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AUTHOR Winkler, Donald R.
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ABSTRACT

This paper evaluates the nature, size, and distribution of public benefits generated by institutions of higher education and assesses the rationale for regional subsidies. Following introductory material, part two discusses the rationale for general public support of higher education and assesses the legitimacy of extending this rationale to regional finance. Enumeration of the activities and outputs of colleges and universities is presented as a means of assessing the sources of social benefits. Part three entails the exposition of a model of social benefits that has implications for the maximization of regional welfare. In part four, a framework for analysis is provided. Part five assesses the social benefits of the outputs of higher education, while part six discusses the social benefits of higher education operations. Part seven derives the implications of this research for regional finance of higher education. A 60-item bibliography is included. (Author/MJM)

THE SOCIAL BENEFITS OF HIGHER EDUCATION: IMPLICATIONS FOR REGIONAL FINANCE

Donald R. Winkler

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RESEARCH DIRECTORATE

Charles J. Hitch President, University of California

Frederick E. Balderston Professor of Business Administration
Chairman, Center for Research in Management Science
University of California, Berkeley
Academic Assistant to the President

OFFICE ADDRESS

2288 Fulton Street
Berkeley, California 94720
(415) 642-5490

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PREFACE

This is one of a continuing series of reports of the Ford Foundation sponsored Research Program in University Administration at the University of California, Berkeley. The guiding purpose of this Program is to undertake quantitative research which will assist university administrators and other individuals seriously concerned with the management of university systems both to understand the basic functions of their complex systems and to utilize effectively the tools of modern management in the allocation of educational resources.

One of the major benefits of being affiliated with the Ford Program for Research in University Administration is the quality and variety of input from one's colleagues. In particular, the author wishes to thank F. E. Balderston, R. Purves, and W. Ziefle for valuable input to this report and D. Breneman and F. Schmidtlein for their incisive comments on an earlier draft. The author, however, bears sole responsibility for remaining errors.

1. The Policy Dilemma

In recent years social scientists have devoted increasing research attention to the conceptualization and quantification of the private and social benefits of higher education.[1] As this research effort continues, institutions of higher education stand in real danger of becoming impaled on a political paradox. To the extent that instructional benefits generated by colleges and universities are private, and it is sometimes claimed that they are all private, researchers argue that the costs of instruction in higher education should be borne by the students and their families. While instructional outputs are thus often seen as generating private benefits, most of the research outputs of higher education are seen as having very wide social benefit, not confined to the locality or region. Furthermore, that part of the benefits of instruction which can be construed as being social rather than private is also often viewed as having national and cosmopolitan rather than local or regional implications. The reason is that high talent manpower has higher inter-regional mobility in the labor market, and the social benefits of educating an individual in one region may accrue to the citizens of another region or the nation at large.

The nature of the paradox is that the policy implications which derive from this research are that higher education should operate only by charging students a price equal to the full costs of their education, on the one hand, or by obtaining subsidy financing only from national

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[1] For example, see Becker [1964] and Hanoch [1967] for estimates of the private returns to investment in education, including higher education; see Weisbrod [1964] and Mundel [1971] for discussions of the social benefits of education.

sources on the other. But at the present time public subsidy to public institutions of higher education is very largely at the state or local level. Furthermore, the property tax exemptions and private philanthropy which have provided financial sustenance to both public and private colleges and universities are also to a very large extent local and regional as to source, although the Federal government does provide significant indirect subsidies to higher education in the form of income tax deductions of philanthropic contributions and state and local tax payments.

Table I provides a picture of the current state of affairs regarding the financing of public and private higher education in the United States. Students provide less than 12% of current-fund revenue of public institutions of higher education and less than 34% of revenue of private institutions. Their contribution to the costs of instruction alone is of course considerably larger, especially if one properly includes foregone income as a real cost of education. State and local governments provide the largest single source of funds to public institutions. While they do not account for a very large fraction of the revenue of private institutions, these figures do not include the value of property tax exemptions or the value of taxes not collected on tax deductible gifts and endowment earnings. Furthermore, the contribution of state and local governments to the revenue of public institutions varies greatly by state from a low of 29.2% in Oklahoma to a high of 60.8% in Massachusetts.[2]

It is pertinent to investigate both the regional impact of higher

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[2] Digest of Educational Statistics, 1970, Table 124. These figures should not be interpreted as the regional demands for public higher education; Massachusetts, for example, contributes a large amount of the revenue of public colleges and universities in that state, but has relatively few public institutions. Per capita expenditures, as reported in Table XIII, are a better measure of state effort.

