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U. S. Department of Education
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NATIONAL CENTER FOR EDUCATION STATISTICS

Working Paper Series

Projected Postsecondary Outcomes of 1992 High School Graduates

Working Paper No. 1999-15 June 1999

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U.S. Department of Education. National Center for Education Statistics. *Projected Postsecondary Outcomes of 1992 High School Graduates.* Working Paper No. 1999-15, by Phillip Kaufman and Xianglei Chen. Project Officer, C. Dennis Carroll. Washington, D.C.: 1999.

June 1999

Foreword

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Projected Postsecondary Outcomes of 1992 High School Graduates

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Prepared for:

U.S. Department of Education
Office of Educational Research and Improvement
National Center for Education Statistics

June 1999

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Highlights

This report uses data combined from the third follow-up of the National Education Longitudinal Study of 1988 (NELS:88/94) and the Beginning Postsecondary Students Longitudinal Study (BPS:89/90) to project the postsecondary outcomes of the high school class of 1992. Specifically, it tracks, over a 4-year period, the expected path of college-qualified students who first enrolled in a 4-year college or university in the 1992–93 academic year. The focus of the report is the attainment and persistence rates for a cohort of high school graduates who had completed the necessary steps in high school to be prepared to enter a 4-year college or university. An earlier study[1] had suggested that if high school students took these steps, overall disparities in enrollment rates by race–ethnicity and family income diminished. This report uses this cohort of students to estimate any differences in college outcomes 4 years after entry. The major findings of the study were as follows:

- Low-income students were less likely than high-income students to be at least minimally qualified for college. White and Asian high school graduates were more likely than their black or Hispanic peers to be at least minimally qualified.
- Once enrolled in a 4-year institution, while high-income students were more likely to receive a bachelor's degree than middle-income students, there were no other differences among income groups in their 4-year persistence and attainment rates.
- Race–ethnicity did have an association with persistence and attainment for college-qualified students. College-qualified black students were less likely than white students to have earned a bachelor's degree 4 years after entering a 4-year institution. This was true not only for black students who were not just minimally qualified, but also true for those who were highly or very highly qualified for college when they first entered.
- Approximately 33 to 34 percent of highly or very highly college-qualified whites and Hispanics had earned bachelor's degrees compared with 14 percent of blacks. After 4 years, highly or very highly college-qualified blacks were also more likely not to be enrolled *and* not to have earned a degree—46 percent of blacks compared with 21 percent of whites.

[1]L. Berkner and L. Chavez, *Access to Postsecondary Education for the 1992 High School Graduates* (NCES 98-105) (Washington, D.C.: U.S. Department of Education, National Center for Education Statistics, 1997).

Preface

This report is part of the Postsecondary Education Descriptive Analysis Reports (PEDAR) series. The PEDAR series consists of reports that focus on postsecondary education policy issues, taking advantage of a variety of education data sources, especially recently completed data collections. Other reports in the series include *Access to Postsecondary Education for the 1992 High School Graduates* (NCES 98-105); *Confronting the Odds: Students at Risk and the Pipeline to Higher Education* (NCES 98-094); and *Postsecondary Financing Strategies: How Undergraduates Combine Work, Borrowing, and Attendance* (NCES 98-088).

This report examines the attainment and persistence rates of a cohort of high school graduates who had completed the necessary steps in high school to be prepared to enter a 4-year college or university. An earlier study had suggested that if high school students took these steps, overall disparities in enrollment rates by race–ethnicity and family income diminished. This report uses this cohort of students to estimate any differences in college outcomes 4 years after entry.

This analysis used merged data from 1) the National Education Longitudinal Study of 1988 (NELS:88/94), a survey that began with eighth graders in 1988 and followed them every two years through 1994, and 2) the Beginning Postsecondary Students Longitudinal Study (BPS:89/90). The analysis was limited to 1992 high school graduates.

The percentages and means presented in this report were produced using the public-access National Education Longitudinal Study and Beginning Postsecondary Students Longitudinal Linkage Data File (NEB) Data Analysis System (DAS), a microcomputer application that allows users to specify and generate their own tables from the NEB data. The DAS produces design-adjusted standard errors necessary for testing the statistical significance of differences shown in the tables. Additional information about the DAS, and how it may be obtained, is included in appendix B of this report.

We hope that the information provided in this report will be useful to a wide range of interested readers, and that the results reported here will encourage others to use the NEB data.

Acknowledgments

The authors wish to thank all those who contributed to the production of this report. At MPR Associates, Laura Horn and Susan Choy reviewed the report and provided helpful criticism. Without the assistance of Barbara Kridl, Leslie Retallick, Andrea Livingston, Mary Mack, Karyn Madden, and Francesca Tussing of MPR Associates, this report could not have been prepared. They provided invaluable analytical, editorial, graphic, and production assistance.

We are grateful to all the reviewers of this report whose insights and helpful criticism strengthened the final product. Ellen Bradburn of NCES provided technical review, while David Bergeron of the Office of Postsecondary Education provided helpful feedback and encouragement.

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Introduction

Research has shown that black and Hispanic students and those with low income or low socioeconomic status (SES) are less likely than other students to enroll in postsecondary education. One reason these groups do not enroll is that they are not prepared for postsecondary education while in high school. However, a recent study of the high school class of 1992 showed that if students are "college qualified" and take the steps necessary to enroll in a 4-year college, enrollment rates among these racial–ethnic and income groups are virtually the same.[2] Nonetheless, the question of what happens to these college-qualified students after they enter a postsecondary institution remains—mere access does not necessarily lead to completion.[3] This analysis uses data from the first three survey waves of the National Education Longitudinal Study of 1988 (NELS:88/94) and the data from the Beginning Postsecondary Students Longitudinal Study survey and follow-up (BPS:89/90) to examine this question.

Borrowing an Analogy

People have used several analogies to describe the paths students take through high school and college in the pursuit of a bachelor's degree. The analogy of a pipeline has been used by the National Science Foundation to describe the pathway to science, mathematics, and engineering degrees.[4] Others have used the pipeline analogy to describe the pathways through high school to entrance into a 4-year college or university.[5] The analogy of a track—the persistence track—has been used to describe the path that many students take through college.[6] Staying "on track" in this context means continuing through postsecondary education until one's educational objectives are met.

In a recent book, William Bowen and Derek Bok used the analogy of a river to describe the flow of students through the educational system to a 4-year degree and beyond.[7] They argue that

[2]L. Berkner and L. Chavez, *Access to Postsecondary Education for the 1992 High School Graduates* (NCES 98-105) (Washington, D.C.: U.S. Department of Education, National Center for Education Statistics, 1997).

[3]C. Adelman, "Turn College 'Access' Into 'Participation'," *Education Week*, October 22, 1997.

[4]National Science Foundation, National Science Board, *Science and Engineering Indicators—1995* (Washington D.C.: U.S. Government Printing Office, 1995).

[5]L. Horn and C.D. Carroll, *Confronting the Odds: Students at Risk and the Pipeline to Higher Education* (NCES 98-094) (Washington D.C.: U.S. Department of Education, National Center for Education Statistics, 1997).

[6]Berkner and Chavez, *Access to Postsecondary Education for the 1992 High School Graduates*.

[7]W. Bowen and D. Bok, *The Shape of the River* (Princeton, NJ: Princeton University Press, 1998).

the image of a pipeline brings to mind a system that is more clearly defined and smooth than it actually is—especially to those in the "pipeline." The mental picture of a river, however, captures the reality of the bends and turns in the path to a 4-year degree. Without knowledge of what is around the bend—for example, taking the SATs to get into a 4-year institution—some students are wrecked on "hidden shoals or snags" in the river and fail to reach their goal of a 4-year degree. Throughout this report the analogy of a river is used to describe the pathway to a 4-year postsecondary institution. The report starts with an analysis of the bends in the river to the point of entry into a 4-year institution—aspiring to a bachelor's degree while in the 10th grade, being academically prepared for college, taking the SAT/ACT, and applying to a 4-year institution.

The conceptualization of one juncture—being academically prepared for college—is based on previous work with the NELS data. In a recent report on access to 4-year colleges, Berkner and Chavez created a scale that captured students' readiness for college.[8] According to their scheme, a "college-qualified" student has a minimum high school grade point average of 2.7, a high school class percentile rank of at least 54, a NELS:88/94 composite test percentile score of at least 56, a combined SAT score of at least 820, or a composite ACT score of at least 19. Being "college qualified" was shown in that work to be particularly important for college access. To set the context for the analysis of college persistence and attainment, this report briefly reexamines the characteristics of those members of the high school class of 1992 who were deemed college qualified by their academic preparation in high school.

The report then explores projected 4-year college persistence rates of 1992 high school graduates who were college qualified, using merged data from NELS:88/94 and BPS:89/90. The next section briefly describes this data set.

Data

The NELS:88/94 data set has proven to be a rich source of data on the relationship between high school experiences and early postsecondary outcomes. However, the last collection of NELS:88/94 captured the sample members when most of them were only 2 years out of high school—much too early to be able to say much about their eventual postsecondary attainment and persistence. Conversely, the BPS:89/90 survey and follow-up have been a rich source of data on the characteristics of beginning postsecondary students' educational attainment and persistence but have little data about participants' high school experiences.

To take advantage of the information on students in both NELS and BPS, a set of variables was created that allows inferences to be made about the students in one data set, based on the

[8]See Berkner and Chavez, *Access to Postsecondary Education for the 1992 High School Graduates*.

characteristics of students in the other data set. Each respondent in the NELS data set was matched with a respondent in the BPS data set based on age, sex, race–ethnicity, SES, and the characteristics of their first postsecondary enrollment status (e.g., full- or part-time or type of institution). Thus, pairs of respondents in each data set were linked, creating a "synthetic cohort." With the merged data from BPS, the progress of the 1992 cohort of college-qualified students can be inferred through the first 4 years after they first enrolled in a 4-year institution. For example, a black, high-SES NELS respondent who first enrolled in a public 4-year institution full time immediately after high school was matched with a BPS respondent with identical characteristics. This BPS respondent's postsecondary outcomes were then attached to the NELS sample member. Appendix B of this report provides a further explanation of the statistical methods used to create this merged data set.

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Navigating Through High School to College

One of the first steps in the process of earning a 4-year degree is preparing to enter a 4-year institution upon graduation from high school. Such a model has been used recently with the NELS data to examine the path through high school to any 4-year college.[9] The junctures in this model are as follows:

- Having aspirations for a bachelor's degree in the 10th grade;
- Preparing academically for college;
- Taking college entrance exams;
- Applying to a 4-year college; and
- Enrolling in a 4-year college.

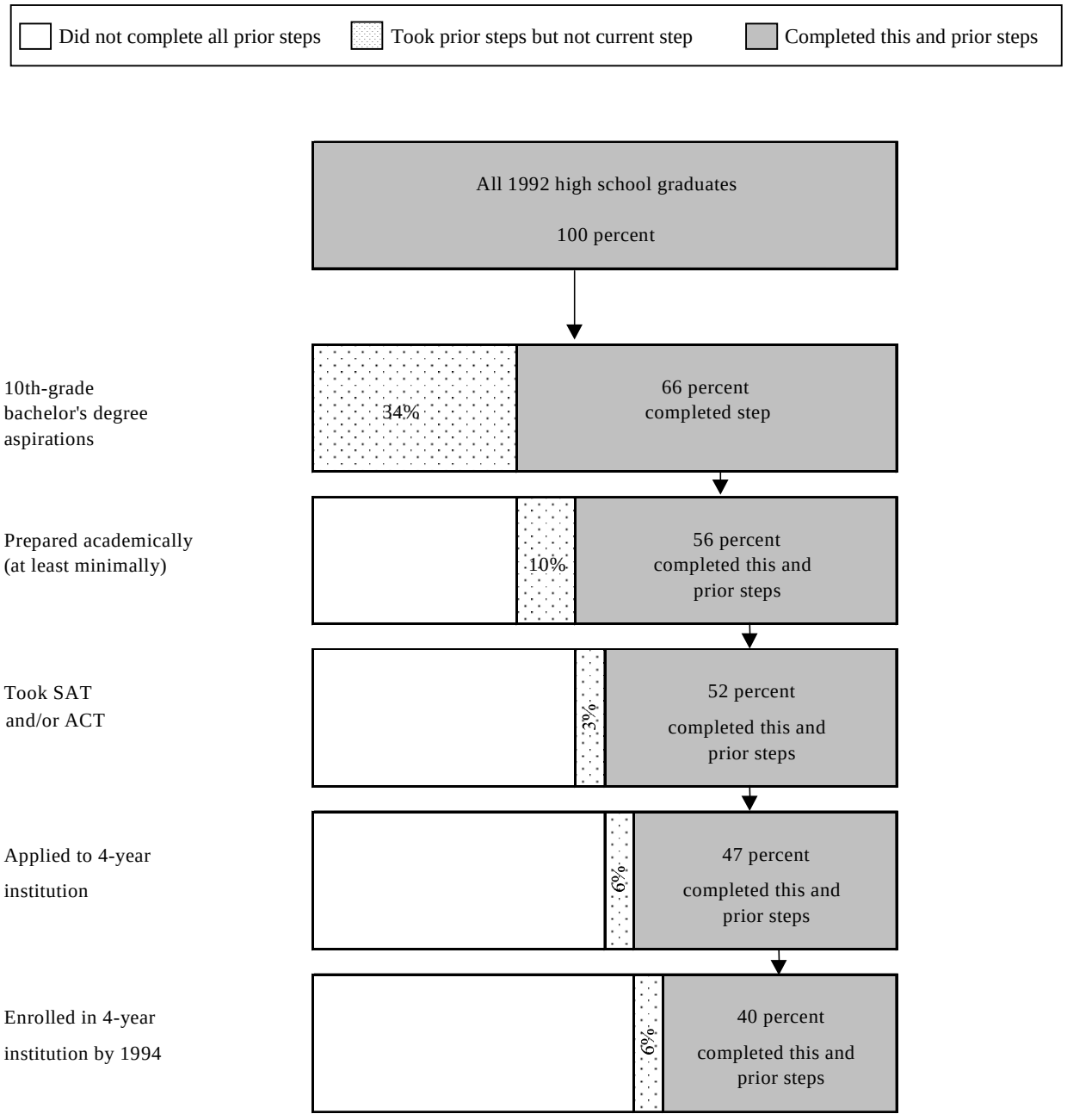
These junctures are presented in figure 1 for all 1992 high school graduates. Jumping to the last "bend in the river," about 40 percent of the high school class of 1992 had taken all of the steps to enrollment in a 4-year institution including enrolling in a 4-year postsecondary institution by 1994 (table 1 and figure 1). About 34 percent of high school seniors never entered "the river" because (for a variety of reasons) they were not striving for this level of education in the 10th grade.

Of those who aspired to a bachelor's degree, the most difficult juncture was becoming academically prepared for college (figure 1). About 10 percent of 1992 graduates were no longer on their way to a 4-year institution because they were not minimally qualified for college. (More about this later.) This is in comparison with 3 percent who then failed to take a college entrance exam, 6 percent who did not apply to a 4-year institution, and 6 percent who did not enroll in a 4-year institution (even though they had applied).

Family income has long been known to be positively associated with educational attainment. It was also associated with successfully navigating the bends in the river to a 4-year college or university. As the level of family income increased, high school graduates were more likely to have passed through each of the steps toward enrollment in a 4-year institution (table 1 and figure 2). Moreover, moving from mere aspirations to being minimally academically

[9]L. Horn and C.D. Carroll, *Confronting the Odds: Students at Risk and the Pipeline to Higher Education* (NCES 98-094) (Washington D.C.: U.S. Department of Education, National Center for Education Statistics, 1997).

Figure 1—Percentage of 1992 high school graduates who prepared for enrollment in a 4-year college or university



NOTE: Percentages may not sum to 100 due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study and Beginning Postsecondary Students Longitudinal Study Linkage Data File (NEB), Data Analysis System.

Table 1—Percentage of 1992 high school graduates who took the steps toward 4-year college enrollment, by selected characteristics[1]

	10th-grade bachelor's degree aspirations	Minimally prepared academically	Took SAT and/or ACT	Applied to a 4-year institution	Enrolled in a 4-year institution by 1994
Total	65.8	55.5	52.4	46.7	40.3
Sex					
Male	62.8	51.3	48.5	43.3	37.1
Female	68.7	59.7	56.4	50.1	43.4
Race–ethnicity					
White, non-Hispanic	66.9	58.4	55.3	49.2	42.5
Black, non-Hispanic	63.6	45.8	43.4	40.8	35.5
Hispanic	56.7	40.6	36.7	31.5	26.4
Asian Pacific Islander	72.6	64.0	61.7	55.6	47.1
American Indian/Alaskan Native	53.1	38.6	35.3	22.6	18.5
Family income					
Low (less than $25,000)	51.0	38.4	34.5	29.8	25.3
Middle ($25,000–$74,999)	69.3	59.4	56.6	49.9	42.5
High ($75,000 or more)	88.0	83.4	81.7	77.7	70.4
Parents' educational level					
High school or less	46.0	32.6	29.3	24.7	20.5
Some college	64.1	53.1	49.3	42.0	35.3
College graduate	86.0	79.3	77.6	72.9	65.2
Number of risk factors[2]					
None	80.8	74.7	72.6	65.9	58.1
One	63.9	54.5	51.1	44.8	39.3
Two	48.9	35.7	30.9	26.0	21.2
Three or more	38.8	23.0	18.8	16.2	9.7

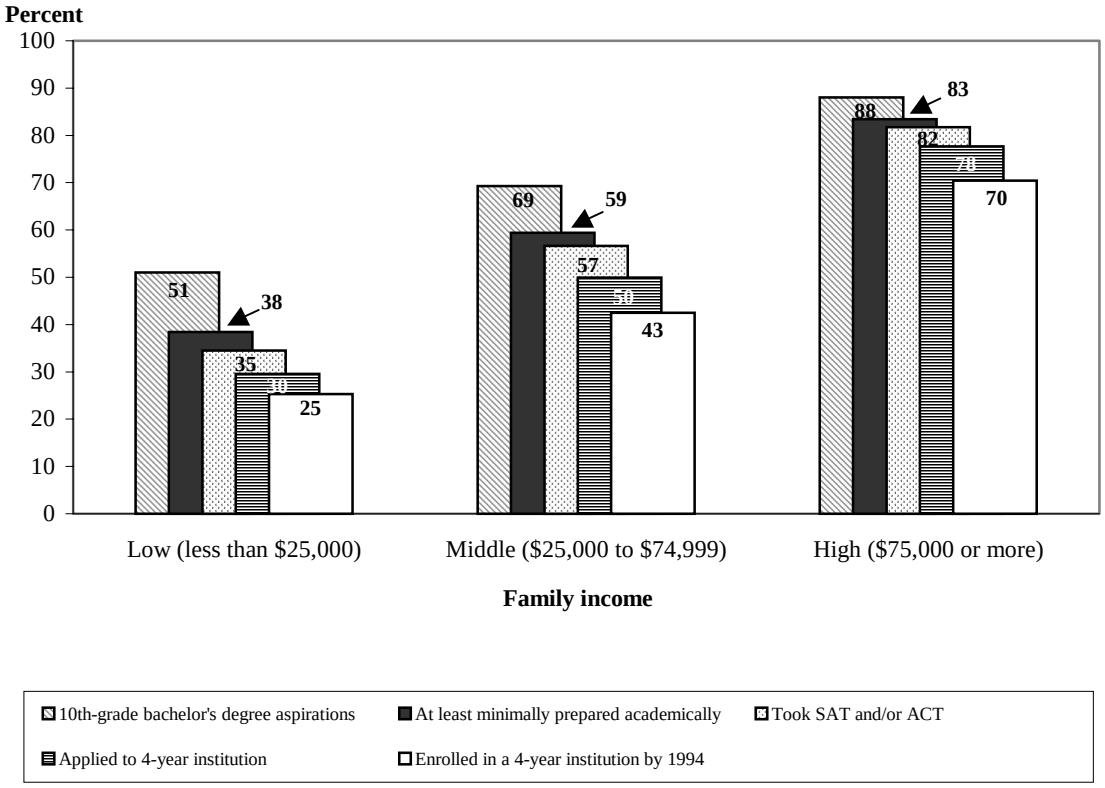
[1]The proportion of students at each step is based on those who successfully completed all the preceding steps.

[2]Risk factors are low SES quartile, average grades of Cs or lower from sixth to eighth grade, changed schools two or more times other than normal progression, lived in a single-parent family, had one or more older siblings who dropped out of high school, or held back a grade before.

SOURCE: U.S. Department of Education, National Center for Education Statistics, merged data from the National Education Longitudinal Study and the Beginning Postsecondary Student Longitudinal Study (NEB), Data Analysis System.

qualified was more difficult for graduates from low-income families than those from high-income families. About 13 percent of low-income graduates aspired to this level of education but do not become academically qualified (51 percent minus 38 percent) compared with 6 percent of high-income graduates.

Figure 2—Percentage of 1992 high school graduates who took each step towards enrollment in a 4-year college, by family income



SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study and Beginning Postsecondary Students Longitudinal Study Linkage Data File (NEB), Data Analysis System.

Characteristics of Graduates Qualified for College

As shown above, becoming academically qualified for college was one of the largest obstacles for 1992 high school graduates. Since this was such a big step for many students, this section takes a closer look at which graduates were and were not college qualified.

In their report on access to 4-year colleges, Berkner and Chavez created a scale that captures students' readiness for college.[10] Judgments about a student's "academic qualifications" for college were based on a composite of high school grade point average, high school class rank, 1992 NELS test score performance, combined SAT score, and composite ACT score. Students were categorized as 1) very highly qualified, 2) highly qualified, 3) somewhat qualified, 4) minimally qualified, and 5) marginally or not qualified. At least minimally "college-qualified"

[10]See Berkner and Chavez, *Access to Postsecondary Education for the 1992 High School Graduates*.

students were those whose highest value on five criteria would put them into the top 75 percent of 4-year college students. Minimum values were a 2.7 GPA, a class rank of at least 54, a NELS:88 composite test percentile score of at least 56, a combined SAT score of at least 820, or a composite ACT score of at least 19.[11]

A majority (65 percent) of 1992 high school graduates were at least minimally qualified for college. That is, about 35 percent were marginally or not qualified (table 2). About 14 percent were very highly qualified—meaning that they were among the top 10 percent of all undergraduate students.

The percentage of students qualified for college varied by sex, race–ethnicity, parental education level, and at-risk status. Females were more likely than males to be at least minimally qualified for college (68 percent compared with 61 percent). However, similar percentages of males and females were very highly qualified.

White and Asian high school graduates were more likely than their black or Hispanic peers to be at least minimally qualified. About 68 percent of white students and 73 percent of Asian students were at least minimally qualified compared with 47 percent of black and 53 percent of Hispanic students. Furthermore, high-income graduates were more likely to be at least minimally college qualified than were their lower income peers, as were graduates with parents with higher education levels compared with those with lower education levels. Eighty-six percent of high-income students and 82 percent of students with a college-educated parent were at least minimally qualified, compared with 52 percent of low-income students and 47 percent of students whose parents did not attend college.

White and Asian graduates, graduates from high-income families, and families with high educational levels were also more likely than were their peers without these characteristics to be very highly qualified for college (table 2). About 15 percent of white and 23 percent of Asian graduates were very highly qualified compared with 6 percent of blacks and 8 percent of Hispanics.

Students "at risk" have traditionally been defined as having those characteristics that have been shown in prior research to increase their risk of dropping out of high school.[12] In the present study, students were classified as at risk in the eighth grade if they 1) came from low SES families, 2) had a C average or lower in the sixth to eighth grade, 3) changed schools two or more

[11]For details of how this variable was created, see appendix A.

[12]P. Kaufman and D. Bradby, *Characteristics of At-Risk Students in NELS:88* (NCES 92-042) (Washington, D.C.: U.S. Department of Education, National Center for Education Statistics, 1992).

Table 2—Percentage distribution of 1992 high school graduates according to qualification to attend a 4-year college, by selected student characteristics

	Qualification to attend a 4-year college				
	Marginally/ not qualified	Minimally qualified	Somewhat qualified	Highly qualified	Very highly qualified
Total	35.5	16.6	15.9	18.2	13.8
Sex					
Male	39.1	16.7	14.5	16.4	13.3
Female	31.9	16.5	17.3	20.0	14.4
Race–ethnicity					
White, non-Hispanic	31.9	16.1	16.6	20.3	15.2
Black, non-Hispanic	53.1	16.7	14.0	9.9	6.3
Hispanic	47.0	20.7	13.6	10.8	7.9
Asian/Pacific Islander	27.3	14.6	15.0	20.2	23.0
American Indian/Alaskan Native	55.2	22.2	15.8	5.9	1.0
Family income					
Low (less than $25,000)	47.5	18.7	12.8	13.6	7.3
Middle ($25,000–$74,999)	32.4	16.1	17.0	19.9	14.6
High ($75,000 or more)	14.1	11.5	18.4	27.0	29.0
Parents' educational level					
High school or less	52.9	19.0	11.4	10.4	6.3
Some college	35.7	18.1	17.8	17.6	10.8
College graduate	18.1	11.9	17.7	27.0	25.4
Number of risk factors*					
None	18.6	13.2	19.5	26.5	22.2
One	33.6	20.1	16.2	17.4	12.7
Two	53.5	18.7	12.8	10.4	4.6
Three or more	66.0	18.8	8.4	4.2	2.6

*Risk factors are low SES quartile, average grades of Cs or lower from sixth to eighth grade, changed schools two or more times other than normal progression, lived in a single-parent family, had one or more older siblings who dropped out of high school, or held back a grade before.

NOTE: Percentages may not sum to 100 due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, merged data from the National Education Longitudinal Study and the Beginning Postsecondary Student Longitudinal Study (NEB), Data Analysis System.

times other than normal progression,[13] 4) lived in single-parent families, 5) had one or more siblings who dropped out of high school, or 6) had been held back a grade.

