



Race and nativity earnings gaps: The role of college networks[☆]

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ABSTRACT

We examine the effect of same-race/same-nativity networks on the annual earnings and employment of college students using data from multiple cohorts of students entering a large public college system merged with state unemployment insurance records. We identify network effects from small changes in same-race/same-nativity shares across cohorts within college-majors. White native-born, Black native-born, and Black immigrant students who belong to cohorts with larger shares of same group peers experience higher earnings and employment in the 10 years after college entry. Benefits to Black immigrants are particularly large: a 1 standard deviation increase in the share of peers who are Black immigrants results in an approximate 2 percent increase in annual earnings. Among Hispanic immigrants, the effects of same-group peers on earnings and educational attainment are negative in the years immediately after college entry, while the effects on employment are large and positive. Hispanic native-born students do not receive earnings gains from a larger potential network.

1. Introduction

The earnings of students with postsecondary training differ markedly across racial/ethnic and nativity groups in the United States. For example, the hourly wages of African-Americans with a college degree was approximately 78 percent that of Whites with a college degree in 2019 (Gould, 2020). White college graduates are also paid more than Hispanic college graduates, many of whom are immigrants (Gould, 2020; Bureau of Labor Statistics, 2020). Prior research offers a number of explanations for these raw earnings gaps, including differences in pre-college skills, college quality, major choices, discrimination, and for nativity gaps, the out-migration of high-wage immigrants.¹ A handful of studies have also examined the role of the networks in which postsecondary students are embedded and how these networks influence their labor market outcomes. The previous findings suggest that college networks improve labor market outcomes among White native-born students who are often enrolled in selective institutions. Little is known, however, about the role of college networks among students

who are less economically privileged, immigrants, or belong to other racial/ethnic groups.

In this paper, we investigate the effects of college networks on the annual earnings of students enrolled in a large urban public college and university system (hereafter, “the system”). Based on previous findings that physical proximity (e.g., sharing the same dorm, classroom, cohort) and shared race/ethnicity are strong predictors of the friendships that students form in U.S. schools and colleges (e.g., Quillian & Campbell, 2003; Marmaros & Sacerdote, 2006; Mayer & Puller, 2008), we define a network as a group of students in the same college, cohort, major, race/ethnicity, and nativity status. We identify the effects of these networks using variation in the share of classmates that are of the same-race/same-nativity across cohorts within the same college and major. This is a measure of exposure to same group classmates, which is not a direct measure of social interaction among students. Indeed, the correlation between network size and social interaction is determined by the strength of the social ties, which are often difficult to measure. We assume that exposure to more same-group students broadens the

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¹ See, for example, Rivkin (1995), Neal and Johnson (1996), Lubotsky (2007), Charles and Guryan (2008), Hellerstein and Neumark (2008), Arcidiacono and Koedel (2014), and Carnevale et al. (2016).

Table 1
Sample Characteristics.

	Full sample	Native-born				Immigrant			
		API	Black	Hispanic	White	API	Black	Hispanic	White
A. Characteristics of students									
Number of students	151,181	8652	32,635	35,754	19,776	14,676	16,025	14,544	9119
Share of sample		0.06	0.22	0.24	0.13	0.10	0.11	0.10	0.06
Age	20.1	19.0	19.9	19.5	19.3	20.5	22.4	20.9	20.8
	(4.1)	(2.4)	(4.0)	(3.1)	(3.3)	(3.8)	(6.0)	(4.7)	(4.7)
Female	0.53	0.41	0.57	0.56	0.42	0.47	0.60	0.59	0.49
Single parent	0.06	0.03	0.07	0.07	0.02	0.06	0.09	0.09	0.05
Disabled	0.02	0.02	0.03	0.03	0.05	0.01	0.01	0.01	0.02
Local public high school graduate ⁱ	0.57	0.68	0.61	0.63	0.42	0.58	0.47	0.61	0.51
GED recipient ⁱ	0.09	0.07	0.09	0.08	0.07	0.05	0.14	0.10	0.07
High school GPA (0–100) ⁱⁱ	76	78	73	75	77	79	74	76	79
	(7)	(8)	(6)	(7)	(7)	(8)	(7)	(7)	(8)
Missing high school GPA	0.17	0.12	0.21	0.15	0.13	0.15	0.22	0.19	0.13
Any earnings in year prior to entry	0.43	0.33	0.50	0.47	0.47	0.26	0.43	0.42	0.35
Earnings in year prior to entry	2473	1214	2755	2356	2512	1296	3771	2742	2214
	(7669)	(5722)	(8369)	(6735)	(8940)	(4941)	(9337)	(7450)	(7347)
Bachelor's degree program	0.17	0.34	0.12	0.17	0.27	0.20	0.10	0.11	0.21
B. Characteristics of programs									
Number of CCM cells	1522	1178	1510	1512	1336	1330	1446	1420	1255
Average total enrollment	108	117	110	102	105	102	106	109	113
	(117)	(123)	(118)	(113)	(114)	(113)	(115)	(118)	(120)
Average same group enrollment	13	6	10	21	10	23	10	14	6
	(22)	(12)	(15)	(26)	(15)	(38)	(12)	(24)	(10)

Notes: Undergraduate degree-seeking students who first enrolled in the system between fall 1999 and fall 2010, who were fall entrants, older than 17 and younger than 45 at entry, took at least one non-remedial course in their first year, and had a non-missing race/ethnicity in the listed categories. Students in college-cohort-major (CCM) cells with fewer than 10 students in any year or fewer than 25 students on average are excluded. Standard deviation of continuous variables displayed below means in parentheses. i) Type of high school only for students with nonmissing data (N = 131,717). ii) High school GPA average only applies to students with nonmissing data (N = 125,902).

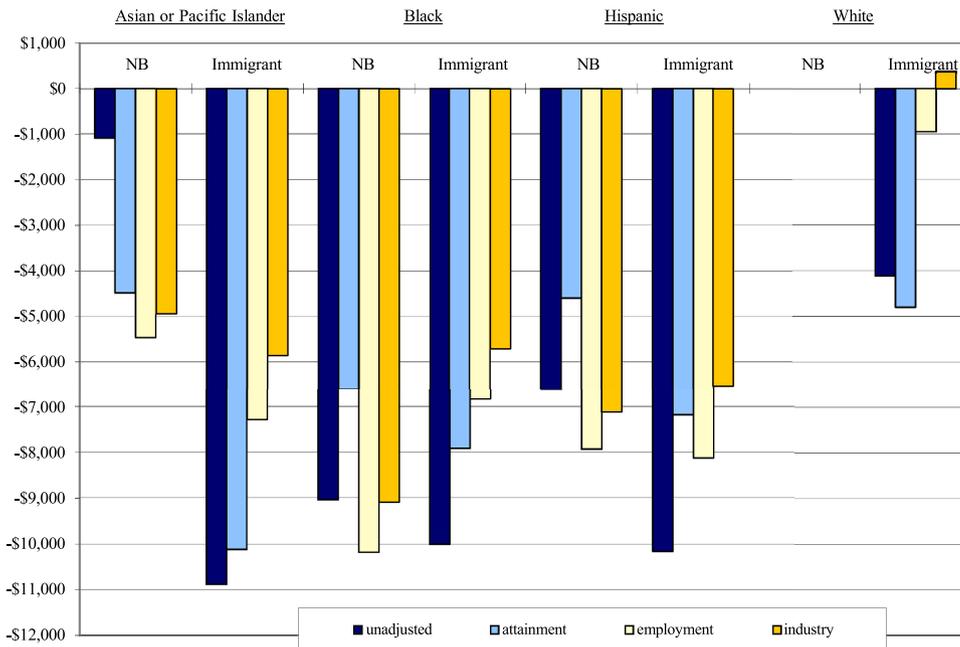


Fig. 1. Raw and Adjusted Earnings Gap 10 Years After Entry (Relative to White Native-born Students)

Notes: Undergraduate degree-seeking students who first enrolled in the large public urban college and university system (“the system”) between fall 1999 and fall 2005. Sample is limited to fall entrants with declared majors at entry. Students in college-cohort-major (CCM) cells with fewer than 10 students in any year or fewer than 25 students on average are excluded. See Appendix Table A.1 for point estimates and standard errors.

network of information with some of the ties being weaker than others (e.g., some students will become friends while others mere acquaintances). We use the phrase “potential network” in places as a reminder of this distinction.

Our sample is restricted to students who choose a major at college entry, thereby minimizing potential biases driven by endogeneity of major choice to peers’ decisions. Our identifying assumption is that students do not choose colleges and majors based on knowledge of the composition of each entering cohort such that deviations in the racial/

ethnic and nativity composition across cohorts is uncorrelated with student traits that affect labor market outcomes. We show that this assumption holds true on most observable pre-enrollment student characteristics and that the effects of network shares on earnings and education are similar with and without these covariates.

Consistent with the previous literature on the role of networks in higher education, we find that White native-born students experience earnings and employment gains when the share of classmates that are also White, native-born students increases. We also find that Black

Table 2
Variation in Network Shares Overall and Within Cohort-College-Major.

	Proportion in network			
	Mean	SD	Min	Max
<i>Panel A: Total Variation</i>				
All students	0.216	0.134	0	0.741
API native-born	0.105	0.089	0	0.385
Black native-born	0.265	0.124	0	0.741
Hispanic native-born	0.287	0.116	0	0.700
White native-born	0.232	0.149	0	0.725
API immigrant	0.157	0.095	0	0.484
Black immigrant	0.174	0.115	0	0.583
Hispanic immigrant	0.156	0.118	0	0.632
White immigrant	0.091	0.060	0	0.360
<i>Panel B: Variation after College by Cohort, Major by Cohort, and College by Major FE</i>				
All students	0	0.119	-0.540	0.318
API native-born	0	0.011	-0.126	0.066
Black native-born	0	0.028	-0.249	0.168
Hispanic native-born	0	0.025	-0.335	0.170
White native-born	0	0.019	-0.280	0.099
API immigrant	0	0.023	-0.215	0.116
Black immigrant	0	0.022	-0.205	0.100
Hispanic immigrant	0	0.027	-0.380	0.141
White immigrant	0	0.015	-0.130	0.060

Notes: For sample, see Table 1 notes. Panel A provides the distribution in network proportion where network is calculated as the proportion in the same racial/ethnic and nativity group. Panel B provides the distribution in residuals from regressions of network proportion on college by cohort, major by cohort, and college by major fixed effects.

native-born and particularly Black immigrants also benefit from their potential networks. Black immigrant students' gains from larger potential networks significantly exceed the benefits received by other student groups, with a 1 standard deviation (2.8 percentage-point) increase in the share of peers who are Black immigrants resulting in a \$571 (2 percent) increase in long-run annual earnings. There is no evidence that the employment gains among these groups are linked to increases in educational attainment.

Among Hispanic students, however, effects of larger potential networks operate quite differently than they do among the other racial/ethnic groups. Neither Hispanic immigrants nor native-born students experience earnings gains as a result of entering a major with a greater share of same-group peers; indeed most of our estimates suggest negative effects on Hispanic immigrant students' earnings. Yet the effect of same group peers on the employment of Hispanic immigrants is large and positive, while effects on degree attainment over the same time period are negative. These results for Hispanic immigrants suggest that the reduction in earnings may be a result of students choosing to enter the labor force sooner at the expense of educational attainment and, ultimately, earnings. In contrast, Hispanic native-born students have lower employment rates when they enter majors with a larger share of same-group peers and their degree completion is unaffected, suggesting that a larger potential network may provide only limited referrals or other job-related information

Our paper informs and draws from research on network and peer effects in neighborhoods and postsecondary institutions. A long line of research has established that job market searches are at least partially

Table 3
Correlation between network share and baseline characteristics.