TABLE I

Current-Fund Revenue Sources for Institutions of Higher Education, 1967-1968

Current-Fund Revenue by Control of Institution

[Amounts in Thousands of Dollars]

Source	Public		Private	
	Amount	Percent	Amount	Percent
Total current-fund revenue	$10,412,055	100.0	$6,498,365	100.0
Educational and general revenue	8,706,993	83.6	5,212,762	80.2
Tuition and fees from students	1,209,328	11.6	2,184,274	33.6
Federal government	1,853,562	17.8	1,509,578	23.2
Research	1,120,331	10.8	1,262,962	19.4
Other revenue from federal government	733,231	7.0	246,616	3.8
State governments	4,153,409	39.9	66,259	1.0
Local governments	482,576	4.6	21,085	0.3
Endowment earnings	35,842	0.3	328,205	5.1
Private gifts and grants	58,598	0.6	494,754	7.6
Other educational and general revenue	913,678	8.8	608,606	9.4
Auxiliary enterprise revenue	1,441,455	13.9	1,045,324	16.1
Student-aid grants	263,608	2.5	240,280	3.7

Source: National Center for Educational Statistics, Office of Education, Digest of Educational Statistics, 1970. Washington, D.C.: U.S. Government Printing Office. 1970. Table 123. p. 92.

education institutions and the justification for investment by a region (state) in the regional university, because the apparent paradox may not be valid. In this paper we attempt to evaluate the nature, size, and distribution of public benefits generated by institutions of higher education and to assess the rationale for regional subsidies. Good empirical research in this area is woefully lacking, a fact which is sometimes reflected in our own attempts to evaluate these benefits.

The remainder of this paper is organized as follows. In part 2 we discuss the rationale for general public support of higher education; we also assess the legitimacy of extending this rationale to regional finance. Next, we enumerate the activities and outputs of colleges and universities as a means of assessing the sources of social benefits. Part 3 entails the exposition of a model of social benefits which has implications for the maximization of regional welfare. In part 4 we simply provide a framework for analysis. Part 5 is an assessment of the social benefits of the outputs of higher education, while part 6 is a discussion of the social benefits of higher education operations. Last, we derive the implications of this research for regional finance of higher education.

2. Rationale for Public Support of Higher Education

Before proceeding to the special case for regional public support of higher education, it may be useful to briefly explore the rationale for public support of higher education in general. As stated earlier, the focus of this paper is an assessment of the external benefits of higher education. However, two other premises are often cited for subsidies of the instructional component of higher education: (i) redistribution of income and improved social mobility and (ii) imperfections in the capital market. As these premises are expertly and thoroughly evaluated in a recent paper by Hartman [1972], our discussion is cursory.

Income Redistribution.

Higher education affects income distribution by altering the distribution of human capital. It is sometimes argued that a policy of "zero tuition" makes higher education more accessible to the poor and thereby results in a more equal distribution of human capital. Although demand by the poor for higher education is price elastic,[3] "zero tuition" may be a relatively ineffective and inefficient tool for redistributing income. It is ineffective because the equalization of schooling which has occurred over the past few decades does not appear to be reflected in a similar equalization of incomes (Thurow [1972]). It is inefficient because rich students receive a subsidy and consequent inducement to attend college equal to that received by poor students.

As suggested by Hartman, the redistributive function of higher education may be considerably more restricted to providing a "ticket of entry"

[3] Hoenack's study [1971] indicates the demand by low-income groups for higher education is somewhat price elastic.

to upward social mobility for children of the poor. Education may be a necessary but not sufficient condition for "getting ahead." As shown in Table II, a high proportion, 46%, of male students completing college demonstrate a high degree of social mobility when comparing their occupational prestige with that of their father.

Another aspect of the redistributive question is whether a policy of "zero tuition" results in larger subsidies net of taxes for poor families than for rich families. In other words, taking into consideration the facts that (i) a smaller proportion of high school graduates from poor families than for rich families attend public institutions of higher education, (ii) the size of subsidy under zero or near-zero tuition is largest for the most expensive institutions, for which a larger proportion of rich students than poor students are eligible to attend, and (iii) the tax structures of most states are not very progressive, do poor families on the average receive more in higher education subsidies than they pay in taxes to support public higher education? In a now famous study, Hansen and Weisbrod [1969] claim that the system of subsidies and taxes in California in 1965 was such that there is an effective redistribution of income from the poor to the non-poor. Pechman [1970] convincingly shows that their conclusion does not follow from their data, but the most important point to emerge from both the study and the critique is that these kinds of redistributive effects are small and relatively unimportant.[4]

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[4] An independent study of this same matter by Windham [1970] for the state of Florida appears to concur with the findings of Hansen and Weisbrod. However, major changes in the tax structure (especially 1967 legislation which made the personal income tax more progressive) and in college attendance patterns (efforts such as EOP to broaden the participation of minority and low-income groups) in California since 1965 might result in reversal of the Hansen-Weisbrod findings.

