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It can be argued that the public investment in student financial aid should be evaluated based on the tax revenue returns that result from this investment. While this is not the only basis on which student aid can be justified in the budget process, this approach does have merit, especially given the large federal deficit. This article develops a model for estimating the tax revenue returns from gains in educational attainment that are attributable to student financial aid. This study examines the impact of student aid on access and persistence.

It is estimated that the net present value of the tax returns on each dollar of federal expenditures on student aid for students in the high school class of 1980 was $4.30, using reasonable economic assumptions. The authors conclude that student financial aid generates a positive return to the federal budget, a research finding that merits consideration in the budget process.

Student financial aid is one of the few areas of the federal budget that has the potential to be profitable. Future tax revenue gains can be attributed directly to this investment in educational attainment. This approach to assessing the impact of the federal investment in student aid is compatible with the intended purpose of the Title IV programs of the Higher Education Act (HEA), as amended, which is to promote equal educational opportunity (EEO),[1] as well as with conservative economic views of how social policy should be evaluated. In fact, Milton Friedman (1962) has argued that tax revenue returns can be used to evaluate the public investment in postsecondary education, especially for programs that prepare people for the workforce. Given the extreme financial conditions that are confronting federal budgetary decisions in the 1990s, including the large deficits, profitability of investment is certainly one basis on which public decisions should be evaluated.[2]

Human capital theory provides a basis for examining individual and public decisions to invest in education (Becker, 1964). For the individual, the direct costs of these "investment" decisions include tuition, fees, books, and living expenses. The indirect costs include forgone earnings they "spent" in education. The individual's monetary returns are increased lifetime earnings from gains in educational attainment. The federal government subsidizes the direct costs for individuals from low- and middle-income families through the student financial aid programs. According to the human capital framework, this financial support can be viewed as an "investment". The return from the federal government's investment is the increased tax

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revenues attributable to the gains in educational attainment that result from this investment. There are, of course, nonmonetary reasons why individuals and society invest in higher education, as well as nonmonetary returns to both. However, the examination of the monetary returns is one way to evaluate student financial aid.

This article estimates the tax returns on federal investment in student financial aid, which are expressed as cash-flow ratios.[3] (Cash-flow ratio is the amount of money spent by the federal government on individuals in a particular cohort divided by the tax revenue on that investment for the same group.) The article has four sections. First, the study approach is described, including a discussion of the model, databases, and study limitations. Second, the procedures used to estimate the model are described. Then, as part of the study finding, a range of cash-flow ratios are presented, using alternative adjustment for background and future economic conditions. Finally, the implications of this research are considered for higher education public policy.

Study Approach

The analysis of the returns on federal investment in student financial aid poses a difficult problem for public policy. It takes a lifetime to determine the impact federal student aid has on an individual or high school cohort. Since federal student aid can change substantially in a decade, or even in a few years, the evaluation of the impact student aid had during one period may not be applicable to another period.

This study examines the impact of financial aid on the high school class of 1972, using the National Longitudinal Study (NLS) and Bureau of Census' estimate of lifetime earnings. NLS was chosen because students in the class of 1972 are already through college and have entered the work force, which makes it possible both to estimate the impact of student aid on attainment levels, as well as to estimate the impact of attainment on earnings. The Bureau of Census' estimates of lifetime earnings are used to calculate tax revenue differentials for four attainment levels: high school, some college, undergraduate degree, and graduate degree. The mathematical model used to estimate cash-flow return statistics for student aid, the data bases, and study limitations are described below.

The Mathematical Model

There are three general components of the model: (1) the calculation of tax differentials related to each attainment level; (2) the calculation of the portions of the tax revenue differential attributable to student financial aid; and (3) the calculation of the amount of federal expenditures on student financial aid. The model uses eight postsecondary attainment groups: high school, some college (including proprietary school), undergraduate degree, and graduate degrees, broken down for males and females. The general equation for the cash-flow ratio for each attainment group i (when i equals a particular attainment group) is the ratio of revenues (R) and outlays (O) where:

$$R = W*[(M_i*LFP_i*REV_i) - (M_{hs}*LFP_{hs}*REV_{hs})]*(A.Adj)*(B.Adj), \text{ and}$$
$$O = W*AID_i$$

And:

W = a vector of weights to adjust for participation rates for each attainment group,

M_i = a vector of mortality factors for each attainment group to adjust average income for mortality rates,

LFP_i = a vector of labor force participation factors for each attainment group to adjust average income for labor force participation rates,

REV_i = a vector of taxes paid on mean income of those in each attainment group, reflecting varying assumptions regarding discount rates and real income growth,

M_{hs} = a vector of mortality factors for the group "high school only" to adjust average income for mortality rates,

LFP_{hs} = a vector of labor force participation factors for the group "high school only" to adjust average income for labor force participation rates,

REV_{hs} = a vector of taxes paid on mean income of those in the attainment group "high school only," reflecting varying assumptions regarding discount rates and real income growth,

A.ADJ. = a vector of aid adjustments to adjust the earnings differentials for the contribution of financial aid in increased attainment,

B.ADJ. = a scale to adjust for the earnings differentials for varying effects of background characteristics on increased earnings of each attainment group,

AID_i = the average amount of aid assigned to each attainment group, discounted back to the base period with varying discount rates.

The future revenues are discounted into "present value" using the following formula:

$$PV = REV/(1 + r)^{N-A+1}$$

where PV = the present value of the future revenues,
Rev = the calculated future revenues,
r = the discount (interest) rate,
N = the future age of the taxpayer,
A = the current age of the taxpayer (18 years old).

