Research and Policy Brief

Investigating the Causal Effects of Advanced Placement Programs on Timely Degree Completion

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Introduction & Study Objectives

National and state-level efforts have focused on strengthening the path from secondary to postsecondary education and improving the likelihood of degree completion. Advanced Placement (AP) programs, an increasingly popular strategy for addressing such concerns, provide participants the opportunity to earn college credit while still in high school. By earning college credit in advance, AP participation may reduce time-to-degree, thereby reducing college costs.

Scholars generally find that AP participation is positively associated with postsecondary enrollment, first-year GPA, and earning a degree (Evans, 2013; Eykamp, 2006; Mattern, Marini, & Shaw, 2013). However, since students typically self-select into AP programs, isolating the impact of advanced course taking from other student characteristics associated with post-secondary success is particularly challenging and remains a limitation of this literature.

With Georgia's statewide longitudinal data system, known as GA●AWARDS, this study investigates the impact of AP course taking on the likelihood of graduating in four years and the number of terms to graduation. We utilize propensity score matching to address selection bias associated with AP participation. We investigate effects for all students taking an AP course and for students taking an AP course, but not earning AP credit.

Population

Our sample consists of 14,743 bachelor's degree recipients[2] who matriculated as first-time freshmen at one of the 29 institutions within the University System of Georgia in Fall 2010. All students in the sample earned a bachelor's degree by Fall 2016. Across the treated and control groups, there were several differences in student characteristics, high school characteristics, and postsecondary variables (Table 1). Interestingly, the AP course-no credit group looks more like the non-AP group on several observable characteristics. These baseline differences between the treated and control groups warranted the use of propensity score matching (PSM).

Creating the propensity score (PS)

The PS is the probability of treatment conditioned on a set of observable characteristics that influence both the likelihood of being treated and the outcome of interest. The observable characteristics used to create the PS include gender, race, receiving free/reduced lunch in high school, End of Course Test (EOCT) scores in literature, the number of years the high school met the Annual Yearly Progress (AYP)

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[2] We limited our sample to bachelor's degree recipients so that students who drop out early would not confound findings related to time.

standards, and the number of students enrolled in the high school. We included high school characteristics to account for both the quality of the AP experience and the potential opportunity to participate in/the availability of AP courses (Speroni, 2011). There is sufficient overlap in the propensity scores across treated and control groups to create good matches.

<u>Propensity score matching results</u>
Matching algorithm. We explored several different matching techniques to determine which would create the best matches: nearest neighbor, nearest neighbor with oversampling, caliper and radius, and kernel matching. Kernel matching produced the best matches (evidenced by the balance of covariates across treated and control groups). Kernel matching pairs up each treated unit with every control unit within the common support region and weights better matches more heavily. This approach is advantageous as it creates a counterfactual out of the weighted average of all control units rather than a few observations from the control group (Caliendo & Kopeinig, 2005).

Balance. After matching on the propensity score, we tested the balance of the treated and control groups. Prior to matching, treated and control groups exhibited large differences across student characteristics, academic performance, and type of high school attended. After matching, these differences were greatly reduced (see Tables 2 and 3).

Results. The results of the propensity score matching models are discussed in terms of the average treatment effect on the treated (ATT; Tables 4 and 5). For the average student who took an AP course, the likelihood of graduating on time is 16 percentage points greater ($p < 0.001$) than if she did not take an AP course. For the average student who took an AP course, *but did not receive AP credit*, the likelihood of graduating on time is 7 percentage points greater ($p < 0.001$) than if she did not take an AP course. The average student who took an AP course reduced her time to degree by 0.7 terms ($p < 0.001$) than if she did not take an AP course. The average student who took an AP course, *but did not receive AP credit*, reduced her time to degree by 0.4 terms ($p < 0.001$) than if she did not take an AP course.