TABLE II*

Percentage Distribution of Males by Intergenerational Mobility

by Level of Educational Attainment

	Educational Attainment					
	Elementary	High School		College		
Mobility	8	1-3	4	1-3	4	5+
High Upward	15.9	18.4	27.7	31.1	45.7	53.1
Upward	25.7	26.1	25.8	23.1	23.4	22.9
Stable	37.2	31.3	24.5	19.1	13.8	12.3
Downward	17.1	17.2	13.6	15.1	11.7	9.2
High Downward	4.2	6.9	8.4	11.6	5.4	2.5
Total	100.1	99.9	100.0	100.0	100.0	100.0

*Source: Blau and Duncan [1967], pp. 499.

Even if the effects are deemed large and significant, the conclusion does not necessarily argue against uniform low tuition; it may argue instead for a more progressive state and local tax structure.

Capital Market Imperfections.

Another familiar argument for public support of higher education is that imperfections in the capital market discriminate against investment in human capital. Hence, if students are required to pay the full costs of their education, there is likely to be a substantial underinvestment in human capital relative to physical capital. The major reason for discrimination in the capital market is that while investors in physical capital can use such capital as collateral for their loan, human capital is not acceptable as collateral, for default on the loan might "enslave" the individual to the lender.

The problem can be alleviated if the price of higher education to the private investor is reduced through government subsidy. However, subsidized user charges do not affect the opportunity costs of attending college, the single largest component of price to the educational investor. A better solution may be for the government to serve as guarantor of educational loans, which cover both the opportunity costs and the direct costs associated with private educational investment. Some, however, doubt whether any loan program could effectively eliminate discrimination against investment in human capital [Balderston, 1970a], while others point out equity and efficiency arguments for the application of such a loan program to all types of private investment in human capital [Tobin, 1968].

Those individuals who most suffer from current imperfections in the capital market are the ones who cannot rely upon the family for financial support. These individuals, who by and large come from poor families, cannot undertake an investment in human capital in the absence of large educational subsidies or loans. In other words, students from low-income homes do not have equal access to funds for the financing of their higher education. This situation may argue for limiting government assistance--whether in the form of guaranteed loans or subsidized tuition--to children from poor families.[5] A policy of uniform low tuition, however, is a very expensive way of providing this specialized assistance.

In short, imperfections in the capital market do not provide a compelling argument for public support of higher education in the form of subsidized costs to all prospective private investors.

The case for public support of higher education must rest on the premise that it generates substantial benefits which are not captured by the individuals investing in their own human capital and would not be supplied in optimal amounts in the absence of governmental subsidies. In other words, higher education must have some of the characteristics of a public good.

Public Good Aspects of Higher Education.

The Samuelsonian public good has two main characteristics: (i) "jointness of supply" and (ii) "external economies" [Samuelson, 1954]. "Jointness" implies that one unit of a good can be made equally available to all.

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[5] A complicating factor in using parental income to determine which individuals warrant public assistance is that increasing numbers of students who are not parent-supported, especially students in older age groups, are enrolling in institutions of higher education.

Familiar examples in the literature of goods which display jointness yet are subject to price exclusion are outdoor circuses and highway bridges, although capacity limits in these cases prevent the good from becoming equally available to all. Joint consumption is a necessary but not sufficient condition for a good to be "public".

External economies give rise to severe exclusion problems; that is, it is impossible for private firms or individuals to exclude other firms or individuals from at least some part of the benefits (or costs) resulting from production or consumption of certain goods. The existence of external effects creates divergences between private and social benefits and costs; as a result, socially optimal conditions for production or consumption of those goods are not met.

Public interference in the market place is warranted if there are external economies, or the market does not operate to produce the socially optimal amount of a good which exhibits "jointness". For example, if left to the private sector, a price considerably higher than the marginal costs (near zero) would be charged for use of a highway bridge. A less than socially optimal use of the bridge will result. It is more efficient for the public sector to use general tax revenues to finance construction of the bridge and then charge nothing for use of the bridge (except where price rationing is desirable to reduce congestion).

As Samuelson [1955] admits, there are very few examples of commodities which satisfy his extreme polar case of a public good. Higher education clearly does not. Many of the benefits of higher education are privately appropriable, e.g., increased personal incomes of college graduates. However, some aspects of higher education do approximately satisfy the definition of a pure public good. Higher education does generate external

economies such as economic growth, technological advances, and new knowledge, and these outputs may be consumed in equal amounts by all.