The future earnings are assumed to grow at varying rates, using the following formula:

$$FE = AE*(a+g)^{N+A+½}$$

where FE = future earnings
AE = average earnings from the US Census data,
g = the growth rate of earnings,
N = the future age of the taxpayer,
A = the current age of the taxpayer (18 years old),
½ = an adjustment following the assumption that the growth takes place in the middle of the year.

Both the discount and growth adjustment formulae are exactly the same as those used in the U.S. Census report. The six sets of adjustments which were required to estimate the cash-flow statistic are:

- Adjustment for the tax paid on the higher earnings;
- Adjustments to accommodate shortcomings of the Census data—income growth, labor force participation and mortality;
- Adjustment for the contribution of background factors (i.e. ability and socio-economic status) to attainment;
- Adjustment for the contribution of aid to attainment;
- Adjustment for proportional attainment levels of the target population; and
- Adjustment for discount rate.

"Under virtually any combination of assumptions, student aid is a profitable area of public investment."

There are three components to the mathematical model developed to estimate the cash-flow statistics. The steps used in the first component of the model to estimate the tax revenue differential for each attainment group are illustrated in Figure 1. First, the tax burden is estimated for each attainment group, by assigning the standard deduction for a typical filing status to each group for each year of the group's working life.[4] This amount is then adjusted for the probability that the individual in the group will reach that age (mortality adjustment) and be working at that age (labor force participation adjustment), which is compatible with the Census estimates of future earnings. Then, the model calculated the tax differentials for each college attainment level by subtracting taxes paid by the high school educated from the higher taxes paid by the college educated. Earnings for each attainment group are also adjusted for productivity growth before tax revenues are calculated.

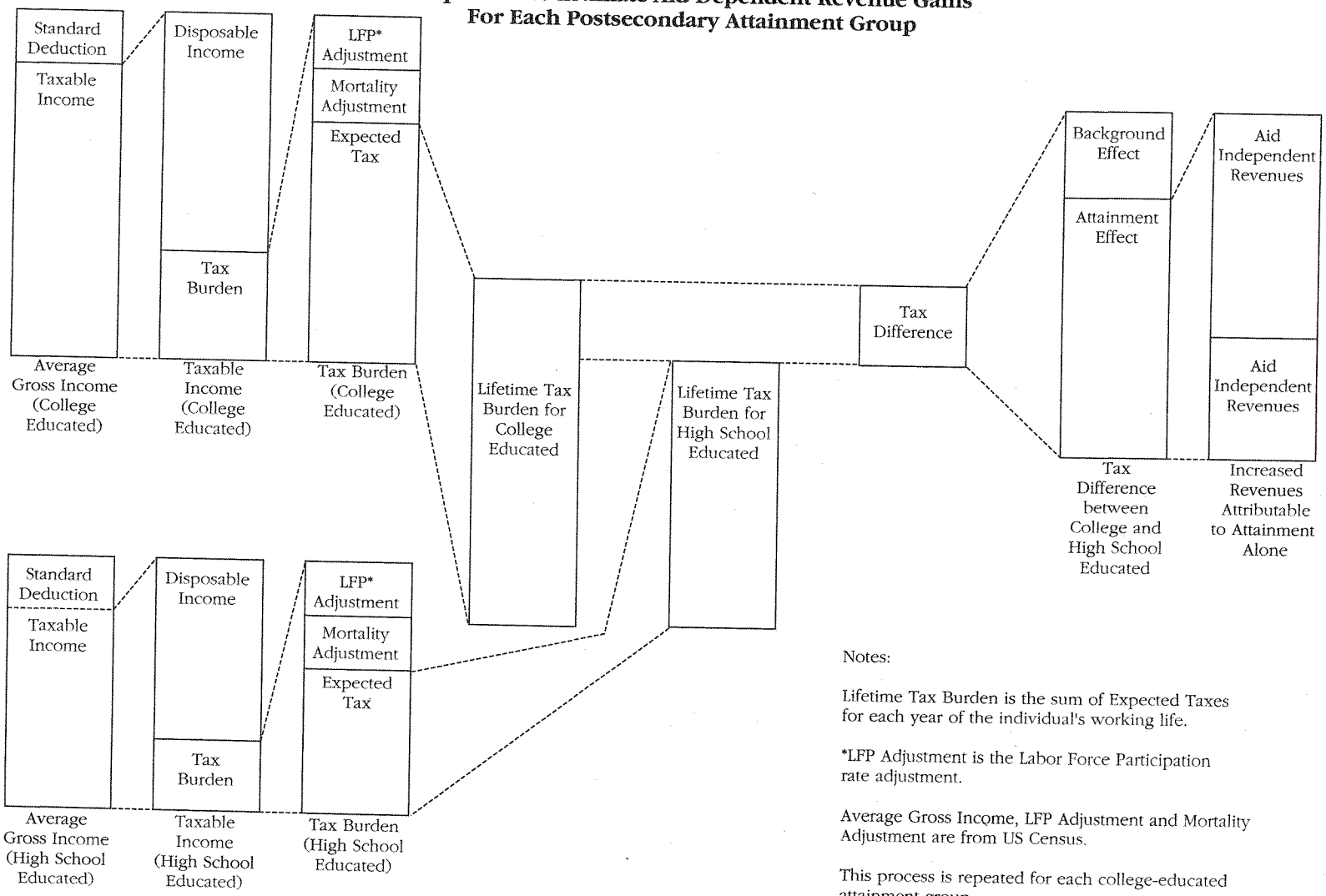
The second component of the model, the estimation of the tax differential for each cohort that is attributable to student financial aid,[5] is also illustrated in Figure 1. The model adjusts for the influence of background factors. This adjustment for possible "omitted ability bias" reduces the returns to college attendance, and also reduces the cash-flow ratios that were calculated. Then the model adjusts this subtotal by subtracting the portion that cannot be attributed to student financial aid, leaving the amount of tax revenues that are attributable to student financial aid. These revenues are then adjusted to their *present value,* using the formula described above.

