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AUTHOR Horch, Dwight H.
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ABSTRACT

Educational loan limits for graduate and professional students were estimated to provide manageable repayments that were a proportion of the borrowers' future consumption budget data. Based on each professional group's income profile, loan repayments were computed for each year of repayment and summed across alternative repayment periods to arrive at the aggregate ability to repay during the repayment period. Manageable aggregate ability to repay for each graduate and professional group was then converted into manageable loan principal limits for loans with alternative interest rates, amortization periods, and repayment plans (equal installment and graduate repayment option). The simulated manageable educational debt levels were intended to illustrate the relationship between the hypothetical prospective income of selected professional groups and their theoretical ability to repay educational loans. Borrowers may want to elect a graduated repayment option and to extend the repayment period from 10 to 15 years if their total educational indebtedness exceeds a threshold amount. Separate borrowing limits and graduated repayment option plans could be established under the Guaranteed Student Loan Program for borrowers in different professions. Simulated loan principal limits were run for the following groups: males with five or more years of college, law students, medical students, and doctoral scientists and engineers. Eleven tables and formulas for estimating loan repayments are included. (SW)

ESTIMATING MANAGEABLE EDUCATIONAL LOAN LIMITS FOR GRADUATE AND PROFESSIONAL STUDENTS

DWIGHT H. HORCH

March 1978

EDUCATIONAL TESTING SERVICE • PRINCETON, NJ 08541

Estimating Manageable Educational Loan Limits for Graduate and Professional Students

Dwight H. Horch
Program Director
Graduate and Professional School
Financial Aid Service

March 1978

Educational Testing Service, Princeton, New Jersey

ABSTRACT OF
ESTIMATING MANAGEABLE EDUCATIONAL LOAN LIMITS FOR GRADUATE AND PROFESSIONAL STUDENTS

Author: Dwight H. Horch, Educational Testing Service, Princeton, New Jersey

The main purpose of this study was to estimate educational loan limits for graduate and professional students, which would result in a theoretically manageable, or comfortable, repayment stream.

Manageable repayments were defined as a proportion of borrowers' future incomes. The proportion of income which could be comfortably devoted to paying off educational loans was estimated, from Bureau of Labor Statistics (BLS) cosumption budget data, to range from 5.4 percent of after-tax income at the BLS lower budget standard, to about 6.5 percent at the BLS intermediate standard, and to almost 12 percent of after-tax income at twice the BLS higher budget standard.

Repayment formulas were derived from BLS consumption budget data, and were applied to projected future income profiles for samplings of lawyers, physicians, doctoral scientists and engineers, and generally for males with five or more years of education beyond high school. Based on each group's income profile, manageable educational loan repayments were computed for each year of repayment, and summed across alternative repayment periods, to arrive at the aggregate ability to repay during the pay-back period.

Manageable aggregate ability to repay for each graduate and professional group was then converted into manageable loan principal limits, for loans with alternative interest rates, amortization periods, and repayment plans -- equal installment and Graduated Repayment Option (GRO).

Based on Bureau of the Census profiles of average (mean) income by age for males with 5 or more years of education beyond high school, the manageable educational loan limit for a 7 percent Guaranteed Student Loan (GSL) repayable in equal installments over 10 years was estimated to be $7,100. Scaling repayments to income, and extending the repayment period to 15 years increased the estimated manageable GSL limit to between $16,000 and $18,900, if the future inflation is between 3 percent and 6 percent annually.

Because of differences in earnings prospects for the selected professions included in this study, manageable educational loan limits differed by profession for repayment plans graduated to prospective income. This finding implies that many heavily indebted borrowers entering the professions may be better served by Graduated Repayment Option (GRO) plans, because of the young professionals' relatively modest starting salaries and because of the comparatively rapid rise in their income generally anticipated during the latter years of repayment.

The study draws upon income profile data that were readily available from previous studies by other researchers. As a result, the simulated manageable educational debt levels are intended to illustrate the relationship between the hypothetical prospective income of selected professional groups and their theoretical ability to repay educational loans.

Several implications of the study are discussed. First, consideration should be given to allowing borrowers to elect a Graduated Repayment Option (GRO) and to extend the repayment period from 10 to 15 years if their total educational indebtedness exceeds a threshold amount. The study also suggests that separate borrowing limits and Graduated Repayment Option (GRO) plans could be established under the Guaranteed Student Loan Program for borrowers in different professions.

While loans are seen as an important instrument for financing graduate and professional education, the author suggests the importance of avoiding excessive reliance on loans at the graduate and professional level to the exclusion of financial aid programs designed to foster equal access, intellectual excellence, and experiential work-study learning opportunities.

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Introduction

Educational loan programs have become a major instrument over the past two decades for financing postsecondary educational costs. In retrospect, the initial appropriation of $60 million in fiscal year 1959 for the National Direct Student Loan Program, the only federal loan program in its time, seems trifling in contrast to current borrowing levels, which approached $1.85 billion for the myriad of federal loan programs in fiscal year 1976.

Loan programs have evolved over the years in response to increasing costs at both the undergraduate and post-baccalaureate levels and to perceived societal needs and political pressures. The National Defense Student Loan Program (NDSL), for example, was created in the post-sputnik era to accelerate postsecondary training. The Guaranteed Student Loan (GSL) Program, on the other hand, was enacted to ease the financial burden of college costs on middle income families, as an alternative to tax credits. Other loan programs on the financial aid landscape include the Nursing Loan Program, the V.A. Educational Loan Program, and the Health Education Assistance Loan (HEAL) Program for prospective physicians.

The importance of loans is underscored by the fact that some $1.3 billion were borrowed in 1976 by students through the Guaranteed and Federally Insured Loan Programs. On an individual basis it is reflected in average borrowings of students, which can only be expected to increase in the future. A recent survey of 70,000 postbaccalaureate students in the 1977-78 Graduate and Professional School Financial Aid Service population, revealed that almost one-half (47 percent) reported they had borrowed some amount during their undergraduate years. And for those unmarried students who had borrowed, the median cumulative educational debts were as follows:[2]

Year in Graduate/ Professional School	Median Cumulative Educational Debt
First	$ 2,684
Second	$ 3,709
Third	$ 5,458
Fourth	$ 7,899

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[1] John F. Morse., "How We Got Here from There - A Personal Reminiscence of the Early Days" in Student Loans: Problems and Policy Alternatives. College Entrance Examination Board, New York, 1977, p. 13.

[2] D.H. Horch, "Need Analysis at the Graduate and Professional Level: Who Needs It"? Paper prepared for the Student Loan Marketing Association Symposium on Financing Graduate and Professional Education, June 1977, p. 53.

While these debt loads are not particularly alarming, the level of indebtedness may be expected to increase in the future, for a variety of reasons. Hough notes, for example, that the demand for loans, especially by graduate and professional students, is likely to rise, despite projected future enrollment declines.[3]

Hough arrives at this seemingly contradictory conclusion through the following logic chain. As the flow of high school graduates begins to decline, enrollments in institutions of higher education may also be expected to decline. This will create an upward push on tuitions, to the extent that the volume of students declines and the fixed cost base for tenured salaries remains constant.

As costs escalate, pressures toward debt financing will mount at the graduate and professional level in the absence of government intervention in the form of uncategorical grant assistance to institutions or grant assistance to students.

