Overcoming the Odds:

The Benefits of Completing College for Unlikely Graduates

Online Appendix

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Appendix A

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Identifying Effects of College Completion

Let college completion status be a binary variable, $W \in \{0, 1\}$. We can divide the population into a subpopulation of the *treated* who complete college ($W = 1$), and a population of the *untreated* who do not complete college ($W = 0$). We consider two potential outcomes, i.e., the potential values of some variable Y (e.g., poverty) that would be realized in the presence and absence of the treatment, or college completion status, denoted by Y_{i1} and Y_{i0}, respectively for the ith individual. We define the observed outcomes:

$$Y_i^{obs} = \begin{cases} Y_{i1} & \text{if } W_i = 1 \\ Y_{i0} & \text{if } W_i = 0 \end{cases}$$

where "obs" refers to the outcome that is observed. This can also be written as:

$$Y_i^{obs} = W_i Y_{i1} + (1 - W_i) Y_{i0}.$$

To assess the effect of college completion, we need to draw on potential outcomes: the outcome when an individual completed college and the outcome when that same individual did not complete college. However, only the outcome corresponding to the treatment received is realized and observed. Causal effects involve comparing the outcome observed with the potential outcome that could have been observed had that individual received a different treatment condition. We need to impute the missing potential outcome.

Random assignment would enable us to estimate college completion effects free of confounding. In the case of estimating effects of college completion, however, we do not generally have experimental data and rely on observational data, conditioning on observed covariates. With observational data, we may have more limited ability to obtain strong internal validity of estimates (i.e., estimates of the causal effects free of confounding) but have greater ability to obtain external validity of estimates (i.e., estimates that generalize to a larger population).[1] Using observational data, we make an *unconfoundedness* or *selection on observables* assumption. We assume away selection bias conditional on observed characteristics, or covariates, of individuals $\boldsymbol{X}$:

$$\{Y_0, Y_1\} \perp W|\boldsymbol{X}.$$

That is, potential outcomes are independent of treatment status conditional on the observed covariates. We then define our estimand of interest, the average treatment effect (ATE) conditional on the covariates $\boldsymbol{X}$ as:

$$\tau_{ATE}(\boldsymbol{X}) = E[Y_1 - Y_0|\boldsymbol{X}].$$

We can also estimate the treatment effect on the treated (TT) conditional on covariates $\boldsymbol{X}$ by:

$$\tau_{TT}(\boldsymbol{X}) = E[Y_1 - Y_0 \ |W = 1, \boldsymbol{X}] = E[Y_1 \ |W = 1, \boldsymbol{X}] - E[Y_0 \ |W = 1, \boldsymbol{X}].$$

The TT represents the difference in average outcomes induced by shifting the entire population of the treated from no college completion to college completion. We can reliably estimate $E[Y_1 \ |W = 1, \boldsymbol{X}]$ using the observed conditional sample mean for the college graduate group. But the term $E[Y_0|W_i = 1, \boldsymbol{X}]$ is unobservable; this would be, for example, the mean earnings for college graduates had they not graduated college. But if it is assumed that the potential outcome Y_0 is mean independent of W conditional on X, then the TT can be consistently estimated. Hence, the assumption:

$$Y_0 \perp W \mid \boldsymbol{X}$$

is sufficient for identification of the TT, for it implies:

$$\mathrm{E}[Y_0|W = 1, \boldsymbol{X}] = \mathrm{E}[Y_0 \ |W = 0, \boldsymbol{X}] = \mathrm{E}[Y_0 \ |\boldsymbol{X}].$$

This is a less stringent assumption than that needed to estimate the average treatment effect (ATE), because it makes no assumption about Y_1. Statisticians Paul Rosenbaum and Donald Rubin show that we can substitute the propensity of treatment for $\boldsymbol{X}$.[2] A propensity score $e(x)$ is the probability of treatment conditional on a set of observed covariates. It is defined as:

$$e(x) = P(W = 1|\boldsymbol{X}).$$

The score provides a summary measure of selection into treatment.

To estimate effects, we also make a stable unit treatment value assumption (SUTVA). SUTVA requires that the response of a particular unit depends only on the treatment to which that unit was assigned, not the treatments of others around that unit. We also assume positivity:

$$0 < e(x) < 1,$$

i.e., that individuals with the same e(x) values have a positive probability of being both college and non-college graduates. Within the NLSY samples, I restrict to the region of support in which there are no college graduates with no comparable non-college graduate units and no non-college graduate units with no comparable college graduate units, i.e., no units with extreme values of the propensity score.[3] If support is not common to college and non-college graduates, different parameters are (often implicitly) defined and estimated. In other words, I eliminate cases in which I would be comparing the incomparable, and effects are unidentified. The estimand is then redefined as the impact of college completion whose propensity scores lie within the region of common support. I describe the region of support in Chapter 4.

Matching Methods for Estimating Effects of College Completion

Matching methods of estimating causal effects involve comparing a treated unit i with a given estimated propensity of treatment and control unit or units j with the same or similar estimated propensity.[4] As Rubin states, the propensity score reduces the "entire collection of background characteristics to a single composite characteristic that appropriately summarizes the collection."[5] It reduces the "curse of dimensionality" that plagued traditional matching methods. Conditioning on the propensity of college completion blocks the path from pre-college characteristics to college completion.[6] The approach allows

us to assess whether the college and non-college graduate groups overlap with respect to background characteristics and then estimate college completion effects.[7]

To estimate the propensity of college completion, I adopt an iterative stepwise procedure outlined by Guido Imbens and Donald Rubin.[8] This allows for a flexible propensity score model specification, yet also allows us to observe the covariates and interactions between covariates retained in the final model. Imbens argues that there is little harm in specification searches at this stage.[9] While the penalty for including irrelevant terms in the propensity score is generally small, eventually the precision will decrease if too many terms are included in the specification. I then allow the algorithm to further select interaction and higher order terms to produce a more flexible specification of the propensity score. This approach provides a data-driven approach to select a subset of higher order terms.

I begin with a set of baseline covariates K_B, which includes theoretically key confounders. These include covariates used in several papers of college effects[10]: race, parents' education, parents' income, family structure, rural residence, southern residence, and test scores. Test scores are the 1980 Armed Services Vocational Aptitude Battery (ASVAB), adjusted for age and standardized by race and gender.[11] I also include a measure indicating whether any variable was imputed. Imputations were based on all other variables. In the NLSY79, father's occupation, parental income, and school characteristics have the most missing values, with other variables under 5 percent missing. In the NLSY97, parental income, ASVAB, rural residence, and family structure have the most missing values, with other variables about 5 percent of fewer missing cases. Imputed values are otherwise assumed to be known, thus potentially underestimating uncertainty.

In the second step, I consider K_L additional possible covariates in turn, where I add the covariate with the largest likelihood ratio statistic that exceeds a pre-set constant C_L

(1.0, or a z-statistic of 1.0), and the process repeats. I select for inclusion pre-college variables that theoretically influence selection into college completion and life outcomes and then allow the algorithm to determine if additional correlated pre-college covariates should be included. I consider additional measures of family background (i.e., knowledge of father's education, father's occupation, religious affiliation); psychosocial skills (i.e., whether the student was enrolled in a college-prep curriculum in high school, educational aspirations, educational expectations, Rotter locus of control, Rosenberg self-esteem, and a scale of delinquent activity); school characteristics (i.e., percentage of students classified as disadvantaged and percentage of students classified as black or Hispanic); and family formation (i.e., a scale of traditional family attitudes, marital status at age 18, and had a child by age 18). Delinquency is an index of seventeen items that includes involvement with illegal activities, damaging property, stealing, fighting, or drugs. Family values is a scale of seven items that ask about traditional family values. Respondents state whether they strongly agree to strongly disagree with items such as "A woman's place is in the home" and "A woman with a family has not time for employment." The measure is standardized to a 0-1 scale. In the NLSY79, this step resulted in a model with 23 linear terms for college attendance and 22 for college completion. Religion, school racial composition, social control, and family attitudes did not reach the threshold for model improvement for college attendance. For college completion, knowledge of father's education and self-esteem also did not reach the threshold. In the NLSY97, both the models for college attendance and completion include 20 linear terms. Except for a few variables highly correlated with those already included, most variables were retained in the final models.

I then assess which of all possible higher order and interaction terms $[K_Q = (K_B + K_L)[(K_B + K_L) + 1]/2]$ (i.e., in the NLSY79, 276 possible additional terms for college attendance and 253 for college completion) to include in the model. I follow the same

procedure as above, where I add the term with the largest likelihood ratio statistic that exceeds a pre-set constant (i.e., a z-statistic of 1.96). I run thousands of regressions to generate the results. In the NLSY79, the final model for college attendance includes, in addition to the 23 linear terms, 1 higher order term and 19 interaction terms; the model for college completion includes, in addition to the 22 linear terms, 1 higher order term and 12 interaction terms. For example, the effect of enrolling in college prep courses on college completion depends upon students' ASVAB, race, fathers' occupation, and living in a rural area. The effects of delinquent activity and educational expectations depend upon parental income. In the NLSY97, the final models for attendance and completion include 2 higher order terms of 9 interaction terms. For example, for college attendance, the effect of being Black interacts with mothers' education, parental income, southern residence, grade point average, and male. For college completion, effect of mother's education interacts with parental income and ASVAB for college completion. I estimate the propensity score with the vector of $K_B + K_L + K_Q$ terms using a logit regression model; results are reported in Appendix Table B.3(a) for the NLSY79 and Table B.3(b) for the NLSY97. Machine learning methods have also been used to estimate $e(x)$ using CART, neural networks, and random forests.[12] The propensity score I estimate here has a high correlation with covariate balancing and machine learning methods. In the NLSY79, for example, I observe a correlation of 0.97 with a propensity score generated by a covariate balancing method[13] and a correlation 0.94 with a propensity score generated by a random forest.

Matching algorithms differ primarily in how the distance between units is defined (e.g., propensity scores), the number of control units used, whether controls are selected with replacement, and how multiple control units are weighted. The decision regarding how many controls to use and whether to match with or without replacement involves a bias-variance tradeoff. More controls units lead to greater efficiency and greater bias, while fewer

control units lead to less efficiency and less bias. Allowing replacement increases the average quality of the matches but reduces the number of unique control units used to construct the counterfactual mean, increasing the variance of the estimator. If we use multiple controls, alternative matching estimators use different weights assigned to the controls:

$$\hat{\tau}_{TT} = \frac{1}{n_1} \sum_{i:W_i=1} \left\{ Y_i - \sum_{j:W_j=0} \hat{\phi}_{i,j}(Y_j) \right\},$$

where n_1 is the number of treated cases, i is the index over treated cases, j is the index over control cases, $\phi_{i,j}$ represents a set of scaled weights that measure the distance between each control case and the target treated case. The weights are unspecified. The difference in the propensity score is the most common distance measure used to construct weights, but other measures of distance are available. The practical advantages of various matching estimators vary depending on the setting.[14] Matching methods are useful because they provide more control over the weighting scheme used to produce average causal effects, i.e., individuals who are most likely to complete college get the most weight in the estimate.[15]

I use propensity score matching with replacement with four control units per treated unit. The algorithm thus constructs the counterfactual for each college graduate using four of the non-college graduates that are closest to the college graduate on the estimated propensity score. I use the linearized propensity score for matching. (i.e., $logit(\hat{e}(x))$). The linearized propensity score is preferable to the raw score because the former does not penalize differences in pretreatment covariates at the tails of the propensity score distribution.[16] For example, on the raw propensity score scale, a treated unit with $\hat{e}(x) = 0.10$ is considered as close to a control unit with $\hat{e}(x) = 0.11$ as to a control unit with $\hat{e}(x) = 0.09$. But in terms of the covariates, the treated unit tends to be closer to the former than to the latter. The linearized propensity score, by transforming $\hat{e}(x)$ back to the scale of the covariates, does not suffer from this issue.[17] I assess the matching quality using the

standardized bias metric before and after matching. The standardized bias before matching is given by:

$$SB_{before} = \frac{\overline{\hat{e}(x)_1} - \overline{\hat{e}(x)_0}}{\sqrt{\left(\frac{\sigma^2{}_1(\hat{e}(x)) + \sigma^2{}_0(\hat{e}(x))}{2}\right)}}.$$

The standardized bias after matching is given by:

$$SB_{after} = \frac{\overline{\hat{e}(x)_{1M}} - \overline{\hat{e}(x)_{0M}}}{\sqrt{\left(\frac{\sigma^2{}_{1M}(\hat{e}(x)) + \sigma^2{}_{0M}(\hat{e}(x))}{2}\right)}},$$

where $\hat{e}(x)_1$ is the mean and $\sigma^2{}_1$ is the variance of the estimated propensity score in the treatment group before matching, and $\hat{e}(x)_0$ is the mean and $\sigma^2{}_0$ is the variance in the control group, and $\hat{e}(x)_{1M}$, $\sigma^2{}_{1M}$, $\hat{e}(x)_{0M}$, $\sigma^2{}_{0M}$ are the corresponding values for the matched samples.[18] I also provide box plots of the propensity score distribution before and after matching for the full sample and for the propensity-stratified samples.

Estimating Variation in Effects of College Completion

I adopt several strategies for assessing college completion effect heterogeneity. First, I compare the average treatment effects (ATE) to the treatment effects on the treated (TT). Differences between the ATE and the TT suggest that there are heterogeneous effects of college completion by the probability that an individual completed college. I estimate these different estimands using matching, as described above. If the ATE is larger than the TT, it means that the effect of college completion is greater for people less likely to graduate than for people more likely to graduate. I test differences between the estimates with unequal variance (Welsh) t-tests. Second, I explore ATE variation by three strata of the propensity score using matching. I test differences between the low and high strata estimates with unequal variance (Welsh) t-tests. Third, I present local polynomial smoothed curves of the college and non-college graduates' outcomes, and then present a difference plot (with

unequal variance confidence intervals). Fourth, I explore ATE variation for different sociodemographic groups using matching. The second and fourth approaches differ by how I partition the data to focus on selected subsets of the population. The estimation strategy is the same. I describe these partitions in Chapter 4.

Fifth, I use a machine learning method based on decision trees to uncover sources of effect heterogeneity. Decision trees, which are simple to understand and interpret, are an important class of machine learning methods gaining popularity in social science applications.[19] They are nonparametric supervised learners that partition data by characteristics of individuals into increasingly smaller subsets, or leaves, where data are more similar. They are built from the "root" by recursively selecting a characteristic and a threshold or cutoff point of that characteristic that makes the remaining data on both sides of the threshold more similar. This process then repeats. A tree represents the resulting hierarchical data structure. In standard decision trees, each leaf represents the average value of an outcome for individuals in that leaf. For example, we might wish to predict voting behavior. We keep splitting the data along specific individual characteristics, resulting in leaves containing a group of individuals with similar voting behavior. A covariate and threshold are selected that minimize the in-sample loss function (e.g., the mean-squared error [MSE]). Because the objective of decision trees is to make leaves homogenous, these algorithms are susceptible to overfitting and require regularization.

In recent years, statisticians and social and computer scientists have made much progress in merging machine learning methods with causal inference.[20] Causal trees adapt decision trees for causal inference with a potential outcome framework and partition the data in a way that minimizes heterogeneity within leaf-specific estimated ATEs rather than minimizing heterogeneity within leaf-specific outcomes.[21] Instead of predicting voting behavior, for example, we now predict college completion's effect on voting behavior. Each

leaf contains the college completion effect estimate for the subgroups within that leaf. A complication arises in modifying decision trees to attend to causal objectives. We have a "ground truth" in prediction models, i.e., we know if our prediction is close to reality. However, given the fundamental problem of causal inference, i.e., that researchers do not observe potential outcomes in both the treated and control states, there is no ground truth in causal models. We must estimate the counterfactual. In addition to adapting the objective to maximize effect heterogeneity across leaves, economists Susan Athey and Guido Imbens advance "honest" estimation.[22] We split the sample into training data for generating partitions, and estimation data for estimating leaf-specific effects and use a modified expected *MSE* for the loss function that accounts for the move to minimizing the *MSE* of treatment effects rather than outcomes. Honest estimation enables standard asymptotic properties in leaf-specific treatment effects. I estimate leaf-specific effects using matching, as described above.[23]

The causal tree approach to uncover treatment effect heterogeneity with observational data can be summarized as follows: (1) Input data with selected covariates; (2) Draw a random subsample for training S^{tr} and retain a holdout sample for estimation S^{es}; (3) Split the sample for k-fold cross-validation to regularize the tree in S^{tr}; (4) Grow a tree via recursive partitioning in S^{tr} that maximizes heterogeneity across leaves and minimizes heterogeneity within leaves using adjustment; (5) Feed the estimation sample into the leaves; and (6) Estimate leaf-specific treatment effects in S^{es} using matching.

An Alternative Strategy using Instrumental Variables

An alternative to the strategies described above is to use an instrumental variables (IV) model. In the first stage regression, the IV and other precollege characteristics are used to predict college, like the propensity score model except here we include the IV, e.g.,

availability of a local college. In the second stage, the predicted values of college from the first stage regression (i.e., college*) are used to predict wages.[24] We assume that individuals have their otherwise natural propensity of treatment, but some of them were "induced" into treatment by some event (i.e., the IV, such as having a college nearby). The presence of effect heterogeneity changes the interpretation of IV estimates to a local average treatment effect ($LATE$), an effect that pertains only to units whose treatment status is induced by the instrument.[25] For the study of college effects, these tend to be students on the margin of school continuation. We define the $LATE$ as:

$$\tau_{LATE} = E(Y_1 - Y_0 \mid W_{Z=1} > W_{Z=0}),$$

where Z is the instrumental variable. The IV approach relies on a different set of assumptions than matching. First, we must satisfy an "independence assumption," i.e., that the instrument is as good as randomly assigned. Second, commonly called the "exclusion restriction," the IV must affect the outcome (e.g., wages) only indirectly through the treatment (i.e., it does not affect the outcome independent of college). Third, sometimes called the "relevance assumption," we assume the IV affects the likelihood of college, even if it does so within a small range. Finally, the IV must satisfy a "monotonicity assumption," that although the instrument may have no effect on some people, all those affected are affected in the same direction.

If the $LATE$ exceeds the ATE and the required assumptions for both estimators hold, we have evidence suggesting that students on the margin, induced by the instrument, have larger effects than average college-goers.[26] Those induced into college will generally differ as the inducement changes because different instruments will affect college-going behavior for different population segments.[27] These differences have implications for different policy prescriptions. For example, Lisa Barrow and Ofer Malamud compare David Card's instrument for college attendance effects, distance to college, to Fred Zimmerman's

instrument, admission based on high school grades. These two instruments may be relevant for students who are induced into attending college for different reasons and thus relate to different policy levers, in this case, whether building new colleges or relaxing entry thresholds.[28]

The IV approach relies on different assumptions that the matching approach described above. The assumptions are unverifiable and more or less plausible in different settings. Identifying a valid IV is difficult; a weak IV may give rise to imprecise and biased estimates. In actual social settings, the inducement effect of an IV on treatment is usually very small. Low inducement is a major limitation if the instrument is so weak as to have very little impact on the treatment of interest. I considered four instruments: presence of a public four-year college in the county of residence; average public four-year college tuition in the county of residence; local area unemployment rate in the state of residence at age 17; and average wage in the county of residence at age 17.[29] The instruments were too weak to be useful in the analysis of college completion effects. However, I draw on them for the comparison across the low propensity vignettes. Each of the low propensity vignette pairs differ by one or more instrumental variables.

Robustness Checks and Sensitivity Analyses

I also consider alternative estimators for the *ATE* stratified by propensity scores as a robustness check on the reported matching results. First, I use a doubly robust estimator of the *ATE*:[30]

$$\hat{\tau}_{ATE} = \frac{1}{n}\sum_{i=1}^{n}\left(\hat{\mu}_1(x_i) - \hat{\mu}_0(x_i) + \frac{W_i(Y_i - \hat{\mu}_1(X_i))}{\hat{e}(x_i)} - \frac{(1-W_i)(Y_i - \hat{\mu}_0(X_i))}{1-\hat{e}(x_i)}\right).$$

Under the assumptions of unconfoundedness, SUTVA, and positivity, it is consistent for the *ATE* if either the outcome model $\mu_W(x)$ or the propensity score model $e(x)$, but not necessarily both, is correctly specified. The double-robustness property occurs because the

bias of the equation as an estimator of the ATE is governed by the product of two bias terms: (1) the bias of the fitted outcome model $\hat{\mu}_W(e)$ and (2) the bias of the fitted propensity score model $\hat{e}(x)$. Provided one of the two biases converges to zero, the bias of the equation will converge to zero.[31] I use a doubly robust inverse-probability weighted (IPW) method.