The third component of the model is the estimation of budget outlays for student financial aid. The self-reported aid awards in NLS are used as a basis for these estimates. Budget outlays and aid dependent revenues are calculated for each attainment group, then adjusted for the different participation rates of each attainment group. Budget outlays and tax revenues are adjusted to 1981 dollars using the Consumer Price Index (CPI).

Databases

Two data sources were used to estimate the model. The first is a U.S. Census report on lifetime earnings (U.S. Bureau of the Census, 1983). The second is NLS, which was used for analysis of earnings from work for 1973 to 1978 and to estimate the effect of aid on educational attainment.[6]

Figure 1
Steps Used to Estimate Aid-Dependent Revenue Gains
For Each Postsecondary Attainment Group



Notes:

Lifetime Tax Burden is the sum of Expected Taxes for each year of the individual's working life.

*LFP Adjustment is the Labor Force Participation rate adjustment.

Average Gross Income, LFP Adjustment and Mortality Adjustment are from US Census.

This process is repeated for each college-educated attainment group.

U.S. Census Data

The Census estimates of lifetime earnings were developed from Current Population Surveys (CPS) conducted in March 1979 and 1980 (U.S. Bureau of the Census, 1983). The basic assumption that underlies the Census estimates of lifetime earnings is that 18 year olds in 1979 will have a similar earnings profile when they are 64 years old as did 64 year olds in 1979. To test the validity of this assumption, the Census tabulated data on each CPS collected during the 1970s. They concluded that "comparisons of cross-sectional and cohort data can be used in this estimation process," since the tabulation indicates very little real growth in income for these groups during the 1970s (U.S. Bureau of the Census, 1983, p. 9).

However, since there was real economic growth in the 1980s, the Census estimates were adjusted for general economic growth, using their own methodology. The Internal Revenue Service (IRS) has calculated that the annual real growth in personal income for the period between 1979 and 1986 was 2.48 percent (IRS, 1988). This extended period of growth in the 1980s limits the accuracy of the Census' estimates. Therefore, we adjusted the Census estimates for general economic growth using the Census' methodology.

The Census estimates were the data source for estimates of working-life incomes, mortality rates and labor participation rates for the 1972 cohort. The methodology used for applying these estimates is described in the section on estimation of the model.

National Longitudinal Study (NLS)

The National Longitudinal Study of the High School Class of 1972 was initiated in the spring of 1972 by the National Center for Education Statistics. NLS surveyed 22,252 high school seniors in a highly stratified random sample, and continued with five follow-ups (Sebring, et al., 1987). A total of 12,841 responded to the last follow-up. Certain groups were deliberately oversampled, so NLS' sampling weights were used throughout this study.

The NLS data were used to estimate the level of educational attainment by the class of 1972, the amount of student aid awards, and the logistic regression analyses for the aid adjustment. The section on model estimation described the procedures for these analyses. Yearly income was analyzed, but was not used for this article for reasons discussed below.

Combining the Census and NLS Data

There were two possible ways to combine the Census and NLS data. Since the average person in the high school class of 1972 was 25 years old in 1979, it was possible to use average self-reported earnings for 1972 to 1978, then to use the Census estimates for the remaining years. The other possibility was to use the Census estimates for 18 year olds in 1979 and to assume that the earnings profile in 1972 was the same as the earnings of 18 year olds in 1979. The second approach was selected because:

- Yearly income for years 1972-1979 for the NLS sample is higher than the Census' for six of eight attainment sample groups, which results in more conservative tax revenue estimates if the Census is used;

- The Census data on earnings is probably more accurate since the Census asked individuals to report actual earnings for the year just completed, while NLS asked individuals for prior year earnings;
- The lack of real income growth in the 1970s means that earnings were static for 18 year olds between 1977 and 1979; and
- There is also a statistical advantage to using a single data set rather than mixing data sets.

Limitations

This study has a few limitations that merit special mention. First, there are limitations inherent in the data used for the study. One is that self-reported data were used to estimate student aid expenditures. Unfortunately no other data were available. Another is that the aggregate nature of the Census data limits our ability to analyze the determinants of income, such as race, labor force experience, ability, and family income.

Second, it appears that earnings differentials do change over time. In the 1980s, the expected earnings for college graduates were declining and Freeman (1976) projected that they would continue to decline. However, earnings differentials rose in the 1980s. The Bureau of Census estimates of lifetime earnings show there is evidence that earnings differentials rose in the early 1980s (O'Neill and Sepielli, 1985). Therefore, earnings are subject to change. However, the differentials used in this study are relatively conservative given the fact that differentials have continued to climb.

Third, there are also state-of-the-art limitations in measuring the impact of student aid on attainment and the impact of attainment on earnings.

Model Estimation

To use the model it was necessary to estimate each variable it used. In some cases, multiple estimates were developed to control for divergent view points in the fields of research that impact this study. This section describes the methods used to estimate weights for each attainment group, aid adjustments, background effect adjustments, tax revenues, and student aid subsidies.

