January, 2003

The Savings Impact of the Implicit Taxes from College Financial Aid

Aaron S. Edlin
Andrew W. Dick, *University of Rochester*
Eric R. Emch

The Savings Impact of College Financial Aid

Andrew W. Dick[*]   Aaron S. Edlin[†]

Eric R. Emch[‡]

[*]University of Rochester School of Medicine, andydick@rochester.rr.com

[†]UC Berkeley, aedlin@bepress.com

[‡]U.S. Dept. of Justice Antitrust Division, eric.emch@usdoj.gov

The Savings Impact of College Financial Aid*

Andrew W. Dick, Aaron S. Edlin, and Eric R. Emch

Abstract

When parents save money for their children's college education, a portion of their savings is later taken away in the form of reduced eligibility for college financial aid. We estimate the long-run impact of this implicit asset tax by estimating family preferences over life-cycle consumption, savings and college choices and then simulating family choices over these variables under various hypothetical financial aid systems with different asset treatments. Our simulations suggest that the implicit taxes in the current college financial aid system may in the long run reduce economy-wide asset holdings in the U.S. by \$186 billion versus aid systems with no implicit asset taxes. This figure is less than 1% of total U.S. wealth during the years of our data. It, however, reflects a 10.2% reduction is asset holdings for affected families.

KEYWORDS: Assets, Savings, College financial Aid, taxes

---

1   Introduction

Several papers have pointed out that the U.S. college financial aid system penalizes families that save (see, e.g., Edlin [1993], Feldstein [1995], Dick and Edlin [1997]). For many parents who save for their children's college education (or for other purposes), a portion of their savings is later taken away in the form of reduced eligibility for college financial aid. This implicit tax on assets creates a potentially important savings disincentive; estimates of the average tax rate range from 20 to 50% over one or more children's educations.[1] What remains unclear is the impact of these asset taxes on savings rates and asset accumulation patterns – both now and potentially in the future if families are currently unaware of the implicit financial aid taxes they face but become more cognizant of them over time.

Existing estimates of the impact rely on a reduced-form approach, regressing families' pre-college asset accumulation on implicit financial aid tax rates and various control variables. Early papers in this literature found that families reduced their savings dramatically in response to implicit financial aid taxes. Feldstein [1995] found that the average financial assets of families in his sample was reduced from $36,000 to $24,000 because of the implicit asset tax. (Kim [1996] found similar reductions with different data.) Feldstein's results, however, relied upon unrealistic assumptions about the aid award process. More recently, Long [2003], with a reduced-form approach similar to that of Feldstein but using a more realistic estimate of implicit financial aid tax rates, brought these findings into question.[2] Long concluded that Feldstein's results are in general very sensitive to the assumptions one makes about the taxes families face, and that under what is arguably the most realistic set of assumptions, in fact, financial aid taxes appear to have little net impact on family savings.

These reduced form approaches attempt to answer an important question – namely the current (circa late 1980s and early 1990s) impact on pre-college savings of implicit financial aid taxes. But these approaches have several shortcomings. First, the reduced-form methodology does not allow one to estimate changes in a lifetime consumption profile and hence in long-run aggregate asset holdings: Instead they focus on a limited segment of the population. Second, it provides no bound on how large the impact could ultimately become as families grow to be aware of these taxes if only some of the families in the data were aware at the time of observation. Third, it has nothing to say about potential impacts of changes in financial aid policies on other outcomes important to policy makers, such as college choice or, ultimately, consumer welfare.

Our simulation approach eliminates these difficulties (at the expense, of course, of introducing new ones). We derive long-run (*full information*) savings

---

[1] See Case and McPherson [1986], Edlin [1993], Feldstein [1995], Kim [1996], and Dick and Edlin [1997].

[2] In addition to estimating taxes based on actual aid awards rather than federal formulas, Long [2003] also modified Feldstein's calculation of the tax rates parents expect to face to include more realistic estimates of college cost, student contributions, the probability that a student will attend college, and parents' expectations of future income.

effects under a range of assumptions about families' *current* understanding of financial aid taxes. Our method also allows us to calculate the impact of changes in the financial aid system on consumer welfare and college choice. Throughout, we use the implicit tax rates derived from actual aid awards to model consumers ultimate reactions to these taxes, rather than relying on assumptions about how the process works.

Our basic methodology is to use the pattern of actual aid awards to estimate how the value of an aid package changes with school cost, type of school, family assets, income and other characteristics. We thus estimate what amounts to a nonlinear budget constraint that limits each family's consumption and college cost choices. From a standard structural model of intertemporal utility maximization augmented to incorporate educational consumption, we use each family's actual choices of college cost and asset accumulation subject to its budget constraint to infer that family's savings propensity (i.e., intertemporal elasticity of substitution) and demand for college. We can then simulate how that family's savings and consumption profiles as well as college choices would change under various financial aid scenarios (effectively, under various budget constraints). Using the weights provided in the National Postsecondary Student Aid Survey (NPSAS) for year 1986-87, we then estimate the long-run impact of each alternative system on aggregate savings. Finally, we calculate equivalent variations for each family to assess the distributional consequences and the efficiency gains or losses from replacing the current financial aid system with alternative systems.

We use NPSAS 1986-1987 data to create a population whose savings and college preferences we "know." We use these data to estimate preferences, rather than more recent data, because recent data do not have good asset information (missing in particular home equity), so estimates of intertemporal savings elasticities with recent data would be unreliable.

Our simulations compare the current financial aid system with four hypothetical alternative systems. Our baseline case is the budget constraint and implicit taxes implied by the distribution of aid in the NPSAS 1995-1996 data. We therefore simulate the choices that the 1986-1987 population would make under the 1995-1996 financial aid system. Second, we consider the elimination of the financial aid system altogether. By doing so, we can assess the impact that financial aid has had on both savings and college choice. Third, we consider a policy in which all financial need is met, where need is determined by the current federal formulas. Fourth, we consider a target asset policy that imputes assets from income and uses this target asset level to determine aid within the current system. This is similar to a proposal made by the Clinton administration in 1998, and is designed to eliminate the asset tax while maintaining access for families with low means as measured by permanent income. Finally, we consider a return to the aid distribution system that was in place in 1986-1987. This alternative allows us to get a sense of the aggregate effects of the various changes between 1986 and 1995, including the elimination of home equity from the federal determination of need, increased protection of assets for low-income families in the federal need calculation, and the growing reliance on

loans during the period.

Clearly, the implementation of each of these policies depends on the coordinated efforts of colleges and universities as well as the state and federal governments, because each plays a role in determining aid awards. It is beyond the scope of this project to explain how political and coordination hurdles might be overcome to effect any of these four alternative policies. This project simply supplies information helpful for assessing their desirability.

We find that in a long-run steady state, the current U.S. financial aid system may lead to $578 billion less economy-wide asset accumulation than a system with no financial aid and $186 billion less than a "target asset" system designed to eliminate implicit asset taxes but otherwise roughly match the present system (all figures given here and throughout the paper are in 1994 dollars unless noted otherwise). Both figures are small compared to total U.S. assets (e.g., total Household and Nonprofit Net Worth was $19.1 trillion in 1985).[3] (Bear in mind that those who apply for financial aid are a minority of the overall population and are also poorer than college attenders who don't apply for aid).

Affected households would hold roughly $4,000 to $5,000 more on average under these systems, an increase of roughly 8-10%. We find, though, that one of the biggest effects from tinkering with the financial aid system is apt to be changes in the amount spent on college education, and our overall welfare calculations suggest that these effects can easily swamp savings efficiencies. Currently students receive substantial subsidies at the margin that encourage them to attend more expensive schools. If students internalize all the costs and benefits of their education, such subsidies must currently lead to substantial inefficiencies. Hence, almost any financial aid reform that results in students switching to cheaper schools is likely to be more efficient. However, if there are good reasons for financial aid, then such gains are illusory, and it may prove quite difficult to reform or eliminate implicit asset taxes without having unintended and dramatic effects on the margin of school choice.

