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Stepping Stones to a Degree: The Impact of Enrollment Pathways and Milestones on Older Community College Student Outcomes

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Community colleges are an important entry point to postsecondary education for adults with no previous college education. Adults over the age of 25 represent more than a third of full-time-equivalent (FTE) enrollments at two-year public colleges, compared with 15 percent of FTE enrollments at four-year public colleges. While enrolled, older students are more likely than younger students to be working, married, caring for children, and less engaged with traditional-age classmates (Horn & Carroll, 1996). They are also more likely to attend part time, to enroll in an occupational rather than an academic program, and to seek an occupational certificate rather than pursue an associate degree or transfer to a four-year institution (Bailey et al., 2003).

These factors associated with older students negatively affect their enrollment patterns, enrollment intensity, and the probability of completing a degree (Choy, 2002). In fact, 60 percent of older first-time community college students, compared with 40 percent of younger first-time students, did not earn any credential or transfer after six years of enrollment, based on Beginning Postsecondary Students Longitudinal Study data. This gap in graduation and transfer rate probabilities could be better understood if we recognized how enrollment pathways (such as remediation) and enrollment milestones (intermediate outcomes such as attaining a certain number of credits) affect these educational outcomes and whether they affect older and younger students differently.

Current research offers only a limited picture of the consequences of enrollment pathways and milestones. Studies show that timely credit attainment is important to degree completion, although such research has focused primarily on four-year college students (see, for example, McCormick, 1999). Other studies suggest that students who pass gatekeeper classes, such as remedial and initial college-level courses, have a substantially higher probability of earning a postsecondary credential. For many community college students, remediation or developmental education is a necessary part of the enrollment path (Adelman, 2006; Bailey & Alfonso, 2005). Yet, remediation might well have differential effects for younger and older students. A study of California community colleges found that for older students, as opposed to younger students, remedial classes were positively related to the probability of transferring to a four-year college or the receipt of a degree or certificate (Jepsen, 2006).

Much recent research also exhibits a methodological weakness. While many studies use longitudinal data to shed light on factors that promote the educational attainment of college students, most look only at two points in time. First, when students start their postsecondary education, researchers collect a set of relevant covariates presumably associated with completion rates, like gender, race/ethnicity, socioeconomic status (SES), test scores, and institutional characteristics. After a given amount of time has passed to allow students to graduate, researchers again collect data to estimate the direct effect of these factors on some combination of policy-relevant educational outcomes, such as graduation, drop-out, persistence, or transfer. This strategy masks fundamental variation that could explain degree completion because factors such as enrollment patterns are likely to change over time. Event history modeling, or survival analysis, is a method specifically designed to study the occurrence and timing of events, thus enabling the measurement of the impacts of enrollment pathways and intermediate outcomes (or milestones) on some final outcome. Yet event history modeling is not prevalent in the higher

education literature, and it has been almost absent from community college research.

This brief reports on a new study that begins to fill this research gap. Using longitudinal unit record transcript data on a cohort of first-time community college students in Florida, the study sought to determine whether remedial pathways, such as enrolling in a developmental math course, and enrollment milestones, such as completing a certain number of credits or a certain portion of a given program, had the same impact on the conditional probability of graduating for older students as they did for younger students. The study presents a model for analyzing student enrollment patterns and milestones, findings based on the Florida student cohort, and implications for practice.

Dataset, Variables, and Methodology

The Student Sample

The study drew upon unit record data on first-time, degree-seeking Florida college students who enrolled in a college-credit course at one of Florida's 28 community colleges in the fall of the 1998-1999 academic year. It tracked enrollment through spring 2004 (17 trimesters, or terms). The sample consisted of 29,421 traditional-age students and 5,652 older students.

The model created for the study considered the demographic characteristics of these students, including age, gender, race/ethnicity, previous education, and college placement test scores. It also took account of basic transcript information: credits attempted and completed by term, full- or part-time enrollment status, program of study, credentials earned, and amount and type of financial aid received in the first trimester.

The data indicated that older students in the cohort had a larger proportion of female students, a larger proportion of Black and White students, and a smaller proportion of Hispanic students than did the younger group. Older students were more likely to have received a nontraditional secondary credential (a GED) than were traditional-age students. Traditional-age college students scored, on average, about 87 points higher than older students on mathematics placement exams, but scored about 29 points lower on tests of verbal skills.

At the time of enrollment, older students were more likely to receive federal financial aid and to work part time. While older students were slightly more likely to be enrolled in shorter term certificate programs, they were also well represented in associate degree programs.

