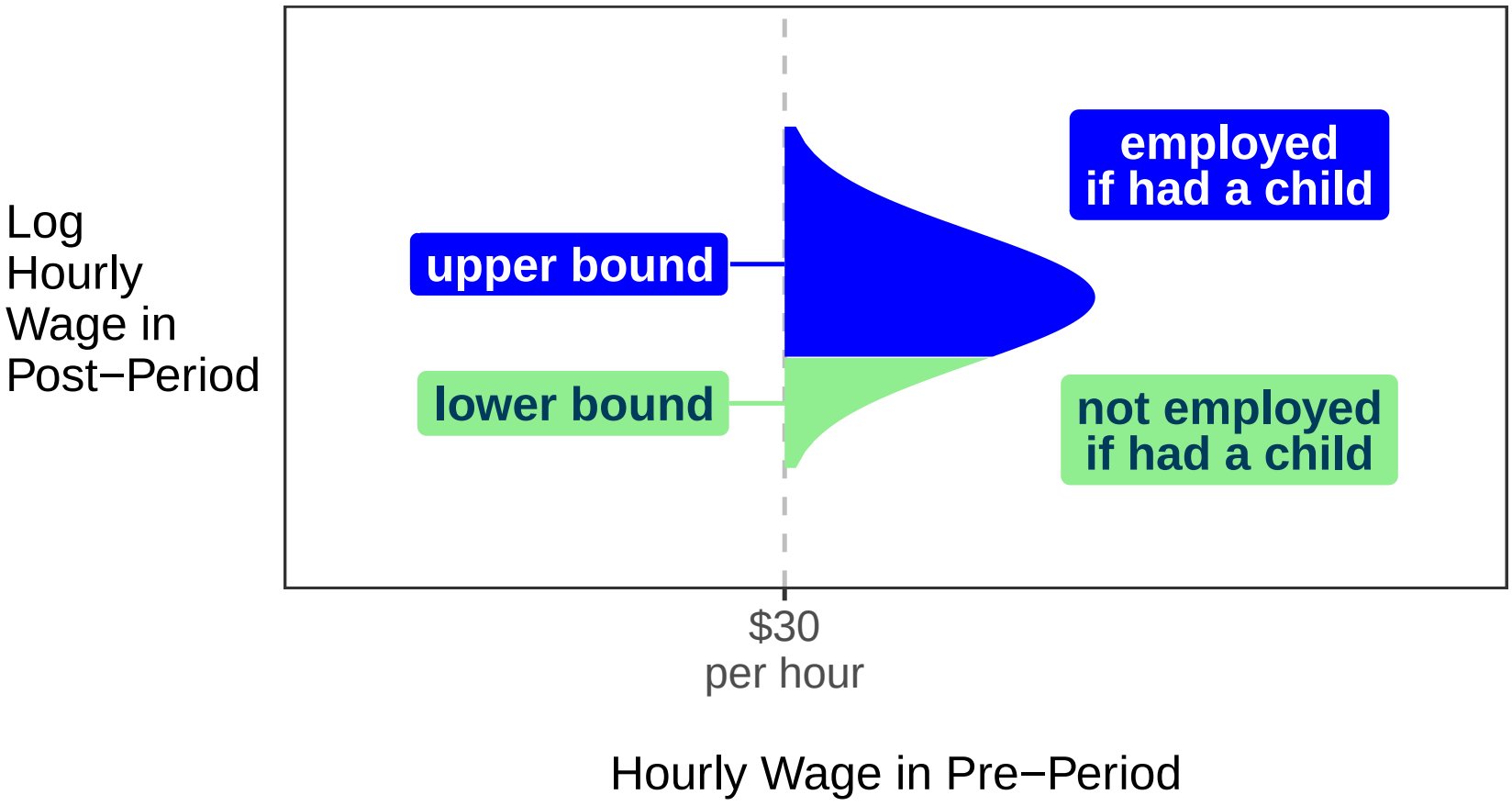

Wages of Employed **Non−Mothers**
Log Hourly Wage in Post−Period
mean
$15 per hour
$30 per hour
$60 per hour
Hourly Wage in Pre−Period


Wages of Employed **Non−Mothers**
distribution
around
mean
mean
Log
Hourly
Wage in
Post−Period
$30
per hour
Hourly Wage in Pre−Period