[13]For example, normal progression from middle school to high school.

Graduates with no risk factors were more likely to be at least minimally qualified than were their peers with one or more risk factors. About 34 percent of those with three or more risk factors were at least minimally qualified compared with 81 percent of those with no risk factors. Similarly, 22 percent of those with no risk factors were highly qualified for college, compared with 3 percent of those with three or more risk factors.

Enrollment in a 4-Year Institution

Overall, about 45 percent of the whole high school class of 1992 enrolled in a 4-year institution by 1994 (figure 3).[14] However, there were differences in enrollment rates according to student characteristics. For example:

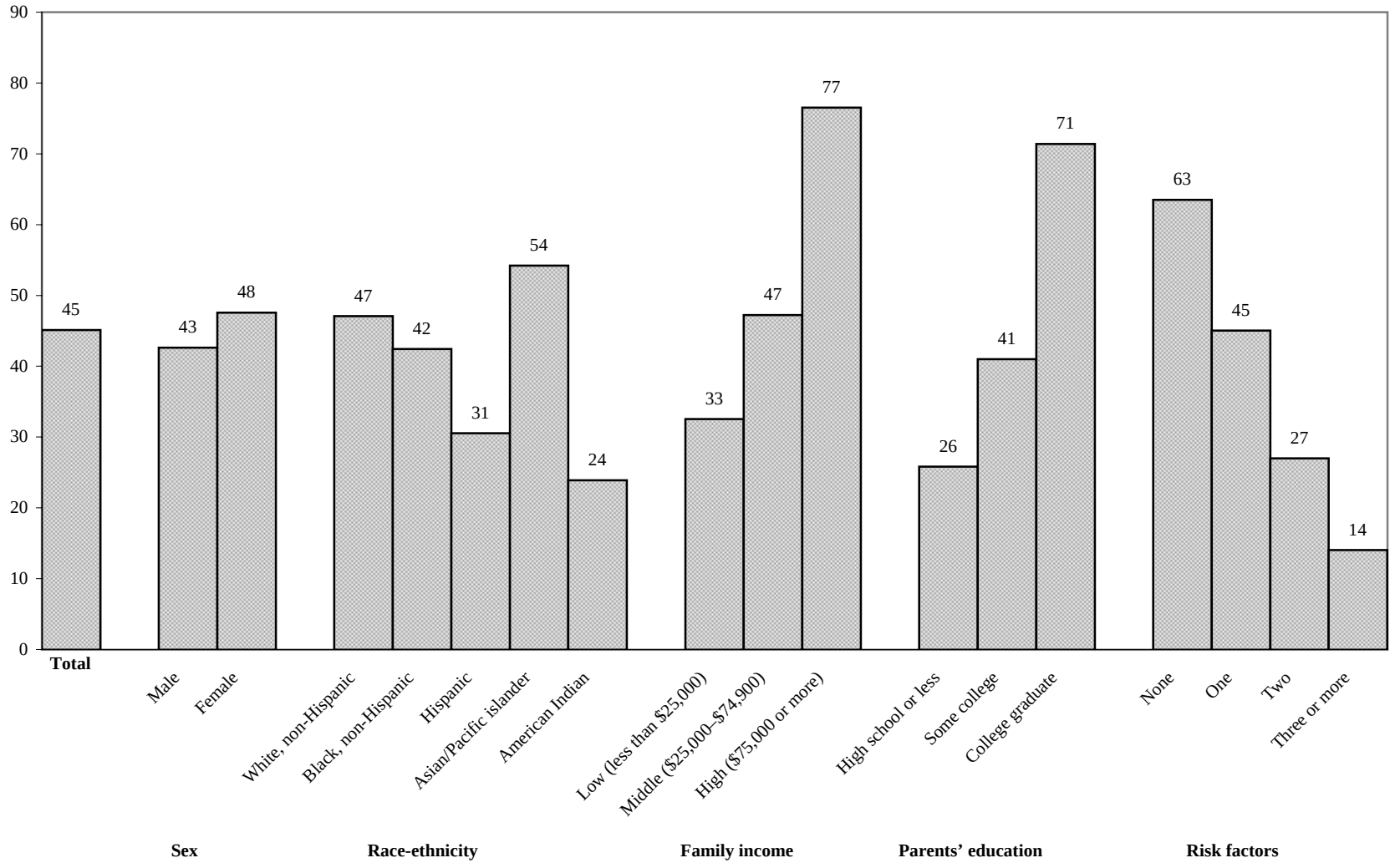
- Hispanics were less likely than whites to enroll in a 4-year institution;
- Low-income students were less likely to enroll than higher income students;
- Students with more highly educated parents were more likely than others to enroll; and
- Students with fewer risk factors enrolled at higher rates than those with more risk factors.

However, when one looks just at those 1992 graduates who were college qualified and took the necessary steps to enroll—those who took college entrance exams and applied to a 4-year institution—many of these differences diminish or disappear. For example, among college-qualified students who took the steps to enroll, 77 percent of Hispanics enrolled in a 4-year school compared with a statistically indistinguishable 82 percent of black students and 84 percent of white students. Furthermore, college-qualified students with one or two risk factors enrolled at similar rates as those with no risk factors—87 percent for those with none compared with 83 percent with one and 79 percent with two risk factors.

While, among college-qualified students, those with college-educated parents still enrolled at higher rates than those with parents without a college degree, these differences were less striking than the differences shown above among all graduates. For example, about 26 percent of all graduates with parents with a high school education enrolled in a 4-year college, compared with 71 percent of those with parents who had a college degree—a 45 percentage-point difference. Among college-qualified graduates, this difference was 14 percentage points—76 percent versus 90 percent.

[14]This percentage is higher than that shown in figure 1 since some proportion of students enrolled in a 4-year institution without navigating all of the junctures in the process.

Figure 3—Percentage of 1992 high school graduates who enrolled in a 4-year institution in the 1992–93 academic year



SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study and Beginning Postsecondary Students Longitudinal Study Linkage Data File (NEB), Data Analysis System.

Projected Overall Persistence and Degree Attainment

The previous sections indicated that among students who were "college qualified" and took the steps necessary to enroll in a 4-year college, enrollment rates among racial–ethnic and income groups were virtually the same. Nonetheless, the question of what happens to these college-qualified students after they enter a postsecondary institution remains—mere access does not necessarily lead to completion.

Using the combined NELS/BPS data, it was possible to project what would have happened to these college-qualified 1992 graduates after they entered a 4-year college based on the experiences of the BPS cohort. Figure 4 projects postsecondary outcomes for a standard cohort of 1,000 college-qualified 1992 high school graduates who entered a 4-year institution in the 1992–93 academic year. The figure illustrates the projected flow of the high school class of 1992 through the first four years after graduation. For example, of 1,000 1992 high school graduates who entered a 4-year institution in the 1992–93 academic year, 832 continued to be enrolled in the 4-year sector in the 1993–94 academic year. That is, 83 percent stayed "on the river" between their first and second academic years.

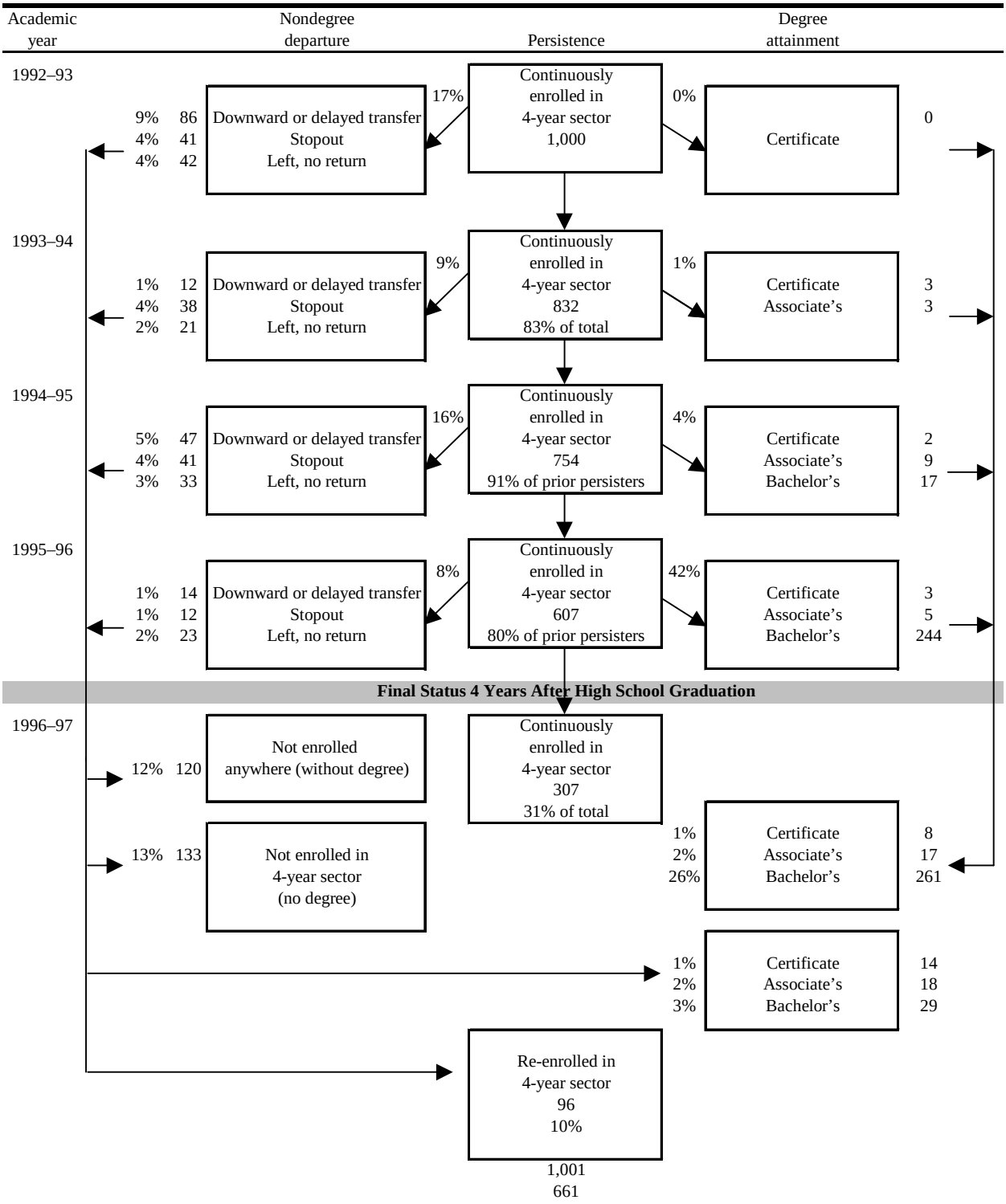
For simplicity of presentation, the findings in this section are discussed as if outcomes of the sample of 1992 high school graduates were actually observed rather than inferred. However, the reader should keep in mind the findings are based on projected data.

Persistence

There are a variety of ways to measure persistence in 4-year colleges and universities.[15] In this report persistence is defined as continued enrollment in the 4-year sector—regardless of whether the student was continuously enrolled in the same institution. Measured in this manner, the projected persistence rates for 1992 high school graduates who continued in the 4-year sector from the previous year were quite high. In the first year, 83 percent stayed, 91 percent of those persisted into their second year, and 80 percent of those who persisted into their second year persisted into their third year (figure 4). Five years after high school graduation, 307 of the original 1,000 college-qualified students (31 percent of the total) were still enrolled in a 4-year institution and had not yet earned a bachelor's degree.

[15]See L. Berkner, A. McCormick, and S. Cuccaro-Alamin, *Descriptive Summary of 1989–90 Beginning Postsecondary Students: 5 Years Later* (Washington D.C.: U.S. Department of Education, National Center for Education Statistics, 1996).

Figure 4—Projected persistence, degree attainment, and nondegree departure among 1992 high school graduates enrolled in a 4-year institution in the 1992–93 academic year



NOTE: Percentages may not sum to 100 due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study and Beginning Postsecondary Students Longitudinal Study Linkage Data File (NEB), Data Analysis System.

Nondegree Departure

Students can stop attending college in a variety of ways. One way is to drop out of the 4-year sector without attaining any degree. About 17 percent of the 1992 graduates were projected to have dropped out of the 4-year sector after their first year. Out of the original 1,000 students, 86 transferred to a less-than-4-year institution, 41 stopped out, and 42 left and never returned to postsecondary education (figure 4).

By the end of the second year, 9 percent of those who were enrolled the previous year dropped out of the 4-year sector—1 percent of the total transferred downward, 4 percent stopped out, and 2 percent left and did not return. (Out of the original 1,000 students, 12 transferred downward, 38 stopped out, and 21 left and did not return.)

By the end of the third year, 16 percent of those who were enrolled the previous year dropped out—5 percent of the initial group transferred downward, 4 percent stopped out, and 3 percent left and did not return. After the fourth year, 8 percent of those who were enrolled the previous year dropped out—1 percent of the original 1,000 students transferred downward, 1 percent stopped out, and 2 percent left and did not return.

After four years, 120 of the original 1,000 students (12 percent of the total) were not enrolled in postsecondary education. About 133 students (13 percent of the original total) were enrolled, but not in a 4-year institution, and 96 students (10 percent of the original total) were reenrolled in a 4-year institution.

Degree Attainment

Another reason students stop attending a 4-year institution is that they achieve their degree objectives. After 4 years, a projected 29 percent of the high school class of 1992 who had entered a 4-year institution in the 1992–93 academic year received a bachelor's degree. About 26 percent had received their degree through continual enrollment in the 4-year sector, while another 3 percent received a bachelor's degree after leaving the 4-year sector but then returning (figure 4).

As expected, most of the predicted bachelor's degrees were earned in the fourth year—84 percent of the predicted degrees earned by all of the original cohort after 4 years were earned in the last year by students who had been continuously enrolled.

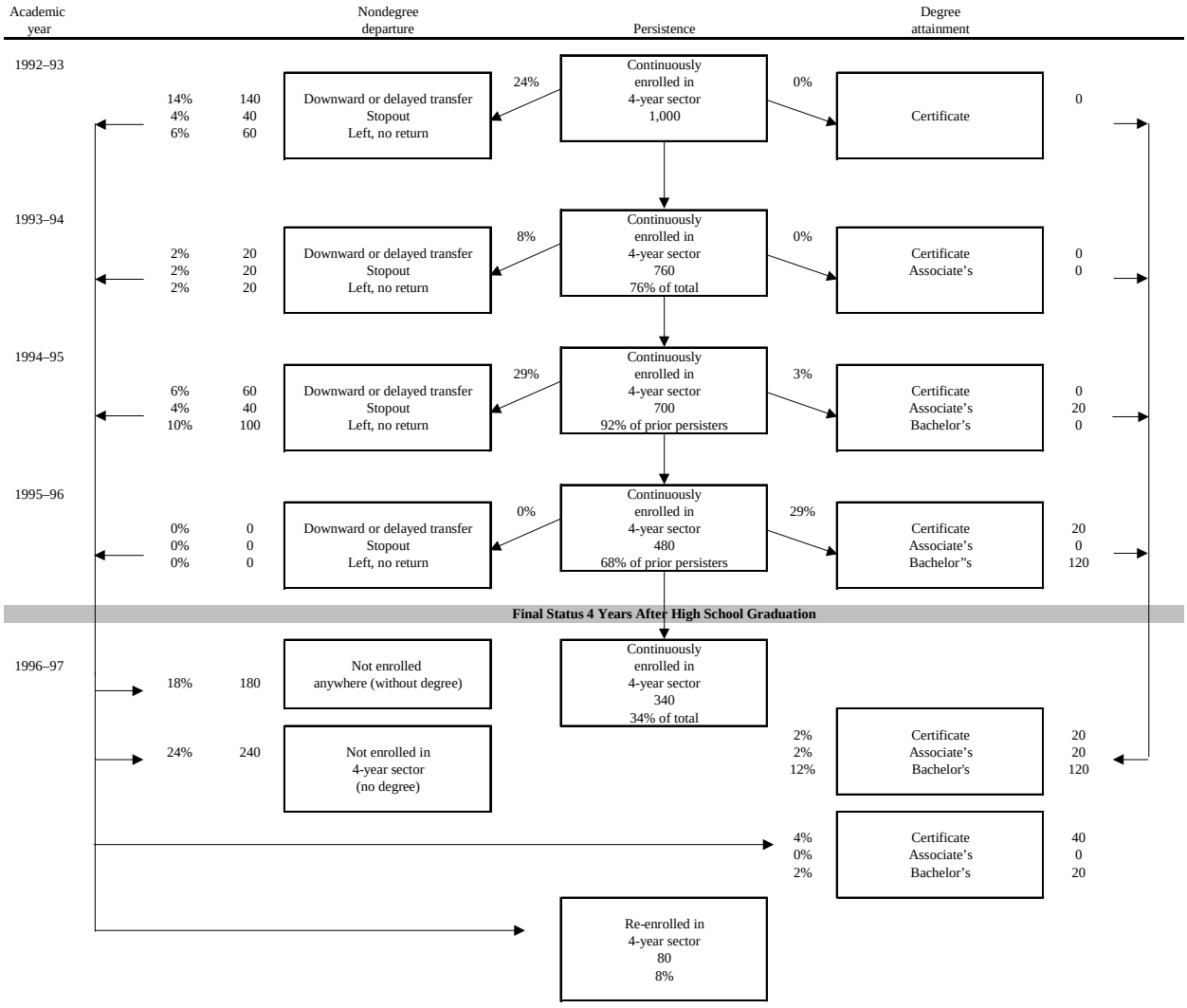
Some college-qualified students may have left the 4-year sector after attaining a certificate or associate's degree. About 4 percent of the 1992 high school graduates were projected to have

received an associate's degree after 4 years, while 2 percent received some type of postsecondary certificate.

Differences Between Non-Hispanic White and Black Students

Figures 5 and 6 show the flow through their first four years of college separately for black and white students. While the sample size for black students is relatively small and the

Figure 5—Projected persistence, degree attainment, and nondegree departure among black non-Hispanic 1992 high school graduates enrolled in a 4-year institution in the 1992–93 academic year

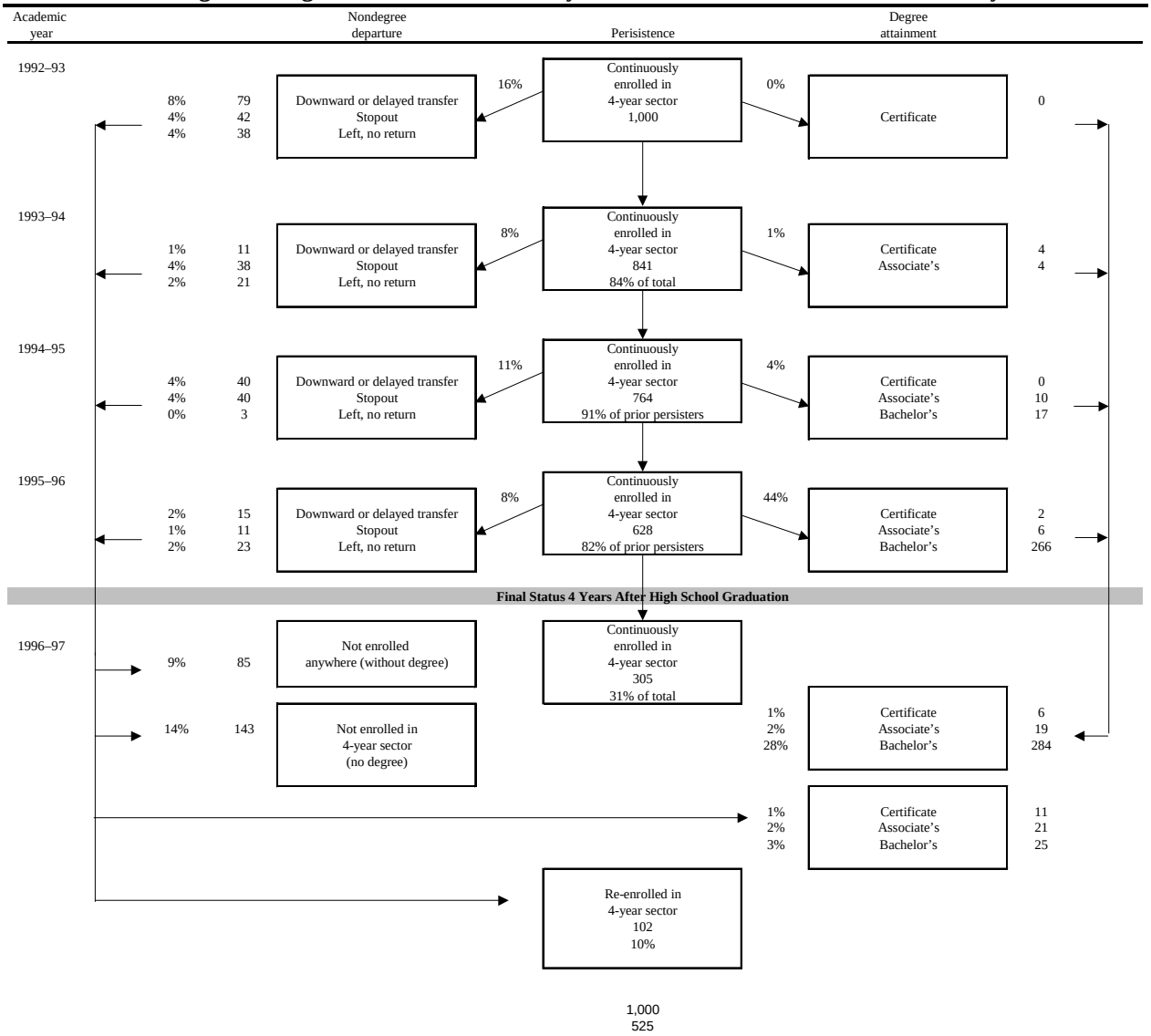


NOTE: Percentages may not sum to 100 due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study and Beginning Postsecondary Students Longitudinal Study Linkage Data File (NEB), Data Analysis System.

corresponding standard errors are large, several differences between white and black students are statistically significant. In particular, after four years, black students were more likely than white students to be not enrolled without any degree (18 percent for blacks compared with 9 percent for whites). After four years black students were less likely to have completed a bachelor's degree (14 percent for black students compared with 29 percent of white students).

Figure 6—Projected persistence, degree attainment, and nondegree departure among white non-Hispanic 1992 high school graduates enrolled in a 4-year institution in the 1992–93 academic year



NOTE: Percentages may not sum to 100 due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study and Beginning Postsecondary Students Longitudinal Study Linkage Data File (NEB), Data Analysis System.

Individual Characteristics Associated With Attainment and Persistence

College-Qualified Students

While the overall persistence and attainment rates shown above are of interest in themselves, the main purpose of this report is to examine differences in persistence and attainment rates for college-qualified students with different background characteristics.

After 4 years, females were more likely than males to still be enrolled or have a degree—72 percent of males (100 percent minus 28 percent with no degree and not enrolled) compared with 77 percent of females (table 3). Females were also more likely to have earned their bachelor's degree. About 37 percent of females had earned their bachelor's degree after 4 years, compared with 22 percent of males.

Black students were more likely than white students to be not enrolled and not have earned a degree after 4 years. About 41 percent of black students who had been college qualified and had enrolled in a 4-year institution in their first year out of high school were estimated to not be enrolled and to have not earned a degree or certificate 4 years later. Black students were also less likely than white students to have earned a bachelor's degree 4 years after entering a 4-year institution. Approximately 13 percent of blacks were estimated to have earned a bachelor's degree compared with 32 percent of whites.[16]

Family income was generally not associated with either persistence or degree attainment. However, college-qualified students who had a parent with a college education were more likely to persist and were more likely to receive their bachelor's degree than were students whose parents had no college experience.

High school graduates who were more highly qualified for college before entering a 4-year college were more successful once they got there. After 4 years, higher qualified students were more likely to attain a degree or certificate of some kind and were more likely to have earned a bachelor's degree (table 3). Five years after first enrolling in a 4-year institution, lower qualified graduates were more likely to no longer be enrolled without having earned any kind of degree or certificate (table 3).

[16]The apparent differences between black students and Hispanic and Asian students were not statistically significant.

Table 3—Percentage distribution of college-qualified[1] 1992 high school graduates who enrolled in a 4-year college, according to projected persistence and attainment 4 years after high school graduation, by selected student characteristics

	Projected persistence and attainment 4 years after high school graduation			Projected highest degree attained 4 years after high school graduation			
	Attained a degree	No degree, enrolled	No degree, not enrolled	None	Certificate	Associate's degree	Bachelor's degree
Total	36.0	38.7	25.3	64.0	2.2	3.9	29.9
Sex							
Male	27.6	44.3	28.1	72.4	1.5	3.8	22.3
Female	43.4	33.8	22.9	56.6	2.8	4.0	36.6
Race–ethnicity							
White, non-Hispanic	38.3	38.9	22.8	61.7	2.0	4.5	31.8
Black, non-Hispanic	19.9	39.1	41.0	80.1	5.1	2.0	12.8
Hispanic	27.6	44.3	28.1	72.4	2.3	0	25.3
Asian/Pacific Islander	34.9	32.7	32.4	65.1	0.7	3.5	30.7
American Indian/Alaskan Native	—	—	—	—	—	—	—
Family income							
Low (less than $25,000)	33.0	37.6	29.4	67.0	3.1	2.6	27.3
Middle ($25,000–$74,999)	34.4	39.6	26.0	65.6	2.3	5.2	26.9
High ($75,000 or more)	42.6	36.6	20.9	57.4	1.8	3.2	37.6
Parents' educational level							
High school or less	29.6	38.7	31.7	70.4	3.7	2.1	23.9
Some college	32.3	39.9	27.8	67.7	2.6	3.4	26.3
College graduate	40.2	37.8	21.9	59.8	1.5	5.0	33.7
College qualification							
Minimally qualified	30.9	36.5	32.7	69.1	4.0	2.2	24.7
Somewhat qualified	32.1	39.2	28.7	67.9	2.3	4.4	25.5
Highly qualified	36.8	39.6	23.6	63.2	1.8	5.4	29.6
Very highly qualified	40.1	38.5	21.4	59.9	1.6	2.9	35.6
Number of risk factors[2]							
None	36.7	38.9	24.5	63.4	1.7	3.6	31.3
One	35.5	38.0	26.5	64.5	2.6	3.7	29.2
Two	32.7	40.2	27.1	67.3	4.1	5.4	23.2
Three or more	26.1	43.1	30.8	73.9	3.5	0	22.6

—Sample size too small for a reliable estimate.