To the extent higher education does result in external economies or public benefits as well as private benefits, it is a mixed, public-private good which requires mixed, public-private financing. If left entirely to the free market, the socially optimal amount of educational services will not be provided because of the divergence between private and social benefits. This fact is depicted in Figure 1. The society under study produces two goods, a pure private good--bread--and a mixed, public-private good--higher education. PP is the production-possibilities frontier between these two goods. The curves labeled U_i are the social utility isoquants depicting those combinations of goods which leave society as a whole equally well off. Of course, $U_3 > U_2 > U_1$.

If the external economies of higher education are recognized and government interferes to bring about optimal levels of production of education, the Pareto Optimal conditions will be satisfied and society will choose that combination of private and public goods which make it best off, at point T where the two lines are tangent. If government does not interfere, society will choose too much of the private good and choose a combination of public and private goods which puts it on a lower utility isoquant, such as at point T'.[6]

If government is to finance higher education so as to bring about optimal amounts of the goods exhibiting external economies, it must have some knowledge about the kinds and sizes of economic externalities

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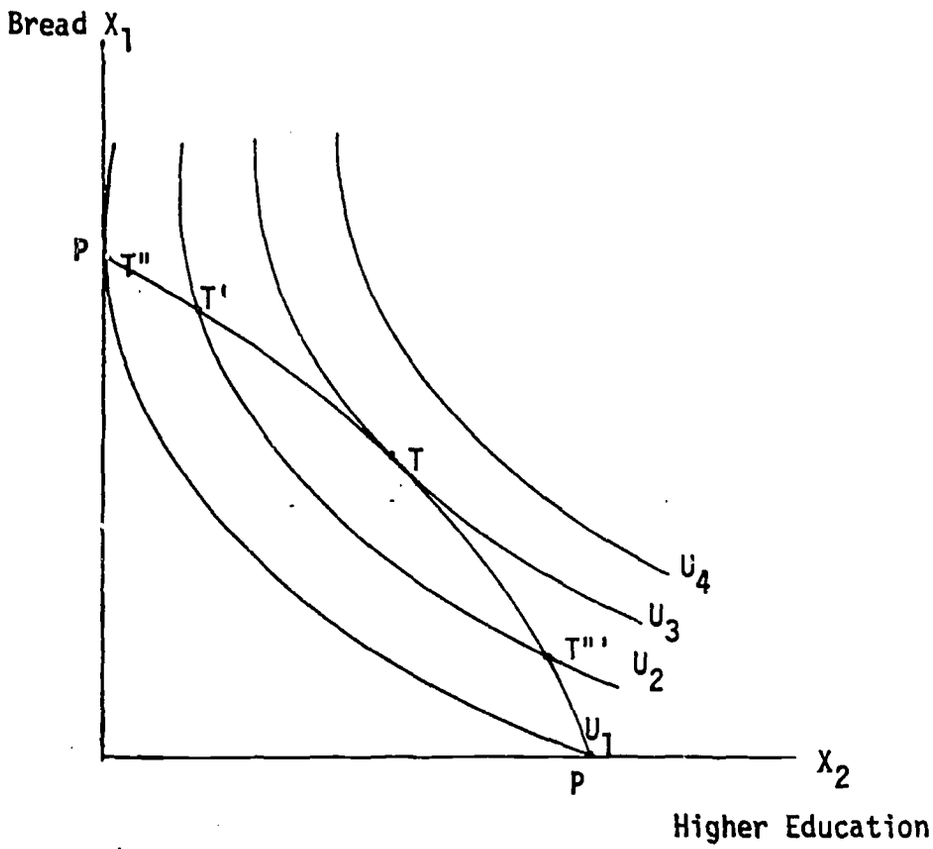
[6] If higher education were a pure public good, none of it would be produced in the absence of government subsidy, and society would end up producing it at point T". On the other hand, if government overestimates the size of external benefits and, hence, oversubsidizes higher education, society may end up over-producing higher education at, say, point T"'.

FIGURE 1



associated with the various outputs. Furthermore, the distribution of those externalities has implications for the level of government which should do the financing.

It is extremely unlikely that the social benefits generated by higher education are distributed uniformly geographically. While some benefits, such as those generated by medical research, may accrue to people of the nation or world as a whole, other benefits such as those associated with cultural activities may be largely confined to the immediate locality. Ideally, each level of government--local, regional, national--would subsidize higher education according to the distribution of public benefits. In reality, this can be done only very approximately because we lack precise knowledge of both the size and distribution of public benefits. However, to the extent the distribution of social benefits is not uniform, there exists an argument for higher education subsidies at every level of government.