Enrollment Pathways, Milestones, and Outcomes

The model created for the study also included enrollment pathway, milestone, and outcome variables, as shown on Table 1. The main outcome event considered was completion, defined as

Table 1: Enrollment Pathway, Milestone, and Outcome Descriptive Statistics

Enrollment Pathway, Milestone, or Outcome	Percentages by Age Group		
	Younger	Older	Difference
Outcome			
Completion in 17 terms	29.92	19.04	10.88*
Nominal Credit Milestones			
Earned 10 credits	78.71	61.50	17.21*
Earned 10 non-remedial credits	70.98	53.72	17.27*
Earned 20 credits	65.47	44.55	20.92*
Earned 20 non-remedial credits	59.13	39.61	19.52*
Percentage of Program Completion Milestones			
Finished 5% of program	88.11	80.91	7.20*
Finished 15% of program	77.17	65.55	11.61*
Finished 25% of program	69.12	56.74	12.38*
Finished 50% of program	55.46	43.97	11.49*
Finished 75% of program	46.70	36.75	9.95*
Remedial Pathways			
Enrolled in Remediation	61.43	60.19	1.24
Mathematics	48.82	51.61	-2.79*
Reading	34.27	21.07	13.20*
Writing	29.38	20.47	8.91*
Passed First College-level Course Milestones†			
Writing	52.58	38.81	13.77*
Mathematics	25.12	17.14	7.98*
Number of Observations	29,421	5,652	

* Denotes significance at 0.01, two-tailed test, unequal variances.
† For students who enrolled in writing or mathematics remediation only; N=9,801 and 17,279 for writing and mathematics, respectively.

receiving a degree or certificate in one of the 17 trimesters reviewed. Traditional-age students were, on average, more likely than older students to graduate during that period.

Additionally, the model contained several time-varying indicators for the enrollment pathways and milestones, classified into four categories: nominal credit milestones, percentage of program completion milestones, remedial pathways, and milestones of passing the first college-level writing and mathematics courses.

Remedial pathways were tested using four different variables, each testing the impact of enrolling in remedial courses: enrolled (or not enrolled) in developmental classes in general, and enrolled (or not) in math, reading, or writing developmental education courses specifically. There was little difference between older and younger students in the percentage of students enrolled in remedial classes: about 60 percent each. However, older students were more likely to enroll in mathematics remediation and much less likely to enroll in reading or writing remediation than their younger counterparts.

One set of milestones, analyzed only for those students who enrolled in remediation, is passing the first college-level course in those subjects in which they needed remediation. The first mathematics course is college algebra. A higher percentage of younger students than older students who took remedial math took and passed algebra. The writing course is the standard first-year composition course. About 53 percent of younger and 39 percent of older students who enrolled in remedial writing passed composition in the observation period.

Another set of milestones, relevant to all students in the sample, identifies when a student completes 10 or 20 credits. In the sample, 62 percent of older and 79 percent of younger students earned at least 10 credits. If remedial credits are excluded from this measure, 54 percent of older and 71 percent of younger students attained at least 10 non-remedial credits during the observation period. Similarly, a greater proportion of younger students, on average, reached the 20-credit milestone, whether counting all credits or only non-remedial credits. These disparities may result from differences in enrollment intensity; older students may be more likely to enroll part time.

If older students are overrepresented in programs requiring fewer credits, then credit accumulation differences may not be very meaningful. Therefore, the study also gauged student progress by considering the percentage of program completed: the proportion of non-remedial credits earned relative to the number of credits required for a given program. Presumably students who completed increasing amounts of their programs would have much better odds of graduating. On all five measures, older students completed a lower percentage of their programs than did younger students.