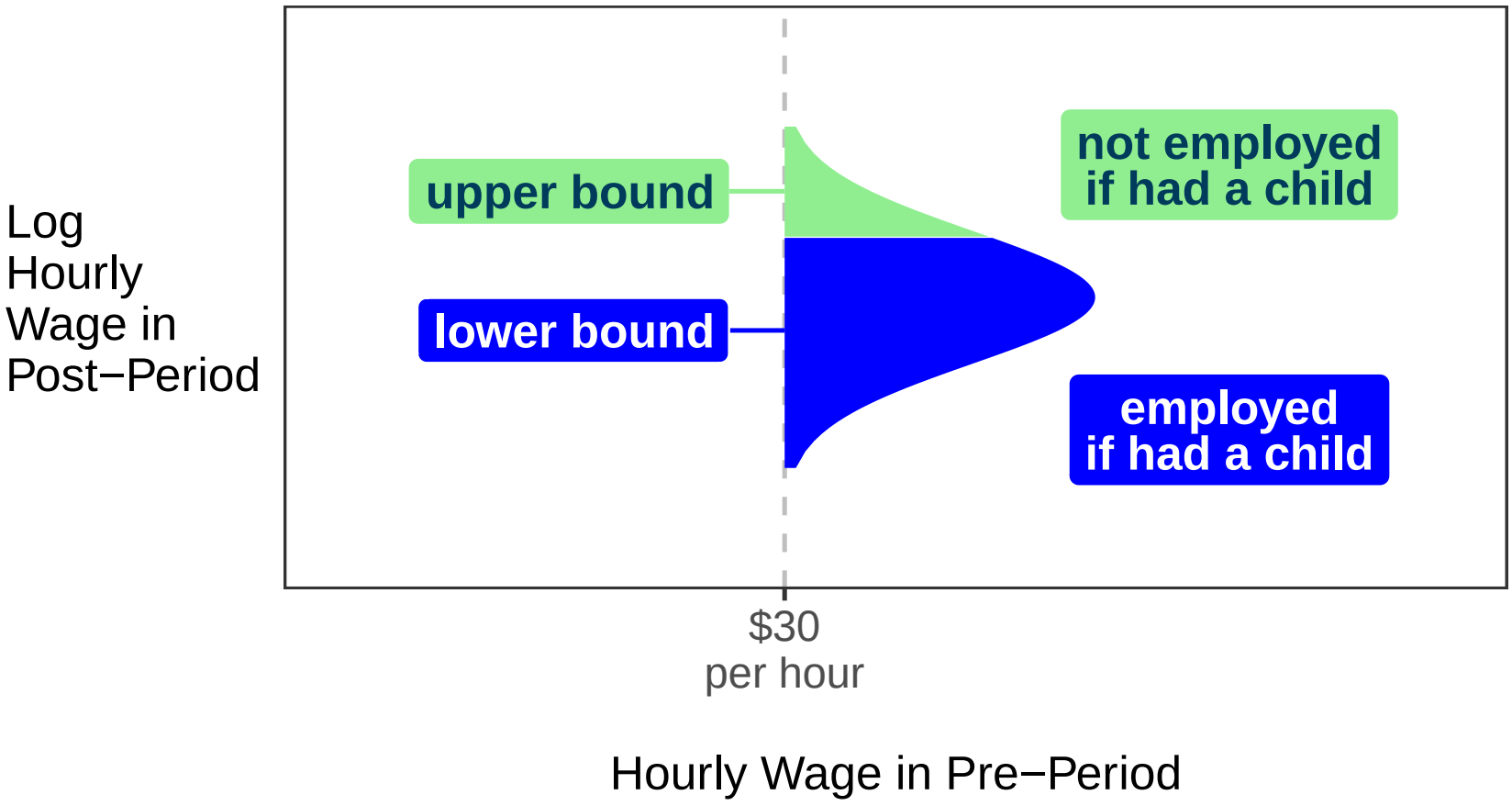
Wages of Employed **Non−Mothers**



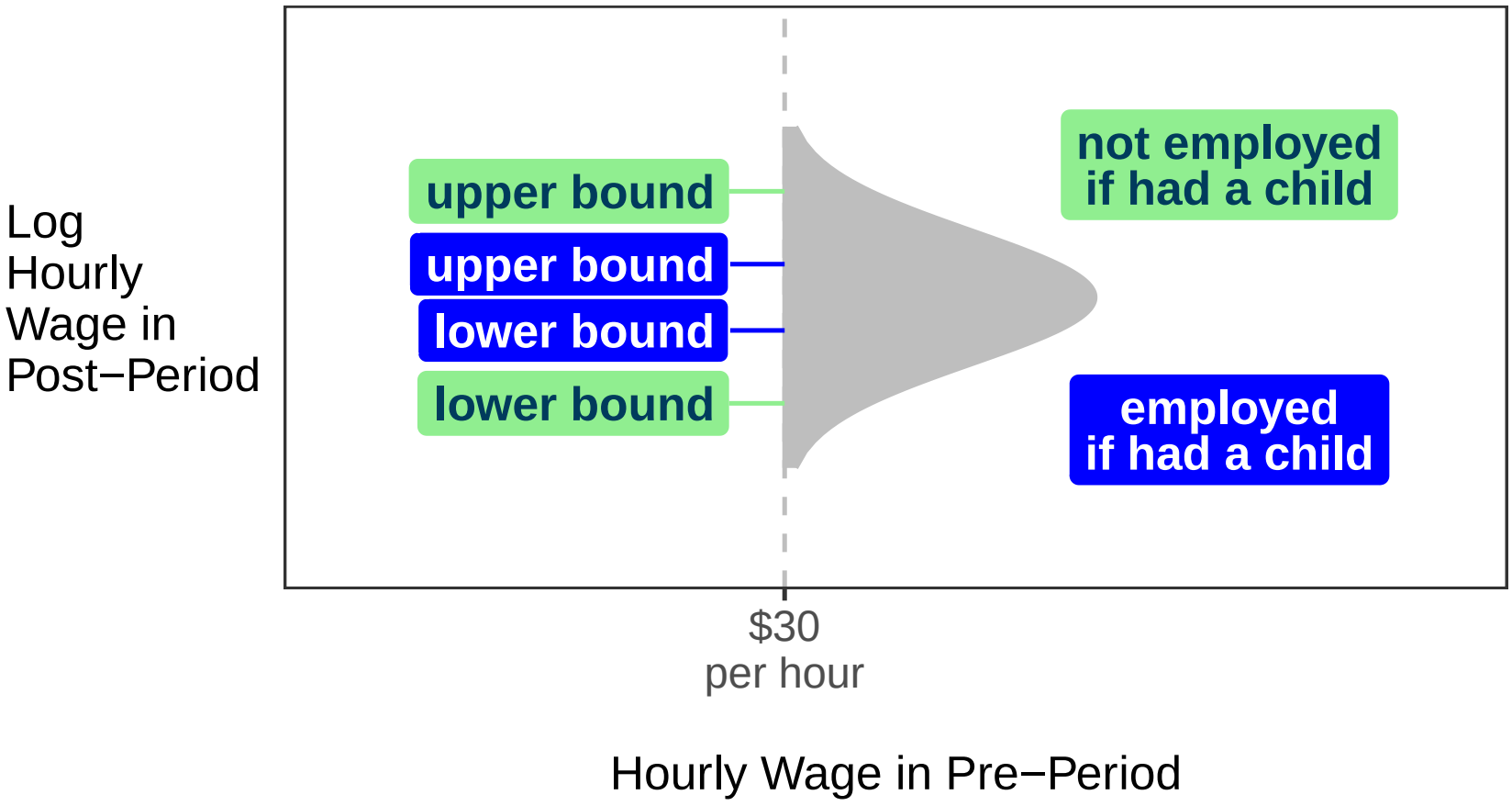
Wages of Employed **Non−Mothers**



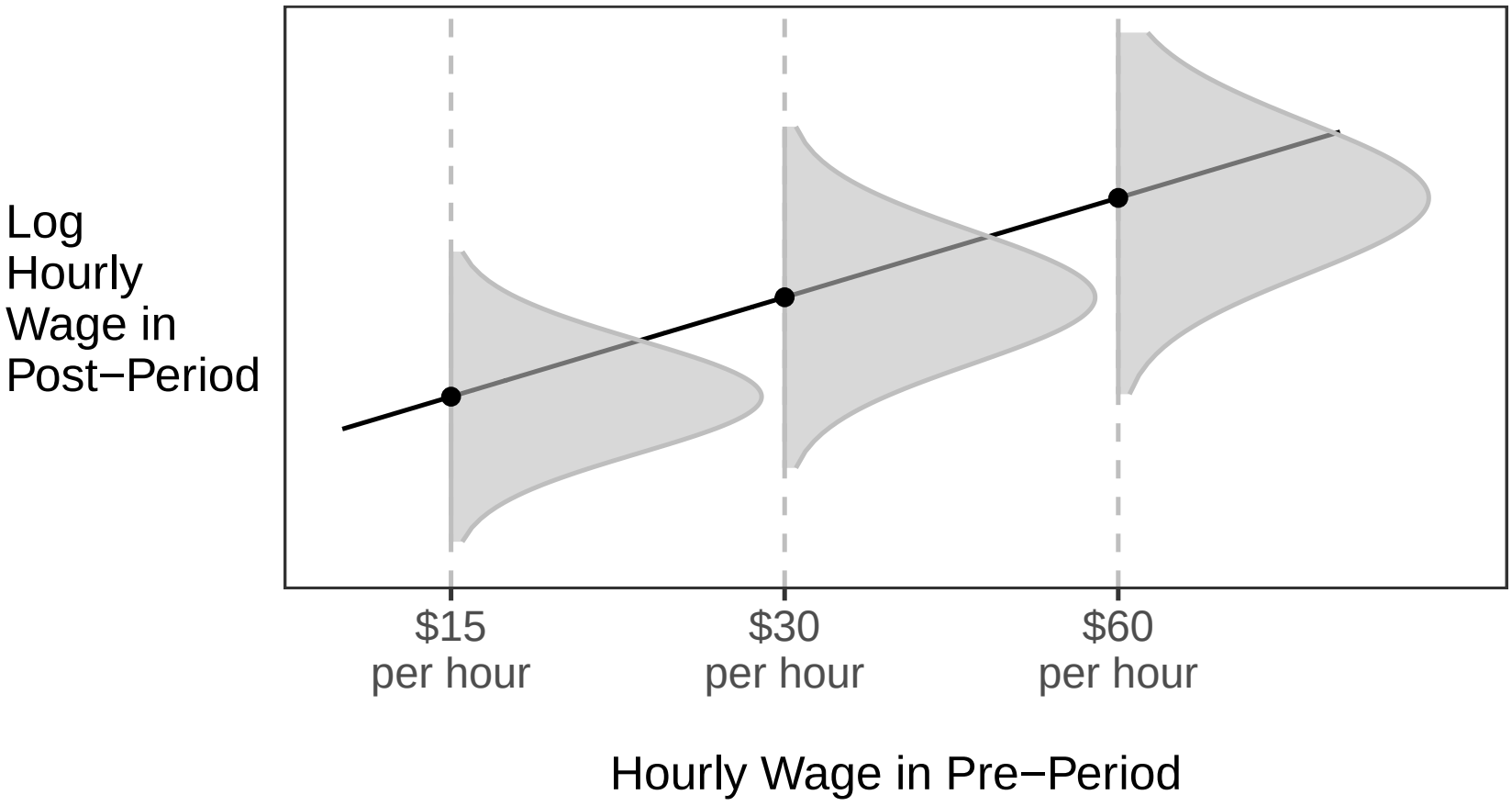
Wages of Employed **Non−Mothers**