Furthermore, there is no practical method of determining the optimal level of public subsidy of universities and colleges. We know that a public good or service should be provided up to that point where the marginal social benefit resulting from an additional unit of output is equal to the marginal social cost of that output. In the real world, the political process is used to approximate this rule. The correctness of the resulting solution depends in part on the amount and accuracy of information available to those collecting and allocating public funds. The lack of data on the social benefits of higher education then in and of itself discourages the efficient allocation of public monies between higher education and other activities.

3. Regional Strategies for Maximizing the Social Benefits of Higher Education

Our special interest in this paper is determining whether or not there exists a satisfactory rationale for regional or state finance of higher education. As determined in the previous section, a large component of this rationale must be the argument that higher education generates external economies or social benefits and that the geographical distribution of some of these benefits is concentrated within the state or region.

We shall attempt to determine the sizes and distributions of social benefits later. For now, let us assume that a state concludes that it receives benefits sufficient to warrant continued public subsidization of higher education. Hence, it grants the university administration a public budget.

If the administration of the state's public university system has the best interests of the regional citizenry in mind, it would then attempt to maximize the social benefits which accrue to those citizens. However, in so doing it would be constrained by the size of its budget as determined by the regional legislature. In short it would attempt to maximize regional welfare subject to a budget constraint imposed by the regional legislature.

This hypothetical behavior on the part of the administration is not necessarily unrealistic. The objective function of the university administration may very well be consistent with maximization of regional social welfare. Like Baumol's revenue-maximizing firm, the university may be interested in maximizing the size of its annual budget.[7] One way of

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[7] Indeed, the university may attempt to maximize its budget subject to a regional social-benefit constraint. See Niskanen [1971] for an analogous model of bureaucracy.

achieving its objective is to demonstrate to the legislature that public higher education generates an abundant flow of regional social benefits.

The remainder of this section entails the development of a theoretical model designed to suggest pricing guidelines to a university which has the objective discussed above--maximization of benefits accruing to the region. No public university is likely to have this as its sole objective, and some may have other objectives which are in conflict with it. However, we present this model not to accurately describe the real world but rather to suggest how a university with this objective should act in order to maximize regional welfare. It should furthermore be noted that if a real objective of a public university is to maximize its budget, it may face a trade-off between federal and state support. For example, increasing the size and prestige of graduate programs at the expense of undergraduate education may diminish state support but result in increased federal research and other support.

The non-technical reader is advised to skip the remainder of this section.

Assuming the hypothesized behavior on the part of the university administration, the objective function, maximization of the social benefits of higher education accruing to the region, can be written as follows:

$$W = W(\alpha_1 Q_1, \alpha_2 Q_2, \ldots, \alpha_n Q_n) \qquad (1)$$

where: W = an index of aggregate regional social benefits,

α_i = proportion of social benefits of the i^{th} output which accrues to citizens of the region, and

Q_i = level of production of i^{th} university output.

The university will maximize the objective function subject to its budget constraint:

$$B \geq \sum_i c_i Q_i \tag{2}$$

where: B = regional higher education budget in dollars and

c_i = regional dollar subsidy per unit of activity i.

The regional or state education budget is, of course, not identical to the total costs of education. Rather total costs are equal to aggregate regional subsidies and aggregate private costs[8]:

$$C = \sum_i C_i = \sum_i c_i Q_i + \sum_i p_i Q_i \tag{3}$$

where: C_i = private plus public costs of one unit of activity i and

p_i = price to consumers of one unit of activity i.

Furthermore, consumers have some demand for higher education outputs and that takes the form:

$$Q_i = Q_i(c_i, p_i, \ldots). \tag{4}$$

In other words, unless demand is extremely price inelastic, changing the public subsidy, ceteris paribus, will result in a change in the quantity of the i^{th} activity demanded by consumers or purchasers.

Setting up the Lagrangian for maximizing W subject to the budget constraint, we obtain the following expression from the first order conditions:

$$\frac{\alpha_i \frac{\partial W}{\partial Q_i}}{\alpha_j \frac{\partial W}{\partial Q_j}} = \frac{c_i \left[1 + \frac{1}{E_i}\right]}{c_j \left[1 + \frac{1}{E_j}\right]} \tag{5}$$

where E_i is the elasticity of demand for output Q_i with respect to the

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[8] To make the model correspond more closely to reality, we should take note of the subsidies granted by the federal government and private foundations.

subsidy c_i. The relationship between c_i and p_i is as follows:

$$c_i + p_i = k_i \tag{6}$$

where k_i is the average cost of production of Q_i. Hence, a decrease in c_i of \$1 is equivalent to an increase in p_i of \$1, and, assuming higher education to be a normal good, a decrease in c_i is reflected in a decrease in the quantity demanded, i.e., $\frac{\partial Q_i}{\partial c_i} \geq 0$ and thus $E_i \geq 0$.