	Age at entry	Female	Single Parent	Disabled	GED recipient	Local public HS graduate	Nonmissing HS GPA	High school GPA (0-100)	Any pre-college earnings	Pre-college earnings	Predicted earnings
Proportion in network *											
API, native-born	1.8 (0.4)** {0.182}	0.007 (0.002)** {0.096}	0.001 (0.0003)** {0.271}	0.0003 (0.0002) {0.204}	-0.0003 (0.0005) {0.752}	0.002 (0.001) {0.546}	0.001 (0.001) {0.348}	0.07 (0.04) {0.306}	0.001 (0.001) {0.642}	19 (9)* {0.311}	87 (31)** {0.007}
Black, native-born	0.3 (0.3) {0.641}	-0.0003 (0.001) {0.875}	0.0004 (0.0003) {0.108}	-0.0003 (0.0001)+ {0.063}	-0.001 (0.0003)+ {0.576}	-0.001 (0.001) {0.456}	-0.001 (0.001) {0.218}	0.03 (0.02) {0.160}	0.001 (0.0004) {0.269}	3 (7) {0.828}	33 (20) {0.358}
Hispanic, native-born	-0.2 (0.3) {0.710}	0.0005 (0.001) {0.615}	-0.0003 (0.0002) {0.313}	-0.0002 (0.0001) {0.155}	-0.0001 (0.0002) {0.913}	0.0001 (0.001) {0.948}	-0.0005 (0.0003) {0.393}	-0.01 (0.01) {0.334}	-0.002 (0.001)+ {0.091}	-13 (6)* {0.135}	-7 (9) {0.140}
White, native-born	-0.1 (0.3) {0.874}	-0.002 (0.001)+ {0.037}	0.001 (0.0002)** {0.329}	-0.0003 (0.0002) {0.367}	0.00002 (0.0003) {0.986}	-0.0005 (0.001) {0.722}	-0.0002 (0.001) {0.915}	-0.03 (0.03) {0.589}	0.001 (0.0004) {0.290}	-23 (13)+ {0.264}	-30 (20) {0.286}
API, immigrant	1.2 (0.4)** {0.142}	0.006 (0.002)** {0.036}	0.00002 (0.0004) {0.965}	0.0001 (0.0001) {0.606}	0.0003 (0.001) {0.830}	-0.005 (0.002)** {0.070}	-0.001 (0.001) {0.494}	0.07 (0.02)** {0.203}	0.001 (0.001) {0.416}	5 (11) {0.855}	5 (19) {0.848}
Black, immigrant	1.1 (0.8) {0.111}	-0.0001 (0.001) {0.971}	-0.0002 (0.0003) {0.645}	-0.0002 (0.0001) {0.380}	0.001 (0.001) {0.185}	-0.002 (0.001) {0.040}	-0.002 (0.001) {0.403}	0.02 (0.01) {0.288}	0.001 (0.001)+ {0.178}	15 (13) {0.093}	19 (20) {0.714}
Hispanic, immigrant	1.5 (1.3) {0.250}	0.001 (0.001) {0.080}	0.001 (0.0005) {0.568}	-0.0002 (0.0001)+ {0.307}	0.001 (0.001) {0.253}	-0.006 (0.002)** {0.060}	-0.002 (0.001)* {0.115}	0.04 (0.01)** {0.054}	0.002 (0.002) {0.240}	10 (7) {0.160}	-7 (12) {0.712}
White, immigrant	1.3 (1.8) {0.625}	0.001 (0.002) {0.592}	0.001 (0.001) {0.321}	0.0001 (0.0002) {0.744}	0.001 (0.001) {0.572}	-0.003 (0.004) {0.632}	-0.0003 (0.001) {0.893}	0.10 (0.03)** {0.027}	0.001 (0.002) {0.591}	-5 (19) {0.780}	32 (58) {0.742}
Observations	151,181	151,181	151,181	151,181	151,181	151,181	151,181	125,902	151,181	151,181	151,181

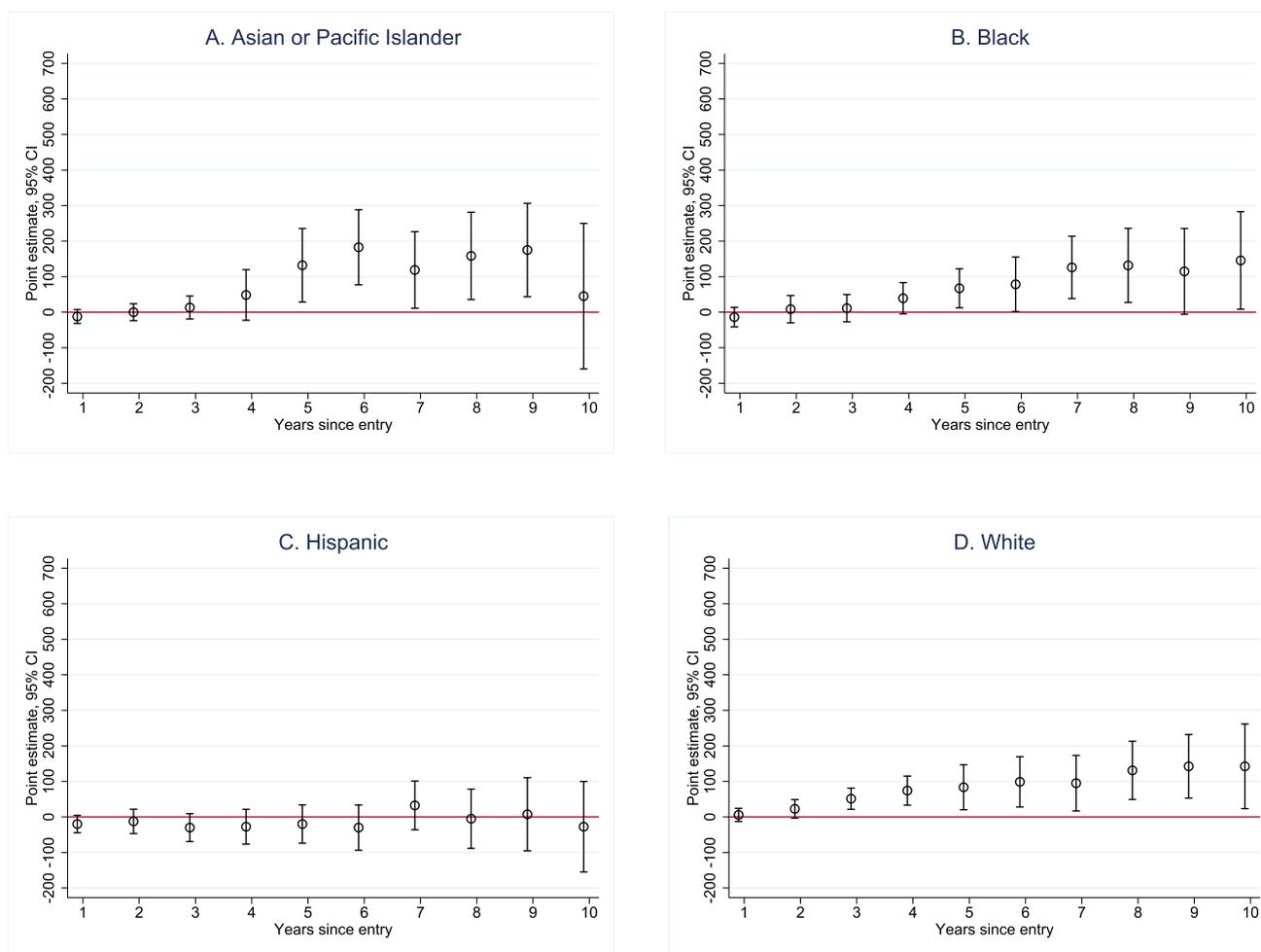


Fig. 2. Estimated Effects of Standard Deviation Increase in Network Share on Earnings: Native-born Students

Notes: Undergraduate degree-seeking students who first enrolled in the system between fall 1999 and fall 2010 and were born in the U.S. or U.S. territories. Sample is limited to fall entrants with declared majors at entry. Students in college-cohort-major (CCM) cells with fewer than 10 students in any year or fewer than 25 students on average are excluded.

dependent upon social networks and that networks operate differently (and lead to different outcomes) for White, Black, and Hispanic job-seekers.² Networks of friends and neighbors can affect employment outcomes through career advice and information about jobs as well as direct referrals. For instance, Hellerstein, McInerney and Neumark (2011) find strong evidence of race-based neighborhood networks where individuals of the same race and zip code are more likely to work in the same establishment than what would be expected from a random allocation of individuals across organizations. Hellerstein, McInerney and Neumark (2011) also find larger network effects on same-establishment employment for Hispanic than for Black and White neighbors, indicating that the effect of a network is larger for job-seekers who face barriers to job searches through traditional channels (e.g., limited familiarity with English). Related to these results, McManus (1990) finds that living in a community with many co-ethnic members who speak the same language provides better jobs for Hispanic adults who are not fully English proficient than for those who are, thereby lowering the returns to English language ability.

These results highlight the substantial heterogeneity in effects: whether networks operate negatively or positively will depend on the

opportunities and information that the network offers. High rates of immigrant entrepreneurship, for example, may lead to stronger network effects for some communities, particularly if the hiring managers are from the same ethnic group (Kerr & Kerr, 2016). At the same time, extensive ethnic networks may afford opportunities outside of the mainstream labor market or in lower-paying industries, which could lead to lower earnings for some groups (Loury, 2006).

In the postsecondary education literature, networks (or “peers”) have been shown to influence students, with effects on both non-academic (e.g., drinking, exercising) and academic outcomes.³ Thus, in addition to influencing labor market outcomes through job-related information and referrals, college classmates can influence the degree of effort that individuals put into their schooling and/or their job searches. A small set of papers explores the effect of college peers on labor market outcomes. In work most similar to our own, Zhu (2021) tests whether community college students receive job referrals from former classmates and finds positive, significant effects. We focus on earnings and employment and provide evidence of heterogeneous effects by race/ethnicity and nativity. Other studies focus on the effect of

² See, for example, Massey et al. (1990), Munshi (2003), Ioannides and Loury (2004), Patel and Vella (2013), Bayer, Ross and Topa (2008), Hellerstein, McInerney and Neumark (2011), and Topa (2011).

³ See, for instance, Sacerdote (2001), Duncan et al. (2005), Carrell, Fullerton and West (2009), Carrell, Hoekstra and West (2011), Martin, Wright and Krieg (2020), and Even and Smith (2022). Sacerdote (2011) provides a thorough review of this literature.

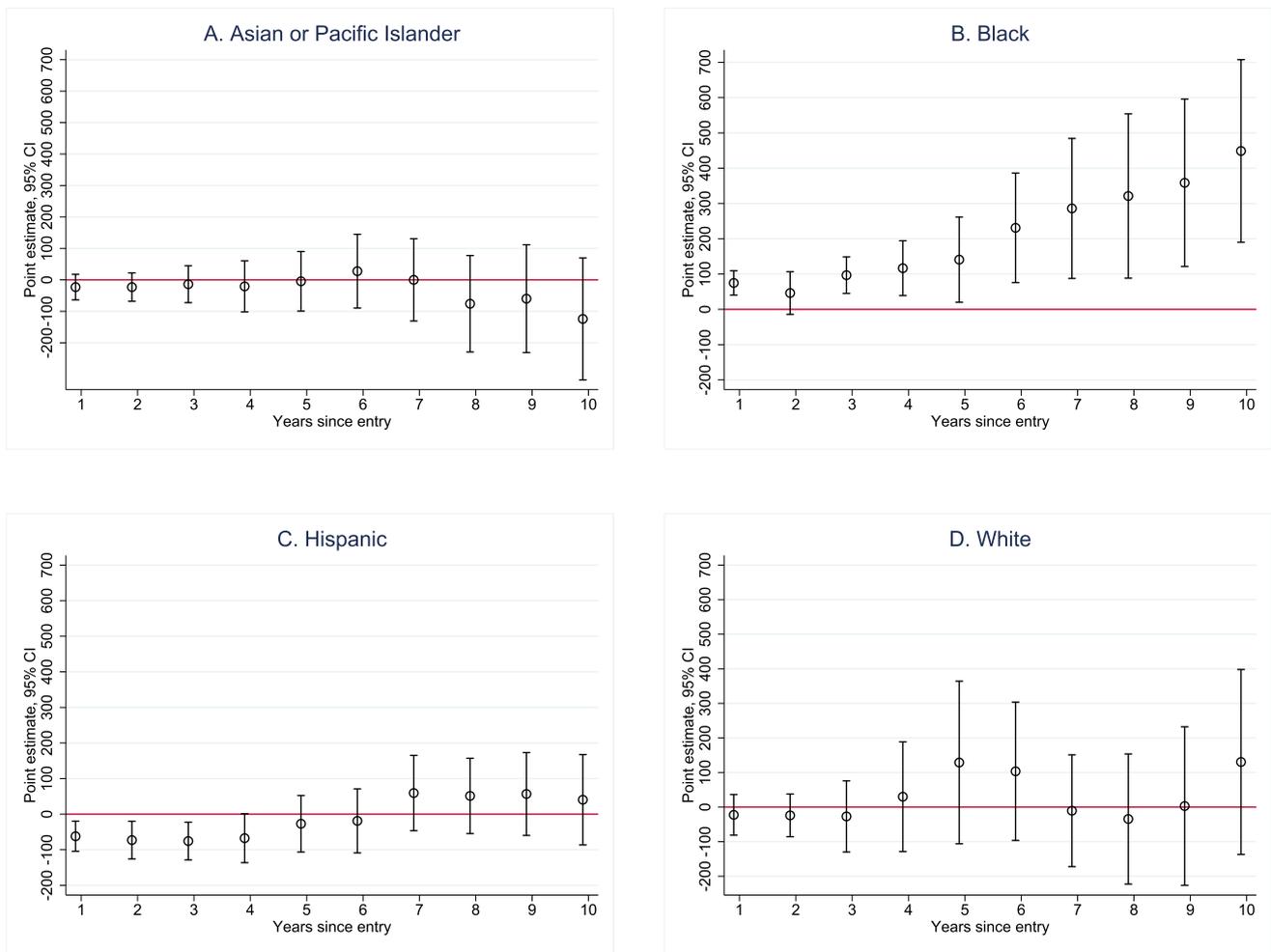


Fig. 3. Estimated Effects of Standard Deviation Increase in Network Share on Earnings: Immigrant Students
Notes: Undergraduate degree-seeking students who first enrolled in the system between fall 1999 through fall 2010 who were born outside of the United States. Sample is limited to fall entrants with declared majors at entry. Students in college-cohort-major (CCM) cells with fewer than 10 students in any year or fewer than 25 students on average are excluded.

peers in relatively elite institutions, such as Harvard University (Shue, 2013; Josh Lerner & Ulrike Malmendier, 2013; Michelman, Price & Zimmerman, 2022), Dartmouth College (Marmaros & Sacerdote, 2002), Indiana University Business School (Hacamo & Kleiner, 2022), and top universities in Chile (Zimmerman, 2019). These inquiries overwhelmingly conclude that friendships with fellow elites leads to better labor market outcomes.