[1]Minimally qualified for attending a 4-year institution.

[2]Risk factors are low SES quartile, average grades of Cs or lower from sixth to eighth grade, changed schools two or more times other than normal progression, lived in a single-parent family, had one or more older siblings who dropped out of high school, or held back a grade before.

NOTE: Percentages may not sum to 100 due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, merged data from the National Education Longitudinal Study and the Beginning Postsecondary Student Longitudinal Study (NEB), Data Analysis System.

Eighth-grade risk factors had no notable association with either persistence or degree attainment. About the same proportion of college-qualified students persisted and received their bachelor's degree regardless of how many risk factors they had.

Highly College-Qualified Students and Minimally Qualified Students

The findings presented so far considered all students who were at least minimally qualified for college. That is, they had either a minimum of a 2.7 high school GPA, a class percentile rank of at least 54, a NELS test composite of at least 56, a combined SAT score of at least 820, or a composite ACT score of at least 19. A wide range of ability and knowledge is included within this group of at least minimally college-qualified students, from students who were barely qualified for a 4-year college (e.g., they had an SAT of 820) to those who were very highly qualified (e.g., they had an SAT of 1530).[17] Differences found in the previous section between groups defined by their parental education and race–ethnicity may be due to variability among these groups in their qualifications for college. That is, minimally qualified students may have parents with lower levels of education than those of highly qualified students. This section attempts to control for some of these differences by separating those students who were only minimally or somewhat qualified from those who were highly or very highly qualified for college.

Looking at just those students who were minimally or somewhat qualified for college, family income did not seem to be associated with either persistence or degree attainment in this group (table 4). However, white students who were only minimally or somewhat college qualified were much more likely than black and Hispanic students to have earned a bachelor's degree after 4 years—30 percent of whites compared with 12 and 13 percent of blacks and Hispanics, respectively (table 4).

Looking at just those students who were highly or very highly college qualified revealed somewhat different patterns (table 5). Highly or very highly qualified students were those students whose highest value on any of the five criteria put them in the top 25 percent of 4-year college students. Minimum values were 1) a minimum high school GPA of 3.6 or higher; 2) a class rank percentile of at least 89; 3) a NELS composite test percentile of at least 90; and 4) a combined SAT of at least 1100 or a composite ACT of at least 25.

As with those minimally or somewhat qualified, there was no significant differences in the proportion of low-, middle-, and high-income students who were not enrolled and had no degree after 4 years. However, middle-income students within this group were less likely than

[17]The figure of 1530 for the highest SAT score is taken from the variable description in the NELS/BPS DAS.

high-income students to have earned a bachelor's degree after 4 years—29 percent compared with 40 percent, respectively.

Table 4—Percentage distribution of minimally or somewhat college-qualified 1992 high school graduates who enrolled in a 4-year college, according to projected persistence and attainment 4 years after high school graduation, by selected student characteristics

	Projected persistence and attainment 4 years after high school graduation			Projected highest degree attained 4 years after high school graduation			
	Attained a degree	No degree, enrolled	No degree, not enrolled	None	Certificate	Associate's degree	Bachelor's degree
Total	31.7	38.1	30.2	68.4	3.0	3.5	25.2
Sex							
Male	23.5	41.0	35.6	76.5	1.9	2.2	19.4
Female	38.7	35.7	25.7	61.3	3.9	4.7	30.2
Race–ethnicity							
White, non-Hispanic	36.3	36.3	27.4	63.7	2.5	4.2	29.5
Black, non-Hispanic	21.9	39.6	38.5	78.1	7.2	2.5	12.2
Hispanic	15.1	64.2	20.6	84.9	2.7	0	12.5
Asian/Pacific Islander	18.0	29.8	52.3	82.0	0	1.1	16.9
American Indian/Alaskan Native	—	—	—	—	—	—	—
Family income							
Low (less than $25,000)	27.5	37.3	35.2	72.5	5.2	1.9	20.3
Middle ($25,000–$74,999)	32.0	39.1	28.9	68.0	3.2	5.1	23.7
High ($75,000 or more)	36.1	36.8	27.1	63.9	1.3	3.2	31.7
Parents' educational level							
High school or less	24.7	36.3	39.0	75.3	4.2	0.6	19.9
Some college	28.6	39.8	31.6	71.4	4.0	4.2	20.4
College graduate	38.7	37.3	24.1	61.3	1.5	4.7	32.5
Number of risk factors*							
None	31.7	35.8	32.5	68.3	2.9	2.3	26.5
One	33.4	42.3	24.3	66.6	2.4	4.5	26.5
Two	27.9	34.4	37.7	72.1	5.1	5.3	17.5
Three or more	19.3	44.8	35.9	80.7	5.7	0	13.6

—Sample size too small for a reliable estimate.

*Risk factors are low SES quartile, average grades of Cs or lower from sixth to eighth grade, changed schools two or more times other than normal progression, lived in a single-parent family, had one or more older siblings who dropped out of high school, or held back a grade before.

NOTE: Percentages may not sum to 100 due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, merged data from the National Education Longitudinal Study and the Beginning Postsecondary Student Longitudinal Study (NEB), Data Analysis System.

Table 5—Percentage distribution of highly or very highly college-qualified 1992 high school graduates who enrolled in a 4-year college, according to projected persistence and attainment 4 years after high school graduation, by selected student characteristics

	Projected persistence and attainment 4 years after high school graduation			Projected highest degree attained 4 years after high school graduation			
	Attained a degree	No degree, enrolled	No degree, not enrolled	None	Certificate	Associate's degree	Bachelor's degree
Total	38.4	39.1	22.6	61.6	1.7	4.2	32.5
Sex							
Male	29.9	46.1	24.0	70.1	1.2	4.7	23.9
Female	46.1	32.7	21.3	54.0	2.2	3.7	40.2
Race–ethnicity							
White, non-Hispanic	39.3	40.2	20.6	60.7	1.8	4.6	32.9
Black, non-Hispanic	16.4	38.1	45.5	83.7	1.4	1.1	13.8
Hispanic	35.6	31.4	32.9	64.4	2.0	0	33.6
Asian/Pacific Islander	43.2	34.2	22.7	56.8	1.0	4.7	37.4
American Indian/Alaskan Native	—	—	—	—	—	—	—
Family income							
Low (less than $25,000)	37.1	37.8	25.2	63.0	1.5	3.1	32.4
Middle ($25,000–$74,999)	35.7	39.9	24.4	64.3	1.9	5.2	28.6
High ($75,000 or more)	45.2	36.5	18.3	54.8	2.1	3.2	40.0
Parents' educational level							
High school or less	34.4	41.0	24.5	65.6	3.2	3.5	27.7
Some college	34.8	40.0	25.2	65.2	1.7	2.9	30.2
College graduate	40.9	38.1	21.1	59.1	1.6	5.1	34.2
Number of risk factors*							
None	38.8	40.2	21.0	61.2	1.3	4.1	33.4
One	36.9	35.1	28.0	63.1	2.8	3.2	30.9
Two	37.6	46.2	16.3	62.4	3.1	5.5	29.0
Three or more	36.6	40.5	23.0	63.4	0	0	36.5

—Sample size too small for a reliable estimate.

*Risk factors are low SES quartile, average grades of Cs or lower from sixth to eighth grade, changed schools two or more times other than normal progression, lived in a single-parent family, had one or more older siblings who dropped out of high school, or held back a grade before.

NOTE: Percentages may not sum to 100 due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, merged data from the National Education Longitudinal Study and the Beginning Postsecondary Student Longitudinal Study (NEB), Data Analysis System.

The pattern among racial–ethnic groups was also somewhat different for just those students who had been highly or very highly qualified compared with the other groups of students examined above (table 5). While white students who were only minimally or somewhat college qualified were more likely than Hispanic students to have earned a bachelor's degree after 4 years,

these differences did not exist among those students who were highly or very highly qualified. About 33 percent of white highly or very highly qualified students had earned bachelor's degrees compared with 34 percent of Hispanics.

However, black students who were highly qualified or very highly qualified were less likely than whites or Hispanics to have earned a bachelor's degree (or any degree or certificate) 4 years after enrolling in a 4-year college. About 14 percent of blacks were projected to have earned a bachelor's degree. Four years after first enrolling in a 4-year college, a projected 46 percent of black highly or very highly qualified students were no longer enrolled in college and had not earned any kind of degree or certificate.

Student Debt[18]

About half of all undergraduate students in the United States receive student financial aid to support their education. Who borrows and the amount they borrow is heavily dependent on the student's enrollment status (full- or part-time), their dependency status (whether they still live with their parents), and the type of institution they attend (e.g., 4-year private, 2-year public). Using the merged NELS/BPS data set, one can project who among the high school class of 1992 received financial aid in their first four years of undergraduate education and the amount that they borrowed. About half of all 1992 high school graduates who enrolled in a 4-year institution borrowed for their education (table 6).[19] The proportion that borrowed varied little regardless of whether they finished their education or not. About 51 percent of those who attained a degree after 5 years had borrowed, 57 percent of those who had not received a degree but were still enrolled had borrowed, and about 46 percent of those who were no longer enrolled and had no degree had borrowed. The percentage that received a loan also did not vary greatly by college qualifications—approximately the same proportion borrowed whether they were minimally qualified or very highly qualified.[20]

The picture changes somewhat when one looks at the amount that students borrowed for their education (table 7). Four years after high school graduation, those who were projected to have no degree and not be enrolled had borrowed less than those who attained a degree—$5,800 compared with $11,200. This may be due to a number of factors, including the type of institution in which the students enrolled, their full-time or part-time status, or their dependency status.

[18]The BPS:89/90 collected data on total amount borrowed during the first four years of college but did not attempt to collect data on the amount of grants that students received. Therefore this section examines only loans rather than loans and grants.

[19]This includes borrowing from all sources, federal, state, institutional, and personal.

[20]Hispanic students who earned a degree appear to have borrowed at higher rates than students from other racial–ethnic groups. However, this difference is not statistically significant at conventional levels.

Table 6—Percentage of college-qualified[1] 1992 high school graduates who borrowed for their education according to projected persistence and attainment 4 years after high school graduation, by selected student characteristics

	Projected persistence and attainment 4 years after high school graduation			Projected highest degree attained 4 years after high school graduation		
	Attained a degree	No degree, enrolled	No degree, not enrolled	None	Associate's degree	Bachelor's degree
Total	51.1	56.5	45.6	52.4	58.5	50.0
Sex						
Male	54.9	58.3	45.9	53.7	69.9	51.8
Female	48.9	54.7	45.2	51.2	46.2	49.0
Race–ethnicity						
White, non-Hispanic	49.8	54.5	46.3	51.6	59.5	48.7
Black, non-Hispanic	52.7	66.2	43.3	56.1	—	47.3
Hispanic	73.3	65.9	43.5	57.7	—	71.6
Asian/Pacific Islander	53.4	58.8	40.0	49.7	—	53.5
American Indian/Alaskan Native	—	—	—	—	—	—
College qualification						
Minimally qualified	49.5	55.1	41.5	49.1	—	49.0
Somewhat qualified	48.4	59.0	53.8	57.0	—	49.9
Highly qualified	49.5	62.4	41.9	54.9	65.7	48.0
Very highly qualified	54.7	48.5	45.0	47.3	70.7	52.2

—Sample size too small for a reliable estimate.

[1]Minimally qualified for attending a 4-year institution and enrolled in a 4-year institution.

SOURCE: U.S. Department of Education, National Center for Education Statistics, merged data from the National Education Longitudinal Study and the Beginning Postsecondary Student Longitudinal Study (NEB), Data Analysis System.

While a full understanding of the association of degree attainment and borrowing is beyond the scope of this report, it is informative to look at the amount of debt burden that accrued to students who left the 4-year sector without receiving any type of degree. In particular, highly qualified students ended their initial college career with a larger debt burden that did those less qualified. Of those minimally qualified students who entered a 4-year institution, about 42 percent had taken out a loan and had borrowed an average of about $3,600. Of the 21 percent of highly qualified students who had no degree and were not enrolled (table 3), about 45 percent had borrowed for their education and had borrowed about $8,000.[21]

[21]NEB Data Analysis System.

Table 7—Average amount borrowed among college-qualified[1] 1992 high school graduates who borrowed for their education, according to projected persistence and attainment 4 years after high school graduation, by selected student characteristics

	Projected persistence and attainment 4 years after high school graduation			Projected highest degree attained 4 years after high school graduation		
	Attained a degree	No degree, enrolled	No degree, not enrolled	None	Associate's degree	Bachelor's degree
Total	$11,229	$9,321	$5,797	$8,186	$6,931	$12,227
Sex						
Male	11,349	9,100	5,035	7,816	—	13,196
Female	11,155	9,557	6,565	8,574	—	11,693
Race–ethnicity						
White, non-Hispanic	11,394	9,200	6,042	8,214	7,320	12,366
Black, non-Hispanic	6,646	9,480	5,473	8,118	—	7,760
Hispanic	11,325	10,390	4,244	8,701	—	11,778
Asian/Pacific Islander	11,937	9,215	5,537	7,782	—	12,842
American Indian/Alaskan Native	—	—	—	—	—	—
College qualification						
Minimally qualified	11,739	9,379	3,599	7,232	—	12,534
Somewhat qualified	10,488	10,132	5,165	8,326	—	11,615
Highly qualified	10,733	9,519	5,728	8,455	—	11,965
Very highly qualified	11,904	8,251	7,996	8,171	—	12,659

—Sample size too small for a reliable estimate.

[1]Minimally qualified for attending a 4-year institution and enrolled in a 4-year institution.

SOURCE: U.S. Department of Education, National Center for Education Statistics, merged data from the National Education Longitudinal Study and the Beginning Postsecondary Student Longitudinal Study (NEB), Data Analysis System.

Summary of Tabular Results

The original question posed by this analysis was what happens to college-qualified students once they enter a 4-year institution. Research by Berkner and Chavez had shown that the well-known differences in college enrollment rates for different groups of students were attenuated when one considered only those students who were qualified for college. The initial portion of this analysis summarized these findings by showing that for college-qualified students there were few differences in 4-year enrollment among students from different racial–ethnic backgrounds or from different families with different income levels. College-qualified students whose parents had a college degree enrolled at rates higher than other students, but the difference was less for college-qualified students than for students as a whole.

Furthermore, in analyzing the outcomes of college-qualified students after they enrolled in a 4-year college or university, there appeared to be few differences associated with two factors that are usually correlated with educational outcomes. That is, family income and prior academic risk factors did not seem to be variables associated with either persistence or attainment.

However, among all college-qualified students, those with college-educated parents were more likely than other college-qualified students to persist and/or attain a bachelor's degree in 4 years. This makes some intuitive sense if one again imagines the path to a 4-year degree as a river with many bends and twists to it. College-educated parents have already navigated this same river and may be able to help their children see beyond the next bend and keep them on course. Alternatively, students with college-educated parents may have other resources at their command that other students do not—simple parental expectation and encouragement may be one of them.

A less intuitive finding was that all college-qualified black students (and even highly qualified black students) were less likely than white peers after 4 years to have received a college degree and were more likely to no longer be enrolled. However, in analyzing these factors associated with persistence and attainment of college-qualified students, the analysis so far looked at each variable or factor individually. Many of the variables presented above are related to one another. For example, parents' education is associated with race–ethnicity. Therefore the differences in the persistence and attainment rates between highly college-qualified white and black students shown above may be due to differences in the parental education of black and white students. White students may have been more likely to have college-educated parents than did black students and, as speculated above, this may be to the advantage of white students in their pursuit of a 4-year degree.

Therefore, to isolate some of these associations, a multivariate analysis was conducted on these data. The results of this analysis are presented in the next section.

Controlling for Related Variables

In this section linear regression models are used to determine the net individual influence of each variable examined in the descriptive analysis on the persistence and attainment rates. (See appendix B for details on the multivariate methods used here.) The analysis looked at just two outcomes: 1) nonpersistence—defined as not having any degree and not being enrolled 4 years after high school, and 2) bachelor's degree attainment 4 years after graduating from high school. The sample of students was further restricted to those who were highly or very highly college qualified.

The results of this analysis of attaining a bachelor's degree are shown in table 8. The first column shows the unadjusted percentages of at least highly qualified students who had received a bachelor's degree 4 years after high school graduation. These percentages match the percentages originally shown in column 7 of table 5 above. The second column presents the adjusted percentages, for which the variation of all the other variables in the table has been controlled. The italicized row is the comparison group within a row variable. The adjusted percentages differ very little from the unadjusted percentages shown in table 5. Even after controlling for sex, parents' education, parents' income, and number of risk factors present, highly qualified black students were projected to be less likely than white students to attain a bachelor's degree.

Table 9 shows the results from the adjustment of the percentages of column 3 in table 5 above—the percentage of 1992 graduates who, after 4 years, were projected to be no longer enrolled and to have not received any type of degree. The adjusted percentages in table 9 also differ very little from the unadjusted percentages. After controlling for other variables in the table, blacks were also more likely than whites to be out of college and without a degree 4 years after high school graduation.

However, even within this group of high and very highly qualified students there was a high degree of variation in "qualifications." These differences may also be the source of the observed differences between black and white projected attainment and persistence rates. To be classified as highly or very highly college qualified, students had only to meet one of five criteria. These criteria were 1) a minimum high school GPA of 3.6 or higher; 2) a class rank percentile of at least 89; 3) a NELS composite test percentile of at least 90; or 4) a combined SAT of at least 1100 or a composite ACT of at least 25. Therefore, a highly qualified student could have

Table 8—Percentage of highly or very highly college-qualified 1992 high school graduates who enrolled in a 4-year college, projected to complete the bachelor's degree, and the adjusted percentage after taking into account the covariation of the variables listed in the table[1]

	Unadjusted percentage[2]	Adjusted percentage[3]	OLS coefficient[4]	Standard error[5]
Total	32.5	32.6	22.48	5.41
Sex				
Male	*23.9*	*23.4*	*†*	*†*
Female	40.2 *	40.7 *	17.30	2.65
Race–ethnicity				
White, non-Hispanic	*32.9*	*33.0*	*†*	*†*
Black, non-Hispanic	13.8 *	13.9 *	-19.13	6.82
Hispanic	33.6	38.7	5.76	6.10
Asian/Pacific Islander	37.4	35.9	2.92	5.13
Family income				
Low (less than $25,000)	*32.4*	*34.4*	*†*	*†*
Middle ($25,000–$74,999)	28.6	28.8	-5.62	4.03
High ($75,000 or more)	40.0	40.0	5.64	4.79
Parents' educational level				
High school or less	*27.7*	*29.1*	*†*	*†*
Some college	30.2	32.2	3.07	4.80
College graduate	34.2	33.6	4.46	4.69
Number of risk factors**				
None	*33.4*	*33.1*	*†*	*†*
One	30.9	31.0	-2.09	3.04
Two	29.0	33.7	0.53	6.02
Three or more	36.5	42.3	9.22	13.07

*$p \leq .05$.

**Risk factors are low SES quartile, average grades of Cs or lower from sixth to eighth grade, changed schools two or more times other than normal progression, lived in a single-parent family, had one or more older siblings who dropped out of high school, or held back a grade before.

†Not applicable for the reference group.

[1]The italicized group in each category is the reference group being compared.

[2]The estimates are from the NEB Data Analysis System.

[3]The percentages are adjusted for differences associated with other variables in the table (see appendix B). The percentages are also adjusted for differences associated with 1992 SAT total score.

[4]Ordinary least squares (OLS) coefficient, multiplied by 100 to reflect percentage (see appendix B).

[5]Standard error of OLS coefficient, adjusted for design effect, multiplied by 100 to reflect percentage (see appendix B).

SOURCE: U.S. Department of Education, National Center for Education Statistics, merged data from the National Education Longitudinal Study and the Beginning Postsecondary Student Longitudinal Study (NEB), Data Analysis System.

Table 9—Percentage of highly or very highly college-qualified 1992 high school graduates who enrolled in a 4-year college, projected to complete no degree and not be enrolled, and the adjusted percentage after taking into account the covariation of the variables listed in the table[1]

	Unadjusted percentage[2]	Adjusted percentage[3]	OLS coefficient[4]	Standard error[5]
Total	22.6	22.7	22.45	5.36
Sex				
Male	*24.0*	*24.8*	*†*	*†*
Female	21.3	20.9 *	-3.83	2.63
Race–ethnicity				
White, non-Hispanic	*20.6*	*20.6*	*†*	*†*
Black, non-Hispanic	45.5 *	46.5 *	25.81	6.76
Hispanic	32.9	32.4 *	11.72	6.05
Asian/Pacific Islander	22.7	23.6 *	2.97	5.09
Family income				
Low (less than $25,000)	*25.2*	*22.1*	*†*	*†*
Middle ($25,000–$74,999)	24.4	24.1	2.07	3.99
High ($75,000 or more)	18.3	20.0	-2.03	4.75
Parents' educational level				
High school or less	*24.5*	*23.9*	*†*	*†*
Some college	25.2	23.7	-0.19	4.76
College graduate	21.1	21.9 *	-1.96	4.65
Number of risk factors**				
None	*21.0*	*30.1*	*†*	*†*
One	28.0	27.1 *	5.10	3.02
Two	16.3	9.9 *	-12.11	5.97
Three or more	23.0	20.5	-1.46	12.96

*$p \leq .05$.

**Risk factors are low SES quartile, average grades of Cs or lower from sixth to eighth grade, changed schools two or more times other than normal progression, lived in a single-parent family, had one or more older siblings who dropped out of high school, or held back a grade before.

†Not applicable for the reference group.

[1]The italicized group in each category is the reference group being compared.

[2]The estimates are from the NEB Data Analysis System.

[3]The percentages are adjusted for differences associated with other variables in the table (see appendix B).

[4]Ordinary least squares (OLS) coefficient, multiplied by 100 to reflect percentage (see appendix B).

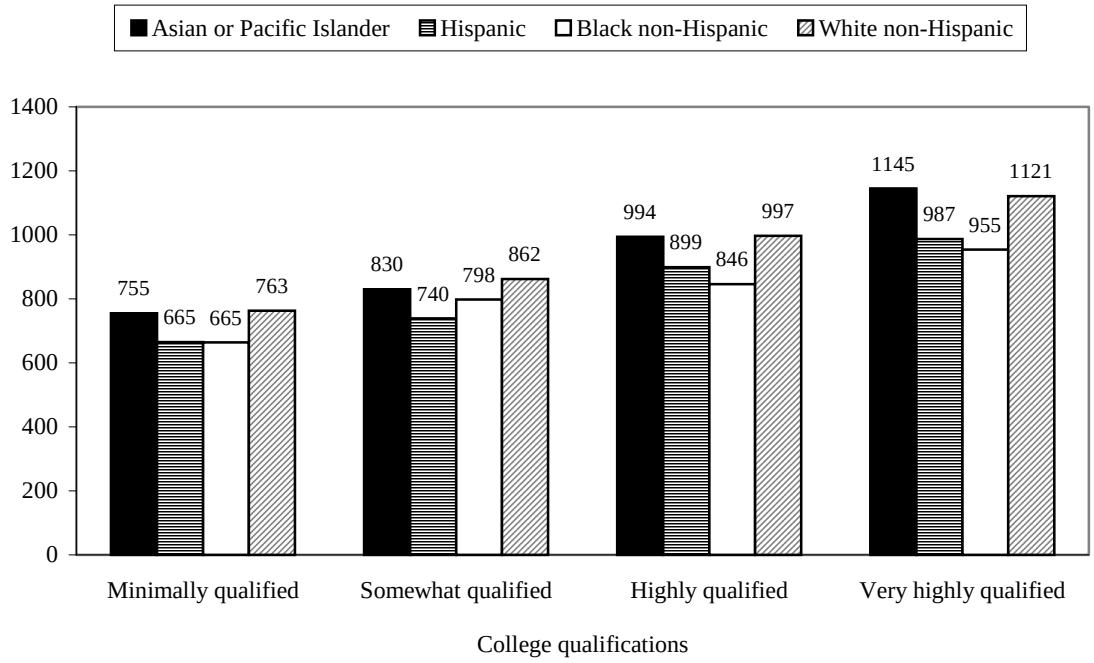
[5]Standard error of OLS coefficient, adjusted for design effect, multiplied by 100 to reflect percentage (see appendix B).

SOURCE: U.S. Department of Education, National Center for Education Statistics, merged data from the National Education Longitudinal Study and the Beginning Postsecondary Student Longitudinal Study (NEB), Data Analysis System.

been in the top 10 percent of his or her high school class, but still have relatively low SAT scores. For example, within the categories of "highly qualified" and "very highly qualified" there was significant variation among racial–ethnic groups in their mean SAT scores (figure 7). Black highly qualified students had an average SAT score 151 points lower than white highly qualified students, while black very highly qualified students had SAT scores 166 points below those of very highly qualified white students. These differences in qualifications may be confounding the association of race–ethnicity with persistence and attainment among highly qualified students.

To further control for this variation in academic background, individual SAT scores are added as a control variable in tables 10 and 11 (while not actually presented as a row variable).[22]

Figure 7—Average SAT scores for 1992 college-qualified* high school graduates by race–ethnicity and level of college qualifications: 1994



*At least minimally qualified.

NOTE: Percentages may not sum to 100 due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study and Beginning Postsecondary Students Longitudinal Study Linkage Data File (NEB), Data Analysis System.

