ARE PUBLIC SUBSIDIES TO HIGHER EDUCATION REGRESSIVE?

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Abstract
This article estimates the dollar amount of public higher education subsidies received by U.S. youth and examines the distribution of subsidies and the taxes that finance them across parental and student income levels. Although youths from high-income families obtain more benefit from higher education subsidies, high-income households pay sufficiently more in taxes that the net effect of the spending and associated taxation is distributionally neutral or mildly progressive. These results are robust to alternative assumptions and are consistent with Hansen and Weisbrod's earlier celebrated findings for California, although not with the conclusions often drawn from those findings.

More than a quarter century ago, Hansen and Weisbrod stirred up a hornet's nest of controversy by claiming that public support for higher education could well be regressive rather than progressive and could therefore lead to a more unequal distribution of income.[1] Their case rested on the empirical observation that the distribution of benefits from higher education (in the California system, which was the focus of their study) appeared to be more concentrated among the upper-income households than did the associated tax burden. The debate sparked by the Hansen-Weisbrod thesis made it clear that the task of assessing the distributional impact of public support for higher education is complicated not only by the usual problem of data availability and the thorny theoretical problem of tax incidence but also by disagreement about the appropriate measure of distributional impact for a policy that is both an inter- and an intragenerational transfer.

As Leslie and Brinkman's (1988) survey reveals, a number of empirical studies, often for individual states, appeared in the years following the original Hansen-Weisbrod analysis.[2] However, interest in the redistributive aspect of higher education finance seems to have waned in the 1980s and 1990s, perhaps because of the seeming intractability of the question. Kane (1999, p. 38) uses NPSAS (National Post-Secondary Student Aid Survey) data to show that high-income youth receive roughly twice as large a subsidy as low-income youth, but Kane's analysis classifies students only by parents' current income and does not consider either taxes paid or the student's future income. Longitudinal data from the National Longitudinal Survey of Youth (NLSY) used here allows a more detailed tracing of the interrelationships between higher education subsidies received by individuals, their own lifetime income, and their parents' income. The data are used to estimate the distribution of higher education subsidies received by young adults and the taxes that finance them as a function of the various measures of their parents' income. The subsidies net of tax can also be related to the younger generation's lifetime income, the dynastic income (parent and child) of the family, the parents' education, and the young adult's academic ability.

The first part of the article sketches a theoretical framework. The second part of the article describes the data and the calculation of the subsidy measures used in the empirical work. The third section looks at the distribution of subsidies by various measures of parents', student's, and dynastic income. My main finding is that while high-income households receive larger benefits on average than low-income households, the taxes they pay to finance those

1. Some of the important contributions at the time were Hansen and Weisbrod (1969), (1971), Hansen (1970), Hartman (1972), and Pechman (1970), (1972).
2. An example is Moore 1978.

benefits are even greater, so that benefits net of taxes are not regressive—low-income households receive positive net benefits, while very-high-income households receive negative net benefits. Undeniably, the system would be more progressive if benefits were concentrated more on low-income households. This finding is robust to consideration of behavioral responses, liquidity constraints, and externalities. Finally, I reconcile my results with Hansen and Weisbrod's earlier findings for California.

1. A MODEL OF REDISTRIBUTION ACROSS DYNASTIC FAMILIES

As a simple starting point for the analysis, consider a dynastic family with two generations each comprising a single person. The welfare of each family depends on the consumption and leisure enjoyed by each generation. Each generation can trade leisure for goods at leisure's real wage rate. The wage rate for the parent in family i, w_{1i}, is exogenous in this model, while the wage for the second generation, w_{2i} (c_i), depends on the family's choice of investment in college education, c_i. The functions w_{2i} $(\cdot)$ might differ across families because of differences in children's ability, location, or other factors. Investment in college is assumed to be non-negative, with variation capturing both the extensive (time) margin and the intensive (quality) margin. The price per unit of college investment, p_c, is relative to the consumption good numeraire, as are wages. Finally, each family is endowed with initial wealth, I_i.

Government taxes the wage income of each generation at the respective proportional rates of t_1 and t_2 and spends on public goods (assumed never to affect the decisions modeled here) and college tuition subsidies. The subsidies are discounts, at rate s, from the full cost of college, permitting parents to purchase c units of investment in college for a cost of $c \cdot p_c \cdot (1 - s)$. The government faces a long-run budget constraint and can borrow or lend at the interest rate, r.

Each family's indirect utility can be written as a function of the parameters of its budget constraint:

$$V\{I_i, w_{1i}(1 - t_1), w_{2i}(\cdot)(1 - t_2), p_c(1 - s)\} \tag{1}$$

Underlying the function V are labor supply choices in each generation, a college investment choice, and borrowing or saving.

The policy experiment is a balanced budget move from a vector of tax rates and no tuition subsidy $(t_1, t_2, 0)$ to another vector of tax rates and a subsidy rate of s: $(t_1 + \Delta t_1, t_2 + \Delta t_2, s)$. The compensating variation measure of the effect of this policy change on family i, CV_i, is the amount of money that restores the household to its original level of well-being:

$$V\{I_i, w_{1i}(1 - t_1), w_{2i}(\cdot)(1 - t_2), p_c(1 - s)\}$$
$$= V\{I_i + CV_i, w_{1i}^*(1 - t_1 - \Delta t_1), w_{2i}^*(\cdot)(1 - t_2 - \Delta t_2), p_c^*(1 - s)\} \quad (2)$$

where the asterisks indicate the possibility that policy changes affect market wage rates and the price of college education.

Redistribution without Behavioral Responses or Borrowing Constraints

Most of the empirical results presented in this article are estimates of the distribution of these compensating variations across families, computed under the assumption that subsidies and taxes do not affect behavior and that households can borrow or lend at the government interest rate, r. The CV measure of tax and subsidy policies in the zero-sum case will simply be the present discounted value of the subsidy received by a family less the extra taxes paid by both the parent's and the child's generation:

$$-CV_i = PDV[-(H_{1i} \cdot w_{1i}) \cdot \Delta t_1 - (w_{2i}(c_i) \cdot H_{2i}) \cdot \Delta t_2] + PDV[c_i \cdot p_c \cdot s] \quad (3)$$

In equation 3, H_{ji} represents the exogenous labor supply of generation j in family i, while c_i is the amount of college chosen by family i. The difference between equations 2 and 3 reflects the assumptions that wages and the price of college are unaffected by the policy; that labor supply, hence earnings and leisure, are unaffected by the policy; and that the absence of borrowing constraints ensures that family utility is a function of leisure and discounted income. Since leisure is unchanged, the effect of the policy is just the change in discounted income. Market wages and prices will be unaffected because no household changes its behavior.

The government budget constraint, that discounted tax revenue equals the government's discounted subsidy payments, implies that the sum of CV_i over all families is just zero. The total tax burden on all families is just the total cost of the subsidy received by all families. To use the NLSY data set, which looks at a sample of a subset of all families, namely those with children born between 1957 and 1964, I need to assume that the subsidies received by this subset of families are financed by taxes imposed on the same subset. That is, if we think of this subset of families as a cohort, I want to abstract from intercohort redistribution and focus on intracohort redistribution.