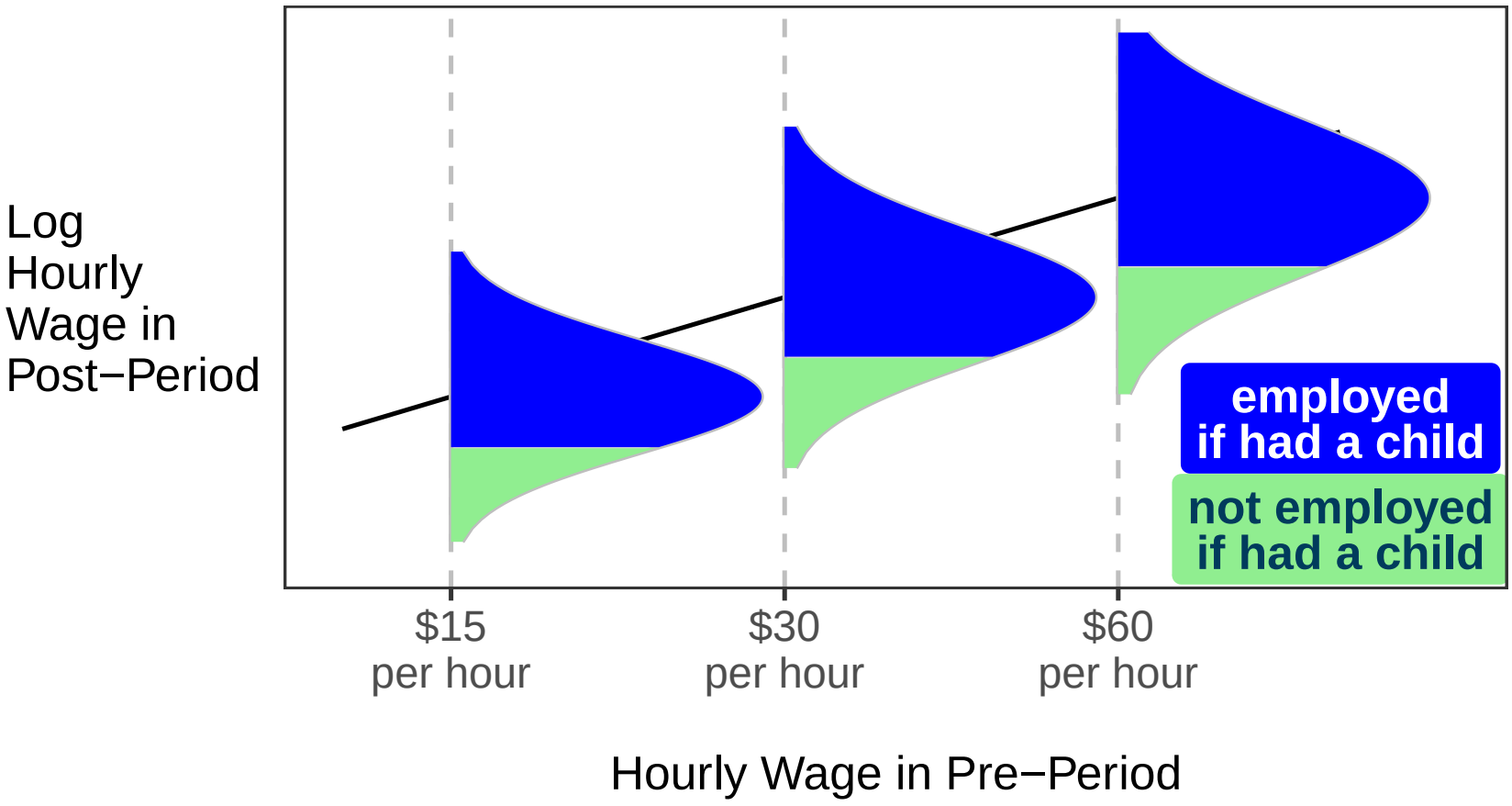
Wages of Employed **Non−Mothers**



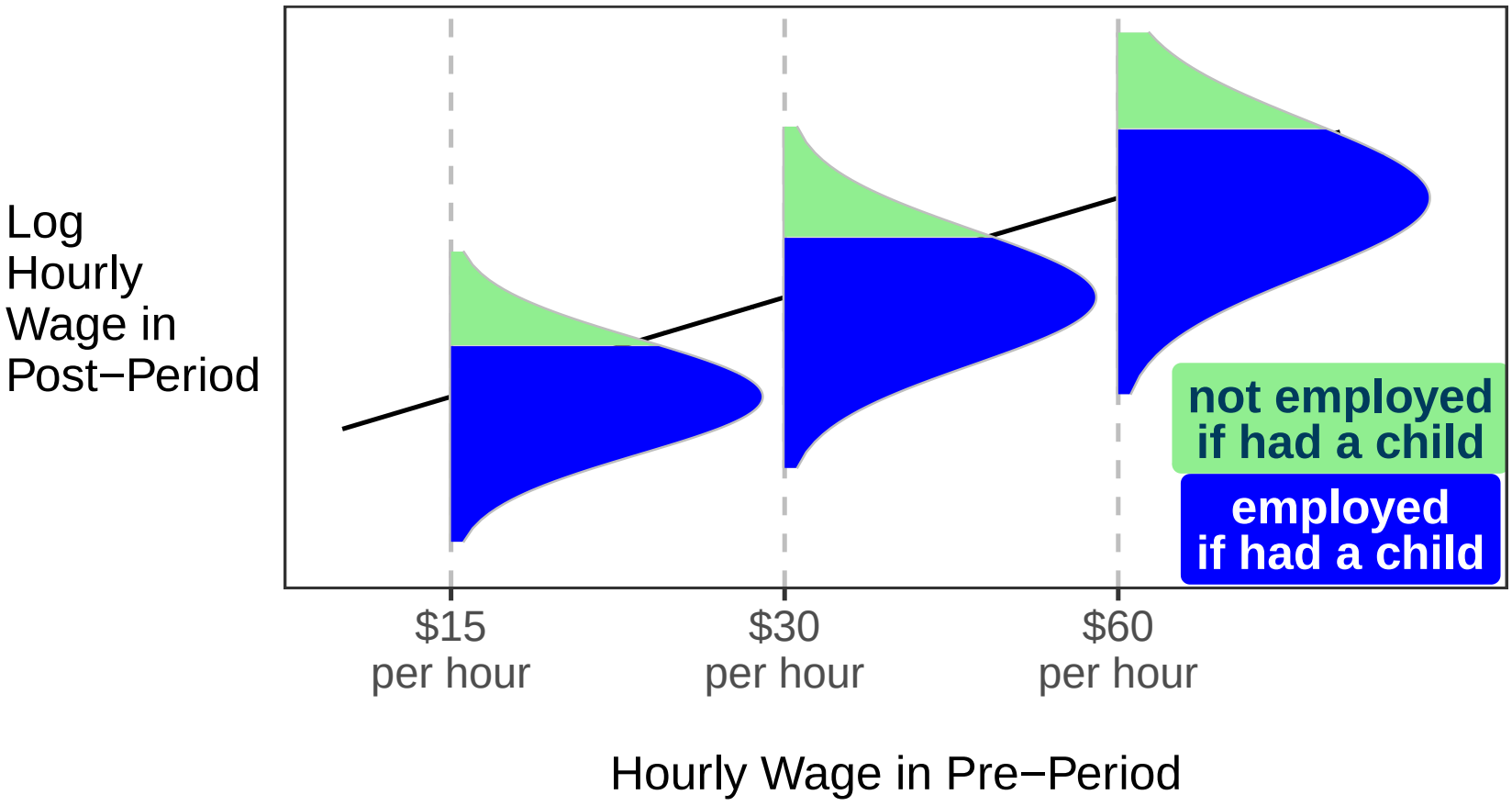
Wages of Employed **Non−Mothers**



Wages of Employed **Non−Mothers**