Second, I use a machine learning approach that extends the causal tree method described above. Susan Athey and colleagues propose a generalized random forest, or causal forest, for estimating treatment effects in the potential outcome framework.[32] The approach avoids overfitting that may characterize single trees by training multiple trees – an ensemble or random forest – and averaging their predictions to obtain treatment effect estimates. The causal forest estimator is like a matching method except that the leaves in the trees generate the space for selecting nearest neighbors, rather than for example, propensity scores. The causal forest generates an ensemble of B causal trees, each with an estimate of $\widehat{\tau_b}(x)$ and averages estimates from individual trees. As the trees are not grown using data on the outcome, we have honest estimation without the use of sample splitting. I compare the propensity-stratified matching estimates to the IPW doubly robust and the generalized random forest estimates. This method uses the inverse of the propensity score as a weight in a weighted least squares regression.

I also conduct sensitivity analyses. The identification strategies described above require college completion to be exogenous conditional on observed covariates, which is a strong assumption. Although it may not hold, it is useful as a working assumption. When we rely on observational data and the unconfoundedness assumption to identify college completion effects, we can assess how sensitive the estimated college completion effects are to unobserved confounding by quantifying how the results obtained under the unconfoundedness assumption would change if we relaxed that assumption. To do so, I

subtract a bias factor from the point estimate and confidence interval of the propensity-stratified college completion effects obtained under unconfoundedness.[33] The bias term is equal to the product of two (partition-specific) parameters:

$$B = \gamma\lambda,$$

where

$$\gamma(w, x) = E(Y|U = 1, W = w, \hat{e}(x)) - E(Y|U = 0, W = w, \hat{e}(x))$$

and

$$\lambda(w, x) = P(U = 1|W = 1, \hat{e}(x)) - P(U = 0|W = 0, \hat{e}(x)).$$

That is, γ is the mean difference in the outcome associated with a unit change in an unobserved binary confounder, U, and λ is the mean difference in the unobserved confounder between college graduates and non-college graduates.

Let us assume that an effect of college completion on a life outcome reaches non-significance when the unobserved confounder strongly impacts college completion (λ) or strongly impacts the outcome of interest (γ). Let us suppose that an unobserved confounder, say resilience, increases wages (or some other outcome) and is higher among individuals who complete college than those who do not. When λ equals 10 percent, we assume that the prevalence of resilient individuals is 10 percent higher in the college-educated group than in the non-college-educated group. When γ equals 10 percent, we assume that resilient individuals have 10 percent higher wages than those who are not resilient (all else equal). I let the values of γ range from 40 to 10 percent and fix the value of λ at 10 percent (or signs flipped for outcomes like poverty). We would not expect many unobserved factors to differ between college and non-college graduates by more than 10 percent. When γ is positive and λ is negative, the sensitivity results are the same as those I present in the book, such that there is no loss of information by not including the opposite sign.

Since I am primarily interested in effect heterogeneity, the findings will be biased more by a differential violation of exogeneity between low- and high-propensity individuals

than by a violation of exogeneity per se. I also use a sensitivity analysis to explore the direction and magnitude of potential bias. The bias formula from the sensitivity analyses posits a larger bias for low and high propensity individuals than for individuals in the middle of the propensity score distribution. The sensitivity analysis constitutes a particularly conservative test for the robustness of findings. The bias for the propensity specific ATEs depends upon two parameters: (1) the correlation between unobserved factors that affect the likelihood of college completion and unobserved factors that affect the outcome of interest in the absence of college (e.g., poverty status without a college degree); and (2) the standard deviation of the unobserved factors that affect the outcome of interest in the absence of college degrees. To assess how possible bias changes as a function of the error correlation (1), I first obtain a crude estimate of the standard deviation (2) using the residual standard deviation from a nonparametric regression of the outcome on the pretreatment covariates among non-college graduates. Here I use Bayesian Additive Regression Trees (BART). Then, for several error correlation values (1) ranging from -0.2 to 0.2, I calculate the bias-adjusted estimates of the propensity score-specific effects of college. The sensitivity analysis is based on the generalized Roy model with joint Gaussian errors. The joint normality of the errors for Y_0, Y_1, and W dictates a parametric functional form regarding how the biases for ATE and TT vary by the propensity score. This sensitivity analysis implies that when error correlation is present, the associated bias is larger for low and high propensity individuals than for individuals in the middle of the propensity score distribution. Appendix Figure C.5 shows this pattern.[34]

Overcoming the Odds:

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Appendix B

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Table B.1

Descriptive Statistics of Pre-College Characteristics: NLSY79

	Non-college attendees (by age 20)		College attendees (by age 20)		Non-college completers (by age 25)		College completers (by age 25)	
	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
Sociodemographic Factors								
Male (0/1)	0.514	---	0.487	---	0.502	---	0.508	---
Black (0/1)	0.152	---	0.106	---	0.157	---	0.071	---
Hispanic (0/1)	0.055	---	0.038	---	0.056	---	0.028	---
Southern residence age 14 (0/1)	0.314	---	0.310	---	0.320	---	0.292	---
Rural residence at age 14 (0/1)	0.251	---	0.198	---	0.245	---	0.191	---
Family Background Factors								
Family income ($100s) (0-750)	192.797	(111.087)	263.472	(140.616)	197.686	(112.375)	280.746	(147.107)
Mothers' education (0-20)	11.359	(2.176)	13.011	(2.437)	11.541	(2.277)	13.220	(2.358)
Fathers' education (0-20)	11.387	(2.929)	13.753	(3.265)	11.621	(3.029)	14.131	(3.204)
Fathers' education unknown (0/1)	0.062	(0.241)	0.022	(0.146)	0.056	---	---	---
Fathers upper-white collar (0/1)	0.170	---	0.437	---	0.193	---	0.488	---
Two-parent family (0/1)	0.727	---	0.811	---	0.729	---	0.842	---
Sibship size (0-19)	3.247	(2.196)	2.692	(1.823)	3.209	(2.188)	2.554	(1.650)
Cognitive and Psychosocial Factors								
ASVAB (continuous -3-3)	-0.121	(0.628)	0.502	(0.566)	-0.054	(0.639)	0.586	(0.544)
High school college prep program (0/1)	0.217	---	0.588	---	0.262	---	0.622	---
Rosenberg self-esteem scale (16-30)	21.903	(3.869)	23.128	(3.846)	21.903	(3.869)	---	---
Rotter locus of control scale (4-16)	8.979	(2.232)	8.356	(2.272)	8.953	(2.270)	8.155	(2.154)
Rosenberg self-esteem scale (16-30)	21.757	(3.773)	22.997	(3.982)	21.903	(3.867)	23.128	(3.846)
Juvenile delinquency scale (0/1)	0.818	(0.386)	0.731	(0.444)	0.808	(0.394)	0.722	(0.448)
College completion expectations (0/1)	0.279	---	0.784	---	0.344	---	0.822	---
College completion aspirations (0/1)	0.418	---	0.849	---	0.474	---	0.879	---
(0/1)	0.343	---	0.706	---	0.390	---	0.732	---
School Factors								
School disadvantage scale (0-99)	21.070	(17.260)	14.384	(13.823)	20.510	(17.069)	13.028	(12.705)
Family Formation Factors								
Family values scale (0-1)	0.233	(0.423)	0.172	(0.378)	0.227	(0.419)	0.164	(0.371)
Marital status at age 18 (0/1)	0.031	---	0.002	---	0.027	---	0.003	---
Had child by age 18 (0/1)	0.023	---	0.005	---	0.021	---	0.002	---
Weighted sample proportion	0.63		0.37		0.74		0.26	
Sample size (analytic sample)	2,732		1,353		3,237		848	

Notes: Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582) and who had completed at least the 12th grade (n = 4,548), and who had common support ((n = 4,085). College attendance is measured as four-year attendance by age 20, and college completion is measured as a four-year degree completed by age 25. All descriptive statistics are weighted by the NLSY sample weight. Rotter locus of control is the degree to which a person perceives an outcome as being contingent on their own actions or those of external forces, existing along a continuum from a more internalized orientation to a more externalized orientation. It is summed such that higher values indicate less control. Rosenberg self-esteem is based on a 10-item scale that measures global self-worth by measuring both positive and negative feelings about the self. Higher values of Rosenberg self-esteem indicates more self-esteem. Juvenile delinquency indicates that the respondent reported delinquent activity from a series of 20 items. School disadvantage measures about the percentage of students in the school classified as disadvtaged according to Elementary and Secondary Education Act (ESEA) guidelines. Family values is a scale based on 16 items where higher values indicate more traditional family values.

Table B.2

Descriptive Statistics of Pre-College Characteristics: NLSY97

	Non-college attendees (by age 20)		College attendees (by age 20)		Non-college completers (by age 25)		College completers (by age 25)	
	Mean	(SD)	Mean	(SD)	Mean	(SD)	Mean	(SD)
Sociodemographic Factors								
Male (0/1)	0.558	---	0.439	---	0.538	---	0.424	---
Black (0/1)	0.175	---	0.114	---	0.173	---	0.087	---
Hispanic (0/1)	0.151	---	0.083	---	0.142	---	0.067	---
Southern residence age 14 (0/1)	0.298	---	0.281	---	0.297	---	0.273	---
Rural residence at age 14 (0/1)	0.190	---	0.197	---	0.193	---	0.195	---
Family Background Factors								
Family income ($1000s) (0-250)	43.243	(31.208)	67.119	(45.390)	46.612	(34.577)	71.860	(46.286)
Mothers' education (0-20)	12.293	(2.388)	13.975	(2.570)	12.541	(2.470)	14.280	(2.531)
Fathers' education (0-20)	12.144	(2.621)	14.156	(2.894)	12.431	(2.732)	14.547	(2.833)
Two-parent family (0/1)	0.414	---	0.661	---	0.444	---	0.723	---
Sibship size (0-16)	4.229	(2.776)	3.622	(2.496)	4.158	(2.760)	3.462	(2.368)
Cognitive and Psychosocial Factors								
ASVAB (-3-3)	-0.339	(0.561)	0.113	(0.582)	-0.269	(0.582)	0.185	(0.568)
High school grade point average (0-4)	2.634	(0.725)	3.302	(0.614)	2.727	(0.730)	3.438	(0.555)
High school college prep program (0/1)	0.179	---	0.553	---	0.239	---	0.608	---
Juvenile delinquency index (0-10)	0.597	(0.491)	0.435	(0.496)	0.573	(0.495)	0.404	(0.491)
1)	0.965	---	0.993	---	0.971	---	0.995	---
School Factors								
School safety (0/1)	0.293	---	0.440	---	0.311	---	0.477	---
Good teachers (0/1)	0.157	---	0.232	---	0.172	---	0.236	---
Family Formation Factors								
Marital status at age 18 (0/1)	0.021	---	0.002	---	0.170	---	0.001	---
Had a child by age 18 (0/1)	0.032	---	0.005	---	0.027	---	0.004	---
Weighted sample proportion	0.57		0.43		0.73		0.27	
Sample size (analytic sample)	4,591		3,035		5,781		1,845	

Notes: Data are from the NLSY97. Sample is restricted to individuals who had completed at least the 12th grade (n = 7,753) and who had common support (n = 7,626). College attendance is measured as a four-year degree attendance by age 20. College completion is measured as a four-year degree completed by age 25. All descriptive statistics are weighted by the NLSY sample weight. Juvenile delinquency is based on an index of activities. Friends' college attendance aspirations is a measure of the percent of friends who plan to attend college. School safety indicates respondent strongly agrees that they feel safe at school. Good teachers indicates respondent strongly agrees that there are good teachers at their school.

Table B.3(a)

Logit Regression Predicting Four-Year College Attendance and Completion: NLSY79

	Four-year college Attendance			Four-year college Completion		
	β	(SE)		β	(SE)	
Sociodemographic factors						
Male (binary 0/1)	-0.356	(0.089)	***	-0.884	(0.228)	***
Black (binary 0/1)	0.500	(0.270)		-0.300	(0.188)	
Hispanic (binary 0/1)	-0.051	(0.180)		-0.725	(0.196)	***
Southern residence at age 14 (binary 0/1)	0.192	(0.117)		-0.287	(0.177)	
Rural residence at age 14 (binary 0/1)	-0.084	(0.112)		0.236	(0.167)	
Family background factors						
Family income ($100s) (continuous 0-750)	0.000	(0.001)		-0.004	(0.001)	**
Fathers' highest education (0-20)	0.105	(0.031)	**	0.027	(0.021)	
Mothers' highest education (0-20)	-0.437	(0.136)	**	-0.088	(0.094)	
Father upper-white collar occupation (0/1)	1.604	(0.566)	**	0.831	(0.180)	***
Two-parent family at age 14 (binary 0/1)	0.177	(0.107)		0.215	(0.124)	
Sibship size (continuous 0-19)	-0.217	(0.077)	**	-0.143	(0.033)	***
Fathers' education unknown (binary 0/1)	-0.420	(0.207)	*			
Cognitive and psychosocial factors						
ASVAB (continuous -3-3)	1.319	(0.100)	***	1.378	(0.124)	***
High school college prepatory program (0/1)	0.777	(0.107)	***	0.918	(0.164)	***
Rotter locus of control scale (4-16)						
Rosenberg self esteem scale (continuous 6-30)	-0.143	(0.057)	*			
Juvenile delinquency scale (0/1)	-0.443	(0.107)	***	-0.886	(0.220)	***
College completion expectations (0/1)	0.962	(0.134)	***	1.380	(0.592)	**
College completion aspirations (0/1)	1.780	(0.451)	***	2.578	(0.695)	***
Friends' college completion aspirations (0/1)	-0.762	(0.519)		0.286	(0.109)	**
School factors						
School disadvantage scale (0-99)	0.003	(0.018)		-0.006	(0.003)	
Family formation factors						
Marital status at age 18 (binary 0/1)	-3.558	(0.740)	***	-2.501	(0.736)	**
Had a child by age 18 (binary 0/1)	-9.034	(3.026)	**	-1.896	(0.629)	**
Non-imputed data (0/1)	-0.139	(0.101)		-0.040	(0.108)	
Higher order terms						
Mothers' education x school disadvantage	-0.002	(0.001)				
Mothers' education x mothers' education	0.018	(0.004)	***	0.014	(0.003)	***
Black x southern residence	0.509	(0.204)	*			
Hispanic x ASVAB	-0.430	(0.146)	**			
Hispanic x high school program	-0.695	(0.248)	**			
Black x educational aspirations	-0.488	(0.214)	*			
Marital status at age 18 x had a child by age 18	3.186	(1.109)	**			
Fathers' highest education x school disadvantage	-0.003	(0.001)	**			
aspirations	-0.120	(0.038)	**			
Had a child by age 18 x fathers' education unknown	1.952	(0.751)	**			
Fathers' highest education x father upper-white	-0.112	(0.040)	**			
Father upper-white x educational aspirations	0.703	(0.266)	**			
Mothers' highest education x had a child by age 18	0.390	(0.188)	*			

Self esteem x friends' educational aspirations	0.051	(0.023)	*			
Self esteem x school disadvantage	0.002	(0.001)	**			
Black x parents' household income	-0.002	(0.001)	*			
Mother's highest education x self esteem	0.008	(0.004)	*			
Mother's highest education x sibship size	0.014	(0.007)	*			
Had a child by age 18 x delinquent activity	2.974	(1.543)				
Father upper-white x fathers' education unknown	-1.693	(0.896)				
Sibship size x southern residence				0.827	(0.048)	***
Male x educational aspirations				0.827	(0.252)	**
Parents' income x delinquent activity				0.003	(0.001)	**
Mothers' education X educational aspirations				-0.195	(0.056)	**
Parents' income x educational expectations				0.003	(0.001)	**
Hispanic x southern residence				-0.819	(0.345)	*
ASVAB x high school program				-0.353	(0.168)	*
Educational expectations x educational aspirations				-1.302	(0.588)	*
Father upper-white x high school program				-0.587	(0.239)	*
Black x high school program				-0.582	(0.239)	*
Rural residence x high school program				-0.511	(0.239)	*
N	4548			4548		
Log Likelihood	2160.0			1667.6		
$P > \chi^2$	0.000			0.000		

Notes : Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582) and who had completed at least the 12th grade (n = 4,548). College attendance is measured as four-year college attended by age 20. College completion is measured as four-year degree completed by age 25. Rotter locus of control is the degree to which a person perceives an outcome as being contingent on their own actions or those of external forces, existing along a continuum from a more internalized orientation to a more externalized orientation. It is summed such that higher values indicate less control. Rosenberg self-esteem is based on a 10-item scale that measures global self-worth by measuring both positive and negative feelings about the self. Higher values of Rosenberg self-esteem indicates more self-esteem. Juvenile delinquency indicates that the respondent reported delinquent activity from a series of 20 items. School disadvantage measures about the percentage of students in the school classified as disadvtaged according to Elementary and Secondary Education Act (ESEA) guidelines. Family values is a scale based on 16 items where higher values indicate more traditional family values.

* $p \leq 0.05$ ** $p \leq 0.01$ *** $p \leq 0.001$; two-tailed tests;

Table B.3(b)

Logit Regression Predicting Four-Year College Attendance and Completion: NLSY97

	Four-year college Attendance			Four-year college Completion		
	β	(SE)		β	(SE)	
Sociodemographic factors						
Male (binary 0/1)	-0.787	(0.294)	**	-1.175	(0.366)	**
Black (binary 0/1)	-0.720	(0.584)		-0.487	(0.132)	***
Hispanic (binary 0/1)	-0.236	(0.090)	**	0.693	(0.404)	
Southern residence at age 14 (binary 0/1)	-0.198	(0.081)	*	-0.232	(0.088)	**
Rural residence at age 14 (binary 0/1)	-0.061	(0.082)		-1.798	(0.538)	**
Family background factors						
Family income ($1000s) (0-250)	0.000	(0.001)		0.021	(0.005)	***
Fathers' highest education (0-20)	-0.112	(0.062)		0.149	(0.021)	***
Mothers' highest education (0-20)	-0.371	(0.082)	***	-0.266	(0.077)	**
Two-parent family at age 14 (binary 0/1)	0.353	(0.066)	***	0.291	(0.096)	**
Sibship size (continuous 0-19)	-0.001	(0.011)		-0.007	(0.013)	
Cognitive and psychosocial factors						
Cognitive ability ASVAB (continuous -3-3)	0.792	(0.056)	***	1.374	(0.327)	***
High school grade point average (0-45)	0.289	(0.228)		0.875	(0.083)	***
(0/1)	1.071	(0.079)	***	2.030	(0.323)	***
Juvenile delinquency scale (0-10)	-0.372	(0.061)	***	-0.613	(0.108)	***
1)	0.963	(0.243)	***	0.853	(0.332)	*
School factors						
School safety (0/1)	0.028	(0.103)		-0.006	(0.003)	
Good teachers (0/1)	0.145	(0.079)		-0.041	(0.085)	
Family formation factors						
Marital status at age 18 (binary 0/1)	-1.591	(0.421)	***	-1.139	(0.539)	*
Had a child by age 18 (binary 0/1)	-1.065	(0.245)	***	-1.282	(0.411)	**
Non-imputed data (0/1)	0.009	(0.075)		0.210	(0.069)	**
Higher order terms						
Mothers' education x mothers' education	0.013	(0.003)	***	0.017	(0.003)	***
Fathers' education x fathers' education	0.008	(0.002)	**			
Black x mothers' education	0.169	(0.039)	***			
Black x parents' income	-0.007	(0.003)	**			
Non-imputed x school safety	0.368	(0.125)	**			
Male x grade point average	0.191	(0.094)	*	0.294	(0.112)	**
Black x southern residence	0.422	(0.144)	**	0.756	(0.175)	***
Black x grade point average	-0.355	(0.108)	**			
Male x Black	-0.410	(0.142)	**			
Mothers' education x grade point average	0.044	(0.017)	*			
Hispanic x school safety	-0.318	(0.129)	*			
Fathers' education x high school program				-0.092	(0.023)	***
Mothers' education x parents' income				0.001	(0.000)	**
ASVAB x ASVAB				-0.192	(0.062)	**
Rural x grade point average				0.493	(0.160)	**
Two-parent x delinquency				0.386	(0.137)	**
ASVAB x delinquency				0.339	(0.121)	**