Our analysis contributes to this emerging literature by exploring network effects on employment outcomes among postsecondary students who come from a wide range of socioeconomic and racial/ethnic backgrounds, including many immigrant students. With these expansive data, we can uncover heterogeneity in network effects that prior studies have been unable to examine. We also provide suggestive evidence on some of the mechanisms through which postsecondary networks may operate, specifically whether networks influence earnings through access to employment and/or indirectly through proxy measures of academic effort, including degree completion and credit accumulation.

2. Data and background

Our analyses rely on administrative data from the large urban public college system, which includes information on first-time, degree-seeking students’ demographic characteristics (including race/ethnicity and immigration status) and academic outcomes. We observe academic

outcomes, such as credits completed, GPA, and degree completion up to ten years after college entry. Student records have been merged with state wage data, allowing us to track quarterly employment and earnings of all students who remain employed in unemployment insurance-covered sectors in-state from 1996 through 2015.⁴

⁴ Approximately 97 percent of non-farm employment is covered by unemployment insurance in the state. While we cannot distinguish between non-employment and employment in a different state, inter-state migration rates are likely low for students in the analysis sample. Using data from the Census Department’s Post-Secondary Employment Outcomes Data (available at: https://lehd.ces.census.gov/data/pseo_experimental.html), we match information on the share of graduates who are employed in a different state to each student’s college and major (defined by credential level and 2-digit CIP code). Only 5 percent of graduates from these programs were employed in a different state in the year following graduation and 5 years after completion; only 9 percent had out-of-state employment. These estimates likely represent an upper bound for the likelihood that a student would have earnings in a different state because only 40 percent of students in our sample have graduated 10 years after entry and, in general, college noncompleters are about half as likely to migrate to a different state than college completers (Wozniak 2010).

Table 4
Effect of Network Share on Annual Earnings by Race/ethnicity and Nativity.

Years since entry:	1	2	3	4	5	6	7	8	9	10
Proportion in network *										
API, native-born	-11 (9) {0.461}	-0.1 (11) {0.996}	12 (15) {0.386}	44 (33) {0.337}	120 (48)* {0.521}	166 (49)** {0.56}	108 (50)* {0.53}	144 (57)* {0.271}	159 (61)* {0.146}	41 (95) {0.632}
Black, native-born	-5 (5) {0.333}	3 (7) {0.714}	4 (7) {0.567}	14 (8)+ {0.197}	24 (10)* {0.161}	28 (14)* {0.161}	45 (16)** {0.052}	47 (19)* {0.091}	41 (22)+ {0.144}	52 (25)* {0.145}
Hispanic, native-born	-8 (5) {0.178}	-5 (7) {0.523}	-12 (8) {0.100}	-11 (10) {0.282}	-8 (11) {0.546}	-8 (13) {0.304}	13 (14) {0.239}	-1 (17) {0.923}	3 (21) {0.898}	-11 (26) {0.823}
White, native-born	3 (5) {0.775}	12 (7)+ {0.405}	27 (8)** {0.226}	39 (11)** {0.141}	44 (17)* {0.109}	52 (19)** {0.024}	50 (21)* {0.02}	69 (22)** {0.028}	75 (24)** {0.038}	75 (32)* {0.086}
API, immigrant	-10 (9) {0.086}	-10 (10) {0.112}	-6 (13) {0.494}	-9 (18) {0.714}	-2 (21) {0.943}	12 (26) {0.711}	0.2 (29) {0.99}	-33 (34) {0.475}	-26 (38) {0.579}	-54 (43) {0.184}
Black, immigrant	34 (8)** {0.003}	21 (14) {0.333}	44 (12)** {0.005}	53 (18)** {0.034}	64 (28)* {0.083}	105 (36)** {0.018}	130 (46)** {0.002}	146 (54)** {0.016}	163 (55)** {0.003}	204 (60)** {0.004}
Hispanic, immigrant	-23 (8)** {0.100}	-27 (10)** {0.094}	-28 (10)** {0.052}	-25 (13)+ {0.144}	-10 (15) {0.625}	-7 (17) {0.76}	22 (20) {0.474}	19 (20) {0.499}	21 (22) {0.445}	15 (24) {0.561}
White, immigrant	-15 (20) {0.221}	-16 (21) {0.413}	-18 (35) {0.592}	20 (54) {0.847}	86 (80) {0.328}	69 (68) {0.322}	-7 (55) {0.909}	-23 (64) {0.787}	2 (78) {0.983}	87 (91) {0.390}
Tests of equality (p-values):										
All native born	0.343	0.297	0.014	0.014	0.016	0.001	0.160	0.051	0.108	0.158
All foreign born	<0.001	0.039	<0.001	0.005	0.076	0.028	0.128	0.060	0.045	0.008
API NB = API immigrant	0.924	0.464	0.347	0.179	0.021	0.003	0.057	0.004	0.003	0.347
Black NB = Black immigrant	<0.001	0.225	0.002	0.015	0.101	0.012	0.037	0.041	0.019	0.006
Hispanic NB = Hispanic immigrant	0.118	0.089	0.229	0.425	0.935	0.833	0.700	0.451	0.599	0.498
White NB = White immigrant	0.363	0.219	0.224	0.730	0.615	0.808	0.344	0.167	0.356	0.896

Notes: For sample, see Table 1 notes. Each column contains estimates from separate regressions. Dependent variable is annual earnings in unemployment insurance covered sectors in the state. In-network defined by race/ethnicity and nativity. Coefficients represent the estimated effect of a 1 percentage-point increase in network share. All regressions include college by cohort fixed effects, major by cohort fixed effects, college by major fixed effects, race/ethnicity by nativity fixed effects, a quadratic in age at entry, high school GPA, average annual earnings in the three years prior to college entry, and indicators for gender, single parent, disabled, attending a local high school, GED recipient, nonmissing high school GPA, and any earnings from employment in the three years prior to college entry. Robust standard errors, clustered at the college-major level in parentheses; ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$; p-values from wild bootstrap-t clustered by entry college in brackets.

2.1. Analysis sample

We focus on the 11 cohorts of degree-seeking students who entered the system in the fall semester of the 2000 through 2011 academic years (i.e., fall 1999 through fall 2010).⁵ To minimize endogeneity of major choice, we limit our sample to students who choose a major/program at college entry and exclude students who enrolled in three institutions where very few students enter with a major. We also drop the small number of Native American students (less than 1 percent of the sample), since this group is too small to generate reasonably precise estimates and students missing information on their race/ethnicity. To ensure sufficient numbers for estimation of network effects, we further limit our sample to students who enter into a college-major with at least 25 students on average across all years and a minimum of 10 students in any given year. Our resulting sample includes 151,181 students.⁶ We track labor market outcomes for all students up to 5 years after college enrollment with declining numbers of students used in the estimation of network effects 6 to 10 years after enrollment.

We use the two measures available in the data to classify students by race/ethnicity (one variable that combines these two constructs) and

⁵ This selection criterion allows for a minimum of five years of post-entry outcomes to be observed for all cohorts.

⁶ Before imposing restrictions on major choice/major size at entry, there are 334,640 students who meet the other requirements. Excluding students who did not declare a major at college entry reduces the sample to 177,997 students. Excluding students in small majors drops an additional 26,816 entrants. The resulting sample size (151,181) represents 45 percent of the original sample.

nativity status. This results in eight groups: Asian or Pacific Islander (API), Black, Hispanic, and White students who are either born in the U. S. or U.S. territories (“native-born”) or born outside the U.S. (“immigrant”). As shown in the top two rows of Table 1, the system serves a large number of students from each of the eight groups. The smallest group, API native-born students, makes up 6 percent of our sample and the largest group, Hispanic native-born students, makes up 24 percent. The table also provides the number of college, cohort, major (CCM) cells for each group, which reflects the level at which the network share varies (note that “major” refers to “degree and major” as students in bachelor’s and associate’s degree programs who declare the same major may enroll in different classes and form separate networks).

Appendix Fig. A.1 shows large racial/ethnic differences in major choice where, for instance, White and Hispanic native-born students are far more likely to choose business majors than their API and Black counterparts (Panel A). Among immigrants, the opposite is true, with API and Black students entering into business majors at higher rates (Panel B). Hispanic and White immigrant students are more likely to choose a health-related major. Our empirical framework, described in Section 3, controls for any possible effects of major on earnings as well as the differential sorting of students into different majors.

2.2. Average annual earnings by race/ethnicity and nativity

To motivate our analyses, we present both raw and adjusted average earnings post enrollment in the system by race/ethnicity and nativity. The y-axis of Fig. 1 represents average annual earnings 10 years after enrollment and each bar reflects the difference in earnings between White native-born students and students in the group identified on the x-

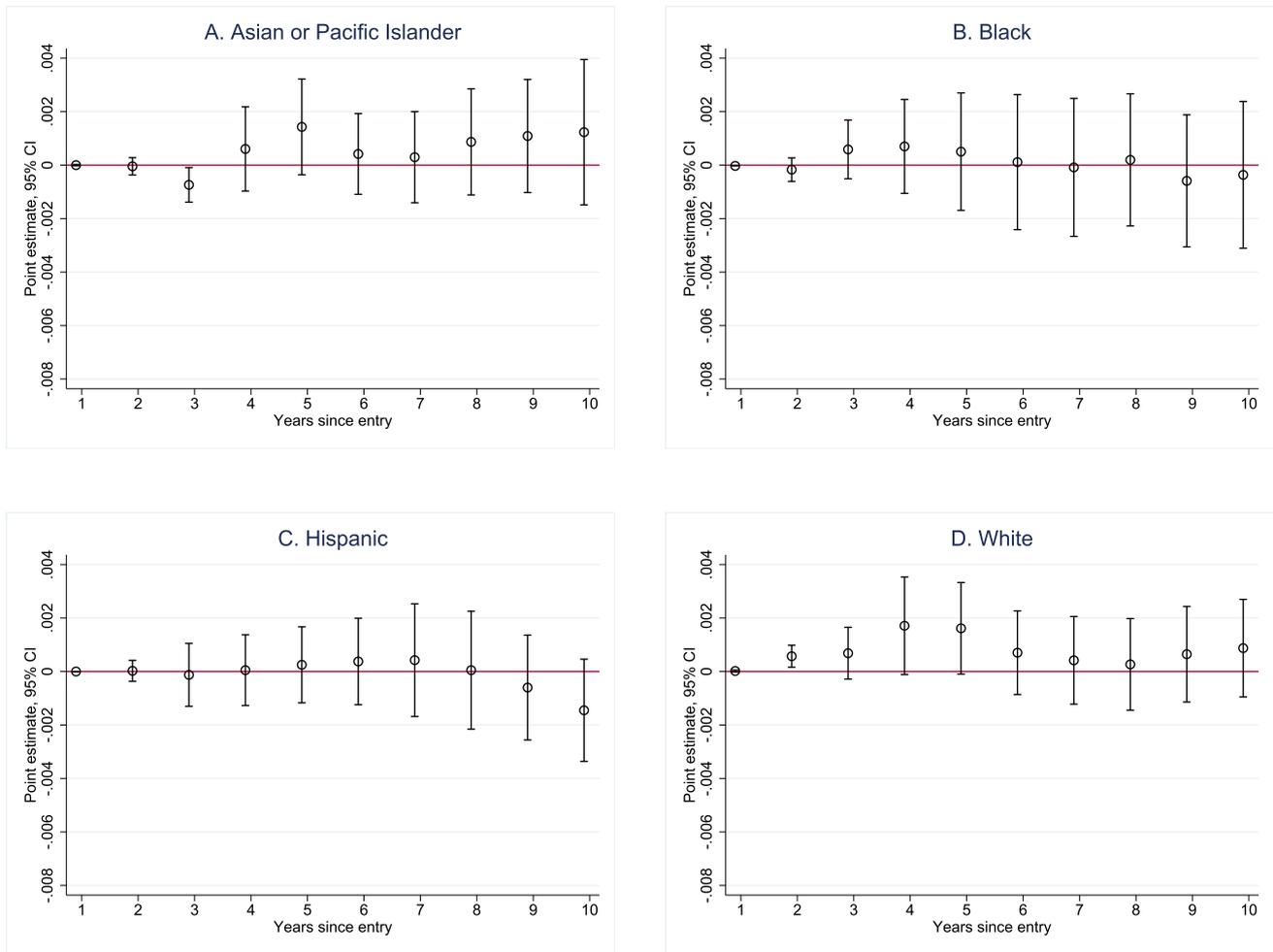


Fig. 4. Estimated Effects of Standard Deviation Increase in Network Share on Degree Receipt: Native-born Students
Notes: Undergraduate degree-seeking students who first enrolled in the system between fall 1999 and fall 2010 and were born in the U.S. or U.S. territories. Sample is limited to fall entrants with declared majors at entry. Students in college-cohort-major (CCM) cells with fewer than 10 students in any year or fewer than 25 students on average are excluded.

axis. As indicated by the legend, the darkest bar shows the raw earnings gap while the other shaded bars reflect the earnings gap conditional on adding sets of covariates, including pre-college characteristics, college, major, and degree attainment (referred to as “attainment” adjusted in the figure); employment; and industry.⁷ Appendix Fig. A.2 displays unadjusted average earnings for each group.

