Treatment Effect of Mother's Work Status and the Respondent's Likelihood to be in Prison

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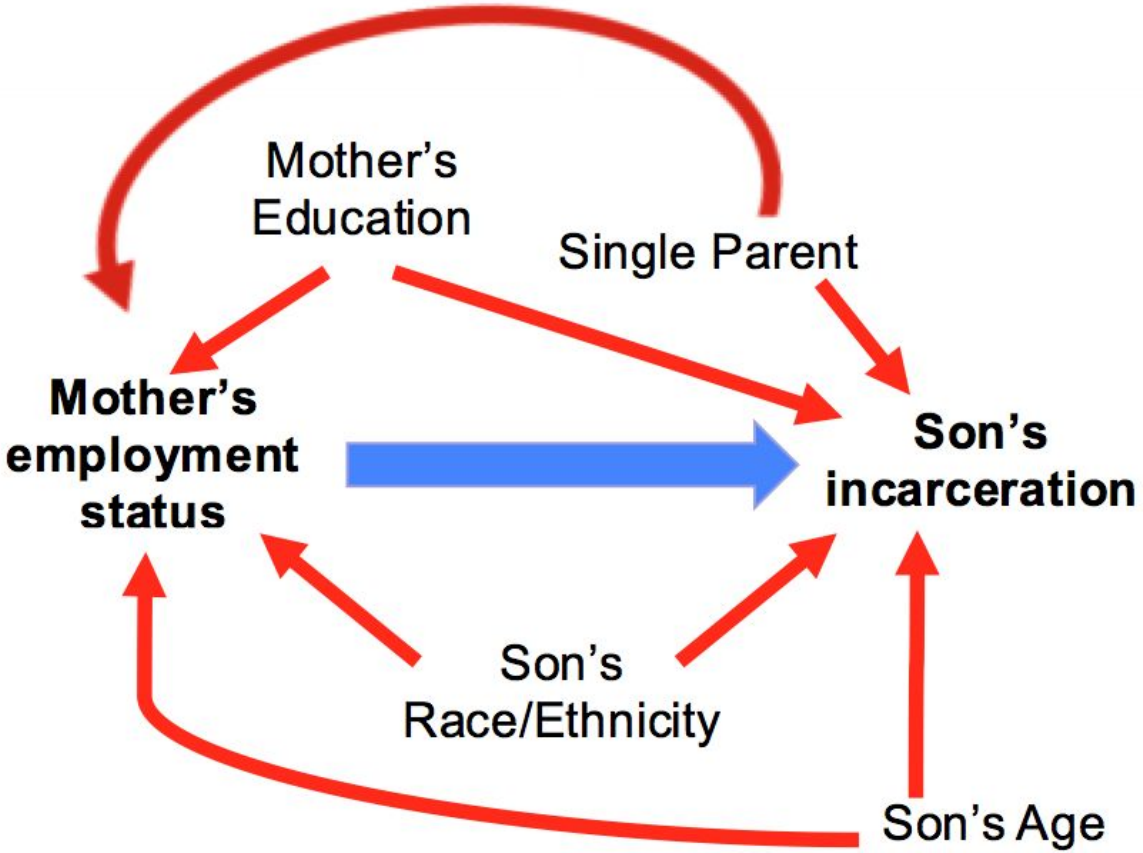
Background

Despite declining crime rates since the 1990s, the prison system in the United States is heavily utilized even today. According to published research, youth from low-income families, especially men, are more likely to engage in criminal behavior that results in incarceration.[1] It is also found that economic-related stress diminishes parental involvement in children's lives as they are maturing into adults because these parental figures have to work outside of the home to survive financially. Additionally, children who grow up in single parent households or whose parents' marital status have been disrupted are more likely to have emotional and behavioral problems that lead to delinquency.[2] Overall, poor parental supervision and weak familial ties also increase this risk of delinquency.[3]

Research Question

Does whether or not mother worked while the son was 5 to 15 years old impact whether or not her son was ever jailed?