The remainder of this paper is organized as follows. Section 2 discusses the related literature. Section 3 presents the theoretical model. Section 4 describes the NPSAS data. Section 5 presents our estimates of financial aid functions and family preferences. Sections 6 and 7 give our alternative financial aid scenarios and our methods for simulating long run reactions to each of the scenarios. Section 8 presents our results.

2   The Literature

Long-standing concern about the low rate of saving in the U.S. has prompted a plethora of economic studies, ranging from Summers [1981, 1983] and Auerbach, Kotlikoff, and Skinner [1983], who simulate a household's response to tax law changes using a structural life-cycle model of intertemporal consumption/saving

---

[3] According to the Statistical Abstract of the United States (1995, Table 758), total 1985 Household and Nonprofit sector net worth was 13.9 trillion dollars, which is 19.1 trillion in 1994 dollars.

trade-offs; to Blinder [1975], Boskin [1978], and Skinner and Feenberg [1989], who regress consumption or savings on rates of return (see Bernheim [1997] or Sandmo [1985] for a more comprehensive survey). The literature on the savings disincentive from the college financial aid system likewise falls into these same two categories: Case and McPherson [1986] and Edlin [1993] use a life-cycle simulation approach, while Feldstein [1995], Kim [1996], and Long [2003] estimate a savings function directly. Neither approach is entirely satisfactory.

Feldstein [1995] is probably the most influential study of how the implicit taxes from college financial aid affect savings. He used the 1986 Federal Reserve Board Survey of Consumer Finances to estimate how financial aid taxes affect a family's savings using a model of the form

$$A_i = b_0 + (b_1 + b_2\theta_i + b_3 Age_i + b_4 N_i)Y_i + \varepsilon_i \tag{1}$$

where A_i represents the net financial asset holdings of the ith family, θ_i is the ith family's marginal financial aid tax on assets, Age_i is the ith family head's age, N_i is the number of children under age 18 living at home in the ith family, Y_i is the ith family's income, ε_i is a family-specific error term, and the b_j are estimated parameters.

As mentioned earlier, Feldstein found that average financial assets of the families in his sample would be $\$36,000$ if there were no financial aid tax, instead of the actual value of $\$24,000$. Kim [1996], who used a similar methodology with different data (The Survey of Income and Program Participation (SIPP)), found remarkably similar but smaller effects: assets were reduced by $20-30\%$ because of the financial aid tax. These results are certainly worrisome.

The results of Feldstein and Kim are open to question, however, because they had no empirical estimates of financial aid tax schedules and so were forced to make strong assumptions about aid distribution. In particular, they assumed that aid is proportional to need as determined by federal formulas. (Federal formulas found in the Higher Education Amendments determine how much parents can reasonably be expected to pay to send a child to college given their income and assets— and "need" is the difference between this expected family contribution (EFC) figure and the full cost of the institution the child attends).[4] Thus, their assumption can be written as

$$Aid = \alpha(Cost - EFC). \tag{2}$$

Dick and Edlin [1997], in contrast, use NPSAS 1986-1987 data on actual aid awards to estimate the following aid function

$$Aid = \beta_0 + \beta_1 EFC + \beta_2 Cost + \beta_3 EFC * Cost + \tag{3}$$
$$\beta_4 EFC^2 + \beta_5 Cost^2 + \beta_6 EFC^2 * Cost +$$
$$\beta_7 EFC * Cost^2 + \beta_8 EFC^3 + \beta_9 Cost^3 + \phi X + \varepsilon,$$

---

[4] See Case and McPherson [1986], Edlin [1993], Feldstein [1995] and Long [2003] for more thorough descriptions of these federal formulas.

where *Aid* represents the value of an aid award to the family, β_i are parameters, ϕ is a vector of parameters, X is a matrix of covariates that includes parental assets, parental income, a student's race, residence, ethnicity and sex, and ε is an unobserved stochastic error term.

Appropriate restrictions in (3) yield (2), allowing Dick and Edlin to test the assumptions of Feldstein and Kim. Not only did Dick and Edlin strongly reject (2), but their estimates also imply that in many instances where Kim and Feldstein assumed that family A faced a higher tax rate than family B, family A actually faced a lower rate. Using the wrong tax rates may have significantly distorted their estimates of the savings impact of these taxes. In fact, Long [2003] (using 1990 SIPP data) found that using more accurate tax rates, along with more realistic assumptions about families' expected paths of wages and college costs, virtually eliminates any discernible impact of implicit financial aid tax rates on currents savings.

Even with correct set of assumptions, however, the reduced form methodology might lead to biased predictions. Parents in the late 1980s and early 1990s may not have understood these implicit taxes; only recently have college advice books begun to explain their existence instead of blindly urging savings at all cost with little consideration for the trade-offs. Regression results such as Kim's, Feldstein's and Long's may therefore understate the potential long-run impact of financial aid taxes.

The other approach to estimating the savings impact of college financial aid stems from Case and McPherson [1986] and Edlin [1993]. Both used a simulation approach like that of Summers [1981] and Evans [1983], Case and McPherson assuming three periods (before college, after college, and retirement) and Edlin assuming 65 periods of equal length representing ages 20-85. Both studies found savings impacts at least as large in percentage terms as those that Feldstein and Kim estimated. Neither Edlin nor Case and McPherson tried to calibrate their models to the U.S. population to estimate total asset reduction.

A simulation approach has the advantage of allowing one to follow asset accumulation throughout the life-cycle to get at least a rough gauge of the overall steady-state effects on U.S. asset holdings. Our study takes advantage of this potential.

The main problem with these previous simulation studies, as with the Feldstein and Kim studies, is that they derived the financial aid tax rates from questionable assumptions about the financial aid system. While Feldstein and Kim assumed that aid was proportional to need, these studies assumed that aid equaled financial need.[5] An additional problem is that they required knowledge of a family's elasticity of intertemporal substitution (Edlin [1992] provides tables for a variety of elasticities, but one must know the correct elasticity to know the savings impact). Our study derives savings propensities for each family from observed asset accumulation. Despite this flexibility and element of realism, we nonetheless suffer— as do all simulations— from the limitations imposed by the

---

[5] To be fair to them, they restricted the application of their analysis to those instances where schools purport to meet all need.

structural form we assume.

3   The Structural Model

We follow Evans [1983] and Summers [1981], who modeled savings in a life-cycle model assuming that households have a constant elasticity of substitution utility function. We adapt their model to incorporate college choice, assuming the family has one child who enters college of quality Q_s at time $t = s$ and spends n years in college. The family's utility function is

$$U(C_0, C_1, ..., C_T, Q_s, ..., Q_{s+n-1}) = \sum_{t=0}^{T} \frac{C_t^{1-\gamma}}{(1-\gamma)(1+\rho)^t} + \alpha \sum_{t=s}^{s+n-1} \frac{Q_t^{1-\gamma}}{(1-\gamma)(1+\rho)^t},$$
(4)

where C_t is real non-college consumption in period t, γ is the inverse of the family's intertemporal elasticity of substitution, ρ is the discount rate, and α is the family's taste for education. Note that a higher γ implies a higher propensity to save but a lower savings elasticity (see Summers [1981] and Evans [1983]). We use a school's sticker price, "*Cost*," to proxy for quality Q.

Household's real assets at time t, A_t, must satisfy the equation

$$A_t = \frac{1}{1+\pi} A_{t-1}(1 + i(1 - \tau^s - \tau^f)) + Y_t - C_t +$$
$$Aid_t(A_{t-1}, Y_{t-1}, Cost_t, X) - Cost_t,$$
(5)

where π is the inflation rate, i is the nominal interest rate, τ^s and τ^f are respectively the state and federal income tax rates, Y_t is family labor income at time t, $Cost_t$ is the cost of the child's college education at time t, Aid_t is the value of financial aid during year t and X are characteristics of the household in question, such as state of residence and number of children, that enter into need determination formulas. If the child does not attend college at time t, then $Aid_t = Cost_t = 0$. We assume that $A_0 = 0$, and the budget constraint is that $A_T \geq 0$.

