Appendix C

Technical Notes and Methodology

Survey Content

The need for a nationally representative database on postsecondary student financial aid prompted the U.S. Department of Education to conduct the 1990 National Postsecondary Student Aid Stud (NPSAS:90). To provide the full range of information on financing postsecondary education, NPSAS included both aided and nonaided students. The 1990/94 Beginning Postsecondary Students Longitudinal Study (BPS:90/94) followed students identified as first-time beginning (FTB) students in the academic year 1989–90 from the NPSAS:90 sample. A computer-assisted telephone interview (CATI) was conducte both 2 and 4 years after the NPSAS:90 survey that obtained information concerning enrollment, program completion, education financing, employment, and family formation; graduate school access and enrollment; and civic participation. The data derived from this survey permit a variety of analyses concerning postsecondary persistence and completion, entry into the work force, and civic participation.

Target Population

The target population of BPS is all students who entered postsecondary education for the first time in academic year 1989–90. In defining the cohort as students who began postsecondary education—regardless of when they graduated from high school—BPS represents a departure from previou longitudinal studies of high school cohorts. The sample was designed to include students enrolled in all types of postsecondary education. Thus, it included students enrolled in public institutions; private, not-for-profit institutions; and private, for-profit institutions. The sample included students at 2-year and 4-year institutions,[1] as well as students enrolled in occupationally specific programs that lasted for less than 2 years.

The BPS sample is more likely than previous longitudinal studies to include some of the increasing numbers of "nontraditional" postsecondary students, such as those who have delayed their education due to financial needs or family responsibilities. Students who began their postsecondary studies during some other period and then returned to them in 1989–90 were not included nor were those who were still enrolled in high school. Similarly, institutions offering only correspondence courses, institutions enrolling only their own employees, and U.S. service academies were not eligible for NPSAS or BPS.

Students eligible for BPS were identified in two stages. The first stage involved selection for the NPSAS:90 sample, identified as being representative of all students enrolled in postsecondary education between July 1, 1989 and June 30, 1990. Of the NPSAS:90 sample, those who were identified as being first-time enrollees were eligible for BPS and were retained in the 1992 interview. BPS data are

[1]Four-year institutions include all institutions offering 4-year baccalaureate degrees.

nationally representative by institution level and control, but like NPSAS data are not representative at the state level.

A database of 11,700 NPSAS:90 participants that was believed to contain all possible FTB students in the NPSAS:90 sample was the basis for selecting the BPS:90/92 sample. Prior to the start of interviewing for BPS:90/92, 1,076 of the 11,700 first-time beginners were excluded from participation after a review of the NPSAS:90 data revealed that they had been improperly classified.

In total the BPS:90/92 working sample consisted of 10,624 students. Considerable effort was directed toward ensuring that the sample for BPS:90/92 contained appropriate members. Since the preliminary sample contained a fairly large number of individuals with questionable status as FTB students, during the course of interviewing for BPS:90/92 2,697 additional students were identified as ineligible and 13 were identified as deceased. Of the 7,914 who remained, 6,520 were given full or partial interviews and 1,394 did not respond.

For additional information on the BPS:90/94 survey, consult the *Beginning Postsecondary Students Longitudinal Study Second Follow-up (BPS:90/94) Final Technical Report*, Postsecondary Longitudinal Studies Branch, Postsecondary Education Division, National Center for Education Statistics, U.S. Department of Education, 555 New Jersey Avenue NW, Washington, DC 20208-5652.

BPS:90/94 Sample Design and Data Collection Procedures

The BPS:90/94 working sample consisted of the BPS:90/92 eligible respondents, plus those 90/92 non-respondents for whom BPS-eligibility (FTB status) had yet to be determined.

Data collection for BPS:90/94 was completed utilizing Computer-Aided Telephone interview (CATI). Location of student cases for the BPS:90/94 full-scale survey was initiated with information provided by the BPS:90/92 locating database. All student and tracing source contact information contained in that database was submitted to a national change of address (NCOA) service for updating. Cases not located during BPS:90/92 were forwarded directly to pre-CATI telephone tracing, and subsequently to field locating if intensive telephone tracing was unsuccessful. Prior to the start of CATI operations, a pre-notification mailing was made to the student, enabling current contact information to be provided to interviewers for basic CATI locating efforts. In the event that CATI locating was unsuccessful, cases were sent to post-CATI central trace for telephone tracing and, again as necessary, field locating.