To see that this necessary restriction is not unreasonable, imagine a steady-state population consisting of many identical cohorts, born at different times, each with the same lifetime distribution of earners and college subsidies. Since each cohort has the same distribution of earnings, taxes paid by each cohort are identical. And since each cohort has the same distribution of college subsidies, subsidies received by each cohort are identical. These assumptions imply that the government budget constraint must be satisfied *within* each cohort; that is, the discounted taxes paid by a cohort must equal the discounted subsidy received by a cohort. In other words, there can be no cross-cohort subsidy when each cohort is identical.[3] Given these assumptions, summing equation 3 over all parents in a particular birth cohort (say, parents of seventeen-year-olds in 1980) yields an expression which is the present value of subsidies received less the present value of additional tax revenues paid by that cohort. By the government budget constraint, this must equal zero. Hence, the sum of compensating variations within a cohort (and its progeny) is zero; losses exactly offset gains within a cohort.

The fact that families can borrow or lend at the government interest rate also implies that the Barro neutrality proposition holds here. It makes no difference how the tax burden is spread across generations (within families) because families can undo the effects of any particular government financing scheme. Moreover, the dynastic family model makes it clear that the appropriate measure of distribution effects is the extent to which the policy affects the long-run welfare of families rather than the short-run income of particular generations. Previous studies have attributed the benefits of public universities to the current annual income of parents of current students at such universities, while the costs were assigned by the annual income of the taxpayers in general. Since parents of college-age children may be near their peak earning years, attributing the subsidy received by their children to that income may overstate the extent to which these subsidies benefit upper-income families.

To summarize, in the base case when no efficiency effects are allowed, higher education policies are zero sum. These policies will be judged to be progressive if higher income families as a group pay more in taxes attributable to the policy than they receive in benefits. All families who do not directly partake of the benefits will be worse off. By assuming a steady state with identical cohorts, all redistribution occurs within a cohort, not across them.

Redistribution with Behavioral Responses and Borrowing Constraints

The above scenario will strike most readers as unrealistic because tuition subsidies are intended to affect college-going behavior, overcoming borrowing constraints or offsetting externalities. How should the gains and losses to

3. The same proposition holds even with growth in earnings over time and growth in the subsidy over time as long as the growth rates are equal.

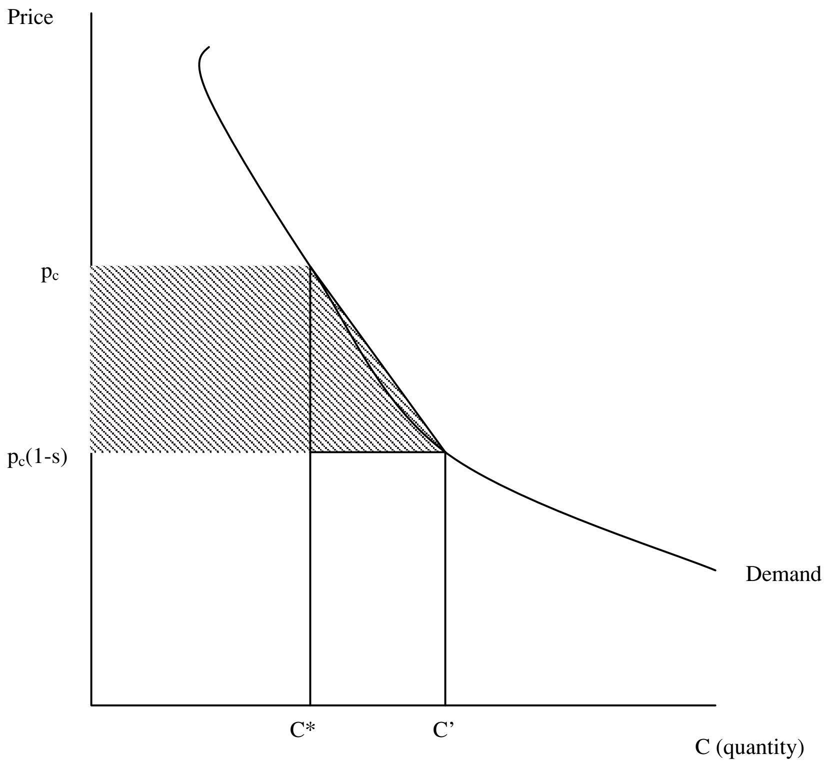

Figure 1. Welfare Gain to Tuition Subsidy

particular households be accounted when behavior is affected by the tuition subsidy? To tackle this question, consider first the case in which the demand for college responds to tuition subsidies but without the additional complication of borrowing constraints or externalities. Figure 1 shows a downward-sloping demand for units of higher education, denoted as c, as a function of the price per unit faced by students and their families. The supply is assumed to be infinitely elastic. With no tuition subsidy, the price is p_c and the amount consumed is c^*. When college is subsidized at the rate s, the net price to the demander becomes $p_c(1-s)$, and c rises by $\Delta c = c' - c^*$. The benefit of the subsidy to the family is the additional consumer surplus, or the shaded area in figure 1, which is clearly less than the dollar cost of the subsidy, $s \cdot p_c \cdot c'$. If we assume a constant elasticity of demand for college of η (in absolute value), the benefit of the tuition subsidy can be expressed as a function of η, s, and the dollar cost of the subsidy.[4] To illustrate how the dollar cost of the subsidy

4. It is straightforward to show that the benefit of the subsidy as a fraction of the dollar cost of the subsidy is $[(1-s)^\eta - (1-s)]/s(1-\eta)$.

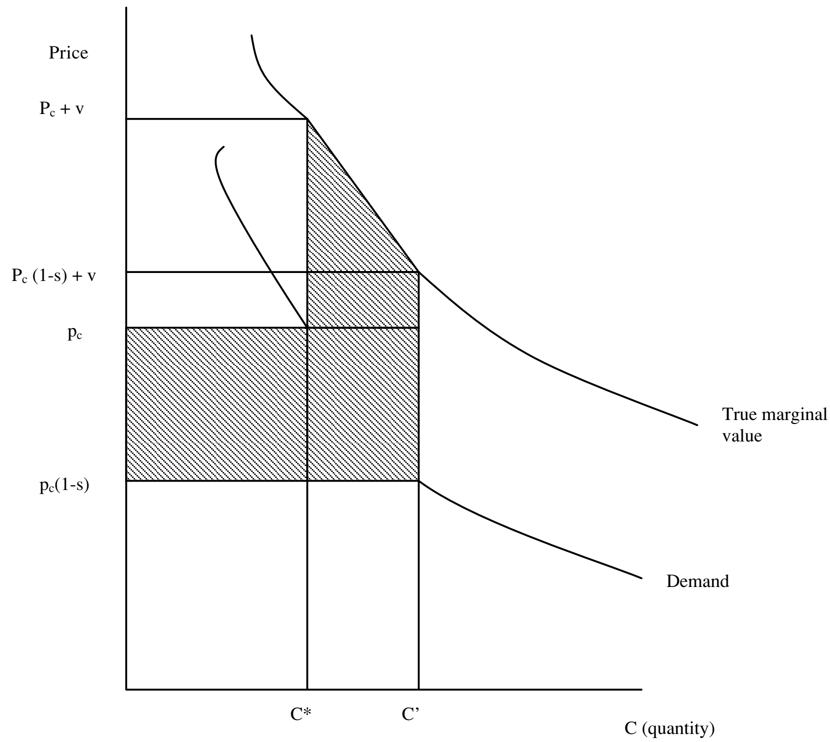

Figure 2. Welfare Gain to Tuition Subsidy with Borrowing Constraints

will be adjusted to account for behavioral response, when the subsidy rate, s, is .9, and the demand elasticity, η, is 0.15, the benefit of the subsidy is about 80 percent of its dollar cost.

