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Multiple Pathways to STEM:
Examining State Differences in Community College Attendance
Among Latino STEM Bachelor's Degree Holders

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Three numbers encapsulate the purpose of this paper: *two million*, 4.3%, and *one-half*.

Two million refers to the number of new professionals needed to enter science, technology, engineering, and mathematics-related (STEM) fields by 2010 just to replace baby boomers retiring from the STEM workforce (IBM Corporation, 2008). The second number, 4.3 percent, represents Latinos' share of the U.S. STEM workforce (National Science Foundation [NSF], 2007), and one-half refers to the current proportion of school-aged youth that are Latino (U.S. Census Bureau, 2008). Why should we take notice of these numbers? The first indicates the pressing need for more highly trained U.S. scientists, engineers and technicians, while the second is illustrative of the ongoing underrepresentation of Latinos in the high-demand STEM fields. However, the third number represents an opportunity to enlarge the STEM talent pool and points to a necessary course of action to strengthen the U.S. competitive condition in an increasingly knowledge-based economy. Latinos represent the nation's fastest growing demographic group, and are projected to comprise nearly 30% of the U.S. population by 2040 (U.S. Census Bureau, 2008). Given this demographic trend, dramatic increases in the proportion of Latinos earning STEM bachelor's and graduate degrees and entering the STEM workforce are necessary for the continuing economic health of the nation.

The underrepresentation of Latinos (and African Americans and Native Americans) in the sciences is not a new problem. There have been long-standing calls to increase participation among students of color in higher education in general, and STEM fields in particular. Indeed, the *numbers* of Latinos and other underrepresented minorities enrolling in some form of postsecondary education and earning bachelor's and graduate degrees are at a record high (National Center for Education Statistics [NCES], 2007). However, the share of Latino STEM degree holders and Latino STEM professionals remains disproportionately low (NSF, 2007).

Countless numbers of reports, statistical briefs, and research studies authored by educational researchers and policy experts explore this problem and attempt to identify barriers to STEM access and success for Latinos and other underrepresented minorities. Yet, the role of the community college in serving as an entry point and pathway to STEM has been largely absent from the discourse, despite the pivotal role of these institutions in educating Latinos.

This paper explores the ways in which community colleges has served as an institutional pathways for Latinos who recently earned a bachelor's degree in a STEM field. As the present analysis of the 2003 NSF National Survey Recent College Graduates (NSRCG) reveals, a significant proportion of Latino STEM bachelor's degree holders earn an associate's degree at a community college before completing the baccalaureate. However, the findings also indicate that there is a large degree of variation in the size of this institutional pathway by state. I attribute these state-level differences to higher education policy particularly as they pertain to transfer and articulation. I conclude by arguing that with the correct policies in place, the community college serves as a viable pathway to STEM for Latino students.

The Path to Community College for Latinos: Contributing Factors

Over the past three decades, Latinos' have seen a marked increase in their access to higher education, with higher proportions of Latinos enrolling in postsecondary institutions (NCES, 2002). However, there remain disturbing inequities in the patterns of this participation. The vast majority of Latinos find themselves at the lower portion of the severely stratified U.S. higher education system, concentrated in open-access community colleges and less-selective Hispanic serving institutions (NCES, 2002). Nearly 60% of Latinos are enrolled in a community college (NCES, 2002), and Latinos are more likely than students from other racial/ethnic

backgrounds to begin their postsecondary education at these institutions (Adelman, 2005).

Previous research points to a multitude of factors that contribute to Latinos' concentration in the community college pathway including student characteristics, school and community resources, and the social, historical, and economic contexts of the nation. However, we have also seen that state-level higher education policy also plays a considerable role in contributing to the large concentration of Latinos in the community college sector.