Event History Modeling

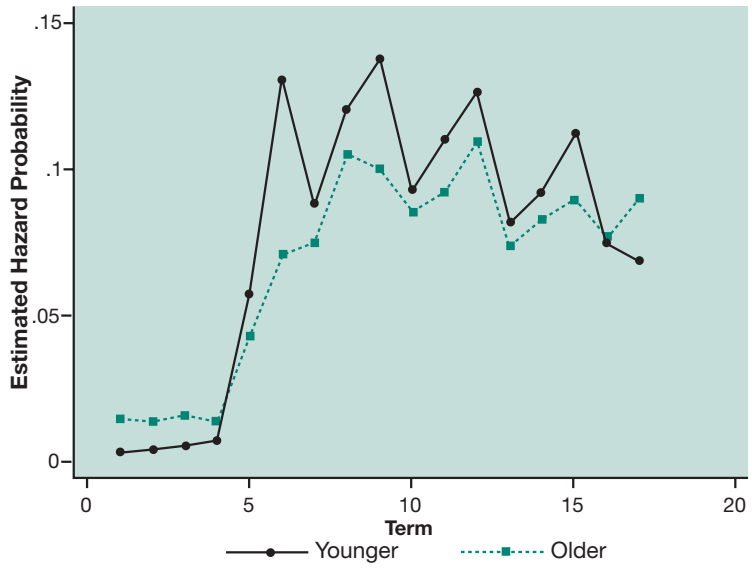
The event history statistical method used to model the outcomes of community college students is the single risk discrete-time hazard model (Singer & Willett, 2003). Rather than one observation per student, the model used a person-period dataset with a maximum of 17 observations per student, one for each trimester, with students observed only if they enrolled in the given term. Time-invariant variables remained constant for each person in each period, and time-varying variables could take on different values in different time periods. The outcome was completion of a credential from a community college in Florida, and the model considered that each student was “at risk” of completing when first enrolled. Once a student experienced an outcome, observations for that student in later time periods were discarded, effectively preventing her from reentering the risk set. The 17 trimesters of data were referred to as the “event time” or “event period.” The beginning of event time was the first trimester of enrollment in a Florida community college (fall 1998) and the end was spring 2004. Students who had not completed by the seventeenth term had unknown outcomes at the end of the event period and thereafter. In essence, the study was modeling the risk of completion in each trimester, called the *hazard*. This is the conditional probability that a student would obtain an outcome in a given time period, assuming that she did not do so in an earlier time period and given that she was enrolled and in the risk set.

Empirical Results

The study estimated several hazard models to test whether remediation, passing the first college-level math and writing courses, and other milestone attainments had a different relationship to the probability that older and younger students would graduate. The first was a simple model that included only the effects of time and the older student dummy variable. Then covariates were introduced into the model to compare the older and younger groups. This step was followed by the entering of intermediate outcomes (or milestones)

as both time-varying and time-invariant predictors. As shown on Figure 1, in any given period between the fifth and fifteenth term an older student was less likely than a student in the younger group to complete a degree or certificate.

Figure 1: Estimated Probability of Completion by Age



Next, controls were added for gender, race/ethnicity (White as the reference group), receipt of federal aid in the first term, U.S. citizenship, secondary credential (diploma or GED), test scores, tuition, program length, and full-time (as opposed to part-time) status. The results show that students who were female and high school diploma holders were more likely to graduate in each period, whereas Black, American Indian, and Hispanic students were less likely to complete a degree or certificate during the event period. Adding this first set of controls pushed the effect of being an older student upward, but older students were still expected to be less likely to graduate in each time period, all other factors held constant. However, when test scores were added to the model, the effect of being an older student reversed in sign. An older student was 1.24 times as likely to complete a degree as a younger student.

Effects of Enrollment in Remedial Courses and College-Level Courses

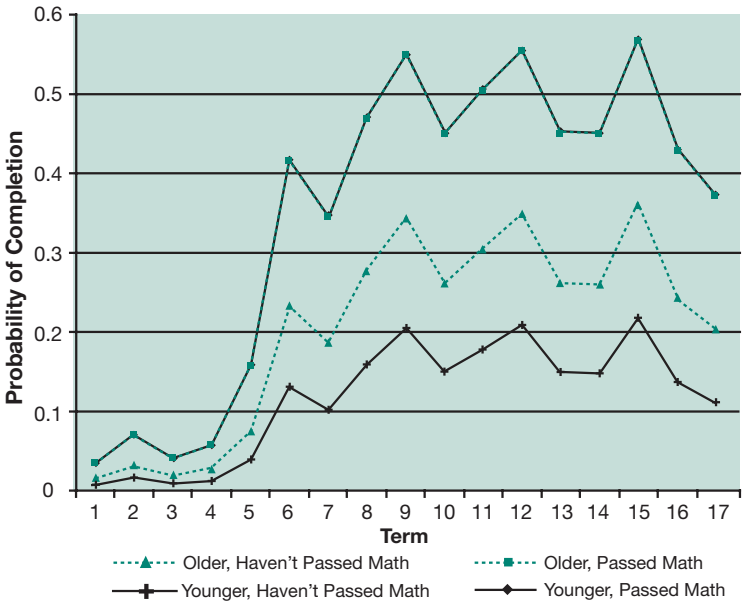
With respect to completion of remedial courses, students who were enrolled in remediation had a significantly lower probability of graduating in any trimester, presumably because they were not obtaining credits that count toward a degree. Younger students who enrolled in remedial courses were 42 percent less likely to graduate than younger students who did not enroll in college preparation classes. Older students who needed remediation decreased their odds of graduating in any term by 23 percent, compared with older students who did not enroll in remediation. Thus, enrollment in remedial classes had a less negative relationship (and significantly so) to the probability of graduating for an older student than for a younger student. This finding may reflect the varying motivations and goals of older students. Older students may not have let academic challenges deter them as much as younger students.