Wages of Employed **Non−Mothers**



bound this ↓

Log wage of **as a mother** − **as a non-mother**

among those who would be employed in either condition

bound this ↓

Log wage of **as a mother** − **as a non-mother**

among those who would be employed in either condition

Assumption

Employed mothers would also be employed
if they had no children

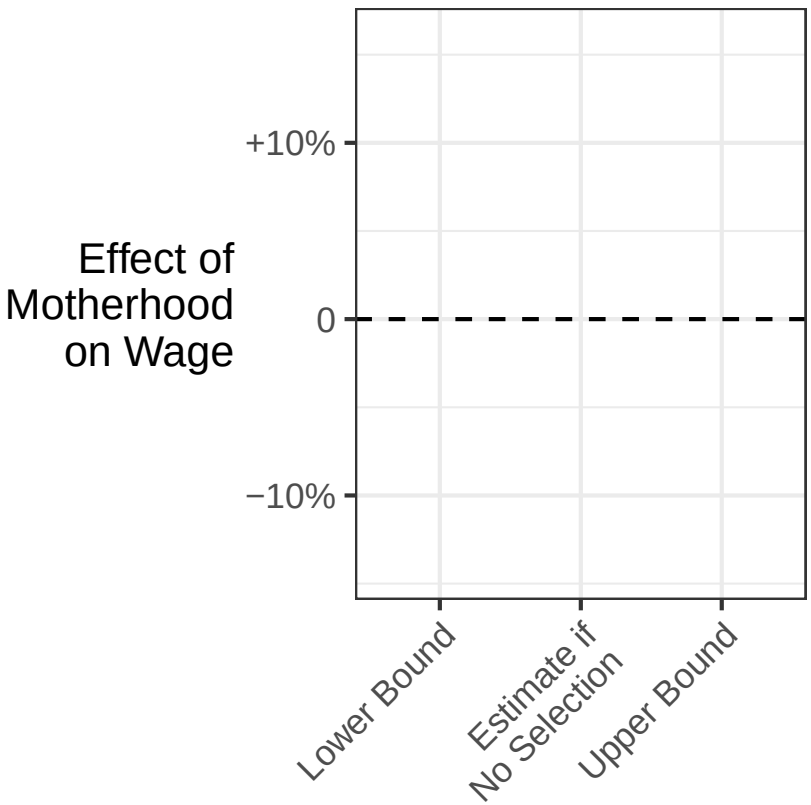
simple **bound**
mean **this**
↓ ↓