The price ratio, i.e., the rate at which the family can trade-off C_t for C_{t-1} so as to maintain A_t and all other consumption levels, is given by

$$R_t = \frac{\partial A_t}{\partial A_{t-1}} = \frac{-\Delta C_t}{\Delta C_{t-1}} = \frac{1}{1+\pi}\left(1 + i\left(1 - \tau^s - \tau^f\right)\right) - \tau_t^c,$$
(6)

where the college financial aid tax rate τ_t^c is given by

$$\tau_t^c = \frac{-\partial Aid_t(A_{t-1}, Y_{t-1}, Cost_t, X)}{\partial A_{t-1}}.$$

The family will choose a consumption path $\{C_t\}$ equating the marginal rate of substitution with the price ratio at each year t. Hence,

$$\frac{U_{C_{t-1}}}{U_{C_t}} = (1+\rho)\left(\frac{C_t}{C_{t-1}}\right)^\gamma = R_t.$$
(7)

From equation (5), we find that the rate at which the family can trade off C_s for school cost $Cost_s$ is given by

$$\frac{-\Delta C_s}{\Delta Cost_s} = 1 - \frac{\partial Aid_s(A_{s-1}, Y_{s-1}, Cost_s X)}{\partial Cost_s}. \tag{8}$$

The family will choose college quality (i.e., college cost) to equate

$$MRS_{C_s, Q_s} = \alpha \left(\frac{C_s}{Cost_s} \right)^\gamma = 1 - \frac{\partial Aid_s}{\partial Cost_s}. \tag{9}$$

These first-order conditions, together with the budget constraint, determine consumption and college cost given the financial aid function, $i, \pi, \{Y_t\}, \rho$, the family's propensity to save, γ, and taste for education, α. A similar equation holds for the other college years provided we imagine that families re-optimize their college choices each year. In our simulations and our estimation, we make the simplifying assumption that the college choice and the aid determinations made in year s apply throughout the college years.

If we do not know γ and α, then these equations allow us to determine them if we know the chosen asset level at time of college, A_{s-1}, and the chosen college cost. This observation forms the basis for the estimation described in Section 5.

4 Data: National Postsecondary Student Aid Survey (NPSAS)

We use data from the National Postsecondary Student Aid Study (NPSAS) for years 1986-1987 and 1995-1996. The NPSAS 1986-1987 is the primary data set for this study due to its more complete asset information. This allows us to form more credible estimates of families' savings preferences. The newer data set, of course, gives us a better picture of how the financial aid system works today.

We use our estimates of the implicit taxes in the 1995-96 financial aid system as one of our policy alternatives. We use data from the NPSAS 1986-1987 to characterize the financial aid system in 1986-87, to estimate each family's propensity to save, and to define populations of families used in our simulations. This survey, conducted by the Department of Education, is the first in a series of surveys conducted to assess how students and their families pay for postsecondary education. It is a nationally representative sample of postsecondary students enrolled in Fall 1986, and it provides financial aid, school cost, and family background data on about 43,000 students from institution, student, and parent surveys. The Fall 1986 survey was updated in 1987 to account for changes in financial aid during the academic year. Institutional records are available only for students who applied for financial aid and thus

filled out appropriate financial aid forms. Since these data are the most reliable, and the student and parental survey data are poor, we restrict our study to aid applicants. In addition, because we are interested in determining the savings disincentive of the financial aid tax, those that do not apply for aid, and thus do not receive aid, face no tax and consequently no savings disincentive.

We further restrict our sample to undergraduate students who are dependent on their parents, who are U.S. citizens or residents eligible for federal aid programs, and who are attending four-year colleges and universities. This leaves us with 10,490 undergraduates, freshman through senior. We exclude students attending two-year colleges, because we think their implicit taxes are apt to be quite different, and we do not have tax estimates for them. As a result, the savings effects we estimate do not include a contribution from these families. Finally, we consider only freshmen, leaving 1,993 observations (1,323 from public and 670 from private institutions).

We use data from the NPSAS 1995-1996 to characterize the financial aid system in the academic year 1995-96. This is the fourth in the NPSAS series of surveys (the two not already mentioned are 1990-1991 and 1993-1994), and it is similar in design to the 1986-1987 survey. Again, it is a nationally representative survey of postsecondary students that combines information from government and institution sources with parent and student surveys. This survey includes data from roughly 950 postsecondary institutions, 50,000 students, and 8,800 parents. Unlike the 1986-1987 survey, however, it does not include complete information about home equity because it was not required in the federal financial aid forms.

As in the 1986-1987 sample, we restrict our sample from the NPSAS 1995-1996 to include first-year students who are dependent on their parents, applied for financial aid, are U.S. citizens or residents eligible for federal aid programs, and are attending four-year colleges and universities. Our resulting sample includes 4,623 observations, with 2,189 from private schools and 2,434 from public schools.

4.1   Definition of Variables

Both NPSAS 1986-1987 and NPSAS 1995-1996 identify financial aid according to its source (federal, state, institutional, or other) and according to its type (grant, loan, work study, or other). Total aid awarded, the sum of grants, loans, work study and other financial aid, is the measure of aid usually referred to when "total aid" figures are quoted. We are interested, however, in the value of aid to a family. Thus, we follow Case and McPherson [1986], Edlin [1993], and Dick and Edlin [1997] in assuming that the value of aid equals grants plus one-half the value of loans. In our previous work, we found that loans do not contribute a large part of the financial aid tax because they do not vary as much as grants with assets, and therefore, the tax is not very sensitive to the value attributed to loans.

Expected Family Contribution (EFC) is the amount that the federal need determination formulas find that a family can reasonably be expected to pay

to send a child to college given the family's assets, income, and demographic characteristics. For each student, the National Center for Education Statistics calculates the EFC using the family contribution formula of the Office of Student Financial Aid, Department of Education. The EFC takes into account both the number of children and the number of children in college (see Edlin [1993]).[6]

Our variable for the cost of attending an institution ($Cost$) includes tuition and fees together with an allowance for living expenses as reported by the institution in the institution survey. Living expenses include books and supplies, room and board, health care insurance and transportation. When we speak of need, we mean $Cost$ less EFC. A family's expenditure on college education is given by $Cost$ less Aid.

The NPSAS 1986-1987 data include variables covering a family's labor income and total income during 1985 as well as asset holdings in 1985. By adjusting for the probable state and federal taxes paid, we impute the family's disposable labor income in 1985. Reported total assets include financial assets, housing equity, business equity, and equity in other investments. Pensions and retirement accounts are excluded from the federal need determination formulas and from the reported measure of assets. Thus, as discussed below, we impute pension and social security contributions from the labor income profile, accrue them over time, and add them to the reported total assets.

The NPSAS 1995-1996 data set contains similar income and assets information. It does not, however, include home equity because home equity was eliminated from the calculation of EFC by the Higher Education Amendments of 1992, and as a result, home equity was dropped from the NPSAS. Thus, we cannot directly determine total assets using the same method as described for the 1986-1987 data. For this reason, we do not attempt to determine savings preferences from this data and instead form more reliable estimates of savings preferences from the earlier NPSAS data.

Both NPSAS data sets also have variables representing sex, race, age, residency status, marital status, and whether a student applied for aid. We inflated all financial data to 1994 dollars using the CPI as reported in the *Economic Report of the President*.

Table 1 contains summary statistics of the measures defined from the 1986-1987 and the 1995-1996 NPSAS data sets.

---

[6]Expected Family Contribution is defined both by the "Federal Methodology" designed by the federal government and used to determine the allocation of state and federal financial aid, and the "Institutional Methodology," designed by the College Board and used by some schools to determine the allocation of non-governmental aid. Our dataset contains EFC as defined by the Federal Methodology. The Institutional Methodology delves more deeply into families' assets and finances than the Federal Methodology, in particular taking account of home equity (ignored by the Federal Methodology since 1992) and the income and assets of noncustodial parents.