Weights for Attainment Groups

It was necessary to calculate the relative size of each attainment group for the vector of weights in the model. First, it was necessary to construct comparable attainment classifications between the two data bases, since the Census categorized by the number of years of education and NLS categorizes by the degree obtained. The crosswalk used to reconcile these categories was:

Census	NLS
Less than 12 years	No comparable group[7]
4 years of high school	No postsecondary education
1 to 3 years of college	Less than undergraduate degree (including attendance at proprietary school)
4 years of college	Undergraduate degree
5 years of college	Graduate degree

TABLE 1
1986 Educational Attainment
High School Class of 1972

Attainment Group	Weighted Frequency	Relative Frequency of College Attenders
High School Only—Men	21.0%	–
High School Only—Women	21.5%	–
College, 1 to 3 Years—Men	14.4%	25.1%
College, 1 to 3 Years—Women	16.9%	29.5%
College, 4 Years—Men	8.7%	15.2%
College, 4 Years—Women	9.3%	16.2%
College, 5+ Years—Men	4.7%	8.2%
College, 5+ Years—Women	3.3%	5.8%
Sample Size = 12,730		

Source: National Longitudinal Study of the High School Class of 1972.

Each of these groups received different subsidies and paid different levels of taxes. The attainment levels for NLS students in 1986, when the average age is 31 years old, are reported in Table 1. The relative frequency of those in each attainment group is used as the vector of weights in the model. All financial variables use this weighting, consistent with the mathematical model.

It should be noted that the weighting considers only 1985 attainment levels. Some members of the 1972 high school class were actually in college at the time of the 1985 follow-up and others no doubt will enter college in the future. Therefore, the relative frequencies presented in Table 1 understate the final attainment levels and, to the degree the weights are underestimated, the cash-flow ratios are underestimated.

Financial Aid Adjustments

To estimate the model, it was necessary to calculate the effect of student aid on attainment. Therefore, it was necessary to estimate the combined impact financial aid had on access and persistence for the high school class of 1972. We decided to develop estimates of the influence of student aid on access and persistence using models developed for these purposes. First, we discuss our approach, then present our analysis, and finally we present the aid adjustments.

Approach to Aid Adjustments

It was necessary to develop aid adjustments for three attainment levels. First, students who gain access but do not complete college are classified as having some college in our model. For these students we made an adjustment for access only, assuming that a certain percentage of these students would not have been able to attend college without aid. Second, students who complete their undergraduate education are potentially influenced by student aid in both their enrollment and persistence decisions. Therefore, this group needs to be adjusted for persistence, as well as access. Finally, because some students pursue a graduate degree, they merit an additional adjustment for the influence of aid on graduate access and persistence. Unfortunately there is very little prior research on this

topic and conducting analyses was beyond the scope of this study. Consequently, an additional persistence adjustment was made for this group under the assumption that a portion of this group would have been less likely to complete their undergraduate education, gain access to graduate school, or persist in graduate school without student aid.

The development of aid adjustments for these three groups posed a methodological problem for us. We needed an estimate of the probability that the average student either gained access or persisted because of student financial aid. Mathematically such a probability can be treated as an average; that is, a 12.5 percent increase in the probability of attendance can be interpreted as meaning that 12.5 percent of the average student's access is attributable to financial aid.[8] We did this because the Census data are presented as averages and thus, we needed to make this assumption to use both databases. Also, our purpose was to estimate a cash-flow ratio for student aid, which requires a measure of average impact.

Estimates of Aid Adjustments

We used logistic regressions of NLS to estimate the influence of student aid on access and persistence. We used methodology recommended by Petersen (1984) to estimate changes in probability for beta coefficients, which we refer to as Delta P statistics. The statistical models used as a basis for these analyses are derived from recent studies of the impact of student aid that examined students in the 1970s and 1980s. By using these models, it is possible to consider the comparability of our findings for the class of 1972 to the high school classes of the 1980s.

Access. Our model for measuring the influence of aid on access used a model that student enrollment decisions were a function of the regions where students were from, their background (race, gender, income, mother's education), high school experience (program and grades in high school), their postsecondary plans, their ability (test scores), and student aid. The statistical model used for this analysis was tested in a recent study that examined the influence of different types of aid packages on the enrollment decisions of students in the high school classes of 1972, 1980 and 1982 (St. John and Noell, 1989).[9]

The analysis of the influence of aid on enrollment (please see Table 2) reveals that financial aid offers increased the probability of enrollment by 12.5 percentage points. This measure was used in our analysis. Since gender was not significant, we used the same Delta P for both men and women. This is slightly lower than the 13.1 percentage point measure we derived from Leslie and Brinkman (1988)[10] and the raw, unadjusted effect of aid, which is 13.5 percent.[11] Therefore, our estimates can be considered conservative.

Persistence. Our persistence analysis used a model developed for national studies of the impact of student aid on persistence (St. John, Kirshstein, and Noell, 1988). The model, in fact, has been used to examine the evolving influence of financial aid on persistence by students in the 1970s and the 1980s (St. John, 1989). The model

TABLE 2
Logistic Regression Results on Access
High School Class of 1972
College Attendance by Applicants:
By Background and Financial Aid

Dependent Variable: Attendance by Applicants
Sample Size: 5342
Model Chi-Square: 778.73**
Baseline P (weighted): 0.787

Variables	Range	Delta P
High School Region—Northeast	0–1	0.016
High School Region—North Central	0–1	0.035**
High School Region—South	0–1	0.020
Black	0–1	−0.124**
Hispanic	0–1	−0.003
Male	0–1	0.013
Family Income	1–10	0.010**
Mother's Education Level	1–5	0.020**
Academic High School Program	0–1	0.011
Vocational High School Program	0–1	0.020
High School Grades	1–7	0.017**
Test Score	1–3	0.018*
Postsecondary Educational Plans	1–5	0.056**
Received an Aid Offer	0–1	0.125**

** Significant at 0.01
* Significant at 0.05

Data Source: National Longitudinal Survey of the High School Class of 1972.