Mothers' education x ASVAB		-0.063	(0.024) **
Hispanic x fathers' education		-0.078	(0.030) *
N	7753	7753	
Log Likelihood	3323.7	1667.6	
$P > \chi^2$	0.000	0.000	

Notes : Data are from the NLSY97. Sample is restricted to individuals who had completed at least the 12th grade (n = 7,753). College attendance is measured as a four-year degree attendance by age 20. College completion is measured as a four-year degree completed by age 25. Juvenile delinquency is based on an index of activities. Friends' college attendance aspirations is a measure of the percent of friends who plan to attend college. School safety indicates respondent strongly agrees that they feel safe at school. Good teachers indicates respondent strongly agrees that there are good teachers at their school.
* $p \leq 0.05$ ** $p \leq 0.01$ *** $p \leq 0.001$; two-tailed tests;

Table B.4(a)

Descriptive Statistics of Pre-College Characteristics by Propensity of College Completion Strata: NLSY79

	Low propensity: College degree least likely		Mid propensity: College degree moderately likely		High propensity: College degree most likely	
	Mean	(SD)	Mean	(SD)	Mean	(SD)
Sociodemographic Factors						
Male (0/1)	0.504	---	0.507	---	0.501	---
Black (0/1)	0.182	---	0.111	---	0.035	---
Hispanic (0/1)	0.065	---	0.036	---	0.019	---
Southern residence age 14 (0/1)	0.326	---	0.318	---	0.272	---
Rural residence at age 14 (0/1)	0.257	---	0.219	---	0.174	---
Family Background Factors						
Family income ($100s) (0-750)	183.324	(106.954)	218.353	(103.721)	312.019	(147.468)
Mothers' education (0-20)	11.122	(2.105)	12.587	(2.112)	13.625	(2.384)
Fathers' education (0-20)	11.009	(2.738)	12.986	(2.848)	14.873	(3.128)
Fathers' education unkown (0/1)	0.069	---	0.022	---	0.012	---
Father upper white-collar (0/1)	0.125	---	0 .283	---	0.629	---
Two-parent family (0/1)	0.706	---	0 .755	---	0.894	---
Sibship size (0-19)	3.414	(2.248)	2.737	(1.791)	2.347	(1.604)
Cognitive and Psychosocial Factors						
ASVAB (continuous -3-3)	-0.230	-(0.580)	0.342	(0.512)	0.782	(0.420)
High school college prep program (0/1)	0.152	---	0.491	---	0.756	---
Rosenberg self-esteem (16-30)	21.567	(3.757)	22.776	(3.824)	23.402	(3.968)
Rotter locus of control (4-16)	9.192	(2.220)	8.424	(2.204)	7.888	(2.145)
Juvenile delinquency scale (0/1)	0.829	---	0 .775	---	0.683	---
College completion expectations (0/1)	0.182	---	0.715	---	0.981	---
College completion aspirations (0/1)	0.334	---	0.833	---	0.982	---
Friends' college comp. aspirations (0/1)	0.286	---	0 .626	---	0.842	---
School Factors						
School disadvantage scale (0-99)	22.212	(17.671)	16.995	(14.633)	10.633	(10.262)
Family Formation Factors						
Family attitudes (0-1)	0.256	0.437	0.159	0.366	0.140	0.347
Marital status at age 18 (0/1)	0.035	---	0.002	---	0.000	---
Had a child by age 18 (0/1)	0.028	---	0.000	---	0.000	---
Weighted sample proportion	0.58		0.20		0.22	
Sample size	2,693		739		653	

Notes: Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582) and who had completed at least the 12th grade (n = 4,548), and who had common support (4,085). College completion is measured as a four-year degree completed by age 25. All descriptive statistics are weighted by the NLSY sample weight. Low propensity is a four-year college completion propensity score from 0 to less than 0.2, middle from 0.2 to less than 0.5, and high from 0.5 to 1. Rotter locus of control is the degree to which a person perceives an outcome as being contingent on their own actions or those of external forces, existing along a continuum from a more internalized orientation to a more externalized orientation. It is summed such that higher values indicate less control. Rosenberg self-esteem is based on a 10-item scale that measures global self-worth by measuring both positive and negative feelings about the self. Higher values of Rosenberg self-esteem indicates more self-esteem. Juvenile delinquency indicates that the respondent reported delinquent activity from a series of 20 items. School disadvantage measures about the percentage of students in the school classified as disadvtaged according to Elementary and Secondary Education Act (ESEA) guidelines. Family values is a scale based on 16 items where higher values indicate more traditional family values.

Table B.4(b)

Descriptive Statistics of Pre-College Characteristics by Propensity of College Completion Strata: NLSY97

	Low propensity: College degree least likely		Mid propensity: College degree moderately likely		High propensity: College degree most likely	
	Mean	(SD)	Mean	(SD)	Mean	(SD)
Sociodemographic Factors						
Male (0/1)	0.585	---	0.444	---	0.391	---
Black (0/1)	0.203	---	0.123	---	0.051	---
Hispanic (0/1)	0.163	---	0.108	---	0.040	---
Southern residence age 14 (0/1)	0.301	---	0.294	---	0.262	---
Rural residence at age 14 (0/1)	0.194	---	0.191	---	0.195	---
Family Background Factors						
Family income ($1000s) (0-250)	39.444	(28.278)	58.052	(35.725)	81.569	(49.419)
Mothers' education (0-20)	12.024	(2.288)	13.360	(2.282)	14.972	(2.404)
Fathers' education (0-20)	11.974	(2.483)	13.490	(2.571)	15.342	(2.608)
Two-parent family (0/1)	0.348	---	0.619	---	0.818	---
Sibship size (0-19)	4.373	(2.813)	3.768	(2.579)	3.232	(2.231)
Cognitive and Psychosocial Factors						
ASVAB (continuous -3-3)	-0.411	(0.547)	-0.009	(0.480)	0.336	(0.532)
High school grade point average (0-4)	2.480	(0.654)	3.191	(0.503)	3.671	(0.377)
High school college prep program (0/1)	0.112	---	0.468	---	0.738	---
Juvenile delinquency scale (0-1)	0.635	---	0.454	---	0.352	---
Friends' college attendance aspirations (0-1)	0.961	---	0.994	---	0.997	---
School Factors						
School safety (0/1)	22.212	---	0.405	---	0.538	---
Good teachers (0/1)	0.148	---	0.219	---	0.255	---
Family Formation Factors						
Marital status at age 18 (0/1)	0.023	---	0.003	---	0.000	---
Had a child by age 18 (0/1)	0.037	---	0.003	---	0.001	---
Weighted sample proportion	0.53		0.24		0.23	
Sample size	4,476		1,714		1,436	

Notes: Data are from the NLYS97. Sample is restricted to individuals who had completed at least the 12th grade (n = 7,753) and who had common support (n = 7,626). College attendance is measured as a four-year degree attendance by age 20. College completion is measured as a four-year degree completed by age 25. All descriptive statistics are weighted by the NLSY sample weight. Low propensity is a four-year college completion propensity score from 0 to less than 0.2, middle from 0.2 to less than 0.5, and high from 0.5 to 1. Juvenile delinquency is based on an index of activities. Friends' college attendance aspirations is a measure of the percent of friends who plan to attend college. School safety indicates respondent strongly agrees that they feel safe at school. Good teachers indicates respondent strongly agrees that there are good teachers at their school.

Table B.5

Effects of Four-Year College Attednance and Completion on Socioeconomic Outcomes: NLSY79

	Four-year college attendance			Four-year college completion		
Outcomes 1990-2014	**Average treatment effect (ATE)**	**Average treatment effect on the Treated (TT)**	**Difference: ATE-ATT**	**Average treatment effect (ATE)**	**Average treatment effect on the Treated (TT)**	**Difference: ATE-ATT**
Earnings (log avg.)	0.304 ***	0.326 ***	-0.022	0.412 ***	0.356 ***	0.056
	(0.040)	(0.055)	(0.068)	(0.051)	(0.045)	(0.068)
Unemployment (prop.)	-0.044 **	-0.050 *	0.006	-0.063 ***	-0.037 **	-0.026
	(0.013)	(0.020)	(0.024)	(0.012)	(0.011)	(0.016)
Not in the labor force (prop.)	-0.061 **	-0.066 **	0.005	-0.089 ***	-0.055 ***	-0.034 †
	(0.014)	(0.022)	(0.026)	(0.013)	(0.013)	(0.018)
Low-wage work (prop.)	-0.155 ***	-0.152 ***	-0.003	-0.194 ***	-0.111 ***	-0.083 **
	(0.020)	(0.029)	(0.035)	(0.020)	(0.018)	(0.027)
Low-skilled work (prop.)	-0.167 ***	-0.149 ***	-0.018	-0.215 ***	-0.172 ***	-0.043
	(0.021)	(0.017)	(0.027)	(0.029)	(0.017)	(0.034)
Job instability (job loss count)	-0.187 ***	-0.162 ***	-0.025	-0.304 ***	-0.169 **	-0.135 **
	(0.040)	(0.046)	(0.061)	(0.025)	(0.049)	(0.055)

Notes : Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582), who had completed at least the 12th grade (n = 4,548), and who had common support (n = 4,085). College attendance is measured as a four-year degree attendance by age 20. College completion is measured as a four-year degree completed by age 25. Analyses are based on nearest neighbor matching on the linearized propensity of college. Low-wage work is defined as two-thirds of the median hourly wage in any given year, and low-skilled work is defined as clerical, service and sales, agricultural, craft, trade, and plant and machine operator and assembler occupations. Job instability is measured with a variable indicating a count of jobs lost due to layoffs or plant closings.

† p ≤ 0.10 * p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B.6

Effects of Four-Year College Attendance and Completion on Socioeconomic Outcomes: NLSY97

	Four-year college attendance			Four-year college completion		
Outcomes 2010-2019	**Average treatment effect (ATE)**	**Average treatment effect on the Treated (TT)**	**Difference: ATE-ATT**	**Average treatment effect (ATE)**	**Average treatment effect on the Treated (TT)**	**Difference: ATE-ATT**
Earnings (log avg.)	0.264 ***	0.299 ***	-0.035	0.401 ***	0.433 ***	-0.032
	(0.038)	(0.066)	(0.076)	(0.085)	(0.043)	(0.095)
Unemployment (prop.)	-0.085 ***	-0.087 ***	0.002	-0.081 ***	-0.086 ***	0.005
	(0.012)	(0.018)	(0.022)	(0.020)	(0.018)	(0.027)
Not in the labor force (prop.)	-0.068 ***	-0.061 ***	-0.007	-0.074 ***	-0.06 ***	-0.014
	(0.010)	(0.017)	(0.020)	(0.013)	(0.010)	(0.016)
Low-wage work (prop.)	-0.135 ***	-0.145 ***	0.010	-0.187 ***	-0.155 ***	-0.032
	(0.013)	(0.017)	(0.021)	(0.025)	(0.014)	(0.029)
Low-skilled work (prop.)	-0.202 ***	-0.196 ***	-0.006	-0.278 ***	-0.229 ***	-0.049 †
	(0.015)	(0.020)	(0.025)	(0.023)	(0.016)	(0.028)
Job loss during COVID	-0.047 ***	0.024 *	-0.071 ***	-0.074 ***	-0.036 *	-0.038 *
	(0.010)	(0.010)	(0.014)	(0.007)	(0.014)	(0.016)

Notes : Data are from the NLSY97. Sample is restricted to individuals who had completed at least the 12th grade (n = 7,753) and who had common support (n = 7,626). College attendance is measured as a four-year degree attendance by age 20. College completion is measured as a four-year degree completed by age 25. Analyses are based on nearest neighbor matching on the linearized propensity of college. Low-wage work is defined as two-thirds of the median hourly wage in any given year, and low-skilled work is defined as clerical, service and sales, agricultural, craft, trade, and plant and machine operator and assembler occupations. Job loss during COVID indicates not working due to COVID in 2020.

† p ≤ 0.10 * p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B.7(a)

Effects of Four-Year College Completion on Socioeconomic Outcomes by Propensity Score Strata (ATE): NLSY79

Outcomes 1990-2014	Low propensity	Mid propensity	High propensity	Difference Low-High
Earnings (log avg.)	0.446 ***	0.334 ***	0.363 ***	0.083
	(0.074)	(0.058)	(0.069)	(0.101)
Unemployment (prop.)	-0.076 ***	-0.059 ***	-0.017	-0.059 *
	(0.017)	(0.014)	(0.018)	(0.025)
Not in the labor force (prop.)	-0.103 ***	-0.085 ***	-0.032	-0.071 **
	(0.018)	(0.015)	(0.020)	(0.027)
Low-wage work (prop.)	-0.233 ***	-0.141 ***	-0.091 **	-0.142 ***
	(0.029)	(0.025)	(0.027)	(0.040)
Low-skilled work (prop.)	-0.241 ***	-0.186 ***	-0.141 ***	-0.100 *
	(0.044)	(0.021)	(0.025)	(0.051)
Job instability (job loss count)	-0.392 ***	-0.104 *	-0.176 *	-0.216 *
	(0.030)	(0.050)	(0.081)	(0.086)

Notes : Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582), who had completed at least the 12th grade (n = 4,548), and who had common support (n = 4,085). College completion is measured as a four-year degree completed by age 25. Low propensity is a four-year college completion propensity score from 0 to less than 0.2, middle from 0.2 to less than 0.5, and high from 0.5 to 1. Analyses are based on nearest neighbor matching on the linearized propensity of college. Low-wage work is defined as two-thirds of the median hourly wage in any given year, and low-skilled work is defined as clerical, service and sales, agricultural, craft, trade, and plant and machine operator and assembler occupations. Job instability is measured with a variable indicating a count of jobs lost due to layoffs or plant closings.

* p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B.7(b)

Robustness Estimates of Effects of Four-Year College Completion on Socioeconomic Outcomes by Propensity Score Strata (ATE): NLSY79

Outcomes 1990-2014	Low propensity	Mid propensity	High propensity	Difference Low-High
probability weighted estimates				
Earnings (log avg.)	0.412 ***	0.347 ***	0.386 ***	0.026
	(0.066)	(0.053)	(0.069)	(0.095)
Unemployment (prop.)	-0.068 **	-0.056 ***	-0.021	-0.047 †
	(0.022)	(0.013)	(0.018)	(0.028)
Not in the labor force (prop.)	-0.089 ***	-0.082 ***	-0.043 †	-0.046
	(0.020)	(0.015)	(0.025)	(0.032)
Low-wage work (prop.)	-0.224 ***	-0.138 ***	-0.104 **	-0.120 **
	(0.026)	(0.024)	(0.031)	(0.040)
Low-skilled work (prop.)	-0.243 ***	-0.193 ***	-0.134 ***	-0.109 *
	(0.045)	(0.020)	(0.023)	(0.051)
Job instability (job loss count)	-0.391 ***	-0.124 **	-0.162 *	-0.229 **
	(0.030)	(0.047)	(0.072)	(0.078)
Generalized random forest estimates				
Earnings (log avg.)	0.398 ***	0.347 ***	0.396 ***	0.002
	(0.053)	(0.051)	(0.066)	(0.085)
Unemployment (prop.)	-0.068 **	-0.056 ***	-0.025	-0.043 *
	(0.012)	(0.013)	(0.017)	(0.021)
Not in the labor force (prop.)	-0.095 ***	-0.083 ***	-0.038 †	-0.057 *
	(0.020)	(0.015)	(0.020)	(0.028)
Low-wage work (prop.)	-0.215 ***	-0.139 ***	-0.105 **	-0.110 **
	(0.027)	(0.024)	(0.028)	(0.039)
Low-skilled work (prop.)	-0.256 ***	-0.193 ***	-0.136 ***	-0.120 ***
	(0.028)	(0.020)	(0.022)	(0.036)
Job instability (job loss count)	-0.369 ***	-0.121 **	-0.161 *	-0.208 *
	(0.036)	(0.048)	(0.073)	(0.081)

Notes : Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582), who had completed at least the 12th grade (n = 4,548), and who had common support (n = 4,085). College completion is measured as a four-year degree completed by age 25. Low propensity is a four-year college completion propensity score from 0 to less than 0.2, middle from 0.2 to less than 0.5, and high from 0.5 to 1. Analyses in the top panel are based on doubly robust inverse-probability-weighted regression adjustment. Analyses in the bottom panel are based on generalized random (causal) forests. Low-wage work is defined as two-thirds of the median hourly wage in any given year, and low-skilled work is defined as clerical, service and sales, agricultural, craft, trade, and plant and machine operator and assembler occupations. Job instability is measured with a variable indicating a count of jobs lost due to layoffs or plant closings.

† p ≤ 0.10 * p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B.8

Effects of Four-Year College Completion on Socioeconomic Outcomes by Propensity Score Strata (ATE): NLSY97

Outcomes 2010-2019	Low propensity	Mid propensity	High propensity	Difference Low-High
Earnings (log avg.)	0.388 **	0.332 ***	0.509 ***	-0.121
	(0.150)	(0.036)	(0.071)	(0.166)
Unemployment (prop.)	-0.103 ***	-0.098 ***	-0.080 ***	-0.023
	(0.027)	(0.012)	(0.017)	(0.032)
Not in the labor force (prop.)	-0.084 ***	-0.073 ***	-0.056 ***	-0.028
	(0.021)	(0.011)	(0.016)	(0.026)
Low-wage work (prop.)	-0.207 ***	-0.176 ***	-0.136 ***	-0.071
	(0.042)	(0.018)	(0.022)	(0.047)
Low-skilled work (prop.)	-0.302 ***	-0.261 ***	-0.221 ***	-0.081 †
	(0.037)	(0.021)	(0.023)	(0.044)
Job loss during COVID	-0.113 ***	-0.047 **	-0.018	-0.095 ***
	(0.008)	(0.014)	(0.021)	(0.022)

Notes: Data are from the NLYS97. Sample is restricted to individuals who had completed at least the 12th grade (n = 7,753) and who had common support (n = 7,626). College completion is measured as a four-year degree completed by age 25. Low propensity is a four-year college completion propensity score from 0 to less than 0.2, middle from 0.2 to less than 0.5, and high from 0.5 to 1. Analyses are based on nearest neighbor matching on the linearized propensity of college. Unemployment is based on doubly robust inverse-probability-weighted regression adjustment. Low-wage work is defined as two-thirds of the median hourly wage in any given year, and low-skilled work is defined as clerical, service and sales, agricultural, craft, trade, and plant and machine operator and assembler occupations. Job loss during COVID indicates not working due to COVID in 2020.

