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Distance to Promotion: Evidence from Military Graduate Education

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ONLINE APPENDIX

Distance to Promotion: Evidence from Military Graduate Education

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1 Matching Estimation

The objective of our estimation strategy is to identify the impact of distance education on student educational outcomes and subsequent job performance. Following the program evaluation literature, our goal corresponds to estimating the difference in potential outcomes, averaged across all students. That is, we would like to estimate the Average Treatment Effect (ATE) of distance learning (DL):

$$\tau = E[Y_i(1) - Y_i(0)]$$

where $Y_i(1)$ is the potential outcome of student i if he/she was enrolled in a DL program while $Y_i(0)$ is his/her outcome if he/she was in a resident degree program. However, we can only observe

$$Y_i = \begin{cases} Y_i(0) & if\ DL_i = 0 \\ Y_i(1) & if\ DL_i = 1 \end{cases}$$

To estimate the ATE, we form counterfactuals using propensity score matching. Introduced by Rosenbaum and Rubin (1983), this involves estimating the propensity of student i to be assigned to a distance learning program

$$p_i(X) = Pr(DL_i = 1|X_i),$$

where X_i denotes student i's observable characteristics. Under the assumptions of unconfoundedness and common support, that is, (i) $Y(1), Y(0) \perp DL|X$ and (ii) $p_{min} \leq p(X) \leq p_{max}$, we form matching estimators to τ where

$$\hat{Y}_i(0) = \begin{cases} Y_i & if\ DL_i = 0 \\ Y_j & if\ DL_i = 1 \end{cases}$$

and

$$\hat{Y}_i(1) = \begin{cases} Y_j & if\ DL_i = 0 \\ Y_i & if\ DL_i = 1 \end{cases}$$

and Y_j is the outcome of student j whose propensity score, or predicted probability of being assigned to a DL program, is the nearest to student i. In our implementation of nearest-neighbor matching, we match with replacement so the same units may be used as a match more than once. In the case where two (or more) observations have the same propensity score and are thus tied for nearest neighbor, we match with all ties. As described in the text, we also remove the bias of the simple nearest matching estimator by a regression adjustment.

Below we show figures illustrating the common support in propensity scores from our first stage, validating a key assumption for matching. We also report the first-stage logit regression results that underlie the propensity scores.