Log wage of **as a mother** − **as a non-mother**

among those who would be employed in either condition

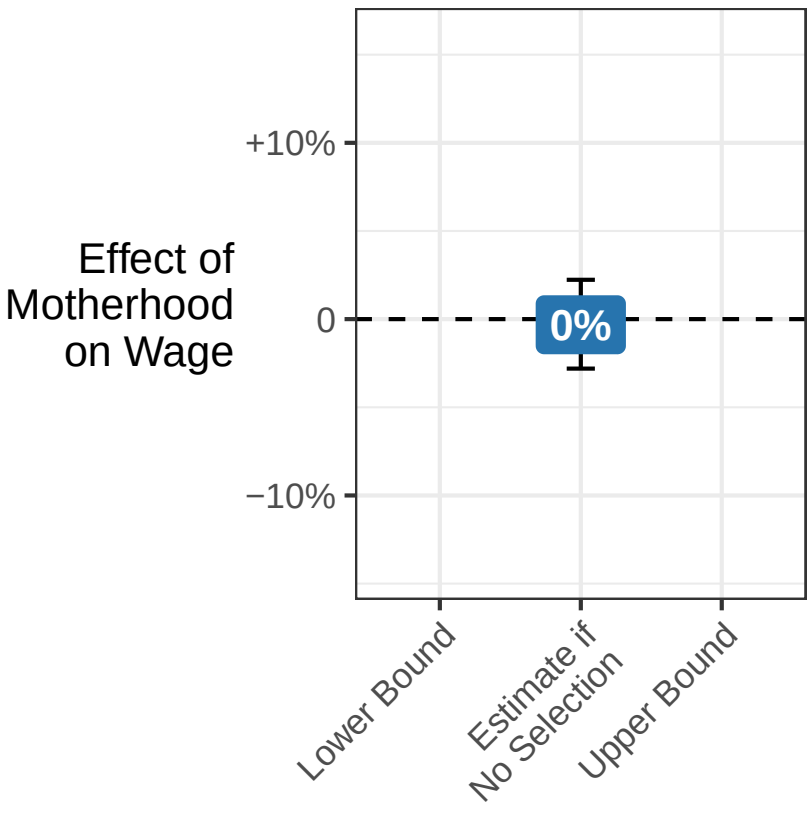
Assumption
Employed mothers would also be employed
if they had no children