The university should subsidize its outputs so as to bring about the equality given in equation (5). This equation provides the university with some guidelines or "subsidy-decision rules"[9] which should be followed in order to maximize the regional social benefits of higher education. Three of these guidelines are of special interest to us in this paper.

First, equation (5) indicates that, ceteris paribus, the larger the ratio of marginal social benefits of activity i to the marginal social benefits of activity j,

$$\frac{\frac{\partial W}{\partial Q_i}}{\frac{\partial W}{\partial Q_j}},$$

the larger should be the ratio of state dollar subsidy of activity i to the state dollar subsidy of activity j, $\frac{c_i}{c_j}$. In other words, larger marginal social benefits warrant a higher dollar subsidy from the state, although not necessarily a subsidy which is a higher proportion of unit costs,

$$\frac{c_i}{(c_i + p_i)}.$$

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[9] The term "subsidy-decision rules" is due to Mundel [1971].

Second, ceteris paribus, the production activity with a lower proportion of benefit spillouts to contiguous states and the nation as a whole should receive a higher state dollar subsidy, although, once again, not necessarily a subsidy which is a higher proportion of unit costs. That is, the smaller the ratio of benefit spillouts from activity i to benefit spillouts from activity j,

$$\frac{\alpha_i}{\alpha_j}$$

the larger should be the ratio

$$\frac{c_i}{c_j} .$$

On the other hand, the federal government should give matching grants for outputs of state universities in direct relation to the ratio

$$\frac{\alpha_i}{\alpha_j} ;$$

outputs which generate relatively larger benefit spillouts should receive relatively larger subsidies from the federal government.

The third guideline concerns the relationship between the size of subsidies received by the purchasers of the instructional outputs of higher education and the income levels of those purchasers (students). Assume that undergraduate instruction is the i^{th} production activity and that the marginal social benefits of the output of that activity decrease with an increase in the income level (Y) of the student. In other words,

$$\frac{\partial^2 W}{\partial Q_i \partial Y} < 0.$$

Then as Y increases in size, $\frac{\partial W}{\partial Q_i}$ decreases in size and the subsidy received should decrease with the income level of the student.

One of the major questions investigated by Mundel [1972a] is whether the social benefits of college instruction are larger for low income and low ability students; he concludes that they are larger, and, therefore, low income or low ability students warrant higher public subsidies than do high income or high ability students.

The above model and consequent decision rules are unrealistic in an important way. While they suggest behavior to maximize regional social benefits, the university administrator does not usually have the power to set either subsidy levels or output levels. These decisions usually are made jointly with faculty, students, and even state legislators; and it is unlikely that these groups all have the same objectives as the administrator.

If states and universities are to follow these guidelines in attempting to maximize regional social benefits, they need to know the approximate size of social benefits resulting from any one activity, the proportion of those benefits which spill over state boundaries, and how instructional benefits vary with income or ability levels of students. The focus of this paper lies with the first two categories of required information. The third category, the relationship between social benefits and student characteristics, has been ably and thoroughly investigated by Mundel in his doctoral dissertation.

Appendix to Section 3[10]

The objective function

$$W = W(\alpha_1 Q_1, \alpha_2 Q_2, \ldots, \alpha_n Q_n)$$

is maximized subject to the budget constraint

$$B \geq \sum_i c_i Q_i \tag{1}$$

Setting up the appropriate Lagrangian for the special case of two outputs only, we obtain

$$L = W(\alpha_1 Q_1, \alpha_2 Q_2) - \lambda(B - \sum_{i=1}^{z} c_i Q_i). \tag{2}$$

The university wishes to allocate its budget between these outputs so as to maximize this expression. We take the derivative with respect to c_1 and derive

$$\alpha_1 \frac{\partial W}{\partial Q_1} \frac{\partial Q_1}{\partial c_1} + \alpha_2 \frac{\partial W}{\partial Q_2} \frac{\partial Q_2}{\partial c_1} + \lambda\left[c_1 \frac{\partial Q_1}{\partial c_1} + Q_1 + c_2 \frac{\partial Q_2}{\partial c_1}\right] = 0. \tag{3}$$

A similar result is obtained when taking the derivative with respect to c_2.