Cases entered CATI in three separate waves. The initial wave contained the 6,950 cases not requiring pre-CATI locating; the secondary wave contained 725 cases located in pre-CATI trace. The third wave into CATI reflects "reactivations" of cases previously in CATI but identified for post-CATI trace and successfully located through those additional tracing procedures.

During tracing operations, 127 cases were identified as "exclusions"; this classification included those who were: (a) out of the calling area[2];(b) deceased; (c) institutionalized or

[2]The calling area consisted of all U.S. states, the District of Columbia, Canada, and some Caribbean Islands (including Puerto Rico)—i.e., numbers not requiring a foreign country or city code. Additionally, 15 international cases for which we obtained valid phone numbers were attempted, yielding 6 completed interviews.

physically/mentally incapacitated and unable to respond to the survey; or (d) otherwise unavailable for the entire data collection period. Discounting these exclusions, 7,132 were located and 655 were not.

For sample members who had not responded to BPS:90/92, FTB status had not been confirmed.[3] Among the 1,376 former nonrespondents for whom BPS eligibility was not determined in BPS:90/92, FTB status was determined for 884 in BPS:90/94. Of these 884, 165 (18.7 percent) were determined to be non-FTBs.[4] A total of 6,786 sample members were interviewed in 1994. Of these, 5,926 were full interviews and 691 were partial interviews (including 448 current status interviews).[5]

Response Rates

A student was defined to be a respondent for BPS:90/94 if the student either confirmed the schools attended (including identification of any additional schools not previously reported) or provided status as of February 1994 for enrollment, employment, and postsecondary degree attainment. Of the 7,239 who are known to be eligible sample students, 6,617 responded; eligibility status is still undetermined for 486 sample members (approximately 6 percent of the BPS:90/94 sample). Thus, the unweighted BPS:90/94 response rate is 91.4 percent among those students known to be eligible for BPS:90/94. The weighted response rate, using the NPSAS:90 analysis weights, is 91.0 percent (table C1). The number of sample members with sufficiently detailed enrollment histories to allow for classification in the persistence variables used in this report was 6,018.

Sample Weighting and Estimation Procedures

Including the BPS:90/92 weights, four sets of weights have been prepared for analysis of the BPS:90/94 data. These four sets of weights include:

(1) BPS:94 primary weight, cross-sectional and retrospective (BPS94AWT). These are the primary weights to be used for analysis of the data collected in the 1994 survey for the population of students who were first-time beginning students in the 1989–90 academic year and had not died prior to 1994. These weights are also used for analysis of trends utilizing data items collected retrospectively in the 1994 interviews for the population of students who were first-time beginning students in the 1989–90 academic year and had not died prior to 1992. These are the weights used in this report.

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[3]There were 18 cases which had been determined BPS-eligible in BPS:90/92 but were BPS:90/92 nonrespondents because they answered no other information.

[4]Four sample members identified in BPS:90/92 as FTBs were actually non-FTBs and thus BPS-ineligible. The non-FTB rate among BPS:90/92 nonrespondents is considerably lower than that previously experienced among BPS:90/92 respondents; this indicates, among other things, that "reentering" (older) students, who did not meet requirements for FTB determination, were easier to locate and interview during the first follow-up and that post-CATI non-FTB modeling done in BPS:90/92 appropriately excluded a fair number of actual non-FTBs from the group of BPS:90/92 nonrespondents.

[5]For those identified as non-FTBs in the interview, the interview was terminated, and considered complete, as soon as they had completed that portion of Section A determining eligibility. Partial interview was defined as either confirming/updating the set of schools attended in Section B or responding to the current status interview, which, by definition, are applicable only to confirmed FTBs.

(2) BPS:92 weight, cross-sectional and retrospective (BPS92CWT). These weights are used for analysis of the 1992 survey data items collected either directly in the 1992 interviews or retrospectively in the 1994 interviews for the population of students who were first-time beginning students in the 1989–90 academic year and had not died prior to 1992.