Suppose that subsidies are introduced to offset borrowing constraints. How can we now measure the benefits of tuition subsidies to households? Consider figure 2, which depicts two curves—the true marginal value of higher education to the family and student, and a lower curve, which represents the actual demand for higher education as a function of the price faced by the family. The effect of borrowing constraints is that the family does not purchase education up to the point where the price equals its true marginal private value. Hence, when the price is p_c, for example, the household purchases only c^* units, leaving some potential gains unexploited.

It is convenient to parameterize the extent of borrowing constraints in this figure by the parameter v, which is the vertical distance between the two curves. Borrowing constraints cause a household that faces a price of p to act as though it maximizes facing a price of $p + v$. In the figure, the household facing a price of p_c chooses an amount of education, c^*, which is the amount it would choose if it maximized net benefits and faced a price of $p_c + v$.

Now consider the effect of a subsidy at rate s. The net price falls to $p(1 - s)$, and the household now chooses c'. The figure shows the case where the subsidy is not sufficient to completely offset the borrowing constraint, that is $s \cdot p_c < v$. The additional consumer welfare is shown by the shaded area, which is seen to be greater than the dollar cost of the subsidy.[5] When $v = 0$, the benefit expression reduces to the simpler formula derived above.

To evaluate this expression, we need to know the extent to which actual subsidies offset the borrowing constraints. When the subsidy is optimal and just offsets the borrowing constraint so that students choose the optimal amount of education, $s \cdot p_c = v$, and the private benefit now exceeds the dollar cost of the subsidy. To illustrate the size of the adjustment to dollar cost implied by borrowing constraints, with a subsidy rate of 90 percent and a demand elasticity of 0.15, the benefit of an optimal subsidy will be 109 percent of its dollar cost.

These results will allow us to adjust the dollar subsidies, which we can observe, to reflect changes in household welfare, using information about the size of the subsidy, the elasticity of demand, and assumptions about the size of borrowing constraints. However, to be consistent, I also need to adjust the dollar tax burdens to reflect the excess burden of the taxes used to finance the tuition subsidies, which can be done using estimates of the marginal welfare cost of taxation.

2. DATA AND MEASUREMENT OF SUBSIDY

The NLSY Data Set

The NLSY data set is a well-known panel data set, which has followed, since 1979, a group of young adults born between 1957 and 1964. Information on college attendance is quite complete, and the data include reasonably good adult earnings information, as this group was in its thirties at the time of the last wave of questioning (in 1996). The NLSY sample contains both a representative sample and additional oversamples of blacks, Hispanics, and low-income whites. All of the results in this article use only the representative sample.

Computing the College Subsidy

The ideal measure of the total higher education subsidy received by each NLSY sample member would be the sum, for all colleges and universities he

5. The ratio of benefits to dollar cost are now equal to

$$\frac{v}{p_c s}[(1 - (1 - s)^{\eta}] + [(1 - s)^{\eta} - (1 - s)]/s(1 - \eta).$$

or she attended, of the difference between the costs attributable to that person's attendance and the student's (or parent's) payment of tuition and fees to the college or university. This would represent the net cost to others (outside the family) of that individual's higher education. In the case of public higher education, the subsidy from the taxpayers is direct; in the case of private higher education institutions, the subsidy is derived from donors whose donations, and the return earned on the funds thereby endowed, enjoy favorable tax treatment. As a result, part of this private subsidy is actually an indirect public subsidy through the tax treatment of charitable donations and nonprofit private institutions.

The measure actually used is derived from the HEGIS/IPEDS data on the finances of higher education institutions collected annually by the U.S. Department of Education. It compromises in the following ways with the ideal described above:

- The subsidy (costs of attendance less tuition and fees) is computed as student instructional costs and institutional financial aid less total tuition and fees divided by total enrollment for the year and the higher education institution in question. Excluded from the subsidy calculation are capital costs, which are both difficult to measure and, more important, problematic to attribute to current or past taxpayers or donors. Winston (1995) and Winston and Yen (1995) show that the neglect of capital costs understates subsidy amounts by approximately 25 percent, with modest variation across types of institutions. Applying a uniform understatement factor to the subsidy measure used here and assuming that all costs are paid by current taxpayers, yields distributional effects that are basically similar to those presented here. Hence I conclude that a thorough treatment of capital costs would probably not appreciably change the results.
- To simplify, the subsidy assigned an individual is that for the last undergraduate institution attended. Thus, if an individual attended X State University for one year, followed by attendance at Y State University for three years, I attribute to this person four years of receipt of the annual subsidy rate of Y State U. Consequently, no one will be recorded receiving both a public and a private subsidy.
- Postgraduate attendance is ignored.
- The subsidy for undergraduate attendance is limited to four years. If someone attended for more than four years before receiving an undergraduate degree, that person is assumed to have received four years of subsidy, under the presumption that they received the equivalent of four years of subsidy spread over more calendar years.

- Individual receipt of financial aid is not accounted for specifically in the subsidy computation because the NLSY has sketchy data on the amounts of financial aid received. Each student is implicitly assigned average per student financial aid for that institution. Since within each institution financial aid is inversely related to family income, this simplification reduces the apparent progressivity of the system.
- Individuals attending U.S. military academies are excluded from the analysis because the subsidy as computed does not account for the substantial service obligation incurred by these students.

Some of these data compromises are motivated by a desire to simplify the calculation of the subsidy; others are necessitated by the lack of information in the NLSY.

3. THE DISTRIBUTION OF SUBSIDIES ACROSS STUDENT AND PARENT CHARACTERISTICS

Table 1 presents the basic facts of the distribution of higher education subsidies across NLSY panel members. Over half of the sample received some higher education subsidy; the mean subsidy received (conditional on receiving a subsidy) was $8,129 in 1982 dollars. Public higher education institutions are attended more frequently than private, so a much higher fraction of the sample received public subsidies (recall that I am computing undergraduate subsidies only and am assigning all years attended to the last institution attended). Males and females receive roughly similar subsidies; males are less likely to attend but receive slightly higher subsidies when they do. Blacks and Hispanics overall are less likely to attend but receive roughly similar subsidies if they do.

Subsidies and Current Parent Income

For a subset of the NLSY sample, a measure of parent income when panel members were from sixteen to eighteen years old is available. Children of higher-income families receive greater public higher education subsidies than do children of lower-income families. Moving from the bottom income decile to the top, the fraction of youth receiving such subsidies rises from about one-quarter to about one-half, and the mean value of the subsidy, conditional on receiving one, doubles.