There is a growing concern that increasing debt burdens will create increasingly serious repayment problems for students in the future, and may have unintended pervasive consequences -- such as income maximization behavior of borrowers -- that may conflict with broader social goals. For example, Congress recently enacted the Health Education Assistance Loan Program with a maximum aggregate loan limit of $50,000, an (unsubsidized) 10 to 12 percent interest rate, and a 15 year repayment period. While it can be argued that the income profiles of physicians permit absorption of this level of indebtedness, it can also be hypothesized that heavily indebted physicians may opt for practices in more lucrative nonshortage areas. Another possible consequence of high debt levels for physicians is a further upward push on their professional fees. Similar types of behavorial consequences of borrowing can be hypothesized for other professions, such as law or business.

The growing importance of loans as an instrument for financing graduate and professional study, and the concern over the repayment legacy they entail, suggests the need to develop a methodology for estimating loan limits that are not overly burdensome.

The balance of this paper is devoted to developing alternative definitions of manageable loan limits, and simulating loan limits for borrowers in selected professions. Because of the key role loans are likely to play in the years ahead at the postbaccalaureate level, this study is restricted to estimating manageable loan limits for graduate and professional students.

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[3] Lawrence A. Hough, Introduction to Student Loan Marketing Association Symposium on Developments in Financing Graduate Education.

Manageable Educational Debts

The question of what constitutes a manageable education debt level has been a vexing one, and, as Johnstone points out "there is little on which to base an answer to the question."[4] There seems to be agreement, however, that the relevant measure of the "oppressiveness of a debt is the relation between future payments and future income. At some level, the ratio of annual repayments to annual income becomes burdensome."[5]

Perhaps the most definitive work in the area of tolerable educational debt levels was undertaken by Daniere in the 1960s.[6] Daniere examined consumer expenditure profiles and concluded that families spend about 90 percent of their after-tax income for consumption, leaving a residual of 10 percent. A priori, he concluded it would be unreasonable to expect borrowers to devote all of their residual income for educational debt repayment and suggested that 6 percent of before-tax income, or 7.5 percent of after-tax income, could be devoted to retiring educational debts, without being overly burdensome.

Daniere concluded that a tolerable educational loan would be defined as one entailing annual repayments equal to, or less than 7.5 percent of an individual's after-tax income.

Hartman, following a different reasoning, concluded that up to 15 percent of the typical college graduate's starting income, before taxes, would not be an overly burdensome educational loan repayment, assuming equal annual installments.[7] He based his conclusion on the assumption that during the payback period students might be willing to accept a level of repayments equal to the increase in their earning power resulting from a college education.

Froompkin, in his study of student loans for women,[8] used three tests of repayment burdens to evaluate loan repayment plans:

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[4]Bruce D. Johnstone, New Patterns for College Lending, Columbia University press, New York and London, 1972, p. 106.

[5]Robert W. Hartman, Credit for College, New York: McGraw Hill, 1971, p. 14.

[6]Andre Daniere, "The Benefits and Costs of Alternative Federal Programs of Financial Aid to College Students," in The Economics and Financing of Higher Education in the United States: A Compendium of Papers Submitted to the Joint Economic Committee (Washington, D.C.: U.S. Government Printing Office, 1969), pp. 576-578.

[7]Hartman, op cit, p. 19.

[8]Joseph Froomkin, Study of the Advantages and Disadvantages of Loans to Women, Prepared for the Department of Health, Education, and Welfare, December 1974; Distributed by National Technical Information Service, U.S. Department of Commerce, p. 14.

1. What proportion of a single woman's annual earnings or of the family income of a married woman will be claimed by loans of varied amounts at different maturities?

2. What proportion women will be overburdened by the repayment of loans, where overburden is defined as 6 percent of an unattached single woman's income and 3 percent of the family income of a married woman?

3. What proportion of women are likely to pay for their loans from their own earnings?

Manageable repayment streams, it seems, can be defined in a number of different ways:

- A manageable annual repayment is one that does not exceed 6 percent of the individual's before-tax (or 7.5 percent after-tax) income during the life of the loan (Daniere).

- A manageable annual repayment is one that does not exceed 15 percent of the individual's before-tax starting income (Hartman).

Hartman's definition, which is tied to first-year, starting income, seems especially suited to equal annual repayment installments, because it prohibits educational loan repayments from exceeding a stipulated maximum percentage of income. Tying repayment to a percentage of first year income more or less ensures that the borrower can manage the educational loan installment during the first repayment year. And, in future years, the fixed annual repayment will decline over time as a proportion of income.

Alternatively, the manageable annual repayment may be defined as some fixed proportion of the individual's future annual income during each year of the amortization period. Thus, as the individual's income grows throughout the amortization period, the annual repayments will grow, but the percentage of income devoted to repayments will remain constant.

Another approach to defining what constitutes a manageable debt level is to review Bureau of Labor Statistics (BLS) budget data. Table 1 presents components of the three annual budget standards for an urban family of four in autumn 1976. There is no debt repayment component within the BLS budgets, since they represent budgets required to achieve these alternative living standards, regardless of income.

It should be noted that the BLS standards are benchmarks developed by economists, scientists and technicians from goods and services selected to represent a predefined, specified theoretical level of living. BLS points out that "while most families that do any budgeting at all base their budgets on current or expected income, any budget which is to be used as a benchmark for economic or social measurements must take the opposite approach. It must be built up from a list of goods and services representing a specified level of living. When the cost of these goods and services has been determined, it is then possible to ascertain the amount of income required to cover the budget."[9]

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[9] 3 Standards of Living for an Urban Family of Four, U.S. Department of Labor, Bureau of Labor Statistics, U.S. Department of Labor, Bulletin No. 1570-5, p. 1.

The BLS budget standards do not imply that individual families at specified levels actually allocate their incomes in a manner necessarily consistent with the components of the standards. Thus, to a lesser or greater extent, depending upon the budget component and the standard, families have some discretion in how they spend their incomes.

Table 1. Three Annual Budgets for an Urban Family of Four, Autumn 1976

Component	Lower	Intermediate	Higher
Food	$3003	$3859	$4856
Housing	1964	3843	5821
Transportation	767	1403	1824
Clothing	799	1141	1670
Personal Care	265	355	503
Medical Care	896	900	939
Other Consumption[1]	468	869	1434
Total Family Consumption	8162	12370	17048
Other Items[2]	451	731	1234
Adjusted Consumption	$8613	$13101	$18282

[1]Other consumption includes average costs for reading, recreation, tobacco, alcoholic beverages, education, and miscellaneous expenses.

[2]Other items includes allowances for gifts and contributions, life insurance and occupational expenses.

Source: Monthly Labor Review, July 1977, p. 35

A review of the BLS standards in Table 1 reveals two components that appear to be largely discretionary--"other consumption" and "other items." While these could be viewed as discretionary amounts which could be allocated entirely to annual educational debt amortization, such an assumption could conceivably require major budgeting dislocations on the part of the family. On the other hand, it can be argued that an amount approximating the other consumption component of the respective budgets could theoretically be devoted to educational loan repayments without creating an undue strain on the family budget. Thus, manageable annual educational loan repayment could be defined as an amount equivalent to the other consumption component of the respective BLS budget standards.

The data in Table 2 present housing and other consumption budget componets expressed as percentages of the three adjusted consumption budgets. At the BLS lower consumption budget standard, housing costs represent 22.8 percent of the standard and other consumption items represent 5.4 percent of the lower standard. These percentages increase progressively to the intermediate and higher standards. Note the fact that the other consumption component represents between 5.4 and 7.8 percent of the respective budgets, a range that encompasses Daniere's 7.5 percent figure.