† p ≤ 0.10 * p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B.9(a)

Effects of Four-Year College Completion on Socioeconomic Outcomes by Key Covariates (ATE): NLSY79

Outcomes 1990-2014	Low income	Mid income	High income
Earnings (log avg.)	0.466 ***	0.410 ***	0.341 ***
	(0.070)	(0.081)	(0.075)
Unemployment (prop.)	-0.100 ***	-0.087 ***	0.004
	(0.021)	(0.009)	(0.051)
Not in the labor force (prop.)	-0.135 ***	-0.112 ***	-0.013
	(0.018)	(0.015)	(0.052)
Low-wage work (prop.)	-0.289 ***	-0.206 ***	-0.091 †
	(0.032)	(0.032)	(0.054)
Low-skilled work (prop.)	-0.225 ***	-0.249 ***	-0.191 ***
	(0.063)	(0.029)	(0.031)
Job instability (job loss count)	-0.368 ***	-0.315 ***	-0.237 ***
	(0.056)	(0.031)	(0.048)
	Mother less than HS	**Mother HS degree**	**Mother College**
Earnings (log avg.)	0.432 ***	0.394 ***	0.379 ***
	(0.092)	(0.064)	(0.057)
Unemployment (prop.)	-0.076 *	-0.064 ***	-0.045 **
	(0.034)	(0.012)	(0.014)
Not in the labor force (prop.)	-0.114 ***	-0.078 ***	-0.067 ***
	(0.021)	(0.021)	(0.016)
Low-wage work (prop.)	-0.274 ***	-0.159 ***	-0.140 ***
	(0.037)	(0.029)	(0.024)
Low-skilled work (prop.)	-0.184 **	-0.252 ***	-0.193 ***
	(0.071)	(0.022)	(0.030)
Job instability (job loss count)	-0.410 ***	-0.267 ***	-0.215 ***
	(0.044)	(0.032)	(0.053)
	Low ASVAB	**Mid ASVAB**	**High ASVAB**
Earnings (log avg.)	0.590 ***	0.019	0.391 ***
	(0.112)	(0.178)	(0.053)
Unemployment (prop.)	-0.091 ***	-0.073 ***	-0.042 ***
	(0.024)	(0.011)	(0.010)
Not in the labor force (prop.)	-0.133 ***	-0.092 ***	-0.066 ***
	(0.022)	(0.015)	(0.012)
Low-wage work (prop.)	-0.320 ***	-0.096	-0.130 ***
	(0.039)	(0.060)	(0.026)
Low-skilled work (prop.)	-0.311 ***	-0.210 ***	-0.171 ***
	(0.034)	(0.035)	(0.037)
Job instability (job loss count)	-0.487 ***	-0.176 *	-0.193 ***
	(0.046)	(0.080)	(0.044)
	Black	**Hispanic**	**White**
Earnings (log avg.)	0.352 ***	0.568 ***	0.399 ***
	(0.083)	(0.126)	(0.057)
Unemployment (prop.)	-0.077 ***	-0.107 ***	-0.041 **
	(0.015)	(0.011)	(0.015)

Not in the labor force (prop.)	-0.117	***	-0.121	***	-0.065	**
	(0.013)		(0.016)		(0.021)	
Low-wage work (prop.)	-0.240	***	-0.231	***	-0.162	***
	(0.031)		(0.031)		(0.027)	
Low-skilled work (prop.)	-0.269	***	-0.205	***	-0.224	***
	(0.030)		(0.043)		(0.022)	
Job instability (job loss count)	-0.422	***	-0.231	†	-0.239	***
	(0.043)		(0.126)		(0.033)	

Notes : Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582), who had completed at least the 12th grade (n = 4,548), and who had common support (n = 4,085). College completion is measured as a four-year degree completed by age 25. Analyses are based on nearest neighbor matching on the linearized propensity of college. Low-wage work is defined as two-thirds of the median hourly wage in any given year, and low-skilled work is defined as clerical, service and sales, agricultural, craft, trade, and plant and machine operator and assembler occupations. Job instability is measured with a variable indicating a count of jobs lost due to layoffs or plant closings. Parental income is divided into terciles. It ranges from $0 to $40,500 (in 2020 dollars) for low income, $40,500 to $74,000 for the middle income, and $74,000 to $267,000 for the high income. ASVAB is also divded into terciles. It ranges from -2.48 to -0.24 for low ASVAB, -0.24 to 0.40 for middle ASVAB, and 0.40 to 2.39 for high ASVAB.

† p ≤ 0.10 * p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B.9(b)

Effects of Four-Year College Completion on Socioeconomic Outcomes for the Most Responsive Subgrouops Determined by Causal Trees: NLSY79

			Descriptive statistics of most responsive subgroup (means and standard deviations)			
Outcomes 1990-2014	**responsive subgroup effect**	**Causal trees splits**	**Propensity score**	**Parental income**	**Mothers' education**	**ASVAB scores**
Earnings (log avg.)	0.52 ***	Hispanic, delinquency, male, 2+ siblings, high social control	0.271	214.128	12.009	0.204
	(0.099)		(0.269)	(0.204)	(2.356)	(0.658)
Unemployment (prop.)	-0.12 ***	Low/mid propensity, mothers HS+, low ASVAB	0.076	182.596	12.451	-0.618
	(0.012)		(0.101)	(116.159)	(1.108)	(0.367)
Not in the labor force (prop.)	-0.14 ***	Mother HS degree +, low/mid propensity, low ASVAB	0.072	181.463	12.441	-0.646
	(0.015)		(0.097)	(114.097)	(1.085)	(0.360)
Low-wage work (prop.)	-0.34 ***	Mother < HS degree, 4+ siblings	0.071	113.488	8.567	-0.153
	(0.020)		(0.107)	(79.720)	(2.591)	(0.637)
Low-skilled work (prop.)	-0.46 ***	Male, two-parents, low social control, low/mid parental income	0.120	111.963	10.611	-0.114
	(0.029)		(0.170)	(47.165)	(2.747)	(0.665)
Job instability (job loss count)	-0.44 ***	Low propensity	0.036	146.047	10.417	-0.305
	(0.033)		(0.030)	(99.986)	(2.506)	(0.572)

Notes: Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582), who had completed at least the 12th grade (n = 4,548), and who had common support (n = 4,085). College completion is measured as a four-year degree completed by age 25. Analyses are based on nearest neighbor matching on the linearized propensity of college. Low-wage work is defined as two-thirds of the median hourly wage in any given year, and low-skilled work is defined as clerical, service and sales, agricultural, craft, trade, and plant and machine operator and assembler occupations. Job instability is measured with a variable indicating a count of jobs lost due to layoffs or plant closings. Parental income is measured in $100s.

† p ≤ 0.10 * p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B.10

Sensitivity Results for Effects of Four-Year College Completion on Socioeconomic Outcomes

	Sensitivity parameters		Low propensity		Mid propensity		High propensity	
	γ	λ	Effect	CI	Effect	CI	Effect	CI
Outcomes								
Earnings (log avg.)	10%	10%	0.436	(0.291,0.581)	0.324	(0.210,0.438)	0.353	(0.218,0.488)
	20%	10%	0.426	(0.281,0.571)	0.314	(0.200,0.428)	0.343	(0.208,0.478)
	40%	10%	0.406	(0.261,0.551)	0.294	(0.180,0.408)	0.323	(0.188,0.458)
Unemployment (prop.)	-10%	10%	-0.066	(-0.099,-0.033)	-0.049	(-0.076,-0.022)	-0.007	(-0.042,0.028)
	-20%	10%	-0.056	(-0.089,-0.023)	-0.039	(-0.066,-0.012)	0.003	(-0.032,0.038)
	-40%	10%	-0.036	(-0.069,-0.003)	-0.019	(-0.046,0.008)	0.023	(-0.012,0.058)
Not in the labor force (prop.)	-10%	10%	-0.093	(-0.128,-0.058)	-0.075	(-0.104,-0.046)	-0.022	(-0.061,0.017)
	-20%	10%	-0.083	(-0.118,-0.048)	-0.065	(-0.094,-0.036)	-0.012	(-0.051,0.027)
	-40%	10%	-0.063	(-0.098,-0.028)	-0.045	(-0.074,-0.016)	0.008	(-0.031,0.047)
Low-wage work (prop.)	-10%	10%	-0.223	(-0.280,-0.166)	-0.131	(-0.180,-0.082)	-0.007	(-0.060,0.046)
	-20%	10%	-0.213	(-0.270,-0.156)	-0.121	(-0.170,-0.072)	-0.071	(-0.124,-0.018)
	-40%	10%	-0.193	(-0.250,-0.136)	-0.101	(-0.150,-0.052)	-0.051	(-0.104,0.002)
Low-skilled work (prop.)	-10%	10%	-0.231	(-0.317,-0.222)	-0.176	(-0.217,-0.135)	-0.131	(-0.180,-0.082)
	-20%	10%	-0.221	(-0.307,-0.212)	-0.166	(-0.207,-0.125)	-0.121	(-0.170,-0.072)
	-40%	10%	-0.201	(-0.287,-0.192)	-0.146	(-0.187,-0.105)	-0.101	(-0.150,-0.052)
Job instability (job loss count)	-10%	10%	-0.382	(-0.441,-0.376)	-0.094	(-0.192,0.004)	-0.166	(-0.325,-0.007)
	-20%	10%	-0.372	(-0.431,-0.366)	-0.084	(-0.182,0.014)	-0.156	(-0.315,0.003)
	-40%	10%	-0.352	(-0.411,-0.346)	-0.064	(-0.162,0.034)	-0.136	(-0.295,0.023)

Notes : Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582) and who had completed at least the 12th grade (n = 4,548). College completion is measured as a four-year degree completed by age 25. Low propensity is a four-year college completion propensity score from 0 to less than 0.2, middle from 0.2 to less than 0.5, and high from 0.5 to 1. Low-wage work is defined as two-thirds of the median hourly wage in any given year, and low-skilled work is defined as clerical, service and sales, agricultural, craft, trade, and plant and machine operator and assembler occupations. Job instability is measured with a variable indicating a count of jobs lost due to layoffs or plant closings.

Table B.11

Effects of Four-Year College Attendance and Completion on Family-Level Outcomes: NLSY79

	Four-year college attendance			Four-year college completion		
Outcomes 1990-2014	**Average treatment effect (ATE)**	**Average treatment effect on the Treated (TT)**	**Difference: ATE-ATT**	**Average treatment effect (ATE)**	**Average treatment effect on the Treated (TT)**	**Difference: ATE-ATT**
Household income (log avg.)	0.365 ***	0.451 ***	-0.086	0.469 ***	0.473 ***	-0.004
	(0.046)	(0.085)	(0.097)	(0.045)	(0.047)	(0.065)
Family poverty (ever)	-0.152 ***	-0.133 **	-0.019	-0.248 ***	-0.105 ***	-0.143 ***
	(0.037)	(0.040)	(0.054)	(0.038)	(0.027)	(0.047)
Family poverty (prop.)	-0.070 ***	-0.049 ***	-0.021	-0.093 ***	-0.037 ***	-0.056 ***
	(0.011)	(0.012)	(0.016)	(0.006)	(0.008)	(0.010)
Married (prop.)	0.025	0.075 **	-0.050	0.077	0.123 ***	-0.046
	(0.031)	(0.025)	(0.040)	(0.046)	(0.024)	(0.052)
Spouse high-skilled work (prop.)	0.063 ***	0.100 ***	-0.037 *	0.061 ***	0.113 ***	-0.052 **
	(0.011)	(0.012)	(0.016)	(0.013)	(0.014)	(0.019)
Single parenthood (prop.)	-0.083 ***	-0.060 ***	-0.023	-0.079 ***	-0.061 ***	-0.018
	(0.015)	(0.012)	(0.019)	(0.022)	(0.010)	(0.024)

Notes : Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582), who had completed at least the 12th grade (n = 4,548), and who had common support (n = 4,085). College attendance is measured as a four-year degree attendance by age 20. College completion is measured as a four-year degree completed by age 25. Analyses are based on nearest neighbor matching on the linearized propensity of college. Spouse high-skilled work measures the time a respondent had a spouse who held a job in managerial, professional, technical, and associated professional occupations. Single parenthood measures the time spent unmarried with at least one child.

* p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B.12

Effects of Four-Year College Attendance and Completion on Family-Level Outcomes: NLSY97

	Four-year college attendance			Four-year college completion		
Outcomes 2010-2019	**Average treatment effect (ATE)**	**Average treatment effect on the Treated (TT)**	**Difference: ATE-ATT**	**Average treatment effect (ATE)**	**Average treatment effect on the Treated (TT)**	**Difference: ATE-ATT**
Household income (log avg.)	0.330 ***	0.373 ***	-0.043	0.340 ***	0.315 ***	0.025
	(0.032)	(0.050)	(0.059)	(0.060)	(0.029)	(0.067)
Family poverty (ever)	-0.121 ***	-0.116 ***	-0.005	-0.166 ***	-0.130 ***	-0.036
	(0.019)	(0.028)	(0.034)	(0.030)	(0.019)	(0.036)
Family poverty (prop.)	-0.083 ***	-0.071 ***	-0.012	-0.097 ***	-0.058 ***	-0.039 *
	(0.011)	(0.019)	(0.022)	(0.014)	(0.007)	(0.016)
Married (prop.)	0.051 **	0.072 *	-0.021	0.097 ***	0.097 ***	0.000
	(0.018)	(0.028)	(0.033)	(0.027)	(0.020)	(0.034)
Single parenthood (prop.)	-0.082 ***	-0.084 *	0.002	-0.114 ***	-0.068 ***	-0.046 *
	(0.013)	(0.016)	(0.021)	(0.016)	(0.011)	(0.019)

Notes : Data are from the NLYS97. Sample is restricted to individuals who had completed at least the 12th grade (n = 7,753) and who had common support (n = 7,626). College attendance is measured as a four-year degree attendance by age 20. College completion is measured as a four-year degree completed by age 25. Analyses are based on nearest neighbor matching on the linearized propensity of college. Single parenthood measures the time spent unmarried with at least one child.

* p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B.13(a)

Effects of Four-Year College Completion on Family-Level Outcomes by Propensity Score Strata (ATE): NLSY79

Outcomes 1990-2014	Low propensity	Mid propensity	High propensity	Difference Low-High
Household income (log avg.)	0.465 ***	0.406 ***	0.549 ***	-0.084
	(0.066)	(0.054)	(0.074)	(0.099)
Family poverty (ever)	-0.319 ***	-0.122 ***	-0.096 **	-0.223 ***
	(0.056)	(0.035)	(0.043)	(0.071)
Family poverty (prop.)	-0.123 ***	-0.043 ***	-0.030 **	-0.093 ***
	(0.008)	(0.009)	(0.011)	(0.014)
Married (prop.)	0.041	0.085 **	0.173 ***	-0.132 †
	(0.070)	(0.033)	(0.037)	(0.079)
Spouse high-skilled occupation (prop.)	0.039 *	0.044 *	0.155 ***	-0.116 ***
	(0.018)	(0.018)	(0.021)	(0.028)
Single parenthood (prop.)	-0.082 *	-0.084 ***	-0.043 **	-0.039
	(0.035)	(0.016)	(0.014)	(0.038)

Notes : Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582), who had completed at least the 12th grade (n = 4,548), and who had common support (n = 4,085). College completion is measured as a four-year degree completed by age 25. Low propensity is a four-year college completion propensity score from 0 to less than 0.2, middle from 0.2 to less than 0.5, and high from 0.5 to 1. Analyses are based on nearest neighbor matching on the linearized propensity of college. Spouse high-skilled work measures the time a respondent had a spouse who held a job in managerial, professional, technical, and associated professional occupations. Single parenthood measures the time spent unmarried with at least one child.

† p ≤ 0.10 * p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B.13(b)

Robustness Estimates of Effects of Four-Year College Completion on Family-Level Outcomes by Propensity Score Strata (ATE): NLSY79

Outcomes 1990-2014	Low propensity	Mid propensity	High propensity	Difference Low-High
Doubly robust inverse-probability weighted estimates				
Household income (log avg.)	0.471 ***	0.416 ***	0.561 ***	-0.090
	(0.053)	(0.054)	(0.072)	(0.089)
Family poverty (ever)	-0.337 ***	-0.119 ***	-0.098 *	-0.239 ***
	(0.034)	(0.034)	(0.044)	(0.056)
Family poverty (prop.)	-0.123 ***	-0.041 ***	-0.027 **	-0.096 ***
	(0.008)	(0.009)	(0.009)	(0.012)
Married (prop.)	0.079	0.075 *	0.162 ***	-0.083
	(0.058)	(0.033)	(0.036)	(0.068)
Spouse high-skilled occ. (prop.)	0.050 **	0.045 *	0.157 ***	-0.107 ***
	(0.017)	(0.017)	(0.021)	(0.027)
Single parenthood (prop.)	-0.085 **	-0.080 ***	-0.037 **	-0.048
	(0.032)	(0.015)	(0.013)	(0.035)
Generalized random forest estimates				
Household income (log avg.)	0.439 ***	0.407 ***	0.544 ***	-0.105
	(0.049)	(0.053)	(0.067)	(0.083)
Family poverty (ever)	-0.306 ***	-0.115 ***	-0.105 *	-0.201 ***
	(0.038)	(0.034)	(0.043)	(0.057)
Family poverty (prop.)	-0.110 ***	0.041 ***	-0.030 **	-0.080 ***
	(0.011)	(0.009)	(0.010)	(0.015)
Married (prop.)	0.086 *	0.076 *	0.196 ***	-0.110 †
	(0.043)	(0.032)	(0.040)	(0.059)
Spouse high-skilled occ. (prop.)	0.060 ***	0.044 **	0.142 ***	-0.082 ***
	(0.017)	(0.017)	(0.022)	(0.028)
Single parenthood (prop.)	-0.093 ***	-0.084 ***	-0.060 **	-0.033
	(0.022)	(0.015)	(0.017)	(0.028)

Notes : Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582), who had completed at least the 12th grade (n = 4,548), and who had common support (n = 4,085). College completion is measured as a four-year degree completed by age 25. Low propensity is a four-year college completion propensity score from 0 to less than 0.2, middle from 0.2 to less than 0.5, and high from 0.5 to 1. Analyses in the top panel are based on doubly robust inverse-probability-weighted regression adjustment. Analyses in the bottom panel are based on generalized random (causal) forests. Spouse high-skilled work measures the time a respondent had a spouse who held a job in managerial, professional, technical, and associated professional occupations. Single parenthood measures the time spent unmarried with at least one child.

† p ≤ 0.10 * p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B.14

Effects of Four-Year College Completion on Family-Level Outcomes by Propensity Score Strata (ATE): NLSY97

Outcomes 2010-2019	Low propensity	Mid propensity	High propensity	Difference Low-High
Household income (log avg.)	0.355 ***	0.329 ***	0.307 ***	0.048
	(0.100)	(0.039)	(0.044)	(0.109)
Family poverty (ever)	-0.187 ***	-0.140 ***	-0.128 ***	-0.059
	(0.049)	(0.021)	(0.028)	(0.056)
Family poverty (prop.)	-0.122 ***	-0.071 ***	-0.049 ***	-0.073 **
	(0.023)	(0.009)	(0.010)	(0.025)
Married (prop.)	0.098 *	0.098 ***	0.094 **	0.004
	(0.044)	(0.026)	(0.030)	(0.053)
Single parenthood (prop.)	-0.144 **	-0.083 ***	-0.052 **	-0.092 **
	(0.025)	(0.016)	(0.016)	(0.030)

Notes: Data are from the NLSY97. Sample is restricted to individuals who had completed at least the 12th grade (n = 7,753) and who had common support (n = 7,626). College completion is measured as a four-year degree completed by age 25. Low propensity is a four-year college completion propensity score from 0 to less than 0.2, middle from 0.2 to less than 0.5, and high from 0.5 to 1. Analyses are based on nearest neighbor matching on the linearized propensity of college. Poverty (ever) is based on doubly robust inverse-probability-weighted regression adjustment. Single parenthood measures the time spent unmarried with at least one child.

* p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B.15(a)

Effects of Four-Year College Completion on Family-Level Outcomes by Key Covariates (ATE): NLSY79

Outcomes 1990-2014	Low income	Mid income	High income
Household income (log avg.)	0.434 ***	0.512 ***	0.420 ***
	(0.057)	(0.077)	(0.063)
Family poverty (ever)	-0.247 *	-0.327 ***	-0.157 ***
	(0.113)	(0.022)	(0.028)
Family poverty (prop.)	-0.151 ***	-0.088 ***	-0.039 **
	(0.016)	(0.006)	(0.015)
Married (prop.)	0.056	0.090 *	0.133 **
	(0.070)	(0.045)	(0.049)
Spouse high-skilled occupation (prop.)	0.007	0.067 **	0.118 ***
	(0.015)	(0.021)	(0.021)
Single parenthood (prop.)	-0.106	-0.084 **	-0.065 ***
	(0.056)	(0.029)	(0.018)
	Mother less than HS	**Mothers HS degree**	**Mothers College**
Household income (log avg.)	0.479 ***	0.403 ***	0.604 ***
	(0.101)	(0.054)	(0.075)
Family poverty (ever)	-0.366 ***	-0.223 ***	-0.163 ***
	(0.036)	(0.055)	(0.046)
Family poverty (prop.)	-0.137 ***	-0.077 ***	-0.063 ***
	(0.099)	(0.008)	(0.011)
Married (prop.)	0.045	0.083	0.125 **
	(0.081)	(0.059)	(0.044)
Spouse high-skilled occupation (prop.)	0.012	0.073 **	0.117 ***
	(0.016)	(0.022)	(0.024)
Single parenthood (prop.)	-0.037	-0.102 ***	-0.056 **
	(0.052)	(0.018)	(0.018)
	Low ASVAB	**Mid ASVAB**	**High ASVAB**
Household income (log avg.)	0.578 ***	0.250 ***	0.572 ***
	(0.092)	(0.064)	(0.078)
Family poverty (ever)	-0.363 ***	-0.200 ***	-0.160 ***
	(0.099)	(0.033)	(0.027)
Family poverty (prop.)	-0.164 ***	-0.065 ***	-0.053 ***
	(0.013)	(0.011)	(0.007)
Married (prop.)	0.076	-0.022	0.167 ***
	(0.117)	(0.058)	(0.036)
Spouse high-skilled occupation (prop.)	0.059	0.020	0.101 ***
	0.047	(0.018)	(0.016)
Single parenthood (prop.)	-0.145 ***	0.008	-0.081 ***
	(0.037)	(0.004)	(0.018)
	Black	**Hispanic**	**White**
Household income (log avg.)	0.507 ***	0.651 ***	0.436 ***
	(0.097)	(0.151)	(0.052)
Family poverty (ever)	-0.354 ***	-0.306 ***	-0.169 ***
	(0.048)	(0.046)	(0.038)
Family poverty (prop.)	-0.157 ***	-0.091 ***	-0.058 ***

	(0.016)		(0.009)		(0.006)	
Married (prop.)	0.226	***	-0.022		0.090	
	(0.056)		(0.090)		(0.051)	
Spouse high-skilled occupation (prop.)	0.042	*	0.005		0.091	***
	(0.017)		(0.025)		(0.026)	
Single parenthood (prop.)	-0.190	***	-0.045		-0.063	***
	(0.028)		(0.057)		(0.015)	

Notes : Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582) and who had completed at least the 12th grade (n = 4,548), and who had common support (n = 4,085). College completion is measured as a four-year degree completed by age 25. Analyses are based on nearest neighbor matching on the linearized propensity of college. Parental income is divided into terciles. It ranges from $0 to $40,500 (in 2020 dollars) for low income, $40,500 to $74,000 for the middle income, and $74,000 to $267,000 for the high income. ASVAB is also divded into terciles. It ranges from -2.48 to -0.24 for low ASVAB, -0.24 to 0.40 for middle ASVAB, and 0.40 to 2.39 for high ASVAB. Spouse high-skilled work measures the time a respondent had a spouse who held a job in managerial, professional, technical, and associated professional occupations. Single parenthood measures the time spent unmarried with at least one child.