Results

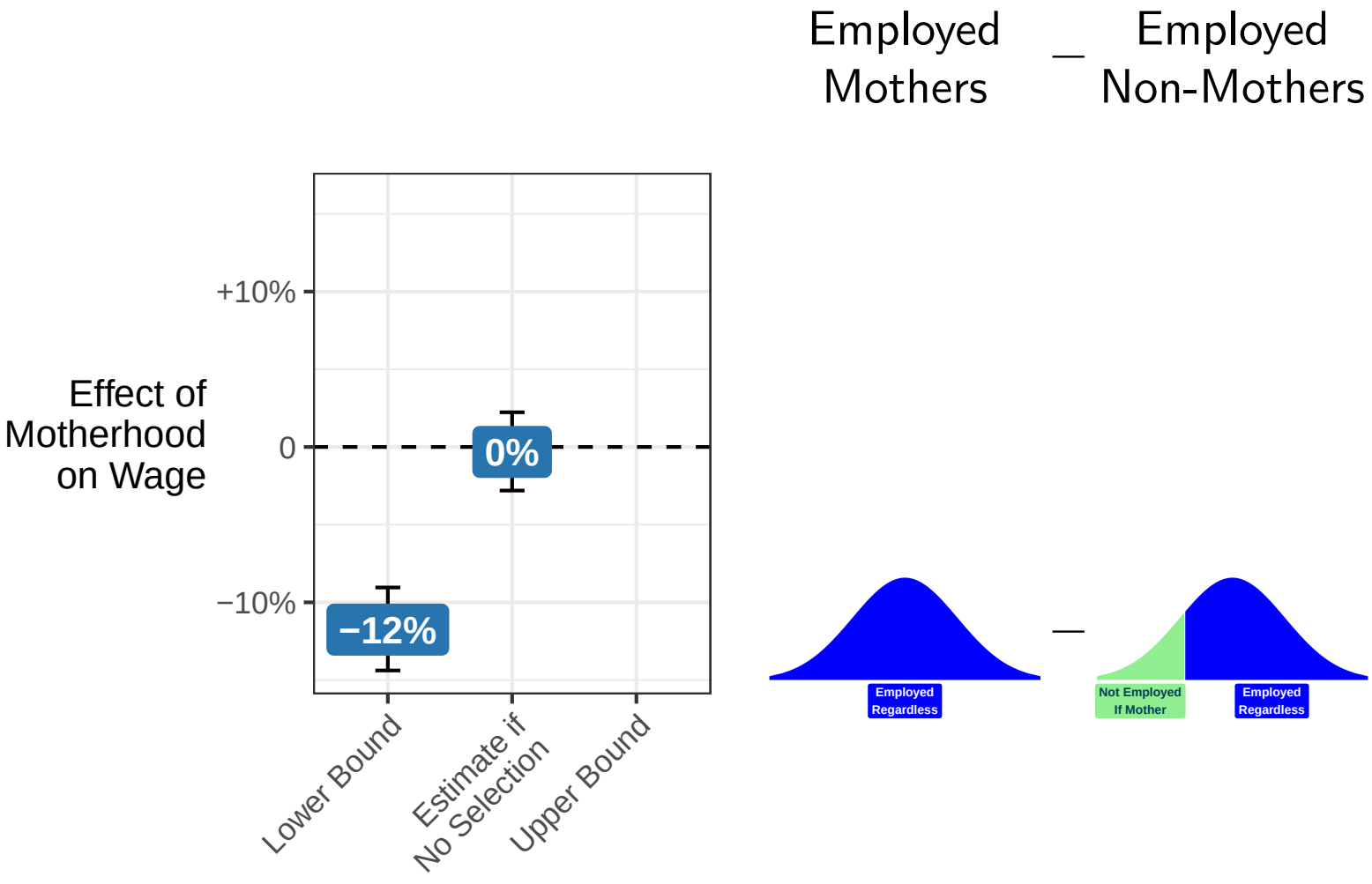

Effect of Motherhood on Wage
+10%
0
−10%
Lower Bound
Estimate if No Selection
Upper Bound