Assuming the level of subsidy for one output has no effect on the quantity demanded of the other output (i.e., zero cross-elasticities of demand) we have

$$\alpha_1 \frac{\partial W}{\partial Q_1} \frac{\partial Q_1}{\partial c_1} + \lambda\left[c_1 \frac{\partial Q_1}{\partial c_1} + Q_1\right] = 0. \tag{4}$$

Multiplying by $\frac{c_1}{Q_1}$

$$\alpha_1 \frac{\partial W}{\partial Q_1} \frac{\partial Q_1}{\partial c_1} \frac{c_1}{Q_1} + \lambda\left[c_1 \frac{\partial Q_1}{\partial c_1} \frac{c_1}{Q_1} + Q_1 \frac{c_1}{Q_1}\right] = 0$$

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[10] The derivation of the first-order conditions for maximization of regional social benefits subject to a public budget constraint is motivated by the work of Mandel [1971].

$$\alpha_1 \frac{\partial W}{\partial Q_1} E_1 + \lambda(c_1 E_1 + C_1) = 0 \tag{5}$$

where $E_1 \geq 0$ because $\frac{\partial Q_1}{\partial C_1} \geq 0$ or,

$$\alpha_1 \frac{\partial W}{\partial Q_1} = -\lambda[C_1(1 + \frac{1}{E_1})]. \tag{6}$$

Similarly we obtain for Q_2,

$$\alpha_1 \frac{\partial W}{\partial Q_2} = -\lambda[C_2(1 + \frac{1}{E_2})]. \tag{7}$$

Dividing (6) by (7),

$$\frac{\alpha_1 \frac{\partial W}{\partial Q_1}}{\alpha_2 \frac{\partial W}{\partial Q_2}} = \frac{c_1 (1 + \frac{1}{E_1})}{c_2 (1 + \frac{1}{E_2})}.$$

The university should subsidize its outputs so as to bring about this equality.

4. Activities of Higher Education

Prior to considering the social benefits of higher education, let us identify the activities and outputs which generate those external effects. There exists literature which attempts to do just that [WICHE, 1968; Balderston, 1970b]. We adopt a classification with which most educational researchers would probably agree.[11] In Table III we specify, first, the major activities of a university, second, the separable objectives of those activities, and, third, the outputs of those activities. This classification is adopted for convenience and acceptance of it on the part of the reader is not necessary for the remainder of our analysis to be valid. Universities generally see themselves as having three major activities: (i) teaching, (ii) research, and (iii) public service. Each of those activities has several objectives and produces multiple outputs.[12]

This classification is obviously not entirely realistic. The objectives and outputs of the teaching activity, for example, may vary depending on the level of instruction--undergraduate or graduate--and the kind of instruction--humanities or science. Where the size of externalities may vary greatly within the output categories given in Table III, we make note of the fact. However, in general, given the primitive state of the art in identifying and measuring educational externalities and the further difficulty in determining the specific activities and outputs which produce those externalities, our simple scheme will more than suffice.

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[11] A much more comprehensive classification scheme is provided in a recent WICHE [1973] publication.

[12] We have adapted the nomenclature used by the National Science Foundation for research and development activities.

TABLE III

Classification of Higher Education Activities, Objectives, and Outputs

Activities	Objectives	Outputs
Teaching	Instruction	Impart Skills and mode of thinking
	Socialization	Impart attitudes and cultural values
	Certification	Match student interests with careers and rank according to aptitude
Research	Development	Application of existing knowledge to the development of new products
	Basic and Applied Research	Discover new knowledge and find solutions to problems
Public service	Diffusion of Knowledge	Provide library services, expert personnel, and extension courses
	Patron of arts	Provide cultural activities and experiences

5. Social Benefits of Higher Education Outputs

The outputs of higher education include external effects for which the purchasers of educational services receive no payment via the private market economy. In the following pages we attempt to identify and measure some of the external effects associated with higher education outputs, keeping in mind that the relevant output measure is one of educational value-added, that is, changes in attitudes, productivity, knowledge, and other individual and societal characteristics.

Past research provides very little guidance in our efforts. Typically, spokesmen for higher education have been extravagant in their claims about social benefits, while critics have taken the attitude that what you can't easily see doesn't exist. For example, Bowen [1971] cites as a social benefit from university instruction that it results in "Enhancing manners and refinement of conduct and beauty of surroundings and thus adding to the graciousness and reducing the tensions of social intercourse." On the other hand, lack of empirical evidence has lead to claims by some that the benefits of higher education are negligible. Singer and Feldman [1969] state, "...lack of serious effort to measure these benefits by proponents of public subsidies to higher education suggests that the magnitude of external benefits is not likely to provide much basis for government subsidies."