For purposes of this study, manageable debt repayment is defined as an amount equivalent to the other consumption component of the respective BLS budget standards. It should be pointed out that the total adjusted consumption budgets in Table 1 exclude federal, state, FICA and local taxes. As such, they represent income after taxes (effective income) needed to achieve each of the three budget standards.

Table 2. Housing and Other Consumption Expenses Expressed as Percentages of Adjusted Consumptions Budgets at Three Levels of Living, Autumn 1976

Component	Lower	Intermediate	Higher
Housing	22.8%	29.3%	31.8%
Other Consumption	5.4%	6.6%	7.8%
Housing plus Other Consumption	28.2%	35.9%	39.6%

If one accepts this definition, the question becomes, "Given a known annual income, how can the annual manageable educational loan repayment be estimated?"

Using the data in Table 1, it is possible to construct a progressive schedule that, at each of the three budget standards, yields expected annual repayments equal to the Other Consumption component. For example, The Other Consumption component (or manageable repayment) represents 5.4 percent of the lower budget standard ($8,610), or $465. At the moderate standard, it is $869 ($465 from the lower standard plus 9 percent of the difference between the amount of the lower and the intermediate standards.)

Table 3 presents a progressive schedule which was constructed to estimate manageable debt repayment from 1976 effective income (income after taxes). At double the BLS higher standard the manageable annual repayment was assumed to be three times the repayment at the higher standard.

Table 3. Formulas for Estimating Manageable Annual Educational Debt Repayment in Autumn 1976 Dollars,

Autumn 1976 effective income[1] (EI)	Manageable Annual Educational Debt Repayment
$ 0- 8,610	5.4% of EI
$ 8,611-13,100	$465 plus 9% of EI in excess of $8610
$ 13,101-18,280	$869 plus 11.0% of EI in excess of $13,100
$ 18,281-over	$1,439 plus 15.7% of EI in excess of $18,280

1. Effective income = Adjusted gross income less allowance for U.S. income taxes, FICA taxes, and state and other taxes.

Effectively, the above formulas result in expecting the following proportions of after-tax income for educational debt repayment: 5.4 percent at the BLS lower standard, 6.6 percent at the BLS intermediate standard, 7.9 percent at the BLS higher standard, and 11.7 percent at twice the BLS higher standard.

Since educational loans are repaid from the student's future income, the ability to repay educational debts can be viewed as a function of the student's future income stream during the amortization period. To estimate aggregate manageable educational loan repayments for graduate and professional students, age-earnings profiles must be taken into consideration. The Bureau of the Census periodically estimates the mean income, lifetime income, and educational attainment of men in the United States. One of the groupings for which these data are available is for men with five years or more of college.

Mean incomes for this group, in 1972 dollars, are presented by age in Table 4. This table reveals that the mean income in 1972 dollars for 26 year old men with five years or more of college was $11,104. The data in the "ratio" column present mean incomes at each age expressed as a ratio of the income for the respective age group to the mean income at the base age of 26. Age 26 was chosen as the base for this group because it is the earliest age at which the majority of graduate/professional borrowers in four year educational programs would begin repaying their loans, assuming a grace period.

Table 4. Estimated Mean Income in 1972 Dollars at Present Age and Age-Earnings Ratios for Males with Five Years or More of Postsecondary Education

Age	Income	Ratio
26	11,104	1.00
27	11,854	1.07
28	12,577	1.13
29	13,273	1.20
30	13,941	1.26
31	14,581	1.31
32	15,194	1.37
33	15,779	1.42
34	16,337	1.47
35	16,868	1.52
36	17,371	1.56
37	17,846	1.61
38	18,295	1.65
39	18,715	1.69
40	19,108	1.72
41	19,474	1.75
42	19,812	1.78
43	20,123	1.81
44	20,406	1.84
45	20,661	1.86
46	20,890	1.88
47	21,090	1.90
48	21,264	1.92
49	21,409	1.93
50	21,528	1.94
51	21,618	1.95
52	21,682	1.95
53	21,718	1.96
54	52,726	1.96
55	21,707	1.95
56	21,660	1.95
57	21,586	1.94
58	21,485	1.93
59	21,356	1.92
60	21,199	1.91
61	21,015	1.89
62	20,804	1.87
63	20,565	1.85
64	20,298	1.83

Source: U.S. Bureau of the Census, Current Population Reports, Series P-60, No. 92.

The census data suggest that income wil grow (in 1972 dollars) as a function of age by 7 percent from age 26 to 27, by 13 percent form age 26 to age 28, and so on. The income of males with five years or more of college may be expected to grow by 52 percent between ages 26 to 35 (first 10 years), and by 86 percent by the twentieth year (age 45).

In measuring aggregate manageable debt repayments, which will be made from future incomes, the impact of inflation on income should not be ignored. Accordingly, the projection of furture income streams should account for both inflation and cross-sectional income growth.

The data in Table 4, therefore, need to be updated to reflect inflationary effects from 1972 to future repayment years. Students entering four-year degree programs in 1978-79 would not be expected to begin repayment of their loans until the beginning of 1983. For this reason, the 1972 census income data need to be updated through 1983 for inflation. Actual and projected Consumer Price Index (CPI) increases for the period 1972 to 1983 are presented in Table 5. Based on the actual increase in the CPI from 1972 through 1976, and projected increases through 1983, it is estimated that the CPI will increase by 103.9 percent for the period 1973 through 1983. Therefore, the average 1972 income of $11,104 for a 26-year-old male with five or more years of college, when updated for CPI increases to 1983, becomes $22,641. Further, the average I972 before-tax income of $16,337 for a 34 year old would grow to $53,092 in 1991, assuming inflation of 103.9 percent from 1972 to 1983, and a 6 percent inflation rate thereafter. Long-range estimates of rises in the CPI are subject to considerable uncertainty. Therefore, for purposes of estimating manageable debt repayments from future income streams, it might be preferable to assume a lower rate of inflation. This would result in the yielding somewhat more conservative estimates of ability to repay from future income streams.

Table 5. Actual and Projected Rises in the Consumer Price Index (CPI): 1972 to 1983

Year	CPI	Percent Increase (1972=Base)
1972[1]	125.3	
1976[1]	170.5	
1977[2]	181.6	
1978	192.1	
1979	202.7	
1980	213.8	
1981	228.4	
1982	241.2	92.3%
1983	255.5	103.9%

[1]Source: Monthly Labor Review, August 1977.

[2]Source: Data Resources Inc. Predictions of National Price and Wage Increases.

Table 6 presents estimated earnings profiles and manageable annual and cumulative educational debt repayments for 10 and 15 year amortization periods, assuming repayments begin in 1983. For this analysis, the census age-income ratios for males were assumed to be representative of earnings profiles for the universe of graduate and professional students.[10]

[10]To the extent that there may be significant differences in starting salaries and age-income ratios (growth profiles) among students in various disciplines and between men and women, one would expect manageable debt loads to vary among disciplines and occupations and between sexes. Moreover, to the extent there may be differences in cross sectional income growth rates among racial and ethnic groups, different manageable debt loads would be implied by the approach.