[22]About 30 percent of the sample did not have SAT scores and were eliminated from this part of the analysis.

The percentage of highly or very highly qualified black students projected to have finished a bachelor's degree after 4 years was no longer statistically different from the rate for whites (table 10) (although it was significant at the 0.10 level). However, the percentage of black students projected to no longer be enrolled without obtaining a degree was still significantly higher than the percentage for whites, even after holding individual SAT scores constant (table 11).

Table 10—Percentage of highly or very highly college-qualified 1992 high school graduates who enrolled in a 4-year college, projected to complete the bachelor's degree, and the adjusted percentage after taking into account the covariation of the variables listed in the table and SAT score[1]

	Unadjusted percentage[2]	Adjusted percentage[3]	OLS coefficient[4]	Standard error[5]
Total	32.5	32.7	2.71	10.50
Sex				
Male	*23.9*	*22.7*	†	†
Female	40.2 *	41.4 *	18.62	3.23
Race–ethnicity				
White, non-Hispanic	*32.9*	*32.9*	†	†
Black, non-Hispanic	13.8 *	16.8	-16.04	8.28
Hispanic	33.6	40.0	7.17	7.35
Asian/Pacific Islander	37.4	34.6	1.79	6.17
Family income				
Low (less than $25,000)	*32.4*	*34.0*	†	†
Middle ($25,000–$74,999)	28.6	29.4	-4.66	4.85
High ($75,000 or more)	40.0	39.0	5.02	5.75
Parents' educational level				
High school or less	*27.7*	*30.9*	†	†
Some college	30.2	33.0	2.06	5.77
College graduate	34.2	32.8	1.91	5.73
Number of risk factors**				
None	*33.4*	*33.0*	†	†
One	30.9	31.1	-1.93	3.65
Two	29.0	35.0	1.97	7.24
Three or more	36.5	39.1	6.08	15.74

	Mean	OLS coefficient	Standard error
SAT score	1062	0.00019	0.00006

*$p \leq .05$.

**Risk factors are low SES quartile, average grades of Cs or lower from sixth to eighth grade, changed schools two or more times other than normal progression, lived in a single-parent family, had one or more older siblings who dropped out of high school, or held back a grade before.

†Not applicable for the reference group.

[1]The italicized group in each category is the reference group being compared.

[2]The estimates are from the NEB Data Analysis System.

[3]The percentages are adjusted for differences associated with other variables in the table (see appendix B).

[4]Ordinary least squares (OLS) coefficient, multiplied by 100 to reflect percentage (see appendix B).

[5]Standard error of OLS coefficient, adjusted for design effect, multiplied by 100 to reflect percentage (see appendix B).

SOURCE: U.S. Department of Education, National Center for Education Statistics, merged data from the National Education Longitudinal Study and the Beginning Postsecondary Student Longitudinal Study (NEB), Data Analysis System.

Table 11—Percentage of highly or very highly college-qualified 1992 high school graduates who enrolled in a 4-year college, projected to have no degree and not be enrolled, and the adjusted percentage after taking into account the covariation of the variables listed in the table and SAT score[1]

	Unadjusted percentage[2]	Adjusted percentage[3]	OLS coefficient[4]	Standard error[5]
Total	22.6	22.7	38.18	10.42
Sex				
Male	*24.0*	*25.3*	†	†
Female	21.3	20.4	-4.88	3.20
Race–ethnicity				
White, non-Hispanic	*20.6*	*20.8*	†	†
Black, non-Hispanic	45.5 *	44.1 *	23.34	8.22
Hispanic	32.9	31.4	10.60	7.29
Asian/Pacific Islander	22.7	24.6	3.87	6.13
Family income				
Low (less than $25,000)	*25.2*	*22.4*	†	†
Middle ($25,000–$74,999)	24.4	23.7	1.31	4.81
High ($75,000 or more)	18.3	20.8	-1.54	5.71
Parents' educational level				
High school or less	*24.5*	*22.5*	†	†
Some college	25.2	23.1	0.62	5.73
College graduate	21.1	22.6	0.07	5.68
Number of risk factors**				
None	*21.0*	*30.1*	†	†
One	28.0	27.0	4.97	3.62
Two	16.3	8.8	-13.26	7.19
Three or more	23.0	23.1	1.05	15.62

	Mean	OLS coefficient	Standard error
SAT score	1062	-0.00015	0.00005

*p ≤ .05.

**Risk factors are low SES quartile, average grades of Cs or lower from sixth to eighth grade, changed schools two or more times other than normal progression, lived in a single-parent family, had one or more older siblings who dropped out of high school, or held back a grade before.

†Not applicable for the reference group.

[1]The italicized group in each category is the reference group being compared.

[2]The estimates are from the NEB Data Analysis System.

[3]The percentages are adjusted for differences associated with other variables in the table (see appendix B).

[4]Ordinary least squares (OLS) coefficient, multiplied by 100 to reflect percentage (see appendix B).

[5]Standard error of OLS coefficient, adjusted for design effect, multiplied by 100 to reflect percentage (see appendix B).

SOURCE: U.S. Department of Education, National Center for Education Statistics, merged data from the National Education Longitudinal Study and the Beginning Postsecondary Student Longitudinal Study (NEB), Data Analysis System.

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Summary

It is well known that there are overall disparities in the college enrollment rates of students from different socioeconomic and racial–ethnic backgrounds. Low-income students and underrepresented minority students enroll in 4-year colleges and universities at lower rates than do white students. Research by Berkner and Chavez cited in this report has demonstrated that if students are college qualified and if they take the appropriate steps that lead to enrolling in a 4-year college or university, these differences in enrollment rates diminish. These findings were repeated in the beginning sections of this report.

The contribution of this report was to project, to 4 years after high school completion, the persistence and attainment rates for those college-qualified students in the high school class of 1992 who enrolled in a 4-year institution in the 1992–93 academic year. Generally, 4 years later, outcomes were similar for college-qualified students despite initial differences in demographic backgrounds. Among all college-qualified students, those who had a parent with a college degree were more likely to have persisted and to have attained a degree, but this appeared to be the result of the higher overall college qualifications of students whose parents had a college education. Among students who were minimally or somewhat qualified and again among students who were highly or very highly qualified, parental education was not associated with higher projected persistence or attainment rates.

The one comparison that stood out in this analysis was the difference between white and black projected persistence and attainment rates. While the statistical methods that were employed were quite simple, none of the statistical controls that were applied to the data had the effect of eliminating these differences. Controlling for parents' education, family income, and the student's SAT scores did not significantly affect this basic finding. This finding does conform to results found by other researchers that even highly qualified black college students graduate at lower rates than their white peers. For example, Vars and Bowen found that in the 11 selective schools they studied, black students at every level of SAT score had lower grades and graduated at lower rates than comparable white students.[23] They also found that the performance gap between whites and blacks was greatest for those at the highest SAT score levels.

[23]F.E. Vars and W. Bowen, "Scholastic Aptitude Test Scores, Race, and Academic Performance in Selective Colleges and Universities," in C. Jencks and M. Phillips (eds.), *The Black-White Test Score Gap* (Washington, D.C.: Brookings Institution Press, 1998).

However, because the present study examined *projected* persistence and attainment rates and the methods used to analyze the data were basically descriptive in nature, this study can only suggest conclusions about actual attainment rates and persistence rates. That our results conform to results found elsewhere should give one confidence that our projections are accurate in the aggregate.

Appendix A—Glossary

This glossary describes the variables used in this report. The items were taken directly from the National Education Longitudinal Study: 1988–94 and Beginning Postsecondary Student Study: 1989–90 Linkage Data File Data Analysis System (DAS) (see appendix B for a description of the DAS). These variables were either items taken directly from the NELS or BPS surveys or they were derived by combining one or more items in these surveys. Unless otherwise noted, the variable labels are those appearing in the DAS.

Glossary Index

Applied to a 4-year institution APP4YR
Weight for BPS imputed data ..... BPSLNKWT
Number of risk factors 1988 ..... BYRISK2
4-year college qualification composite CQCOMV2
Ever took SAT/ACT/applied to 4-year college (composite)..... EXMAPLY2
1992 NELS test percentile F22XCEN
Family income in 1991 ..... F2P74
Parents' highest education level 1992..... F2PARED
ACT composite 1992 ..... F2RACTC
Weight for 1992 high school graduates ... F3QWT92G
Race–ethnicity 1994 ..... F3RACE
High school class rank percentile 1992 ... F3RANK_C
Type of first postsecondary institution..... F3SEC2A1
Gender as of 1994 ..... F3SEX
High school GPA (high school transcripts) ..... GPA
Postsecondary persistence and attainment in academic year 1989–90..... P8990
Postsecondary persistence and attainment in academic year 1990–91..... P9091
Postsecondary persistence and attainment in academic year 1991–92..... P9192
Postsecondary persistence and attainment in academic year 1992–93..... P9293
Took first step in PSE pipeline PIPE1
Took at least 2 sequential steps in PSE pipeline PIPE2
Took at least 3 sequential steps in PSE pipeline PIPE3
Took at least 4 sequential steps in PSE pipeline PIPE4
Took all 5 sequential steps in PSE pipeline PIPE5
Delayed PSE enrollment (matched to BPS) ..... PSEDELAY
Enrollment status first PSE institution (matched to BPS) ..... PSEFTPT
Institution type of first PSE enrollment ..... PSETYPE
Combined SAT score ..... SAT
High attainment and persistence status in AY89–90 ..... STS8990
Highest attainment and persistence status in AY90–91 ..... STS9091
Highest attainment and persistence status in AY91–92 ..... STS9192
Highest attainment and persistence status in AY92–93 ..... STS9293
Ever took SAT/ACT ..... TOOKEXAM

Applied to a 4-year institution **APP4YR**

This derived variable describes whether or not a respondent ever applied to a 4-year institution. It is based primarily on student-reported data.

Yes	Respondent applied to a 4-year postsecondary institution.
No	Respondent did not apply to a 4-year postsecondary institution.

Weight for BPS imputed data **BPSLNKWT**

Weight created for the BPS/NELS study where BPS persistence variables are used to project persistence and attainment by NELS participants over a five-year time period.

Number of risk factors 1988 **BYRISK2**

Number of risk factors 1988. The sum of 6 possible risk factors determined to increase the chances of dropping out of high school after controlling for SES and race/ethnicity. Note that this variable is different from BYATRISK. All of the risk factors were identified in 8th grade with the exception of students having older siblings who dropped out of high school, which was asked in the tenth grade. If a student had missing data for 2 or more risk items, the variable was set to missing. Risk factors are as follows: 1. Low SES (BYSES); 2. Single parent family (BYFCOMP); 3. Older sibling dropped out (F1S94); 4. Changed schools 2 or more times (BYP40) (reported by the parent); 5. Average grades of Cs or lower from 6th to 8th grades (BYGRD68); 6. Repeated an earlier grade (BYS74).

None
One
Two
Three
Four
Five
Six or more
Missing, legitimate skip

4-year college qualification composite **CQCOMV2**

For this study, a composite measure of 4-year college readiness or qualification index was developed that uses cumulative academic coursework GPAs, senior class rank, the NELS 1992 test scores, and the SAT and ACT college entrance examination scores. Since admission standards and requirements vary widely among 4-year colleges and universities, the approach used here was to examine the actual distribution of these five measures of academic aptitude and achievement among those graduating seniors who did attend a 4-year college or university. Data sources were available for approximately half (45 percent) of the NELS graduating seniors for four or five of the criteria: class rank, GPA, the NELS test, and ACT or SAT scores or both. For about one-third of the seniors there were only three data sources available because they had no ACT or SAT scores. All of these had NELS test scores, however. In order to identify as many students as possible who were potentially academically qualified for a 4-year college, even if data were missing for these students on some of the criteria, the seniors were classified according to the *highest* level they had achieved on *any* of the five criteria for which data were present.

The initial classification of the graduating seniors was determined as follows:

- Very highly qualified: those whose highest value on any of the five criteria would put them among the top 10 percent of 4-year college students (specifically the NELS 1992 graduating seniors who enrolled in 4-year col-

leges and universities) for that criterion. Minimum values were GPA=3.7, class rank percentile=96, NELS test percentile=97, combined SAT=1250, composite ACT=28.

- Highly qualified: those whose highest value on any of the five criteria would put them among the top 25 percent of 4-year college students for that criterion. Minimum values were GPA=3.6, class rank percentile=89, NELS test percentile=90, combined SAT=1110, composite ACT=25.

- Somewhat qualified: those whose highest value on any of the five criteria would put them among the top 50 percent (i.e., in the second quartile) of 4-year college students for that criterion. Minimum values were GPA=3.2, class rank percentile=75, NELS test percentile=76, combined SAT=960, composite ACT=22.

- Minimally qualified: those whose highest value on any of the five criteria would put them among the top 75 percent (i.e., in the third quartile) of 4-year college students for that criterion. Minimum values were GPA=2.7, class rank percentile=54, NELS test percentile=56, combined SAT=820, composite ACT=19. [Those in vocational programs (according to their high school transcript) were classified as not college qualified.]

- Marginally or not qualified: those who had no value on any criterion that would put them among the top 75 percent of 4-year college students (i.e., all values were in the lowest quartile).

Then some adjustments were made for programs of rigorous academic coursework, defined as including at least 4 years of English; 3 years each of science, mathematics, and social studies; and 2 years of a foreign language.

Those who had taken a program of rigorous academic courses were moved up into one higher level of qualification: and

Those in the "very highly qualified" category were moved down into the "highly qualified" category if they had not taken the rigorous academic coursework;

Marginally or not qualified	Student was marginally or not qualified to attend a 4-year college.
Minimally qualified	Student was minimally qualified to attend a 4-year college.
Somewhat qualified	Student was somewhat qualified to attend a 4-year college.
Highly qualified	Student was highly qualified to attend a 4-year college.
Very highly qualified	Student was very highly qualified to attend a 4-year college.

For some tables, students were identified as "college qualified" if they were other than "marginally or not qualified" for the variable **CQCOMV2**.

Ever took SAT/ACT/applied to 4-year college (composite) **EXMAPLY2**

This variable resolves the inconsistencies in student reporting of where they applied and where they were first enrolled (EXMAPLY1). The specific purpose of this composite variable is to consider type of institution first attended (PSEFIRTY). Students who attended a 4-year institution (as revealed in PSEFIRTY) probably applied to such an institution. Therefore, students who indicated that the first type of postsecondary institution they enrolled in was a 4-year institution were considered to have applied to at least one 4-year institution for the purpose of determining the steps students must take in order to attend a 4-year college. First, EXMAPLY2 was set equal to EXMAPLY1. If EXMAPLY1 was equal to 2 (student took exam but did not apply) and they indicated that their first type of postsecondary institution was a 4-year institution, EXMAPLY2 was set equal to 1 (took exam and applied). Similarly, if EXMAPLY1 was equal to 4 (student did not take an exam nor did they apply) and they indicated that their first type of postsecondary institution was a 4-year institution, EXMAPLY2 was set equal to 3 (did not take exam but applied).

Took exam and applied
Took exam, did not apply
Did not take exam, applied
Did neither
Missing, legitimate skip

1992 NELS test percentile **F22XCEN**

The source for this variable was the composite variable consisting of math and reading NELS Second Follow-up test scores. To create the derived variable, a ranking was created by first calculating a weighted frequency distribution of test composite variables. Next, cutoff points were determined and numbered sequentially from 1 to 99.

Family income in 1991 **F2P74**

In 1992, parents were asked, "What was your total gross family income from all sources before taxes in 1991 (If you are not sure of the amount, please estimate)?" For purposes of this report, the original 13 income categories were collapsed into three.

Low (less than $25,000)	Family income was less than $25,000.
Middle ($25,000–$74,999)	Family income was between $25,000 and $74,999.
High ($75,000 or higher)	Family income was $75,000 or higher.

Parents' highest education level 1992 **F2PARED**

This composite characterizes the level of education attained by the parent with the highest reported education level. It was constructed using second follow-up parent questionnaire data; data from earlier survey waves were used if data were missing. For purposes of this report, levels of education were collapsed to create three categories.

High school graduate or less	Highest level of parental education was either high school graduation or less than high school graduation.
Some college	Highest level of parental education was greater than high school and less than 4-year degree.
College graduate	Highest level of parental education was college graduate, M.A. or equivalent, or Ph.D., M.D., or other professional degree.

ACT composite 1992 **F2RACTC**

American College Test (composite score). The valid range for this test score is 1 to 36.

Weight for 1992 high school graduates **F3QWT92G**

F3QWT92G contains F3QWT for respondents who received a high school diploma between September 1, 1991 and August 31, 1992 or respondents whose diploma receipt date is not known but who began their postsecondary education during the period of June 1992 through October 1992. It allows projections to the population of persons who received a high school diploma during those time periods and were eligible to complete questionnaires in 1992 and 1994.

Race–ethnicity 1994 **F3RACE**

Frequencies for this variable were created with F3QWT. "What is your racial or ethnic background?" Interviewer: If necessary, probe by reading response categories.

Asian or Pacific Islander
Hispanic, regardless of race
Black, not of Hispanic origin
White, not of Hispanic origin
American Indian or Alaskan Native
Other

1992 data for this variable were preloaded into the CATI instrument. The question was asked only in instances where the 1992 value was missing. If it became apparent from responses to other questions that the preloaded value was incorrect, this variable's value was corrected. This question was not asked at all in the hard copy questionnaire and 1992 values were used for these sample members. Sample members with the value of Other were assigned the value -1 for this data file.

Asian or Pacific Islander
Hispanic regardless of race
Black not of Hispanic origin
White not of Hispanic origin
American Indian or Alaskan Native
Missing, legitimate skip

High school class rank percentile 1992 **F3RANK_C**

Frequencies for this variable were calculated with F3QWT. F3RANK_C is a measure of a student's class rank during the last year he or she attended high school. It draws on F2RRANK (class rank for last year attended) and F2RCSIZE (class size for last year attended) from the 1992 transcript data and the 1994 cross sectional weight, F3QWT. It is calculated by dividing the class rank by the class size and subtracting the result from 1. The weighted distribution of these values is determined using F3QWT and percentiles assigned. The valid values of the percentiles ranges from 1–99, with the first 1.5 percent assigned the value 1 and the highest 1.5 percent assigned the value of 99. The value of 99 thus indicates the highest-ranking students and the value of 1 indicates the lowest.

Type of first postsecondary institution **F3SEC2A1**

Frequencies for this variable were created with F3QWT. This variable contains the institution type associated with the first institution attended. The primary source is the SECTOR variable in the 1993/94 Integrated Postsecondary Education Data System (IPEDS) data file. SECTOR is recoded to 6 values for this variable. For the few instances where SECTOR is missing, the variable CONTROL from the same file is used.

None
Private, for-profit
Private, not-for-profit less-than-4-year
Public less-than-2-year
Public 2-year
Private, not-for-profit 4-year
Public 4-year
Missing, legitimate skip

Gender as of 1994 **F3SEX**

Frequencies for this variable were created with F3QWT. 1992 data for gender were preloaded into the CATI instrument and displayed to the interviewer. There were no missing values in the 1992 data and the question was never asked. In a few instances it became apparent to the interviewer that the 1992 value was incorrect and the value was corrected. The hard copy questionnaire did not include this question and 1992 values were used for the hard copy respondents.

Male
Female

High school GPA (high school transcripts) **GPA**

This variable is the overall grade point average on a 4.0 scale for all courses taken for a grade. It is multiplied by 100 for file purposes.

Postsecondary persistence and attainment in academic year 1989–90 **P8990**

The difference between this variable and PER8990R is that this variable further distinguishes those who attained a certificate/degree in AY89–90 and re-enrolled in PSE later (e.g., in AY90–91, AY91–92, or AY92–93) from those who attained a certificate/degree in AY89–90 and left without re-enrolling. Note: the status of academic year of 1993–94 (PER9394R) was not considered in making this variable.

Attained AA in AY89–90+re-enrolled later
Attained BA in AY89–90+re-enrolled later
Persisted to AY90–91
Downward/delayed transfer in AY89–90
Stopout in AY89–90
Left without return in AY89–90
Attained cert. in AY89–90+no further PSE

Postsecondary persistence and attainment in academic year 1990–91 **P9091**

The difference between this variable and PER9091R is that this variable further distinguishes those who attained a certificate/degree in AY90–91 and re-enrolled in PSE later (e.g., in AY91–92 or AY92–93) from those who attained a certificate/degree in AY90–91 and then left without re-enrolling. In addition, those identified as not enrolled, downward, delayed transfer, stopout, left, or attained a certificate/degree without further PSE in AY89–90 were coded as "Skip." Note: the status of academic year of 1993–94 (PER9394R) was not considered in making this variable.

Not enrolled
Attained cert. in AY90–91+re-enrolled later
Attained AA in AY90–91+re-enrolled later
Attained BA in AY90–91+re-enrolled later
Downward/delayed transfer in AY90–91
Persisted to AY91–92
Stopout in AY90–91
Left without return in AY90–91
Attained cert. in AY90–91+no further PSE
Attained AA in AY90–91+no further PSE
Missing

Postsecondary persistence and attainment in academic year 1991–92 **P9192**

The difference between this variable and PER9192R is that this variable further distinguishes those who attained a certificate/degree in AY91–92 and re-enrolled in PSE later (e.g., in AY92–93) from those who attained a certificate/degree in AY92–93 and left without re-enrolling. In addition, those identified as not enrolled, downward, delayed transfer, stopout, left, or attained a certificate/degree without further PSE in AY89–90 or AY90–91 were coded as "Skip." Note: the status of academic year of 1993–94 (PER9394R) was not considered in making this variable.

Not enrolled
Attained cert. in AY91–92+re-enrolled later
Attained AA in AY91–92+re-enrolled later
Attained BA in AY91–92+re-enrolled later
Downward/delayed transfer in AY91–92
Persisted to AY92–93
Stopout in AY91–92
Left without return in AY91–92
Attained cert. in AY91–92+no further PSE
Attained AA in AY91–92+no further PSE
Attained BA in AY91–92+no further PSE
Missing

Postsecondary persistence and attainment in academic year 1992–93 **P9293**

All students who were identified as not enrolled, downward/delayed transferred, stopout, left without return or attained a certificate/degree without further PSE in AY89–90, 90–91, or 91–92 were coded as "Skip."

Attained cert. in AY92–93
Attained associate's degree in AY92–93
Attained bachelor's degree in AY92–93
Persisted to AY93–94
Downward/delayed transfer in AY92–93
Stopout in AY92–93

Left without return in AY92–93
Missing

Took first step in PSE pipeline **PIPE1**

The pipeline is a cumulative sequence of 5 steps usually taken to enroll in a 4-year college (see PIPELINE for a detailed description) including:

10th grade aspirations for a bachelor's degree [see F1S49]
Academic preparation [see CQCOMV1]
Entrance exams [see EXMAPLY2]
Application to college [see EVR4YRA]
Enrollment in a 4-year college [see F3SEC2A1, if missing ENST1092]

PIPE1 identifies all those who took at least the first step which is to have 10th grade aspirations for a bachelor's degree.

No
Yes
Missing, legitimate skip

Took at least 2 sequential steps in PSE pipeline **PIPE2**

The pipeline is a cumulative sequence of 5 steps usually taken to enroll in a 4-year college (see PIPELINE for a detailed description) including:

10th grade aspirations for a bachelor's degree [see F1S49]
Academic preparation [see CQCOMV1]
Entrance exams [see EXMAPLY2]
Application to college [see EVR4YRA]
Enrollment in a 4-year college [see F3SEC2A1, if missing ENST1092]

PIPE2 identifies all who took at least the first 2 steps: having a bachelor's degree goal and being academically prepared.

No
Yes
Missing, legitimate skip

Took at least 3 sequential steps in PSE pipeline **PIPE3**

The pipeline is a cumulative sequence of 5 steps usually taken to enroll in a 4-year college (see PIPELINE for a detailed description) including:

10th grade aspirations for a bachelor's degree [see F1S49]
Academic preparation [see CQCOMV1]
Entrance exams [see EXMAPLY2]
Application to college [see EVR4YRA]
Enrollment in a 4-year college [see F3SEC2A1, if missing ENST1092]

PIPE3 identifies all who took at least the first 3 sequential steps: having a bachelor's degree goal, being academically prepared, and taking entrance exams.

No
Yes
Missing, legitimate skip

Took at least 4 sequential steps in PSE pipeline **PIPE4**

The pipeline is a cumulative sequence of 5 steps usually taken to enroll in a 4-year college (see PIPELINE for a detailed description) including:

10th grade aspirations for a bachelor's degree [see F1S49]
Academic preparation [see CQCOMV1]
Entrance exams [see EXMAPLY2]
Application to college [see EVR4YRA]
Enrollment in a 4-year college [see F3SEC2A1, if missing ENST1092]

PIPE4 identifies all who took at least the first 4 sequential steps: having a bachelor's degree goal, being academically prepared, taking entrance exams, and applying to a 4-year college.

No
Yes
Missing

Took all 5 sequential steps in PSE pipeline **PIPE5**

The pipeline is a cumulative sequence of 5 steps usually taken to enroll in a 4-year college (see PIPELINE for a detailed description) including:

10th grade aspirations for a bachelor's degree [see F1S49]
Academic preparation [see CQCOMV1]
Entrance exams [see EXMAPLY2]
Application to college [see EVR4YRA]
Enrollment in a 4-year college [see F3SEC2A1, if missing ENST1092]

PIPE5 identifies those who took all 5 steps and successfully enrolled in a 4-year college.

No
Yes
Missing, legitimate skip

Delayed PSE enrollment (matched to BPS) **PSEDELAY**

This variable was created by two variables in the third follow-up of NELS: 1) high school completion date (F3HSCPDT) and 2) first PSE enrollment date (PSEFIRDT) in the third follow-up of NELS. A value of 1 means that a student did not enroll in PSE within one year of high school graduation. A value of 2 means that a student enrolled in PSE within one year of high school graduation.