Looking first at the raw earnings disparities, White native-born students (whose average annual earnings ten years after college entry equal \$34,329) earn far more than their API, Black, and Hispanic counterparts (both those who are immigrant and native-born). API immigrants have the lowest relative earnings; 10 years after school entry, they earn approximately 30 percent less than White native-born. Native-born also significantly out-earn immigrants, overall and within-race. In fact, the

⁷ All pre-enrollment characteristics are measured at the beginning of the first semester of college including high school GPA, high school type (local public, GED, or other), disability, a quadratic in age, gender, single parent status, any employment in the three years prior to entry, and average annual earnings in the three years prior to college entry. Attainment measures include initial major and degree, cumulative credits earned, bachelor’s degree receipt, and associate degree receipt. Industry is measured using 3-digit NAICS codes for the primary job (that which produced the highest annual earnings for individuals with more than one employer during the year). Point estimates and standard errors for raw and adjusted earnings gaps are displayed in Appendix Table A.1.

lower earnings of White immigrants relative to their White native-born counterparts renders the racial/ethnic earnings gaps larger among native-born than among immigrants.

Raw disparities in earnings are attenuated or amplified by conditioning on pre-enrollment characteristics, attainment, and employment outcomes. However, for most groups, earnings disparities are not entirely explained by these factors. The fully-adjusted earnings gaps shown in the bars furthest to the right for each group reveal substantially higher average earnings for native-born White students relative to all other groups except White immigrants. The largest disparity is between White native-born and Black native-born, where Black native-born students earn over \$9,000 less on average than their observationally-equivalent White counterparts 10 years after college entry. In fact, the unadjusted gap between native-born Black and White students is essentially the same as the adjusted gap. Taken together, these results reveal that the earnings disparities among students in the system resemble those reported at the national level with large racial and nativity gaps that cannot be explained entirely by pre-enrollment traits, success in college, employment, or industry.

3. Empirical framework

We estimate the effect of network shares using a generalized differences-in-differences approach:

Table 5
Effect of Network Share on Degree Receipt by Race/ethnicity and Nativity.

Years since entry:	1	2	3	4	5	6	7	8	9	10
Proportion in network*										
API, native-born	-0.000001 (0.00001) {0.939}	-0.00004 (0.0002) {0.863}	-0.001 (0.0003)* {0.386}	0.001 (0.001) {0.551}	0.001 (0.001) {0.107}	0.0004 (0.001) {0.662}	0.0003 (0.001) {0.644}	0.001 (0.001) {0.254}	0.001 (0.001) {0.326}	0.001 (0.001) {0.238}
Black, native-born	-0.00001 (0.000005) {0.220}	-0.0001 (0.0001) {0.521}	0.0002 (0.0002) {0.525}	0.0003 (0.0003) {0.545}	0.0002 (0.0004) {0.700}	0.00004 (0.0005) {0.932}	-0.00003 (0.0005) {0.951}	0.0001 (0.0004) {0.912}	-0.0002 (0.0004) {0.746}	-0.0001 (0.0005) {0.858}
Hispanic, native-born	-0.000002 (0.000004) {0.632}	0.00001 (0.0001) {0.97}	-0.0001 (0.0002) {0.929}	0.00002 (0.0003) {0.977}	0.0001 (0.0003) {0.849}	0.0001 (0.0003) {0.704}	0.00002 (0.0004) {0.571}	0.0002 (0.0005) {0.949}	-0.0002 (0.0004) {0.511}	-0.001 (0.0004) {0.102}
White, native-born	0.00001 (0.00001) {0.328}	0.0003 (0.0001) {0.087}	0.0004 (0.0003) {0.384}	0.001 (0.001)+ {0.134}	0.001 (0.0005)+ {0.091}	0.0004 (0.0004) {0.332}	0.0002 (0.0004) {0.602}	0.0001 (0.0005) {0.725}	0.0003 (0.0005) {0.443}	0.0005 (0.0005) {0.406}
API, immigrant	0.00001 (0.00001) {0.101}	0.0003 (0.0002) {0.464}	0.0003 (0.001) {0.612}	0.001 (0.001) {0.395}	0.001 (0.001) {0.314}	-0.00004 (0.001) {0.958}	-0.0003 (0.001) {0.761}	-0.0001 (0.001) {0.929}	-0.0002 (0.001) {0.862}	-0.00005 (0.001) {0.966}
Black, immigrant	-0.00001 (0.000005) {0.164}	-0.0004 (0.0001) {0.249}	-0.0001 (0.0003) {0.685}	0.0002 (0.0004) {0.626}	0.001 (0.0004)+ {0.198}	0.001 (0.001)+ {0.23}	0.0005 (0.001)+ {0.575}	0.001 (0.001) {0.481}	0.001 (0.001) {0.494}	0.0004 (0.001) {0.661}
Hispanic, immigrant	0.00001 (0.00001) {0.179}	-0.0003 (0.0001)* {0.129}	-0.001 (0.0004) {0.057}	-0.001 (0.001) {0.277}	-0.001 (0.0004)* {0.162}	-0.001 (0.0004) {0.295}	-0.001 (0.0005)+ {0.196}	-0.001 (0.001)* {0.061}	-0.002 (0.001) {0.054}	-0.002 (0.001)** {0.02}
White, immigrant	-0.0001 (0.00002) {0.724}	0.001 (0.001) {0.507}	-0.0002 (0.001) {0.881}	-0.0002 (0.001) {0.861}	-0.001 (0.001)+ {0.043}	-0.003 (0.001)** {0.027}	-0.003 (0.001)** {0.027}	-0.003 (0.001) {0.053}	-0.002 (0.001)* {0.055}	-0.002 (0.001)* {0.072}
Tests of equality (p-values):										
All native born	0.467	0.029	0.045	0.389	0.311	0.95	0.976	0.890	0.505	0.301
All foreign born	0.339	0.052	0.054	0.231	0.003	0.001	0.008	0.003	0.006	0.018
API NB = API immigrant	0.208	0.204	0.044	0.927	0.472	0.632	0.553	0.425	0.305	0.399
Black NB = Black immigrant	0.884	0.029	0.308	0.924	0.369	0.257	0.541	0.527	0.283	0.520
Hispanic NB = Hispanic immigrant	0.274	0.036	0.029	0.176	0.031	0.091	0.090	0.038	0.046	0.126
White NB = White immigrant	0.380	0.680	0.509	0.293	0.014	0.002	0.002	0.008	0.015	0.013

Notes: For sample, see Table 1 notes. Each column contains estimates from separate regressions. Dependent variable is the probability of receiving any degree from a system institution. In-network defined by race/ethnicity and nativity. Coefficients represent the estimated effect of a 1 percentage-point increase in network share. See Table 4 notes for additional controls. Robust standard errors, clustered at the college-major level in parentheses; ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$; p-values from wild bootstrap-t clustered by entry college in brackets.

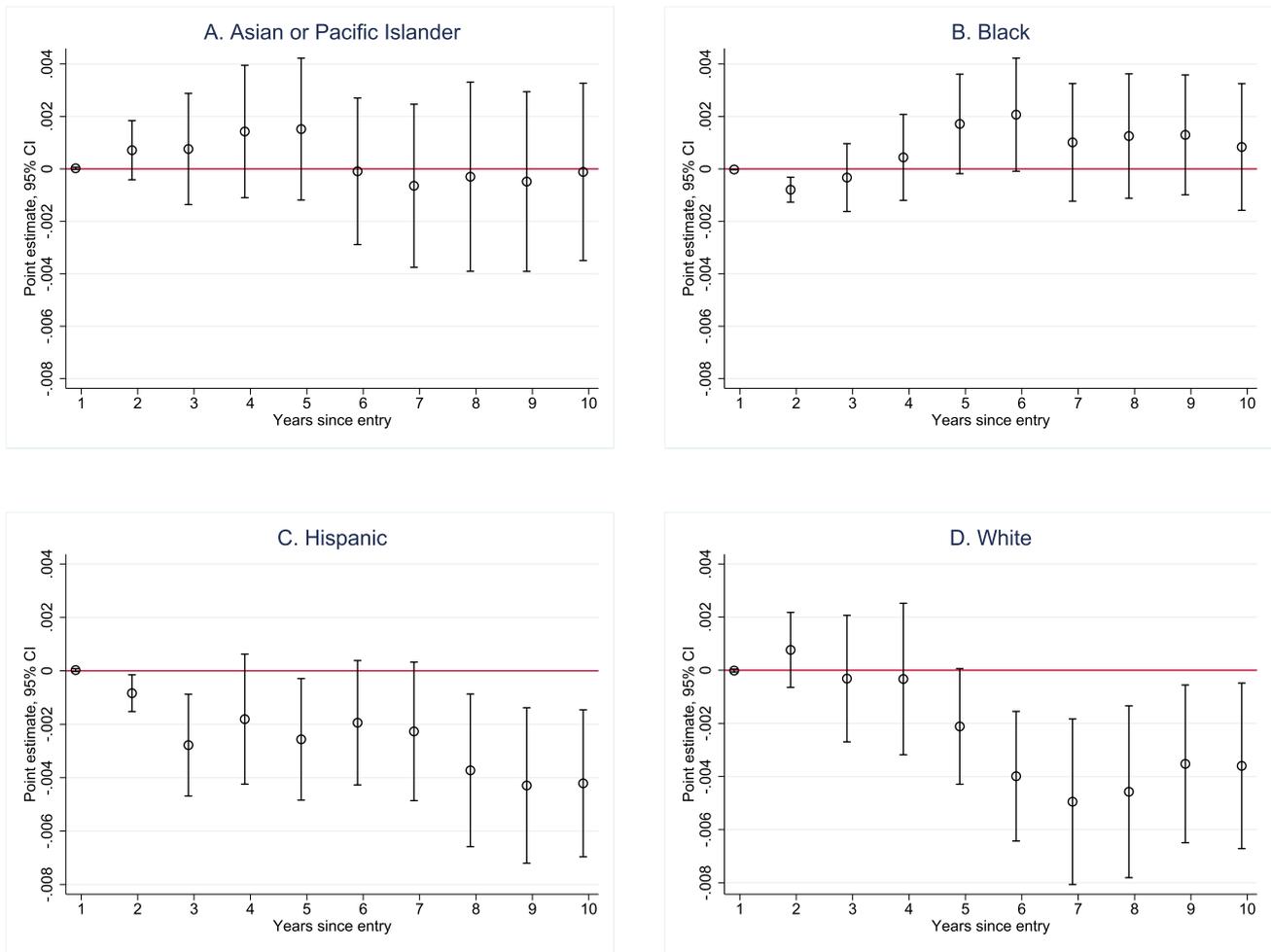


Fig. 5. Estimated Effects of Standard Deviation Increase in Network Share on Degree Receipt: Immigrant Students
Notes: Undergraduate degree-seeking students who first enrolled in the system between fall 1999 and fall 2010 and who were born outside of the United States. Sample is limited to fall entrants with declared majors at entry. Students in college-cohort-major (CCM) cells with fewer than 10 students in any year or fewer than 25 students on average are excluded.

$$Y_{iscm} = \beta CCM_{iscm} + \rho Pct_{scm} + \gamma X_i + \delta_{sc} + \delta_{cm} + \delta_{sm} + \varepsilon_{iscm} \quad (1)$$

In Eq. (1), Y_{iscm} is the earnings for student i who initially entered college s as a member of entry cohort c and major m . CCM_{iscm} represents the share of classmates in student i 's college-cohort-major (excluding student i) that are of the same race and nativity while Pct_{scm} is a vector of main effects for the share of each racial/ethnic by nativity group in the college-cohort-major. X_i is a vector of student covariates measured in the first semester of college, including high school GPA, high school type (public, GED, or other), disability, a quadratic in age, gender, race/ethnicity by nativity, single parent status, any employment in the three years prior to entry, and average earnings in the three years prior to college entry. We include college by cohort, major by cohort, and college by major fixed effects, δ_{sc} , δ_{cm} , and δ_{sm} , respectively. Finally, under the identifying assumption that CCM_{iscm} and ε_{iscm} are uncorrelated, ε_{iscm} represents a stochastic disturbance term. We also estimate impacts of same-group peers on employment and degree completion to determine whether same-group peers might operate on earnings through these outcomes. Standard errors are clustered at the college by major level. Given the possibility that outcomes might be correlated within colleges across majors, and the small number of distinct colleges in our analysis sample, we also estimate p -values using the wild bootstrap- t clustered by entry college (Cameron, Gelbach & Miller, 2008).

The three sets of fixed effects ensure that estimates are based off of deviations in network shares across cohorts in different college-major

groupings. More specifically, the college-cohort and major-cohort fixed effects control for time-varying changes in college- or major-level policies and practices or other time-varying factors that may influence the outcomes of each cohort. The college-major fixed effects account for time-invariant factors that drive variation in the college and labor market outcomes of students in different college-majors.