Note that manageable annual debt repayments were computed for each year using the "effective" or after-tax income formulas presented in Table 3, updated for inflation. Just as inflation of income neeeds to be accounted for, so too do inflationary impacts on the repayment formulas themselves. Formulas for each future year were, therefore, indexed for inflation.[11] Effective income was defined as adjusted annual income (i.e., adjusted for inflation and age growth) less the sum of estimated federal income taxes, FICA taxes and state and other taxes. The allowance for state and other taxes is 8 percent of adjusted income, the amount allowed by uniform methodology fianancial need analyais procedures for famlies whose total income exceeds $10,000.

[11] See Appendix A, formula 3, which was used to index the annual repayment schedule.

Table 6. Estimated Earnings Profiles and Manageable Annual Educational Loan Repayments for Males with Five Years or More of College, Assuming 6 Percent Inflation After 1983

Loan Repayment Year[1]	Before Tax Income in 1972 Dollars[2]	After Tax Income in Current Dollars	Manageable Annual Loan Repayments	Cumulative Repayments
(1) 1983	$11,104	$16,127	$ 988	
(2) 1984	11,854	18,003	1,129	
(3) 1985	12,577	19,795	1,261	
(4) 1986	13,273	21,803	1,410	
(5) 1987	13,941	23,720	1,550	
(6) 1988	14,581	25,543	1,679	
(7) 1989	15,194	27,560	1,823	
(8) 1990	15,779	29,510	1,966	
(9) 1991	16,337	31,626	2,122	10 Year Amortization ($16,221)
(10) 1992	16,868	33,921	2,293	
(11) 1993	17,371	36,218	2,460	
(12) 1994	17,846	38,902	2,663	
(13) 1995	18,295	41,594	2,862	15 Year Amortization $30,575
(14) 1996	18,715	44,500	3,079	
(15) 1997	19,108	47,396	3,289	

[1]Assumes entry into a four-year graduate/professional program in 1978-79, exit age 25 in 1982, nine month grace period, and repayments beginning in 1983.

[2]Source: See Table 4.

[3]Assumes 103.9 percent rise in CPI from 1972 to 1983, and six percent annual increases thereafter in before-tax income. After-tax income equals income less allowances for federal taxes, state and other taxes, and FICA taxes.

The far right column of Table 6 presents the cumulative manageable repayments at the tenth and fifteenth years. The outcomes of this analysis suggest that, given a 10 year repayment period, aggregate repayments, graduated to income, of $16,221 would be manageable; given a 15-year amortization period, aggregate repayments of $30,575 would be manageable.[12] It is extremely important to note that these statements assume annual repayments are scaled to income and an inflation rate of 6 percent. Without such scaling, the student amortizing a loan in equal installments could be expected to repay more than a manageable amount during the first years of repayment.

The chart on the next page illustrates the ability of selected professional groups to make annual educational loan repayments over a 15 year amortization period. The chart demonstrates, on average, little difference in ability to repay educational loans of doctoral scientists and engineers, and males with 5 or more years of college. Moreover, the ability of lawyers and physicians to repay educational loans is not markedly different, if physicians are required to begin repayments during internship and residency. Not surprisingly, if physicians are permitted to begin repaying educational loans after the residency period they appear as a group, to theoretically have the ability to make the largest annual repayments.

Conversion of Cumulative Repayments from Future Income into Manageable Loan Principal Limits

In the preceding section, a methodology was presented for measuring manageable aggregate educational loan repayments as a function of future income profiles for a group that may approximate graduate and professional students as a whole.

Having presented this methodology, the question becomes, "What is the aggregate tolerable loan principal (as opposed to repayment), given manageable aggregate repayments?" Naturally, to answer this question, the repayment period and the interest rate must be stipulated, because repayments include both principal and interest.

Table 7 presents a general formula for computing total principal, given monthly repayments, interest rate, and number of months in the repsyment period. Table 8 presents denominators for the formula for different repayment periods and interest rates. Table 9 converts the cumulative manageable repayments developed in Table 7 into total tolerable debt principal for a 7 percent interest-bearing loan repayable in 10 or 15 years.

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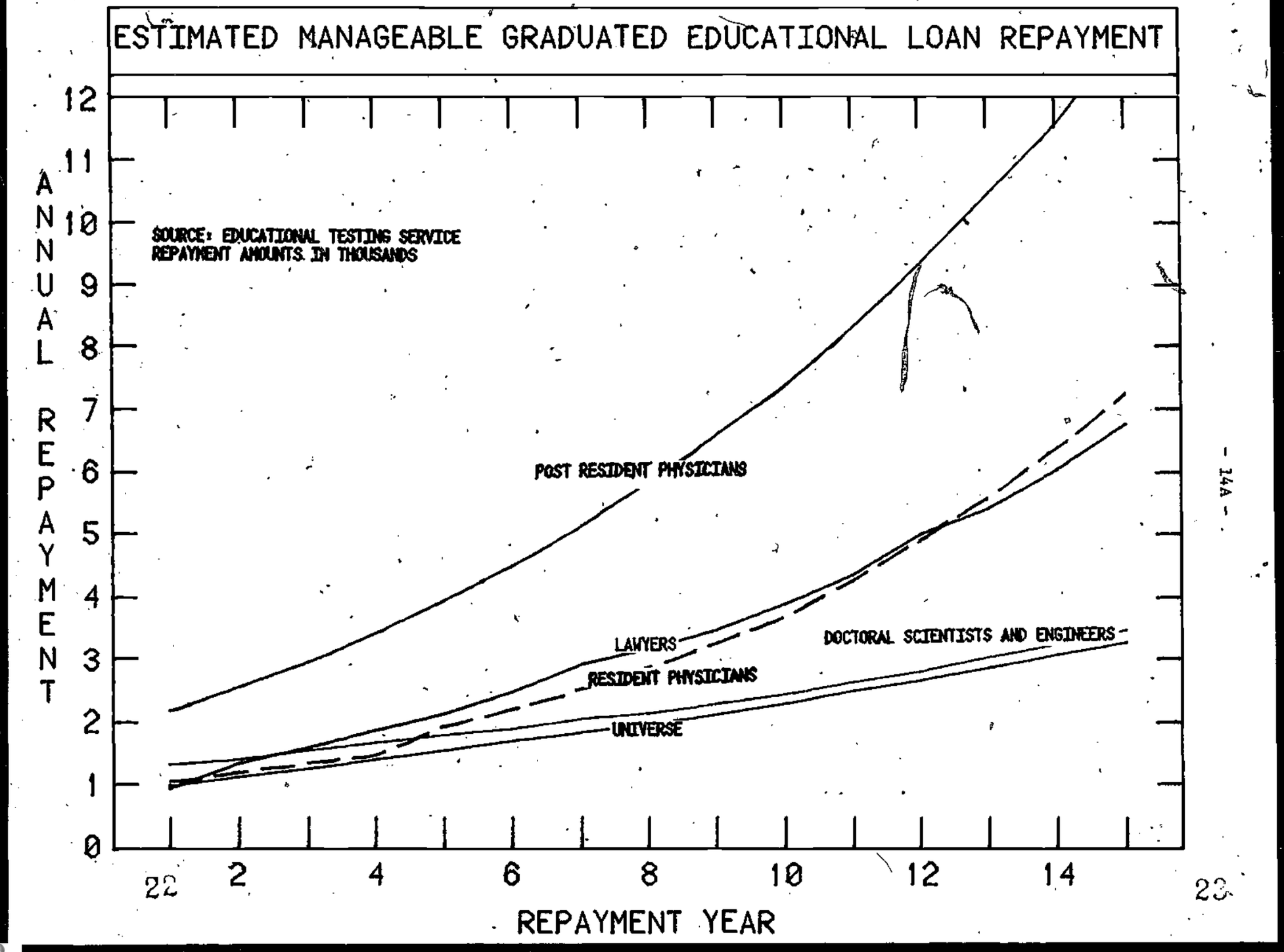
[12] Formulas 1-4 of Appendix A were used to determine cumulative manageable repayments.