<u>Limitations & Future work</u>
This study is limited in a few ways. First, choices students make after matriculation can affect time to degree (e.g., changing major) and are not accounted for in this study. Moving forward, we plan to incorporate these "mediating" behaviors in a regression analysis on the matched data. Second, this study does not account for censored data (i.e., students who dropped out or never graduated); as such, we plan to utilize event history analysis on the matched data to address this issue. Finally, we plan to explore the different treatment effects across AP subjects and number of AP courses taken to gain a more complete and nuanced understanding of the impact of AP course taking.

<u>Discussion & Significance</u>
Even when utilizing PSM, findings herein show that taking AP courses in high school significantly decreases time to degree. This finding holds up for students who took AP courses but did not earn AP credit. One would expect the earning of AP credit to be the factor leading to on-time graduation; however, the results of this analysis suggest that the AP course experience itself (perhaps by providing better college preparation) also promotes timely graduation.

For more information and results for terms to graduation, contact Lori (Lori.Hagood@usg.edu).

Table 1. Summary Statistics for Bachelor's Degree Recipients, by AP Participation

Variable	ALL	Treated Group 1: AP Course	Treated Group 2: AP Course- No Credit	Control Group: No AP
Student Characteristics				
Female	0.61	0.61	0.65	0.61
Black	0.22	0.18	0.31	0.34
Hispanic	0.05	0.05	0.05	0.05
Other race	0.05	0.05	0.05	0.05
White	0.60	0.62	0.53	0.55
Asian	0.07	0.09	0.06	0.02
High School Variables				
% received free/reduced lunch	0.23	0.21	0.30	0.31
End of Course Test score	447.41	452.72	439.87	430.65
% participated in Dual enrollment	0.01	0.01	0.02	0.01
HS GPA	3.46	3.55	3.39	3.16
Characteristics of High School Attended				
# years met AYP	2.94	3.00	2.63	2.80
size of HS student body	1,908.78	1,946.65	1,800.44	1,817.89
Postsecondary Variables				
First institution sector				
% enrolled in Research	0.41	0.50	0.29	0.13
% enrolled in Comprehensive	0.36	0.31	0.43	0.52
% enrolled in State Universities	0.21	0.18	0.26	0.31
% enrolled in State Colleges	0.02	0.01	0.02	0.03
% required Learning Support	0.03	0.01	0.03	0.07
% received Pell at any time	0.45	0.43	0.53	0.54
Number of majors	1.89	1.86	1.91	1.96
% earned an Associate degree	0.01	0.01	0.01	0.02
Terms elapsed	12.93	12.69	13.23	13.66
% graduated in 4 years	0.45	0.50	0.38	0.29
N	**14,743**	**10,890**	**4,888**	**3,597**

Notes: all students matriculated in Fall 2010 and earned a bachelor's degree by Fall 2016.

Table 2. Comparison of Means for Matched and Unmatched Samples for Treated Group 1: AP Course and Outcome: Likelihood of Graduating in Four Years

Variable	Unmatched/ Matched	Means: Treated	Means: Control	% bias	% bias reduction	t	Significance
Female	U	0.60347	0.61915	-3.2		-1.58	
	M	0.60383	0.61407	-2.1	34.7	-1.49	
Black	U	0.17876	0.33656	-36.7		-19.14	***
	M	0.17953	0.17883	0.2	99.6	0.13	
Hispanic	U	0.04903	0.04336	2.7		1.31	
	M	0.04917	0.0519	-1.3	51.9	-0.88	
Other race	U	0.0535	0.0471	2.9		1.42	
	M	0.05376	0.05739	-1.7	43.3	-1.12	
White	U	0.63117	0.55708	15.1		7.52	***
	M	0.63226	0.64429	-2.5	83.8	-1.77	
Asian	U	0.08754	0.01591	32.8		13.92	***
	M	0.08528	0.06758	8.1	75.3	4.72	***
Free/reduced lunch	U	0.20516	0.30973	-24.1		-12.32	***
	M	0.20586	0.19881	1.6	93.3	1.24	
End of Course (literature) score	U	452.72	430.65	89.7		42.37	***
	M	452.22	453.03	-3.3	96.3	-2.2	*
FRL X EOCT	U	90.379	131.15	-21.8		-11	***
	M	90.679	87.577	1.7	92.4	1.24	
# years met AYP	U	3.0131	2.8069	15		7.55	***
	M	3.011	2.9637	3.4	77.1	2.5	*
# HS enrolled	U	1954.4	1813.8	19.1		9.39	***
	M	1953	1894.7	7.9	58.5	5.44	***
FRL X HS enrolled	U	365.7	499.05	-16.2		-8.14	***
	M	366.88	342.42	3	81.7	2.21	*