(3) BPS:92 weight, cross-sectional but not retrospective (BPS92NWT). These weights are used for analysis of the data collected only in the 1992 survey for the population of students who were first-time beginning students in the 1989–90 academic year and had not died prior to 1992.

(4) BPS:92 to BPS:94 weight, longitudinal but not retrospective (BPS92LWT). These weights are used for analysis of trends based on responses to comparable items collected in the 1992 and 1994 interviews for the population of students who were first-time beginning students in the 1989–90 academic year and had not died prior to 1994. These weights are used primarily for analysis of those items that were not collected retrospectively in the 1994 interviews.

Each set of weights contains an estimation weight to be used for estimating population parameters (e.g., means, percentages, and regression coefficients). Each set of weights also contains a set of 35 replicate weights for computation of sampling variance estimates using the Jackknife replication technique.

Taylor series variance estimates for nonlinear survey statistics are based on representation of the nonlinear statistic by its first-order Taylor series expansion and computation of its variance as if the sampling design were a nested, multistage design with a stratified sample of PSUs selected at the first stage.[6] Hence, given the linearization of any nonlinear survey statistic, the essential ingredients for computation of Taylor series variance estimates are the analysis strata and analysis PSUs.

The Taylor series analysis strata and analysis PSUs are based on the first stage of the sampling design, which for BPS:90 was the first stage of the NPSAS:90 sampling design. Hence, the analysis strata and analysis PSUs developed for use with the NPSAS:90 weights (OFCON2 and PSU) can also be u with the BPS:90/92 weights to compute estimates of sampling variances using the Taylor series technique.

Two types of replication techniques are commonly used for variance estimation for stratified multistage sampling design like the NPSAS:90 design. They are balanced repeated replication (BRR) and Jackknife replications. The Jackknife procedure has generally been shown to produce variance estimators that are at least as accurate as, if not more accurate than, their BRR competitors.[7]

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[6]Woodruff, R.S. (1971). "A Simple Method for Approximating the Variance of a Complicated Estimate." *Journal of the American Statistical Association 66*, 411–414.

[7]Kovar, J.G., Rao, J.N.K., and Wu, C.F.J. (1988). "Bootstrap and Other Methods to Measure Errors in Survey Estimates." *Canadian Journal of Statistics 16, Supplement*, 25–45.

Moreover, the Jackknife variance estimators tend to be less erratic when computing variances for small analysis domains because each Jackknife replicate contains sample members except those in a single analysis PSU, whereas each BRR replicate contains only half the analysis PSUs in the sample. Therefore, 35 Jackknife replicate weights were defined for estimation of NPSAS:90 sampling variances. All BPS:90 weight adjustments were independently replicated with each of the Jackknife replicate weights to produce replicate weights that can be used for estimation of sampling variances for the BPS:90 analysis files.

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 happen because observations are made only on samples of students, not on entire populations. Non-sampling 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 estimating missing data.

Data Analysis System

The estimates presented in this report were produced from the BPS:90/94 Data Analysis System (DAS). The DAS software makes it possible for users to specify and generate their own tables from postsecondary data sets. With the DAS, users can recreate or expand upon the tables presented in this report. In addition to the table estimates, the DAS calculates proper standard errors[8] and weighted sample sizes for these estimates. For example, table C2 presents the standard errors that correspond to selected tables in the text, and the weighted sample size appear in C3. If the number of valid cases is too small to produce an estimate (i.e., less than 30), the DAS prints the message “low-N” instead of the estimate.

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 (DEFT) for all the variables identified in the matrix. Since statistical procedures generally compute regression coefficients based on simple random sample assumptions, the standard errors must be adjusted with the design effects to take into account the BPS-stratified sampling method.

For more information about the NCES Data Analysis Systems, contact:

[8]The BPS sample is not a simple random sample 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.