ESTIMATED MANAGEABLE GRADUATED EDUCATIONAL LOAN REPAYMENT
SOURCE: EDUCATIONAL TESTING SERVICE
REPAYMENT AMOUNTS IN THOUSANDS
ANNUAL REPAYMENT
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POST RESIDENT PHYSICIANS
LAWYERS
RESIDENT PHYSICIANS
DOCTORAL SCIENTISTS AND ENGINEERS
UNIVERSE
22
2
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6
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12
14
REPAYMENT YEAR

Table 7. Formula for Computing Total Principal Given Monthly Repayments (including Principal and Interest), Interest Rate, and Repayment Period.

$$P = \frac{CR/(12 \times y)}{\left[\frac{R + 12}{(1 + R/12)^{NM} - 1} + \frac{R}{12}\right]}$$

Where:

P = Principal

CR = Cumulative repayment

Y = Number of years in amortization period

R = Interest rate

NM = Number of months in repayment period

Table 8. Formula Denominators by Amortization Period and Interest Rate.

Amortization Period in Years	Interest Rate		
	3 Percent	7 Percent	10 Percent
10	.0096575	.0116117	.0132152
15	.0069067	.0089889	.0107461
20	.0055467	.0077534	.0096503

The data in Table 9 suggest that repayments of $16,221 would be manageable over a 10 year amortization period for a loan bearing 7 percent interest converts into a loan principal of $11,641. Stated differently, the analysis suggests that an aggregate loan limit of $11,641 for the universe of graduate and professional students, may be a manageable loan ceiling for a 10 year amortization period, assuming repayments are scaled to future income. If the amortization period is extended to 15 years, it appears that a $18,896 loan principal ceiling would be tolerable.

The aggregate loan (principal) limit for the Guaranteed Student Loan Program (GSLP) was recently extended to $15,000 for graduate and professional students. This analysis suggests that the $15,000 limit is not unreasonable, provided the 10 year amortization period is extended to 15 years and repayments are graduated or scaled to income. Given a fixed repayment schedule and a ten year amortization period, one could argue that the total debt repayment should not exceed 10 times the manageable repayment during the first year of repayment. If the required equal monthly installment exceeds the manageable monthly repayment the first year, one might hypothesize that undesirable personal and social consequences, such as default, might result. Following this line of reasoning for the example in Table 6, a manageable aggregate GSL loan principal limit for males with 5 or more years of postsecondary training, given an equal monthly repayment schedule, would be about $7,100.

$$\frac{\$988 \times 10 \text{ yrs.}}{120 \text{ months}} \div .0116117 = \$7,090$$

The preceding example highlights the importance of permitting graduate and professional GSL Program borrowers the option of graduated repayments, and suggests that the amortization period should be extended to 15 years for those borrowing in excess of $7,100. Referring back to the manageable annual repayment column of Table 6, it appears that annual GSL repayments, if graduated to allow approximately a doubling of annual payments from the first to the tenth year of repayment or a tripling from the first to fifteenth year, would result in a manageable repayment stream for males with 5 or more years of postsecondary education.

Table 9. Conversion of manageable repayments into total manageable loan principal for alternative amortization periods, at 7% interest, for males with 5 or more years of postsecondary education.

(Assumes 6 percent inflation after 1983)

Item	10 Years (120 Months)	15 Years (180 Months)
Total Manageable Repayment	$16,221[1]	$30,575[1]
Average Monthly Repayment	$135.18	$169.86
Formula Denominator	.0116117[2]	.0089889[2]
Total Manageable Loan Principal	$11,641[3]	$18,896[3]

[1]Source: Table 6

[2]Source: Table 8

[3]Computed as follows: Montly repayments divided by formula denominator.

The preceeding example reveals that several variables impinge upon the assessment of manageable educational loan principal limits:

- Length of the amortization period
- Interest rate
- Shape of the age-income profile
- Assumed inflation rate in future years
- Equal installment or graduated repayment option (GRO) schedules
- Starting salary

In summary, the methodology suggested for estimating manageable educational loan principal limits for equal installment repayment plans is outlined below:

1. Mean starting income in constant dollars is updated for inflation to the year in which repayment will begin.

2. Effective starting income in current dollars is computed as the difference between current before-tax starting income less allowances for taxes (federal, FICA, state and other).

3. Repayment formulas (Table 3), indexed for inflation to the first repayment year, are applied to effective income to estimate the manageable repayment during the first repayment year of repayment.

4. Manageable annual repayment based on first year effective income is multiplied by the number of years in the repayment period, and is then converted into a manageable principal limit. Principal limits will vary depending upon the stipulated interest rate and length of the amortization period.

For graduated repayment option (GRO) plans, the six step method for estimating manageable loan principal limits is summarized as follows:

1. Mean starting income in constant dollars is updated for inflation to the year in which repayment will begin.

2. For successive repayment years, mean starting salary is adjusted for inflation and cross sectional growth rates.

3. Estimated effective income for each repayment year is calculated as the difference between before-tax income and federal, FICA, and state and other taxes.

4. The manageable annual repayment formula (see Appendix A, formula 3), indexed for inflation, is applied to effective income for each repayment year.

5. Annual repayments are summed across the amortization period to determine aggregate manageable repayments from future income.

6. Aggregate manageable repayments are converted to manageable principal limits based upon the stipulated interest rate and length of the amortization period.

Because starting incomes and cross sectional income growth rates vary among graduate and professional disciplines, there is no single answer to the manageable loan principal question. As will become more apparent in the next section, one set of loan program features (interest rate, amortization period, scaling of repayments to income) may yield educational loan principal limits that would be manageable for one discipline, but not another.

Manageable Educational Loan Principal Limits for Selected Professional Groups

To test the sensitivity of the methodology for estimating manageable educational loan principal limits, an interactive computer model was developed. The model allows the user to stipulate the following variables: starting income in current dollars, age-income growth ratios, inflation rate, interest rate, and number of years in the pay-back period. It then computes manageable educational debt loads using the formulas in Appendix A.

A series of simulations were run to estimate manageable educational loan principal limits for each of the following groups:

- Males with 5 or more years of college
- Law students
- Medical students, assuming repayment begins during internship
- Medical students, assuming repayment begins after residency
- Doctoral scientists and engineers.

The simulations drew upon income profile data that were readily available from previous studies by other researchers. In addition to simulations based on Bureau of the Census data for males with 5 or more years of college, the simulations for lawyers utilized income profile data published by the Massachusetts Bar Association, those for doctoral scientists and engineers drew upon data published by the National Academy of Sciences; and unpublished income data from the Institute for Demogrphic and Economic Studies were used to simulate manageable educational debt levels for physicians.[12] As a result, the simulated manageable educational loan limits are intended to illustrate the relationship between the hypothetical prospective average (mean) income of selected professional groups during the pay-back period and their theoretical ability to repay educational loans. Because available income profile data for the selected professional groups may not be wholly representative, the reader is urged to interpret the results of the simulations cautiously. Similarly, because the estimates of manageable debt levels are based on group mean incomes at selected ages, the reader is cautioned against inferring that the results are necessarily applicable to individuals.