Few open access public four-year institutions exist, which reflects many states' decision to make the community college a heavily traversed pathway into higher education. Some states, many of which have large Latino populations, have provided a structure to smooth this pathway through policy. California, Florida, and New York, three states in which 45% of U.S. Latinos reside (U.S Census Bureau, 2007), have legitimated the community college as an entry point to the bachelor's degree through their highly structured and articulated public postsecondary education systems (Cohen & Brawer, 2003; Wellman, 2002). These states' purport to offer students a seamless route from the community college to four-year institutions via articulation agreements, and in some cases, guaranteed admission to public four-year institutions after transferring. For example, California's 1960 Master Plan for Higher Education stipulates that the University of California (UC) and California State University (CSU) systems reserve 60% of its statewide undergraduate enrollment capacity for community college transfer students. In Florida, the community college plays a vital role in the 2+2 higher education system, serving as the entry point to nearly 53% of juniors and seniors enrolled in the state's universities (Florida Department of Education, 2005). Students who earn an associate degree in the Florida community college system are guaranteed admission to the public four-year university system. The structure and policies of Florida's higher education system encourages community college attendance among

all students, and Latinos in particular. In New York, community colleges are designated as campuses in the state's two major university systems, the City University of New York (CUNY) and the State University of New York (SUNY). The inclusion of public two-year institutions in the CUNY and SUNY systems seeks to facilitate the transfer of community college credits toward a four-year degree (Wellman, 2002). In these three Latino-rich states, higher education policy acts to encourage community college attendance through the promise of transfer as indicated by the high concentrations of Latinos enrolled in California, Florida, and New York community colleges.

Other states with large Latino populations lack longstanding agreements between community colleges and public four-year colleges and universities. Texas, home to 19% of the nation's Latino population, does not have a statewide cooperative agreement between two-year and four-year institutions. Instead, Texas' public higher education system is comprised of a combination of large-scale university systems, regional systems, and independent institutions. Community colleges were tasked with developing voluntary articulation agreements with each of these systems and institutions until the state's higher education coordinating board developed a statewide transfer curriculum in the late nineties (Wellman, 2002). Further, there is no guaranteed transfer program mandated by state policy, though some institutions have developed such agreements on their own. Perhaps as a result from these policies, the rate of community college attendance in Texas is lower than that of California and Florida. However, Latinos remain disproportionately represented in public two-year institutions (Admon, 2006).

Certainly many have recognized that higher education policy often has the consequence (unintended or not) of concentrating disadvantaged students, including Latinos, in the community college sector. However, this is often justified through the promise of transfer—that

is, by providing access to a bachelor's degree through the two-year sector. However, low transfer rates (Grubb, 1991) and the small proportions of Latino community college students who transfer to highly selective institutions (Dowd, Cheslock, & Melguizo, 2008) indicate that state policies that serve to concentrate Latinos in community colleges may act to hinder access to the baccalaureate degree.

To what extent do community colleges serve as a pathway to the STEM baccalaureate for Latinos? How do these patterns vary by state? I address these questions in the remaining portions of this paper.

Community College Pathways to STEM

Data, Sample, and Analytical Strategy

In order to address the two research questions above, I analyzed the 2003 National Survey of Recent College Graduates (NSRCG), which is administered by the National Science Foundation every two years. The 2003 NSRCG provides information on a nationally representative sample of individuals who earned a STEM¹ bachelor's and master's degree from a U.S. institution between July 1, 2000 and June 30, 2002. Though the entire sample was comprised of 10,831 respondents, the analytical sample ($n=1,065$) consisted of Latinos who earned a bachelor's degree from a mainland U.S. institution in the years 2000-01 or 2001-02.

To characterize the role of community colleges in producing STEM bachelor's degree holders, I used descriptive statistical techniques² to determine the share of Latino students who

¹ The definition of STEM fields employed by the National Science Foundation includes: Computer Science, Mathematics, Life Sciences, Physical Sciences, Behavioral and Social Sciences, and Health related fields.

² In order to account for the complex survey design of the NSRCG, I used Stata's survey (SVY) commands to tabulate the results, and interpreted the reported design-based *F* statistics to determine the statistical significance of inter-group differences.

earned an associate degree at a community college and conducted state by state comparisons.