Private subsidies are more dramatically concentrated among the children of higher income families, though some lower-income students receive considerable private subsidies. Private subsidies, which are financed by donations past and present to private institutions, are also relevant to policy discussions

Table 1. Distribution of Subsidy to Higher Education across NLSY Sample

	Percent receiving subsidy	Distribution of subsidy if subsidy > 0 (1982 dollars): Mean	Median	25th percentile	75th percentile
Distribution of Public Subsidy					
Total sample	41.6%	7,784	5,493	2,392	11,281
Males: White	41.1%	8,240	6,229	2,569	12,126
Black	27.2%	6,171	4,126	2,051	8,885
Hispanic	26.9%	8,000	6,433	3,115	11,134
Females: White	43.9%	7,418	5,207	2,270	10,368
Black	35.8%	6,614	4,446	1,858	8,222
Hispanic	32.5%	10,161	4,808	2,632	12,121
Distribution of Private Subsidy					
Total sample	12.1%	9,324	4,693	1,771	10,188
Males: White	11.2%	8,848	4,673	1,849	8,125
Black	9.5%	15,373	8,591	2,099	22,389
Hispanic	8.5%	7,237	6,516	4,456	8,173
Females: White	13.3%	9,532	4,815	1,618	10,495
Black	10.0%	6,114	2,516	1,354	5,338
Hispanic	10.1%	14,234	12,256	4,108	26,552
Distribution of Total Subsidy					
Total sample	53.7%	8,129	5,337	2,208	11,101
Males: White	52.3%	8,370	5,750	2,346	11,746
Black	36.7%	8,553	4,359	2,099	10,561
Hispanic	35.4%	7,816	6,433	3,115	11,134
Females: White	57.2%	7,909	5,090	2,145	10,381
Black	45.8%	6,505	3,997	1,800	8,112
Hispanic	42.6%	11,126	6,285	3,398	13,356

Notes: Based on cross-section portion of NLSY sample, excluding military academy graduates. Subsidy is difference between per student instructional expenses and average tuition and fees.

because of the tax preferences given to charitable contributions, the earnings of endowment funds of private colleges and universities, and the real property of private colleges. The tax subsidy to private institutions will be included in some of the calculations to follow.

These data allow a calculation of the *net* redistributive effect of higher education policy *as measured by the taxes paid by parents and the subsidy received by their NLSY children*. Let us consider first only direct public subsidies (taxpayer support of public institutions) and assume that marginal changes in public expenditure on higher education are financed with taxes that are proportional

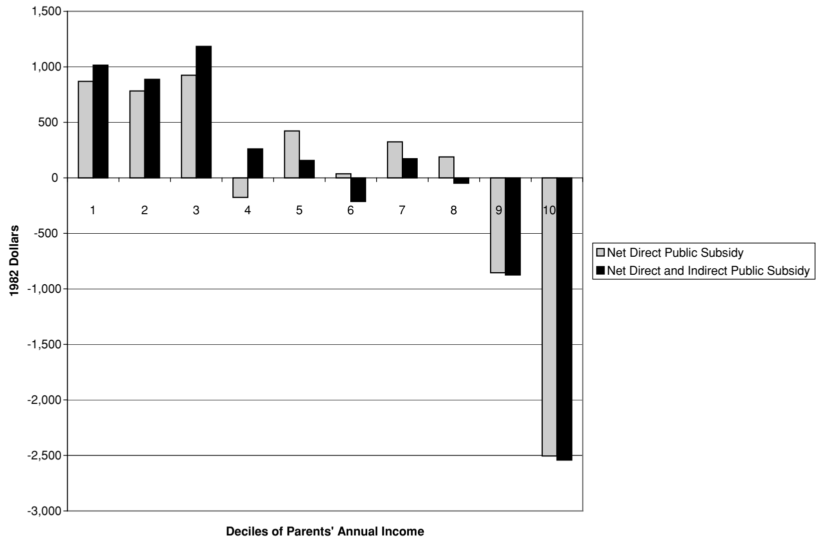

Figure 3. Net Public Subsidy per Child by Parents' Annual Income

to income. Public higher education subsidies are financed largely by state governments, who rely on income taxes and sales taxes for revenue. Fullerton and Rogers (1993) find that state income taxes are progressive, while state sales taxes are regressive. Overall proportionality is probably not a terribly inaccurate assumption.

Since the average public subsidy is almost exactly 10 percent of average parents' income, a proportional income tax of 10 percent would finance the entire public higher education subsidy. The overall pattern is shown by the light gray bars in figure 3. Families in income deciles 1, 2, 3, 5, 6, 7, and 8 receive more in subsidy than they pay in tax, while families in the remaining income deciles (4, 9, and 10) pay more than they receive. Since decile 4 pays only slightly more than it receives, the overall redistributive effect of the policy would appear to be progressive. The top two deciles pay more in tax than they receive in subsidy, while the reverse is true in general for the bottom eight deciles. Of course, there is also redistribution within income deciles, with some families at all income levels benefiting directly from higher education subsidies and others paying taxes but not receiving benefits.

The darker bars in figure 3 add the additional indirect tax subsidy to private institutions to the direct tax subsidy for public institutions. I approximate the net tax subsidy to private institutions as 40 percent of each dollar spent. The three principal tax preferences are deductibility of charitable donations, the exclusion of endowment earnings from taxation, and the exemption of real property from property taxation. The first preference alone would imply a subsidy equal to the donor's marginal tax rate, t_d. The second implies that a dollar donation to an endowment buys a perpetuity of r dollars a year, while if the endowment interest were taxed at the rate t_r and the original donation were not deductible, the annual income stream endowed by a dollar gift would be $r(1 - t_d)(1 - t_r)$. Setting $t_d = .28$ (a common marginal income tax rate) and $t_r = .35$ (the corporate income tax rate), each dollar of nonprofit endowment earnings is subsidized by 53.2 cents of tax reduction. Hence, 40 percent is a conservative estimate of the subsidy to private institutions, at least when donations are used to fund endowments. The overall pattern of progressivity is not greatly affected by the addition of the indirect public subsidy of private institutions.

Approximating the Distribution of Net Benefits by Parents' Permanent Income

For several reasons, the estimates shown in figure 3 might seriously misrepresent the redistributive effect of public higher education subsidies. In what follows, I attempt to address some of these issues.

Distribution of Children versus Distribution of Parents

Since the sampling frame of the NLSY is designed to replicate the children's generation, not the parent's generation, parents with many children are overrepresented and parents with few children are underrepresented. If high-income parents have more children than low-income parents, the calculations above will overstate progressivity by understating the benefits received by high-income parents relative to low-income parents. This flaw can be partially corrected by using information on the number of siblings of each NLSY respondent and weighting the benefits received by each parent by the total size of the family. The expected value of benefits received by a family with n children is just n times the expected per child benefit. The actual benefit received by the NLSY child is an unbiased estimate of the family's per child benefit. For example, a two-child family in which one child, the NLSY panel member, is observed receiving a $5,000 public subsidy, would be estimated as having received $10,000 in public higher education subsidies. This is only a partial correction because families with no children are completely unrepresented in the NLSY. The failure to include adults who never have children overstates progressivity only if such adults have lower incomes than the median observed household. However, data from the June 2000 Current Population Survey show that across all household income levels, roughly the same fraction of women, 35–44 years old, are childless. This implies that the income distribution of childless women is roughly the same as the income distribution of women with children, so the omission of childless households does not obviously bias the estimated progressivity of tuition subsidies.

Life-Cycle Income Patterns

The parent's annual income when the child is age seventeen misrepresents the family's permanent income because of well-known patterns of earnings and income over the life cycle. Parents of seventeen-year-olds may be close to their peak earning years, and it is well known that life-cycle earnings growth is greater for highly educated workers. The dispersion of the annual income of parents at that stage of life cycle would overstate the dispersion of lifetime income and could misrepresent the progressivity of higher education subsidies.

I deal with this issue by linking each family's annual income to the estimated life-cycle earnings patterns estimated by Murphy and Welch (1990). This amounts to assuming that each household's income profile follows the average pattern for households with that household's characteristics. Using a 3 percent real discount rate, the present discounted value of these life-cycle income profiles can be computed.

Adjusting Lifetime Income for Transitory Effects

As is well known, transitory fluctuations in income imply that the dispersion of current income overstates the dispersion of permanent income. This could bias the apparent progressivity of subsidies upward because taxes are assumed to be proportional to lifetime income. If annual income, or even lifetime income pegged to annual income, overstates permanent income for upper-income households, then too much tax would be imputed to these households while too little is imputed to low-income households, whose actual lifetime income will be understated by annual income.