"Increased funding of student aid programs seems to be very much in the public interest."

assumes persistence is a function of family background (race, gender, family income, and mother's education), high school experience (program), ability/achievement (test score), postsecondary plans, institutional characteristics (whether students started in a two-year/four-year or public/private institution), college grades, and financial aid.[12]

To develop a change in probability measure for persistence, we examined the influence of these background factors and aid on persistence to completion of a four-year degree (by 1986).[13] (Please see Table 3.)

The analysis considered whether receiving aid any time during an undergraduate career influenced persistence to degree attainment. The point estimates for gender were small, so we did not use separate values for males and females. If we had used separate values, the value for males would have increased by 0.018. Using the smaller female estimate for both males and females will tend to underestimate the cash-flow ratio, and yield a more conservative estimate of the returns of the federal investment.

Receiving financial aid increased the probability of persisting to degree completion by 10.6 percentage points, which is the change in

TABLE 3
Logistic Regression Results on Persistence
High School Class of 1972
Persistence to an Undergraduate Degree:
By Background and Financial Aid

Dependent Variable: Persist to Bachelor's degree
Sample Size: 3821
Model Chi-Square: 1340.19**
Baseline P (weighted): 0.452

Variables	Range	Delta P
Black	0–1	−0.036
Hispanic	0–1	−0.060
Male	0–1	0.018
Family Income	1–10	0.018**
Mother's Education Level	1–5	0.022**
Academic High School Program	0–1	0.046*
Vocational High School Program	0–1	−0.157**
Postsecondary Educational Plans	1–5	0.126**
Test Score	1–3	0.066**
College Grades—First Year	1–7	0.066**
Four-Year College—First Year	0–1	0.266**
Private College First Year	0–1	0.057**
Received Financial Aid	0–1	0.106**

** Significant at 0.01
* Significant at 0.05

Data Source: National Longitudinal Survey of the High School Class of 1972.

probability measure we use in our estimates. This is slightly lower than the change in probability measure developed by Terkla (1985, p. 17) in another analysis of the NLS. She reported a change in probability of 12.5 percentage points. Our Delta P is also smaller than the statistical averages (13.2 percentage points) developed by Leslie and Brinkman (1988, p. 173) from their review. It is also smaller than the 17.4 percentage point raw unadjusted effect of student aid on persistence from NLS.[14] Therefore, the change in probability measure used for persistence provides a conservative estimation of the impact of student aid.

Adjustments

Based on these analyses, we developed a set of three aid adjustments:[15]

- 12.5 percent for males and females with some college;
- 24.4 percent for males and females with undergraduate degrees; and
- 37.6 percent for males and females with graduate degrees.

These changes in probability measures represent conservative estimates of the impact of student aid. They are lower than measures that would be derived from recent reviews of research in the field. How-

ever, we think they are appropriate measures for the class of 1972 since they were derived from analyses especially developed for this study.

Background Adjustment

One of the problems associated with calculating the returns to higher education is measuring the effect of background factors on income. We observe that those who receive a college degree have higher incomes than those without college degrees. However, it could be true that these college graduates would have had higher incomes even if they did not attend college, due to a higher ability level or some other unmeasured background factor.

The adjustment for background factors is called the "alpha" value, following the work of Psacharopoulos (1975). It is a value which is expressed as a percentage of the higher earnings of college graduates which is attributable to the college degree and not these other background factors. Leslie and Brinkman (1988) reviewed thirteen studies that reported alpha values for the undergraduate degree. The simple average of these alpha values was 0.79 (p. 44). They also note that the apparent influence of background declines as higher education levels are attained. They conclude the 0.88 is an estimate of the alpha value that yields "fairly consistent results" (p. 44).

Recent findings have pointed toward a lack of "omitted ability bias" in calculating the returns to education. However, there are still some divergent viewpoints on this point. To accommodate these divergent viewpoints, three alternative alpha values were used in the estimation of cash-flow ratios: 0.8, which is close to the sample average (i.e. 0.79) computed by Leslie and Brinkman (1988); 0.9 which is close to the recommendation by Leslie and Brinkman (i.e. 0.88); and 1.0 which is consistent with a lack of "omitted variable bias."

The Census Lifetime Revenue Estimates

The Bureau of the Census lifetime income estimates were used for tax burden estimation. Census (1983) estimated expected lifetime earnings by attainment level for males and females. The methodologies for estimating tax burden and adjusting for mortality and labor force participation are discussed briefly below.

A simple method for calculating tax burden was used. We assigned each taxpayer the following filing status: married, filing joint return, with two dependents, taking the standard deduction. This method will underestimate the tax paid by those who itemize deductions. Since those with higher incomes are more likely to itemize, this method will lead to overestimating the difference in taxes paid by those with college degrees. However, this is offset by the observation that those with lower incomes tend to have more children, and will have more tax dependents. Whether these effects are offsetting cannot be calculated. Unfortunately, there was not enough information available in the Census data to use a more sophisticated approach to calculating the taxes paid.