2 Figures of Overlap in Propensity Scores for DL

Figure 1. Education Outcomes, MBA students

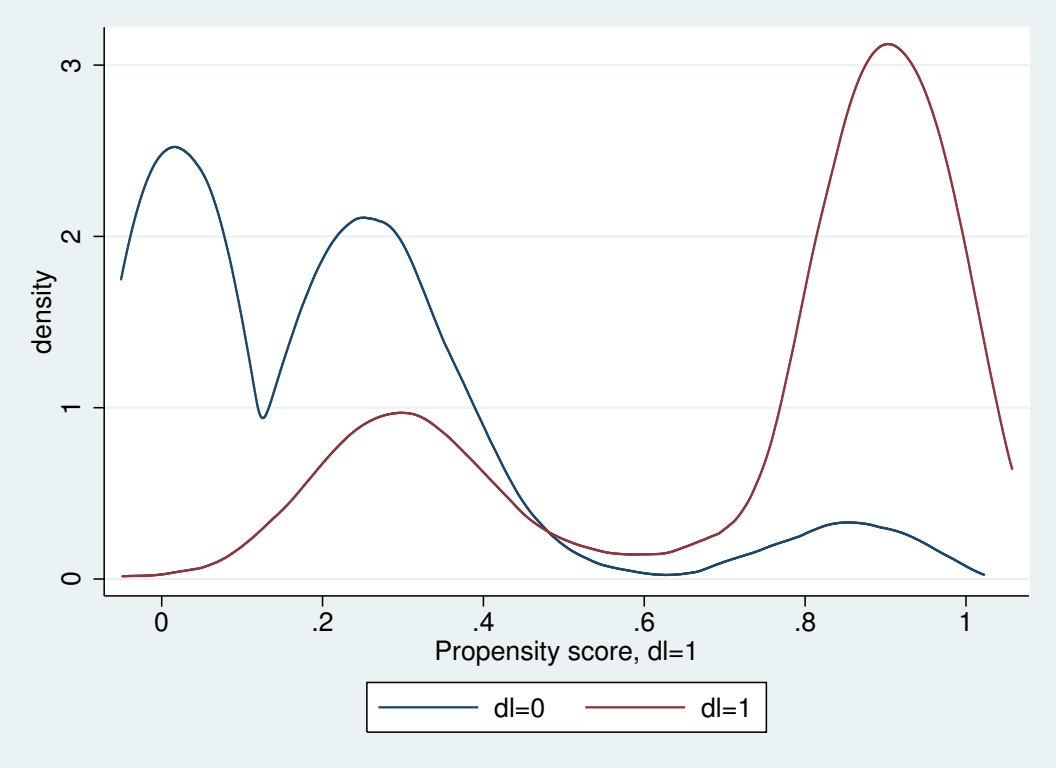


Figure 2. Education Outcomes, Engineering students