No
Yes
Missing, blank

Enrollment status first PSE institution (matched to BPS) **PSEFTPT**

This variable was recoded from PSEFIRST in the third follow-up of NELS.

Full-time
Part-time
Missing, blank

Institution type of first PSE enrollment **PSETYPE**

This variable was recoded from PSEFIRTY in the third follow-up of NELS. Students attending institutions identified as Private, for-profit or Private, not-for-profit less than 4-year were excluded from this study.

Public 2-year
Private, not-for-profit 4 year
Public 4-year
Missing, blank

Combined SAT score **SAT**

The combined scores of the Scholastic Assessment Test (SAT) verbal and math scores. The valid range is 400 to 1600.

Highest attainment and persistence status in AY89–90 **STS8990**

This variable identifies the highest attainment level and persistence status in AY89–90.

Attained certificate
No degree but enrolled
No degree and not enrolled
Missing/skip

Highest attainment and persistence status in AY90–91 **STS9091**

This variable identifies the highest attainment level and persistence status in AY90–91.

Attained certificate
Attained associate's degree
No degree but enrolled
No degree and not enrolled
Missing/skip

Highest attainment and persistence status in AY91–92 **STS9192**

This variable identifies the highest attainment level and persistence status in AY91–92.

Attained certificate
Attained associate's degree
Attained bachelor's degree
No degree but enrolled
No degree and not enrolled
Missing/skip

Highest attainment and persistence status in AY92–93 **STS9293**

This variable identifies the highest attainment level and persistence status in AY92–93.

Attained certificate
Attained associate's degree
Attained bachelor's degree
No degree but enrolled
No degree and not enrolled
Missing/skip

Ever took SAT/ACT **TOOKEXAM**

This variable was recoded from EXMAPLY2.

No
Yes
Missing, legitimate skip

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Appendix B—Technical Notes and Methodology

The NELS:88/94 and BPS:89/90 Linkage Data

The NELS:88/94 and BPS:89/90 linkage file was created to provide a set of variables from the NELS and the BPS datasets that would allow inferences to be made about the students in one dataset, based on the characteristics of students in the other survey. For example, there are high school achievement measures (e.g. qualifications for college) in the NELS survey but there are no long-term postsecondary outcome measures in the NELS survey. BPS data can be used to supplement the NELS data to obtain estimates of these long-term postsecondary outcomes.

The two datasets share a fairly extensive set of common variables describing the background characteristics of sample members. These characteristics were used to link students in each of the datasets, thereby creating a type of "synthetic cohort," to provide values for variables missing in the NELS dataset. In a sense, the data on long-term postsecondary outcomes in NELS (due to the censoring of the data 2 years after high school graduation), were treated as a huge missing data problem. These missing data were imputed for the NELS students using multiply imputation methods developed by Rubin, and later expanded upon by Rubin and Little.[24]

As a first step in this process we created the primary imputation cells from three variables of students' early postsecondary experiences: 1) type and level of first PSE institution; 2) timing of PSE entry (immediate or delayed); and 3) enrollment status (part-time vs. full-time). Within each of these cells, we performed a crosstabulation based on students' sex, race, and socioeconomic status. Because in each imputation cell, a minimal of 5 BPS donors was required for each NELS recipient, it was clear that cells defined by crossing students' sex, race, and SES in most of the primary cells needed to be collapsed in order to reach this requirement. As a result, a total of 67 imputation cells in BPS were created.

The imputation was performed through hotdecking procedures in the computer program PROC IMPUTE developed by the American Institutes for Research. In this procedure a NELS student was matched with a BPS student with replacement (WR), and the data on postsecondary outcomes for the BPS student were assigned to the NELS student. This procedure was performed 36 times to capture the measurement error associated with the imputations. A disturbance term

[24]D.B. Rubin, *Multiple Imputation for Nonresponse in Sample Surveys*, 1987, Wiley and Sons; R.J.A. Little and D.B. Rubin, *Statistical Analysis With Missing Data*, 1987, Wiley and Sons.

was added to the NELS sample weights to reflect this added source of error in the data. This disturbance term inflated the weight (BPSLNKWT) so that the variance component of the estimates associated with the size of the weight was also inflated—accurately inflating the total variance of the estimate to account for measurement error due to imputation.

Accuracy of Estimates

The statistics in this report are estimates derived from a sample. Two broad categories of error occur in such estimates: sampling and nonsampling errors. Sampling errors occur because observations are made only on samples of students, not on entire populations. Nonsampling errors occur not only in sample surveys but also in complete censuses of entire populations. Nonsampling errors can be attributed to a number of sources: inability to obtain complete information about all students in all institutions in the sample (some students or institutions refused to participate, or students participated but answered only certain items); ambiguous definitions; differences in interpreting questions; inability or unwillingness to give correct information; mistakes in recording or coding data; and other errors of collecting, processing, sampling, and imputing missing data.

Data Analysis System

The estimates presented in this report were produced using the merged data from the National Education Longitudinal Study and Beginning Postsecondary Longitudinal Study (NEB) Data Analysis System (DAS). The DAS software makes it possible for users to specify and generate their own tables from the NEB data. With the DAS, users can replicate or expand upon the tables presented in this report. In addition to the table estimates, the DAS calculates proper standard errors[25] and weighted sample sizes for these estimates. For example, table B1 contains standard errors that correspond to table 1 in the text, and was generated by the DAS. If the number of valid cases is too small to produce a reliable estimate (fewer than 30 cases), the DAS prints the message “low N” instead of the estimate.

All variables in the DAS are integers. To preserve decimal precision for certain variables, values in the DAS have been multiplied by a factor of 10. For example, grade point averages range from 0–400 in the DAS. When averages for such variables appear in this report, estimates and standard errors were divided by the appropriate factor of 10 to restore the original scale.

[25]The NELS and BPS samples are not simple random samples and, therefore, simple random sample techniques for estimating sampling error cannot be applied to these data. The DAS takes into account the complexity of the sampling procedures and calculates standard errors appropriate for such samples. The method for computing sampling errors used by the DAS involves approximating the estimator by the linear terms of a Taylor series expansion. The procedure is typically referred to as the Taylor series method.

Table B1—Standard errors for Table 1: Percentage of 1992 high school graduates who took the steps toward 4-year college enrollment, by selected characteristics[1]

	10th-grade bachelor's degree aspirations	Minimally prepared academically	Took SAT and/or ACT	Applied to a 4-year institution	Enrolled in a 4-year institution by 1994
Total	0.7	0.8	0.8	0.9	0.8
Sex					
Male	1.1	1.1	1.1	1.1	1.1
Female	0.9	1.0	1.0	1.0	1.0
Race–ethnicity					
White, non-Hispanic	0.8	0.9	0.9	1.0	1.0
Black, non-Hispanic	2.1	2.3	2.2	2.3	2.0
Hispanic	2.0	1.9	1.9	1.9	1.8
Asian Pacific Islander	3.0	3.4	3.4	3.3	3.1
American Indian/Alaskan Native	5.7	5.0	5.1	4.7	4.4
Family income					
Low (less than $25,000)	1.2	1.2	1.2	1.1	1.1
Middle ($25,000–$74,999)	0.9	1.0	1.0	1.0	1.0
High ($75,000 or more)	1.2	1.5	1.5	1.6	1.8
Parents' educational level					
High school or less	1.3	1.2	1.2	1.1	1.0
Some college	0.9	1.0	1.0	1.1	1.0
College graduate	0.9	1.1	1.2	1.2	1.3
Number of risk factors[2]					
None	0.8	0.9	0.9	1.0	1.1
One	1.2	1.2	1.2	1.2	1.2
Two	1.6	1.5	1.4	1.3	1.2
Three or more	2.4	2.5	2.6	2.6	1.0

[1]The proportion of students at each step is based on those who successfully completed all the preceding steps.

[2]Risk factors are low SES quartile, average grades of Cs or lower from sixth to eighth grade, changed schools two or more times other than normal progression, lived in a single-parent family, had one or more older siblings who dropped out of high school, or held back a grade before.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Merged data from the National Education Longitudinal Study and the Beginning Postsecondary Student Longitudinal Study (NEB), Data Analysis System.

In addition to tables, the DAS will also produce a correlation matrix of selected variables to be used for linear regression models. Included in the output with the correlation matrix are the design effects (DEFTs) for each variable in the matrix. Since statistical procedures generally compute standard errors based on an assumption of simple random sampling, the standard errors

must be adjusted with the design effects to take into account NELS:88/94 and BPS:89/90's complex sample design. (See discussion under "Statistical Procedures" below for the adjustment procedure.)

For more information about the NEB and other Data Analysis Systems, consult the NCES DAS website (www.nces.ed.gov/das) or its West Coast mirror site (www.pedar-das.org), or contact:

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NCES Postsecondary Studies Division
555 New Jersey Avenue, NW
Washington, DC 20208-5652
(202) 219-1365
Internet address: Aurora_D'Amico@ed.gov

Statistical Procedures

Three types of statistical procedures were employed in this report: testing differences between means (or proportions), testing for linear trends, and adjustment of means after controlling for covariation among several variables. Each procedure is described below.

Differences Between Means

Most descriptive comparisons in this report were tested using Student's *t* statistic. Statistical significance was determined by calculating *t* values for differences between pairs of means or proportions and comparing these with published values of *t* for two-tailed hypothesis testing, using a 5 percent probability of a Type I error (a significance level of .05).[26]

Student's *t* values may be computed to test the difference between estimates with the following formula:

$$t = \frac{E_1 - E_2}{\sqrt{se_1^2 + se_2^2}} \qquad (1)$$

where E_1 and E_2 are the estimates to be compared and se_1 and se_2 are their corresponding standard errors. Note that this formula is valid only for independent estimates. When the estimates are not independent (for example, when comparing a total percentage with that for a subgroup that is included in the total), a covariance term must be added to the denominator of the *t*-test

[26] A Type I error occurs when one erroneously concludes that a difference observed in a sample reflects a true difference in the population from which the sample was drawn.

formula. When comparing the estimate for a total with that of a subgroup, the following formula was used:

$$t = \frac{E_{sub} - E_{tot}}{\sqrt{se_{sub}^2 + se_{tot}^2 - 2p\, se_{sub}^2}} \quad (2)$$

where p is the proportion of the total contained in the subgroup.

There are hazards in reporting statistical tests for each comparison. First, comparisons based on large t statistics may appear to merit special attention. This can be misleading, since the magnitude of the t statistic is related not only to the observed differences in means or percentages but also to the number of students in the specific categories used for comparison. Hence, a small difference compared across a large number of students would produce a large t statistic.

A second hazard in reporting statistical tests for each comparison occurs when making multiple comparisons among categories of an independent variable. For example, when making paired comparisons among different levels of income, the probability of a Type I error for these comparisons taken as a group is larger than the probability for a single comparison. When more than one difference between groups of related characteristics or "families" are tested for statistical significance, one must apply a standard that assures a level of significance for all of those comparisons taken together.

Comparisons were made in this report only when $p \leq .05/k$ for a particular pairwise comparison, where that comparison was one of k tests within a family. This guarantees both that the individual comparison would have $p \leq .05$ and that for k comparisons within a family of possible comparisons, the significance level for all the comparisons will sum to $p \leq .05$.[27]

For example, when comparing males and females only one comparison is possible. In this family, k=1, and there is no need to adjust the significance level. When students are divided into five racial–ethnic groups and all possible comparisons are made, then k=10 and the significance level for each test within this family of comparisons must be $p \leq .05/10$, or $p \leq .005$. The formula for calculating family size (k) is as follows:

$$k = \frac{j(j-1)}{2} \quad (3)$$

[27]The standard that $p \leq .05/k$ for each comparison is more stringent than the criterion that the significance level of the comparisons should sum to $p \leq .05$. For tables showing the t statistic required to ensure that $p \leq .05/k$ for a particular family size and degrees of freedom, see Olive Jean Dunn, "Multiple Comparisons Among Means," Journal of the American Statistical Association 56 (1961): 52–64.

where *j* is the number of categories for the variable being tested. For example, in the case of a variable with five categories such as race–ethnicity, one substitutes 5 for *j* in equation 3:

$$k = \frac{5(5-1)}{2} = 10$$

Linear Trends

Some comparisons across categories of an ordered variable with three or more levels involved a test for a linear trend across all categories, rather than a series of tests between pairs of categories. Two procedures were used to test the statistical significance of an apparent linear trend, depending upon whether the estimates being examined were proportions (such as percentages) or averages.

Linear trends in proportions or averages. When proportions or averages of a continuous variable were examined relative to a variable with ordered categories, Analysis of Variance (ANOVA) was used to test for a linear relationship between the two variables. To do this, ANOVA models included orthogonal linear contrasts corresponding to successive levels of the independent variable. The squares of the Taylorized standard errors (that is, standard errors that were calculated by the Taylor series method), the variance between the means, and the unweighted sample sizes were used to partition total sum of squares into within- and between-group sums of squares. These were used to create mean squares for the within- and between-group variance components and their corresponding *F* statistics, which were then compared with published values of *F* for a significance level of .05.[28] Significant values of both the overall *F* and the *F* associated with the linear contrast term were required as evidence of a linear relationship between the two variables. Means and Taylorized standard errors were calculated by the DAS. Unweighted sample sizes are not available from the DAS and were provided by NCES.

Adjustment of Means to Control for Covariation Among Several Variables

Tabular results are limited by sample size when attempting to control for the multiplicity of factors that may account for the variation observed between two variables. For example, when examining the average number of credits completed, it is impossible to know to what extent the observed variation is due to socioeconomic status (SES) differences and to what extent it is due to differences in other factors related to SES, such as type of institution attended, intensity of enrollment, and so on. However, if a nested table were produced showing SES within type of institution attended, within enrollment intensity, the cell sizes would be too small to identify the

[28]More information about ANOVA and significance testing using the F statistic can be found in any standard textbook on statistical methods in the social and behavioral sciences.

patterns. When the sample size becomes too small to support controls for another level of variation, one must use other methods to take such variation into account.

To overcome this difficulty, multiple linear regression was used to obtain means that were adjusted for covariation among a list of control variables.[29] Adjusted means for subgroups were obtained by regressing the dependent variable on a set of student and enrollment characteristics. Substituting ones or zeros for the subgroup characteristic(s) of interest and the mean proportions for the other variables results in an estimate of the adjusted mean for the specified subgroup, holding all other variables constant. For example, consider a hypothetical case in which two variables, race–ethnicity and SES, are used to describe an outcome, *Y* (such as the number of credits completed). The variables race–ethnicity and SES are recoded into dummy variables:

Race–ethnicity	*R*
Black, non-Hispanic	1
All others	0

and

SES	*S*
Low SES	1
All others	0

The following regression equation is then estimated from the correlation matrix output from the DAS:

$$\hat{Y} = a + b_1R + b_2S \qquad (4)$$

To estimate the adjusted mean for any subgroup evaluated at the mean of all other variables, one substitutes the appropriate values for that subgroup's dummy variables (1 or 0) and the mean for the dummy variable(s) representing all other subgroups. For example, suppose we had a case where Y was being described by race–ethnicity (*R*) and SES (*S*), coded as shown above, and the means for *R* and *S* are as follows:

[29]For more information about multiple regression, see Michael S. Lewis-Beck, *Applied Regression: An Introduction,* Vol. 22 (Beverly Hills, CA: Sage Publications, Inc., 1980) or William D. Berry and Stanley Feldman, *Multiple Regression in Practice,* Vol. 50 (Beverly Hills, CA: Sage Publications, Inc., 1987).

Variable	Mean
R	0.109
S	0.282

Suppose the regression equation results in:

$$\hat{Y} = 51.07 + (17.63)R + (-22.46)S$$

To estimate the adjusted value for black students, one substitutes the appropriate parameter values into equation 4.

Variable	Parameter	Value
a	51.07	—
R	17.63	1.000
S	-22.46	0.282

This results in:

$$\hat{Y} = 51.07 + (17.63)(1) + (-22.46)(0.282) = 62.37$$

In this case, the estimated mean number of credits is 62.37 and represents the expected outcome for non-Hispanic black students who resemble the average student with respect to the other variables in the model (in this example, SES).

It is relatively straightforward to produce a multivariate model using the DAS, since one of the DAS output options is a correlation matrix, computed using pairwise missing values and properly weighted to account for the complex sample design and for nonresponse.[30] This matrix can be used by most statistical software packages as the input data for least-squares regression. That is the approach used for this report, with an additional adjustment to incorporate the complex sample design into the statistical significance tests of the parameter estimates (described below).

Most statistical software packages assume simple random sampling when computing standard errors of parameter estimates. Because of NELS:88/94 and BPS:89/90's complex sample design, this assumption is incorrect. A better approximation of the standard errors is to multiply

[30]Although the DAS enables the analyst to estimate regression models, it also limits the choices available. Analysts who wish to use other than pairwise treatment of missing values or to estimate other models can apply for a restricted data license from NCES.

each standard error by the average design effect of the dependent variable (DEFT),[31] where the DEFT is the ratio of the true standard error to the standard error computed under the assumption of simple random sampling. It is calculated by the DAS and produced with the correlation matrix.

[31]The adjustment procedure and its limitations are described in C.J. Skinner, D. Holt, and T.M.F. Smith, eds., *Analysis of Complex Surveys* (New York: John Wiley & Sons, 1989).

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Appendix C—NELS/BPS Merged Data File Methodology Report

Overview

The National Education Longitudinal Study (NELS:88/94) data set is a rich source of data on the relationship between high school experiences and early postsecondary outcomes. However, the last collection of NELS:88/94 captured the sample members when most of them were only 2 years out of high school—much too early to be able to say much about their eventual postsecondary attainment and persistence. Conversely, the Beginning Postsecondary Students Longitudinal Study and follow-up (BPS:90/94) is a rich source of data on the characteristics of beginning postsecondary students' educational attainment and persistence but has little information about participants' high school experiences.

These two data sets share a fairly extensive set of common variables describing the background characteristics of sample members. These characteristics were used in this project to link students in each of the data sets, thereby creating a "synthetic cohort," to provide values for variables missing in the NELS:88/94 data set. In a sense, the data on long-term postsecondary outcomes in NELS:88/94 (due to the censoring of the data 2 years after high school graduation) were treated as a huge missing data problem. These missing data were imputed for the NELS:88/94 students using multiply imputation methods developed by Rubin, and later expanded upon by Little and Rubin.[32]

The imputation was performed through a hotdeck procedure implemented through the SAS programming language. In this procedure a NELS:88/94 student was matched with a BPS:90/94 student, and the data on postsecondary outcomes for the BPS:90/94 student were assigned to the NELS:88/94 student. This procedure was performed 36 times to capture the measurement error associated with the imputations. A disturbance term was added to the NELS:88/94 sample weights to reflect this added source of error in the data. This disturbance term inflated the weight (BPSLNKWT) so that the variance component of the estimates associated with the size of the weight was also inflated—accurately inflating the total variance of the estimate to account for measurement error due to imputation.

[32]D.B. Rubin, *Multiple Imputation for Nonresponse in Surveys* (New York: John Wiley and Sons, 1987); R.J.A. Little and D.B. Rubin, *Statistical Analysis With Missing Data* (New York: John Wiley and Sons, 1987).

Each of the steps in the creation of this data set is discussed in the following sections.

Selection of Sample and Variables for Analysis

Sample Selection

In order to make inferences about the students in each data set, it was important that the respondents drawn from the NELS:88/94 and BPS:90/94 data sets be as close as possible in terms of certain student characteristics, such as age, high school graduation status, and initial Postsecondary Education (PSE) enrollment. For instance, since BPS:90/94 was a cohort of first-time beginning postsecondary students, sample members in the NELS:88/94 were drawn who enrolled in some type of postsecondary education within 2 years after high school graduation. Similarly, the sample of BPS:90/94 respondents had to be restricted to sample members whose age was 22 years or younger as of December 31, 1989, because the age range for sample members in NELS:88/94 had an upper limit of 22 years in 1992, the year that most of them graduated from high school. In addition, since this new data set was based on high school graduates, students in both data sets who did not have a high school diploma, General Educational Development (GED), certification, or equivalent were excluded. Table C1 lists several selection criteria used to select students from the NELS:88/94 and BPS:90/94. Application of these criteria resulted in a total of 5,523 first-time beginning postsecondary sample members from BPS:90/94 and 7,563 high school graduates from NELS:88/94, accounting for 72.4 and 50.7 percent, respectively, of original samples.

Table C2 presents the comparison of the selected students from the two data sets based on students' sex, race–ethnicity, and age. The weighted proportions of male and female students in the two samples were quite comparable: in each data set, male students account for about 48 percent and female students, 52 percent. When examined by race–ethnicity, the proportion of minority students appears higher in the NELS:88/94 sample than in the BPS:90/94 sample: 20 percent in BPS:90/94 compared with 25 percent in the NELS:88/94. This may reflect the fact that minority enrollment in higher education increased significantly between 1990 and 1992. According to *The Condition of Education 1996* (p. 144), minority students in U.S. colleges and universities increased from 20 percent in 1990 to 22 percent in 1992 (recall that the BPS:90/94 sample was based on the 1989–90 NPSAS first-time beginning postsecondary education students and the NELS:88/94 sample members were high school graduates in 1992).

When examined by age, BPS:90/94 students were older than NELS:88/94 students were—about 12 percent of BPS:90/94 students were age 20 or older, compared with 2 percent of

Table C1—Selection of students from BPS:90/94 and NELS:88/94

	BPS:90/94	NELS:88/94
Original sample	The BPS:90/94 study uses 1990 National Postsecondary Student Aid Study (NPSAS) data collected from first-time beginning postsecondary students and follows these students for 5 years from their initial enrollment in postsecondary education. BPS:90/92 is the first follow-up and BPS:90/94 is the second.	The NELS:88/94 began with a nationally representative sample of 1988 eighth graders and followed them up in 1990 when most of them were in 10th grade, in 1992 when most were in 12th grade, and in 1994, 2 years after most graduated from high school.
Selection of the sample	Exclude students who did not complete high school, i.e., those without a high school diploma, GED, certification, or equivalent. Exclude students who were not American citizens (because these students might have received substantial elementary and/or secondary education outside the United States). Select students whose age was less than 22 years old as of 12/31/89 (to match the age range for the NELS:88/94 students in 1992—i.e., the year that most students graduated from high school and could start their PSE).	Select high school graduates, i.e., those with a diploma, GED, or equivalent in 1992. Select students who enrolled in some PSE by 1994 (because sample members in BPS:90/94 were all first-time beginning postsecondary students). Select students whose 12th grade achievement test scores were available.
Resulting sample size	5,523	7,563
Percent of students selected	72.4	50.7

NOTE: Selection of sample is from the Beginning Postsecondary Student Study Base Year and Second Follow-up (BPS:90/94) and the National Education Longitudinal Study of 1988 Third Follow-up (NELS:88/94).

Table C2—Comparison (in percentage distribution by columns) of selected samples of BPS:90/94 and NELS:88/94 based on sex, race–ethnicity, and age

Variable	BPS:90/94 (N=5,523)[1]	NELS:88/94 (N=9,264)[2]
Total	100.0	100.0
Sex		
Male	47.7	48.3
Female	52.3	51.7
Race–ethnicity		
White, non-Hispanic	79.8	74.8
Black, non-Hispanic	8.8	10.1
Hispanic	6.9	9.2
Asian/Pacific Islander	3.6	5.0
American Indian/Alaskan Native	0.8	0.8
Age[3]		
17 years or younger	3.5	1.2
18 years	64.2	71.0
19 years	20.8	25.7
20–22 years	11.5	2.1

[1]Weighted by BPS94AWT.

[2]Weighted by F3QWT.

[3]For NELS:88/94 students, age was as of 1992 when students graduated from high school and could start their postsecondary education. For BPS:90/94 students, age was as of 1989, the year that students started their first-time postsecondary education.

NOTE: Detail may not sum to 100.0 due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1990 Beginning Postsecondary Students Longitudinal Study Second Follow-up and National Education Longitudinal Study of 1988 Third Follow-up.

NELS:88/94 students. This difference was due to the different base samples targeted by the two surveys. BPS:90/94 started with a cohort of individuals beginning their postsecondary studies, regardless of when they completed high school, whereas NELS:88/94 targeted 8th-grade students and followed them through high school and beyond. There are several implications for "older" students in BPS:90/94—they may have delayed their postsecondary education enrollment or could have been held back one or more grades in elementary, middle, or high school. "Delaying" and "holding back" will have different impacts on the estimated values of high school achievement or postsecondary education attainment; therefore, close attention was paid to these "older" students in the imputation process.

Variable Selection

Table C3 presents the variables selected for linking NELS:88/94 and BPS:90/94 respondents. Variables were selected to assure that they were defined in the same manner or could be recoded so that they were defined as similarly as possible between the data sets. The list includes basic demographic characteristics of students such as sex, race–ethnicity, and age, as well as some socioeconomic measures such as parental education, occupation, and various items the family owns. Previous research indicates the importance of students' educational expectations relative to students' achievement and postsecondary outcomes; therefore, this variable was included in the list. In addition, some characteristics that describe students' postsecondary experiences were considered, such as immediate versus delayed enrollment, part-time versus full-time enrollment, type and level of institution, and major field of study for earliest postsecondary education enrollment.

Table C4 displays the imputation matrix for this study. The primary imputation cells (columns) were created from the three variables that describe students' early postsecondary experiences: type and level of first postsecondary education institution, timing of postsecondary education entry (immediate or delayed), and attendance status (part-time versus full-time enrollment). In order to make the type and level of the postsecondary education institution comparable between the two data sets, we combined the categories so that the variable had three categories common to NELS:88/94 and BPS:90/94: 1=public 4-year, 2=private not-for-profit 4-year, and 3=public 2-year. There are a total of 12 primary imputation cells. Note that the number of BPS:90/94 students in each cell for private postsecondary education institutions is larger than the number of NELS:88/94 students (see rows 1 and 11 in table C4). However, in each cell for public postsecondary education institutions, the number of BPS:90/94 students is smaller than the number of NELS:88/94 students.