3.1. Identifying variation

The precision of our estimates depends upon a sufficient amount of within college major variation in same-race/same-nativity shares across cohorts. To that end, Panel A of Table 2 presents the total (across and within college/major) variation in network shares for all eight groups; and Panel B presents the within college-major variation. The distribution shown in Panel B is calculated from the residuals of a regression of network share on college by cohort, major by cohort, and college by major. Panel B shows meaningful variation in the proportion of same-race, same-nativity shares across cohorts within college-majors. Among Black native-born, for instance, the average across-cohort, within-college major change in the share Black native-born ranges from a roughly 25 percentage-point decrease to a 17 percentage-point increase. The within college-major standard deviations for each group range from 1.1 percentage-points (API native-born) to 2.8 percentage-

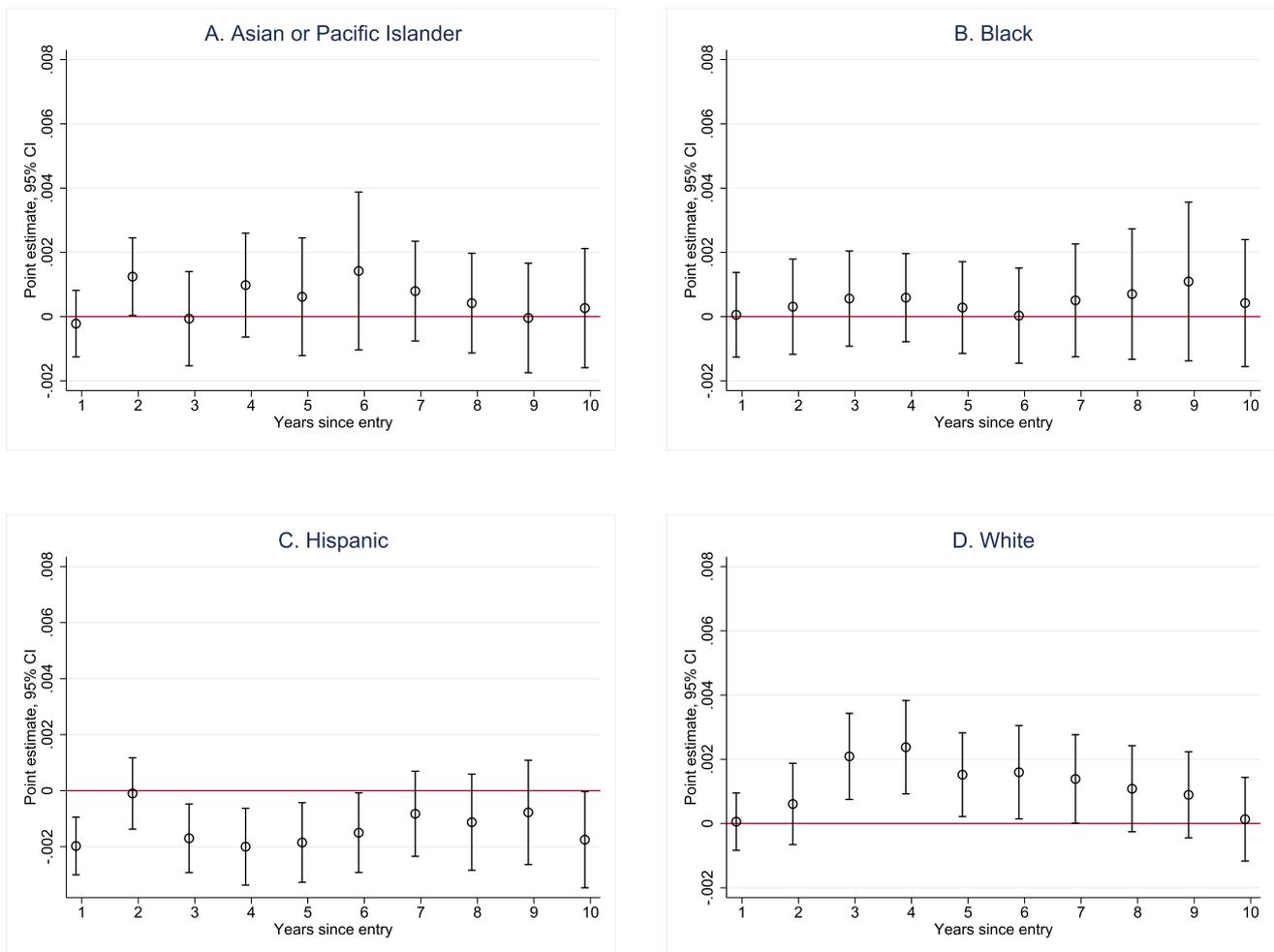


Fig. 6. Estimated Effects of Standard Deviation Increase in Network Share on the Probability of Nonzero Earnings: Native-born Students

Notes: Undergraduate degree-seeking students who first enrolled in the system between fall 1999 and fall 2010 and were born in the U.S. or U.S. territories. Sample is limited to fall entrants with declared majors at entry. Students in college-cohort-major (CCM) cells with fewer than 10 students in any year or fewer than 25 students on average are excluded.

points (Black native-born).⁸

3.2. Testing identifying assumptions

Our main identifying assumption is that variation in network shares across cohorts within college-majors is uncorrelated with variation in student attributes that affect labor market outcomes. For instance, if students with high levels of ambition select into college-majors that experience an increase in the share Black native-born, then our estimated effect of Black native-born peers will be upwardly biased. To test this assumption, we first estimate separate regressions of each pre-enrollment characteristic as a function of same-race/same-nativity shares as well as college by cohort, major by cohort, college by major,

⁸ We sequentially add fixed effects for major, college, and college by major to understand which of these terms contributes the most to the reduction in variation in network shares between Panel A and Panel B. Including only major fixed effects or only college fixed effects reduces the standard deviation of network share by 21 to 50 percent. Controlling for the interaction between college and major results in a 38 to 70 percent reduction. Thus, our estimates will reflect the effect of small deviations in same-group shares rather than the impacts of switching to a major or college with a much larger or smaller potential network.

and race/nativity fixed effects. We then use all of the pre-enrollment characteristics to predict earnings 5 years after college entry (see Appendix Table A.2) and estimate a final regression of predicted earnings on same/race nativity shares and all of the college-cohort-major fixed effects. Table 3 reports the parameter estimates, standard errors, and wild bootstrap-*t* *p*-values from these regressions. All point estimates are scaled to represent a 1 percentage-point increase in network share and most of the correlations are small and statistically insignificant using both inferential approaches. There are a few exceptions, however. For instance, API native-born students with higher levels of baseline and predicted earnings sort into college-cohort-majors with higher shares of API native-born students ($p < 0.01$ with conventional standard errors and wild bootstrap-*t* in the case of predicted earnings). We find a negative correlation between Hispanic native-born students' baseline earnings and the share of their classmates that are also Hispanic native-born, although this estimate is only statistically significant with conventional standard errors. Taken together, these results suggest that the identifying assumption holds up in many ways but that some of the baseline traits may serve as important controls. In Section 4.3 (Robustness and Heterogeneity), we show that the effects of same-group network shares on earnings and degree receipt do change when we condition on baseline covariates, yet the differences between the models with and without these covariates are very small. Further, given the

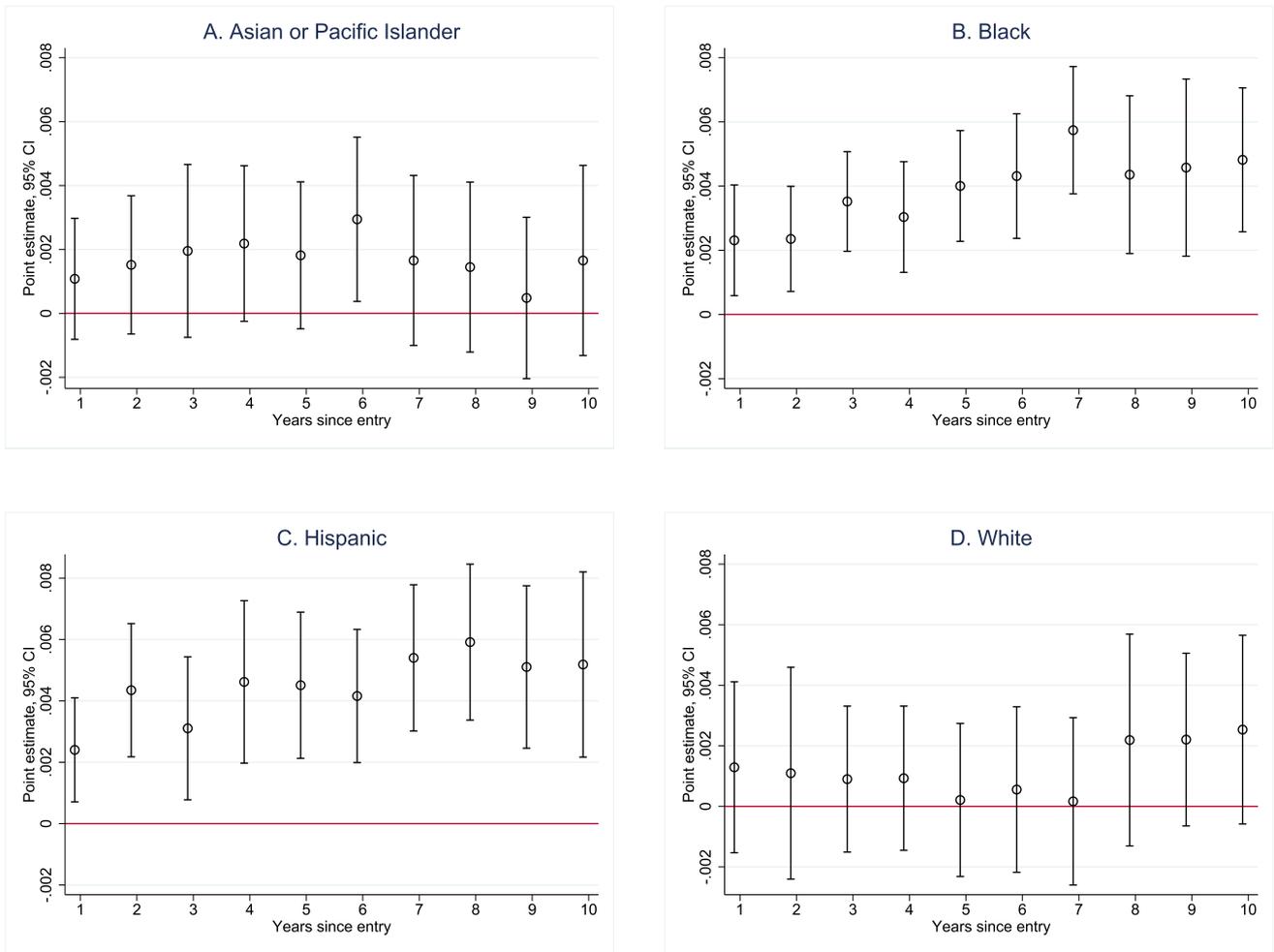


Fig. 7. Estimated Effects of Standard Deviation Increase in Network Share on the Probability of Nonzero Earnings: Immigrant Students
Notes: Undergraduate degree-seeking students who first enrolled in the system between fall 1999 and fall 2010 and who were born outside of the United States. Sample is limited to fall entrants with declared majors at entry. Students in college-cohort-major (CCM) cells with fewer than 10 students in any year or fewer than 25 students on average are excluded.

Table 6
Effect of Network Share on Employment by Race/ethnicity and Nativity.

Years since entry:	1	2	3	4	5	6	7	8	9	10
Proportion in network *										
API, native-born	-0.0002 (0.0005) {0.672}	0.001 (0.001)* {0.258}	-0.0001 (0.001) {0.892}	0.001 (0.001) {0.615}	0.001 (0.001) {0.829}	0.001 (0.001) {0.729}	0.001 (0.001) {0.66}	0.0004 (0.001) {0.686}	-0.00004 (0.001) {0.965}	0.0002 (0.001) {0.792}
Black, native-born	0.00002 (0.0002) {0.959}	0.0001 (0.0003) {0.495}	0.0002 (0.0003) {0.543}	0.0002 (0.0003) {0.486}	0.0001 (0.0003) {0.819}	0 (0.0003) {0.976}	0.0002 (0.0003) {0.602}	0.0002 (0.0004) {0.562}	0.0004 (0.0004) {0.502}	0.0002 (0.0004) {0.738}
Hispanic, native-born	-0.001 (0.0002) **	-0.00004 (0.0003) **	-0.001 (0.0003) **	-0.001 (0.0003) **	-0.001 (0.0003)* **	-0.001 (0.0003)* **	-0.0003 (0.0003) **	-0.0004 (0.0003) **	-0.0003 (0.0004) **	-0.001 (0.0004) *
White, native-born	{0.040} 0.00003 (0.0002)	{0.881} 0.0003 (0.0004)	{0.061} 0.001 (0.0004) **	{0.036} 0.001 (0.0004) **	{0.107} 0.001 (0.0004)*	{0.22} 0.001 (0.0004)*	{0.266} 0.001 (0.0004)+	{0.287} 0.001 (0.0004)	{0.353} 0.0005 (0.0004)	{0.09} 0.0001 (0.0004)
API, immigrant	{0.884} 0.0005 (0.0004)	{0.254} 0.001 (0.0005)	{0.002} 0.001 (0.001)	{0.005} 0.001 (0.001)+	{0.010} 0.001 (0.001)	{0.029} 0.001 (0.001)*	{0.062} 0.001 (0.001)	{0.108} 0.001 (0.001)	{0.382} 0.0002 (0.001)	{0.883} 0.001 (0.001)
Black, immigrant	0.001 (0.0004)*	0.001 (0.0004) **	0.002 (0.0004) **	0.001 (0.0004) **	0.002 (0.0004) **	0.002 (0.0005) **	0.003 (0.0005) **	0.002 (0.001)**	0.002 (0.001)**	0.002 (0.001) **
Hispanic, immigrant	{0.002} 0.001 (0.0003) **	{0.008} 0.002 (0.0004) **	{<0.001} 0.001 (0.0004) **	{0.007} 0.002 (0.0005) **	{0.002} 0.002 (0.0004) **	{<0.001} 0.002 (0.0004) **	{0.001} 0.002 (0.0005) **	{0.004} 0.002 (0.0005) **	{0.014} 0.002 (0.001)** **	{0.002} 0.002 (0.001) **
White, immigrant	{0.04} 0.001 (0.001) {0.413}	{0.01} 0.001 (0.001) {0.442}	{0.159} 0.001 (0.001) {0.49}	{0.031} 0.001 (0.001) {0.464}	{0.027} 0.0001 (0.001) {0.867}	{0.021} 0.0004 (0.001) {0.686}	{0.014} 0.0001 (0.001) {0.942}	{0.004} 0.001 (0.001) {0.481}	{0.014} 0.001 (0.001) {0.405}	{0.011} 0.002 (0.001) {0.385}
Tests of equality (p-values):										
All native born	0.045	0.395	0.001	<0.001	0.008	0.033	0.198	0.317	0.498	0.324
All foreign born	0.789	0.536	0.579	0.618	0.184	0.481	0.028	0.175	0.049	0.32
API NB = API immigrant	0.213	0.482	0.309	0.945	0.781	0.992	0.998	0.776	0.785	0.622
Black NB = Black immigrant	0.005	0.034	0.002	0.006	<0.001	<0.001	<0.001	0.007	0.025	0.001
Hispanic NB = Hispanic immigrant	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
White NB = White immigrant	0.389	0.734	0.582	0.475	0.485	0.634	0.535	0.473	0.313	0.125

Notes: For sample, see Table 1 notes. Each column contains estimates from separate regressions. Dependent variable is the probability of having any annual earnings in unemployment insurance covered sectors in the state. In-network defined by race/ethnicity and nativity. Coefficients represent the estimated effect of a 1 percentage-point increase in network share. See Table 4 notes for additional controls. Robust standard errors, clustered at the college-major level in parentheses; ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$; p-values from wild bootstrap-t clustered by entry college in brackets.