The 2003 NSRCG contains two variables that I used to determine if a respondent earned an associate degree at a community college. For the purposes of my analyses, I defined community college students narrowly as those who attended community college *and* earned an associate degree. This approach is necessitated by the fact that the variable in the NSRCG indicating community college attendance does not indicate the number of units earned or the dates of attendance. My approach excludes some students who used the community college as a pathway to a STEM bachelor's degree via transfer, as many students do not earn an associate degree before transferring. However, it also allows for the identification of community college students and transfers with greater certainty. The results of the present study, therefore, reflect the population of transfer students who earned associate degrees. Though this represents a limitation in that the population under study is a subset of all community college transfer students, the current higher education policy environment in which heavily incentivized or mandated associate degree attainment is being explored as a means to increase the efficiency of public higher education systems makes this population particularly interesting. As state policy makers consider making the associate degree a necessary step for more students, it is important to understand the extent to which associate degree holders gain access to STEM bachelor's degrees and the ways in which these students might differ from non-associate degree holders in terms of educational outcomes (e.g., baccalaureate-granting institutional characteristics, field of study, and patterns of participation in financial aid).

Findings

In order to gain a better understanding of the institutional pathways Latino STEM degree holders used to gain access to that degree, two paths of interest have been identified: (1) associate degree completion at a community college followed by bachelor's degree completion at a four-year institution and (2) entrance to a four-year institution without earning an associate degree³. Observed proportions presented⁴ for Latino STEM bachelor's degree holders using each pathway are illustrated in Table 1. The table also indicates the proportion of Latino STEM bachelor's degree holders who attended community college for *any* reason.

Table 1. Institutional Pathways of Latino STEM Bachelor's Degree Holders

Weighted Sample		Latinos <i>n</i> =61,233
Institutional Pathway	AA/AS at CC to 4-year institution Did not earn an AA/AS at CC	19.8% 80.2%
Community College Attendance	Attended Community College for <i>any</i> Reason Never Attended Community College	38.0% 62.0%

Source: Analyses of the NSF 2003 *National Survey of Recent College Graduates* (NSRCG), using final survey weight (WTSURVY).

Nearly two-thirds of Latino STEM bachelor's degree holders attended community college at some point, though it cannot be determined whether these students transferred. Even with this ambiguity, clear state patterns emerge from the data. Table 2 shows the rates of community college attendance for the four states with the largest Latino populations and also the largest community college enrollments in the U.S. (California, Florida, New York, and Texas);

³ Due to the limitations of the NSRCG dataset, I was unable to determine which respondents may have transferred from a community college to a four-year institution *without* earning an associate degree. For this reason, the term "direct entrant" is not used to describe those individuals who did not follow pathway (1) as defined above.

⁴ Without controlling for other factors.

data for the other 46 U.S. states are reported in the aggregate. Community college attendance was most common in California, Texas and Florida, where Latino STEM bachelor's degree holders attended community college in roughly similar proportions. In New York and in all other states, community college attendance was less common, with less than half of Latino STEM B.S. holders attending.

When considering associate degree attainment at a community college, stark state-level differences exist (see Table 3). Nearly half of all Latinos who were awarded a STEM bachelor's degree from an institution located in Florida earned an associate degree. In New York, just below 28% of Latinos who earned a STEM B.S. from an institution in the state earned an associate degree; in California, the figure was slightly lower at 22.2%. The proportion of Latino STEM B.S. holders who earned an AA/AS in Texas (9.5%) was lower than the figure for all other states (9.9%).

Table 2. Community College Attendance Rates of Latino STEM Bachelor's Degree Holders by State

	Community College Attendance	
	Attended CC for <i>any</i> reason	Never Attended CC
Weighted Sample	<i>n</i> = 37,964	<i>n</i> = 23,269
State		
Uncorrected χ^2 =699.090, <i>df</i> =4	California	76.5%
Design-based <i>F</i> (3.42, 731.46)= 17.738, <i>p</i> <0.001	Florida	72.2%
	New York	47.0%
	Texas	74.7%
	Other State	44.8%
	Total Latino	62.0%
		38.0%

Design-based *F* statistics are presented to account for the complex sample design of the 2003 NSRCG.
 Source: Analyses of the NSF 2003 *National Survey of Recent College Graduates* (NSRCG), using final survey weight (WTSURVY).