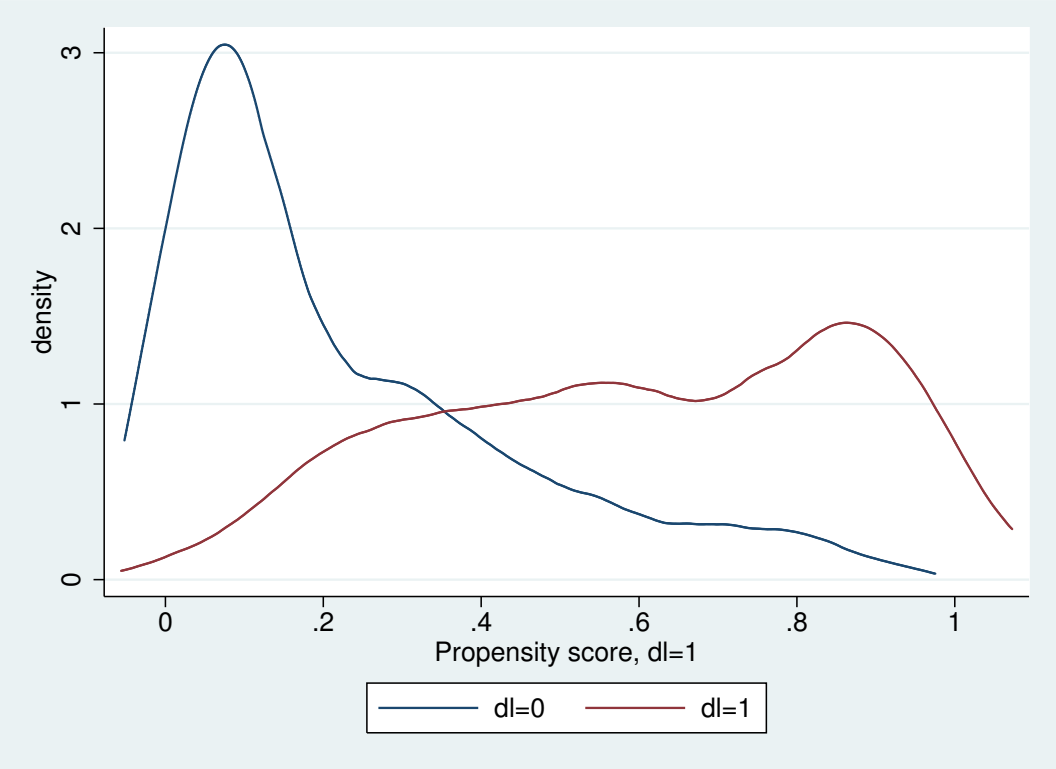


Figure 3. Employment Outcomes, MBA students

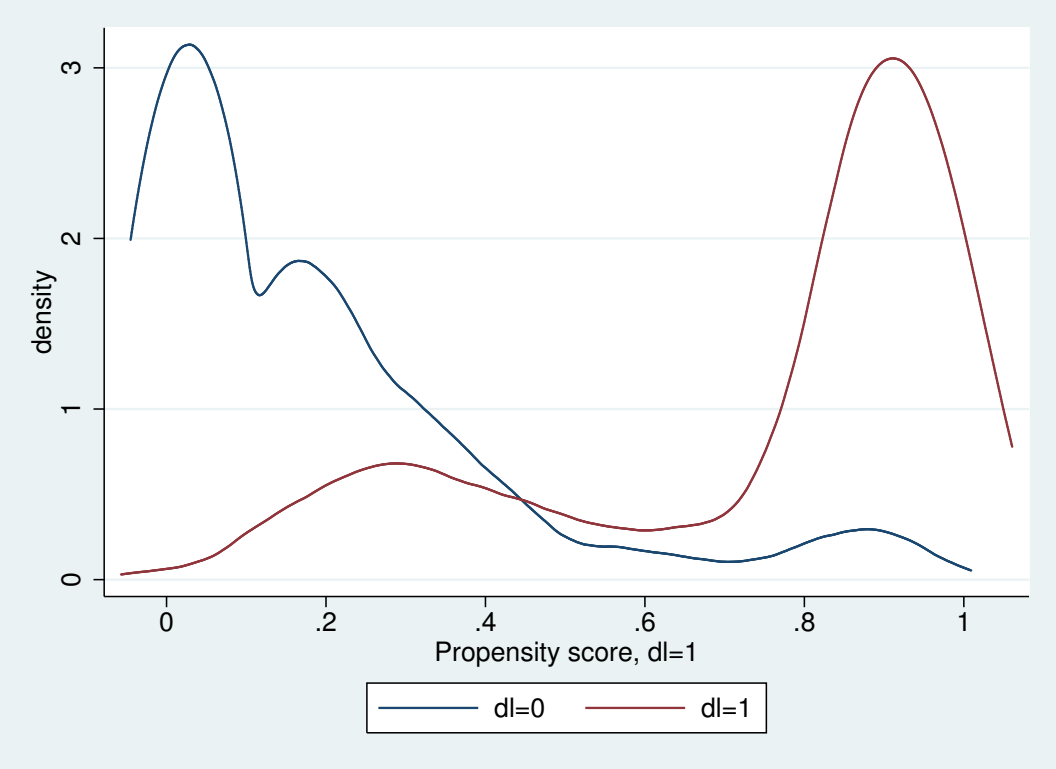
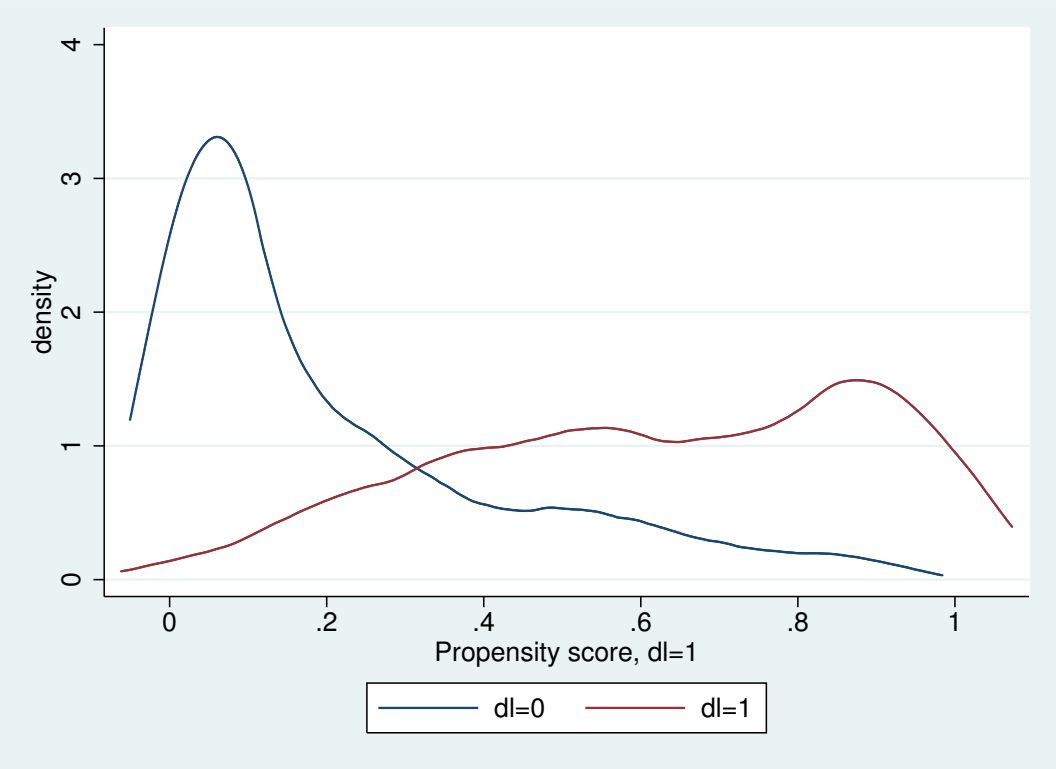