Table 7
Robustness of Effects on Earnings and Degree Receipt.

	Dependentvariable = averagearnings				Dependentvariable = anydegreereceipt			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Proportion in network *								
API, native-born	33 (18)+ {0.309}	33 (22) {0.414}	34 (18)+ {0.364}	33 (18)+ {0.328}	0.001 (0.001) {0.107}	0.002 (0.001)* {0.082}	0.002 (0.001)* {0.093}	0.001 (0.001) {0.105}
Black, native-born	8 (6) {0.323}	17 (7)* {0.112}	6 (6) {0.464}	8 (6) {0.308}	0.0002 (0.0004) {0.700}	-0.0001 (0.0004) {0.933}	0.0003 (0.0004) {0.560}	0.0002 (0.0004) {0.724}
Hispanic, native-born	-9 (7) {0.207}	-19 (9)* {0.086}	-10 (7) {0.124}	-9 (7) {0.184}	0.0001 (0.0003) {0.849}	0.0002 (0.0003) {0.72}	0.0001 (0.0003) {0.848}	0.0001 (0.0003) {0.825}
White, native-born	25 (8)** {0.214}	6 (12) {0.83}	23 (8)** {0.273}	25 (8)** {0.211}	0.001 (0.0005)+ {0.091}	0.001 (0.001) {0.131}	0.001 (0.0004)+ {0.127}	0.001 (0.001)+ {0.098}
API, immigrant	-7 (12) {0.584}	-14 (14) {0.486}	-11 (12) {0.448}	-7 (12) {0.600}	0.001 (0.001) {0.314}	0.001 (0.001)+ {0.206}	0.001 (0.001) {0.159}	0.001 (0.001) {0.304}
Black, immigrant	43 (15)** {0.06}	78 (19)** {0.002}	39 (14)** {0.09}	43 (15)** {0.043}	0.001 (0.0004)+ {0.198}	0.0004 (0.001) {0.642}	0.001 (0.0004)* {0.119}	0.001 (0.0004)+ {0.221}
Hispanic, immigrant	-22 (9)* {0.114}	-1 (12) {0.965}	-26 (10)** {0.111}	-23 (9)* {0.110}	-0.001 (0.0004)* {0.162}	-0.001 (0.001)+ {0.175}	-0.001 (0.0004)* {0.215}	-0.001 (0.0004)* {0.160}
White, immigrant	11 (35) {0.849}	9 (45) {0.894}	13 (34) {0.802}	11 (35) {0.842}	-0.001 (0.001)+ {0.043}	-0.001 (0.001) {0.269}	-0.002 (0.001)* {0.026}	-0.001 (0.001)+ {0.049}
Tests of equality (p-values):								
All native born	0.022	0.015	0.028	0.022	0.311	0.123	0.214	0.311
All foreign born	0.003	0.002	0.004	0.002	0.003	0.015	<0.001	0.003
API NB = API immigrant	0.065	0.076	0.032	0.065	0.472	0.383	0.335	0.472
Black NB = Black immigrant	0.010	<0.001	0.020	0.010	0.369	0.549	0.301	0.368
Hispanic NB = Hispanic immigrant	0.262	0.232	0.182	0.254	0.031	0.031	0.026	0.032
White NB = White immigrant	0.709	0.947	0.796	0.714	0.014	0.143	0.008	0.014
Observations	151,181	151,181	151,181	151,181	151,181	151,181	151,181	151,181
Specification								
Baseline controls	X		X	X	X		X	X
Major, cohort, college FE			X				X	
Major-cohort, college-cohort, college-major FE	X	X		X	X	X		X
Average predicted earnings 5 years after entry				X				X

Notes: For sample, see Table 1 notes. Each column contains estimates from separate regressions. Dependent variable is average earnings between 1 and 5 years after college entry (columns 1 through 4) or degree receipt within 5 years of entry (columns 5 through 7). In-network defined by race/ethnicity and nativity. Coefficients represent the estimated effect of a 1 percentage-point increase in network share. See Table 6 notes for list of additional controls. See Section 3.2 for description of the measure of predicted earnings. Averages calculated within college-cohort-major cells (excluding student *i*). Robust standard errors, clustered at the college-major level in parentheses; ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$; *p*-values from wild bootstrap-*t* clustered by entry college in brackets.

Table A.1
Raw and Adjusted Earnings Gap 10 Years After Entry (Relative to White Native-born).

	(1) Unadjusted	(2) Pre-college characteristics	(3) Attainment	(4) Employment	(5) Industry
API, native-born	-1088 (1212)	-1340 (887)	-4484 (932)**	-5461 (1509)**	-4944 (1824)**
Black, native-born	-9035 (1274)**	-7211 (873)**	-6606 (689)**	-10,186 (928)**	-9085 (1022)**
Hispanic, native-born	-6617 (1176)**	-5500 (891)**	-4601 (657)**	-7934 (986)**	-7101 (1081)**
API, immigrant	-10,883 (917)**	-9049 (822)**	-10,125 (810)**	-7280 (1012)**	-5863 (1284)**
Black, immigrant	-10,002 (1515)**	-6607 (1020)**	-7909 (845)**	-6829 (1081)**	-5716 (1163)**
Hispanic, immigrant	-10,163 (1290)**	-8339 (1045)**	-7179 (756)**	-8122 (1061)**	-6537 (1206)**
White, immigrant	-4113 (950)**	-3021 (745)**	-4795 (773)**	-941 (957)	372 (1194)
Tests of equality (<i>p</i> -values):					
All native born	<0.001	<0.001	<0.001	<0.001	<0.001
All foreign born	<0.001	<0.001	<0.001	<0.001	<0.001
API NB = API immigrant	<0.001	<0.001	<0.001	0.079	0.397
Black NB = Black immigrant	0.204	0.335	0.017	<0.001	<0.001
Hispanic NB = Hispanic immigrant	<0.001	<0.001	<0.001	0.675	0.230
Observations	79,908	79,908	79,908	52,045	43,918

Notes: For sample, see Table 1 notes. Estimates from regressions of annual earnings 10 years after college entry on race/ethnicity-nativity categories (White native-born students form omitted group). Column 2 model also includes controls for a quadratic in age at entry, high school GPA, average annual earnings over the three years prior to college entry, and indicators for single parenthood, presence of a disability, local high school graduate, GED recipient, nonmissing high school GPA, any employment in the three years prior to college entry, and gender. Column 3 model includes column 2 controls and controls for initial major, initial degree program, bachelor's degree receipt, associate degree receipt, and cumulative credits earned 10 years after college entry. Column 4 model includes column 3 controls and limits the sample to students with nonzero earnings 10 years after college entry. Column 5 model includes column 3 controls and controls for industry of main job (NAICS 3-digit code); students in jobs with missing industry are excluded. Robust standard errors, clustered at the college-major level in parentheses; ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$. Earnings are adjusted for inflation using the CPI-U (2016\$).

relatively large positive correlation with predicted earnings among native-born API students, we minimize discussion of network effects on earnings for this group.

3.3. Interpretation of estimates

We focus our analyses on students who enter college having selected a major to avoid concerns of endogenous sorting into different programs based on peers. However, this means that our estimates may not be generalizable to many (predominantly) bachelor's degree seeking students who do not declare a major in their first semester. Appendix Table A.3 provides a comparison between the characteristics of students in our analysis sample with the broader set of students in the same entry cohorts when the restriction to students who declare a major at entry is relaxed. In comparison to the broader undergraduate population in the system, students in our sample are substantially less likely to be pursuing a bachelor's degree (17 versus 37 percent), more likely to be native-born Black students (22 versus 19 percent), and less likely to be native-born White students (13 versus 18 percent). Other differences between the two groups are small, including standardized high school GPAs (76 versus 78 on a 100-point scale), the probability of being a graduate from the local public school system (57 versus 59 percent), and age at entry (approximately 20 years old for both groups).

A second consideration for the interpretation of our estimates is that students' peers in the major they enter into may be different than the set of peers they are exposed to during the entirety of their college career. Thus, our estimates should be interpreted as intent-to-treat estimates of the effect of assignment to a specific potential network in a student's first year. To the extent that students persist in their initial major, our estimates will also reflect the effects of network composition in subsequent years. In our analysis sample, 42 percent of students are enrolled in the same major and degree program in their first and last semesters. However, some majors are very closely related (e.g., "Elementary Education and Teaching" versus "Secondary Education and Teaching"). Thus, we also examine the extent to which students remain in a program in the same broad field of study, defined as a major belonging to the same 2-

digit CIP code as the student's initial major. We find that 47 percent of students are in the same degree level and broad field of study in their first and last semesters. If we further relax the requirement that students remain in a major in the same degree level in which they started (e.g., allowing for switching between associate and bachelor's degree programs), we find that 59 percent of students have a major in the same broad field of study in their first and last semester.

4. The effect of college networks

In this section, we discuss estimated effects of students' potential networks on labor market and educational attainment outcomes. We scale estimates from Eq. (1) in two ways. First, Figs. 2 through 7 show the estimated effect of a standard deviation increase in network share (i. e., Panel B of Table 2), which ranges from 1.1 percentage points for native-born API students to 2.8 percentage points for native-born Black students. In Tables 4 through 6, we present estimates that are scaled to represent a 1 percentage-point increase in network share across all race/ethnicity-nativity groups.

4.1. Effects on earnings

We start by examining effects of network share on earnings. Fig. 2 displays point estimates and 95 percent confidence intervals from estimation of Eq. (1) for each of the four native-born racial/ethnic groups where all estimates have been scaled to represent the effect of a 1 standard deviation increase in network share in each of the 10 years after college entry.⁹

Point estimates suggest positive effects of same-race peers on Black and White native-born students. Specifically, a standard deviation increase in the Black native-born share within a student's college, cohort, and major leads to an approximately \$70 increase in a Black native born

⁹ We observe earnings for all cohorts in the first 5 years after entry. In each of the sixth through tenth year after entry, we lose one additional entry cohort.

Table A.2
Predicted Earnings, 5 Years After Entry.

	Earnings: $t + 5$
Age	-478
	(95)**
Age ²	8.90
	(1.71)**
Female	-1556
	(106)**
Single parent	-1006
	(204)**
Disabled	-4596
	(308)**
GED recipient	-1483
	(203)**
Local public high schools graduate	897
	(123)**
Nonmissing high school GPA	-7165
	(677)**
* High school GPA (0-100)	98
	(9)**
Any pre-college earnings	3973
	(102)**
Pre-college earnings (3-year average)	0.622
	(0.008)**
Race\ethnicity and nativity (rel. to white native-born)	
API, native-born	-2723
	(243)**
API, immigrant	-5134
	(213)**
Black, native-born	-1423
	(178)**
Black, immigrant	-1416
	(212)**
Hispanic, native-born	33
	(173)
Hispanic, immigrant	-1905
	(216)**
White, immigrant	-1666
	(237)**
Observations	151,181

Notes: For sample, see Table 1 notes. Estimates from a regression of annual earnings 5 years after college entry. Earnings are adjusted for inflation using the CPI-U (2016\$). Robust standard errors in parentheses; ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$.

student's annual earnings five years after college entry. By year 10, the boost in annual earnings equals \$146, which translates to a 0.6 percent increase in earnings relative to the group mean of \$25,294 (see Appendix Fig. A.2 for average earnings for each group). For White native-born students, the estimated effect of a standard deviation increase in White native-born cohortmates on earnings 10 years post entry is \$143 (a 0.4 percent increase relative to average earnings). A different picture emerges for Hispanic native-born where the estimated effects are negative up to 6 years after entry, albeit small in magnitude and statistically insignificant. Ten years after entry, 95 percent confidence intervals exclude effects larger in magnitude than a \$100 increase in annual earnings from a standard deviation increase in same-group cohortmates.

Table A.3
Comparison of Analysis Sample with Full Sample.