* $p \leq 0.05$ ** $p \leq 0.01$ *** $p \leq 0.001$; two-tailed tests;

Table B.15(b)

Effects of Four-Year College Completion on Family-Level Outcomes for the Most Responsive Subgrouops Determined by Causal Trees: NLSY79

			Descriptive statistics of most responsive subgroup (means and standard deviations)			
Outcomes 1990-2014	**responsive subgroup effect**	**Causal trees splits**	**Propensity score**	**Parental income**	**Mothers' education**	**ASVAB scores**
Household income (log avg.)	0.54 ***	Hispanic	0.136	154.200	9.126	0.162
	(0.047)		(0.185)	(94.226)	(3.861)	(0.678)
Family poverty (ever)	-0.42 ***	Low propensity	0.032	144.827	10.364	-0.330
	(0.020)		(0.025)	(99.475)	(2.489)	(0.568)
Family poverty (prop.)	-0.19 ***	Low parental income, 4+ siblings	0.077	83.572	9.623	-0.164
	(0.013)		(0.112)	(38.789)	(3.007)	(0.665)
Married (prop.)	0.27 ***	College aspirations, father 11th grade+, high ASVAB	0.629	256.989	13.111	1.241
	(0.058)		(0.206)	(146.290)	(2.374)	(0.263)
Spouse high-skilled occ. (prop.	0.07 ***	College aspirations	0.059	159.591	10.758	-0.174
	(0.010)		(0.092)	(106.192)	(2.413)	(0.628)
Single parenthood (prop.)	-0.24 ***	Low social control, 4+ siblings	0.091	139.000	10.178	-0.187
	(0.018)		(0.147)	(109.229)	(2.967)	(0.640)

Notes: Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582), who had completed at least the 12th grade (n = 4,548), and who had common support (n = 4,085). College completion is measured as a four-year degree completed by age 25. Analyses are based on nearest neighbor matching on the linearized propensity of college. Spouse high-skilled work measures the time a respondent had a spouse who held a job in managerial, professional, technical, and associated professional occupations. Single parenthood measures the time spent unmarried with at least one child. Parental income is measured in $100s.

† p ≤ 0.10 * p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B16

Sensitivity Results for Effects of Four-Year College Completion on Family-Level Outcomes: NLSY79

	Sensitivity parameters		Low propensity		Mid propensity		High propensity	
	γ	λ	Effect	CI	Effect	CI	Effect	CI
Household income (log avg.)	10%	10%	0.455	(0.326,0.584)	0.396	(0.290,0.502)	0.549	(0.404,0.694)
	20%	10%	0.445	(0.316,0.574)	0.386	(0.280,0.492)	0.549	(0.404,0.694)
	40%	10%	0.425	(0.296,0.554)	0.366	(0.260,0.472)	0.549	(0.404,0.694)
Family poverty (ever)	-10%	10%	-0.309	(-0.419,-0.199)	-0.112	(-0.181,-0.043)	-0.086	(-0.170,-0.002)
	-20%	10%	-0.299	(-0.409,-0.189)	-0.102	(-0.171,-0.033)	-0.076	(-0.160,0.008)
	-40%	10%	-0.279	(-0.389,-0.169)	-0.082	(-0.151,-0.013)	-0.056	(-0.140,0.028)
Family poverty (prop.)	-10%	10%	-0.113	(-0.129,-0.111)	-0.033	(-0.051,-0.015)	-0.020	(-0.042,0.002)
	-20%	10%	-0.103	(-0.119,-0.101)	-0.023	(-0.041,-0.005)	-0.010	(-0.032,0.012)
	-40%	10%	-0.083	(-0.099,-0.081)	-0.003	(-0.021,0.015)	0.010	(-0.012,0.032)
Married (prop.)	10%	10%	0.031	(-0.106,0.168)	0.075	(0.010,0.140)	0.163	(0.028,0.298)
	20%	10%	0.021	(-0.116,0.158)	0.065	(0.000,0.130)	0.153	(0.018,0.288)
	40%	10%	0.001	(-0.136,0.138)	0.045	(-0.020,0.110)	0.133	(-0.002,0.268)
Spouse high-skilled work (prop.)	10%	10%	0.029	(-0.006,0.064)	0.034	(-0.001,0.069)	0.145	(0.104,0.186)
	20%	10%	0.019	(-0.016,0.054)	0.024	(-0.011,0.059)	0.135	(0.094,0.176)
	40%	10%	-0.001	(-0.036,0.034)	0.004	(-0.031,0.039)	0.115	(0.074,0.156)
Single parenthood (prop.)	-10%	10%	-0.072	(-0.141,-0.003)	-0.074	(-0.105,-0.043)	-0.033	(-0.060,-0.006)
	-20%	10%	-0.062	(-0.131,0.007)	-0.064	(-0.095,-0.033)	-0.023	(-0.050,0.004)
	-40%	10%	-0.042	(-0.111,0.027)	-0.044	(-0.075,-0.013)	-0.003	(-0.030,0.024)

Notes : Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582) and who had completed at least the 12th grade (n = 4,548), and who had common support (n = 4,085). College completion is measured as a four-year degree completed by age 25. Low propensity is a four-year college completion propensity score from 0 to less than 0.2, middle from 0.2 to less than 0.5, and high from 0.5 to 1. Spouse high-skilled work measures the time a respondent had a spouse who held a job in managerial, professional, technical, and associated professional occupations. Single parenthood measures the time spent unmarried with at least one child.

Table B.17

Effects of Four-Year College Attendance and Completion on Social Assistance Outcomes: NLSY79

	Four-year college attendance			Four-year college completion		
Outcomes 1990-2014	**Average treatment effect (ATE)**	**Average treatment effect on the Treated (TT)**	**Difference: ATE-ATT**	**Average treatment effect (ATE)**	**Average treatment effect on the Treated (TT)**	**Difference: ATE-ATT**
Social assistance (any)	-0.155 ***	-0.128 ***	-0.027	-0.222 ***	-0.127 ***	-0.095 ***
	(0.023)	(0.023)	(0.033)	(0.017)	(0.022)	(0.028)
AFDC/TANF (any)	-0.082 ***	-0.076 ***	-0.006	-0.121 ***	-0.061 ***	-0.060 **
	(0.020)	(0.017)	(0.026)	(0.014)	(0.015)	(0.021)
SNAP (any)	-0.144 ***	-0.124 ***	-0.020	-0.205 ***	-0.112 ***	-0.093 ***
	(0.022)	(0.022)	(0.031)	(0.016)	(0.020)	(0.026)
SSI (any)	-0.079 ***	-0.074 ***	-0.005	-0.132 ***	-0.082 ***	-0.050 *
	(0.021)	(0.019)	(0.028)	(0.015)	(0.019)	(0.024)
UI (any)	-0.078 ***	-0.041	-0.037	-0.184 ***	-0.075 **	-0.109 **
	(0.029)	(0.023)	(0.037)	(0.021)	(0.026)	(0.033)
Social assistance (cumulative amount)	-7170.91 ***	-4331.80 ***	-2839.112 *	-7996.35 ***	-4169.24 ***	-3827.114 ***
	(712.088)	(955.834)	(1191.926)	(521.856)	(765.590)	(926.532)

Notes : Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582) and who had completed at least the 12th grade (n = 4,548), and who had common support (n = 4,085). College attendance is measured as a four-year degree attendance by age 20. College completion is measured as a four-year degree completed by age 25. Analyses are based on nearest neighbor matching on the linearized propensity of college. AFDC/TANF measures assistance received through the Temporary Assistance to Needy Families program, previously Aid to Families with Dependent Children, which provides cash assistance to low-income families with children (commonly called "welfare"); SNAP measures assistance received through the Supplemental Nutritional Assistance Program, which provides benefits for acquiring unprepared foods to low-income families (previously called "Food Stamps"); SSI measures assistance received through the Supplemental Security Income, which provides income support to low-income disabled, blind, or elderly individuals; and UI measures assistance received through the unemployment insurance benefits program.

* p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B.18

Effects of Four-Year College Attendance and Completion on Social Assistance Outcomes: NLSY97

	Four-year college attendance			Four-year college completion		
Outcomes 1990-2014	**Average treatment effect (ATE)**	**Average treatment effect on the Treated (TT)**	**Difference: ATE-ATT**	**Average treatment effect (ATE)**	**Average treatment effect on the Treated (TT)**	**Difference: ATE-ATT**
Social assistance (any)	-0.174 ***	-0.189 ***	0.015	-0.270 ***	-0.188 ***	-0.082 ***
	(0.019)	(0.026)	(0.032)	(0.016)	(0.017)	(0.023)
TANF (any)	-0.049 ***	-0.052 ***	0.003	-0.061 ***	-0.039 ***	-0.022 *
	(0.011)	(0.016)	(0.019)	(0.009)	(0.006)	(0.011)
SNAP/WIC (any)	-0.158 ***	-0.173 ***	0.015	-0.252 ***	-0.177 ***	-0.075 ***
	(0.019)	(0.026)	(0.032)	(0.016)	(0.016)	(0.023)
SSI (any)	-0.052 ***	-0.050 ***	-0.002	-0.065 ***	-0.038 ***	-0.027 **
	(0.011)	(0.014)	(0.018)	(0.006)	(0.008)	(0.010)

Notes: Data are from the NLSY97. Sample is restricted to individuals who had completed at least the 12th grade (n = 7,753) and who had common support (n = 7,626). College attendance is measured as a four-year degree attendance by age 20. College completion is measured as a four-year degree completed by age 25. Analyses are based on nearest neighbor matching on the linearized propensity of college. TANF measures assistance received through the Temporary Assistance to Needy Families program, which provides cash assistance to low-income families with children (previously AFDC, commonly called "welfare"); SNAP measures assistance received through the Supplemental Nutritional Assistance Program, which provides benefits for acquiring unprepared foods to low-income families (previously called "Food Stamps"); WIC measures assistance received through the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), which provides nutrition education, breastfeeding support and referrals, and nutritious foods based on situation (pregnant, breastfeeding, postpartum woman, infant or child); SSI measures assistance received through the Supplemental Security Income, which provides income support to low-income disabled, blind, or elderly individuals.

* $p \leq 0.05$ ** $p \leq 0.01$ *** $p \leq 0.001$; two-tailed tests;

Table B.19(a)

Effects of Four-Year College Completion on Social Assistance Outcomes by Propensity Score Strata (ATE): NLSY79

Outcomes 1990-2014	Low propensity	Mid propensity	High propensity	Difference Low-High
Social assistance (any)	-0.249 ***	-0.109 ***	-0.106 ***	-0.143 ***
	(0.015)	(0.025)	(0.028)	(0.029)
AFDC/TANF (any)	-0.100 ***	-0.062 ***	-0.012	-0.088 ***
	(0.009)	(0.011)	(0.008)	(0.014)
SNAP (any)	-0.221 ***	-0.097 ***	-0.090 ***	-0.131 ***
	(0.014)	(0.020)	(0.023)	(0.024)
SSI (any)	-0.121 ***	-0.035	-0.050 *	-0.071 **
	(0.011)	(0.020)	(0.020)	(0.023)
UI (any)	-0.242 ***	-0.099 **	-0.039	-0.203 ***
	(0.029)	(0.035)	(0.040)	(0.045)
Social assistance (cumulative amount)	-10232.32 ***	-5133.28 ***	-2215.50 *	-8016.817 ***
	(688.756)	(1286.881)	(911.780)	(1459.605)

Notes : Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582) and who had completed at least the 12th grade (n = 4,548), and who had common support (n = 4,085). College completion is measured as a four-year degree completed by age 25. Low propensity is a four-year college completion propensity score from 0 to less than 0.2, middle from 0.2 to less than 0.5, and high from 0.5 to 1. Analyses are based on nearest neighbor matching on the linearized propensity of college. AFDC/TANF measures assistance received through the Temporary Assistance to Needy Families program, previously Aid to Families with Dependent Children, which provides cash assistance to low-income families with children (commonly called "welfare"); SNAP measures assistance received through the Supplemental Nutritional Assistance Program, which provides benefits for acquiring unprepared foods to low-income families (previously called "Food Stamps"); SSI measures assistance received through the Supplemental Security Income, which provides income support to low-income disabled, blind, or elderly individuals; and UI measures assistance received through the unemployment insurance benefits program.

* p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B.19(b)

Robustness Estimates of Effects of Four-Year College Completion on Social Assistance Outcomes by Propensity Score Strata (ATE): NLSY79

Outcomes 1990-2014	Low propensity	Mid propensity	High propensity	Difference Low-High
Doubly robust inverse-probability weighted estimates				
Social assistance (any)	-0.244 ***	-0.110 ***	-0.106 ***	-0.138 ***
	(0.016)	(0.024)	(0.027)	(0.029)
AFDC/TANF (any)	-0.102 ***	-0.062 ***	-0.015	-0.087 ***
	(0.009)	(0.011)	(0.008)	(0.014)
SNAP (any)	-0.215 ***	-0.010 ***	-0.092 ***	-0.123 ***
	(0.015)	(0.020)	(0.023)	(0.025)
SSI (any)	-0.119 ***	-0.031	-0.044 *	-0.075 **
	(0.010)	(0.018)	(0.018)	(0.021)
UI (any)	-0.223 ***	-0.110 **	-0.030	-0.193 ***
	(0.032)	(0.032)	(0.037)	(0.045)
Social assistance (cum. amount)	-10212.56 ***	-4557.92 ***	-1893.70 *	-8318.860 ***
	(676.257)	(1049.337)	(803.755)	(1248.372)
Generalized random forest estimates				
Social assistance (any)	-0.238 ***	-0.109 ***	-0.104 ***	-0.134 ***
	(0.021)	(0.024)	(0.027)	(0.032)
AFDC/TANF (any)	-0.099 ***	-0.063 ***	-0.016	-0.083 ***
	(0.011)	(0.011)	(0.009)	(0.016)
SNAP (any)	-0.208 ***	-0.099 ***	-0.091 ***	-0.117 ***
	(0.019)	(0.019)	(0.023)	(0.027)
SSI (any)	-0.114 ***	-0.029	-0.047 *	-0.067 **
	(0.012)	(0.019)	(0.019)	(0.022)
UI (any)	-0.205 ***	-0.110 **	-0.034	-0.171 ***
	(0.035)	(0.032)	(0.036)	(0.047)
Social assistance (cum. amount)	-9394.70 ***	-4629.03 ***	-1998.26 *	-7396.448 ***
	(791.658)	(1049.337)	(874.738)	(1314.470)

Notes : Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582) and who had completed at least the 12th grade (n = 4,548), and who had common support (n = 4,085). College completion is measured as a four-year degree completed by age 25. Low propensity is a four-year college completion propensity score from 0 to less than 0.2, middle from 0.2 to less than 0.5, and high from 0.5 to 1.Analyses in the top panel are based on doubly robust inverse-probability-weighted regression adjustment. Analyses in the bottom panel are based on generalized random (causal) forests. AFDC/TANF measures assistance received through the Temporary Assistance to Needy Families program, previously Aid to Families with Dependent Children, which provides cash assistance to low-income families with children (commonly called "welfare"); SNAP measures assistance received through the Supplemental Nutritional Assistance Program, which provides benefits for acquiring unprepared foods to low-income families (previously called "Food Stamps"); SSI measures assistance received through the Supplemental Security Income, which provides income support to low-income disabled, blind, or elderly individuals; and UI measures assistance received through the unemployment insurance benefits program.

* p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B.20

Effects of Four-Year College Completion on Social Assistance Outcomes by Propensity Score Strata (ATE): NLSY97

Outcomes 2006-2014	Low propensity	Mid propensity	High propensity	Difference Low-High
Social assistance (any)	-0.321 ***	-0.229 ***	-0.153 ***	-0.168 ***
	(0.024)	(0.021)	(0.025)	(0.035)
AFDC/TANF (any)	-0.073 ***	-0.058 ***	-0.027 **	-0.046 *
	(0.015)	(0.009)	(0.010)	(0.018)
SNAP/WIC (any)	-0.300 ***	-0.208 ***	-0.147 ***	-0.153 ***
	(0.024)	(0.021)	(0.024)	(0.034)
SSI (any)	-0.085 ***	-0.039 ***	-0.035 **	-0.050 **
	(0.009)	(0.008)	(0.013)	(0.016)

Notes: Data are from the NLSY97. Sample is restricted to individuals who had completed at least the 12th grade (n = 7,753) and who had common support (n = 7,626). College completion is measured as a four-year degree completed by age 25. Low propensity is a four-year college completion propensity score from 0 to less than 0.2, middle from 0.2 to less than 0.5, and high from 0.5 to 1. Analyses are based on nearest neighbor matching on the linearized propensity of college. TANF measures assistance received through the Temporary Assistance to Needy Families program, which provides cash assistance to low-income families with children (previously AFDC, commonly called "welfare"); SNAP measures assistance received through the Supplemental Nutritional Assistance Program, which provides benefits for acquiring unprepared foods to low-income families (previously called "Food Stamps"); WIC measures assistance received through the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), which provides nutrition education, breastfeeding support and referrals, and nutritious foods based on situation (pregnant, breastfeeding, postpartum woman, infant or child); SSI measures assistance received through the Supplemental Security Income, which provides income support to low-income disabled, blind, or elderly individuals.