Our use of a single filing status will tend to underestimate the amount of taxes paid by each group, since few people are married for

each year of their lives between 18 and 64, and probably do not have two dependents for each of these years. Since we are only concerned with the *difference* in the tax paid by each attainment group, this will not significantly affect the results we present.

The methodology included in the *Tax Reform Act of 1986* was used for calculating the tax burden of each group. Since this act adjusts tax brackets for inflation, we did not have to consider "bracket creep" arising from future inflation. All of our data were adjusted to constant 1981 dollars.

The calculated tax revenues estimated using this methodology were further adjusted for mortality and labor market participation. The mortality rates adjust survey results for the probability that an 18 year old will survive to the age of retirement. Estimated tax revenues are also adjusted for a period of unemployment. The Bureau of Census adjustment ratios are used.

Student Subsidy Estimation

The federal student aid programs provide a direct subsidy, based on a student's financial need, to support some of the student's direct educational costs. The cash-flow ratio is a relative measure of the return to the federal government of each dollar invested in student aid. To calculate the cash-flow ratio, it was necessary to estimate the full costs of these subsidies for each NLS cohort.

To estimate the direct cost of student aid subsidies, it was necessary to control for inconsistencies in the way student aid data were reported. College Work-Study was not consistently reported. Therefore, neither federal fund outlays, nor the tax revenue returns were estimated for College Work-Study.[16] Students reported the amount of aid for each program in 1972-73, 1974-75 and 1975-76. For the other years, only the total amount of scholarship/grant aid and the total amount of loans were reported. Since not all grants and loans are federally subsidized, we needed to estimate the portion of grants and loans that were federally subsidized for 1973-74, 1976-77, 1977-78 and 1978-79. Therefore, the federal portion of 1972-73 grants and loans were applied to the 1973-74 totals[17] and the federal portion's 1975-76 grants and loans were applied to 1976-77 to 1978-79. Each of these amounts is converted to 1981 dollars. For all loan amounts it was assumed that the total federal costs were about half of the loan amount, which was the estimated average cost of default, in-school interest subsidies, and payments for administrative costs.

Differential aid amounts were assigned to each attainment group. Students with some college were credited with two years of subsidy, students with four-year degrees were credited with four years of subsidy, and students with graduate degrees were assigned seven years of aid subsidy. The average amount of subsidy received was assigned to each cohort. These aid stream subsidies were discounted to "present value" using the same discount rates that were used by the Census.[18]

As a check on the accuracy of the self-reported data on aid, we compared a tabulation from NLS for 1974-75 and 1975-76 to actual average awards for these years reported in the *Condition of Educa-*

TABLE 4
Comparison of NLS Self-Reported Awards
With Awards Reported in the
Condition of Education (COE)

	COE	NLS
Academic Year 1974-75		
BEOG/Pell	$ 631	$ 689
SEOG	506	665
GSL	1215	1192
NDSL	647	752
Academic Year 1975-76		
BEOG/Pell	$ 747	$ 721
SEOG	513	570
GSL	1310	1269
NDSL	667	734

Sources: The COE amounts are from *Condition of Education, 1986* published by the Center for Education Statistics, U.S. Department of Education, Table 2:6, page 112. The NLS amounts are from a weighted tabulation of aid recipients.

tion. (Please refer to Table 4.) The comparison clearly indicates self-reported data from NLS are reasonably close to the actual average awards. Therefore, the self-reported amounts of aid in NLS appear to be reasonably accurate.

Findings

There are many benefits to the federal investment in student financial aid, in addition to the tax revenues that accrue from the investment. Indeed, federal student aid is usually justified based on its human impact. Equalizing educational opportunity is thought to have its own value to society. This study examines just one narrow definition of benefits, increased tax revenues, but the results clearly demonstrate that these benefits are far in excess of the financial costs.

The cash-flow analysis (using the model and estimations described in the prior sections) clearly demonstrates that student financial aid was a profitable investment during the 1970s. (Please see Table 5.) The results are presented as a range of estimates allowing for the different background adjustments and economic assumptions (discount rates and growth rates).

Consistent with our prior discussion, three alternate background adjustments are used: one that assumes background accounts for 20 percent of earnings (an .80 background adjustment); one that assumes background accounts for 10 percent of earnings (.90); and one that assumes background is already accounted for in the model and therefore no background adjustment is needed (1.00). Two economic variables are treated as assumptions: *discount rate,* which is an estimation of how much future interest rates will discount the present value of future tax revenues, and *growth rate,* which is an estimation of the real growth in personal income. Three discount

TABLE 5
Cash-Flow Ratios for the Entire Cohort
With Varying Aid and Background Adjustments
(Federal Portion of Aid)

Discount Rate:	0%				3%				5%			
Growth Rate:	0%	1%	2%	3%	0%	1%	2%	3%	0%	1%	2%	3%
Background Adjustments												
.80	5.0	9.4	15.0	23.1	2.3	4.1	6.4	9.6	1.4	2.5	3.8	5.6
.90	5.6	10.5	16.9	25.9	2.6	4.6	7.2	10.8	1.6	2.8	4.3	6.3
1.00	6.3	11.7	18.8	28.8	2.9	5.1	8.0	12.0	1.8	3.1	4.8	7.0

rates are estimated (1 percent, 3 percent, and 5 percent) and four growth rates (0 percent, 1 percent, 2 percent and 3 percent).