Directed Acyclic Graph



Dataset

Our question was analyzed using the National Survey for Family Growth (NSFG) dataset. The specific dataset we used was the 2011-2013 NSFG survey for males aged 15-44.[4] This was a cross-sectional study with a 5 stage sampling design as follows: i) selection of primary sampling units (PSUs) that consists of Metropolitan Statistical Areas based on census data, counties, and groups of counties; ii) selection of secondary sampling units (SSUs) with a minimum measure of size equal to 50 household units; iii) listing and selection of housing units within SSUs that are selected systematically and then contacted by interviewers to determine if anyone in the household was eligible to participate by distributing screening questionnaires at their doorsteps; iv) selecting one of the eligible persons within each sampled household; iv) two-phase sampling for nonresponse and subsample selected for continued follow-up.[5]

Exclusion Criteria

Below is a list of exclusion criteria:

Total number of male interviews = 4,815

Missing data (don’t know, refusal) = 456

Final sample size = 4,359

NSFG is a weighted dataset.[5] Hispanics, African-Americans and teenagers were oversampled in comparison to their proportional representation in the U.S. population.[6] This oversampling was done to ensure that the number of respondents in each of these groups were large enough to draw valid statistical inferences. We, however, did not apply weights when using R software for our TMLE analysis.

Variables

Y: Whether the respondent was ever jailed

A: Whether or not mother worked (either full time or part time) when the respondent was between age 5 - 15

W: Age of respondent
Race of respondent
Mother's education level
Whether responded lived at home with both parents

Estimand

The average effect of mother's working status during the respondent's childhood on outcome (whether the respondent was ever jailed):

$$\Psi(P_0) = E_{W,0}[E_0(Y|A=1,W)-E_0(Y|A=1,W)]$$

Method

We used the TMLE package in R to calculate the TMLE estimate of the average treatment effect.

Into the TMLE package, we included the following algorithms:

- Y ~ SL.glm_All + SL.step_All + SL.glm.interaction_All + SL.gbm_All + SL.rpartPrune_All + SL.earth_All + SL.bayesglm_All
- A ~ SL.glm_All + SL.step_All + SL.glm.interaction_All + SL.gbm_All + SL.rpartPrune_All + SL.earth_All + SL.bayesglm_All

Using the results from the TMLE package, we also calculated IPTW estimate, one-step estimate, and their respective confidence intervals.

Results

Inverse Probability of Treatment Weighted (IPTW) Estimate

$$\widehat{\Psi}_{IPTW}(P_n) = \frac{1}{n}\sum_{i=1}^{n}\left(\frac{I(A_i = a)}{g_n(A_i = a|W_i)}Y_i\right)$$

$$\widehat{\Psi}_{IPTW}(P_n) = 0.0082$$

95% CI = (-0.011, 0.029)

One-Step (Augmented-IPTW) Estimate

$$\widehat{\Psi}_{A-IPTW}(P_n) = \frac{1}{n}\sum_{i=1}^{n}\left(\frac{I(A_i = 1) - I(A_i = 0)}{g_n(A_i = a|W_i)}(Y - \bar{Q}_n(A_i, W_i)\right) + \frac{1}{n}\sum_{i=1}^{n}(\bar{Q}_n(1, W_i) - \bar{Q}_n(0, W_i))$$

$$\widehat{\Psi}_{A-IPTW}(P_n) = 0.0054$$

95% CI = (-0.013, 0.025)

Y ~ SL.glm_All + SL.step_All + SL.glm.interaction_All + SL.gbm_All + SL.rpartPrune_All + SL.earth_All + SL.bayesglm_All

Algorithms	Coefficients
SL.glm_All	0
SL.step.All	0.2343217
SL.glm.interaction_All	0
SL.gbm_All	0.2932426
SL.rpartPrune_All	0.1784643
SL.earth_All	0.1306631
SL.bayesglm_All	0.1633082

A ~ SL.glm_All + SL.step_All + SL.glm.interaction_All + SL.gbm_All + SL.rpartPrune_All + SL.earth_All + SL.bayesglm_All

Algorithms	Coefficients
SL.glm_All	0
SL.step.All	0.1295436
SL.glm.interaction_All	0.2517624
SL.gbm_All	0.5294572
SL.rpartPrune_All	0.08923682
SL.earth_All	0
SL.bayesglm_All	0