* $p \leq 0.05$ ** $p \leq 0.01$ *** $p \leq 0.001$; two-tailed tests;

Table B.21(a)

Effects of Four-Year College Completion on Social Assistance Outcomes by Key Covariates (ATE): NLSY79

Outcomes 2006-2014	Low income	Mid income	High income
Social assistance (any)	-0.235 ***	-0.224 ***	-0.151 ***
	(0.030)	(0.017)	(0.016)
AFDC/TANF (any)	-0.121 ***	-0.091 ***	-0.025 †
	(0.014)	(0.008)	(0.015)
SNAP (any)	-0.210 ***	-0.203 ***	-0.122 ***
	(0.029)	(0.017)	(0.014)
SSI (any)	-0.107 ***	-0.094 ***	-0.065 ***
	(0.023)	(0.012)	(0.018)
UI (any)	-0.196 ***	-0.223 ***	-0.085 *
	(0.037)	(0.061)	(0.039)
Social assistance (cumulative amount)	-10901.72 ***	-8254.33 ***	-4754.24 ***
	(1101.564)	(882.748)	(682.024)
	Mother less than HS	**Mothers HS degree**	**Mothers College**
Social assistance (any)	-0.259 ***	-0.166 ***	-0.177 ***
	(0.019)	(0.016)	(0.025)
AFDC/TANF (any)	-0.110 ***	-0.064 ***	-0.057 ***
	(0.011)	(0.012)	(0.010)
SNAP (any)	-0.229 ***	-0.148 ***	-0.157 ***
	(0.017)	(0.015)	(0.024)
SSI (any)	-0.122 ***	-0.075 ***	-0.081 ***
	(0.015)	-(0.011)	(0.018)
UI (any)	-0.199 *	-0.171 ***	-0.117 **
	(0.082)	(0.025)	(0.043)
Social assistance (cumulative amount)	-10802.38 ***	-6524.91 ***	-5784.43 ***
	(857.306)	(808.501)	(1091.481)
	Low ASVAB	**Mid ASVAB**	**High ASVAB**
Social assistance (any)	-0.288 ***	-0.178 ***	-0.133 ***
	(0.020)	(0.025)	(0.018)
AFDC/TANF (any)	-0.134 ***	-0.047 *	-0.052 ***
	(0.009)	(0.018)	(0.008)
SNAP (any)	-0.260 ***	-0.161 ***	-0.116 ***
	(0.019)	(0.022)	(0.016)
SSI (any)	-0.147 ***	-0.087 ***	-0.042 ***
	(0.012)	(0.016)	(0.013)
UI (any)	-0.275 ***	-0.138 †	-0.111 ***
	(0.031)	(0.075)	(0.029)
Social assistance (cumulative amount)	-12359.73 ***	-6891.72 ***	-4781.07 ***
	(987.014)	(876.431)	(898.848)
	Black	**Hispanic**	**White**
Social assistance (any)	-0.288 ***	-0.265 ***	-0.146 ***
	(0.032)	(0.022)	(0.011)
AFDC/TANF (any)	-0.125 ***	-0.108 ***	-0.053 ***

	(0.020)		(0.013)		(0.005)	
SNAP (any)	-0.265	***	-0.245	***	-0.126	***
	(0.029)		(0.019)		(0.010)	
SSI (any)	-0.135	***	-0.091	***	-0.073	***
	(0.023)		(0.016)		(0.008)	
UI (any)	-0.182	†	-0.217	***	-0.142	***
	(0.100)		(0.043)		(0.039)	
Social assistance (cumulative amount)	-13818.77	***	-9861.52	***	-4926.10	***
	(1347.566)		(1265.291)		(526.927)	

Notes : Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582) and who had completed at least the 12th grade (n = 4,548), and who had common support (n = 4,085). College completion is measured as a four-year degree completed by age 25. Analyses are based on nearest neighbor matching on the linearized propensity of college. Parental income is divided into terciles. It ranges from $0 to $40,500 (in 2020 dollars) for low income, $40,500 to $74,000 for the middle income, and $74,000 to $267,000 for the high income. ASVAB is also divded into terciles. It ranges from -2.48 to -0.24 for low ASVAB, -0.24 to 0.40 for middle ASVAB, and 0.40 to 2.39 for high ASVAB. AFDC/TANF measures assistance received through the Temporary Assistance to Needy Families program, previously Aid to Families with Dependent Children, which provides cash assistance to low-income families with children (commonly called "welfare"); SNAP measures assistance received through the Supplemental Nutritional Assistance Program, which provides benefits for acquiring unprepared foods to low-income families (previously called "Food Stamps"); SSI measures assistance received through the Supplemental Security Income, which provides income support to low-income disabled, blind, or elderly individuals; and UI measures assistance received through the unemployment insurance benefits program.

† $p \leq 0.10$ * $p \leq 0.05$ ** $p \leq 0.01$ *** $p \leq 0.001$; two-tailed tests;

Table B.21(b)

Effects of Four-Year College Completion on Social Assistance Outcomes for the Most Responsive Subgrouops Determined by Causal Trees: NLSY79

				Descriptive statistics of most responsive subgroup (means and standard deviations)			
Outcomes 1990-2014	**responsive subgroup effect**		**Causal trees splits**	**Propensity score**	**Parental income**	**Mothers' education**	**ASVAB scores**
Social assistance (any)	-0.30	***	Delinquency, no college aspirations, low/mid ASVAB	0.042	157.182	10.834	-0.377
	(0.017)			(0.055)	(107.921)	(2.285)	(0.446)
AFDC/TANF (any)	-0.20	***	Female, Black	0.141	126.429	11.086	0.050
	(0.030)			(0.165)	(100.733)	(2.432)	(0.690)
SNAP (any)	-0.25	***	Non-Hispanic, female, delinquency, no college aspirations	0.085	169.390	11.172	-0.167
	(0.027)			(0.103)	(118.818)	(2.015)	(0.637)
SSI (any)	-0.17	***	Low/mid ASVAB, 3+ siblings, low parental income	0.047	85.388	9.757	-0.474
	(0.016)			(0.062)	(41.039)	(2.800)	(0.448)
UI (any)	-0.32	***	Father < HS degree, low/mid ASVAB	0.048	122.048	9.440	-0.463
	(0.022)			(0.069)	(83.921)	(2.692)	(0.438)
Social assistance (cum. amount	-19000	***	Female, low parental income, no friends' college aspirations	0.071	85.658	9.805	-0.226
	(2398)			(0.109)	(39.795)	(2.858)	(0.663)

Notes: Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582), who had completed at least the 12th grade (n = 4,548), and who had common support (n = 4,085). College completion is measured as a four-year degree completed by age 25. Analyses are based on nearest neighbor matching on the linearized propensity of college. AFDC/TANF measures assistance received through the Temporary Assistance to Needy Families program, previously Aid to Families with Dependent Children, which provides cash assistance to low-income families with children (commonly called "welfare"); SNAP measures assistance received through the Supplemental Nutritional Assistance Program, which provides benefits for acquiring unprepared foods to low-income families (previously called "Food Stamps"); SSI measures assistance received through the Supplemental Security Income, which provides income support to low-income disabled, blind, or elderly individuals; and UI measures assistance received through the unemployment insurance benefits program. Parental income is measured in $100s.

† p ≤ 0.10 * p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B22

Sensitivity Results for Effects of Four-Year College Completion on Social Assistance Outcomes: NLSY79

	Sensitivity parameters		Low propensity		Mid propensity		High propensity	
	γ	λ	Effect	CI	Effect	CI	Effect	CI
Social assistance (any)	-10%	10%	-0.239	(-0.268,-0.210)	-0.099	(-0.158,-0.040)	-0.096	(-0.151,-0.041)
	-20%	10%	-0.229	(-0.258,-0.200)	-0.089	(-0.148,-0.030)	-0.086	(-0.141,-0.031)
	-40%	10%	-0.209	(-0.238,-0.180)	-0.069	(-0.128,-0.010)	-0.066	(-0.121,-0.011)
AFDC/TANF (any)	-10%	10%	-0.090	(-0.108,-0.072)	-0.052	(-0.074,-0.030)	-0.002	(-0.018,0.014)
	-20%	10%	-0.080	(-0.098,-0.062)	-0.042	(-0.064,-0.020)	0.008	(-0.008,0.024)
	-40%	10%	-0.060	(-0.078,-0.042)	-0.022	(-0.044,0.000)	0.028	(0.012,0.044)
SNAP (any)	-10%	10%	-0.211	(-0.238,-0.184)	-0.087	(-0.126,-0.048)	-0.080	(-0.125,-0.035)
	-20%	10%	-0.201	(-0.228,-0.174)	-0.077	(-0.116,-0.038)	-0.070	(-0.115,-0.025)
	-40%	10%	-0.181	(-0.208,-0.154)	-0.057	(-0.096,-0.018)	-0.050	(-0.095,-0.005)
SSI (any)	-10%	10%	-0.111	(-0.133,-0.089)	-0.025	(-0.064,0.014)	-0.040	(-0.079,-0.001)
	-20%	10%	-0.101	(-0.123,-0.079)	-0.015	(-0.054,0.024)	-0.030	(-0.069,0.009)
	-40%	10%	-0.081	(-0.103,-0.059)	0.005	(-0.034,0.044)	-0.010	(-0.049,0.029)
UI (any)	-10%	10%	-0.232	(-0.289,-0.175)	-0.089	(-0.158,-0.020)	-0.029	(-0.107,0.049)
	-20%	10%	-0.222	(-0.279,-0.165)	-0.079	(-0.148,-0.010)	-0.019	(-0.097,0.059)
	-40%	10%	-0.202	(-0.259,-0.145)	-0.059	(-0.128,0.010)	0.001	(-0.077,0.079)
Social assistance (cum. amount	-10%	10%	-10232.310	-11582.272,-8882.348	-5133.270	(-7655.557,-2610.983)	-2215.493	(-4002.582,-428.404)
	-20%	10%	-10232.300	-11582.262,-8882.338	-5133.260	(-7655.547,-2610.973)	-2215.483	(-4002.572,-428.394)
	-40%	10%	-10232.280	-11582.242,-8882.318	-5133.240	(-7655.527,-2610.953)	-2215.463	(-4002.552,-428.374)

Notes : Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582) and who had completed at least the 12th grade (n = 4,548). College completion is measured as a four-year degree completed by age 25. Low propensity is a four-year college completion propensity score from 0 to less than 0.2, middle from 0.2 to less than 0.5, and high from 0.5 to 1. AFDC/TANF measures assistance received through the Temporary Assistance to Needy Families program, previously Aid to Families with Dependent Children, which provides cash assistance to low-income families with children (commonly called "welfare"); SNAP measures assistance received through the Supplemental Nutritional Assistance Program, which provides benefits for acquiring unprepared foods to low-income families (previously called "Food Stamps"); SSI measures assistance received through the Supplemental Security Income, which provides income support to low-income disabled, blind, or elderly individuals; and UI measures assistance received through the unemployment insurance benefits program.

Table B.23

Effects of Four-Year College Attendance and Completion on Civic Outcomes: NLSY79

	Four-year college attendance			Four-year college completion		
Outcomes 2006-2014	**Average treatment effect (ATE)**	**Average treatment effect on the Treated (TT)**	**Difference: ATE-ATT**	**Average treatment effect (ATE)**	**Average treatment effect on the Treated (TT)**	**Difference: ATE-ATT**
Volunteering (any)	0.105 **	0.102 *	0.003	0.136 *	0.118 **	0.018
	(0.036)	(0.047)	(0.059)	(0.054)	(0.036)	(0.065)
Civic volunteering	0.088 **	0.090 *	-0.002	0.151 **	0.088 *	0.063
	(0.033)	(0.047)	(0.057)	(0.053)	(0.034)	(0.063)
Educational volunteering	0.089 **	0.108 ***	-0.019	0.141 **	0.111 ***	0.030
	(0.030)	(0.027)	(0.040)	(0.051)	(0.028)	(0.058)
Charitable volunteering	0.047 **	0.074 *	-0.027	0.069 *	0.083 **	-0.014
	(0.018)	(0.029)	(0.034)	(0.033)	(0.030)	(0.045)
Voted in midterm election	0.182 ***	0.099 *	0.083	0.172 ***	0.093 ***	0.079 †
	(0.028)	(0.041)	(0.050)	(0.036)	(0.028)	(0.046)
Government trust	0.060 *	0.076 †	-0.016	0.086 **	0.039 *	0.047
	(0.026)	(0.040)	(0.048)	(0.025)	(0.018)	(0.031)

Notes : Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582) and who had completed at least the 12th grade (n = 4,548), and who had common support (n = 4,085). College attendance is measured as a four-year degree attendance by age 20. College completion is measured as a four-year degree completed by age 25. Analyses are based on nearest neighbor matching on the linearized propensity of college. Voted indicates the respondent is sure they voted in the 2006 election. Trust in government is a measure of belief that the government does what people want it to do. Civic volunteering includes civic, community, and youth groups; educational includes organizations promoting education; charitable includes charities or social welfare groups.

† p ≤ 0.10 * p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B.24

Effects of Four-Year College Attendance and Completion on Civic Outcomes: NLSY97

	Four-year college attendance			Four-year college completion		
Outcomes 2006-2014	**Average treatment effect (ATE)**	**Average treatment effect on the Treated (TT)**	**Difference: ATE-ATT**	**Average treatment effect (ATE)**	**Average treatment effect on the Treated (TT)**	**Difference: ATE-ATT**
Volunteering (any)	0.108 ***	0.102 ***	0.006	0.132 ***	0.129 ***	0.003
	(0.021)	(0.029)	(0.036)	(0.037)	(0.022)	(0.043)
Voted in midterm election	0.134 ***	0.141 ***	-0.007	0.106 ***	0.126 ***	-0.020
	(0.021)	(0.031)	(0.037)	(0.026)	(0.024)	(0.035)

Notes: Data are from the NLSY97. Sample is restricted to individuals who had completed at least the 12th grade (n = 7,753) and who had common support (n = 7,626). College attendance is measured as a four-year degree attendance by age 20. College completion is measured as a four-year degree completed by age 25. Analyses are based on nearest neighbor matching on the linearized propensity of college. Volunteering refers to any form in 2011-2013. Voted indicates the respondent is sure they voted in the 2010 election.

* p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B.25(a)

Effects of Four-Year College Completion on Civic Outcomes by Propensity Score Strata (ATE): NLSY79

Outcomes 2006-2014	Low propensity	Mid propensity	High propensity	Difference Low-High
Volunteering (any)	0.137 †	0.175 ***	0.089 †	0.048
	(0.081)	(0.044)	(0.054)	(0.097)
Civic volunteering	0.168 *	0.155 ***	0.071	0.097
	(0.080)	(0.043)	(0.052)	(0.095)
Educational volunteering	0.159 *	0.112 **	0.096 *	0.063
	(0.076)	(0.038)	(0.042)	(0.087)
Charitable volunteering	0.057	0.126 ***	0.062	-0.005
	(0.048)	(0.040)	(0.046)	(0.066)
Voted in midterm election	0.211 ***	0.138 ***	0.057	0.154 *
	(0.053)	(0.039)	(0.043)	(0.068)
Government trust	0.112 **	0.039	0.034	0.078 †
	(0.038)	(0.028)	(0.025)	(0.045)

Notes : Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582) and who had completed at least the 12th grade (n = 4,548), and who had common support (n = 4,085). College completion is measured as a four-year degree completed by age 25. Low propensity is a four-year college completion propensity score from 0 to less than 0.2, middle from 0.2 to less than 0.5, and high from 0.5 to 1. Analyses are based on nearest neighbor matching on the linearized propensity of college. Voted indicates the respondent is sure they voted in the 2006 election. Trust in government is a measure of belief that the government does what people want it to do. Civic volunteering includes civic, community, and youth groups; educational includes organizations promoting education; charitable includes charities or social welfare groups.

† p ≤ 0.10 * p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B.25(b)

Robustness Estimates of Effects of Four-Year College Completion on Civic Outcomes by Propensity Score Strata (ATE): NLSY79

Outcomes 2006-2014	Low propensity	Mid propensity	High propensity	Difference Low-High
probability weighted estimates				
Volunteering (any)	0.087 †	0.189 ***	0.081	0.006
	(0.051)	(0.046)	(0.054)	(0.074)
Civic volunteering	0.106 *	0.177 ***	0.060	0.046
	(0.049)	(0.043)	(0.052)	(0.071)
Educational volunteering	0.107 *	0.141 ***	0.076 †	0.031
	(0.048)	(0.037)	(0.044)	(0.065)
Charitable volunteering	0.056	0.126 ***	0.039	0.017
	(0.035)	(0.038)	(0.045)	(0.057)
Voted in midterm election	0.225 ***	0.142 ***	0.054 †	0.171 **
	(0.048)	(0.038)	(0.029)	(0.056)
Government trust	0.131 ***	0.037	0.030	0.101 *
	(0.031)	(0.026)	(0.027)	(0.041)
Generalized random forest estimates				
Volunteering (any)	0.121 *	0.188 ***	0.097	0.024
	(0.051)	(0.045)	(0.053)	(0.074)
Civic volunteering	0.135 **	0.177 ***	0.077	0.058
	(0.049)	(0.043)	(0.050)	(0.070)
Educational volunteering	0.118 *	0.142 ***	0.083 †	0.035
	(0.044)	(0.037)	(0.041)	(0.060)
Charitable volunteering	0.089 *	0.120 ***	0.053	0.036
	(0.038)	(0.037)	(0.040)	(0.055)
Voted in midterm election	0.186 ***	0.139 ***	0.070 †	0.116 †
	(0.049)	(0.038)	(0.039)	(0.063)
Government trust	0.113 ***	0.032	0.025	0.088 *
	(0.035)	(0.026)	(0.023)	(0.042)

Notes : Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582) and who had completed at least the 12th grade (n = 4,548), and who had common support (n = 4,085). College completion is measured as a four-year degree completed by age 25. Low propensity is a four-year college completion propensity score from 0 to less than 0.2, middle from 0.2 to less than 0.5, and high from 0.5 to 1. Analyses in the top panel are based on doubly robust inverse-probability-weighted regression adjustment. Analyses in the bottom panel are based on generalized random (causal) forests.Voted indicates the respondent is sure they voted in the 2006 election. Trust in government is a measure of belief that the government does what people want it to do. Civic volunteering includes civic, community, and youth groups; educational includes organizations promoting education; charitable includes charities or social welfare groups.

† p ≤ 0.10 * p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B.26

Effects of Four-Year College Completion on Civic Outcomes by Propensity Score Strata (ATE): NLSY97

Outcomes 2006-2014	Low propensity	Mid propensity	High propensity	Difference Low-High
Volunteering (any)	0.138 *	0.089 **	0.161 ***	-0.023
	(0.060)	(0.028)	(0.034)	(0.069)
Voted in midterm election	0.175 ***	0.150 ***	0.117 **	0.058
	(0.046)	(0.028)	(0.034)	(0.057)

Notes: Data are from the NLSY97. Sample is restricted to individuals who had completed at least the 12th grade (n = 7,753) and who had common support (n = 7,626). College completion is measured as a four-year degree completed by age 25. Low propensity is a four-year college completion propensity score from 0 to less than 0.2, middle from 0.2 to less than 0.5, and high from 0.5 to 1. Analyses are based on nearest neighbor matching on the linearized propensity of college. Voting is based on doubly robust inverse-probability-weighted regression adjustment. Volunteering refers to any form in 2011-2013. Voted indicates the respondent is sure they voted in the 2010 election.

* p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B.27(a)

Effects of Four-Year College Completion on Civic Outcomes by Key Covariates (ATE): NLSY79

Outcomes 2006-2014	Low income	Mid income	High income
Volunteering (any)	0.204 †	0.158 †	0.078
	(0.121)	(0.081)	(0.052)
Civic volunteering	0.248 *	0.149	0.066
	(0.120)	(0.081)	(0.051)
Educational volunteering	0.256 *	0.116	0.086 †
	(0.118)	(0.077)	(0.048)
Chartiable volunteering	0.118	0.063 †	0.080
	(0.118)	(0.037)	(0.050)
Voted in midterm election	0.185	0.123	0.134 *
	(0.130)	(0.082)	(0.057)
Government trust	0.099	0.097 *	0.032
	0.089	0.041	0.047
	Mother less than HS	**Mothers HS degree**	**Mothers College**
Volunteering (any)	0.101	0.168 *	0.079
	(0.111)	(0.071)	(0.056)
Civic volunteering	0.101	0.168 **	0.079
	(0.110)	(0.071)	(0.056)
Educational volunteering	0.115	0.184 **	0.040
	(0.107)	(0.064)	(0.044)
Chartiable volunteering	0.132	0.115 *	0.021
	(0.110)	(0.041)	(0.044)
Voted in midterm election	0.186	0.145 *	0.103 *
	(0.132)	(0.060)	(0.048)
Government trust	0.105	0.069 *	0.032
	0.084	0.034	0.039
	Low ASVAB	**Mid ASVAB**	**High ASVAB**
Volunteering (any)	0.128	0.077 †	0.129 *
	(0.110)	(0.040)	(0.050)
Civic volunteering	0.160	0.073 *	0.141 **
	(0.109)	(0.036)	(0.050)
Educational volunteering	0.163	0.066 *	0.141 **
	(0.107)	(0.029)	(0.047)
Chartiable volunteering	0.023	0.069 *	0.072 †
	(0.059)	(0.035)	(0.040)
Voted in midterm election	0.247 ***	0.161	0.117 **
	(0.067)	(0.092)	(0.040)
Government trust	0.098 *	0.062	0.071 ***
	(0.048)	(0.090)	(0.017)
	Black	**Hispanic**	**White**
Volunteering (any)	0.105 †	0.118	0.129 *
	(0.053)	(0.105)	(0.066)
Civic volunteering	0.122 *	0.189	0.101
	(0.049)	(0.106)	(0.062)

Educational volunteering	0.086	**	0.137	0.142	*
	(0.031)		(0.090)	(0.061)	
Chartiable volunteering	0.063		0.065	0.076	*
	(0.049)		(0.090)	(0.034)	
Voted in midterm election	0.129		0.253	0.132	*
	(0.109)		(0.150)	(0.053)	
Government trust	0.068		0.034	0.068	**
	0.096		0.147	0.022	

Notes : Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582) and who had completed at least the 12th grade (n = 4,548), and who had common support (n = 4,085). College completion is measured as a four-year degree completed by age 25. Analyses are based on nearest neighbor matching on the linearized propensity of college. Parental income is divided into terciles. It ranges from $0 to $40,500 (in 2020 dollars) for low income, $40,500 to $74,000 for the middle income, and $74,000 to $267,000 for the high income. ASVAB is also divded into terciles. It ranges from -2.48 to -0.24 for low ASVAB, -0.24 to 0.40 for middle ASVAB, and 0.40 to 2.39 for high ASVAB. Voted indicates the respondent is sure they voted in the 2006 election. Trust in government is a measure of belief that the government does what people want it to do. Civic volunteering includes civic, community, and youth groups; educational includes organizations promoting education; charitable includes charities or social welfare groups.