The results of all of the simulations are highlighted in Tables 10 and 11. Table 10 presents estimated manageable cumulative repayments, including principal and interest, by type of repayment (fixed or graduated), for selected pay-back periods and professional groups. Inspection of Table 10 reveals that, for males with 5 or more years of college, total repayments of $9,900 would be theoretically manageable, given a 10 year amortization period and restricting cumulative repayments to 10 times the repayment that is manageable from the student's income during the first year of repayment. On the other hand, if annual repayments were scaled to income, the cumulative manageable repayment, given a 10 year amortization period would be between $14,700 (if the inflation rate were 3 percent annually) or $16,200 (if the inflation rate were 6 percent annually).

[12] The age-income profiles and estimated starting incomes for each professional group may be found in Appendices B through E.

Table 10. Estimated Manageable Cumulative Repayments (Principal and Interest) by Amortization period for Selected Professional Groups

Amortization Period	Males with 5 or more Years of College		Lawyers		Physicians (Repayments Beginning after Residency)		Pysicians (Repayments Beginning in Internship)		Doctoral Scientists and Engineers	
	Equal Repayments	Graduated Repayments	Equal Repayments	Graduated Repayments	Equal Repayments	Graduated Repayments	Equal Repayments	Graduated Repayments	Equal Repayments	Graduated Repayments
10 Years	$9.9	$14.7-16.2[1]	$8.9	$20.9-23.4	$22.0	$39.1-44.2	$10.4	$19.0-21.4	$12.9	$16.7-18.3
15 Years	$14.8	$25.8-30.6	$13.4	$41.7-50.8	$33.0	$77.5-96.7	$15.6	$40.4-49.6	$19.4	$28.3-33.4
20 Years	$19.8	$39.4-50.8	$17.9	$70.9-95.7	$44.0	$134.3-186.9	$20.8	$73.9-101.8	$25.8	$42.8-55.1

[1] Lower limit assumes 3 percent annual inflation rate; upper limit assumes 6 percent annual inflation rate.

The following findings emerge from the data in Table 10.

- Given equal monthly repayment schedules, physicians could repay more than any other group, assuming their repayments begin after residency. Doctoral scientists and engineers follow physicians in their ability to manage equal monthly repayments, due to their relatively high starting incomes. Interestingly enough, heavily indebted law students would appear to be least well served by equal monthly schedules, due to their comparatively lower first year incomes.

- If repayments were graduated to prospective income, the ordering by ability to repay would be physicians, followed by lawyers, followed by doctoral scientists and engineers. The reordering of lawyers and doctoral scientists and engineers is due to the shape of their respective future income profiles. Lawyers, on average, appear to begin at lower starting incomes than doctoral scientists and engineers. The rate of income growth is much steeper for lawyers; hence, their ability to repay educational loans, where repayments are graduated to income, is greater on average than doctoral scientists and engineers.

Table 11 presents aggregate manageable educational loan principal borrowing limits by interest rate within amortization period for selected professional groups.

For sake of convenience, the results for each group shown in Table 11 will be discussed separately.

Males with 5 or more years of college

For males with five years or more of college, it appears that $8,500 would represent a manageable level of borrowing for a 3 percent interest-bearing loan repayable in equal installments over ten years, such as National Direct Student Loans. For a 7 percent loan repayable in equal installments over 10 years, such as Guaranteed and Federally Insured Student Loans, a limit of $7,100 would be manageable. The lower limit for the 7 percent loan is due to the higher interest rate.

TABLE 11. Estimated Aggregate Manageable Educational Principal Borrowing Limits for Equal Installment and Graduated Repayment Option (GRO) Plans for Selected Professional Groups (Amounts in Thousands)

Length of Repayment Period/Interest Rate	Males with 5 Yrs or More of College		Lawyers		Physicians: Repayments Beginning after Residency		Pysicians: Repayments Beginning in Internship		Doctoral Scientists and Engineers	
	Equal Repay-ments	Graduated Repayment Option (GRO)	Equal Repay-ments	Graduated Repayment Option (GRO)	Equal Repay-ments	Graduated Repayment Option (GRO)	Equal Repay-ments	Graduated Repayment Option (GRO)	Equal Repay-ments	Graduated Repayment Option (GRO)
10 Year Amortization										
3% Interest	$ 8.5	$12.6-14.0[1]	$ 7.7	$18.1-20.2	$18.9	$33.7-38.1	$ 9.0	$16.5-18.4	$11.2	$14.4-15.8
7% Interest	$ 7.1	$10.5-11.6	$ 6.4	$15.0-16.8	$15.8	$28.1-31.8	$ 7.5	$13.7-15.3	$ 9.3	$12.0-13.1
10% Interest	$ 6.2	$ 9.3-10.2	$ 5.6	$13.2-14.7	$13.8	$24.6-27.9	$ 6.6	$12.0-13.5	$ 8.2	$10.5-11.5
15 Year Amortization										
3% Interest	$11.9	$20.8-24.6	$10.7	$33.5-40.8	$26.5	$62.3-77.8	$12.6	$32.5-39.9	$15.6	$22.8-26.9
7% Interest	$ 9.1	$16.0-18.9	$ 8.2	$25.7-31.4	$20.4	$47.9-59.8	$ 9.7	$25.0-30.7	$12.0	$17.5-20.6
10% Interest	$ 7.6	$13.4-15.8	$ 6.9	$21.5-26.3	$17.0	$40.1-50.0	$ 8.1	$20.9-25.7	$10.1	$14.6-17.3
20 Year Amortization										
3% Interest	$14.8	$29.6-38.2	$13.3	$53.2-71.9	$33.0	$100.9-140.4	$15.7	$55.6-76.4	$19.5	$32.4-41.4
7% Interest	$10.5	$21.2-27.3	$ 9.5	$38.1-51.4	$23.6	$72.2-100.5	$11.2	$39.7-54.7	$13.9	$23.1-29.6
10% Interest	$ 8.5	$17.0-21.9	$ 7.7	$30.6-41.3	$19.0	$60.0-80.7	$ 9.0	$31.9-43.9	$11.2	$18.4-23.8
Assumed Year in which Repayments Begin	1983		1982		1987		1983		1983	
Estimated Income During First Year of Repayment	$22.6		$21.0		$47.6		$23.5		$28.0	

[1] Lower limit assumes 3 percent annual inflation rate; upper limit assumes 6 percent inflation rate.

These two findings suggest the advisability of (a) considering extension of the NDSL repayment period from 10 to 15 years for graduate and professional students, if repayments are in equal installments, and (b) reviewing both the length of the pay-back period and the equal installment norm for the Guaranteed Student Loan Program.

If repayments were scaled to income, it appears that total borrowings of $12,600 to $14,000 would be manageable for graduate and professional students under the National Direct Student Loan Program, given a 10-year repayment period. Thus, one option would be to extend the NDSL loan maximum from $10,000 to $15,000 and include a graduated repayment option for those whose debts exceed $8,500.

These data also seem to suggest the advisability of considering revision of the Guaranteed Student Loan Program to permit postbaccalaureate students to borrow up to $16,000-$19,000, and to provide them the option of graduated repayments over 15 years if their debt exceeds $7,100.