Estimated Value of Epsilon

$$logit(E[Y|A,W]) - logit(\bar{Q}_0) = \varepsilon H(A,W)$$

$$H(A,W) = \left(\frac{I(A=1)}{g_n(A=1|W)} - \frac{I(A=0)}{g_n(A=0|W)}\right), called\ the\ clever\ covariate$$

$$\hat{\varepsilon}_0 = -0.0082, \hat{\varepsilon}_1 = 0.0016: fitted\ values\ of\ \varepsilon\ used\ to\ target\ initial\ Q$$

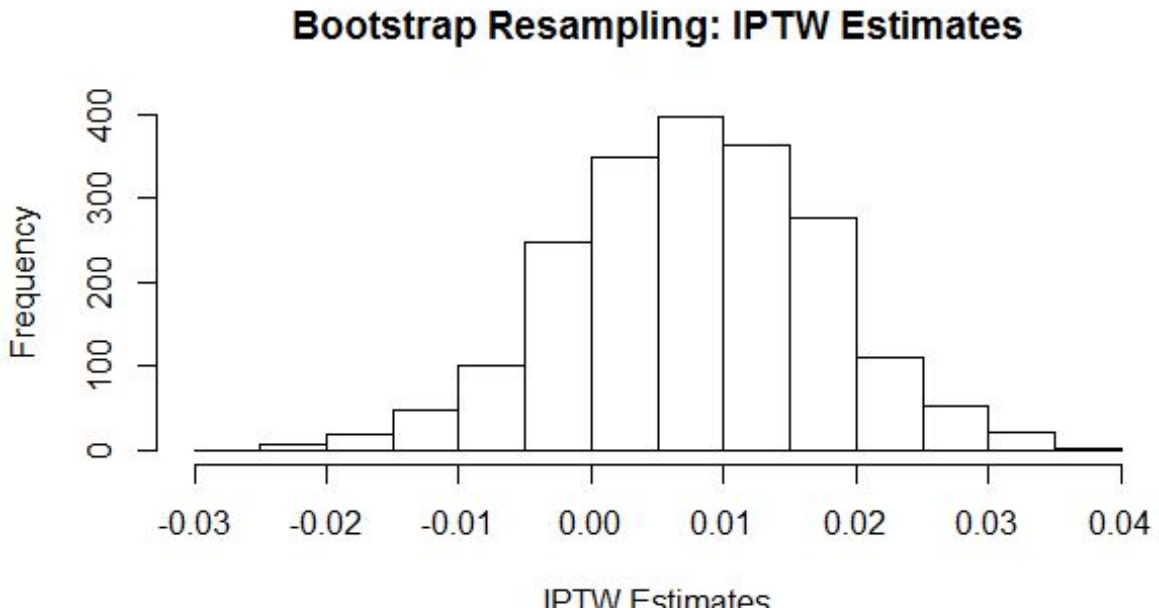
TMLE Estimate

$$\widehat{\Psi}_{TMLE}(P_n) = \frac{1}{n}\sum_{i=1}^{n}[Q^*(1, W_i) - Q^*(0, W_i)]$$

$$\widehat{\Psi}_{TMLE}(P_n)\ 0.0056$$

95% CI: (-0.013, 0.024)