Within each of the primary imputation cells, a crosstabulation was performed based on students' sex, race–ethnicity, and socioeconomic status (SES). First, the SES variable was categorized into three levels: low SES (less than 25th percentile), middle SES (between 25th and 75th percentiles), and high SES (more than 75th percentile). The results of the crosstabulation indicated that there were too many small cells in the BPS:90/94 data to be managed in later matching procedures. Thus, the race variable was collapsed into two categories: white or Asian, Pacific Islander, and non-Asian, Pacific Islander minority (to collapse within the primary cell rather than across primary cells). Again, small cells were a problem. SES was therefore further collapsed into two categories split at the 50th percentile: low to middle SES (less than 50th percentile) and middle to high SES (equal to or more than 50th percentile).

Table C3—Common variables selected from BPS:90/94 and NELS:88/94

Variable	BPS:90/94	NELS:88/94
Gender	H_GENDR	F3SEX
Race–ethnicity Hispanic origin Asian origin	H_RACE+H_HISP H_HISPT (Mexican, Cuban, Puerto Rican, other) H_ASIAN (Chinese, Filipino, Hawaiian, Japanese, Korean, Vietnamese, Asian Indian, Samoan, Guamanian, other Asian or Pacific Islander)	F3RACE F3HISP (Mexican, Cuban, Puerto Rican, other) F3API (East Asian, South Asian, Pacific Islander, other Asian, Pacific Islander) API (Chinese, Filipino, Japanese, Korean, Southeast Asian, Pacific Islander, South Asian, West Asian, Middle Eastern Asian, other Asian)
Age	AGE (as of 12/31/89—range from 15 to 68, mode is 18)	BIRTHYR (birth year)
Highest education of parents	RPARED (less than high school, high school graduate, trade school, less-than-2-year college, 2-or-more-year college, bachelor's degree, postgraduate/professional)	BYPARED, F1PARED, F2PARED (did not finish high school, high school graduate or GED, more than high school and less than a 4-year degree, college graduate, master's degree or equivalent, Ph.D., M.D., or other professional)
Father's or mother's education	RFATHED/RMOTHED (less than high school, high school graduate, trade school, less-than-2-year college, 2-or-more-year college, bachelor's degree, postgraduate/ professional)	BYS34A/BYS34B (did not finish high school, graduated from high school, junior college, college less than 4-year, graduated college, master's degree, Ph.D./M.D., other professional/advanced)
Father's or mother's occupation	DADOC/MOMOC (marketing, administrative, support, service, executive, postsecondary instructor, other education, engineer/architect, scientist, computer scientist, social/ recreation, doctor/dentist, other medical, technical, lawyer, blue collar, writer/artist) DADOC1/MOMOC1 (professional, executive, marketing, administrative support, technical, service, blue collar)	BYS7OCC/F1N7B/F2N7/BYS40OCC/F1N5B/F2N5 (clerical, craftsperson, farmer/farm manager, homeworker, laborer, manager/administrative, military, operative, professional I, professional II, protective service, sales, school teacher, service, technical, never worked)

Table C3—Common variables selected from BPS:90/94 and NELS:88/94—Continued

Variable	BPS:90/94	NELS:88/94
Socioeconomic status (SES) measures while you were in high school:		
A room of your own	OWNROOM	F2N12P
Home had two or more vehicles	TWOCARS	N/A
Home had VCR	VCR	F2N12N
Home had daily newspaper	DALYNEWS	F2N12B
Home had dishwasher	DISHWASH	F2N12I
Home had reference book	REFBOOKS	F2N12D, F2N12E, F2N12F (encyclopedia, atlas, dictionary)
Home had more than 50 books	BOOK50	F2N12M
Home had personal computer	COMPUTER	F2N12H
Home had pocket calculator	CALCUL	F2N12O
Home had specific place for study	STUDYPL	F2N12A
Home had typewriter	TYPEWRIT	F2N12G
High school completion status	H_HSDIP (regular diploma, GED/other equivalency test, certification of high school completion)	F3DIPLOM (regular high school diploma, GED, certification, currently in high school, working toward equivalent, not graduate/no GED or certification)
Students' educational expectations	EXEDCOL (highest level of education that students expected to complete—base year survey: less than 1 year trade, 1 to 2 years trade, 2 or more years trade, less than 2 years college, bachelor's degree, master's degree, Ph.D./professional degree) EG_EDLEV (Considering all practical constraints, what is the highest level of education you ever expect to complete—first follow-up: GED or equivalent, high school degree, 2 or more years occupational/trade/ technical/business school, less than 2 years college, 2 or more years college, completed bachelor's degree, master's degree or equivalent, M.D./D.D.S./L.L.B./other, doctorate degree)	F2S43 (How far in school respondent thinks she or he will get—from 1992 survey: less than high school, high school only, less than 2 years of college, more than 2 years of college, trade school degree, less than 2 years college, more than 2 years college, finish college, master's degree or equivalent, Ph.D./M.D./other) EDEXPECT (What is the highest level of education you ever expect to complete—from 1994 survey: some high school, finish high school, vocational/trade-less than 2 years, vocational/trade-2 or more years, college-less than 2 years, college-2 or more years bachelor's degree, master's degree, Ph.D., M.D./L.L.B./J.D./D.D.S./equivalent)

Table C3—Common variables selected from BPS:90/94 and NELS:88/94—Continued

Variable	BPS:90/94	NELS:88/94
Immediate versus delayed postsecondary education enrollment	DELAYENR (derived variable in BPS:90/94 created based on type of students' high school diploma and high school graduation year).	This variable can be constructed based on high school completion date, i.e., the date receiving diploma, GED, and certification (F3HSCPDT), and the earliest postsecondary education enrollment date for valid institutions (PSEFIRDA). "Delayed enrollment" students are defined as those who did not enroll in some postsecondary education by spring of 1993.
Part-time versus full-time postsecondary education enrollment (earliest institution)	FRSTRTFT (for first enrollment status reported by student—base year survey, 1=full-time and 2=less than full-time) or ATTNST3 (enrollment intensity AY89–90—base year survey, full-time or part-time attendance status over full year; part-time includes students who were full-time in one term and part-time in another from July 1989 to June 1990 full-time in one term	PSEFIRST (enrollment status from the valid postsecondary education institution with the earliest enrollment date: 1=full-time, 2=at least half, less than full, and 3=less than half-time)
Level and control of earliest postsecondary education institution	CTRL8990 (control of principal institution AY89–90: 1=public, 2=private not-for-profit, and 3=private for-profit) SCHL8990 (level of principal institution AY89–90: 1=4-year institution, 2=2-year institution, and 3= less-than-2-year institution)	PSEFIRTY (institution type of the first postsecondary education enrollment: 1=private for-profit, 2=private not-for-profit, less-than-4-year, 3=public less-than-2-year, 4=public 2-year, 5=private not-for-profit, 4-year, and 6=public 4-year)
Study major in the earliest postsecondary education institution	MAJ8990 (field of study AY89–90: 1=humanities, 2=social and behavioral sciences, 3=life science, 4=physical science, 5=mathematics, 6=computer and information technology, 7=engineering, 8=education, 9=business and management, 10=health, 11=vocational/ technical, 12=other technical/professional)	PSEFIRMJ (Major field of study from the valid postsecondary education institution with the earliest enrollment date.

NOTE: Study major is combined into four categories: 1) math/science/engineering; 2) humanities/social behavioral science; 3) business/finance/management/vocational; 4) other.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1990 Beginning Postsecondary Students Longitudinal Study Second Follow-up and National Education Longitudinal Study of 1988 Third Follow-up.

Table C4—Imputation matrix and sample size in the imputation cells

		Public 4-year				Private, not-for-profit 4-year				Public 2-year			
		Immediate		Delayed		Immediate		Delayed		Immediate		Delayed	
	Total	Full	Part	Full	Part	Full	Part	Full	Part	Full	Part	Full	Part
BPS:90/94	4406	1361	102	125	35	1972	67	83	19	375	103	75	89
Low to middle SES													
Male													
White/Asian/Pacific Islander		52	3	16	8	60	5	8	2	20	1	9	9
Non-Asian/Pacific Islander minority		22	1	4	0	27	2	0	1	11	5	2	5
Female													
White/Asian/Pacific Islander		71	10	9	2	78	8	5	2	24	6	12	18
Non-Asian/Pacific Islander minority		35	2	5	2	31	3	2	1	9	5	4	8
Middle to high SES													
Male													
White/Asian/Pacific Islander		516	31	47	12	818	22	36	5	139	38	28	23
Non-Asian/Pacific Islander minority		42	4	3	0	64	2	5	0	16	7	5	4
Female													
White/Asian/Pacific Islander		545	36	35	10	805	23	23	8	137	35	15	18
Non-Asian/Pacific Islander minority		79	15	6	1	89	2	4	0	19	6	0	4
Number of imputation cells	67	8	4	6	3	8	4	5	3	8	7	5	6
NELS:88/94	6686	2560	102	158	44	1378	12	66	6	1395	437	304	224
Low to middle SES													
Male													
White/Asian/Pacific Islander		229	8	21	6	76	1	6	1	193	54	54	35
Non-Asian/Pacific Islander minority		94	7	11	3	38	1	5	2	91	41	30	20
Female													
White/Asian/Pacific Islander		285	18	15	13	115	4	7	1	270	80	58	31
Non-Asian/Pacific Islander minority		147	4	16	3	55	1	4	0	111	45	43	29
Middle to high SES													
Male													
White/Asian/Pacific Islander		778	25	45	9	438	2	22	1	319	91	66	40
Non-Asian/Pacific Islander minority		126	9	13	3	43	0	1	0	54	19	11	13
Female													
White/Asian/Pacific Islander		778	27	26	5	540	3	19	1	304	84	37	43
Non-Asian/Pacific Islander minority		123	4	11	2	73	0	2	0	53	23	7	13

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1990 Beginning Postsecondary Students Longitudinal Study Second Follow-up and National Education Longitudinal Study of 1988 Third Follow-up.

Validation of the Imputation Procedure

Before imputing all of the postsecondary outcomes for the NELS:88/94 respondents, an analysis was run to evaluate the validity of the proposed imputation procedure. Since both NELS:88/94 and BPS:90/94 had persistence and attainment information on their respondents approximately 2 years after entering postsecondary education, this information was used to test the accuracy of the proposed imputation procedure for all postsecondary outcomes. Table C5 presents the definition of 2-year persistence and attainment rates used in NELS:88/94 and BPS:90/94. Substantial effort was made to construct these variables so that they had minimal missing data and were comparable between the two data sets. For comparability, students who persisted were defined as those who enrolled in postsecondary education as of May 1991 (for BPS:90/94 students) or as of May 1994 (for NELS:88/94 students) or those who did not enroll but attained some type of degree. For the attainment outcome, two measures were examined: 1) whether a student attained some type of degree including a certificate or associate's degree within the first 2 years of postsecondary education; and 2) whether a student attained an associate's degree.

Table C6 presents actual persistence and attainment rates for both BPS:90/94 and NELS:88/94 students and proportions of students according to their timing of postsecondary education enrollment, enrollment status, sex, race–ethnicity, and SES in three types of postsecondary education institutions. While the overall persistence rates appear comparable across the two data sets, the attainment rates are not—compared with BPS:90/94 students, NELS:88/94 students appear to have higher overall attainment rates in 4-year public and private institutions, but have a lower rate for attaining associate's degrees in all three types of institutions. It is plausible that the different make-up of students in the two samples contributes to these differences, for the percentages of students according to their postsecondary education experiences and individual characteristics are not equivalent. For example, the NELS:88/94 sample appears to include more minority and low-SES students than the BPS:90/94 sample, whereas the BPS:90/94 sample appears to consist of more students who delayed their postsecondary education and enrolled in postsecondary education on a part-time basis than the NELS:88/94 sample.

Table C5—Definition and construction of key outcome variables to be imputed

Variable	BPS:90/94	NELS:88/94
Attainment for the first 2 years of postsecondary education	Use PER8990R and PER9091R (persistence and attainment in attainment in academic years 1989–90 and 1990–91) to determine whether a student attained a certificate or an associate's degree within the first 2 years of postsecondary education. Coding is "1" for students who attained a certificate or an associate's degree within the first 2 years of postsecondary education and "0" for students who did not attain any degree.	Recode F3PSEATN (highest PSE level attained) so that 1=Attained a certificate, license, or associate's degree and 0=No degree, working toward a degree.
Attaining an associate's degree for the first 2 years of postsecondary education	Use PER8990R and PER9091R to determine whether a student attained an associate's degree. Coding is "1" for students who attained an associate's degree either in 1989–90 or 1990–91 and "0" for students who did not attain a degree or who attained a certificate.	Recode F3PSEATN so that 1=Attained an associate's degree and 0=No degree but working toward a degree or attained only a certificate or license.
Persistence for the first 2 years of postsecondary education	Use ENR9105 (enrollment status 91/5) and attainment (see above definition) to determine students' postsecondary education persistence. Coding is "1" for students who either enrolled in postsecondary education in May 1991 or attained a degree by 1991and "0" for students who did not enroll or attain.	Use ENRL0594 (enrollment status 94/5) and attainment (see above definition) to determine students' postsecondary education persistence. Coding is "1" for students who either enrolled in postsecondary education in May 1994 or attained a degree by 1994 and "0" for students who did not enroll or attain.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1990 Beginning Postsecondary Students Longitudinal Study Second Follow-up and National Education Longitudinal Study of 1988 Third Follow-up.

Table C6—Comparison (by columns) of key variables in BPS:90/94 and NELS:88/94 selected for the imputation

Variable	Public 4-year		Private, not-for-profit, 4-year		Public 2-year	
	BPS:90/94[1]	NELS:88/94[2]	BPS:90/94[1]	NELS:88/94[2]	BPS:90/94[1]	NELS:88/94[2]
Outcome variable						
Persistence rate	79.9	87.3	87.0	91.4	56.4	71.8
Attainment rate	1.7	4.7	2.1	2.8	10.4	8.6
Percent attaining an associate's degree	1.0	0.0	1.2	0.1	5.0	0.5
Variables used for creating imputation cells						
Timing of postsecondary education entry						
Immediate	88.7	92.9	94.1	95.4	67.1	77.7
Delayed	11.3	7.1	5.9	4.6	32.9	22.3
Attendance status						
Full-time	88.2	95.4	94.4	99.0	62.7	72.3
Part-time	11.8	4.6	5.6	1.0	37.3	27.7
Sex						
Male	46.9	48.8	47.8	44.7	51.0	50.7
Female	53.1	51.2	52.2	55.3	49.0	49.3
Race–ethnicity						
White/Asian/Pacific Islander	86.8	82.1	89.8	84.8	80.1	77.0
Non-Asian/Pacific Island minority	13.2	17.9	10.2	15.2	19.9	23.0
Socioeconomic status						
Low-middle	14.7	27.1	11.7	19.0	23.9	47.0
Middle-high	85.3	72.9	88.3	81.0	76.1	53.0

[1]Proportions were weighted by BPS94AWT.

[2]Proportions were weighted by F3QWT.

NOTE: Details may not sum to totals due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1990 Beginning Postsecondary Students Longitudinal Study Second Follow-up and National Education Longitudinal Study of 1988 Third Follow-up.

Imputation of 2-Year Persistence and Attainment Rates

The imputation was performed through a sequential hotdeck procedure. First, the BPS:90/94 and NELS:88/94 data were combined into one data set in which 2-year persistence and attainment indicators (1=Yes and 0=No) were retained for BPS:90/94 sample members but missing for all NELS:88/94 sample members. Next, one imputation was performed in each imputation cell defined in table 4. Finally, imputed and actual rates were compared. Table C7 presents the results of this imputation.

Overall, the imputation for the 2-year persistence rate appears to be more successful than the imputation for the 2-year attainment rate. While the imputed persistence rates appear to be comparable to the actual rates in NELS, particularly for students enrolling in 4-year public and private not-for-profit institutions, the imputed attainment rates are mostly lower than the actual rates across all three types of institutions and the imputed rates for attaining an associate's degree are mostly higher than the actual rates. Recall that there are many cells collapsed in "delayed postsecondary education" and "part-time attendance status" (see table C4). Therefore, only full-time students who enrolled in postsecondary education immediately after high school graduation were selected (no cells are collapsed for these students) and one hotdeck imputation for these students was performed. The results are presented in table C8. Again, the conclusions are similar to those derived from table C7. While the imputed persistence rates, whether for totals or broken down by sex, race–ethnicity, and SES, appear close to the actual rates across all three types of institutions, the gap between imputed and actual attainment rates persists and appears large.

However, the definition for attainment in the two data sets is not strictly comparable. In the NELS:88/94, attainment is a student's self-report of the highest postsecondary degree attained and certificates *and licenses* are included. In the BPS:90/94, attainment is a derived and retrospective variable indicating whether a student attained some type of degree at the end of academic year 1990–91, and licenses are not included. Therefore, while the imputed 2-year attainment rates are not consistent with actual reported 2-year attainment rates, the overall results of the imputation of attainment and persistence were judged to be of reasonable quality.

Table C7—Comparison of imputed and actual persistence and attainment rates for the first 2 years of postsecondary education, by type of institution and selected student characteristics

	NELS:88/94[1]							BPS:90/94[2]						
				Race							Race			
		Sex		White/Asian/ Pacific Islander	Non-Asian/ Pacific Islander minority	SES			Sex		White/Asian/ Pacific Islander	Non-Asian/ Pacific Islander minority	SES	
	Total	Male	Female			Low to middle	Middle to high	Total	Male	Female			Low to middle	Middle to high
Persistence														
Public 4-year														
Actual rate	87.3	85.8	88.7	87.7	85.2	82.6	89.0	79.9	76.6	82.9	79.9	80.3	75.6	80.7
Imputed rate	88.3	88.0	91.4	87.4	92.2	81.7	90.7							
Private, not-for-profit, 4-year														
Actual rate	91.4	90.5	92.1	91.9	88.3	84.8	92.9	87.0	86.6	87.4	87.2	85.3	79.2	88.0
Imputed rate	93.4	94.9	92.2	93.9	90.8	84.2	95.6							
Public 2-year														
Actual rate	71.8	73.1	70.5	72.4	70.0	68.6	74.7	56.4	54.6	58.4	57.6	51.6	43.9	60.4
Imputed rate	62.3	52.8	72.1	65.0	53.4	59.5	64.8							
Attainment (percent having a certificate or associate's degree)														
Public 4-year														
Actual rate	4.7	6.1	3.4	4.6	5.2	4.6	4.8	1.7	0.8	2.4	1.7	1.6	2.5	1.5
Imputed rate	1.4	0.5	2.3	1.8	0.1	1.8	1.3							
Private, not-for-profit, 4-year														
Actual rate	2.8	3.7	2.0	2.1	6.4	3.9	2.5	2.1	2.1	2.2	2.2	1.8	5.4	1.7
Imputed rate	1.5	1.2	1.8	1.4	1.9	4.8	0.7							
Public 2-year														
Actual rate	8.6	9.0	8.2	8.5	8.9	9.1	8.1	10.4	6.1	15.1	10.6	10.0	12.0	9.9
Imputed rate	6.5	7.3	5.7	7.0	4.7	8.4	4.8							
Attainment (percent having an associate's degree)														
Public 4-year														
Actual rate	0	0	0	0	0	0	0	1.0	0.3	1.5	1.1	0	0.9	1.0
Imputed rate	1.1	0.1	2.1	1.4	0	1.3	1.1							
Private, not-for-profit, 4-year														
Actual rate	0.1	0	0.1	0	0.5	0.4	0	1.2	0.9	1.4	1.3	0	2.3	1.0
Imputed rate	1.0	0.3	1.7	1.3	0	2.6	0.7							
Public 2-year														
Actual rate	0.5	0.5	0.5	0.4	0.8	0.5	0.4	5.0	2.7	7.6	5.6	2.9	4.6	5.2
Imputed rate	3.8	3.5	4.2	4.6	1.4	3.7	3.9							

[1]Attainment and persistence rates were weighted by F3QWT.

[2]Attainment and persistence rates were weighted by BPS94AWT.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1990 Beginning Postsecondary Students Longitudinal Study Second Follow-up and National Education Longitudinal Study of 1988 Third Follow-up.

Table C8—Comparison of imputed and actual persistence and attainment rates for the first 2 years of postsecondary education for students who enrolled full time and immediately after high school graduation, by type of institution and selected student characteristics

	NELS:88/94[1]							BPS:90/94[2]						
				Race							Race			
		Sex		White/Asian/ Pacific Islander	Non-Asian/ Pacific Islander minority	SES			Sex		White/Asian/ Pacific Islander	Non-Asian/ Pacific Islander minority	SES	
	Total	Male	Female			Low to middle	Middle to high	Total	Male	Female			Low to middle	Middle to high
Persistence														
Public 4-year														
Actual rate	88.4	86.7	90.1	88.8	86.8	84.5	89.8	82.7	79.6	85.5	83.0	81.2	77.2	83.5
Imputed rate	90.5	86.7	94.1	89.7	94.6	84.3	92.7							
Private, not-for-profit, 4-year														
Actual rate	91.7	90.6	92.6	91.9	91.0	86.5	92.9	88.3	88.2	88.3	88.5	85.9	78.5	89.3
Imputed rate	93.7	95.3	92.3	94.2	90.3	83.3	95.9							
Public 2-year														
Actual rate	73.1	75.4	70.7	74.2	68.4	68.5	76.5	67.8	63.9	72.0	66.9	72.4	60.7	69.1
Imputed rate	76.2	62.3	70.3	77.9	69.3	77.1	75.5							
Attainment (percent having a certificate or associate's degree)														
Public 4-year														
Actual rate	4.6	6.0	3.4	4.3	5.9	4.6	4.6	1.5	1.0	1.9	1.5	1.5	2.9	1.3
Imputed rate	1.6	0.5	2.6	1.9	0.1	2.1	1.4							
Private, not-for-profit, 4-year														
Actual rate	2.8	4.0	1.9	2.2	6.7	4.0	2.6	1.8	1.2	2.4	2.0	0	3.4	1.6
Imputed rate	1.2	0.5	1.8	1.4	0	3.3	0.7							
Public 2-year														
Actual rate	7.4	8.4	6.3	7.1	8.4	7.9	7.0	11.9	5.4	18.9	11.8	12.9	17.9	10.9
Imputed rate	10.4	12.1	8.7	10.9	8.5	14.4	7.4							
Attainment (percent having an associate's degree)														
Public 4-year														
Actual rate	0	0	0	0	0	0	0	1.0	0.4	1.5	1.1	0	1.2	0.9
Imputed rate	1.2	0.1	2.3	1.5	0	1.5	1.2							
Private, not-for-profit, 4-year														
Actual rate	0.1	0	0.1	0	0.5	0.4	0	1.2	0.8	1.5	1.3	0	2.8	1.0
Imputed rate	1.1	0.3	1.8	1.3	0	2.9	0.7							
Public 2-year														
Actual rate	0.8	0.8	0.8	0.6	1.6	0.9	0.7	8.3	3.9	13.1	9.1	4.9	11.8	7.7
Imputed rate	6.5	5.9	7.1	7.5	7.6	6.8	6.3							

[1]Attainment and persistence rates were weighted by F3QWT.

[2]Attainment and persistence rates were weighted by BPS94AWT.

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1990 Beginning Postsecondary Students Longitudinal Study Second Follow-up and National Education Longitudinal Study of 1988 Third Follow-up.

Full Imputation

Since the results above looked reasonable, other persistence and attainment variables were imputed for NELS:88/94 students. A partial list of imputed variables is included below:

1) *Enrolled anytime in postsecondary education during academic years 1993 to 1996*
   - Enrolled
   - Not enrolled
2) *Month-by-month enrollment status July 1992 to June 1997*
   - Full-time
   - More than half time, less than full-time
   - Less than half time or unknown
3) *Ever attended graduate school*
4) *Ever attended a 4-year institution*
5) *Ever attended a private for-profit less-than-4-year institution*
6) *Ever attended a public 2-year institution*
7) *First degree attained at first institution*
   - Certificate
   - Associate's degree
   - Bachelor's degree
8) *Highest undergraduate degree 1997*
   - None
   - Certificate
   - Associate's degree
   - Bachelor's degree
9) *Level and control where ended first attainment*
10) *Level and control where received highest degree*
11) *gLevel and control, last institution*
   - Public 4-year
   - Private, not-for-profit, 4-year
   - Private, for-profit, 4-year
   - Public 2- to 3-year
   - Private, not-for-profit 2- to 3-year
   - Private, for-profit, 2- to 3-year
   - Public less-than-2-year
   - Private, not-for-profit, less-than-2-year
   - Private, for-profit, less-than-2-year
12) *Number of institutions attended through first attainment*
13) *Number of institutions attended during 1992–97*
14) *Persistence and attainment during academic years 1992 to 1996*
   - Attained certificate
   - Attained associate's degree
   - Attained bachelor's degree
   - Persisted to academic year 1993–94
   - Downward/delayed transfer
   - Stopout
   - Left without return

While it is well known that hotdeck imputation is a convenient method for providing a fully allocated data set that produces unbiased estimates, it is also known that using just one imputation systematically underestimates the variance of these estimates. To correct for this underestimation, Rubin has suggested using a multiply imputed data set.[33] That is, the missing data imputation is repeated a number of times (*M*). Let θ be some parameter of interest and $\hat{\theta}_l$, w_l, l=1,….*M* are the estimated θ and their variances for *M* imputations. Then the combined estimate is:

$$\bar{\theta}_m = \sum_{l=1}^{M} \frac{\hat{\theta}_l}{M} \tag{1.1}$$

The variance associated with this estimate is the combination of the mean of the within imputation variances (or, alternatively, the variance associated with the first imputation):

$$\overline{W}_M = \sum_{l=1}^{M} \frac{\hat{W}_l}{M} \tag{1.2}$$

and the between imputation variance:

$$B_M = \frac{\sum(\hat{\theta}_l - \bar{\theta}_M)^2}{M-1} \tag{1.3}$$

The total variance (sampling and measurement) of $\bar{\theta}_M$ is:

$$T_M = \overline{W}_M + \frac{M+1}{M} B_M \tag{1.4}$$

or for the sake of simplicity:

$$T_M = W_1 + \frac{M+1}{M} B_M \tag{1.5}$$

In this study, this procedure was used to capture the uncertainty due to measurement error related to imputing data. For example, using the imputation cells defined above in table C4, NELS:88/94 sample member #1 was matched with a BPS:90/94 sample member within the appropriate imputation cell. The BPS:90/94 sample member's postsecondary outcome variables were then attached to NELS:88/94 sample member #1's record. The BPS:90/94 member was returned to the matrix and another random draw for NELS:88/94 sample member #1 was taken from the imputation matrix. This was repeated 36 times. The variance between the 36 imputed

[33]D. B. Rubin, *Multiple Imputation for Nonresponse in Surveys* (New York: John Wiley and Sons, 1987), p. 15.

values for NELS: 88/94 sample member #1 represented the measurement error variance for sample member #1 due to imputing his/her postsecondary outcomes. Separate imputations were conducted for NELS:88/94 students who first enrolled in private 4-year institutions and public 4-year institutions.