	(1) Analysis sample	(2) Full sample
Number of students	151,181	334,640
Race/ethnicity - native-born students		
Asian or Pacific Islander	0.06	0.07
Black	0.22	0.19
Hispanic	0.24	0.22
White	0.13	0.18
Race/ethnicity - immigrant students		
Asian or Pacific Islander	0.10	0.10
Black	0.11	0.09
Hispanic	0.10	0.09
White	0.06	0.07
Age	20.1	19.8
	(4.1)	(3.8)
Female	0.53	0.56
Single parent	0.06	0.05
Disabled	0.02	0.02
Local public high school graduate ⁱ	0.57	0.59
GED recipient ⁱ	0.09	0.07
High school GPA (0-100) ⁱⁱ	76	78
	(7)	(8)
Missing high school GPA	0.17	0.15
Any earnings in year prior to entry	0.43	0.42
Earnings in year prior to entry	2473	2144
	(7669)	(7412)
Bachelor's degree program	0.17	0.37

Notes: Undergraduate degree-seeking students who first enrolled in the system between fall 1999 and fall 2010, were fall entrants, older than 17 and younger than 45 at entry, took at least one non-remedial course in their first year, and had a non-missing race/ethnicity in the categories listed in the table. The analysis sample further excludes students who did not declare a majors at entry and students in college-cohort-major (CCM) cells with fewer than 10 students in any year or fewer than 25 students on average. Standard deviation of continuous variables displayed below means in parentheses. i) Type of high school only for students with nonmissing data (Analysis sample $N = 131,717$; Full sample $N = 295,517$). ii) High school GPA average only applies to students with nonmissing data (Analysis sample $N = 125,902$; Full sample $N = 285,467$).

Fig. 3 displays the results for immigrants. Again, we observe large positive network effects for Black students that begin almost immediately upon entry and grow over time, reaching a \$450 (1.8 percent) increase in annual earnings from a standard deviation increase in same group peers 10 years after entry. Effects of same group peers on API and White immigrant students' earnings are not significant at the 5 percent level in any year. Finally, like their native-born counterparts, Hispanic immigrant earnings appear to be negatively affected by increases in Hispanic immigrant cohortmates in the first 5 years after entry, with significant and negative effects in the first three years, and remain small and close to zero for the duration of years we observe student outcomes.

These patterns also can be seen in Table 4, which presents point estimates scaled to represent the effect of a 1 percentage-point increase in network share for all groups. We can reject a test of the hypothesis of equal effects of same group peers for immigrant students in almost every year and for native-born students in the third through eighth years since entry. The benefits to sharing networks with other Black immigrants are significantly larger than those for Black native-born students in most time periods.

In sum, there appears to be earnings benefits from larger potential networks among White native-born and Black (particularly immigrant) students, and possibly API native-born students. In contrast, we observe negative effects among Hispanic immigrants early in their schooling.

4.2. Effects on employment and educational attainment

The effects of same group peers on earnings could operate through career advice, job search, and referrals consistent with existing literature on neighborhood networks. Yet peers can also influence the level of effort that students put into completing their degrees. In this section, we

Table A.4
Effect of Network Share on Credit Accumulation by Race/ethnicity and Nativity.

Years since entry:	1	2	3	4	5	6	7	8	9	10
Proportion in network*										
API, native-born	-0.008 (0.009) {0.375}	-0.020 (0.023) {0.419}	-0.024 (0.041) {0.484}	-0.018 (0.057) {0.722}	-0.068 (0.063) {0.544}	-0.121 (0.066)+ {0.422}	-0.122 (0.069)+ {0.216}	-0.114 (0.081) {0.190}	-0.069 (0.094) {0.245}	-0.018 (0.122) {0.853}
Black, native-born	-0.012 (0.008) {0.354}	-0.015 (0.017) {0.617}	-0.015 (0.025) {0.738}	-0.023 (0.035) {0.763}	-0.030 (0.040) {0.735}	-0.024 (0.044) {0.806}	-0.012 (0.045) {0.901}	-0.014 (0.047) {0.899}	-0.021 (0.047) {0.851}	-0.023 (0.050) {0.860}
Hispanic, native-born	-0.001 (0.005) {0.828}	-0.001 (0.010) {0.943}	0.005 (0.016) {0.847}	0.006 (0.021) {0.825}	0.013 (0.023) {0.6940}	0.023 (0.029) {0.568}	0.020 (0.034) {0.659}	-0.015 (0.035) {0.739}	-0.027 (0.034) {0.561}	-0.043 (0.035) {0.337}
White, native-born	-0.007 (0.005) {0.332}	0.001 (0.012) {0.975}	0.005 (0.025) {0.848}	-0.003 (0.037) {0.95}	-0.025 (0.039) {0.7450}	-0.046 (0.035) {0.561}	-0.048 (0.037) {0.487}	-0.042 (0.039) {0.446}	-0.024 (0.040) {0.614}	-0.009 (0.040) {0.846}
API, immigrant	-0.020 (0.010)* {0.155}	0.002 (0.021) {0.953}	0.021 (0.029) {0.600}	0.037 (0.035) {0.474}	0.018 (0.043) {0.803}	-0.009 (0.052) {0.935}	-0.015 (0.060) {0.886}	0.016 (0.062) {0.862}	0.001 (0.060) {0.994}	0.003 (0.062) {0.971}
Black, immigrant	0.025 (0.009)** {0.062}	0.065 (0.019)** {0.004}	0.107 (0.027)** {0.001}	0.129 (0.035)** {0.001}	0.145 (0.039)** {0.001}	0.148 (0.042)** {0.001}	0.139 (0.045)** {0.036}	0.133 (0.048)** {0.055}	0.149 (0.050)** {0.03}	0.115 (0.050)* {0.076}
Hispanic, immigrant	-0.017 (0.009)+ {0.340}	-0.020 (0.018) {0.601}	-0.017 (0.024) {0.720}	-0.016 (0.030) {0.769}	-0.033 (0.036) {0.576}	-0.053 (0.040) {0.466}	-0.073 (0.045) {0.358}	-0.099 (0.049)* {0.203}	-0.105 (0.050)* {0.154}	-0.121 (0.051)* {0.099}
White, immigrant	-0.0130 (0.015) {0.562}	-0.032 (0.035) {0.508}	-0.063 (0.059) {0.359}	-0.122 (0.084) {0.212}	-0.188 (0.104)+ {0.1440}	-0.250 (0.119)* {0.095}	-0.279 (0.132)* {0.070}	-0.267 (0.139)+ {0.102}	-0.219 (0.130)+ {0.101}	-0.164 (0.152) {0.469}
Tests of equality (p-values):										
All native born	0.631	0.773	0.824	0.894	0.475	0.097	0.147	0.627	0.973	0.932
All foreign born	0.002	0.013	0.008	0.006	0.002	0.001	0.001	0.001	0.001	0.006
API NB = API immigrant	0.385	0.519	0.400	0.428	0.257	0.149	0.225	0.206	0.555	0.878
Black NB = Black immigrant	0.002	0.004	0.004	0.008	0.008	0.016	0.045	0.063	0.035	0.091
Hispanic NB = Hispanic immigrant	0.130	0.337	0.421	0.519	0.236	0.102	0.074	0.134	0.172	0.180
White NB= White immigrant	0.681	0.365	0.277	0.203	0.151	0.110	0.098	0.127	0.158	0.326

Notes: For sample, see Table 1 notes. Each column contains estimates from separate regressions. Dependent variable is total academic credits earned within system institutions. In-network defined by race/ethnicity and nativity. Coefficients represent the estimated effect of a 1 percentage-point increase in network share. See Table 4 notes for additional controls. Robust standard errors, clustered at the college-major level in parentheses; ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$; p-values from wild bootstrap-t clustered by entry college in brackets.

Table A.5
Effect of Network Share on Persistence in Initial Major by Race/ethnicity and Nativity.

	Fraction of semesters enrolled in original:		
	(1) Major x degree	(2) 2-Digit CIP x Degree	(3) 2-Digit CIP
Proportion in network *			
API, native-born	0.001 (0.001)* {0.109}	0.003 (0.001)** {0.041}	0.003 (0.0004)** {0.016}
Black, native-born	0.001 (0.0003)* {0.073}	0.001 (0.0003) {0.381}	0.0004 (0.0003) {0.284}
Hispanic, native-born	0.001 (0.0002)** {0.060}	0.0004 (0.0003) {0.176}	0.0002 (0.0002) {0.368}
White, native-born	0.001 (0.0002)** {0.282}	0.0004 (0.0003) {0.255}	-0.0002 (0.0003) {0.562}
API, immigrant	0.001 (0.0004)* {0.094}	0.001 (0.001)+ {0.204}	0.002 (0.001)** {0.019}
Black, immigrant	0.001 (0.0004) {0.204}	-0.0001 (0.0004) {0.818}	0.0002 (0.0003) {0.668}
Hispanic, immigrant	0.001 (0.0003)** {0.014}	0.0004 (0.0003) {0.251}	-0.00003 (0.0003) {0.924}
White, immigrant	0.001 (0.001) {0.446}	0.002 (0.001) {0.395}	0.001 (0.001) {0.379}
Tests of equality (<i>p</i> -values):			
All native born	0.742	<0.001	<0.001
All foreign born	0.869	0.217	0.056
API NB = API immigrant	0.810	0.021	0.115
Black NB = Black immigrant	0.983	0.221	0.582
Hispanic NB = Hispanic immigrant	0.615	0.822	0.404
White NB = White immigrant	0.702	0.350	0.165

Notes: For sample, see Table 1 notes. Each column contains estimates from separate regressions. Dependent variable is percentage of enrolled semesters spent in initial major. CIP = classification of instructional programs. In-network defined by race/ethnicity and nativity. Coefficients represent the estimated effect of a 1 percentage-point increase in network share. See Table 4 notes for additional controls. Robust standard errors, clustered at the college-major level in parentheses; ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$; *p*-values from wild bootstrap-*t* clustered by entry college in brackets.

aim to unpack the total effect of peers on earnings by exploring whether same-group peers influence students' probability of degree completion and probability of having nonzero earnings (as a proxy for employment).¹⁰ We find largely positive point estimates of same-group peers on all native-born students' degree completion, with 95 percent confidence intervals that also include zero and negative effects as the time since college entry increases (Fig. 4 and Table 5). For White students, the effects are statistically different from zero only in the early years. Among immigrants (see Fig. 5), estimates for API and Black students are small and insignificant at the 5 percent level in almost every period. Yet for White and Hispanic immigrants, the effects of same-group peers on degree completion are primarily negative, with statistically significant impacts on Hispanic immigrant students' degree completion in almost every year since college entry.¹¹

Fig. 6, Fig. 7, and Table 6 present estimates from estimation of Eq. (1) on the probability of having nonzero earnings in the same state as the college system. To the extent that same-group networks do not affect the

likelihood of leaving the state, these estimates will reflect effects on the probability of employment. Out-of-state migration rates are low among students graduating from the same major-college combinations as the students in our sample, with only 5 percent having earnings in a different state in the initial year after graduation. In our sample, which includes both graduates and noncompleters, it is likely that interstate mobility is even more rare. College graduates are twice as likely to move to a different state than nongraduates (Wozniak, 2010) and less than 40 percent of students in the analysis sample complete a degree in the 10 years after entry.

Across both figures, there are roughly three types of results. The first relate to the three groups that experience clear gains from an increase in same-group cohortmates, including Black and Hispanic immigrants and White native-born students in their third through seventh years since entry. Among Black immigrants, for instance, a standard deviation increase in same-group cohortmates leads to a 0.5 percentage-point increase in the probability of having nonzero earnings 10 years after college entry. Black immigrants also experience earnings gains, suggesting that boosts in employment are partial mechanisms. The second category of results pertain to the four groups for whom the point estimates are largely positive but the interval estimates are imprecise and zero effects cannot be ruled out; these four groups are API native-born, API immigrant, Black native-born, and White immigrant students.

The final category of results belong to one group for whom enrolling in a major with a greater share of same group cohortmates has a negative impact on employment: among native-born Hispanics, the point estimates are consistently negative, and statistically significant between years 3 and 6. The differences between Hispanic native-born and Hispanic immigrants are striking and tell two very different stories. Both

¹⁰ We also estimate the effects of same group peers on credit accumulation; results are largely consistent with degree completion estimates (Appendix Table A.4).

¹¹ We also estimate effects of potential network composition on the fraction of enrollment that a student remains in their entry major. We find some evidence that students who enter a major with a higher share of same-group classmates persist in their entry major for a significantly higher share of semesters (Appendix Table A.5). These effects are most pronounced for the narrowest definition of major (same detailed major and degree program) and do not significantly vary across race/ethnicity and nativity groups. Using broader definitions attenuates these estimates.

Table A.6
Heterogeneity in Effects of Network Share on Earnings and Degree Receipt between Associate Degree and Bachelor's Degree Program Entrants.