95% Confidence Interval for IPTW Estimate

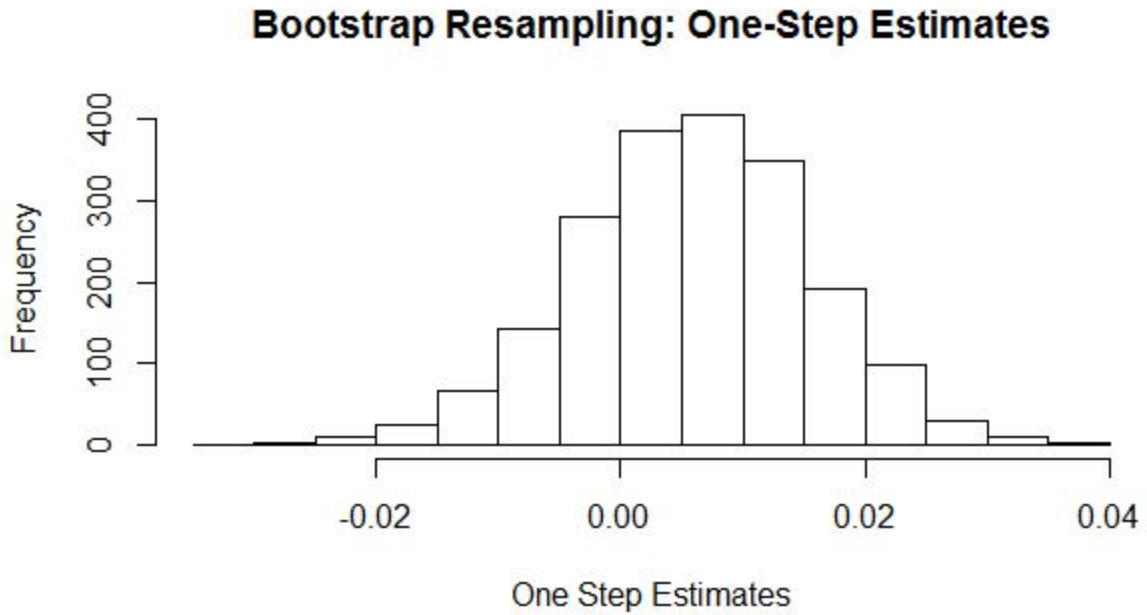


$$95\%\ CI\ for\ \widehat{\Psi}_{IPTW}(P_n) = \left(2 * \widehat{\Psi}_{IPTW}(P_n) - Q_{0.975}, 2 * \widehat{\Psi}_{IPTW}(P_n) - Q_{0.025}\right)$$

$$= (-0.011, 0.029)$$

*Sample quantiles obtained using bootstrap method

95% Confidence Interval for One-Step Estimate



$$95\%\ CI\ for\ \widehat{\Psi}_{A-IPTW}(P_n) = \left(2 * \widehat{\Psi}_{A-IPTW}(P_n) - Q_{0.975}, 2 * \widehat{\Psi}_{A-IPTW}(P_n) - Q_{0.025}\right)$$

$$= (-0.011, 0.029)$$

*Sample quantiles obtained using bootstrap method

95% Confidence Interval for TMLE

Variance of the TMLE:

$$\sigma_n^2 = \frac{1}{n}\sum_{i=1}^{n} IC_n^2(o_i).$$

Where the estimate of the influence curve (IC) for TMLE is

$$IC_n(O) = \left(\frac{I(A=1)}{g_n(1 \mid W)} - \frac{I(A=0)}{g_n(0 \mid W)}\right)(Y - \bar{Q}_n^1(A,W)) + \bar{Q}_n^1(1,W) - \bar{Q}_n^1(0,W) - \psi_n$$

95% CI:

$$\widehat{\Psi}_{TMLE}(P_n) \pm 1.96 * \widehat{SE}_{TMLE} = (-0.013, 0.024)$$

Discussion

Our results reveal that the mother's working status during the respondent's childhood does not have significant effect on the respondent from being jailed. This can be seen based on our three estimates - the tMLE estimate, IPTW estimate, and the one-step estimate. All three estimators produced positive values for the estimated average treatment effect. However, the confidence intervals for all three estimators included zero, which suggests that the mother's working status does not have significant effect on the outcome. Further, the three estimates all produced similar estimated average treatment effects. When examining the confidence intervals, it can be seen that the tMLE estimate has the smallest width, which means that the tMLE estimate has the smallest variance. Hence, the tMLE estimate is the most precise among the three estimates.

References

1. Kearney, M., Harris B., Jácome, E., & Parker, L. 2014. *Ten Economic Facts about Crime and Incarceration in the United States*. Washington, DC: Brookings.

2. Wells, L. Edward, and Joseph H. Rankin. "Families and delinquency: A meta-analysis of the impact of broken homes." *Social problems* (1991): 71-93.

3. Perkins-Dock, Robin E. "Family interventions with incarcerated youth: A review of the literature." *International Journal of Offender Therapy and Comparative Criminology* 45, no. 5 (2001): 606-625.

4. Centers for Disease Control and Prevention. (2014). *NCHS user's guide: 2011-2013 National Survey of Family Growth*.

5. Potter, Frank J., Vincent G. Iannacchione, William D. Mosher, Robert E. Mason, and Jill D. Kavee. "Sample design, sampling weights, imputation, and variance estimation in the 1995 National Survey of Family Growth." *Vital and health statistics. Series 2, Data evaluation and methods research* 124 (1998): 1-63.

6. Centers for Disease Control and Prevention. (2015). *NCHS data brief: About the National Survey of Family Growth.*