5   Estimation of Financial Aid Functions and Family Preferences

Here, we derive the preferences of families in the NPSAS 1986-87 data set over consumption substitution and college quality (γ_j, α_j) that would rationalize observed choices of school cost and asset accumulation. To do so, we must know the relative prices that families thought they faced when they made their choices regarding school quality and their consumption path. (These relative prices are given by the school subsidy rate $\frac{dAid}{dCost}$ and the asset tax rate τ^c.)

We estimate preference parameters under three different assumptions about families' perceptions of τ^c and $\frac{dAid}{dCost}$. First, we assume that families have "rational" beliefs, so that τ^c and $\frac{dAid}{dCost}$ correspond with the empirical distribution of aid as estimated by Dick and Edlin [1997], which we call the "Dick-Edlin" tax rates. Next, we assume that families did not realize that the financial aid taxes or subsidies existed and so optimized under the assumption that $\tau^c = 0$ and $\frac{dAid}{dCost} = 0$.[7] This assumption seems plausible when one considers the plethora of advice books urging families to save for their children's college education, without giving any warning that such savings may reduce financial aid; it is consistent with the results of Long [2003], who found little current impact of financial aid taxes on families' savings rates. Finally, we assume that families perceived τ^c and $\frac{dAid}{dCost}$ to be the values given by an "all-need-met" assumption, in which *Aid* equals need as determined by federal need-determination formulas. We present all of our results under each of these three perceptions about tax and subsidy rates.

We assume that families have chosen optimally given their perceived relative prices, so that the first-order conditions in equations (7) and (9) are satisfied. NPSAS 1986-1987 provides the *EFC* for each family and enough supplemental information to determine τ^c under either the all-need-met assumption or the Dick-Edlin tax estimates, given the actual college choice.

To determine preferences from observed choices, we must make some assumptions about each family's income stream. The NPSAS 1986-1987 data contain labor income for the year prior to college entrance, 1985. To impute the remaining elements of $\{Y_{tj}\}$ for each family j, we use the Welch [1979] estimates of income profiles given by

$$ln(Y_{tj}) = a_j + 0.033t - 0.00067t^2, \tag{10}$$

where t is the family head's age less 20. Using our single observation on labor income, we solve for the intercept (a), and impute the rest of the labor income profile directly from (10). We assume that the wage-earner retires at age 65, and receives only pension and social security income from age 66 to 85. We consider parents' life-cycle savings to begin at age 25, and we follow them to

---

[7]One could argue that it is more realistic to assume that, while ignorant of asset taxes, parents are aware of the implicit subsidy to education implied by the financial aid system. Our results are quite similar, however, if we assume $\frac{dAid}{dCost}$ is given by the Dick-Edlin estimates while $\tau^c = 0$.

age 85, when we assume they die with $A_T = 0$. Hence T=60 in our model. We assume throughout that this income stream is exogenous, and thus is not affected by the particular financial aid policies in place.

No information on pension and social security contributions is available in our data; instead, we assume that in their post-retirement years, each family receives the equivalent of 50% of its age 65 earnings from social security and pension disbursements.[8] Social security and pension contributions are deducted from each year's income along with state and federal taxes. These contributions are assumed to be 7.5% of income, while state taxes are assumed to be 8% of income. Federal taxes are calculated individually for each family from 1985 tax tables.[9]

We also assume that a family has children in college for six years, since we do not know how long one child will be in school and to account for the possibility that multiple children will attend college. We set $\pi = 0.05$, $\rho = 0.03$, and $i = 0.08$, and $T = 60$.

For each family j, we first choose a trial γ_j. Given γ_j and wages, there is a unique consumption stream $(C_t)_{t=0}^s$ that is consistent with the first-order condition (7), $A_0 = 0$, the asset accumulation equation (5), and the observed assets A_{s-1}. After we calculate this consumption stream, we use (9) and the cost of the actual school chosen to compute the unique α_j for each family that is consistent with this consumption stream and with utility maximization.[10] We can then calculate the remainder of the consumption and asset accumulation profile $\{C_t, A_t\}$, and compare A_T to zero. If $A_T \neq 0$, we adjust γ appropriately, and repeat the procedure, iterating until $A_T = 0$.[11]

Once $A_T = 0$, we have found the unique preference parameters γ_j and α_j consistent with utility maximization, the family's wages and the family's observed choices of asset accumulation and school cost.

Our estimates of the elasticity of intertemporal substitution ($\frac{1}{\gamma_J}$) range from a median of .20 under the all-need-met tax perception to a median of .27 under the no tax perception. This elasticity increases as perceived tax rates

---

[8] According to The Social Security Administration the current average replacement rate for Social Security Alone is 40%. See http://www.ssa.gov/OACT/TR/TR01/lr3B5-a.html. Even if we had data on what each family will actually receive in Social Security and other pensions, these figures would not be the right ones for this exercise; the question is what parents imagine their Social Security and other pension income will be, because they optimize under this perception, not reality.

[9] These taxes are based on income, marital status, and number of children. Married couples are assumed to be filing jointly.

[10] We actually use a slightly varied version of the first-order condition (9) that accounts for our simplifying assumption that college quality is chosen in year s and remains constant, and that financial aid for all six college years is delivered at time s.

[11] This procedure will yield very high (low) gammas for families whose income is unusually low (high) in the year reported relative to their lifetime income stream, or who have received (or given) a bequest. These very high γ values will color families' responses to simulated changes in financial aid policies, but may not represent actual savings elasticities. For this reason, we constrain γ to be between 10 and -10, and assume that families who reach this γ bound have positive or negative initial assets such that their first order condition (7) and budget constraint are satisfied. These families are few enough that they contribute little to our estimates, and it matters little whether we do this or drop them from our sample.

fall because given a stream of savings across a lifetime, the lower the financial aid tax rate perceived by the family, the lower the preference for consumption smoothing (e.g., the lower the elasticity) must be to justify that given level of savings.

These numbers fall within the range seen in the literature. While Hall [1988] and Campbell and Mankiw [1989] find an aggregate elasticity of intertemporal substitution indistinguishable from 0, more recent work from Beaudry and van Wincoop [1996] and Ogaki and Reinhart [1998] place the number as significantly greater than zero but less than one.

Our estimates for the median of the taste for education parameter (α) range from .01 under the all-need-met tax perception to .05 under the no-tax perception. The all-need-met perception implies a lower taste for college than the other two perceptions because its implicit subsidy for college (dAid/dCost) is much higher.[12] Given an observed college choice, an increase in the subsidy implies a lower taste for college to remain at that choice.

6   Alternative Financial Aid Scenarios

Each of the alternative scenarios that we consider can be characterized by a financial aid function. We start by defining these functions for each of the alternatives, and then we present the general solution methods for the simulations.

6.1   Scenario #1. The Base Case: 1995-1996 financial aid system

The base case financial aid function is defined to follow the actual patterns of aid distribution in 1995-1996. This scenario serves as a starting point against which the alternative scenarios can be compared.

Exactly as Dick and Edlin [1997] did for 1986-87, here we characterize the 1995-1996 financial aid tax function by forming an OLS estimate for

$$
\begin{aligned}
Aid_j = \beta_0 &+ \beta_1 EFC_j + \beta_2 Cost_j + \beta_3 EFC_j * Cost_j + \qquad (11)\\
&\beta_4 EFC_j^2 + \beta_5 Cost_j^2 + \beta_6 EFC_j^2 * Cost_j + \\
&\beta_7 EFC_j * Cost_j^2 + \beta_8 EFC_j^3 + \beta_9 Cost_j^3 + \phi X_j + \varepsilon_j,
\end{aligned}
$$

where Aid_j represents the value of aid awarded to family j, ϕ is a vector of parameters, X_j is a matrix of covariates that includes parental assets, parental income, a student's race, residence, ethnicity and sex, and ε_j is an unobserved idiosyncratic aid term. See Dick and Edlin [1997] for a more detailed explanation of this methodology. We estimate distinct aid functions for both public and private schools.