Whether repayment periods should be extended to 20 years for graduate and professional students is debatable. Extension of the pay-back period to 20 years could have the curious result of expecting this generation of graduate and professional students to simultaneously repay their educational loans and contribute toward their offspring's educational costs. It should be noted, however, that such an extension would significantly increase manageable loan principal limits.

Law Students

It was pointed out earlier that heavily indebted law students because of their relatively modest starting incomes, would appear to be least well served, particularly during the first repayment years, by equal installment loans. Their manageable aggregate loan principal for equal installment loans, when restricted to a proportion of the average first year salary, ranges from a low of $5,600 for a 10 percent, 10 year loan, to $13,300 for a 3 percent, 20 year loan. On the other hand, because of lawyers' typically more rapid income growth experience, graduating repayments to income would enable them to borrow considerably more, yet result in manageable annual repayments. For example, the analysis in Table 11 suggests that law students could comfortably borrow between $18,100 and $20,200, for a 10 year, 3 percent loan (such as NDSL), provided repayments were graduated to prospective income. From the perspective of lawyers' income profiles, it appears as though the current Guaranteed Student Loan aggregate borrowing limit of $15,000 is manageable at 7 percent interest and 10 years for pay-back, provided repayments are scaled to income. On the other hand, it appears that extension of the GSL pay-back period from 10 to 15 years, and graduation of repayments to income, would increase the manageable GSL principal limits of law students to between $25,700 and $31,400.

Even at a 10 percent interest rate for a 15 year pay-back period, a indebtedness of between $21,500 and $26,300 would not appear to be overly burdensome for law students, on an income graduated basis.

Medical Students

Despite the fact that the future income expectations for physicians are typically higher than those for the other groups in this analysis, it does not follow that physicians have unlimited ability to repay educational loans, nor does it follow that they have infinite manageable educational debt ceilings. As with other professional groups for whom debt level analyses were conducted, whether a given level of educational debt is manageable for medical students depends on the terms and conditions of the educational loan program. The data in Table 11, for example, indicate that a manageable debt for medical students ranges from $6,600 for a 10-percent, 10-year equal installment loan (if repayments begin in internship) to $33,000 for a 3-percent, 20 year equal installment loan (if repayments begin after residency).

In terms of specific loan programs, which typically offer equal installment terms, it appears that the manageable limits for medical students are $9,000 for NDSL, $7,500 for GSL, or $17,000 for a 10 percent interest-bearing loan.

The new Health Education Assistance Loan (HEAL) program allows medical students to borrow up to $50,000, at a 10 to 12 percent interest rate for 15 years, and allows them to defer repayment for up to three years of residency. However, it contains no provisions for scaling repayments to income. If repayments were scaled to physicians' income, a $40,000 to $50,000 limit would, on average, probably be manageable. Without such scaling, a $50,000, 10 percent interest bearing HEAL loan, which converts to a equal monthly installment payment of $537, would likely be burdensome for physicians during the initial repayment years.

Science and Engineering Students

The estimates of aggregate manageable borrowing limits for doctoral scientists and engineers range, for an equal installment loan, from $8,200 (10 percent, 10-years) to $19,500 (3 percent, 20 years). Given current program features, either $11,200 in NDSL or $9,300 in GSL borrowing would be theoretically manageable.

The results in Table 11 also suggest that increasing the GSL pay-back period from 10 to 15 years and scaling repayments to income would increase the manageable principal limits for science and engineering students to between $17,500 and $20,600. One interesting observation is that scaling requirements to income has a smaller effect on borrowing limits for doctoral science and engineering students than for either medical or law students, because of their comparatively lower average rate of income growth over time.

Major Findings and Policy Implications

This study has attempted to develop a methodology for estimating manageable edcuational loan repayments from the future incomes of selected graduate and professional student groups. Manageable cumulative repayments were converted

into aggregate loan principal limits, given alternative interest rates, amortization periods and repayment plans (equal installment or graduated).

Several findings emerge from the simulations. They are:

1. For males with 5 or more years of college the manageable loan limit for NDSL, given equal installments, is $8,500. Holding the 10 year repayment period constant, but graduating repayments to income would raise the manageable NDSL limit to between $12,600 and $14,000. Graduating GSL repayments to income and extending the GSL pay-back period from 10 to 15 years would result in manageable GSL limits of between $16,000 and $18,900.

2. Of the groups analyzed, heavily indebted lawyers would appear on average to be less well served by equal installment loan repayment plans because of their typically modest starting incomes. Permitting them the option of repayments scaled to income would raise their manageable NDSL limits to between $18,100 and $20,200 or their GSL limit to between $15,000 and $16,800. Allowing both income graduated repayments and extending the amortization period from 10 to 15 years would raise their manageable NDSL limit to between $33,500 and $40,800 and the manageable GSL limits to between $25,700 and $31,400.

3. Despite the fact that the future income expectations of physicians are higher than those of the other groups analyzed, it does not follow that medical students have infinite educational debt ceilings. Given a fixed or equal installment repayment plan, a 15-year amortization period, and a 10-percent interest rate the manageable loan limit for physicians is estimated at $17,000. Scaling repayments to income would result in a manageable loan principal limit of between $40,100 and $50,000 for 10 percent, 15-year loans, with repayment beginning after residency.

4. For doctoral science and engineering students, an $11,200 NDSL or a $9,300 GSL limit would be manageable. For a 10-year amortization period, graduation of repayments to income would increase their NDSL ceiling to between $14,400 and $15,800; the tolerable limit for GSL would be between $12,000 and $13,100.

The thrust of this study has been to quantify manageable education loan limits given permutations of repayment period, type of repayment schedule (equal installment or graduated), interest rate, inflation rate, and hypothetical prospective income growth profiles. The study is intended to aid in discussions of alternative loan policies, because loan programs are an important ingredient of current federal policy toward financing graduate and professional education. As graduate and professional school costs continue their upward spiral, there will likely be more pressure to increase borrowing limits for graduate and professional students. The results of this study suggest that borrowing limits,

repayment terms and amortization periods may require restructuring; otherwise graduate and professional students could well face an unmanageable repayment legacy. If loans are to play a key role in the future financing of graduate and professional education, and if the Guaranteed or Federally Insured Program is to be the federal student aid vehicle for this purpose, then it may be advisable to consider certain technical changes to the program:

(1) In order to maximize manageable debt loads of graduate and professional students, their undergraduate educational indebtedness should be minimized. This goal can be achieved through expansion of undergraduate grant programs such as the Basic Educational Opportunity Grant (BEOG) program and the Supplementary Education Opportunity Grant (SEOG) program.

(2) Graduate and professional students whose educational indebtedness, from all sources, exceeds an agreed-upon threshold amount, should be offered Graduated Repayment Option (GRO) plans, and the option of a 15 year repayment period.

(3) Separate threshold limits, aggregate principal limits, and graduated repayment schedules should be developed for meaningful occupational clusters and should be based on an assessment of their manageable educational debt loads.

While loans are currently an important financing mechanism for graduate and professional students, they should not be viewed as a panacea either by students, policy analysts or financially stressed graduate and professional schools. Fellowship programs and experiential work-study learning opportunities for students in the arts, humanities, sciences, and professions are needed to insure equal access to graduate and professional school, as well as to foster intellectual excellence.