Disaggregating remedial courses by subject, we found that the need to enroll in reading and writing developmental education courses did not seem to have different impacts on older and younger students, but age was a factor with math remediation. This finding highlights an important link between older students and the mathematics subject area. It is likely that older students, having been out of school longer, were more likely to need some remediation (but not a lot) because their basic skills were merely "rusty" rather than grossly deficient.

Two important milestones that the study considered pertain to students who enrolled in either math or writing developmental courses and went on to take college-level courses in those subjects. For students enrolled in remedial writing, passing a standard first-year composition course more than doubled their odds of graduating, and there was no difference between older and younger students. For students who passed college algebra, the first college-level math course, the odds ratio for older students was about half as high as the ratio for younger students, although passing algebra was predicted to have a positive impact on graduation probabilities for all students. Thus, passing the first college-level math course could be much more important for younger students. This relationship is consistent with the study's earlier findings regarding math remediation and older students. Figure 2 represents these results graphically. It is interesting to note the top two coincident hazard profiles, which show the probability of graduation for both older and

younger remedial students who have passed college algebra. The gaps between the top line and the two lower lines are commensurate with the difference in the increase in probability of graduation for younger and older students who passed this course.

Figure 2: Estimated Probability of Completion by Age and Passing First College-Level Math Class Subgroups



Note: The data points for *Older, Passed Math* and *Younger, Passed Math* are coincident and represented by the top line on the graph.

Effects of Credits Earned and Percentage of Program Completed

We then analyzed the difference in older and younger student responses to enrollment milestones. We found that older students, on average, were more likely than their younger counterparts to graduate in any given period, everything else held constant, but they were less affected by all the credit milestones than were their younger counterparts. Younger and older students seemed to respond similarly to reaching the 10 non-remedial credit milestone, but earning 20 credits increased by seven times the chances that a younger student would graduate in any given trimester over a similar younger student who had not reached this credit milestone. Older students who earned 20 non-remedial credits also boosted their chances of completion over older students who did not reach that milestone, but the amount of the increase was not as great as it was for younger students.

Like the credit milestones, the odds ratio for the portion-of-program-completed milestones grew as the percentage of the program completed increased, but the boost in odds was not as great for older students as it was for younger students. For example, an older student who completed 50 percent of her program increased her odds of graduating in any given term by a factor of 11.5, whereas a younger student increased her odds by a factor of 15.5.

Implications for Practice

The research study reported upon here demonstrates that younger and older students responded differently to taking remedial courses, passing college-level "gatekeeper" courses, and reaching credit milestones. Older students who enrolled in remediation, and specifically mathematics remediation, were less negatively affected than were younger students, although enrollment in remediation decreased the odds of graduating in any given term for both older and younger students. Reaching milestones associated with credits earned or completing a portion of a program increased the probability of graduation for all students, but doing so had a greater impact on younger students than on older ones. The analysis also produced the unexpected finding that older students had a higher probability of graduating in any given trimester, after controlling for the level of math skills as measured by math placement test scores.

These findings have a number of implications for community college practice. They support efforts to provide more intensive supports to students early in their enrollment. Younger students in particular would benefit from orientations to college life, intensive advising and counseling, and other activities designed to engage them in the academic and social life of the college.

One explanation for the finding that older students were less negatively affected by enrolling in remedial courses is that many of these students, having been out of school for longer periods of time, may merely have had basic skills that were "rusty" rather than seriously deficient. Therefore, colleges should consider offering short "brush up" workshops or tutorials instead of semester-long courses to older students who place into remedial courses but who do not have serious skills deficiencies.

Because students who enroll in remedial courses

are less likely to succeed, colleges should work with middle and high schools to help better prepare and motivate youth for postsecondary education. In addition, colleges should provide intensive supports to help remedial students, especially younger students, take and pass initial-level college math courses, since passing these "gatekeepers" substantially increases the chances that students will succeed.

Finally, the finding that older students had a higher probability than younger students of graduating, after controlling for factors such as test scores and enrollment patterns, supports Bean and Metzner's (1985) idea that older students are more affected than traditional-age students by the need to balance work and family with school, and that these external pressures outweigh the benefits of social integration. Thus, colleges need to help mitigate the effects of the external pressures on older students through flexible scheduling, evening and weekend courses, childcare, distance learning, and other means. Colleges should also consider offering accelerated programs and financial support to enable older students to attend full time and thus shorten the time it takes to reach the key milestones on the way to degrees and further education.

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