---

[12] We assume that 1/2 of the aid is grants and the remaining 1/2 is loans, which is the actual ratio of grants to loans for our sample in 1995-1996. Since we value loans at 50 cents on the dollar, this means that the quality subsidy is .75 in this scenario.

Table 2 gives our results. Our estimates suggest that implicit taxes were similar in magnitude to the Dick-Edlin tax estimates for 1986-1987 (also shown in Table 2), although the shapes of the tax functions differ somewhat. From these estimates, we calculate that the mean subsidy for educational quality increased dramatically from 20% in 1986-87 to 43% in 1995-96. Put differently, the extra financial aid given at high-cost schools increased dramatically over that decade. This change is one of the more striking in the distribution of aid.

6.2   Scenario #2.   No financial aid

This scenario assumes no financial aid, and hence no implicit taxes on assets nor subsidies to school quality. Comparing this scenario with scenario #1 tells us how much the current financial aid system will ultimately reduce savings (once everyone understands the system and reacts fully to it). It also suggests the extent to which the current system has promoted high quality post-secondary education.

6.3   Scenario #3.   Full need met

Under this scenario, we assume that all need determined by the 1995-1996 federal financial aid formulas is met with aid. Thus, financial aid determinations are based entirely on EFC and school costs, and the financial aid taxes and quality subsidies are determined directly from the EFC formula. We assume that 1/2 of the aid is grants and the remaining 1/2 is loans, which is the actual ratio of grants to loans for our sample in 1995-1996. Since we value loans at 50 cents on the dollar following McPherson and Shapiro [1991], this means that the quality subsidy is .75 in this scenario.

6.4   Scenario #4.   1995-1996 financial aid system with target assets

This scenario explores one way of eliminating the implicit asset tax that maintains many of the features of the current system. We substitute a "target" asset level for a family's actual asset level in aid calculations. This target-asset level, based on observed income, age, and number of children, eliminates the implicit asset tax and the resulting distortion of savings behavior. We construct a target-asset (T_ASSET) level by regressing observed assets on a full third order Taylor series expansion in income, number of children, and the age of family head at time of college entrance. To the extent that a family's actual assets are lower (respectively, higher) than target assets, this change will raise (respectively lower) the family's EFC. Aid is otherwise given by equation (11). This scenario eliminates the implicit tax on assets.

6.5   Scenario #5.   1986-1987 financial aid system

In this scenario, the financial aid function is the one that Dick and Edlin [1997] estimated for 1986-87. This scenario allows us to gauge the long run effects of changes in the financial aid system that have occurred between 1986 and 1995. It is well to keep in mind that these changes result from a complex interaction of changes in federal and institutional policy that we do not attempt to disentangle.

7   Simulation Methodology

We simulate optimal consumption/savings profiles and college choices under each of the above scenarios (i.e. alternative financial aid systems) and for each of the three preferences estimated in the previous section. Each scenario described above defines an aid function, $Aid_t(A_{t-1}, Y_{t-1}, Cost_t)$, for each policy.

We have estimated preference parameters under the assumption that perceptions might differ from the actual aid system. Here, however, we are interested in the long run steady-state effects of each potential aid system. Hence, here we assume that families optimize with full knowledge of the aid they will receive and of the effect of their choices on that aid. The implicit idea is that families will ultimately come to roughly understand the workings of the financial aid system, or anyway that systematic errors in perception will disappear over time. We assume that families who choose public schools continue to choose public schools under alternative aid policies, and likewise with private schools, and that aid policies do not affect the decision to attend college or the timing of college attendance. Finally, we assume that capital markets place no borrowing constraints on families.

Given values of $i, \pi, \{Y_t\}, \rho, \gamma,$ and α, we calculate the family's optimal choices of $\{C_t\}$ and $Cost_s$. The nonlinearities and kinks in the budget constraint created by the financial aid functions make it impossible to solve in closed form for the households' optimal choices. Convergence difficulties also prevent us from using a full first-order approach. In order to find the optimal choices for a family, we use a 2-step optimization approach. We first define the value function:

$$V(\tilde{Cost}_s, \tilde{A}_{s-1}) = \max_{\{C_t\}_{t=0}^T, \{A_t\}_{t=0}^T} U(C_1, ..., C_T, \tilde{Cost}_s)$$

$$s.t. \;\; A_{s-1} = \tilde{A}_{s-1},$$

$$A_0 = 0$$

$$A_T = 0,$$

$$A_t = \frac{1}{1+\pi} A_{t-1}(1 + i(1 - \tau^s - \tau^f)) + Y_t - C_t +$$

$Aid_t(A_{t-1}, Y_{t-1}, Cost_t, X) - Cost_t$ for $t = 1, ...T.$

and then use a combined grid search and generalized Newton's method to maximize $V(\cdot)$ over possible values for school quality $\tilde{Cost}_s$ and asset level at the

time of college entrance, $\tilde{A}_{s-1}$.[13]

Evaluating $V(\cdot)$ is fairly straightforward for any given family. We use eq. (7) to solve for a pre-college consumption stream that optimally smooths pre-college consumption consistent with accumulating the college asset level $\tilde{A}_{s-1}$. The cost of the school, the college asset level, and the family's income and other characteristics yield the financial aid award given a particular aid scenario. This determines the resources for college and post-college consumption and eq. (7) yields a unique post-college consumption smoothing path that exhausts these resources.

Using the procedure outlined above, we simulate savings profiles and college choices under each of these alternative aid policies, using the three different estimates of γ_j and α_j for each family j, as described in Section 5. We consider an economy comprised of the sequence of cohorts with preferences and income that are jointly distributed just as those in the NPSAS 1986-87 data, thus covering all stages in the life-cycle. Appropriate weights for projecting our sample into an entire cohort are given in the NPSAS data.

8 Simulation Results

We have simulation results for three different sets of family preferences. To begin, however, we will restrict our discussion to the simulations that use the preferences that we derived under the assumption that the sampled families in 1986-87 optimized with full knowledge of the financial aid taxes and subsidies as estimated by Dick and Edlin [1997].

All of our estimates are long run steady-state estimates; they assume that all families have had time to learn and react to the alternative financial aid system. In our steady state simulation, families anticipate that their children will attend college, and know the financial aid system that they will face. Each family j chooses its child's college as well as its pre-college, post-college, and during-college consumption to maximize utility subject to its budget constraint. We consider 60 cohorts, aged 25-85 each with the same joint distribution of earnings, preferences, and family characteristics as those in the 1986-87 NPSAS data.[14] At any given time in the steady state there are young cohorts that will eventually be sending children to college, older ones that have already done so, and middle aged cohorts doing so. Our estimates of per-family asset accumulation average across these generations, since families of all ages are always present at any

---

[13] We use starting values of 1,000 and 28,000, the highest and lowest cost in our sample, in addition to the actual cost for that family. We check to ensure that we are not identifying local optima by modifying the initial grid. In only a handful of cases does this modification lead to different optima so we are confident that we have successfully maximized utility for almost all families in our sample.

[14] Effects of changes in the distribution of characteristics of families receiving financial aid since 1986-87 are therefore not captured by our analysis. As shown in Table 1, however, the distribution of these characteristics remained relatively stable over the 86-87 to 95-96 period, with the exception of a large drop in reported assets induced mainly by the exclusion of home equity from the 95-96 data.

given time.

One might object to this approach because parents of young children or couples that do not yet have children cannot know for certain that they will someday face the financial aid tax; they do not know that they will have children, nor that their children will attend college, nor that they will have financial need when they do. In short, they don't know they will become the types of families in our sample. This observation only means, though, that there may be 1.5 or 2 or 3 families for each family in our sample, each of whom faces a 2/3 or 1/2 or 1/3 chance of paying the financial aid tax observed in our sample. Such a random tax could have a somewhat higher or a somewhat lower effect on total asset accumulation and other decisions than a certain tax, but a rough estimate of aggregate effects would be found from our simulations. If we departed from the perfect foresight assumption, the per-family effects would be lower than we estimate, but the effects of the tax would be on a correspondingly larger population than we estimate, and our estimates represent a good guess of the aggregate effects. It is well beyond the scope of this paper to attempt to gauge the likelihood that a family places on being exposed to the tax at each stage in the lifecycle, so we take the simplified approach of assuming perfect foresight. Our per-family estimates or behavioral effects should consequently be biased high somewhat, while our aggregate estimates should be roughly accurate.