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Analysis Variables

The analysis variables used in this report were derived from the base year NPSAS:90 survey, the 1992 BPS first follow-up, and the 1994 BPS second follow-up. Many of the student characteristics variables originally collected in NPSAS:90 (age, race–ethnicity, type of high school diploma, high school graduation year) were verified, completed, or corrected in the follow-up interviews, so there are small differences in the distributions of the characteristics of the BPS students identified in the NPSAS:90, in the BPS:90/92, and in the BPS:90/94 Data Analysis Systems (DAS). The income variable u in this report is the original NPSAS:90 variable which includes imputed values for approximately one-third of the cases.

The cases with sufficiently detailed enrollment histories to allow classification in the persistence variables used in this report and available in the BPS:90/94 DAS represent 89.4% of the weighted BPS sample. Each of the persistence variables (described in appendix A) is accompanied by a set of descriptive variables (age, attendance status, risk factors, type of institution) specific to the approach that the persistence variable represents. These are described in the glossary (appendix B). The notes to the analysis variables in the BPS:90/94 DAS include the SAS code used to create them.

Statistical Procedures

The comparisons described in the report have all been tested for statistical significance to ensure that the differences are larger than those that might be expected due to sampling variation. The following two types of comparisons have been made in the report:

Differences in two estimated percentages. The paired comparisons were tested using Student's *t* statistics. Comparisons based on the estimates of the proportions include the estimates of the probability of a Type I error, or significance level. The significance levels were determined by calculating the Student's *t* values for the differences between each pair of means or proportions and comparing these with published tables of significance levels for two-tailed hypothesis testing. Student's *t* values may be computed for comparisons using these tables' estimates with the following formula:

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

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 were not

independent, for example, when comparing the percentages across a percent distribution in this report—a row in a table—a covariance term was added to the denominator of the *t* test formula. The addition of the covariance term results in the following formula:

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

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 is 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 when *k* comparisons were made within a family of possible tests, the significance level of the comparisons would sum to $p \leq .05$.[9]

For example, in a comparison of the percentages of males and females who enrolled in postsecondary education, only one comparison is possible (males v. females). In this family, *k*=1, and the comparison can be evaluated with a Student's *t* test. When students are divided into five racial–ethnic groups and all possible comparisons are made, then *k*=10 and the significance level of each test must be $p \leq .05/10$, or .005. The formula for calculating family size (k) is as follows: $k = j * (j - 1)/2$, where j is the number of categories for the variable being tested. In the case of race–ethnicity, there are five racial–ethnic groups (American Indian/Alaskan Native; Asian/Pacific Islander; black, non-Hispanic; Hispanic; and white, non-Hispanic), so *k*=5*(5-1)/2=10.

Trends. In some instances pair-wise comparisons proved too cumbersome. For example, one would like to say something about the general relationship between the percentage of first-time beginners who attained a degree and their number of risk factors when they began postsecondary education. In many cases not all of the six possible comparisons are statistically significant, even though the data appear to suggest clear trends. In such cases, a weighted least squares regression formula was used to test whether the inverse trend between the number of risk factors and the percentage of students with a postsecondary degree was significant, even if all of the pair-wise comparisons were not.

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[9]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: 52-64.

This regression test for linearity was done in this analysis using the data manipulation and regression capabilities of the Microsoft EXCEL spreadsheet program. The input data for the regressions were the estimates and standard errors in the output tables created by the Data Analysis System. All of the variables included in the regression equations were transformed by dividing them by the standard error of the relevant proportion. An intercept variable was also created by dividing a column of 1s by the standard error of the corresponding proportion. The new dependent variable was then regressed on the new independent variable and the intercept variable. The statistical significance of beta for the independent variable was then evaluated in relation $p \leq 0.05$, or $t \geq 1.96$. One important limitation of this test is that it can only be used to assess trends across interval variables or variable categories.

Table C1—Response rates for students included in the BPS:90/94 analysis file, by selected institution characteristics

	Unweighted response rate	Weighted response rate
All students	91.4	91.0
Institution type		
Less-than-2-year	88.1	87.0
2-year	89.3	90.2
4-year, nondoctorate-granting	92.9	92.7
4-year, doctorate-granting	93.1	92.8
Institution control		
Public	92.1	91.3
Private, not-for-profit	92.7	92.5
Private, for-profit	87.2	86.7
Level and control		
4-year		
Public	93.0	92.8
Private, not-for-profit	93.1	92.8
2-year		
Public	90.0	90.4
Private, not-for-profit	89.4	89.5
Private, for-profit (2-year or more)	88.6	87.9
Less-than-2-year		
Public	92.4	89.2
Private, not-for-profit	95.3	94.7
Private, for-profit	86.4	85.9

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1990 Beginning Postsecondary Students Longitudinal Study—Second Follow-up (BPS:90–94).