Table 3. Location of Latino STEM Bachelor's Degree Holders by Associate Degree

Weighted Sample	Institutional Pathway	
	AA/AS @ CC	No AA/AS @ CC
	<i>n</i> = 12,142	<i>n</i> = 49,092
State		
Uncorrected χ^2 =644.325, df =4	California	22.2% 77.8%
Design-based F (3.74, 801.35)= 12.486, p <0.001	Florida	49.5% 50.5%
	New York	27.9% 72.1%
	Texas	9.5% 90.5%
	Other State	9.9% 90.1%
	Total Latino	19.8% 80.2%

Design-based F statistics are presented to account for the complex sample design of the 2003 NSRCG.

Source: Analyses of the NSF 2003 *National Survey of Recent College Graduates* (NSRCG), using final survey weight (WTSURVY).

Because community college attendance is related to a number of factors in addition to state higher education policy contexts, I conducted a confirmatory analysis using logistic regression to assess whether higher education policy context (i.e., state) remained a significant determinant of associate degree attainment while controlling for other factors such as gender, national origin (e.g., Mexican American, Cuban, Puerto Rican, or Other Latino) and highest parental education level.¹ State¹ remained a statistically significant determinant of associate degree attainment, indicating that higher education policy context truly does impact the institutional pathways traversed by Latino STEM bachelor's degree holders.

Unpacking the Role of Policy: Discussion of State-level Differences in Community College Pathways

Much of the literature on the underrepresentation of Latinos in STEM fields neglects to consider the ways in which these students typically access postsecondary education, i.e., via community colleges. The community college institutional pathway was of particular interest to

this analysis given that it is seen as an 'unconventional' route to STEM, despite the frequency with which all Latinos employ this pathway. This investigation revealed that community colleges do in fact serve as institutional pathway for Latino STEM bachelor's degree holders. Nearly one-fifth (19.8%) of Latino STEM bachelor's degree holders earn associate degrees at community colleges prior to completing the baccalaureate.

The findings of the present study suggest that while Latino STEM B.S. degree holders employ community college pathways to some extent, this pathway is not as large as it is for all Latino students. Recognizing that my study employs a particularly narrow definition of community college attendance due to limitations in the NSRCG data source, even employing the 'looser' definition of attendance as enrollment in a community college at *any* point for *any* reason, Latino STEM bachelor's degree holders attend community college in lower proportions than all Latino undergraduates (62.0% versus 79.3%) (NCES, 2007). It seems as if, however common among all Latino students, institutional pathways through the community college remain 'unconventional' in the sense that the patterns of access among Latino STEM bachelor's degree holders differ from those of all Latino students.

Factors within states' higher education policy context also shaped Latinos' patterns of access with regard to the role of the community college in serving as an institutional pathway to STEM. In the current study I was interested in the extent to which Latino STEM bachelor's degree holders earned associate degrees at community colleges prior to attending their baccalaureate-granting institution. Clear state patterns emerged from my analysis of the data. Half of Latino STEM B.S. degree holders who graduated from institutions in Florida earned an associate degree. The numbers were lower in California and New York; in California, 22% of Latino STEM bachelor's degree holders earned an AA/AS degree and 28% earned AA/AS

degrees in New York. In Texas, the numbers were considerably lower; just 9.5% of Latino STEM bachelor's degree holders earned associate degrees from a community college.