Since we assume in all scenarios that each family's income stream is exogenous, shifts in labor supply that might be expected to occur as a result of policies (like our target asset scenario) that shift taxation to income and away from savings are not captured by our simulation methodology. Future research might do so.

8.1   Families' Steady-state Assets

We estimate that under scenario #1 (the 1995-96 system) average asset holdings are $52,640 per family. That is, once the whole population has time to adjust to the financial aid system in 1995-96, we predict assets will be $52,640 per family. This figure is an average over families at all stages in the lifecycle of our model, as explained above. Table 3 shows, for each of the alternative financial aid scenarios, the long-run estimates of the change in assets held by families that send children to college. They range from a mean increase of $5,370 per family (10.2% increase) with the target-assets financial aid system, to a mean reduction of $1,928 per family (3.7% decrease) under the full need met system. Elimination of the financial aid system would result in a mean increase of $3,856 per family (7.4% increase).

A return to the 1986-1987 financial aid system would result in an increase in long-run assets of $275 per family (a 0.4% increase). Thus, our simulations suggest that the combination of changes to the financial aid system from between the year 1986 and the year 1995 will reduce total long-run savings by families.[15]

---

[15]Two major changes in the federal EFC methodology were implemented in 1992: elimination of home equity from the formula and increased protection of assets for low-asset and low-income families. See Long [2003] for a discussion.

Adopting the target-assets system would increase the asset accumulation of the families throughout the life-cycle who have sent children to college, are sending children to college, or will someday send children to college, and receive financial aid. According to the weights in the NPSAS survey, in a steady-state economy simulated from 1985, the target-assets system would increase the total asset holdings of these families by $250 billion. By way of comparison, the total long run assets held by these families we estimate to be $2.5 trillion. Total U.S. 1985 Household and Nonprofit Sector Net Worth was much larger – $19.1 trillion in 1994 dollars. Financial aid applicants are poorer than other college matriculants, and college attenders remain a minority of the population.

Our simulations predict much smaller behavioral effects per affected family than are suggested by Feldstein's regression results. Feldstein studied households with household heads aged 40-50, children under 18, and no children in college. These families held $24,000 in assets and from their behavior he predicted that absent the tax they would have held $36,000 – an increase of 50%. We estimate the increase in per-family assets (for families with children in college) when going from the full-need-met scenario to the no financial aid scenario to be 29%. The difference between our estimate and Feldstein's, though, is starker than this comparison suggests. The population Feldstein studies does not know that their children will attend college, nor that they will have financial need if they do. In short, most of the people in his sample will face no tax, yet his regression argues that the average reaction is still substantially larger than our simulation methodology predicts for a population that faces the tax with certainty. Hence, his implied behavioral elasticities could be several times as large as ours. Long [2003], on the other hand, adopting a reduced-form approach similar to that of Feldstein but correcting many of the problems with Feldstein's implementation, finds that the financial aid system has little discernible effect on asset accumulation. Such a result is not necessarily inconsistent with our work, since we are agnostic about whether families currently perceive financial aid taxes accurately and act accordingly, and estimate our effects under several assumptions about families' current perceptions. We do assume, however, that families in the long run will correctly perceive these taxes on assets and will act accordingly.

One might argue that Long's results also demonstrate the ability of many families to relatively costlessly shift assets into asset types not taxed by the federal financial aid methodology. However, the largest category of these "protected" assets, home equity, was not protected in 1990, the date of Long's SIPP data. Other notable categories of protected assets, such as retirement accounts, cars, and furniture, are not included in Long's asset measure, and thus assets shifted into these protected savings vehicles would appear as a reduction in savings in Long's data. In any case, the ability of families to protect their savings by shifting it into particular protected categories is limited by the requirement of many colleges that applicants complete the PROFILE financial aid application used for calculating EFC via the College Board's Institutional Methodology. The PROFILE application delves deeper into parents assets than the federal financial aid form (FAFSA) and does not exclude home equity from EFC.

8.2   Financial Aid Award Effects

Table 4 shows the mean simulated financial aid award under each of the alternative financial aid systems. Under the base case, the mean award is $5,724. Aid awards increase by 15.9% under the target-asset system, and 115% under the full-need-met system. A return to the 1986-1987 system would result in a reduction of more than 17% in mean aid awards.

To put these numbers into perspective, total financial aid award outlays per year would increase by nearly $14 billion under the full-need-met system. The target-asset system would result in increases of almost $1.9 billion in annual aid awards, while returning to the 1986-87 system would result in a reduction of more than $2 billion in total financial aid awards. Obviously, then, the alternative systems are not revenue neutral. The additional costs due to increases in aid awards would be borne by government and private financial aid sources.

Assuming that the differences in college costs represent the actual differences in the production costs at these colleges, the total change in economy-wide asset holdings, including family asset holdings, institutional endowments, and government debt, can be found by summing changes in family asset holdings and the capitalized value of decreased financial aid awards. Capitalizing financial aid awards at the 3% real rate of interest assumed in our simulations, we arrive at the changes in total economy-wide asset holdings given in Table 4. These figures should be taken with an appropriate dose of skepticism since they assume that institutional or governmental dissavings or savings induce no Ricardian adjustment by taxpayers or donors. Nevertheless, we estimate that economy-wide asset holdings would increase by $578 billion if the financial aid system were eliminated, by $186 billion under the target-asset system, and by $78 billion if we returned to the 1986-87 system. Extending aid to meet all need would reduce economy-wide assets by $549 billion.

8.3   College Quality

Using school cost as a measure for school quality, our simulations suggest that the financial aid system leads families to choose higher quality post-secondary education. As shown in Table 5, we estimate that the elimination of the financial aid system would reduce the mean quality of post-secondary education, among families with need, by 26%, because families would choose to attend cheaper schools. Conversely, we estimate that, if all need were met under the current system, quality would increase by 38%. The target-assets systems would increase quality by roughly 5%, and returning to the 1986-1987 system would reduce quality by 17%.[16]

The changes in the choice of quality under the alternative systems result primarily from changes in the financial aid subsidy, the additional aid awarded

---

[16]We assume throughout that the sticker price of a college of a given quality is fixed regardless of the financial aid regime in place. Realistically, changes in financial aid policies would likely induce changes in the the price of college for a given unit of quality. An increase in educational subsidies would thus likely induce additional distortions not captured by our analysis.

as a result of an increase in cost. The mean subsidy increases only slightly for the target-assets scenario, (from 42% to 49%), but it increases dramatically for the full-need-met scenario (83%). The mean subsidy under the 1986-1987 system was only about 20%. The change in the subsidy rate between 1986-1987 and 1995-1996 is one of the more striking changes in the distribution of financial aid over that time period.

8.4 Welfare Effects

We measure welfare by calculating the equivalent variation of moving from the status quo to one of the alternative aid policies. The consumption profile under the old intertemporal price ratios is shifted until the new utility level is reached, then deflated to calculate a dollar value in 1994 dollars.

Altering the financial aid system induces three changes that can affect a family's welfare: a change in the amount of college consumed, a change in the net cost of college, and a change in the asset tax which induces changes in the pattern of non-college consumption over time. The value of these changes can be measured by calculating an equivalent variation for each family. Average family EV under each of the five alternatives are shown in the left column of Table 6. These range from a loss of $27,071 over six years under the no financial aid scenario to a gain of $20,476 under the full-need-met scenario.

Because the adoption of the alternative financial aid systems would result in large changes in financial aid awards, they are not revenue-neutral. Thus, each system will also affect social welfare through changes in financial aid spending. Table 6 shows the mean social gain/loss per family with financial need and a child in college. The mean social gain/loss is the sum of the mean EV and the mean change in financial aid. This total per family welfare impact ranges from -$19,155 per family under the full-need-met scenario to $7,271 per family under the no financial aid scenario.