Table C2—Standard errors for table 1.3 (partial)—Percentage distribution of 1989–90 beginning postsecondary students according to overall persistence and attainment of highest degree as of spring 1994, by demographic characteristics

	None	Certificate	Associate's degree	Bachelor's degree
Total	1.08	0.79	0.81	1.05
Gender				
Male	1.52	1.05	0.91	1.31
Female	1.47	1.10	1.18	1.29
Age when began at first institution				
18 years or younger	1.22	0.69	0.99	1.37
19 years	3.12	2.30	2.63	1.54
20–29 years	2.67	2.34	1.52	0.88
30 years or older	3.35	2.80	1.69	0.55
Socioeconomic status				
Lowest quartile	2.98	2.38	1.55	1.04
Middle quartiles	1.58	1.15	1.09	1.14
Highest quartile	1.48	0.90	1.25	1.66
Race–ethnicity of student				
American Indian/Alaskan Native	13.06	11.05	9.39	5.89
Asian/Pacific Islander	5.37	3.38	2.94	4.61
Black, non-Hispanic	3.22	2.44	2.08	2.09
Hispanic	3.99	3.23	2.62	2.80
White, non-Hispanic	1.25	0.90	0.90	1.21
Marital status when began at first institution				
Not married	1.09	0.79	0.91	1.19
Married	3.32	2.77	1.64	1.01
Separated	10.50	10.53	1.86	0.79
Parental education				
Less than high school diploma	3.43	3.10	1.57	1.51
High school diploma	1.78	1.45	1.36	1.22
Some postsecondary	2.04	1.46	1.54	1.70
Bachelor's or higher	1.64	0.93	1.26	1.77
Dependency status in 1989–90				
Dependent	1.15	0.75	0.97	1.28
Independent	2.27	1.92	1.10	0.60
Income and dependency status in 1989–90				
Dependent				
Less than $20,000	2.33	1.72	1.90	1.76
$20,000–39,999	2.02	1.43	1.61	1.75
$40,000–59,999	2.28	1.45	1.69	1.93
$60,000 or more	2.25	1.14	2.04	2.64
Independent				
Less than $10,000	3.21	2.90	1.80	1.09
$10,000–19,999	4.30	3.79	2.14	0.91
$20,000 or more	3.36	2.92	1.77	1.00

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1990 Beginning Postsecondary Students Longitudinal Study—Second Follow-up (BPS:90/94).

Table C3—Weighted sample sizes for selected row variables

	N (in thousands)
Total	2,562
Gender	
Male	1,179
Female	1,383
Age when began at first institution	
18 years or younger	1,402
19 years	276
20–29 years	462
30 years or older	218
Socioeconomic status	
Lowest quartile	375
Middle quartiles	1,169
Highest quartile	1,017
Race–ethnicity of student	
American Indian/Alaskan Native	18
Asian/Pacific Islander	103
Black, non-Hispanic	226
Hispanic	194
White, non-Hispanic	2,016
Marital status when began at first institution	
Not married	1,911
Married	267
Separated	25
Parental education	
Less than high school diploma	233
High school diploma	818
Some postsecondary	555
Bachelor's or higher	817
Dependency status in 1989–90	
Dependent	1,895
Independent	666
Level and control of institution	
4-year	
Public	705
Private, not-for-profit	339
2-year	
Public	1,148
Private, not-for-profit	44
Private, for-profit	98
Less-than-2-year	
Public	47
Private, not-for-profit	10
Private, for-profit	168

SOURCE: U.S. Department of Education, National Center for Education Statistics, 1990 Beginning Postsecondary Students Longitudinal Study—Second Follow-up (BPS:90/94).