	Dependent variable = Average earnings		Dependent variable = Any degree	
	(1) Associate degree entrants	(2) Bachelor's degree entrants	(3) Associate degree entrants	(4) Bachelor's degree entrants
Proportion in network *				
API, native-born	-24 (38) {0.466}	74 (24)** {0.100}	0.002 (0.002) {0.270}	0.001 (0.001) {0.066}
Black, native-born	11 (7)+ {0.137}	-3 (21) {0.891}	0.0002 (0.0004) {0.683}	0.001 (0.001) {0.554}
Hispanic, native-born	-5 (7) {0.410}	-31 (17)+ {0.352}	-0.0003 (0.0003) {0.533}	0.002 (0.001)** {0.147}
White, native-born	27 (9)** {0.046}	18 (32) {0.816}	0.001 (0.0005) {0.152}	0.001 (0.001) {0.491}
API, immigrant	-20 (13) {0.037}	41 (16)* {0.039}	0.0002 (0.001) {0.764}	0.003 (0.001)* {0.066}
Black, immigrant	38 (16)* {0.099}	75 (21)** {0.071}	0.001 (0.0005) {0.344}	0.001 (0.001)+ {0.010}
Hispanic, immigrant	-21 (9)* {0.107}	57 (109) {0.76}	-0.001 (0.0004)** {0.083}	-0.006 (0.003)+ {0.120}
White, immigrant	-28 (34) {0.083}	98 (28)** {0.113}	-0.001 (0.001) {0.202}	-0.002 (0.001) {0.023}
Tests of equality (p-values):				
All native born	0.055	0.029	0.110	0.525
All foreign born	0.015	0.284	0.012	0.002
API NB = API immigrant	0.917	0.304	0.260	0.086
Black NB = Black immigrant	0.068	0.012	0.558	0.547
Hispanic NB = Hispanic immigrant	0.187	0.461	0.075	0.006
White NB = White immigrant	0.152	0.088	0.053	0.096
Observations	125,000	26,181	125,000	26,181

Notes: For sample, see Table 1 notes. Each column contains estimates from separate regressions. Dependent variable is average earnings between 1 and 5 years after college entry (columns 1 and 2) or degree receipt within 5 years of entry (columns 3 and 4). In-network defined by race/ethnicity and nativity. Coefficients represent the estimated effect of a 1 percentage-point increase in network share. See Table 4 notes for list of additional controls. Robust standard errors, clustered at the college-entry-cohort- major level in parentheses; ** $p < 0.01$, * $p < 0.05$, + $p < 0.1$; p-values from wild bootstrap-t clustered by entry institution in brackets.

groups experience modest negative to zero earnings gains from same-group peers. For Hispanic native-born students, this effect may be partially driven by a reduction in employment (for instance, same-group networks do not provide employment opportunities or job referrals). In contrast, Hispanic immigrants who have a greater share of other Hispanic immigrants in their major and cohort experience large employment gains, suggesting that the negative earnings effects could be partially driven by referrals to low-paying jobs. This finding, paired with the negative effects of same-group peers on degree receipt, is consistent with the hypothesis that Hispanic immigrants networks may reduce earnings by encouraging students to substitute away from college in favor of lower-wage jobs.

4.3. Robustness and heterogeneity

We test for the robustness of our estimates to different specifications. To reduce the number of outcomes examined, we focus on a summary measure of earnings equal to average annual earnings between 1 and 5 years from college entry. For academic outcomes, we focus on the probability of earning any degree within 5 years of entry. Columns 1 and 5 of Table 7 presents the estimated effect of a 1 percentage-point increase in potential network size on these summary measures using our main specification (Eq. (1)). Estimates are consistent with the patterns shown in Figs. 2 and 3: native-born API, Black, and White students and Black immigrant students see their average annual earnings increase as their potential network size grows, while Hispanic students earn significantly less. Estimates in columns 2 and 6 show that these estimates are robust to excluding predetermined student covariates, while

columns 3 and 7 show that results do not change when we use lower-dimensional fixed effects (i.e., major, cohort, and college versus major by cohort, cohort by college, and cohort by major fixed effects). Finally, the estimates in columns 4 and 7 come from a specification that includes an additional control – average predicted earnings 5 years after entry for the entire college by major entering cohort (excluding student i) to account for the earnings potential of the larger potential network a given student is exposed to at entry. We obtain similar results after including this measure.

Given the disproportionate share of students in the analysis sample that are pursuing an associate degree, we examine heterogeneity in potential network effects by initial degree program. Appendix Table A.6 contains separate estimates for students who entered into an associate degree program at the start of college (i.e., community college entrants) and those who entered into a bachelor's degree program at the start of college (i.e., four-year college entrants). Several of our main findings – sizable earnings gains for Black foreign-born students, modest earnings gains for all Hispanic students, and lower attainment for Hispanic immigrants – are present for both associate degree and bachelor's degree entrants. We also find suggestive evidence of heterogeneity in effects of same-group peers between associate and bachelor's degree entrants, including significant increases in attainment for native-born Hispanic and foreign-born API students and positive albeit insignificant effects on Hispanic immigrant students' earnings when they enter bachelor's degree majors with more same group peers and null or negative effects for associate degree program entrants. However, estimates are sufficiently imprecise that we do not reject a test of the hypothesis of equal network effects by type of degree program at entry.

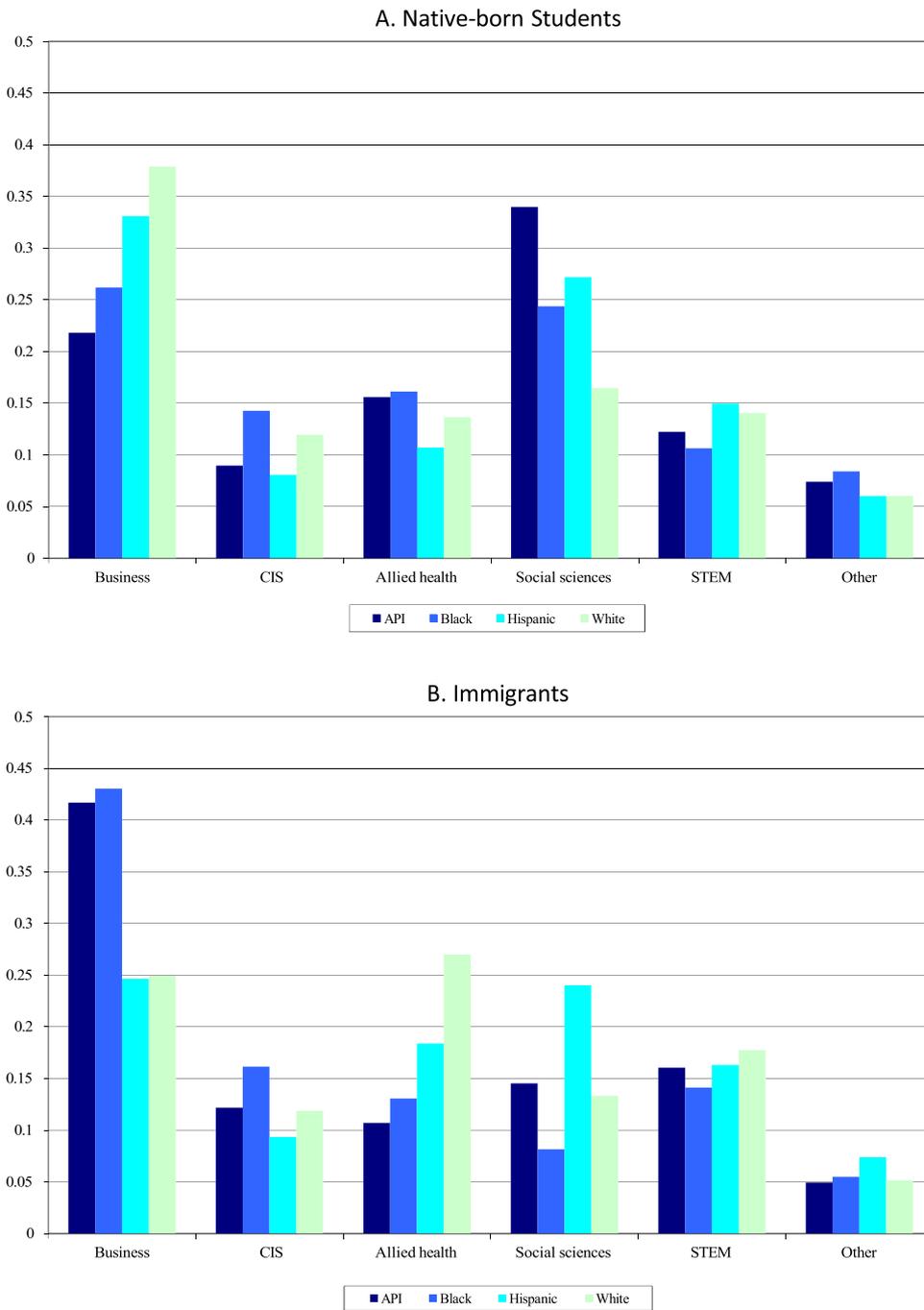


Fig. A.1. Major by Race/ethnicity and Nativity
Notes: For sample, see Table 1 notes. Business majors include accounting, business, finance, management, marketing, and related support services programs. CIS majors include computer and information sciences and digital design programs. Social sciences includes criminal justice, education, human services, psychology, legal studies, and social work programs. STEM majors include biological and biomedical sciences, engineering, engineering technologies, and physical science programs. Other majors include arts, humanities, communications, journalism, and service programs.

5. Conclusions

Our investigation into the labor market impact of networking with peers who are of the same race and nativity status reveal a great deal of heterogeneity. Consistent with the previous literature on networking in predominantly White institutions, White native-born students experience earnings and employment gains from networking with other White native-born students (e.g., Marmoros & Sacerdote, 2002). Black native-born students and particularly Black immigrant students also benefit from entering a major with more same group peers. In fact, the magnitude of the benefit is the same between White native-born and Black native-born students and much larger for Black immigrants. The positive effects of earnings for Black native-born students is consistent with the literature on neighborhood-based networks (Hellerstein, McInerney & Neumark, 2011), yet we also document earnings gains as a

result of these employment gains and network effects that are much larger among Black immigrants than among Black native-born. We find no evidence that the labor market benefits of same-group peers are partially driven by increased academic effort.

In contrast, the earnings of Hispanic immigrant and native-born Hispanic students do not increase when they enter a major with a relatively larger share of same-group peers. Yet Hispanic immigrants experience an increase in the probability of employment when they have more same-group peers. This result suggests that a larger potential network may facilitate job finding, but potentially at the cost of educational attainment and earnings. The mechanisms appear to be entirely different among Hispanic native-born where networks reduce their employment rates (with no effect on degree attainment), suggesting that networking leads to limited job referrals, information, and advice.

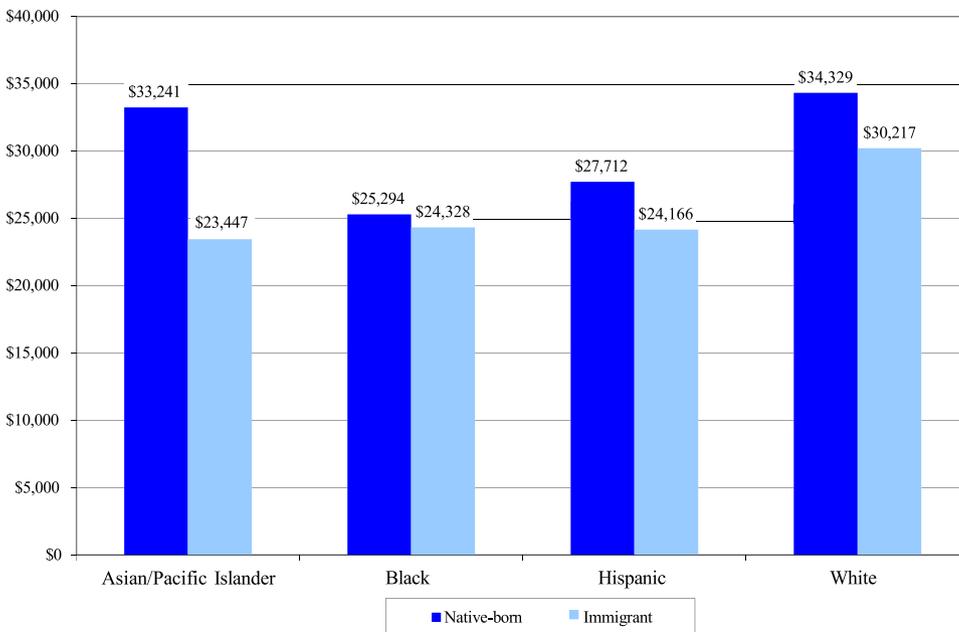


Fig. A.2. Annual Earnings 10 Years After Entry, by Race/Ethnicity and Nativity
Notes: Undergraduate degree-seeking students who first enrolled in the system between fall 1999 and fall 2006, were fall entrants, older than 17 and younger than 45 at entry, took at least one non-remedial course in their first year, and had a non-missing race/ethnicity in the categories listed. Students in college-cohort-major (CCM) cells with fewer than 10 students in any year or fewer than 25 students on average are excluded.

Our findings suggest that earnings gaps between White native-born and Black native-born students are unlikely to be explained by differences in their potential postsecondary networks. For Hispanic students, search frictions that result in lower earnings and employment are not reduced by a larger potential network, at least in this large, racially-diverse context. At a minimum, our results suggest that postsecondary institutions could do more to ensure that students have up-to-date and accurate information about the potential earnings of their respective job opportunities and that information be delivered through structured or formal career counseling. Hurwitz and Smith (2018) show that the release of median earnings data through the U.S. Department of Education's College Scorecard affected college application decisions of students at the higher end of SAT scores from well-resourced high schools, but had no impact on educationally-disadvantaged and less well-performing students. Students who are well prepared for college are best positioned to access information and to act on that information; lower performing students need more structure and formal assistance in accessing and using information such as wage data. For such students, relying more on labor market information provided through career services offices and less on networks might lead to greater earnings gains.

It is worth underscoring that our results best generalize to students in a large urban system who have chosen their fields of study upon college entry. Still, our findings that not all students benefit equally from their potential networks should be relevant to policymaking at any institution that seeks to maximize the labor market opportunities for its students.

Data availability

The authors do not have permission to share data.

Appendix

Tables A.1–A.6.

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