Notes: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. To facilitate better matches, we included interaction terms, a strategy recommended by Caliendo and Kopeinig (2005).

Table 3. Comparison of Means for Matched and Unmatched Samples for Treated Group 2: AP Course-no credit and Outcome: Likelihood of Graduating in Four Years

Variable	Unmatched/ Matched	Means: Treated	Means: Control	% bias	% bias reduction	t	Significance
Female	U	0.65171	0.61915	6.8		2.94	**
	M	0.65243	0.65486	-0.5	92.5	-0.24	
Black	U	0.3021	0.33656	-7.4		-3.21	**
	M	0.30331	0.30073	0.6	92.5	0.27	
Hispanic	U	0.04597	0.04336	1.3		0.55	
	M	0.04625	0.04786	-0.8	38.4	-0.36	
Other race	U	0.05392	0.0471	3.1		1.34	
	M	0.05426	0.05724	-1.4	56.2	-0.62	
White	U	0.06122	0.01591	23.7		9.8	***
	M	0.0567	0.04554	5.8	75.4	2.4	*
Asian	U	0.5368	0.55708	-4.1		-1.76	
	M	0.53947	0.54862	-1.8	54.9	-0.87	
Free/reduced lunch	U	0.29746	0.30973	-2.7		-1.16	
	M	0.29753	0.29326	0.9	65.2	0.44	
End of Course (literature) score	U	439.87	430.65	41.3		17.9	***
	M	439.57	440.33	-3.4	91.8	-1.59	
# years met AYP	U	2.6427	2.8069	-11.5		-4.97	***
	M	2.6451	2.6447	0	99.8	0.01	
# years as "needs improvement"	U	0.9421	0.82252	8.8		3.8	***
	M	0.94107	0.92335	1.3	85.2	0.6	
# years as "adequate"	U	0.57945	0.54398	4.1		1.8	
	M	0.57905	0.53382	5.3	-27.5	2.52	*
# HS enrolled	U	1807.4	1813.8	-0.9		-0.39	
	M	1807.2	1805.1	0.3	68.3	0.13	

Notes: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 4. Kernel Matching Results for Likelihood of Graduating in Four Years

Treatment Group	Sample	Treated	Controls	Difference	S.E.	t
AP Course	Unmatched	0.50	0.29	0.22	0.01	21.9
	ATT	0.50	0.34	0.16	0.01	11.05
AP Course-No Credit	Unmatched	0.38	0.29	0.09	0.01	8.66
	ATT	0.38	0.31	0.07	0.01	6.01

Notes: ATT = average treatment effect on the treated

Table 5. Kernel Matching Results for Terms to Graduation

Treatment Group	Sample	Treated	Controls	Difference	S.E.	t
AP Course	Unmatched	12.68	13.68	-1.00	0.04	-24.12
	ATT	12.69	13.39	-0.71	0.07	-10.47
AP Course-No Credit	Unmatched	13.22	13.68	-0.46	0.05	-9.67
	ATT	13.22	13.55	-0.33	0.05	-6.20

Notes: ATT = average treatment effect on the treated

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