† p ≤ 0.10 * p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B.27(b)

Effects of Four-Year College Completion on Civic Outcomes for the Most Responsive Subgrouops Determined by Causal Trees: NLSY79

			Descriptive statistics of most responsive subgroup (means and standard deviations)			
Outcomes 1990-2014	**Responsive subgroup effect**	**Causal trees splits**	**Propensity score**	**Parental income**	**Mothers' education**	**ASVAB scores**
Volunteering (any)	0.42 ***	College aspirations, mother < college degree, school disadv., mid social control, female	0.308	169.247	11.074	0.345
	(0.060)		(0.242)	(98.453)	(2.384)	(0.672)
Civic volunteering	0.33 ***	College aspirations, low parental income	0.170	64.325	10.070	0.059
	(0.042)		(0.171)	(26.603)	(3.215)	(0.717)
Educational volunteering	0.32 ***	College aspirations, low parental income	0.170	64.325	10.070	0.059
	(0.039)		(0.171)	(26.603)	(3.215)	(0.717)
Charitable volunteering	0.30 ***	Low ASVAB, school disadvantage, non-south residence	0.135	208.577	11.312	-0.087
	(0.440)		(0.164)	(102.780)	(2.778)	(0.482)
Voted in midterm election	0.34 ***	Male, father < college degree, low/mid social control	0.115	150.758	10.760	-0.052
	(0.031)		(0.163)	(98.253)	(2.529)	(0.670)
Government trust	0.19 ***	Low/mid social control, school disadvantage, friends no college aspirations	0.077	144.010	10.483	-0.204
	(0.021)		(0.127)	(92.294)	(2.815)	(0.652)

Notes: Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582), who had completed at least the 12th grade (n = 4,548), and who had common support (n = 4,085). College completion is measured as a four-year degree completed by age 25. Analyses are based on nearest neighbor matching on the linearized propensity of college. Voted indicates the respondent is sure they voted in the 2006 election. Trust in government is a measure of belief that the government does what people want it to do. Civic volunteering includes civic, community, and youth groups; educational includes organizations promoting education. Parental income is measured in $100s.

† p ≤ 0.10 * p ≤ 0.05 ** p ≤ 0.01 *** p ≤ 0.001; two-tailed tests;

Table B28

Sensitivity Results for Effects of Four-Year College Completion on Civic Outcomes: NLSY79

	Sensitivity parameters		Low propensity		Mid propensity		High propensity	
	γ	λ	Effect	CI	Effect	CI	Effect	CI
Volunteering (any)	10%	10%	0.127	(-0.032,0.286)	0.165	(0.079,0.251)	0.079	(-0.027,0.185)
	20%	10%	0.117	(-0.042,0.276)	0.155	(0.069,0.241)	0.069	(-0.037,0.175)
	40%	10%	0.097	(-0.062,0.256)	0.135	(0.049,0.221)	0.049	(-0.057,0.155)
Civic volunteering	10%	10%	0.158	(0.001,0.315)	0.145	(0.061,0.229)	0.049	(-0.053,0.151)
	20%	10%	0.148	(-0.009,0.305)	0.135	(0.051,0.219)	0.049	(-0.053,0.151)
	40%	10%	0.128	(-0.029,0.285)	0.115	(0.031,0.199)	0.049	(-0.053,0.151)
Educational volunteering	10%	10%	0.149	(0.000,0.298)	0.102	(0.020,0.184)	0.086	(0.004,0.168)
	20%	10%	0.139	(-0.010,0.288)	0.092	(0.010,0.174)	0.076	(-0.006,0.158)
	40%	10%	0.119	(-0.030,0.268)	0.072	(-0.010,0.154)	0.056	(-0.026,0.138)
Charitable volunteering	10%	10%	0.047	(-0.047,0.141)	0.116	(0.038,0.194)	0.052	(-0.038,0.142)
	20%	10%	0.037	(-0.057,0.131)	0.106	(0.028,0.184)	0.042	(-0.048,0.132)
	40%	10%	0.017	(-0.077,0.111)	0.086	(0.008,0.164)	0.022	(-0.068,0.112)
Voted in midterm election	10%	10%	0.201	(0.097,0.305)	0.128	(0.052,0.204)	0.047	(-0.037,0.131)
	20%	10%	0.191	(0.087,0.295)	0.118	(0.042,0.194)	0.037	(-0.047,0.121)
	40%	10%	0.171	(0.067,0.275)	0.098	(0.022,0.174)	0.017	(-0.067,0.101)
Government trust	10%	10%	0.102	(0.028,0.176)	0.029	(-0.026,0.084)	0.024	(-0.025,0.073)
	20%	10%	0.092	(0.018,0.166)	0.019	(-0.036,0.074)	0.014	(-0.035,0.063)
	40%	10%	0.072	(-0.002,0.146)	-0.001	(-0.056,0.054)	-0.006	(-0.055,0.043)

Notes : Data are from the NLSY79. Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582) and who had completed at least the 12th grade (n = 4,548). College completion is measured as a four-year degree completed by age 25. Low propensity is a four-year college completion propensity score from 0 to less than 0.2, middle from 0.2 to less than 0.5, and high from 0.5 to 1. Voted indicates the respondent is sure they voted in the 2006 election. Trust in government is a measure of belief that the government does what people want it to do. Civic volunteering includes civic, community, and youth groups; educational includes organizations promoting education; charitable includes charities or social welfare groups.

Overcoming the Odds:

The Benefits of Completing College for Unlikely Graduates

Appendix C

Version: March 28, 2023
Running head: Rose appendix

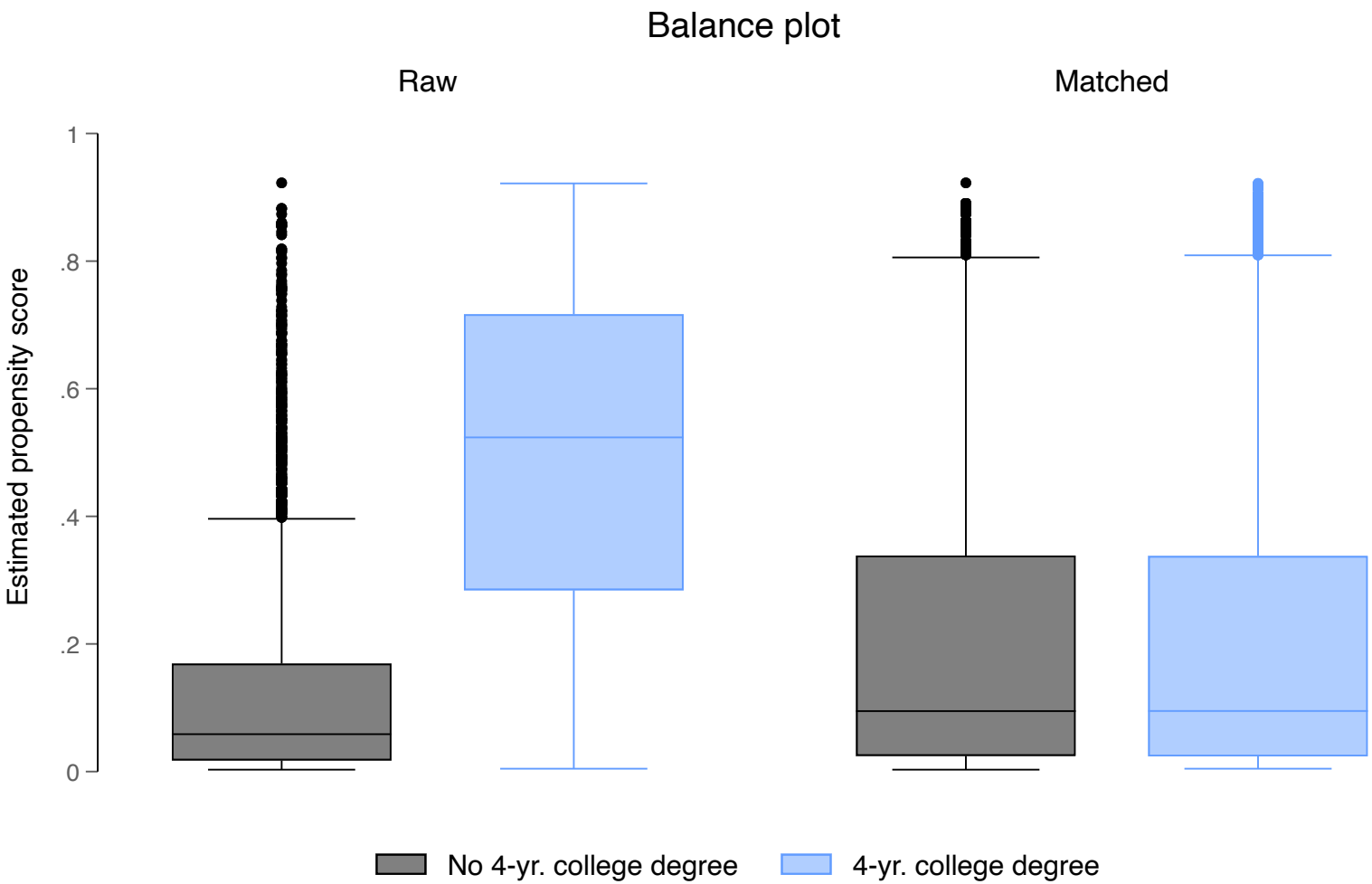


Figure C.1. Balance Plots for Four-Year College Completion: NLSY79

Notes: Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582) and who had completed at least the 12th grade (n = 4,548), and who have sufficient overlap (n = 4,085). College completion is measured as a four-year degree completed by age 25. Matching for average treatment effects.

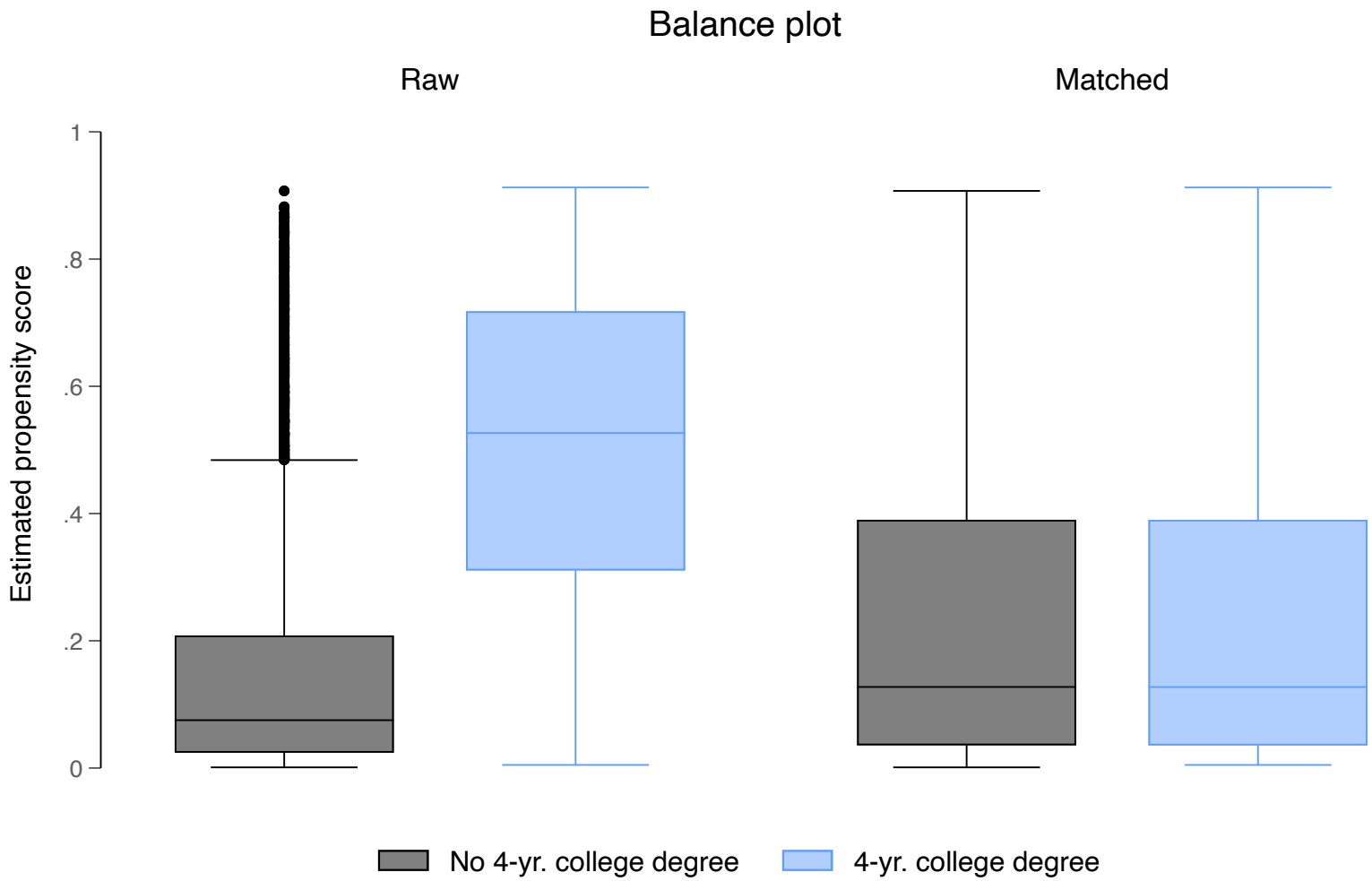
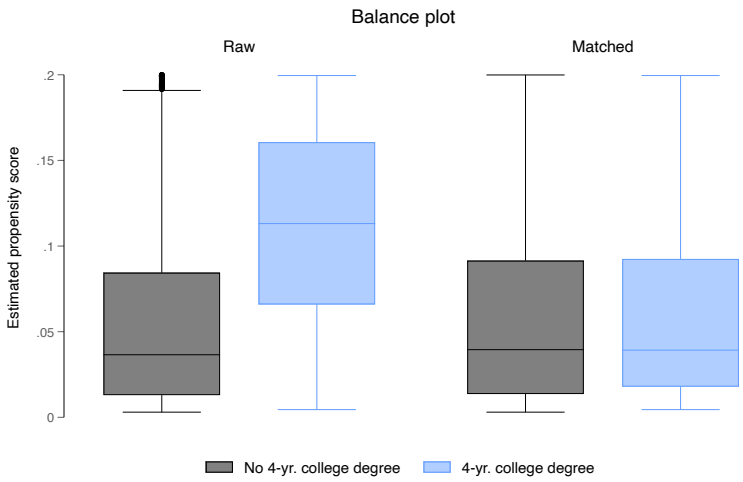


Figure C.2. Balance Plots for Four-Year College Completion: NLSY97

Notes: Data are from the NLYS97. Sample is restricted to individuals who had completed at least the 12th grade (n = 7,753) and who had common support (n = 7,626). College completion is measured as a four-year degree completed by age 25. Matching for average treatment effects.



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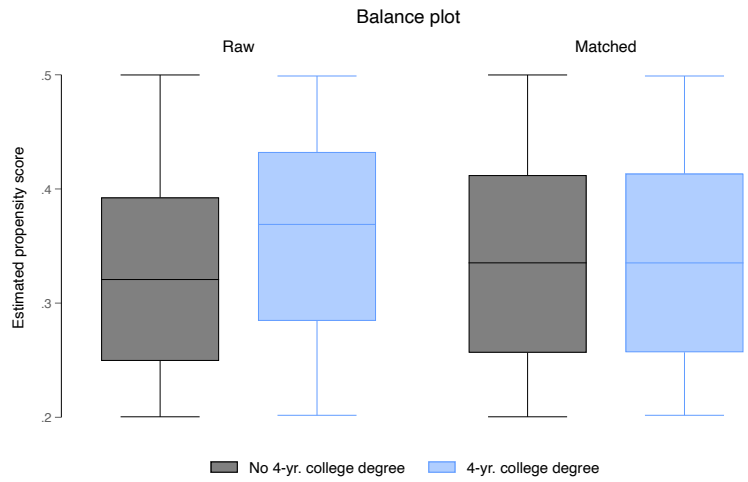
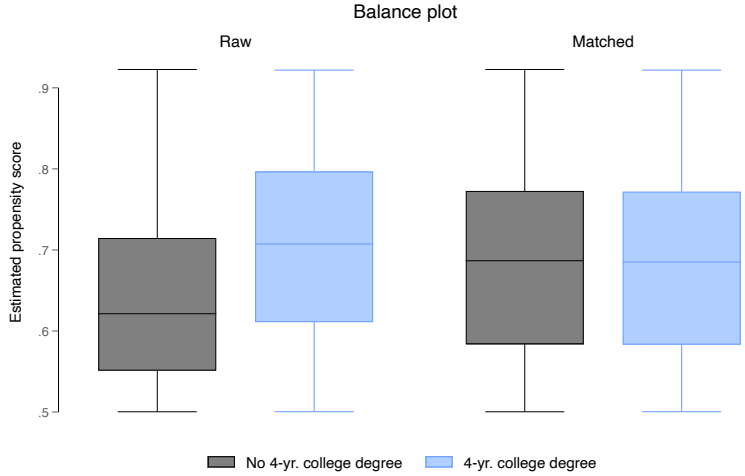


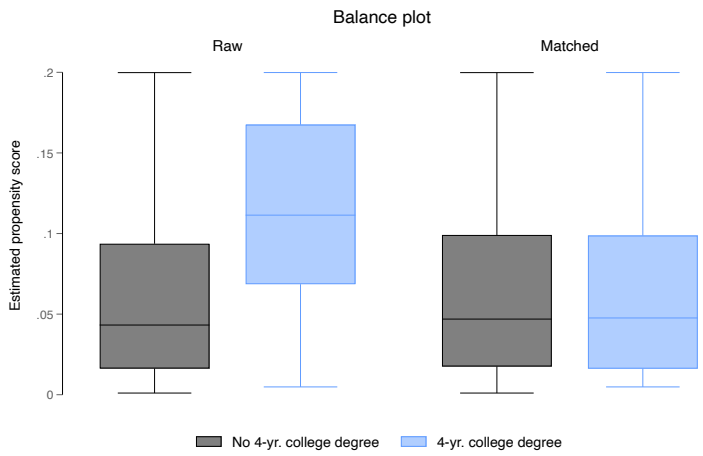
Mid propensity



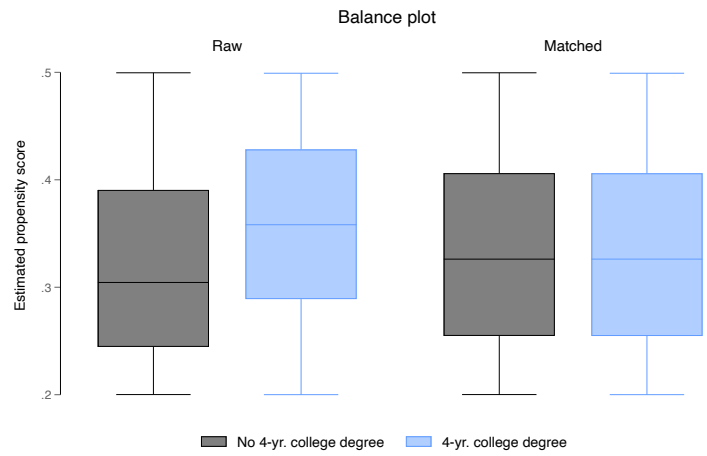
High propensity

Figure C.3. Balance Plots for Four-Year College Completion by College Completion Propensity: NLSY79

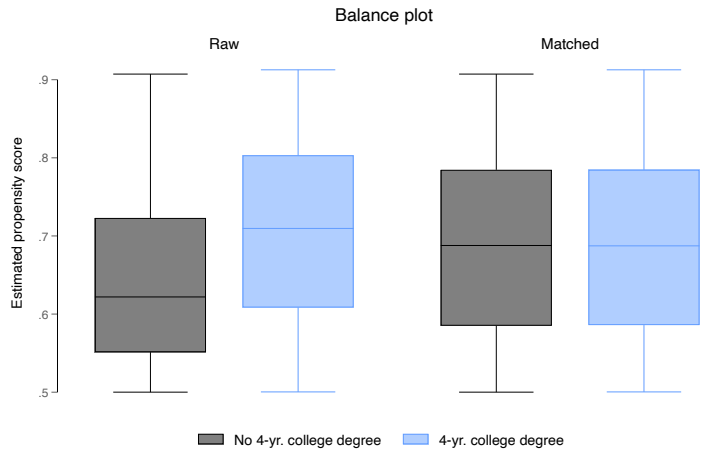
Notes: Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582) and who had completed at least the 12th grade (n = 4,548), and who have sufficient overlap (n = 4,085). College completion is measured as a four-year degree completed by age 25. Low propensity is a four-year college completion propensity score from 0 to less than 0.2, middle from 0.2 to less than 0.5, and high from 0.5 to 1. Matching for average treatment effects.