A summary of the results of these imputations is presented in table C9. (Some of the imputed variables are not shown in this table for the sake of simplicity.)

The second and sixth columns of this table show the mean of the average of the 36 values imputed for respondents who first enrolled in a private 4-year college or university and in a public 4-year college or university. The third and seventh columns show the variance between imputations. The fourth and fifth show the standard error due to sampling (assuming simple random sampling), and the sampling variance (assuming simple random sampling) for the first mean for those attending private 4-year college or university. The eighth and ninth columns show the analogous data for public 4-year students. The complex standard errors (in columns 11 and 12) were calculated using the computer program SUDAAN, which takes into account the complex nature of the sampling design of NELS:88/94. The total standard errors (the last two columns) are based on equation 1.5 above. The last row of the table show the mean across these columns.

Table C9—Summary of results from full imputation of BPS:90/94 variables

Selected BPS:90/94 variable	Private, not-for-profit 4-year				Public 4-year				Complex S.E.		Total S.E.	
	Mean of 36 means of imputation	Var. across 36 means of imputation	S.E. for the mean of first imputation	Variance for the first mean	Mean of 36 means of imputation	Var. across 36 means of imputation	S.E. for the mean of first imputation	Variance for the first mean	Private, not-for-profit 4-year	Public 4-year	Private, not-for-profit 4-year	Public 4-year
degall2	2.141	0.001	0.030	0.001	1.539	0.001	0.030	0.001	0.050	0.034	0.061	0.043
degastat	2.242	0.002	0.040	0.002	1.566	0.001	0.030	0.001	0.052	0.036	0.067	0.046
degreefs	1.805	0.001	0.040	0.002	1.219	0.001	0.030	0.001	0.058	0.034	0.069	0.042
enr8907	1.994	0.152	0.380	0.144	3.631	0.133	0.360	0.130	0.511	0.489	0.646	0.613
enr8908	41.992	1.999	1.320	1.742	48.392	1.116	0.970	0.941	1.958	1.267	2.427	1.659
enr8909	97.209	0.249	0.470	0.221	96.151	0.121	0.380	0.144	0.506	0.435	0.715	0.560
enr8910	98.979	0.071	0.330	0.109	96.981	0.103	0.340	0.116	0.369	0.309	0.458	0.449
enr8911	98.852	0.088	0.330	0.109	96.301	0.087	0.380	0.144	0.369	0.366	0.476	0.473
enr8912	97.151	0.210	0.450	0.203	95.016	0.107	0.430	0.185	0.524	0.425	0.700	0.539
enr9001	93.223	0.423	0.710	0.504	91.507	0.330	0.570	0.325	0.843	0.787	1.070	0.979
enr9002	96.111	0.291	0.490	0.240	93.873	0.203	0.490	0.240	0.714	0.642	0.899	0.788
enr9003	96.372	0.255	0.510	0.260	94.461	0.156	0.460	0.212	0.690	0.639	0.860	0.754
enr9004	95.399	0.446	0.550	0.303	93.416	0.222	0.490	0.240	0.808	0.687	1.054	0.837
enr9005	88.447	0.613	0.890	0.792	88.521	0.383	0.620	0.384	1.247	0.911	1.478	1.106
enr9006	19.466	1.140	1.050	1.103	25.761	0.414	0.830	0.689	1.455	1.169	1.814	1.339
enr9007	11.315	0.889	0.850	0.723	12.903	0.262	0.630	0.397	1.105	0.972	1.461	1.101
enr9008	41.597	1.881	1.280	1.638	43.693	0.896	0.930	0.865	1.999	1.299	2.435	1.615
enr9009	86.040	0.742	0.910	0.828	80.346	0.494	0.730	0.533	1.710	0.925	1.920	1.168
enr9010	86.869	0.716	0.900	0.810	80.729	0.468	0.730	0.533	1.701	0.904	1.905	1.139
enr9011	86.966	0.720	0.900	0.810	80.628	0.464	0.730	0.533	1.696	0.908	1.901	1.141
enr9012	86.058	0.709	0.930	0.865	79.646	0.486	0.740	0.548	1.699	0.925	1.901	1.164
enr9101	85.001	1.219	0.970	0.941	76.837	0.588	0.780	0.608	1.345	0.939	1.750	1.219
enr9102	86.259	1.124	0.930	0.865	78.234	0.601	0.760	0.578	1.348	0.901	1.724	1.195
enr9103	86.673	0.993	0.920	0.846	78.782	0.601	0.750	0.563	1.344	0.887	1.681	1.185
enr9104	85.774	1.027	0.940	0.884	77.576	0.584	0.770	0.593	1.319	0.907	1.672	1.193
enr9105	81.480	0.929	1.040	1.082	75.635	0.639	0.790	0.624	1.449	0.945	1.747	1.245
enr9106	24.919	1.446	1.140	1.300	28.531	0.577	0.850	0.723	1.970	1.146	2.317	1.381
enr9107	19.885	1.180	1.060	1.124	18.469	0.427	0.730	0.533	1.947	1.068	2.237	1.257
enr9108	46.009	2.156	1.300	1.690	46.004	1.045	0.930	0.865	2.101	1.177	2.575	1.568
enr9109	83.077	1.255	0.990	0.980	78.855	0.520	0.750	0.563	1.747	0.894	2.084	1.155
enr9110	83.711	1.121	0.990	0.980	78.872	0.512	0.750	0.563	1.740	0.889	2.045	1.147
enr9111	83.746	1.145	0.990	0.980	78.751	0.512	0.760	0.578	1.740	0.899	2.051	1.155
enr9112	83.153	1.119	1.010	1.020	78.021	0.488	0.770	0.593	1.745	0.918	2.049	1.159

Table C9—Summary of results from full imputation of BPS:90/94 variables—Continued

Selected BPS:90/94 variable	Private, not-for-profit 4-year				Public 4-year				Complex S.E.		Total S.E.	
	Mean of 36 means of imputation	Var. across 36 means of imputation	S.E. for the mean of first imputation	Variance for the first mean	Mean of 36 means of imputation	Var. across 36 means of imputation	S.E. for the mean of first imputation	Variance for the first mean	Private, not-for-profit 4-year	Public 4-year	Private, not-for-profit 4-year	Public 4-year
enr9201	82.136	1.527	1.030	1.061	75.276	0.754	0.790	0.624	1.684	0.922	2.099	1.275
enr9202	83.214	1.554	1.000	1.000	76.328	0.706	0.780	0.608	1.683	0.887	2.105	1.230
enr9203	82.948	1.541	1.000	1.000	75.992	0.746	0.780	0.608	1.717	0.895	2.129	1.252
enr9204	81.005	1.491	1.040	1.082	73.689	0.844	0.820	0.672	1.696	0.932	2.100	1.317
enr9205	76.086	1.450	1.130	1.277	71.027	0.923	0.830	0.689	2.279	0.960	2.585	1.368
enr9206	18.303	0.948	0.990	0.980	23.098	0.608	0.800	0.640	1.516	1.025	1.809	1.295
enr9207	11.504	0.562	0.810	0.656	14.156	0.245	0.660	0.436	1.178	0.900	1.402	1.031
enr9208	36.830	1.736	1.260	1.588	38.986	0.731	0.910	0.828	1.889	1.145	2.314	1.436
enr9209	74.212	1.797	1.130	1.277	65.428	0.715	0.890	0.792	1.700	1.046	2.177	1.352
enr9210	74.304	1.735	1.130	1.277	65.628	0.714	0.890	0.792	1.701	1.039	2.162	1.346
enr9211	74.266	1.750	1.130	1.277	65.586	0.708	0.890	0.792	1.701	1.040	2.166	1.345
enr9212	73.579	1.707	1.150	1.323	65.418	0.691	0.890	0.792	1.671	1.041	2.132	1.340
enr9301	72.832	2.286	1.170	1.369	63.270	0.685	0.900	0.810	1.669	1.087	2.266	1.374
enr9302	73.362	2.118	1.160	1.346	64.155	0.708	0.900	0.810	1.634	1.075	2.201	1.372
enr9303	73.701	2.129	1.160	1.346	64.309	0.745	0.900	0.810	1.632	1.075	2.202	1.386
enr9304	73.062	1.995	1.160	1.346	63.541	0.753	0.900	0.810	1.612	1.082	2.156	1.395
enr9305	70.766	1.892	1.190	1.416	62.751	0.727	0.900	0.810	1.627	1.088	2.143	1.390
enr9306	15.988	0.919	0.950	0.903	22.408	0.682	0.790	0.624	1.345	1.080	1.659	1.367
enr9307	10.018	0.729	0.800	0.640	17.030	0.630	0.720	0.518	1.067	0.949	1.374	1.244
enr9308	18.985	1.097	1.020	1.040	33.977	0.920	0.890	0.792	1.537	1.174	1.868	1.525
enr9309	31.090	1.397	1.220	1.488	50.053	1.134	0.930	0.865	1.661	1.187	2.048	1.605
enr9310	31.263	1.400	1.220	1.488	50.149	1.064	0.930	0.865	1.668	1.182	2.054	1.578
enr9311	31.239	1.382	1.220	1.488	50.052	1.039	0.930	0.865	1.668	1.184	2.050	1.571
enr9312	30.593	1.460	1.210	1.464	49.564	1.083	0.930	0.865	1.705	1.179	2.099	1.582
enr9401	24.740	1.136	1.120	1.254	40.305	0.787	0.920	0.846	1.959	1.167	2.237	1.473
enr9402	24.933	1.216	1.120	1.254	40.640	0.810	0.920	0.846	1.966	1.163	2.261	1.478
enr9403	25.091	1.184	1.130	1.277	40.453	0.850	0.920	0.846	1.966	1.182	2.254	1.507
enr9404	23.316	0.980	1.100	1.210	37.174	0.816	0.910	0.828	1.872	1.176	2.124	1.490
enr9405	21.181	0.863	1.070	1.145	35.006	0.726	0.890	0.792	1.821	1.182	2.050	1.464
enr9406	3.561	0.238	0.490	0.240	5.564	0.178	0.440	0.194	0.775	0.593	0.919	0.731
everprop	18.723	0.825	1.080	1.166	22.311	0.606	0.820	0.672	1.326	0.972	1.614	1.252
gradschl	1.584	0.073	0.370	0.137	1.936	0.076	0.280	0.078	0.452	0.296	0.529	0.408
ninscum	9.514	0.397	0.770	0.593	4.202	0.171	0.400	0.160	1.177	0.509	1.339	0.660

Table C9—Summary of results from full imputation of BPS:90/94 variables—Continued

Selected BPS:90/94 variable	Private, not-for-profit 4-year				Public 4-year				Complex S.E.		Total S.E.	
	Mean of 36 means of imputation	Var. across 36 means of imputation	S.E. for the mean of first imputation	Variance for the first mean	Mean of 36 means of imputation	Var. across 36 means of imputation	S.E. for the mean of first imputation	Variance for the first mean	Private, not-for-profit 4-year	Public 4-year	Private, not-for-profit 4-year	Public 4-year
ninstot	1.573	0.000	0.020	0.000	1.540	0.000	0.010	0.000	0.026	0.016	0.033	0.022
nummcum	1.641	0.000	0.020	0.000	1.589	0.000	0.020	0.000	0.029	0.017	0.036	0.024
nummel1	36.124	0.076	0.270	0.073	36.172	0.063	0.260	0.068	0.445	0.313	0.525	0.404
nummel2	34.348	0.393	0.560	0.314	25.990	0.169	0.480	0.230	0.783	0.584	1.009	0.717
nummelaa	46.442	0.118	0.310	0.096	46.709	0.093	0.280	0.078	0.493	0.336	0.604	0.457
nummelba	3.069	0.083	0.310	0.096	4.173	0.059	0.260	0.068	0.389	0.297	0.486	0.386
nummelct	42.228	0.277	0.380	0.144	40.254	0.153	0.370	0.137	0.515	0.451	0.742	0.600
nummfirs	1.796	0.051	0.240	0.058	2.123	0.034	0.180	0.032	0.914	0.190	0.942	0.266
nummtot	28.146	0.153	0.380	0.144	28.347	0.091	0.320	0.102	0.668	0.384	0.776	0.491
ofcolast	37.229	0.068	0.270	0.073	37.245	0.067	0.250	0.063	0.411	0.303	0.488	0.401
ofcolast	14.383	1.243	0.980	0.960	82.923	0.562	0.750	0.563	1.834	0.885	2.154	1.167
ofcolast	77.038	1.967	1.170	1.369	3.953	0.123	0.410	0.168	1.928	0.448	2.395	0.571
ofcolast	0.274	0.016	0.130	0.017	0.288	0.010	0.130	0.017	0.095	0.044	0.161	0.112
ofcolast	6.736	0.391	0.700	0.490	10.416	0.337	0.600	0.360	0.826	0.750	1.041	0.954
ofcolast	0.219	0.015	0.150	0.023	0.534	0.021	0.120	0.014	0.070	0.184	0.144	0.235
ofcolast	0.417	0.025	0.150	0.023	0.587	0.019	0.170	0.029	0.315	0.164	0.354	0.215
ofcolast	0.247	0.012	0.160	0.026	0.112	0.004	0.070	0.005	0.142	0.041	0.179	0.078
ofconcum	0.519	0.035	0.220	0.048	0.696	0.032	0.170	0.029	0.241	0.210	0.306	0.277
ofconcum	12.286	0.702	0.920	0.846	84.114	0.475	0.730	0.533	1.765	0.865	1.959	1.112
ofconcum	79.110	1.481	1.120	1.254	3.104	0.118	0.370	0.137	1.864	0.408	2.236	0.536
ofconcum	0.274	0.016	0.130	0.017	0.107	0.003	0.070	0.005	0.095	0.036	0.161	0.069
ofconcum	6.733	0.347	0.690	0.476	9.914	0.233	0.590	0.348	0.821	0.746	1.016	0.892
ofconcum	0.322	0.025	0.150	0.023	0.573	0.017	0.130	0.017	0.091	0.195	0.184	0.236
ofconcum	0.366	0.019	0.130	0.017	0.626	0.020	0.170	0.029	0.288	0.164	0.320	0.217
ofconcum	0.181	0.012	0.150	0.023	0.112	0.004	0.070	0.005	0.176	0.041	0.209	0.078
ofconhi	0.554	0.037	0.250	0.063	0.893	0.035	0.200	0.040	0.162	0.211	0.253	0.283
ofconhi	6.861	0.819	0.720	0.518	47.443	0.689	0.970	0.941	1.686	1.200	1.919	1.466
ofconhi	64.713	1.932	1.290	1.664	1.779	0.069	0.270	0.073	1.913	0.325	2.376	0.420
ofconhi	1.948	0.098	0.380	0.144	3.290	0.093	0.360	0.130	0.507	0.400	0.598	0.505
ofconhi	0.219	0.016	0.100	0.010	0.471	0.014	0.120	0.014	0.089	0.184	0.157	0.220
ofconhi	0.318	0.017	0.130	0.017	0.289	0.007	0.130	0.017	0.288	0.123	0.317	0.151
per8990r	0.357	0.019	0.220	0.048	0.813	0.034	0.190	0.036	0.162	0.211	0.213	0.281
per8990r	25.205	1.532	1.150	1.323	45.636	0.858	0.970	0.941	1.635	1.171	2.061	1.501

Table C9—Summary of results from full imputation of BPS:90/94 variables—Continued

	Private, not-for-profit 4-year				Public 4-year				Complex S.E.		Total S.E.	
Selected BPS:90/94 variable	Mean of 36 means of imputation	Var. across 36 means of imputation	S.E. for the mean of first imputation	Variance for the first mean	Mean of 36 means of imputation	Var. across 36 means of imputation	S.E. for the mean of first imputation	Variance for the first mean	Private, not-for-profit 4-year	Public 4-year	Private, not-for-profit 4-year	Public 4-year
per8990r	0.093	0.009	0.100	0.010	0.116	0.003	0.080	0.006	0.195	0.120	0.217	0.133
per8990r	86.085	0.862	0.960	0.922	79.355	0.452	0.790	0.624	1.349	0.954	1.645	1.173
per8990r	7.759	0.575	0.750	0.563	10.016	0.248	0.600	0.360	0.889	0.669	1.175	0.838
per9091r	3.387	0.203	0.470	0.221	4.592	0.143	0.410	0.168	0.616	0.491	0.767	0.623
per9091r	2.675	0.168	0.480	0.230	5.919	0.256	0.450	0.203	0.656	0.584	0.777	0.777
per9091r	6.994	0.367	0.720	0.518	12.258	0.460	0.620	0.384	0.868	0.792	1.063	1.049
per9091r	0.590	0.041	0.220	0.048	0.926	0.028	0.210	0.044	0.245	0.187	0.319	0.254
per9091r	1.170	0.057	0.280	0.078	0.931	0.044	0.210	0.044	0.604	0.219	0.651	0.304
per9091r	82.660	1.063	1.050	1.103	73.844	0.792	0.850	0.723	2.005	1.032	2.261	1.371
per9091r	1.707	0.125	0.340	0.116	2.337	0.080	0.260	0.068	0.372	0.356	0.517	0.457
per9192r	4.546	0.267	0.550	0.303	6.894	0.242	0.480	0.230	0.750	0.623	0.915	0.797
per9192r	2.334	0.184	0.450	0.203	2.810	0.090	0.320	0.102	1.135	0.358	1.215	0.469
per9192r	8.850	0.571	0.800	0.640	14.231	0.509	0.660	0.436	1.639	0.782	1.810	1.065
per9192r	0.959	0.055	0.250	0.063	0.864	0.029	0.220	0.048	0.330	0.226	0.406	0.284
per9192r	1.626	0.079	0.360	0.130	1.641	0.049	0.230	0.053	0.345	0.366	0.448	0.428
per9192r	3.756	0.204	0.520	0.270	4.136	0.138	0.380	0.144	0.766	0.392	0.892	0.543
per9192r	70.078	2.050	1.240	1.538	60.492	0.792	0.950	0.903	1.859	1.133	2.359	1.448
per9192r	4.810	0.365	0.610	0.372	6.995	0.171	0.500	0.250	0.822	0.574	1.025	0.711
per9293r	6.002	0.386	0.610	0.372	4.837	0.125	0.430	0.185	0.837	0.639	1.047	0.733
per9293r	3.920	0.260	0.470	0.221	6.807	0.164	0.500	0.250	0.663	0.559	0.841	0.694
per9293r	17.478	1.434	1.020	1.040	25.573	0.657	0.850	0.723	1.582	1.032	1.994	1.319
per9293r	0.488	0.036	0.190	0.036	0.733	0.035	0.160	0.026	0.221	0.161	0.294	0.249
per9293r	0.558	0.035	0.160	0.026	1.540	0.036	0.230	0.053	0.124	0.316	0.226	0.371
per9293r	46.436	2.108	1.350	1.823	15.372	0.526	0.700	0.490	1.907	0.856	2.409	1.128
per9293r	25.311	1.531	1.190	1.416	45.205	1.030	0.970	0.941	1.548	1.181	1.992	1.566
per9293r	2.458	0.184	0.390	0.152	2.067	0.094	0.280	0.078	0.615	0.370	0.753	0.483
per9394r	3.513	0.252	0.460	0.212	4.190	0.188	0.390	0.152	0.610	0.379	0.794	0.581
per9394r	3.759	0.336	0.500	0.250	5.320	0.206	0.390	0.152	0.534	0.520	0.794	0.695
per9394r	60.485	1.977	1.320	1.742	40.465	1.154	0.950	0.903	2.042	1.186	2.490	1.610
per9394r	0.976	0.063	0.260	0.068	1.233	0.043	0.200	0.040	0.393	0.252	0.468	0.328
per9394r	0.481	0.039	0.240	0.058	0.819	0.036	0.210	0.044	0.179	0.186	0.269	0.268
per9394r	19.150	1.410	1.080	1.166	26.848	0.509	0.870	0.757	1.396	1.071	1.844	1.293
per9394r	11.846	0.651	0.870	0.757	21.414	0.656	0.780	0.608	1.744	0.982	1.926	1.280

Table C9—Summary of results from full imputation of BPS:90/94 variables—Continued

Selected BPS:90/94 variable	Private, not-for-profit 4-year				Public 4-year				Complex S.E.		Total S.E.	
	Mean of 36 means of imputation	Var. across 36 means of imputation	S.E. for the mean of first imputation	Variance for the first mean	Mean of 36 means of imputation	Var. across 36 means of imputation	S.E. for the mean of first imputation	Variance for the first mean	Private, not-for-profit 4-year	Public 4-year	Private, not-for-profit 4-year	Public 4-year
peraaa	0.468	0.039	0.220	0.048	1.005	0.032	0.250	0.063	0.302	0.250	0.362	0.309
peraaa	6.594	0.573	0.620	0.384	8.218	0.328	0.550	0.303	0.894	0.728	1.178	0.931
peraaa	89.470	0.631	0.840	0.706	86.637	0.477	0.670	0.449	1.115	0.822	1.376	1.080
peraaa	2.487	0.131	0.400	0.160	2.422	0.096	0.300	0.090	0.438	0.359	0.571	0.477
peraaa	0.430	0.047	0.150	0.023	0.770	0.029	0.180	0.032	0.196	0.105	0.294	0.202
peraaa	0.226	0.016	0.160	0.026	0.328	0.010	0.110	0.012	0.125	0.129	0.179	0.163
peraaa	0.201	0.014	0.070	0.005	0.542	0.024	0.140	0.020	0.070	0.238	0.138	0.285
peraaa	0.179	0.018	0.100	0.010	0.468	0.017	0.160	0.026	0.118	0.179	0.180	0.223
peraaa	2.276	0.150	0.360	0.130	3.101	0.105	0.350	0.123	0.599	0.419	0.716	0.533
peraaa	0.195	0.016	0.130	0.017	0.303	0.006	0.130	0.017	0.119	0.171	0.176	0.189
peraaa	0.146	0.008	0.070	0.005	0.502	0.023	0.120	0.014	0.088	0.174	0.127	0.232
peraaa	0.344	0.019	0.210	0.044	0.486	0.014	0.160	0.026	0.105	0.136	0.174	0.180
peraaa	0.356	0.026	0.160	0.026	0.104	0.004	0.040	0.002	0.162	0.011	0.229	0.063
peraaa	0.317	0.020	0.220	0.048	0.696	0.014	0.150	0.023	0.195	0.154	0.241	0.196
peraaa	0.303	0.023	0.130	0.017	0.436	0.014	0.140	0.020	0.226	0.122	0.273	0.170
peraba	1.771	0.081	0.380	0.144	1.093	0.025	0.170	0.029	0.463	0.317	0.546	0.356
peraba	1.194	0.061	0.330	0.109	2.068	0.126	0.290	0.084	0.610	0.372	0.659	0.518
peraba	3.543	0.253	0.440	0.194	7.126	0.197	0.500	0.250	0.616	0.630	0.800	0.775
peraba	50.739	1.682	1.350	1.823	34.288	0.710	0.920	0.846	2.130	1.084	2.504	1.380
peraba	1.685	0.038	0.330	0.109	7.438	0.231	0.500	0.250	0.368	0.656	0.418	0.817
peraba	8.277	0.305	0.710	0.504	4.497	0.130	0.410	0.168	1.127	0.490	1.259	0.611
peraba	0.805	0.047	0.210	0.044	2.254	0.071	0.290	0.084	0.298	0.338	0.371	0.433
peraba	1.564	0.094	0.320	0.102	3.452	0.163	0.350	0.123	0.361	0.469	0.477	0.623
peraba	7.961	0.420	0.770	0.593	12.678	0.471	0.640	0.410	1.418	0.803	1.563	1.062
peraba	7.291	0.598	0.700	0.490	5.493	0.160	0.470	0.221	1.677	0.530	1.851	0.667
peraba	2.712	0.131	0.400	0.160	3.914	0.176	0.400	0.160	0.430	0.443	0.565	0.614
peraba	2.473	0.213	0.480	0.230	1.613	0.056	0.230	0.053	0.554	0.253	0.726	0.348
peraba	2.730	0.217	0.450	0.203	4.277	0.256	0.340	0.116	0.687	0.432	0.834	0.671
peraba	1.879	0.108	0.370	0.137	2.395	0.093	0.270	0.073	0.432	0.367	0.546	0.479
peraba	3.276	0.257	0.480	0.230	2.699	0.086	0.330	0.109	0.578	0.397	0.773	0.496
peraba	0.379	0.024	0.160	0.026	0.151	0.005	0.080	0.006	0.116	0.062	0.195	0.094

Table C9—Summary of results from full imputation of BPS:90/94 variables—Continued