The central finding of this study is that under virtually any combination of assumptions, student aid is a profitable area of public investment. The following examples illustrate this conclusion:

- *Example 1: Worst Case Economic Assumptions and Large Background Adjustment.* Assumes a 5 percent discount rate, 0 percent economic growth rate, and .80 background adjustment. Under these assumptions, the net present value of the expected federal tax revenues attributable to each dollar the federal government invested in student aid on the class of 1972 would be $1.40.
- *Example 2: Worst Case Economic Assumptions and No Background Adjustment.* Assumes a 5 percent discount rate, a 0 percent growth rate, and a 1.00 background adjustment. Under these assumptions, the net present value of the expected federal tax revenues attributable to each dollar the federal government invested in student aid on the class of 1972 would be $1.80.
- *Example 3: Optimistic Economic Assumptions and Large Background Adjustment.* Assumes a 0 percent discount rate, 3 percent growth rate, and .80 background adjustment. Under these assumptions, the net present value of the expected federal tax revenues attributable to each dollar the federal government invested in student aid on the high school class of 1972 would be $23.10.
- *Example 4: Optimistic Economic Assumptions and No Background Adjustment.* Assumes a 0 percent discount rate, a 3 percent growth rate and 1.00 background adjustment. Under these assumptions, the net present value of expected federal tax revenues attributable to each dollar the federal government invested in student financial aid on the high school class of 1972 would be $28.80.

These examples illustrate that the economic assumptions we make have a larger influence on the cash-flow ratio than does the background adjustment. Under the worst economic assumptions, the net present value of the federal investment ranges from $1.40 cash-flow ratio, when a large background adjustment was used (Example

1), to $1.80 cash-flow ratio when no background adjustment was used (Example 2). In contrast, under optimistic economic assumptions, the cash-flow ratio ranges from $23.10 cash-flow ratio for a large background adjustment (Example 3), to $28.80 cash-flow ratio for no background adjustment (Example 4).

If we make the reasonable economic assumptions that there will be a 5 percent discount rate and a 2 percent growth rate, and if we assume a 90 percent background adjustment, then the return on a one dollar investment in student aid would be $4.30. Given the factors already considered, these assumptions appear to be reasonable. Therefore, we conclude that the net present value of each dollar invested in student aid during the 1970s was about $4.30.[19]

TABLE 6
Break-Even Discount Rate Under Varying Assumptions
(Internal Rate of Return for Federal Investment in Student Aid)

Background Adjustments	Growth Rates 0%	1%	2%	3%
.80	6.71%	9.14%	11.13%	12.87%
.90	7.28%	9.73%	11.74%	13.51%
1.00	7.81%	10.27%	12.30%	14.09%

The internal rate of return (IROR) was also estimated for each set of assumptions (Please see Table 6). The IROR is the discount rate at which a dollar of investment would be one dollar. These are the real interest rates the federal government would receive on its investment.[20] A positive percentage for the internal rate of return indicates that the government would receive an interest rate in excess of inflation. It is like putting money in the bank and earning a positive interest rate during a period when there is no inflation. It should be noted that under every set of assumptions, the investment in aid has a substantial rate of return. The IRORs range from 6.71 percent for no economic growth and a large background adjustment, to 14.09 percent for a 3 percent growth rate and no background adjustment. Using the reasonable assumptions cited above—the 2 percent growth and 90 percent background adjustment—the real interest rate is 11.74 percent. Even if the federal government were to invest money in the bank, it would receive a substantially smaller real interest rate.

It should be noted that no measure of statistical reliability can easily be calculated for this type of analysis. Since about 40 different parameters are used to estimate each cash-flow statistic, an error in any of these parameters would be compounded when the estimated numbers are combined. However, the large sample sizes for these data (over 180,000 households for the Census and over 22,000 individuals for NLS) will keep the standard error quite low. Also to the extent possible, conservative assumptions have been used that result in an underestimation of the cash-flow ratio. Therefore, our overall

conclusion is that student aid was at least as "profitable" in the 1970s as we have estimated.

Implications

The implication of these findings is that student financial aid is a profitable area of public investment, perhaps more profitable than any other way the federal government can use its funds. Certainly, the tax-revenue return on defense expenditures does not have a positive net present value. Even investment in land seldom has this level of real annual return. Therefore, the failure to invest in student financial aid is short sighted, if not foolish, given the high level of federal debt that will confront future generations. Beyond this obvious implication, three additional points are made.

First, all available evidence suggests that the "profitability" of the public investment in student financial aid remained high in the 1980s. Comparative cross-sectional analyses of the impact of student aid in the 1970s and 1980s reveal that there has been relatively little change in the impact of aid on access (Jackson, 1988; St. John and Noell, 1989) and persistence (St. John, 1989). In fact, the effectiveness of loans (a lower cost form of aid) in promoting persistence appears to have increased in the 1980s (St. John, 1989).

Additionally, there is little reason to assume that changes in aid policy since the 1970s would substantially change the cash-flow ratios. The federal investment in student aid climbed in the 1970s, when the class of 1972 was in college, and declined slightly in the 1980s, due to budget constraints. Even though the high school class of 1970 entered before Pell was implemented, many in this cohort did receive Pell awards after their first year in college, especially those who stopped out or entered late.