Results

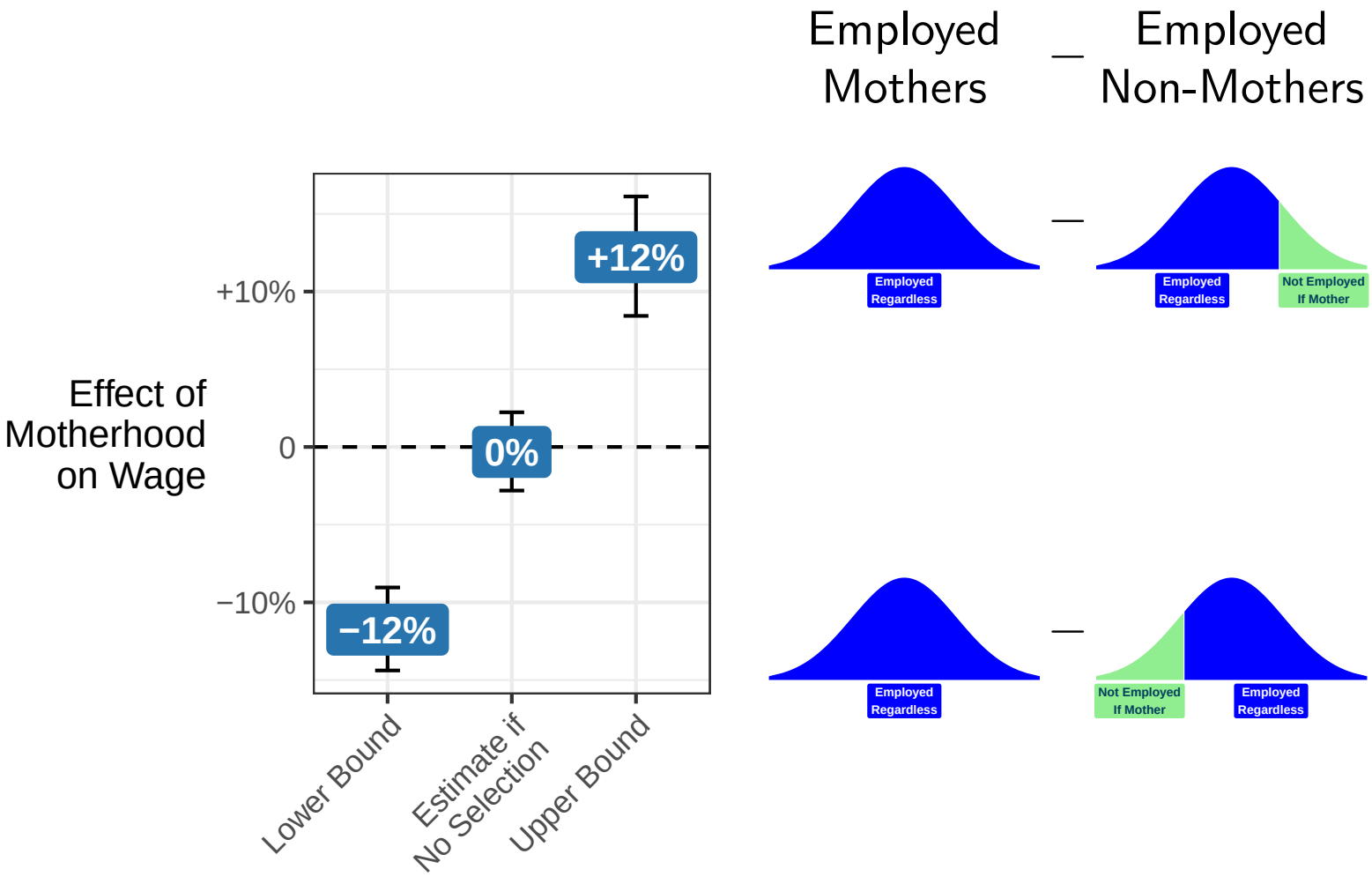
Employed Mothers _ Employed Non-Mothers



Results


Employed Mothers
–
Employed Non-Mothers
Effect of Motherhood on Wage
+10%
0
−10%
0%
−12%
Lower Bound
Estimate if No Selection
Upper Bound
Employed Regardless
–
Not Employed If Mother
Employed Regardless

Results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What we know that we did not know before

We knew

in recent years, motherhood only weakly predicts pay*

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*among the employed

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This fact is consistent with two stories

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This fact is consistent with two stories

1. motherhood's causal effect on pay is small

What we know that we did not know before

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in recent years, motherhood only weakly predicts pay*

*among the employed

This fact is consistent with two stories

1. motherhood's causal effect on pay is small

or

2. employed non-mothers are the wrong comparison population

What we know that we did not know before

We knew

in recent years, motherhood only weakly predicts pay*

*among the employed

This fact is consistent with two stories

1. motherhood's causal effect on pay is small

or

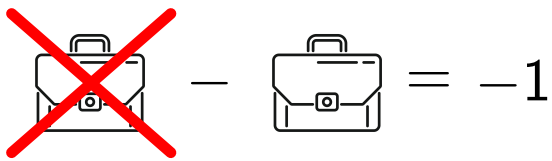
2. employed non-mothers are the wrong comparison population
   - lowest-earning non-mothers might stop paid work with a child

What we know that we did not know before

We know how to think
about outcomes that
don't exist

What we know that we did not know before

We know how to think
about outcomes that
don't exist

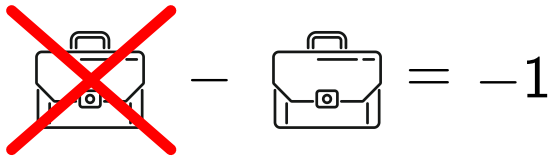


$$- \quad = -1$$

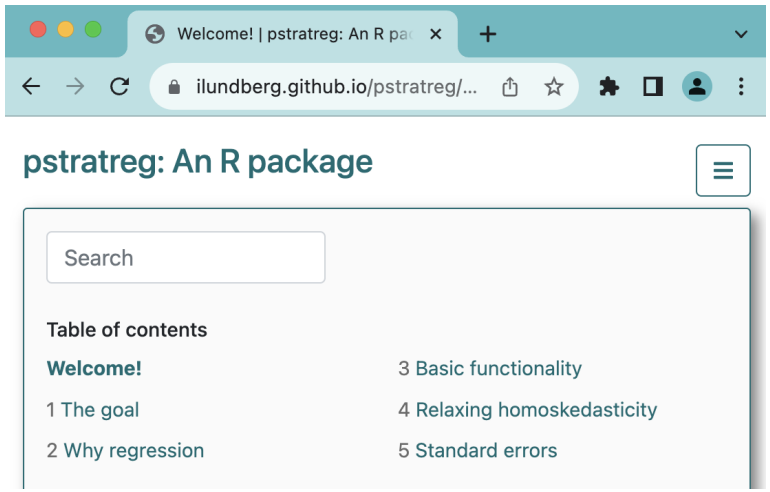
$$?? \quad - \quad \$25 \quad = \quad ??$$

What we know that we did not know before

We know how to think about outcomes that **don't exist**



$$?? - \$25 = ??$$



pstratreg {pstratreg} R Documentation

Estimate Principal Stratification Regression Bounds

Description

Uses principal stratification and parametric models to bound the average causal effect among those who would have a valid outcome under either treatment condition

Usage

```
pstratreg(
  formula_y,
  formula_m,
  family_y = "gaussian",
  homoskedastic = T,
  data,
  weights = NULL,
  treatment_name,
  monotonicity_positive = FALSE,
  monotonicity_negative = FALSE,
  aggregate = TRUE,
  group_vars = NULL
)
```

Learning goals for today

At the end of class, you will be able to

1. define effects when some potential outcomes do not exist
2. estimate by bounding
3. connect ideas from this class to current research