Summing these results over all such families, we find the total social gain per year. By this measure, scrapping the financial aid system entirely seems the best of the alternatives, with an annual social gain of $5.6 billion, while greatly expanding the current aid system by meeting need fully is the worst, with a net welfare loss of nearly $14.8 billion. The scenario that removes the distortionary asset tax, the target-assets scenario, yields a mild social loss, as the positive impact of removing distortionary taxes is outweighed by the negative impact of disbursing additional financial aid that is not fully valued by families.

These results may be disturbing to those who support public funding of higher education on fairness grounds, or because they believe there are significant positive externalities to higher education. Indeed, our calculations assume that the benefits of education are purely private and thus completely captured by a family's EV. To the extent that the private benefit to families does not capture some public benefits, such as equal access to education, increased tax collections, or other positive externalities from education, the numbers in Table 6 understate the value of the full-need-met and the target-assets scenarios, and overstate the value of the no financial aid and the 86-87 aid function scenarios.

Such effects could be substantial and could in principal swamp those for which we account.

8.5   The Role of Families' Perceptions

In the results described above, we estimated the structural parameters under the assumption that families accurately perceive the financial aid taxes and subsidies. While this seems reasonable, it is far from certain, given the conflicting advice of financial aid "experts." Families may not recognize that they are penalized by saving, or they may conclude that the actual taxes can be found directly in the college financial aid formulas. Either way, our estimates of the structural parameters would be wrong, and thus our estimates of the savings effects, college choice effects, and welfare effects would be wrong.

To quantify the sensitivity of our results to our preference assumption, we re-estimate the structural preference parameters and recalculate the simulations under two extreme assumptions about the perceptions of families in the 1986-87 sample that led them to choose the asset accumulation and college choice observed: (1) they assumed that there were no financial aid taxes and (2) they assumed that taxes could be calculated from the financial aid formulas – as if all need were met. Assumption 1 implies that the median γ we estimate is 3.77 compared with a median of 4.36 that we previously estimated. Assumption 2 implies that the median γ we estimate is 5.06.

The results change only slightly when we run the simulations with perceptions that the financial aid taxes are zero (the low $\gamma's$). The increase in savings relative to the status quo is slightly higher under each of the scenarios and changes in aid awards are slightly increased. The results change much more, however, when we run the simulations with the full-need-met perceptions (the high $\gamma's$) . In that case, families have higher propensities to save to smooth consumption, and their savings decisions are less affected by changes in the asset taxes. As a result, the increase in savings relative to the status quo is considerably less (typically about 50%) under each of the scenarios. Similarly, the changes in aid awards are considerably smaller (typically about 50%) under each of the scenarios.

9   Discussion

The implicit taxes from college financial aid may lower household assets by roughly \$5,000 per family affected in our sample, which would amount to \$250 billion economywide. This savings effect represents a substantial inefficiency, one that alternative policies might correct. However, the largest effects of most practical changes in financial aid policy are likely to be from changes in school choice. Our estimates of total welfare changes under various policies make this clear. For example, our target asset scenario, which is not designed to affect school choice, nonetheless leads to a 5% increase in school cost (which could already be inefficiently high because of the cost subsidy). For this reason, even

though this scenario increased asset accumulation by eliminating an inefficient tax on assets, the target asset scenario has net lower welfare than the 1995-6 financial aid distribution.

We are not confident, however, that our estimates of overall welfare are reliable, because our model contains no market failures that create a reason for financial aid in the first place. Hence, elimination of financial aid appears to be the most attractive alternative in our study; this result may be illusory and should only convince those who previously saw no reason for aid. In addition to this failing, we must also concede that our methodology, though intricate, must be regarded as a rough cut. In particular, it contains no mechanism for colleges to change their sticker prices in response to alternative financial aid policies, nor does it allow for any labor supply response to changes in the financial aid system. We leave more realistic refinements to future work and to others.

Our paper emphasizes two basic points: first, that the asset reductions from financial aid policies could be or could become substantial, and second that any changes in financial aid policy should be made only with the understanding that the attainment of other financial aid goals (principally access and school choice) could be meaningfully affected by changes in financial aid policy in subtle ways.

References

[1] Auerbach, Alan, Laurence J. Kotlikoff, and Jonathan Skinner, 1983, "The Efficiency Gains from Dynamic Tax Reform," *International Economic Review,* Vol. 24, No. 1, 81-100.

[2] Beaudry, Paul and Eric van Wincoop, 1996, "The Intertemporal Elasticity of Substitution: An Exploration Using a US Panel of State Data," *Economica*, 63(251), 495-512.

[3] Bernheim, Douglas B., 1997, "Rethinking Saving Incentives," in Alan Auerbach, ed., *Fiscal Policy: Lessons from Economic Research*, Cambridge: MIT Press.

[4] Blinder, Alan S., 1975, "Distribution Effects and the Aggregate Consumption Function," *Journal of Political Economy*, 83, 447-475.

[5] Boskin, Michael J., 1978, "Taxation, Saving, and the Rate of Interest," *Journal of Political Economy*, 86, S3-S27.

[6] Campbell, John and Gregory Mankiw, 1989, "Consumption, Income, and Interest rates: Reinterpreting the Time Series Evidence," in O. Blanchard and S. Fischer (eds), *NBER Macroeconomics Annual 1989* Cambridge: MIT Press

[7] Case, Karl E. and Michael S. McPherson, 1986, "Student Aid Incentives and Parental Effort: The Impact of Need-Based Aid on Saving and Labor Supply," Technical report prepared for the Washington Office of the College Entrance Examination Board.

[8] Dick, Andrew W., and Aaron S. Edlin, 1997, "The Implicit Taxes From College Financial Aid," *The Journal of Public Economics*, 65, 295-322.

[9] Edlin, Aaron S., 1992, "Financing Higher Education: Inequitable and Inefficient? The Worst of All Possible Worlds," CEPR working paper, Stanford University.

[10] Edlin, Aaron, S., 1993, "Is College Financial Aid Equitable and Efficient?" *Journal of Economic Perspectives*, Spring, 7(2), 143-158.

[11] Evans, Owen J., 1983, "Tax Policy, the Interest Elasticity of Saving, and Capital Accumulation: Numerical Analysis of Theoretical Models," *American Economic Review,* June 73(3), 398-410.

[12] Feldstein, Martin, 1995, "College Scholarship Rules and Private Saving," *American Economic Review,* June, 85(3), 552-566.

[13] Hall, Robert E., 1988, "Intertemporal Substitution in Consumption," *Journal of Political Economy*, 96(2), 339-357.

[14] Kim Taejong, 1996, "Implicit Taxes in College Financial Aid and Family Saving," Unpublished Manuscript, York University and Massachusetts Institute of Technology.

[15] Long, Mark, 2003, "The Impact of Asset-Tested College Financial Aid on Household Savings," forthcoming, *The Journal of Public Economics.*

[16] McPherson, Michael S. and Morton O. Shapiro, 1991, *Keeping College Affordable,* Washington, DC: Brookings Institution.

[17] Ogaki, Masao and Carmen M. Reinhart, 1998, "Measuring Intertemporal Substitution: The Role of Durable Goods," *Journal of Political Economy*, 106(5), 1078-98.

[18] Sandmo, Agnar, 1985, "The Effects of Taxation on Savings and Risk Taking," in Alan Auerbach and Martin Feldstein, eds., *Handbook of Public Economics*, vol. I, Amsterdam: North Holland.

[19] Skinner, Jonathan, and Daniel Feenberg, 1989, "The Impact of the 1986 Tax Reform on Personal Saving," in Joel Slemrod, ed., *Do Taxes Matter? The effect of the 1986 Tax Reform Act on the U.S. Economy,*" Cambridge: MIT Press.