Figure 4. Employment Outcomes, Engineering students



3 Tables

Appendix Table: First Stage Logit Coefficients by Sample

Independent Variables	*Education Outcomes*		*Employment Outcomes*	
	MBA	Engineering	MBA	Engineering
	(1)	(2)	(3)	(4)
Female	0.2991	-0.1856	0.4978	0.1795
	[0.2925]	[0.3955]	[0.3027]	[0.4097]
Black	0.1545	-0.5893	0.1219	-0.6203
	[0.2589]	[0.4577]	[0.2682]	[0.4896]
Hispanic	0.3440	-0.2255	0.3208	-0.2184
	[0.2936]	[0.3801]	[0.3019]	[0.3972]
Married	0.2029	0.2325	0.3361*	0.3127
	[0.1912]	[0.2448]	[0.2004]	[0.2584]
Age	-0.0044	0.0013	0.1230***	0.1655***
	[0.0085]	[0.0184]	[0.0209]	[0.0322]
UG - Public University	0.0358	-0.5324**	0.1372	-0.6008**
	[0.1687]	[0.2633]	[0.1825]	[0.2804]
UG - Service Academy	0.2855	-0.0907	0.7281***	0.3955
	[0.2198]	[0.2417]	[0.2402]	[0.2679]
UG - IPEDS missing	0.1205	1.6601***	0.0828	1.7973***
	[0.3030]	[0.3126]	[0.3287]	[0.3313]
Navy	3.5275***	-2.3022***	3.4434***	-2.6493***
	[0.3401]	[0.3005]	[0.3474]	[0.3215]
Military Occupation - Surface	-0.0163	0.2361	-0.0988	0.3367
	[0.2383]	[0.3180]	[0.2666]	[0.3402]
Military Occ -Submarine	0.3111	2.1042***	0.5502	2.3081***
	[0.3423]	[0.3238]	[0.3628]	[0.3454]
Military Occ -Aviation	3.0612***	1.0117***	3.1876***	1.0541***
	[0.1912]	[0.2762]	[0.2068]	[0.2925]
Military Occ -GroundCombat	-0.2904	-1.1391*	-0.2753	-0.9675
	[0.4365]	[0.6786]	[0.4570]	[0.6964]
Military Rank -O3	3.8688***	-0.0360	3.6591**	-0.7541
	[1.4610]	[0.4812]	[1.4853]	[0.5168]
Military Rank - O4 and above	3.7774***	1.2331**	2.6998*	-0.4702
	[1.4630]	[0.5358]	[1.4939]	[0.6207]
UG - GPA, A	0.5384**	0.1653	0.5931**	0.2686
	[0.2209]	[0.3258]	[0.2353]	[0.3399]
UG - GPA, B	0.1015	-0.1067	0.2221	-0.0585
	[0.2106]	[0.3067]	[0.2271]	[0.3250]
UG - Math	-0.0085	-0.2247	0.0153	-0.0481
	[0.1864]	[0.2274]	[0.2011]	[0.2393]
UG - Grade, missing	2.3216***	0.8036	2.4109***	1.2007**
	[0.4026]	[0.5201]	[0.4313]	[0.5440]
Mechanical Engineering		1.2877***		1.3573***
		[0.3766]		[0.3997]
System Engineering		1.3760***		1.4332***
		[0.3197]		[0.3423]

Note: Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1

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Appendix Table: First Stage Logit Coefficients by Sample (con't)

Independent Variables	*Education Outcomes*		*Employment Outcomes*	
	MBA	Engineering	MBA	Engineering
	(1)	(2)	(3)	(4)
Year of entry to NPS - 2007	0.7105**	2.2070***	0.6135*	2.1828***
	[0.3137]	[0.7453]	[0.3401]	[0.8044]
Year of entry to NPS - 2008	0.5961**	2.7443***	0.5680*	3.0100***
	[0.2994]	[0.7325]	[0.3313]	[0.7848]
Year of entry to NPS - 2009	0.9688***	3.4904***	0.9351***	3.6090***
	[0.2992]	[0.7104]	[0.3261]	[0.7618]
Year of entry to NPS - 2010	0.5319*	2.9119***	0.5756*	3.0136***
	[0.3009]	[0.7234]	[0.3245]	[0.7771]
Year of entry to NPS - 2011	0.5734*	4.2777***	0.7321**	4.5041***
	[0.2997]	[0.7118]	[0.3226]	[0.7698]
Year of entry to NPS - 2012	0.8003***	3.1002***	0.7658**	3.2705***
	[0.3002]	[0.7061]	[0.3213]	[0.7588]
Year of entry to NPS - 2013	-0.0177	2.8067***	-0.0847	2.9822***
	[0.3087]	[0.7181]	[0.3319]	[0.7711]
Constant	-9.2372***	-4.0742***	-13.3219***	-8.7608***
	[1.5657]	[0.9951]	[1.7246]	[1.3077]
Observations	1,641	803	1,540	787

Note: Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1