Low propensity



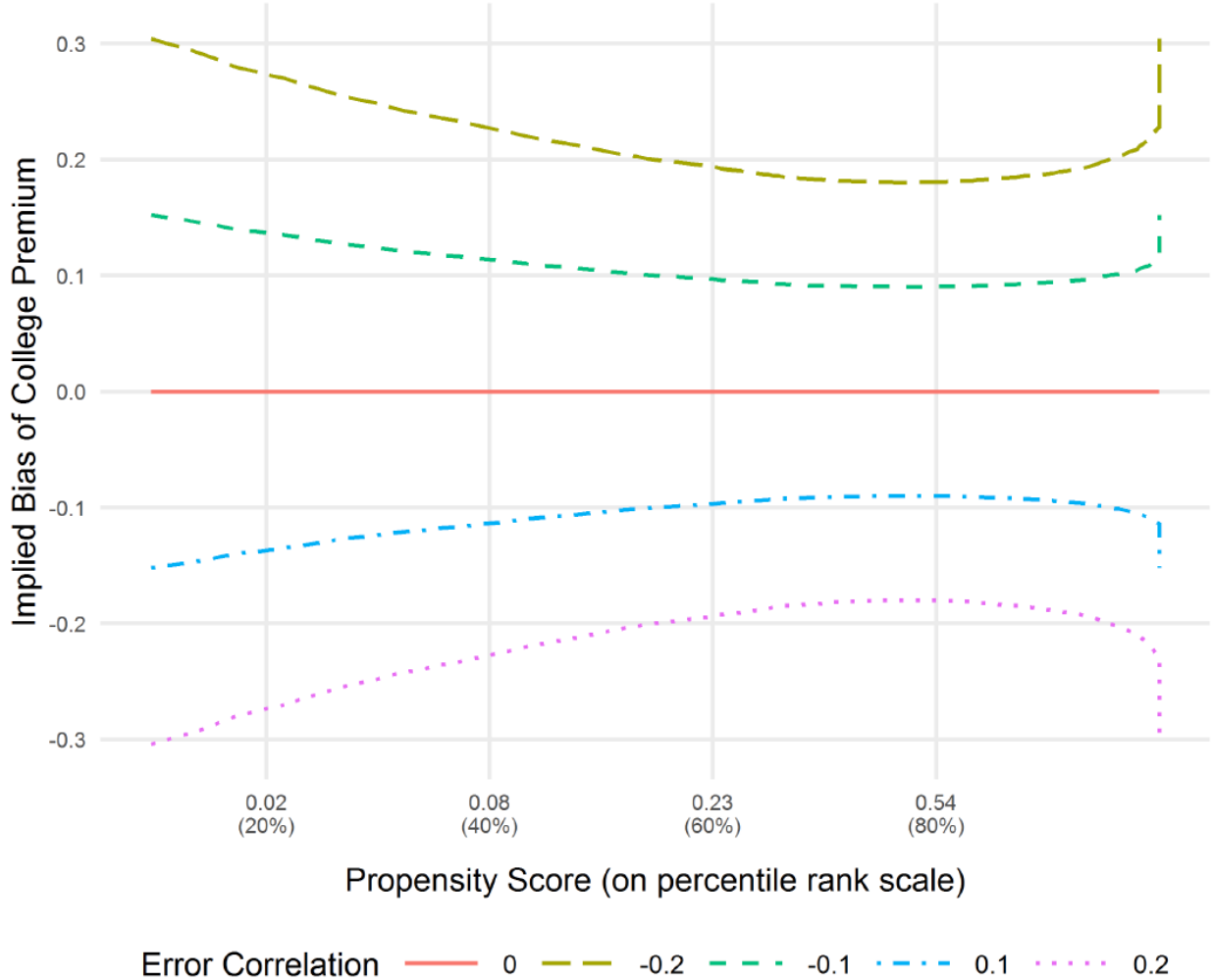
Mid propensity



High propensity

Figure C.4. Balance Plots for Four-Year College Completion by College Completion Propensity: NLSY97

Notes: Data are from the NLYS97. Sample is restricted to individuals who had completed at least the 12th grade (n = 7,753) and who had common support (n = 7,626). College completion is measured as a four-year degree completed by age 25. Low propensity is a four-year college completion propensity score from 0 to less than 0.2, middle from 0.2 to less than 0.5, and high from 0.5 to 1. Matching for average treatment effects.



Note: The horizontal axis shows the propensity score on its percentile rank scale such that each grid represents the same number of individuals. The labels of the axis ticks indicate the values of the propensity score at its 20th, 40th, 60th, and 80th percentiles.

Figure C.5. Four-Year College Completion Effects Bias Under Varying Degrees of Error Correlation
Adapted from Cheng et al. (2021)

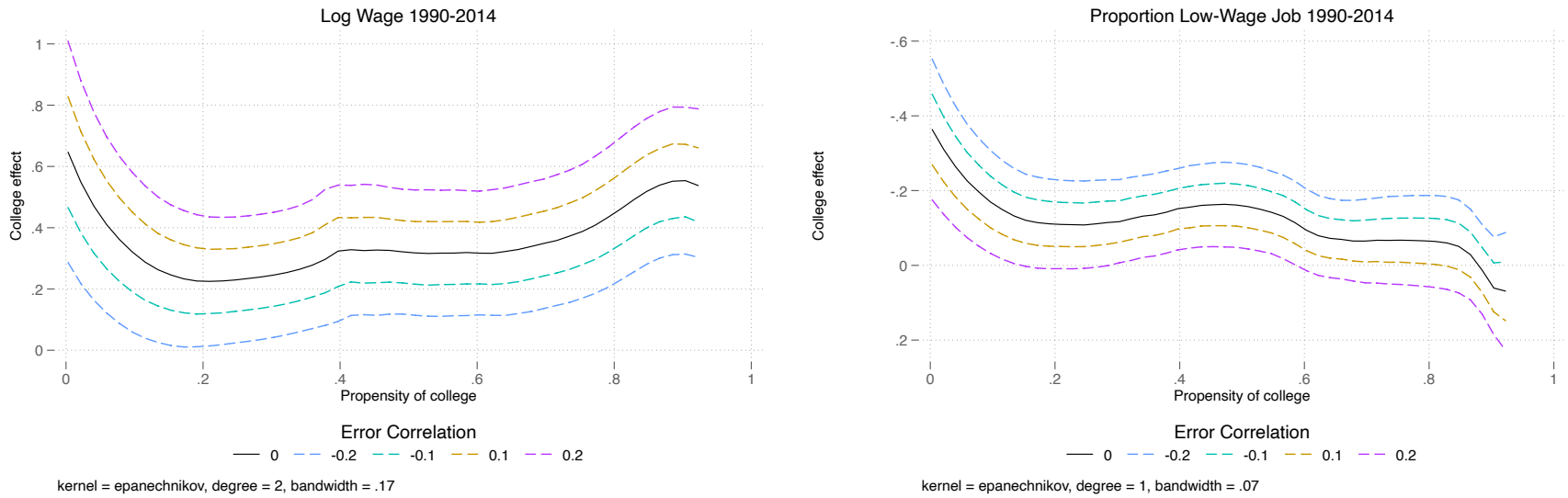


Figure C.6. Sensitivity Analysis for Socioeconomic Outcomes
(a) Log wage; (b) Proportion low-wage job Likelihood (*y*-axis reversed);
Notes: Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582) and who had completed at least the 12th grade (n = 4,548), and who have sufficient overlap ((n = 4,085). College completion is measured as a four-year degree completed by age 25.

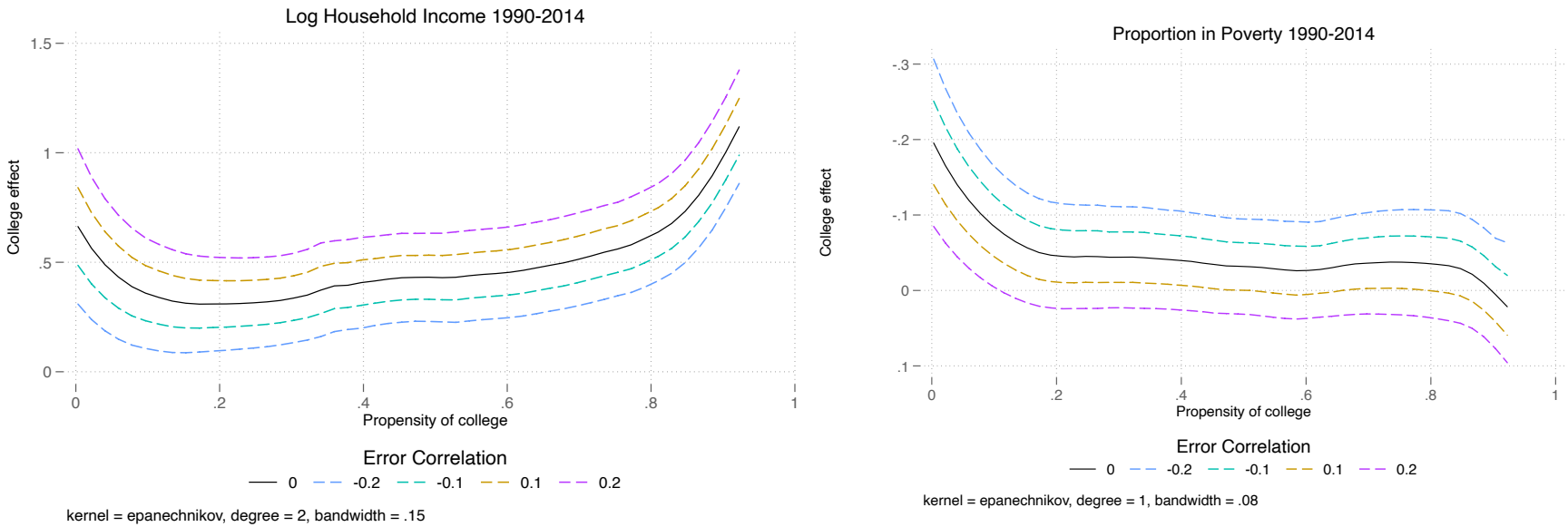


Figure C.7. Sensitivity Analysis for Family-Level Outcomes
(a) Household income; (b) Poverty (prop.) Likelihood (*y*-axis reversed);
Notes: Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582) and who had completed at least the 12th grade (n = 4,548), and who have sufficient overlap ((n = 4,085). College completion is measured as a four-year degree completed by age 25.

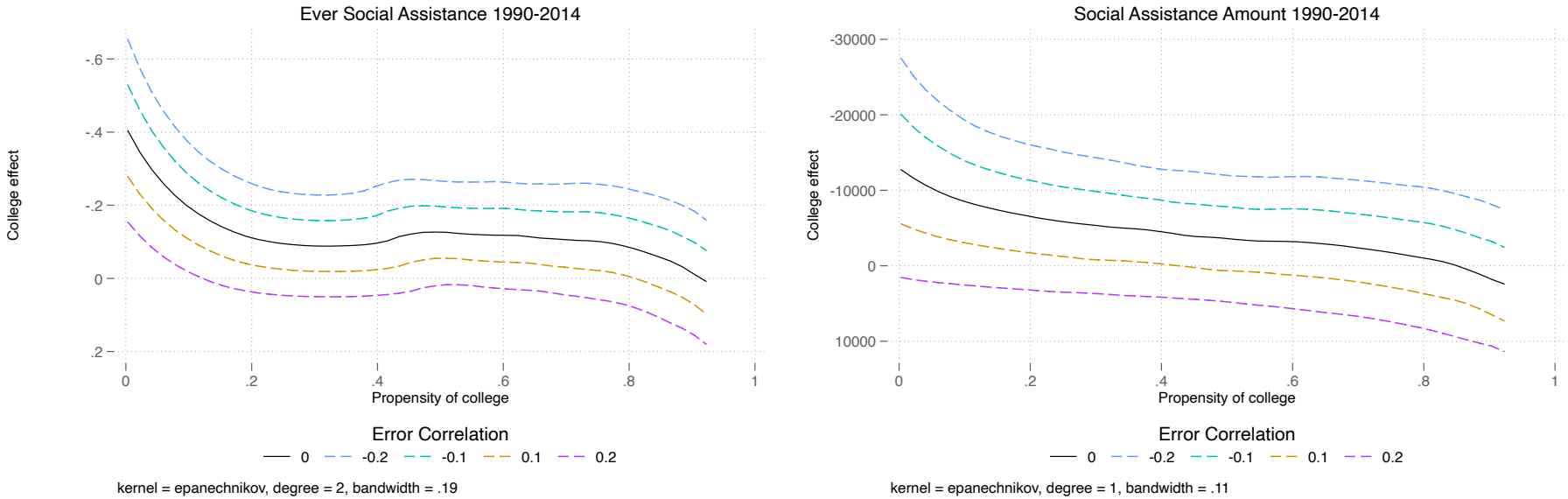
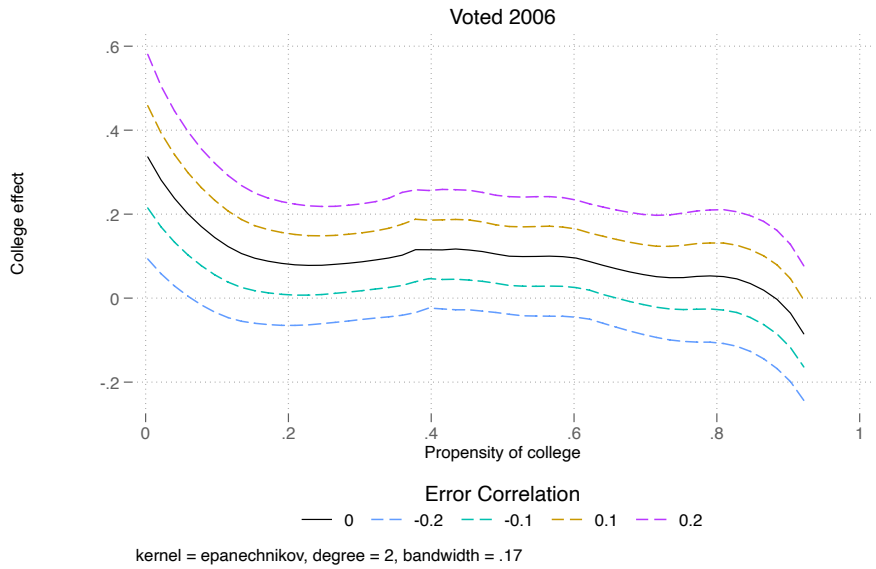


Figure C.8. Sensitivity Analysis for Civic Outcomes
(a) Any social assistance Likelihood (*y*-axis reversed); (b) Amount social assistance (*y*-axis reversed);
Notes: Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582) and who had completed at least the 12th grade (n = 4,548), and who have sufficient overlap ((n = 4,085). College completion is measured as a four-year degree completed by age 25.



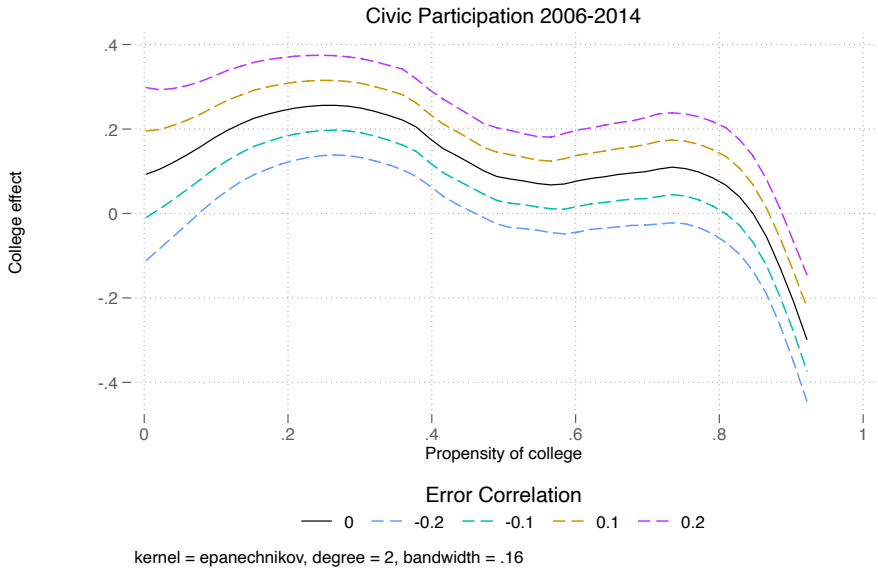


Figure C.9. Sensitivity Analysis for Civic Outcomes
(a) Voted in midterm election; (b) Volunteering (any);

Notes: Sample is restricted to individuals who were 14-17 years old at the baseline survey in 1979 (n = 5,582) and who had completed at least the 12th grade (n = 4,548), and who have sufficient overlap ((n = 4,085). College completion is measured as a four-year degree completed by age 25.

[1] Brand, Zhou, and Xie 2023.

[2] Rosenbaum and Rubin 1983.

[3] Imbens 2015.

[4] Imbens 2008; Imbens and Rubin 2015.

[5] Rubin, 1997, p. 757.

[6] Lee, Lessler, and Stuart 2010.

[7] Rubin 1997, p. 757.

[8] Imbens and Donald Rubin 2015. See itpscore in Stata.

[9] Imbens 2015.

[10] E.g., Carneiro, Heckman, and Vytlacil 2011.

[11] Cawley et al. 1997.

[12] Machine learning is a computational and statistical approach for extracting patterns and trends from data (Brand, Koch, and Xu 2020; Lee, Lessler, and Stuart 2009; McCaffrey, Ridgeway, and Morral 2004; Westrich, Lessler, and Funk 2010).

[13] Imai and Ratkovic 2014.

[14] Morgan and Harding (2006) and Caliendo and Kopeinig (2008) offer useful discussions of the various matching algorithms.

[15] Matching methods relax the linearity assumption that characterizes OLS regression models. OLS regression tends to have less attractive properties than matching when the covariate distributions substantially differ between the treated and control units (Imbens 2015).

[16] Imbens and Rubin 2015.

[17] I use sampling weights for all descriptive statistics, but not in estimates based on matching. Descriptive statistics are weighted to make them representative of the U.S. If sampling weights are a function of the independent variables in the models estimating causal effects, unweighted estimates are preferable because they are unbiased, consistent, and have smaller standard errors than weighed estimates (Winship and Radbill 1994). Moreover, studying effect heterogeneity is preferable to weighting effect estimates based on unmodeled heterogeneity (Solon, Haider and Woolridge 2015). Results are generally robust to the use of weights.

[18] Caliendo and Kopeinig 2008.

[19] Athey and Imbens 2016; Brand et al. 2021.

[20] Athey 2019.

[21] Athey and Imbens 2016.

[22] Athey and Imbens 2016.

[23] Brand et al. 2019.

[24] Angrist and Pischke 2009.

[25] Angrist, Imbens, and Rubin 1996; Angrist and Pischke 2009.

[26] Heckman and Vytlacil 1999, 2001; Henderson, Polachek, and Wang 2011.

[27] Heckman and Urzua 2009.

[28] Barrow and Malamud 2015; Card 1995; Zimmerman 2014.

[29] Card 1995; Carneiro, Heckman, and Vytlacil 2010.

[30] Robins and Rotnitzky 1995; Robins, Rotnitzky, and Zhao 1994; Scharfstein, Rotnitsky, and Robins 1999.

[31] See Chernozhukov et al. (2018) for debiased machine learning estimators.

[32] Athey, Tibhirani, and Wager 2019; Wager and Athey 2018.

[33] Arah 2017; Gangl 2013.

[34] Cheng et al. 2021.