Selected BPS:90/94 variable	Private, not-for-profit 4-year				Public 4-year				Complex S.E.		Total S.E.	
	Mean of 36 means of imputation	Var. across 36 means of imputation	S.E. for the mean of first imputation	Variance for the first mean	Mean of 36 means of imputation	Var. across 36 means of imputation	S.E. for the mean of first imputation	Variance for the first mean	Private, not-for-profit 4-year	Public 4-year	Private, not-for-profit 4-year	Public 4-year
peract	3.579	0.306	0.470	0.221	6.673	0.288	0.510	0.260	0.634	0.576	0.846	0.792
peract	1.110	0.112	0.360	0.130	1.054	0.033	0.180	0.032	0.392	0.189	0.519	0.264
peract	94.448	0.374	0.610	0.372	92.910	0.226	0.510	0.260	1.673	0.558	1.784	0.737
peract	2.405	0.189	0.410	0.168	3.171	0.167	0.360	0.130	0.560	0.387	0.713	0.567
peract	0.309	0.032	0.130	0.017	0.156	0.006	0.070	0.005	0.231	0.110	0.294	0.133
peract	0.055	0.004	0.100	0.010	0.096	0.003	0.050	0.003	0.016	0.072	0.063	0.091
peract	0.761	0.050	0.190	0.036	1.505	0.040	0.250	0.063	0.370	0.252	0.433	0.323
peracum	0.593	0.042	0.150	0.023	0.718	0.023	0.170	0.029	0.142	0.225	0.251	0.273
peracum	0.918	0.055	0.270	0.073	0.632	0.019	0.160	0.026	0.299	0.195	0.381	0.240
peracum	52.668	1.854	1.350	1.823	37.077	0.601	0.940	0.884	2.137	1.129	2.544	1.375
peracum	0.813	0.033	0.220	0.048	7.706	0.304	0.510	0.260	0.185	0.657	0.261	0.863
peracum	8.502	0.318	0.730	0.533	4.777	0.119	0.420	0.176	1.134	0.492	1.269	0.604
peracum	1.502	0.074	0.310	0.096	3.938	0.155	0.380	0.144	0.343	0.490	0.440	0.631
peracum	1.952	0.107	0.340	0.116	4.503	0.168	0.400	0.160	0.389	0.541	0.511	0.682
peracum	8.315	0.710	0.750	0.563	13.743	0.667	0.660	0.436	1.431	0.778	1.667	1.136
peracum	9.489	1.099	0.810	0.656	8.703	0.236	0.590	0.348	1.716	0.654	2.018	0.818
peracum	2.130	0.121	0.350	0.123	2.305	0.089	0.320	0.102	0.447	0.341	0.569	0.457
peracum	4.231	0.387	0.590	0.348	4.016	0.132	0.370	0.137	0.875	0.437	1.078	0.572
peracum	3.395	0.212	0.470	0.221	4.808	0.213	0.370	0.137	0.458	0.494	0.654	0.681
perafirs	3.171	0.164	0.460	0.212	5.067	0.175	0.400	0.160	0.644	0.538	0.763	0.684
perafirs	3.830	0.212	0.520	0.270	3.356	0.112	0.360	0.130	0.580	0.457	0.745	0.569
perafirs	0.626	0.034	0.180	0.032	0.632	0.016	0.180	0.032	0.254	0.195	0.316	0.233
perafirs	1.573	0.120	0.320	0.102	1.882	0.090	0.250	0.063	0.326	0.399	0.479	0.502
perafirs	50.677	1.686	1.350	1.823	34.610	0.664	0.930	0.865	2.126	1.087	2.501	1.366
perafirs	0.869	0.038	0.220	0.048	7.756	0.311	0.510	0.260	0.185	0.657	0.270	0.867
perafirs	8.761	0.334	0.790	0.624	9.536	0.359	0.590	0.348	1.022	0.674	1.178	0.908
perafirs	21.091	0.987	1.100	1.210	20.801	0.681	0.780	0.608	1.823	0.978	2.082	1.287
PERSIST2	8.087	0.445	0.690	0.476	11.039	0.508	0.620	0.384	0.887	0.715	1.116	1.017
AADEG2	8.315	0.710	0.750	0.563	13.743	0.667	0.660	0.436	1.431	0.778	1.667	1.136
Mean	26.902	0.609	0.631	0.553	26.835	0.327	0.499	0.333	0.954	0.611	1.164	0.789

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1990 Beginning Postsecondary Students Longitudinal Study Second Follow-up and National Education Longitudinal Study of 1988 Third Follow-up.

Adjustment for Measurement Error

In most applications of Rubin and Little's multiply imputation scheme, a completely imputed data set is created *M* number of times (in most applications at NCES, *M*=5). Separate analyses are then run on these *M* data sets and then the variances of the estimates are calculated as in equation 1.5. In the present application of their multiply imputation scheme, the measurement error due to imputation was to be incorporated into an automated Data Analysis System (DAS). Therefore, a more computationally convenient method of incorporating the measurement error due to multiple imputations was needed. Calculating separate analyses based on *M* complete data sets was considered too computationally laborious and time intensive for the DAS. Instead, the task was accomplished by estimating the total variances as shown in table 8 above and calculating the resulting design effects due to complex sampling and due to measurement error. These parameters were then used to inflate the variance of the weights so that the resulting standard errors were inflated to reflect the added source of error due to multiple imputations. That is, a new weight was created:

$$BPSLNKWT = F3QWT + N(0,E)$$

in which the NELS:88/94 third follow-up weight was "disturbed" by a factor normally distributed with a mean of 0 and a variance of *E*. *E* is defined as:

$$E = \sqrt{(D-1) + \sum(F3QWT^2)/N} \qquad (1.6)$$

and D is defined as:

$$D = deff_{ws/cs} / deff_{cs} \qquad (1.7)$$

where $\boldsymbol{deff}_{ws/cs}$ is the ratio of the design effect due to measurement error (ws) to the design effect due to complex sampling (cs) and $\boldsymbol{deff}_{cs}$ is the design effect due to complex sampling. Separate *E* and *D* parameters were calculated for students who first enrolled in 4-year private institutions and students who first enrolled in 4-year public institutions.

This disturbance term *E* was randomly assigned to the third follow-up weight for each case in sequence. For example, respondent S_1 was assigned a disturbance term to his/her F3QWT as in equation 1.6 above. After assigning the disturbance term, if S_1's weight was less than 1, S_1 was assigned a value of 1 for his/her weight (to avoid extremely low or negative weights) and S_2 had a disturbance term assigned to his/her F3QWT that was the residual of disturbance term of S_1. If

S_1 had a new weight greater than 1, then S_2 had a disturbance term assigned to his/her F3QWT as in 1.6 above.

Thus, new weights were calculated for each individual whose variance reflected the measurement error due to imputation. However, given the lower bound of unity for the weights, the disturbance term was ultimately not randomly distributed with a mean of zero. The new weights were therefore adjusted to sum back to the old weights by a simple post-stratification to the sum of the weights for each postsecondary institution type (4-year private, not-for-profit and 4-year public).

To check on the results of these calculations, weights were created based on the values of *D* and *E* for just the first variable in the list in table 9 (degall2). In this way one could see how well the calculation of variance based on disturbing the weights compared to the actual variances calculated from the spreadsheet. Using BPSLNKWT resulted in standard errors very close to what was estimated in the spreadsheet. For private, not-for-profit 4-year institutions SUDAAN produced a standard error of 0.0618 versus 0.0612 in the spreadsheet, and for public 4-year institutions, 0.0392 versus 0.0429.

Listing of NCES Working Papers to Date

Please contact Angela Miles at (202) 219-1761 (angela_miles@ed.gov)
if you are interested in any of the following papers

Number	Title	Contact
94-01 (July)	Schools and Staffing Survey (SASS) Papers Presented at Meetings of the American Statistical Association	Dan Kasprzyk
94-02 (July)	Generalized Variance Estimate for Schools and Staffing Survey (SASS)	Dan Kasprzyk
94-03 (July)	1991 Schools and Staffing Survey (SASS) Reinterview Response Variance Report	Dan Kasprzyk
94-04 (July)	The Accuracy of Teachers' Self-reports on their Postsecondary Education: Teacher Transcript Study, Schools and Staffing Survey	Dan Kasprzyk
94-05 (July)	Cost-of-Education Differentials Across the States	William Fowler
94-06 (July)	Six Papers on Teachers from the 1990-91 Schools and Staffing Survey and Other Related Surveys	Dan Kasprzyk
94-07 (Nov.)	Data Comparability and Public Policy: New Interest in Public Library Data Papers Presented at Meetings of the American Statistical Association	Carrol Kindel
95-01 (Jan.)	Schools and Staffing Survey: 1994 Papers Presented at the 1994 Meeting of the American Statistical Association	Dan Kasprzyk
95-02 (Jan.)	QED Estimates of the 1990-91 Schools and Staffing Survey: Deriving and Comparing QED School Estimates with CCD Estimates	Dan Kasprzyk
95-03 (Jan.)	Schools and Staffing Survey: 1990-91 SASS Cross-Questionnaire Analysis	Dan Kasprzyk
95-04 (Jan.)	National Education Longitudinal Study of 1988: Second Follow-up Questionnaire Content Areas and Research Issues	Jeffrey Owings
95-05 (Jan.)	National Education Longitudinal Study of 1988: Conducting Trend Analyses of NLS-72, HS&B, and NELS:88 Seniors	Jeffrey Owings

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Number	Title	Contact
95-06 (Jan.)	National Education Longitudinal Study of 1988: Conducting Cross-Cohort Comparisons Using HS&B, NAEP, and NELS:88 Academic Transcript Data	Jeffrey Owings
95-07 (Jan.)	National Education Longitudinal Study of 1988: Conducting Trend Analyses HS&B and NELS:88 Sophomore Cohort Dropouts	Jeffrey Owings
95-08 (Feb.)	CCD Adjustment to the 1990-91 SASS: A Comparison of Estimates	Dan Kasprzyk
95-09 (Feb.)	The Results of the 1993 Teacher List Validation Study (TLVS)	Dan Kasprzyk
95-10 (Feb.)	The Results of the 1991-92 Teacher Follow-up Survey (TFS) Reinterview and Extensive Reconciliation	Dan Kasprzyk
95-11 (Mar.)	Measuring Instruction, Curriculum Content, and Instructional Resources: The Status of Recent Work	Sharon Bobbitt & John Ralph
95-12 (Mar.)	Rural Education Data User's Guide	Samuel Peng
95-13 (Mar.)	Assessing Students with Disabilities and Limited English Proficiency	James Houser
95-14 (Mar.)	Empirical Evaluation of Social, Psychological, & Educational Construct Variables Used in NCES Surveys	Samuel Peng
95-15 (Apr.)	Classroom Instructional Processes: A Review of Existing Measurement Approaches and Their Applicability for the Teacher Follow-up Survey	Sharon Bobbitt
95-16 (Apr.)	Intersurvey Consistency in NCES Private School Surveys	Steven Kaufman
95-17 (May)	Estimates of Expenditures for Private K-12 Schools	Stephen Broughman
95-18 (Nov.)	An Agenda for Research on Teachers and Schools: Revisiting NCES' Schools and Staffing Survey	Dan Kasprzyk
96-01 (Jan.)	Methodological Issues in the Study of Teachers' Careers: Critical Features of a Truly Longitudinal Study	Dan Kasprzyk

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Number	Title	Contact
96-02 (Feb.)	Schools and Staffing Survey (SASS): 1995 Selected papers presented at the 1995 Meeting of the American Statistical Association	Dan Kasprzyk
96-03 (Feb.)	National Education Longitudinal Study of 1988 (NELS:88) Research Framework and Issues	Jeffrey Owings
96-04 (Feb.)	Census Mapping Project/School District Data Book	Tai Phan
96-05 (Feb.)	Cognitive Research on the Teacher Listing Form for the Schools and Staffing Survey	Dan Kasprzyk
96-06 (Mar.)	The Schools and Staffing Survey (SASS) for 1998-99: Design Recommendations to Inform Broad Education Policy	Dan Kasprzyk
96-07 (Mar.)	Should SASS Measure Instructional Processes and Teacher Effectiveness?	Dan Kasprzyk
96-08 (Apr.)	How Accurate are Teacher Judgments of Students' Academic Performance?	Jerry West
96-09 (Apr.)	Making Data Relevant for Policy Discussions: Redesigning the School Administrator Questionnaire for the 1998-99 SASS	Dan Kasprzyk
96-10 (Apr.)	1998-99 Schools and Staffing Survey: Issues Related to Survey Depth	Dan Kasprzyk
96-11 (June)	Towards an Organizational Database on America's Schools: A Proposal for the Future of SASS, with comments on School Reform, Governance, and Finance	Dan Kasprzyk
96-12 (June)	Predictors of Retention, Transfer, and Attrition of Special and General Education Teachers: Data from the 1989 Teacher Followup Survey	Dan Kasprzyk
96-13 (June)	Estimation of Response Bias in the NHES:95 Adult Education Survey	Steven Kaufman
96-14 (June)	The 1995 National Household Education Survey: Reinterview Results for the Adult Education Component	Steven Kaufman

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Number	Title	Contact
96-15 (June)	Nested Structures: District-Level Data in the Schools and Staffing Survey	Dan Kasprzyk
96-16 (June)	Strategies for Collecting Finance Data from Private Schools	Stephen Broughman
96-17 (July)	National Postsecondary Student Aid Study: 1996 Field Test Methodology Report	Andrew G. Malizio
96-18 (Aug.)	Assessment of Social Competence, Adaptive Behaviors, and Approaches to Learning with Young Children	Jerry West
96-19 (Oct.)	Assessment and Analysis of School-Level Expenditures	William Fowler
96-20 (Oct.)	1991 National Household Education Survey (NHES:91) Questionnaires: Screener, Early Childhood Education, and Adult Education	Kathryn Chandler
96-21 (Oct.)	1993 National Household Education Survey (NHES:93) Questionnaires: Screener, School Readiness, and School Safety and Discipline	Kathryn Chandler
96-22 (Oct.)	1995 National Household Education Survey (NHES:95) Questionnaires: Screener, Early Childhood Program Participation, and Adult Education	Kathryn Chandler
96-23 (Oct.)	Linking Student Data to SASS: Why, When, How	Dan Kasprzyk
96-24 (Oct.)	National Assessments of Teacher Quality	Dan Kasprzyk
96-25 (Oct.)	Measures of Inservice Professional Development: Suggested Items for the 1998-1999 Schools and Staffing Survey	Dan Kasprzyk
96-26 (Nov.)	Improving the Coverage of Private Elementary-Secondary Schools	Steven Kaufman
96-27 (Nov.)	Intersurvey Consistency in NCES Private School Surveys for 1993-94	Steven Kaufman

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Number	Title	Contact
96-28 (Nov.)	Student Learning, Teaching Quality, and Professional Development: Theoretical Linkages, Current Measurement, and Recommendations for Future Data Collection	Mary Rollefson
96-29 (Nov.)	Undercoverage Bias in Estimates of Characteristics of Adults and 0- to 2-Year-Olds in the 1995 National Household Education Survey (NHES:95)	Kathryn Chandler
96-30 (Dec.)	Comparison of Estimates from the 1995 National Household Education Survey (NHES:95)	Kathryn Chandler
97-01 (Feb.)	Selected Papers on Education Surveys: Papers Presented at the 1996 Meeting of the American Statistical Association	Dan Kasprzyk
97-02 (Feb.)	Telephone Coverage Bias and Recorded Interviews in the 1993 National Household Education Survey (NHES:93)	Kathryn Chandler
97-03 (Feb.)	1991 and 1995 National Household Education Survey Questionnaires: NHES:91 Screener, NHES:91 Adult Education, NHES:95 Basic Screener, and NHES:95 Adult Education	Kathryn Chandler
97-04 (Feb.)	Design, Data Collection, Monitoring, Interview Administration Time, and Data Editing in the 1993 National Household Education Survey (NHES:93)	Kathryn Chandler
97-05 (Feb.)	Unit and Item Response, Weighting, and Imputation Procedures in the 1993 National Household Education Survey (NHES:93)	Kathryn Chandler
97-06 (Feb.)	Unit and Item Response, Weighting, and Imputation Procedures in the 1995 National Household Education Survey (NHES:95)	Kathryn Chandler
97-07 (Mar.)	The Determinants of Per-Pupil Expenditures in Private Elementary and Secondary Schools: An Exploratory Analysis	Stephen Broughman
97-08 (Mar.)	Design, Data Collection, Interview Timing, and Data Editing in the 1995 National Household Education Survey	Kathryn Chandler

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Number	Title	Contact
97-09 (Apr.)	Status of Data on Crime and Violence in Schools: Final Report	Lee Hoffman
97-10 (Apr.)	Report of Cognitive Research on the Public and Private School Teacher Questionnaires for the Schools and Staffing Survey 1993-94 School Year	Dan Kasprzyk
97-11 (Apr.)	International Comparisons of Inservice Professional Development	Dan Kasprzyk
97-12 (Apr.)	Measuring School Reform: Recommendations for Future SASS Data Collection	Mary Rollefson
97-13 (Apr.)	Improving Data Quality in NCES: Database-to-Report Process	Susan Ahmed
97-14 (Apr.)	Optimal Choice of Periodicities for the Schools and Staffing Survey: Modeling and Analysis	Steven Kaufman
97-15 (May)	Customer Service Survey: Common Core of Data Coordinators	Lee Hoffman
97-16 (May)	International Education Expenditure Comparability Study: Final Report, Volume I	Shelley Burns
97-17 (May)	International Education Expenditure Comparability Study: Final Report, Volume II, Quantitative Analysis of Expenditure Comparability	Shelley Burns
97-18 (June)	Improving the Mail Return Rates of SASS Surveys: A Review of the Literature	Steven Kaufman
97-19 (June)	National Household Education Survey of 1995: Adult Education Course Coding Manual	Peter Stowe
97-20 (June)	National Household Education Survey of 1995: Adult Education Course Code Merge Files User's Guide	Peter Stowe
97-21 (June)	Statistics for Policymakers or Everything You Wanted to Know About Statistics But Thought You Could Never Understand	Susan Ahmed
97-22 (July)	Collection of Private School Finance Data: Development of a Questionnaire	Stephen Broughman

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Number	Title	Contact
97-23 (July)	Further Cognitive Research on the Schools and Staffing Survey (SASS) Teacher Listing Form	Dan Kasprzyk
97-24 (Aug.)	Formulating a Design for the ECLS: A Review of Longitudinal Studies	Jerry West
97-25 (Aug.)	1996 National Household Education Survey (NHES:96) Questionnaires: Screener/Household and Library, Parent and Family Involvement in Education and Civic Involvement, Youth Civic Involvement, and Adult Civic Involvement	Kathryn Chandler
97-26 (Oct.)	Strategies for Improving Accuracy of Postsecondary Faculty Lists	Linda Zimbler
97-27 (Oct.)	Pilot Test of IPEDS Finance Survey	Peter Stowe
97-28 (Oct.)	Comparison of Estimates in the 1996 National Household Education Survey	Kathryn Chandler
97-29 (Oct.)	Can State Assessment Data be Used to Reduce State NAEP Sample Sizes?	Steven Gorman
97-30 (Oct.)	ACT's NAEP Redesign Project: Assessment Design is the Key to Useful and Stable Assessment Results	Steven Gorman
97-31 (Oct.)	NAEP Reconfigured: An Integrated Redesign of the National Assessment of Educational Progress	Steven Gorman
97-32 (Oct.)	Innovative Solutions to Intractable Large Scale Assessment (Problem 2: Background Questionnaires)	Steven Gorman
97-33 (Oct.)	Adult Literacy: An International Perspective	Marilyn Binkley
97-34 (Oct.)	Comparison of Estimates from the 1993 National Household Education Survey	Kathryn Chandler
97-35 (Oct.)	Design, Data Collection, Interview Administration Time, and Data Editing in the 1996 National Household Education Survey	Kathryn Chandler
97-36 (Oct.)	Measuring the Quality of Program Environments in Head Start and Other Early Childhood Programs: A Review and Recommendations for Future Research	Jerry West

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Number	Title	Contact
97-37 (Nov.)	Optimal Rating Procedures and Methodology for NAEP Open-ended Items	Steven Gorman
97-38 (Nov.)	Reinterview Results for the Parent and Youth Components of the 1996 National Household Education Survey	Kathryn Chandler
97-39 (Nov.)	Undercoverage Bias in Estimates of Characteristics of Households and Adults in the 1996 National Household Education Survey	Kathryn Chandler
97-40 (Nov.)	Unit and Item Response Rates, Weighting, and Imputation Procedures in the 1996 National Household Education Survey	Kathryn Chandler
97-41 (Dec.)	Selected Papers on the Schools and Staffing Survey: Papers Presented at the 1997 Meeting of the American Statistical Association	Steve Kaufman
97-42 (Jan. 1998)	Improving the Measurement of Staffing Resources at the School Level: The Development of Recommendations for NCES for the Schools and Staffing Survey (SASS)	Mary Rollefson
97-43 (Dec.)	Measuring Inflation in Public School Costs	William J. Fowler, Jr.
97-44 (Dec.)	Development of a SASS 1993-94 School-Level Student Achievement Subfile: Using State Assessments and State NAEP, Feasibility Study	Michael Ross
98-01 (Jan.)	Collection of Public School Expenditure Data: Development of a Questionnaire	Stephen Broughman
98-02 (Jan.)	Response Variance in the 1993-94 Schools and Staffing Survey: A Reinterview Report	Steven Kaufman
98-03 (Feb.)	Adult Education in the 1990s: A Report on the 1991 National Household Education Survey	Peter Stowe
98-04 (Feb.)	Geographic Variations in Public Schools' Costs	William J. Fowler, Jr.

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Number	Title	Contact
98-05 (Mar.)	SASS Documentation: 1993-94 SASS Student Sampling Problems; Solutions for Determining the Numerators for the SASS Private School (3B) Second-Stage Factors	Steven Kaufman
98-06 (May)	National Education Longitudinal Study of 1988 (NELS:88) Base Year through Second Follow-Up: Final Methodology Report	Ralph Lee
98-07 (May)	Decennial Census School District Project Planning Report	Tai Phan
98-08 (July)	The Redesign of the Schools and Staffing Survey for 1999-2000: A Position Paper	Dan Kasprzyk
98-09 (Aug.)	High School Curriculum Structure: Effects on Coursetaking and Achievement in Mathematics for High School Graduates—An Examination of Data from the National Education Longitudinal Study of 1988	Jeffrey Owings
98-10 (Aug.)	Adult Education Participation Decisions and Barriers: Review of Conceptual Frameworks and Empirical Studies	Peter Stowe
98-11 (Aug.)	Beginning Postsecondary Students Longitudinal Study First Follow-up (BPS:96-98) Field Test Report	Aurora D'Amico
98-12 (Oct.)	A Bootstrap Variance Estimator for Systematic PPS Sampling	Steven Kaufman
98-13 (Oct.)	Response Variance in the 1994-95 Teacher Follow-up Survey	Steven Kaufman
98-14 (Oct.)	Variance Estimation of Imputed Survey Data	Steven Kaufman
98-15 (Oct.)	Development of a Prototype System for Accessing Linked NCES Data	Steven Kaufman
98-16 (Dec.)	A Feasibility Study of Longitudinal Design for Schools and Staffing Survey	Stephen Broughman
98-17 (Dec.)	Developing the National Assessment of Adult Literacy: Recommendations from Stakeholders	Sheida White

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1999-01 (Jan.)	A Birth Cohort Study: Conceptual and Design Considerations and Rationale	Jerry West
1999-02 (Feb.)	Tracking Secondary Use of the Schools and Staffing Survey Data: Preliminary Results	Dan Kasprzyk
1999-03 (Feb.)	Evaluation of the 1996-97 Nonfiscal Common Core of Data Surveys Data Collection, Processing, and Editing Cycle	Beth Young
1999-04 (Feb.)	Measuring Teacher Qualifications	Dan Kasprzyk
1999-05 (Mar.)	Procedures Guide for Transcript Studies	Dawn Nelson
1999-06 (Mar.)	1998 Revision of the Secondary School Taxonomy	Dawn Nelson
1999-07 (Apr.)	Collection of Resource and Expenditure Data on the Schools and Staffing Survey	Stephen Broughman
1999-08 (May)	Measuring Classroom Instructional Processes: Using Survey and Case Study Fieldtest Results to Improve Item Construction	Dan Kasprzyk
1999-09a (May)	1992 National Adult Literacy Survey: An Overview	Alex Sedlacek
1999-09b (May)	1992 National Adult Literacy Survey: Sample Design	Alex Sedlacek
1999-09c (May)	1992 National Adult Literacy Survey: Weighting and Population Estimates	Alex Sedlacek
1999-09d (May)	1992 National Adult Literacy Survey: Development of the Survey Instruments	Alex Sedlacek
1999-09e (May)	1992 National Adult Literacy Survey: Scaling and Proficiency Estimates	Alex Sedlacek
1999-09f (May)	1992 National Adult Literacy Survey: Interpreting the Adult Literacy Scales and Literacy Levels	Alex Sedlacek
1999-09g (May)	1992 National Adult Literacy Survey: Literacy Levels and the Response Probability Convention	Alex Sedlacek

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Number	Title	Contact
1999-10 (May)	What Users Say About Schools and Staffing Survey Publications	Dan Kasprzyk
1999-11 (May)	Data Sources on Lifelong Learning Available from the National Center for Education Statistics	Lisa Hudson
1999-12 (June)	1993-94 Schools and Staffing Survey: Data File User's Manual, Volume III: Public-Use Codebook	Kerry Gruber
1999-13 (June)	1993-94 Schools and Staffing Survey: Data File User's Manual, Volume IV: Restricted-Use Codebooks: Principals, Schools, and Teachers	Kerry Gruber
1999-14 (June)	1994-95 Teacher Followup Survey Data File User's Manual: Restricted-Use Version	Kerry Gruber
1999-15 (June)	Projected Postsecondary Outcomes of 1992 High School Graduates	Aurora D'Amico