To adjust for transitory effects, I use estimates by Gottschalk and Moffitt (1994) of the relative variances of transitory and permanent earnings by education level to form a weighted average of predicted permanent income and the family's actual transitory income. Specifically, suppose that the income of household i in year t, Y_{it}, is a linear function of observables, X_{it}, plus a permanent family fixed effect, μ_i, and a transitory shock, e_{it}

$$Y_{it} = \beta X_{it} + \mu_i + e_{it}. \tag{4}$$

Let the weighting factor, w, be the share of transitory variance in the total error variance:

$$w = \text{var}(e)/[\text{var}(e) + \text{var}(\mu)]. \tag{5}$$

The proposed estimator of $\beta X_{it} + \mu_i$ is then

$$(1 - w)Y_{it} + wbX_{it} \tag{6}$$

where b is the estimate of β from an OLS cross section regression of equation 4. If all variance is transitory, $w = 1$, and the estimator of permanent income is the prediction of the cross-section regression (no need to worry about unobserved heterogeneity). If all the variance is permanent heterogeneity, however, then $w = 0$ and the estimator is observed income of the household. "Adjusted lifetime income" takes the value computed by equation 6 and adjusts by the same Murphy-Welch profiles described above to estimate discounted lifetime income.

The results of these additional adjustments are shown in table 2 and the first four columns of table 3. As table 2 shows, adjusting for transitory variance compresses the income distribution. Since taxes are again assumed to be proportional to lifetime income, this reduces the share of total taxes paid by the upper deciles of the income distribution, but not enough to reverse the progressive pattern of the policy as shown by figure 4. In order to assess the statistical properties of the pattern depicted in figure 4, table 3 presents regression estimates of the adjusted income decile pattern of net subsidies. In column 1, I regress net direct subsidy only on income decile dummies, omitting the lowest decile. Most of the higher deciles receive smaller net subsidies than does the bottom decile, with the top two deciles receiving significantly less subsidy, both in an economic sense and in a statistical sense. Column 2 of table 3 estimates the same relation with three covariates—the child's AFQT score, the parent's combined years of education, and a dummy variable for black. Because parents' education and AFQT are strong predictors of college attendance and are positively correlated with parents' income, their addition to the equation makes the net subsidy received by high-income families on the basis of their income alone even more negative. The positive coefficient on black in this regression may be surprising, but it reflects the fact that black students are more likely to attend college than white students, holding constant family income and academic skill.

As in the previous figures, the concept of the direct and indirect public subsidy adds the implicit public subsidy of private institutions and the taxes which pay for that subsidy to the direct public subsidy already discussed. Results using this subsidy concept are shown as the dark bars in figure 4 and the regression results in columns 3 and 4 of table 3. The results confirm the progressive nature of higher education subsidies.

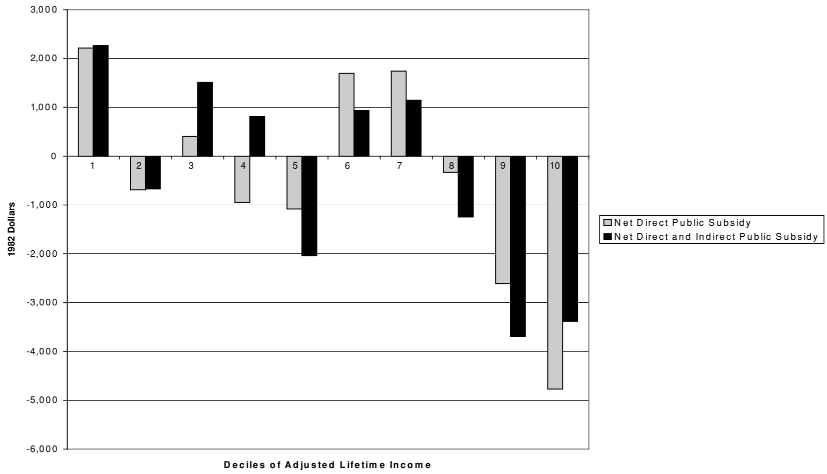

Figure 4. Net Public Subsidy per Household by Parents' Adjusted Lifetime Income

Table 2. Distribution of Total Subsidy by Parents' Lifetime Income (Adjusted for Transitory Changes)

		PUBLIC SUBSIDY		PRIVATE SUBSIDY		TOTAL SUBSIDY	
Decile	**Mean lifetime income (1982$)**	**Percent receiving**	**Mean value**	**Percent receiving**	**Mean value**	**Percent receiving**	**Mean value**
1	179,507	34.7	7,562	5.4	1,187	38.1	8,749
2	235,938	27.6	5,779	11.7	1,961	36.7	7,740
3	270,614	41.2	9,082	8.9	5,591	52.3	14,673
4	298,638	36.0	7,856	13.4	7,727	46.7	15,583
5	326,360	46.8	11,738	8.1	2,493	55.0	14,231
6	358,179	46.8	15,346	10.1	2,635	62.8	17,981
7	392,700	55.2	12,946	13.9	1,814	59.4	14,760
8	431,047	52.2	18,228	14.5	2,625	73.7	20,853
9	488,049	54.5	16,643	12.3	3,838	69.1	20,481
10	625,440	48.3	19,045	30.7	11,061	79.6	30,106
All	360,427	40.3	12,301	11.7	3,706	53.7	16,007

Note: Lifetime income is adjusted by averaging lifetime income with predicted income from a regression of lifetime income on parent characteristics (education, race, location, occupation) with weights equal to the relative permanent and transitory variances, as a fraction of total variance, by education level (Gottschalk and Moffitt 1994).

Distributions by Dynastic Income

The presence of data in the NLSY on both parent's income and child's income as a young adult allows an approximation of dynastic income, or the discounted sum of parent's and child's lifetime income. The child's lifetime income is estimated by applying the Murphy-Welch trajectories and the Moffitt-Gottschalk variance decompositions to the latest three observations on the

Table 3. Net Subsidy by Income Deciles: Regression Results (Huber-White Standard Errors in parentheses)