Second, the failure to invest appropriate levels of federal funds in student financial aid has serious consequences that merit consideration when federal budgets are debated. Failure to invest has three possible consequences. Access could be limited since students who are able to attend college would fail to do so because of lack of finances. Also, institutions could change their pricing policies by raising tuitions to generate revenue to support need-based aid, thus maintaining some access at a higher cost to those who could afford to attend. Even worse, a combination of these two scenarios could develop, thus promoting access for the majority, but putting college out of reach for those with extreme financial need. We suspect that the last scenario developed in the 1980s, a period when minority enrollment rates apparently declined and college prices increased faster than inflation.

Finally, there is no evidence that the returns on public investment will decline in the near future. Theoretically, the impact of student aid will decrease when the ideal state is reached—at which point additional investment would not further increase enrollments. However, American society simply does not appear to have attained such a condition. A recent time-series analysis of student demand concluded that students remained about as price sensitive in the 1980s, as they were in prior decades (McPherson and Schapiro,

1989). Therefore, it appears that student aid would continue to generate positive tax revenue returns to the federal government, even if the amount of federal expenditures were to grow substantially.

Under these conditions, how can the public afford not to invest more in student aid? Given the size of federal budget deficits, student aid may be one of the few components of the federal budget that can lead to increased future tax revenues and, thus, ease the debt burden for future generations. Therefore, the increased funding of student aid programs seems to be very much in the public interest and to merit serious consideration as new budget priorities emerge in the post cold war era that we are now entering. ✦

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Notes

[1]The EEO goal, if realized, results in increased levels of educational attainment. There are, of course, other non-monetary social benefits from student aid and, therefore, the federal investment is student aid should not be evaluated exclusively on this basis.

[2]We recognize that this approach has serious limitations. For example, Windham (1979) calls lifetime tax revenue returns "at worst a totally misleading measure of society's interest in individual educational decisions" (p. 122). Nevertheless, as we demonstrate, student financial aid appears very favorable when examined in this light. And while there are many other non-monetary reasons to invest in student aid, the fact that student aid is profitable merits consideration in the process.

[3]We borrow this term from Windham (1979) in recognition that this measure is not a complete cost-benefit ratio for federal student aid programs.

[4]The calculations of taxes paid will overestimate those taxes, especially since those with higher incomes will be more likely to itemize deductions. However, this estimate is not sufficient to change the magnitude of our final result.

[5]The model uses estimates of the impact of any type of aid, while costs are considered only for the federal portion of total student aid. It should be noted that states, institutions, and philanthropies also contribute to student aid. Since we are concerned here only with the costs to the federal government of the aid they provide, and the monetary returns to the federal government of this investment, it is not necessary or appropriate to consider non-federal expenditures on student aid.

[6]Generalized estimates of the impact of student aid from Leslie and Brinkman (1988) were also used.

[7]NLS was conducted in spring of the senior year of high school. Therefore, by definition, no students had less than four years of high school, even though some did not graduate.

[8]The assumption is consistently made in the research literature. For example, Leslie and Brinkman (1978) used this assumption when they developed estimates of the percentage of students who enrolled because of student aid.

[9]The reader who wishes to have a full discussion of the model or the impact of other variables in the model is referred to St. John and Noell (1989).

[10]In their review of economic studies on access, Leslie and Brinkman (1988) estimated that aid influenced 31.7 percent of attendance by low-income students, 12.9 percent of attendance by middle-income students, and 3.0 percent attendance by high-income students. In NLS, we calculated that 18.2 percent of those attending were low-income students, 49.3 percent were middle-income students, and 32.6 percent were upper-income students. When the average effects developed by Leslie and Brinkman (1988) are combined with these percentages, the resulting estimate is 13.1 percent of college attenders are influenced by student aid.

[11]In NLS, 88.6 percent of applicants who received aid offers actually enrolled, while only 75.1 percent of applicants who did not receive aid offers attended. Therefore, the "raw" impact of aid on the probability of enrollment is 88.6 minus 75.1, or 13.5 percent.

[12]The reader is referred to St. John (1989) for a description of the variables in the model.

[13]This approach is similar to the approach used by Terkla (1985) who used path analysis to estimate the influence of the receipt of student aid on seven-year persistence (or persistence to degree) by students in the class of 1972.

[14]In NLS, 47.4 percent of those students who received aid as an undergraduate persisted to complete a bachelor's degree, while only 30.0 percent of those who did not receive aid persisted to a degree. Thus, the unadjusted effect of aid is 47.4 minus 30.0, or 17.4 percent.

[15]We assumed that each of these events was independent. Hence, the probability of receiving an undergraduate degree is the probability of attaining access and the probability of persisting to a degree.

[16]We expect that this has a negative effect on the final cash-flow ratio. In fact, the exclusion of work-study may partially explain why our estimates of the impact of aid on persistence were lower than in other studies.

[17]The Pell Grant program was first implemented in 1973-74. However, continuing students from the class of 1972 were ineligible, since Pell Grants were only available to freshmen that year. Therefore, there is no reason to expect this ratio to increase substantially.

[18]Administrative costs of the Pell Grant and campus-based programs were not considered. Therefore, to a very small extent the total aid subcosts are underestimated. Instead, the cost side of the equation provides an estimate of the direct subsidy to the individual student.

[19]This is actually an extremely conservative estimate of the return on the investment. Not only did we make conservative assumptions in the estimation of the model, but the use of the .9 background adjustment is extremely conservative, given the fact that we already controlled for the impact of ability on attainment. If we assumed no background adjustment, then the return would be $4.80.

[20]To illustrate the concept of real interest, consider the following: if Treasury bills have an interest rate of 7.5 percent and inflation is 3.5 percent, the "real" interest rate paid by the government to the borrower is 4.0 percent (7.5 - 3.5).

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