APPENDIX A

Formulas for Estimating Manageable Educational Loan Repayments Assuming First Repayment Begins in 1983

(1) Adjusted Income (AI) in year y

$$AI_y = S * (1 + r)^{y-1} * I_y$$

Where: AI = Adjusted Income

S = Starting salary

r = inflation rate

y = specified year (i.e. first, second, third) of repayment period

I_y = Age-Income Ratio in year y

(2) Effective Income (EI) in year y

$$EI_y = AI_y - FT_y - FICA_y - ST_y$$

Where: AI_y = Adjusted Income in year y of the amortization period

FT_y = Federal taxes in year y, based on 1977 tax schedules

$FICA_y$ = Amount of social security taxes in year y computed as follows:

$$FICA_y = 1293 \times (1.05)^{y-1}$$

ST_y = State and other taxes in year y, computed as follows:

$$ST_y = AI_y \times .08$$

(3) Annual Repayment (AR) in year y

Effective Income in year y	Annual Repayment in year y (AR_y)
\$0 to ($12870 \times (1+r)^{y-1}$	$.054 \times EI_y$
$12871 \times (1+r)^{y-1}$ to $19548 \times (1+r)^{y-1}$	$(695 \times (1+r)^{y-1}) + (.09 \times (EI_y - (12870 \times (1+r)^{y-1}))$
$19549 \times (1+r)^{y-1}$ to $27328 \times (1+r)^{y-1}$	$(1299 \times (1+r)^{y-1}) + (.09 \times (EI_y - (19548 \times (1+r)^{y-1}))$
$27329 \times (1+r)^{y-1}$ and over	$(2151 \times (1+r)^{y-1} + (.157 \times EI_y - (27328 \times (1+r)^{y-1}))$

(4) Cumulative Repayments for amortization period N years in length

$$CR = \sum_{y=1}^{N} AR$$

Where CR = Cumulative Repayments

N = Number of years in amortization period

Y = Year

(5) Tolerable Debt Limit (Principal) P

$$P = \frac{CR/(12 \times y)}{\frac{i/12}{(i/12)^{(N \times 12)} - 1)} + i/12}$$

Where: i = annual interest rate

APPENDIX B

INCOME OF LAWYERS

1973 INCOME OF LAWYERS IN MASSACHUSETTS SURVEY				
Years Admitted[1]	Mean 1 Income	Estimated Age	Age Midpoint	Mean Annual Growth Rate
Less Than 1	$ 8,903	24	24	
				.....30%
1 - 4	$15,135	25 - 28	26	
				.....10.5%
5 - 9	$25,047	29 - 33	31	
				.....4.7%
10 - 14	$31,585	34 - 38	36	
				.....4.0%
15 - 19	$38,445	39 - 43	41	
				.....1.5%
20 - 29	$42,773	44 - 53	49	

[1] Source: Economic Survey Conducted by the Massachusetts Bar Association 1973. Massachusetts Bar Association, 1975, page 5.

Estimated Starting Salary:

$11,600 in 1973 Dollars
x 1.81 Estimated Rise in CPI from 1973 - 1982 (133.1 to 241.2)
$ 21.0 = Estimated Starting Salary in 1982

ESTIMATED MEAN 1973 INCOME OF LAWYERS BY AGE

Age	1973 Income	Ratio
25	$11.6	1.00
26	$15.1	1.30
27	$16.6	1.43
28	$18.4	1.59
29	$20.3	1.75
30	$22.4	1.93
31	$25.0	2.16
32	$26.0	2.24
33	$27.2	2.34
34	$28.4	2.45
35	$29.8	2.57
36	$31.6	2.72
37	$32.4	2.79
38	$33.7	2.90
39	$35.1	3.03
40	$36.5	3.15
41	$37.9	3.27
42	$38.5	3.32
43	$39.1	3.37
44	$39.7	3.42
45	$40.3	3.47
46	$40.9	3.53
47	$41.5	3.58
48	$42.1	3.63
49	$42.7	3.68

APPENDIX C

Professional Income of Physicians

PHYSICIANS MEAN PROFESSIONAL INCOME
IN 1977 DOLLARS

Age	1977 Income	Ratio 1	Ratio 2
26	16.7	1.0	
27	17.7	1.06	
28	18.9	1.13	
29	19.9	1.19	
30	24.0	1.44	1.00
31	26.3	1.57	1.10
32	28.6	1.71	1.19
33	30.9	1.85	1.29
34	33.3	1.99	1.39
35	35.6	2.13	1.48
36	37.9	2.27	1.58
37	40.3	2.41	1.68
38	42.6	2.55	1.78
39	44.9	2.69	1.87
40	47.3	2.83	1.97
41	49.6	2.97	2.07
42	51.9	3.11	2.17
43	54.2	3.25	2.26
44	56.6	3.39	2.36
45	58.9	3.52	2.45
46	61.2	3.66	2.55
47	63.1	3.78	2.63
48	64.0	3.83	2.76
49	64.7	3.87	2.70

Source: Unpublished Data, Institute of Demographic and Economic Studies

Ratio 1 - Assumes repayments start during internship

Ratio 2 - Assumes deferment during one year of residency and three years of internship.

ESTIMATED STARTING INCOME OF PHYSICIANS

In 1983, at age 26

$16,700 = 26 year old's income in 1977 dollars

x 1.407 Rise in CPI from 1977 to 1983 (181.6 to 255.5)

$23,496 = Estimated mean 1983 income of 26 year old.

In 1987, at age 30

$24,000 = 30 year old's income in 1977 dollars

x 1.776 Estimated rise in CPI from 1977 to 1987 (181.6 to 322.6)

$42,624 = Estimated mean income of 30 year old in 1987 dollars.

APPENDIX D

Income of Doctoral Scientists and Engineers

ESTIMATED MEDIAN 1983 STARTING INCOME OF DOCTORAL SCIENTISTS AND ENGINEERS		
Estimated Income of 26 year old in 1973 dollars		$14,600
Rise in CPI from 1973 to 1983 (133.1 to 255.5)		1.92
Estimated 1983 starting income	=	$28,032

UNITED STATES DOCTORAL SCIENTISTS AND ENGINEERS

Median Annual Salary by Age -- 1973

	Median 1973 Salary [1]	Age Midpoint	Mean Annual Growth Rate
Under 30	$15,500	28	
			.....1.032
30-34	17,500	32	
			.....1.023
35-39	19,600	37	
			.....1.022
40-44	22,000	42	
			.....1.018
45-49	24,200	47	
			.....1.0065
50-54	25,000	52	
			.....1.0024
55-59	25,300	57	
60-64	25,800	62	.....1.004
Over 64	24,700	—	—

[1] Source: Doctoral Scientists and Engineers in the United States: 1973 Profile, National Academy of Sciences, March 1974, page 25, Table 10.

INTERPOLATED MEDIAN 1973 SALARY OF DOCTORAL SCIENTISTS AND ENGINEERS

Age	1973 Salary	Ratio
26	14.6	1.00
27	14.9	1.02
28	15.5	1.06
29	16.0	1.10
30	16.5	1.13
31	17.0	1.16
32	17.5	1.20
33	17.9	1.22
34	18.3	1.25
35	18.7	1.28
36	19.2	1.32
37	19.6	1.34
38	20.1	1.38
39	20.5	1.41
40	21.0	1.44
41	21.5	1.47
42	22.0	1.51
43	22.4	1.53
44	22.8	1.56
45	23.3	1.60