	ADJUSTED LIFETIME INCOME				DYNASTIC INCOME			
	Net direct subsidy		**Net direct and indirect subsidy**		**Net direct subsidy**		**Net direct and indirect subsidy**	
Decile 2	−2,907 (1,820)	−5,131* (1,801)	−2,936 (1,862)	−5,982* (1,815)	−224 (1,753)	−3,827* (1,789)	1,670 (2,183)	−3,336 (2,047)
Decile 3	−1,812 (1,805)	−4,660* (1,789)	−754 (2,040)	−4,462* (1,971)	2,593 (1,959)	−1,127 (2,001)	3,706 (2,256)	−1,505 (2,114)
Decile 4	−3,164 (2,053)	−6,970* (2,121)	−1,456 (2,505)	−6,582* (2,258)	149 (1,550)	−4,465* (1,588)	−212 (1,572)	−6,710* (1,613)
Decile 5	−3,299 (2,100)	−6,860* (2,161)	−4,306* (2,111)	−9,341* (2,172)	−254 (1,675)	−4,924* (1,707)	−634 (1,708)	−7,320* (1,732)
Decile 6	−521 (2,560)	−5,655* (2,719)	−1,331 (2,564)	−8,565* (2,718)	−772 (1,993)	−6,516* (2,178)	−866 (1,990)	−8,949* (2,185)
Decile 7	−475 (2,411)	−6,679* (2,417)	−1,120 (2,402)	−9,768* (2,397)	69 (2,053)	−6,301* (2,169)	97 (2,057)	−9,131* (2,171)
Decile 8	−2,546 (2,374)	−8,857* (2,439)	−3,509 (2,368)	−12,440* (2,432)	−241 (1,869)	−7,251* (1,984)	−991 (1,843)	−10,804* (1,982)
Decile 9	−4,826* (2,136)	−12,631* (2,193)	−5,957* (2,128)	−16,720* (2,185)	5,332* (2,750)	−3,809 (3,020)	4,943* (2,688)	−7,923* (3,004)
Decile 10	−6,987* (2,990)	−17,702* (3,307)	−5,647* (2,968)	−20,362* (3,307)	−7,967* (3,605)	−17,295* (3,634)	−8,326* (3,675)	−21,701* (3,720)
AFQT		221* (24)		280* (24)		202* (26)		268* (27)
Parents' Education		557* (171)		868* (185)		429* (175)		701* (187)
Black		5,098* (1,628)		5,407* (1,624)		6,192* (1,626)		6,654* (1,639)
Constant	2,216 (1,213)	−18,013* (3,743)	2,265 (1,246)	−26,741* (4,082)	127 (931)	−1,559 (3,814)	76 (944)	−23,389* (4,148)
Number of Observations	1,691	1,610	1,691	1,610	1,658	1,582	1,658	1,582

Note: * = 95% confidence

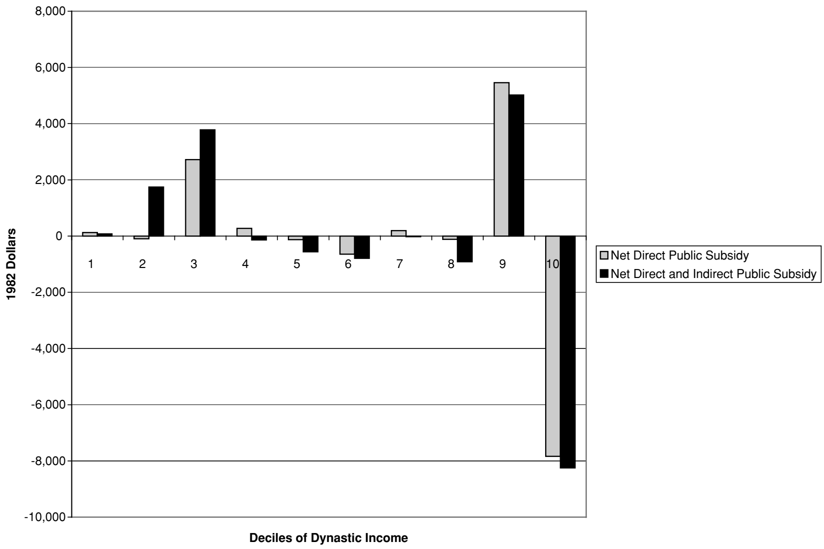

Figure 5. Net Public Subsidy by Dynastic Income (Parent and Child)

child's income as an adult. As was the case with adjusted lifetime income, while high-income dynasties enjoy greater public subsidies than lower-income dynasties, the distribution of mean subsidies is not as unequal as the distribution of mean dynastic income. Private subsidies are more focused on the very top decile but are also substantial for low-income dynasties. Figure 5 displays the net subsidy calculations, when taxes are assumed to be proportional to dynastic income. Here the top decile appears to be, on net, subsidizing the college expenses of the lower nine deciles, but curiously the ninth decile receives the greatest positive subsidy. The regression results in columns 5–8 of table 3 confirm that the top decile's net subsidy is large and significantly negative, while the ninth's is strongly positive.

Distributions by Child's Lifetime Income

Another distributional perspective argues that the parent's income is irrelevant. Since the child is the beneficiary of the subsidy, the appropriate distributional analysis compares net subsidies received across the distribution of the child's lifetime income. The tax burden for the subsidy is then assigned to the child's lifetime income. One could imagine the costs of educating the child's cohort being financed by borrowing, with the debt repaid by levying taxes in the future on the income of that cohort. Figure 6 displays the distributional pattern of subsidies by deciles of child's lifetime income. Clearly, the pattern of mild progressivity exhibited by other income measures is preserved here.

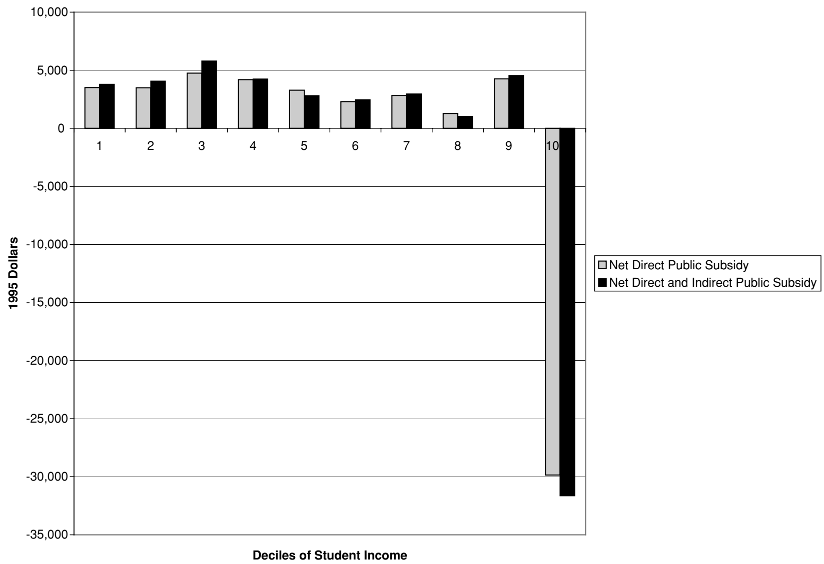

Figure 6. Net Public Subsidy by Student's Lifetime Income

Distributions by Parent's Education

The distribution of subsidies by parents' education is also of interest. Parents' education may be a rough proxy for the household's permanent income, and data on it are available for many more NLSY panel members than on parents' income.[6] Public subsidies are highly skewed toward the children of well-educated parents. The income of the top decile in the distribution of parents' education is only twice the income of the bottom, but the children of the top decile receive four times the direct public subsidy and thirty-two times the private subsidy obtained by the children of the bottom decile.

The net redistributive effect of direct and indirect subsidies across deciles of parents' education favors highly educated parents, again assuming proportional taxation of parents' adjusted lifetime income. Evidently parents' education has such a strong effect on children's college attendance (and quality of college) that the children of highly educated parents receive more subsidy than their parents pay in taxes. So even if higher education subsidies do not redistribute from the poor to the rich, they do redistribute from the less educated to the more educated. The contrast between the results for parents' education and parents' income make clear that while income and education are correlated, the correlation is far from perfect.

6. Data on parents' income were available only for the younger members of the sample, who had not reached the age of eighteen when the panel began.

Caveats

No matter which definition of income is used, or whether the focus is parents' or students' income, the implication of the results above is that the net redistributive effect of public subsidies for higher education is either distributionally neutral or mildly progressive. On the other hand, the subsidy strongly redistributes toward the families with well-educated parents. The reason for the progressivity is that while subsidies are larger for higher income families, a proportional tax system means that taxes are even higher. While we are used to thinking of benefits as regressively distributed if high-income households receive more benefit than low-income households, the net impact of a policy is the difference between benefits and costs. Hence an equal payment to all households financed by proportional taxes is progressive.