These findings are indicative of the differences in these states' higher education system structures and policies. As noted previously, Florida, California, and New York have highly articulated, stratified systems of postsecondary education in which community colleges are intended to act as a means to access four-year institutions. Through systemwide articulation agreements, Florida, California and New York facilitate the transfer of credits to the four-year institution for those students who attend community college. California has policies in place that guarantee transfer admission to a public four-year institution provided that students successfully complete the necessary requirements. Florida's 2+2 higher education system goes steps further than both California and New York by providing incentives for students to earn the associate degree prior to transfer in the form of guaranteed admission for only AA/AS degree holders. The large number of Latino STEM bachelor's degree holders who earn associate degrees at community colleges in Florida, California, and New York were able to successfully navigate the path from the community college to four-year institutions by using the policies and structures in place. The considerable difference in the proportion of Latino STEM bachelor's degree holders who earn associate degrees in Florida, California and New York likely results from Florida's emphasis on associate degree attainment prior to transfer.

In contrast, Texas' postsecondary landscape consists of loosely coupled state and regional university systems, independent colleges and universities, and community colleges. Though many Texas community colleges have established articulation agreements with a number of four-year institutions, the state's higher education governing body only recently began to facilitate the transfer process through formal structures (Wellman, 2002). Thus, Texas' nascent transfer

policies do not go nearly as far as those of Florida, California, and New York in terms of paving the way from the community college to four-year institutions for Latinos in the sciences. This is certainly borne out by the relatively small percentage of Latino STEM bachelor's degree holders who graduate from institutions in Texas and earn an associate degree.

Conclusions and Implications

While the present study contributes to our knowledge regarding the institutional pathways of Latino STEM bachelor's degree holders, the findings raise a key question that ought to be pursued in future research: *In what ways do those Latino STEM bachelor's degree holders who do not earn an associate degree but still attend community college use the 2-year institutions?* The primary data source for this study, the NSRCG, only indicates if respondents earn an associate degree and whether they attend community college at any point for any reason. Thus, I was unable to determine the ways in which Latino STEM bachelor's degree holders who attended community college but did not earn an associate degree used the two-year institution. Do these students simply transfer from the community college without earning the associate degree? Or, do these Latino STEM bachelor's degree holders take courses for credit 'a la carte' via reverse transfer or "swirling," i.e., concurrent enrollment at two-year and four-year institutions (McCormick, 2003)? These two functions are very different, and it is important to characterize the role of community colleges in the educational experiences of Latino STEM bachelor's degree holders. Unfortunately, data available through the National Science Foundation, which compiles the most information on STEM degree holders, do not include these indicators. The questions raised by this study underscore the importance of collecting additional data on community college experiences of STEM degree holders. The study also points to the potential benefits of employing national and state-level data sources with detailed transcript data

to examine the ways in which Latino STEM bachelor's degree holders use the community colleges. Such data sources will allow researchers to further understand the function of community colleges in the education of Latino STEM bachelor's degree holders.

The present study has important implications regarding the viability of community college pathways to STEM for Latino students and the role that state policy plays in shaping the nature of these pathways. First, while community colleges have largely been absent from the discourse on strategies for increasing the representation of Latinos in STEM fields, Latino students *are* in fact using community college pathways to the STEM baccalaureate. Significant proportions of Latino students utilize these pathways, with large variability by state. Even without large-scale focus on community college pathways to STEM, this study illustrates that many Latino students have been able to overcome the typical barriers faced by transfer students *and* minority STEM majors. With a purposeful injection of resources designed to stimulate interest in STEM fields among Latino community college students and provide the academic and institutional support necessary to facilitate transfer and degree attainment, these community college pathways can be widened, providing more access to STEM for Latino students.

The present study also suggests that emphasis on AA/AS degree attainment through state policy shapes the nature of the pathway to STEM through the community college for Latino students. Even in states with highly articulated systems, state policy is a powerful determinant of community college pathways to STEM. This study illustrates that higher education policies that incentivize associate's degree attainment in order to increase the cost efficiency of public higher education can accomplish this aim while providing access to the baccalaureate degree. This is certainly good news as a growing number of states face simultaneous crises of increased

competition for resources within higher education and the urgent need to increase the proportion of Latinos completing STEM degrees and entering the science and technology workforce.

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