[20] Summers, Larry, 1981, "Capital Taxation and Accumulation in a Life Cycle Growth Model," *American Economic Review,* September, 71(4), 533-544.

[21] Summers Larry, 1983, "The After-Tax Rate of Return Affects Private Savings," *American Economic Review Papers and Proceedings,* 74, 249-253.

[22] U.S. Department of Commerce, Bureau of the Census, 1995, *Statistical Abstract of the United States 1995*. Washington, DC: U.S. Department of Commerce.

[23] Welch, Finis, 1979, "Effects of Cohort Size on Earnings: The Baby Boom Babies' Financial Bust," *Journal of Political Economy*, Vol. 87, No. 5, S65-97.

Table 1: NPSAS 1995-1996 and 1986-1987 Summary Statistics, Freshmen Only (1994 dollars)

	Private Institutions				Public Institutions			
	1995-1996 Sample		1986-1987 Sample		1995-1996 Sample		1986-1987 Sample	
	No. Obs. = 2189		No. Obs. = 1323		No. Obs. = 2434		No. Obs. = 670	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Expected Family Contribution (EFC)	$5,314	$5,518	$5,017	$4,229	$3,146	$3,379	$2,624	$2,125
Total Cost	$18,835	$6,257	$14,460	$5,588	$10,349	$3,206	$6,969	$3,337
Need	$13,522	$6,742	$9,442	$5,715	$7,203	$3,715	$4,344	$3,069
Financial Aid	$8,651	$5,626	$7,003	$4,534	$3,944	$2,867	$3,162	$2,122
Income	$46,118	$27,735	$42,415	$23,431	$36,147	$21,999	$30,749	$18,051
Total Parental Assets	$21,370	$60,371	$68,437	$74,450	$11,797	$31,205	$45,260	$53,868
Money Assets	$4,381	$12,157	$7,164	$18,662	$2,991	$8,160	$3,507	$8,756
Home Equity			$47,619	$47,972			$32,990	$39,097
Male Student	0.44	0.50	0.46	0.50	0.43	0.50	0.44	0.50
Asian	0.07	0.25	0.05	0.21	0.09	0.29	0.05	0.23
Black	0.13	0.34	0.10	0.30	0.16	0.36	0.15	0.36
Hispanic	0.11	0.31	0.04	0.20	0.11	0.32	0.07	0.25
White	0.69	0.46	0.80	0.40	0.63	0.48	0.72	0.45

Table 2: Financial Aid Function: Parameter Estimates for Public and Private Schools

Figures in Dollars	1995/6				1986/7			
	Private Schools		Public Schools		Private Schools		Public Schools	
	Parameter	St. Err.	Parameter	St. Err.	Parameter	St. Err.	Parameter	St. Err.
Intercept	1.00E+03	9.01E+02	1.16E+03	3.48E+02	6.67E+03	5.67E+02	3.31E+03	1.95E+02
EFC	4.83E-01	2.16E-01	-2.86E-01	8.95E-02	-7.78E-02	1.75E-01	-8.27E-01	1.55E-01
Cost	5.29E-02	2.13E-01	2.54E-01	9.23E-02	-6.70E-01	1.45E-01	2.31E-01	4.49E-02
EFC*Cost	-1.20E-04	2.85E-05	-1.21E-04	1.97E-05	-8.94E-05	2.56E-05	-1.69E-05	1.23E-05
EFC^2	3.35E-05	1.53E-05	1.40E-04	1.50E-05	6.45E-05	2.09E-05	1.59E-04	3.99E-05
Cost^2	5.61E-05	1.65E-05	2.96E-05	8.26E-06	1.08E-04	1.26E-05	-6.91E-06	3.37E-06
EFC^2*Cost	1.19E-09	1.02E-09	-5.00E-10	2.09E-09	-2.94E-09	1.28E-09		
EFC*Cost^2	2.11E-09	1.00E-09	3.51E-09	1.34E-09	3.47E-09	1.14E-09		
EFC^3	-1.27E-09	5.71E-10	-5.92E-09	1.51E-09			-8.07E-09	2.78E-09
Cost^3	-1.38E-09	4.03E-10	-6.41E-10	2.73E-10	-3.18E-09	3.53E-10		
Assets	-5.49E-03	9.74E-04	-6.38E-03	1.12E-03	-6.29E-03	9.09E-04	-4.54E-03	8.59E-04
Income	-9.29E-04	4.39E-03	-3.33E-03	2.86E-03	-2.26E-02	4.51E-03	-2.39E-02	4.00E-03
Male	5.78E+01	9.57E+01	3.15E+01	4.90E+01	9.23E+01	9.54E+01	-6.57E+01	6.40E+01
Race								
Native American	-1.89E+02	7.19E+02	2.47E+02	2.52E+02	5.30E+00	6.30E+02	5.37E+02	4.29E+02
Asian	-5.59E+02	1.82E+02	8.79E+01	9.31E+01	5.67E+02	2.35E+02	4.48E+02	1.58E+02
African American	4.18E+02	1.68E+02	9.97E+01	7.46E+01	1.55E+02	1.71E+02	-1.04E+02	8.87E+01
Hispanic	5.04E+02	1.96E+02	3.48E+01	8.85E+01	4.55E+02	2.32E+02	3.42E+02	1.32E+02
Residence								
Off Campus	-8.42E+02	1.43E+02	-3.43E+02	5.93E+01	-6.14E+02	1.56E+02	1.51E+02	7.96E+01
Parents	-9.97E+02	1.44E+02	-5.91E+02	7.06E+01	-9.57E+02	1.31E+02	-6.69E+02	8.44E+01
H.S. Degree								
GED	-3.03E+02	3.97E+02	2.21E+02	3.07E+02	7.48E+02	7.45E+02	-6.75E+02	3.59E+02
Certificate	1.20E+03	2.09E+03	-2.03E+03	1.50E+03	-4.66E+02	6.31E+02	-2.95E+02	2.58E+02
No	-5.27E+02	1.12E+03	1.58E+03	1.06E+03	5.56E+02	5.82E+02	-1.18E+02	3.72E+02

Table 3: Simulated Changes to Steady-State Household Asset Stock

	Change in Accumulated Savings (1994 dollars)		
	Increase Per Family		Total U.S. Increase
	(Thousands)	% Increase	(Billions)
1995/6 Aid Function	$0	0.0%	$0
No Financial Aid	$3,856	7.4%	$180
Target Assets	$5,370	10.2%	$250
Full Need Met	-$1,928	-3.7%	-$90
1986/7 Aid Function	$275	0.4%	$10

Table 4: Simulated Financial Aid Awards (1994 dollars)

	Mean Family Aid	% Change	Increase in Total Aid Per Year (Millions)	Capitalized Increase in Aid at 3% interest (Billions)	Total Economy-Wide Increase in Asset Stock (Billions)
1995/6 Aid Function	$5,724	0.0%	$0	$0	$0
No Financial Aid	$0	-100.0%	-$11,932	-$398	$578
Target Assets	$6,634	15.9%	$1,898	$63	$186
Full Need Met	$12,329	115.4%	$13,770	$459	-$549
1986/7 Aid Function	$4,745	-17.1%	-$2,041	-$68	$78

Table 5: Simulated College Costs (1994 dollars)

	Mean College Cost per Family	% Increase From Status Quo
1995/6 Aid Function	$12,925	0%
No Financial Aid	$9,608	-26%
Target Assets	$13,555	5%
Full Need Met	$17,838	38%
1986/7 Aid Function	$10,695	-17%

Table 6: Simulated Welfare Effects (1994 dollars)

	Mean Family EV	Six Year Increase in Mean Family Aid	Mean Social Gain Per Family	Total Social Gain Per Year (Millions)
1995/6 Aid Function	$0	$0	$0	$0
No Financial Aid	-$27,071	-$34,342	$7,271	$5,610
Target Assets	$3,607	$5,462	-$1,855	-$1,431
Full Need Met	$20,476	$39,631	-$19,155	-$14,780
1986/7 Aid Function	-$331	-$5,873	$5,542	$4,276