It is worth recapitulating some of the limitations and biases of the procedure. Progressivity is probably understated because the subsidy measure does not include the intra-institutional distributional effect of financial aid, which is undoubtedly progressive. Instead, because my subsidy measure is computed as per student costs less tuition receipt, financial aid is in effect allocated equally to all students.

The simplifying assumption of a proportional tax system has been adopted. This may not be a reasonable assumption for marginal changes in tax revenue, even if it characterizes the overall tax systems of many states. Georgia's HOPE scholarships are financed by a state lottery that is not close to a proportional tax. One could compute exactly how regressive a state tax system would have to be to push the net redistributive effect into regressivity. To illustrate, in the case of the parent's lifetime income, the tax system would have to impose tax rates three times as high on the bottom two deciles as on the top two deciles in order to make the net subsidy distributionally neutral. Fullerton and Rogers (1993, p. 174) find that while sales and excise taxes are regressive, the ratio of the effective tax rate faced by the bottom 20 percent of the population to the rate faced by the top 20 percent is on the order of 1:2, nowhere near the degree of regressivity needed to reverse the conclusions above.

Behavioral Responses

How robust are these results when behavioral responses are considered? Table 4 presents results using the adjusted lifetime parental income measure of the first column of table 3. To adjust for behavioral responses, we need to estimate the shaded areas in figures 1 and 2 and that requires an estimate of the subsidy rate, s, and the demand elasticity, η. Winston, Carbone, and Lewis (1998) estimate the subsidy rate for public higher education institutions in the mid-1980s at about 90 percent, so I use $s = 0.9$. For the elasticity of demand

Table 4. Robustness of Net Subsidy to Behavioral Responses

Income Decile	(1)	(2)	(3)	(4)	(5)
1	2,410	823	1,581	−5	2,216
2	−423	−1,859	−1,564	−3,000	−989
3	718	−1,212	−622	−2,553	150
4	−595	−2,481	−2,099	−3,986	−1,344
5	−692	−2,766	−2,351	−4,424	−1,522
6	2,125	−740	294	−2,573	−2,571
7	2,217	−928	190	−2,955	−2,955
8	197	−2,837	−2,049	−5,083	−5,083
9	−1,999	−5,062	−4,597	−7,660	−7,660
10	−3,958	−7,775	−7,414	−11,232	−11,323
Subsidy Response		X		X	X
Tax Response			X	X	X
Borrowing Constraints with Optimal Subsidy					X

Notes: Income measure is adjusted lifetime family income. Elasticity of demand = .15, subsidy rate = .9, marginal welfare cost of taxation = .15. For column (5), borrowing constraints are assumed to affect only the bottom five deciles.

for higher education with respect to net tuition, I rely on two sources that yield similar estimates. Leslie and Brinkman (1988, p. 132) present a meta-analysis of demand studies from which they conclude that the enrollment rate falls by .7 percentage point for each additional $100 in net tuition. Using this response, along with information about enrollment rates and tuition in the mid-1980s, I conclude that $\eta = .13$. Kane (1999, p. 114) estimates an enrollment effect of 5 percentage points per $1,000 in tuition in the early 1990s, which implies an $\eta = .15$. Finally, a consensus estimate of the marginal welfare cost of taxation in the 1980s based on work of Ballard, Shoven, and Whalley (1985) and Browning (1987) is 15 percent, implying that a dollar of tax revenue imposes a burden of $1.15. These three parameter values underlie the results in table 4.

The first column of table 4 reproduces the net subsidy results underlying the first column of table 3. This is a zero-sum case with no behavioral responses to taxes or subsidies. The second column shows the effect of behavioral response to subsidies with no borrowing constraints; here the value of the subsidy is .8 of its dollar cost, so the sum of net subsidies is negative, but the effect is still progressive, with the lowest decile gaining and the highest income deciles losing. Column 3 shows just the effect of tax distortions, while column 4 considers both subsidy and tax distortions. Finally, column 5 assumes that the subsidy exactly offsets borrowing constraints that face the bottom five deciles of the income distribution. While this is a case that would seem to be most favorable to finding progressivity of subsidies, the bottom five deciles actually lose on net because what they gain from the subsidies is more than matched by their loss from the taxation that finances those subsidies. Still, the effect of the policy is progressive in the sense that the highest deciles lose the most in percentage terms.

4. COMPARISON WITH HANSEN AND WEISBROD

Can these results be reconciled with the famous study by Hansen and Weisbrod (1969) that found the California higher education system to be regressive? Perhaps no reconciliation is needed. Hansen and Weisbrod studied one state, California, in the 1960s, while this study encompasses the entire nation and looks at students who attended college primarily in the 1980s. It is also possible, though implausible, that California's system is regressive while other states' systems are progressive. It is also possible that the progressivity of the entire system rose between the 1960s and the 1980s. But a simpler reconciliation is possible if we ask the same questions of the data in this study that Hansen and Weisbrod did of their data.

The limitations of the data available to Hansen and Weisbrod led them to analyze the problem in the following way. They divided the population of California families into four groups, corresponding to the level of higher education institution attended by the family's child. Some families have no children in the university system, some have children in junior college, some in state colleges, and some with children in University of California (UC) campuses. These four groups represent an ascending order of gross subsidy, as UC students receive more subsidy per year and spend more years in college than junior college students. What Hansen and Weisbrod showed was that, comparing these four groups of parents, gross subsidy was positively related to both mean household income and to net subsidy. That is, the parents of the UC students have both the highest family incomes of the four groups and receive the greatest net subsidy, when their tax burdens are accounted for. Families with no students in the system have the lowest incomes and, of course, receive negative net subsidies since they enjoy no direct benefit and must pay taxes to support the system. These empirical patterns led Hansen and Weisbrod to conclude, "On the whole, the effect of these subsidies is to promote greater rather than less inequality among people of various social and economic backgrounds, by making available substantial subsidies that lower-income families are either not eligible for or cannot make use of" (1969, p. 191).

Table 5 describes an exercise parallel to Hansen and Weisbrod's using this study's data. Households are arrayed by level of gross public subsidy. Decile 10 corresponds to those households receiving the most gross subsidy; they have

Table 5. Family Income and Net Subsidy by Gross Subsidy Level

Deciles of Gross Subsidy	Annual Family Income	Net Subsidy	Gross Subsidy
1–5	30,694	−3,124	0
6	34,208	−2,685	838
7	32,228	−1,492	1,722
8	33,888	754	4,127
9	34,048	5,029	8,603
10	40,341	13,262	17,740

the highest mean incomes and receive the greatest net subsidies. The bottom five deciles are lumped together, as they are families who receive no direct subsidy because their NLSY child did not attend a public institution. If one looked only at table 5, one might conclude, as Hansen and Weisbrod did, that the system is regressive. However, as we know, the same data generated the progressive patterns revealed in figures 3 through 6.

It may appear paradoxical that net subsidy and income can both be positively correlated with gross subsidy, as table 5 shows, yet net subsidy and income are negatively correlated with each other. A simple numerical example shows how this can happen. Suppose half the families have high incomes of $10,000, while the other half have low incomes of $2,000. Suppose that if a child goes to college, the gross subsidy is $6,000; the alternative is not going to college, where the gross subsidy is 0. Proportional taxes on income are levied to finance the system, and 30 percent of high-income families' children go to college, while only 20 percent of low-income children go to college. In this economy, the average household income of children who go to college is $6,800, compared with only $5,733 for non-college-goers. The average net subsidy received by college goers is $4,300, compared with −$1,433 for non-college goers. Yet, average net subsidy received by high-income households is −$700, compared with +$700 received by low-income households.[7] The key is the 70 percent of high-income households who pay substantial taxes yet have no children receiving subsidies.

Since the overall redistributive effect of a policy is revealed by the pattern of net subsidy across income levels, one could conclude that Hansen and Weisbrod got the numbers right but drew an incorrect conclusion of regressivity from their evidence.

7. This basic pattern holds for a wide range of assumptions about the income distribution and the proportion of children from each income level going to college, as long as high-income children are more likely to go to college.

5. FINAL COMPLICATIONS: CHANGES IN PRICES AND EXTERNALITIES

Changes in Prices

The recent work of Heckman, Lochner, and Taber (1999) has emphasized the effect of subsidies in changing market prices. In this model, two important prices that could be altered by tuition subsidies are the price of college, p_c, and the second generation's wage function, which could become flatter as the real wage of the less educated rose and the real wage of the more educated fell. Such a change in relative wages would augment the progressivity of a tuition subsidy policy.[8] The price of college might also rise as input suppliers such as college professors earn greater rents. This price change would likely reduce progressivity if faculty have higher incomes than the families of their students. However, in 2000–2001, the average faculty salary at four-year institutions was around $59,000, while the median family income of freshmen at four-year institutions was reported to be roughly $64,000.[9] Hence there is no strong evidence that students' parents are poorer than faculty, although the salary figure is not family income.

Externalities

If college educations for some confer benefits on others, a complete reckoning of distributional effects should include these externalities, both real and fiscal. A fiscal externality arises because those who are induced by subsidy to acquire college educations will, on average, pay more tax and receive fewer transfer payments. A real externality occurs if the pretax incomes of non-college-educated workers rise when more workers attend college. Externalities of either variety, in the absence of other complications to the basic model, make a tuition subsidy a positive-sum policy and alter the pattern of net benefits by income class.

Reasonable assumptions about the nature of externalities lead straightforwardly to the conclusion that externalities will reinforce the progressive distributional effects found in the basic model. Here, a policy is called progressive if the *relative* inequality of income is reduced by the policy, that is, if the policy raises the income of low-income households by a greater percentage than it raises the income of high-income households. A policy could reduce relative inequality, therefore, while still raising the dollar gap between the incomes of rich and poor. To make the point requires some algebra. Indexing income deciles by k, let B_k, T_k, and N_k denote respectively the average

8. Johnson (1984) provides a particularly compelling version of this argument.
9. *Chronicle of Higher Education* 2001: 23, 27. The median freshman family income was found by interpolating a uniform distribution between $60,000 and $75,000.

benefit received by households who receive positive direct benefits, the average tax paid per household, and the fraction of households who receive positive benefits. With this notation, the average net benefit received by households in income decile k is just the difference between benefits received and taxes paid, or $N_k \cdot B_k - T_k$. As we have seen, these net benefits in the simple model have been positive for low-income deciles and negative for the very highest income deciles.

To account for the distributional impact of externalities, we need a reasonable and simple way to allocate externalities across households. Fiscal externalities—higher future tax revenue attributable to the policy—reduce the incremental lifetime tax revenue needed to finance the policy. Let us simply assume that the tax reduction attributable to the fiscal externality is the same fraction, e, of each household's incremental tax burden in the simple model.[10] The net benefit received by income decile k is now equal to $N_k \cdot B_k - T_k + e \cdot T_k$. If $e = 0$, we are back in the simple model without externalities. If $e = 1$, the tuition subsidy is self-financing—it generates enough incremental tax revenue to pay for itself. In the self-financing case, nonbeneficiary taxpayers invest in the college educations of others and will earn the market rate of return on that investment in the form of higher net taxes paid by the direct beneficiaries of subsidies. Note that when $e = 1$, the distribution of net benefits is the same as the distribution of gross benefits, since there is no extra tax required to finance the policy. As table 2 shows, gross benefits are absolutely higher, but a smaller percentage of income, for high-income deciles. Therefore, when externalities are so large that $e = 1$, tuition subsidies reduce the relative inequality of income. Since we have already shown that when $e = 0$ and we are back in the simple model without externalities, tuition subsidies reduce relative income inequality, any value of e between 0 and 1 will also reduce relative inequality.[11]

What if the externalities are not fiscal externalities but real externalities raising the earnings of nonrecipients? Again, a reasonable and simple assumption is that the real externality is the same proportion of every household's income. Using this assumption, we get the same result that we got above with fiscal externalities. Suppose the real externality parameter is e^*, so that a household with income Y receives an externality benefit of $e^* Y$. Since incremental taxes have assumed to be proportional, this gives the same pattern of benefits as the

10. I am ignoring the timing of the future tax revenue. One could imagine the government borrowing now to reduce current tax burdens, paying off the debt with the future tax revenue generated by the additional college graduates.

11. This result is easy to show using the fact that the net benefit for any value of e between 0 and 1 is just a weighted average of the net benefits at $e = 0$ and net benefits at $e = 1$.

fiscal externality analysis, since $T = tY$ and $eT = etY = e^*Y$, where $e^* = et$ and t is the proportional tax rate. Hence, assuming fiscal externalities are proportional to incremental taxes and assuming real externalities are proportional to income yield the same distributional impact, which is to reduce relative income inequality.

In most models of real externalities (see Acemoglu and Angrist 2000 or Moretti 2004), the wages of non-college-educated workers are increased more by an increase in the number of college graduates than are the wages of college graduates. This would suggest that e^* is higher for low-income deciles than for high-income deciles, and the tuition subsidy would be even more progressive.

6. CONCLUSION

This article takes two approaches to the question of the distributional effect of higher education subsidies. The first approach neglects the resource allocation effects of subsidies and the taxes levied to pay for them and treats higher education policy as a zero-sum game. The costs and benefits of public subsidies can be allocated across various concepts of parent income and parental education. In this framework, higher education subsidies clearly redistribute toward households with highly educated parents. With respect to redistribution by parental or student lifetime income, however, the evidence for a range of alternative income concepts shows the effect subsidies net of the taxes which finance them as mildly progressive or roughly distributionally neutral. Although high-income families receive more in subsidies, they pay sufficiently more in taxes that the net subsidies for high-income households are negative, while those for low-income households are on average positive. This basic result holds up even when we consider behavioral responses to subsidies and taxes.

Since my conclusion conflicts with the results of Hansen and Weisbrod's justly famous 1969 study, I apply their methodology to my data and derive results parallel to their findings. A reasonable conclusion might be that Hansen and Weisbrod's results were incorrectly interpreted as implying the regressivity of subsidies. Although those who receive higher education subsidies are from families with higher-than-average incomes, and those families do not pay in tax the cost of educating their children, it is still the case that all high-income families considered together (including those with no children receiving subsidies) are receiving negative net subsidies. Low-income families, taken together, receive positive net subsidies. Higher education subsidies benefit upper-income households more than lower-income households, but when the taxes that finance the subsidies are accounted for, the net effect is somewhat progressive or at least not regressive.

The data for the results in this article pertain to college finances in the 1980s, leaving open the possibility that the distributional effect of the public higher education financing system has changed in the intervening two decades. For example, the rise of merit aid (such as Georgia's HOPE scholarships) and the decline of public university tuition subsidies would make the current system less progressive than the one described here.

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