Instruction.

Instruction at both the undergraduate and graduate levels imparts new skills, knowledge, and modes of thinking to recipients. These outputs increase the human capital embodiment of students and make them more productive individuals. Under the assumption that the market rewards

individuals in accordance with their productivity, studies on the rates of return to investment in higher education certainly confirm the hypothesis that most college-trained individuals are more productive than most non-college-trained individuals. The private returns from investing in a college education are sizeable for most individuals even after controlling for other determinants of human capital such as family contacts and innate ability [Hause, 1972].

Assuming that college instruction makes some independent contribution to labor productivity, what external effects are thereby generated? We consider three. First, educated manpower may be an important source of economic growth. Second, increased incomes change the patterns of demand for and use of publicly-provided goods and services. Third, increased incomes change the total amount of local, state, and federal tax payments paid by individuals. Changes in the use of and payment for governmental services do not necessarily entail large changes in resource use, but they do affect the distribution of income in society. For example, increased tax payments on the part of college-educated persons may affect the taxes paid by other individuals in society.

a. Contribution to Economic Growth.

As the technology of the industrialized economy becomes increasingly complex, labor is required which is highly skilled, flexible, and innovative. In short, many of the required characteristics are those which higher education contributes to improvements in human capital. Hence, it is often argued, higher education is likely to make a substantial contribution to economic growth.[13]

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[13] General manpower considerations and the desire to assure an appropriately trained manpower supply have been a dominant reason for federal subsidy of higher education during the past decade or two.

This argument is supported by research aimed at providing empirical estimates of the contribution of improved labor quality to economic growth. We can identify at least three approaches to the question of the contribution of education to economic growth. The international comparisons approach has correlated per capita income levels with educational or literacy levels in countries at various stages of economic development.[14] The results are unconvincing for one cannot sort out the direction of causation: do increased educational levels cause increases in per capita income, or do increases in per capita income cause increased consumption of education?

The residual approach consists of attempting to explain economic growth by taking account of increases of inputs used in the production process over some time period. The unexplained part of economic growth, the residual, is then said to in part measure the effects of improved education in the society. Solow [1957] attempted to explain the increase in output per man-hour in the private, non-agricultural economy of the United States in the period 1909-1949 and found a residual of 87.5% which he labeled "technical progress". He furthermore postulated that this residual in part reflects the effects of improved education of the labor force. Another study using the residual approach was conducted by Denison [1962], who estimated that increased education per worker accounted for 23% of the growth of national (U.S.) income in the period 1929-1957. His estimate was arbitrarily adjusted for innate ability and socio-economic background.

The third approach explicitly includes changes in labor quality as a determinant of economic output. Schultz [1961] estimated the educational stock in cost terms and applied a rate of return to arrive at the economic

[14]For an example of this approach and a discussion of its shortcomings, see Harbison and Myers [1964] and Bowman [1966].

value of education. He then divided this figure by GNP to arrive at the percentage contribution of education to economic growth. The results, of course, are sensitive to the assumed rate of return to investment in education. Using a number of estimates of the rate of return, Schultz concluded that 16.5 - 20.0% of economic growth in the U.S. over the period 1929-1956 can be accounted for by additional schooling in the labor force.

A variant of this third approach is the estimation of aggregate production functions. Estimating a modified Cobb-Douglas function, Thurow [1969] found that 22% of output growth in the United States between 1929-1957 could be accounted for by improvements in quality of the labor stock. Also using a Cobb-Douglas function, Griliches [1970] has estimated aggregate production functions for single manufacturing or agricultural sectors. He concludes that there is "reasonably strong evidence on the aggregate productivity of education."

Taken together these studies appear to support the contention that increased education has contributed to economic growth, especially for the period 1929-1957 in the United States. Furthermore, as the proportion of the U.S. population obtaining a college education was increasing rapidly over that period, it is likely that higher education accounts for a large part of education's contribution to economic growth during that period.

In this age of environmental awareness it does not suffice to say simply that economic growth is a public "good". However, recognizing that growth entails significant social costs, we shall point out a few of its possible regional social benefits. The most important of these may be an increased opportunity for social mobility. Economic growth may also

increase the demand for less highly educated manpower and thereby increase their real incomes. That is, there may be interdependencies among factors of production, and highly educated individuals may not be able to fully capture their contribution to economic productivity. Citizens of a region may also value economic growth because it results in higher property values and windfall gains to the owners of property.

b. Changes in the Use of Publicly-Provided Goods and Services.

A college education may lead to a change in one's use of publicly-provided goods and services. This change in use or demand is due to (i) an income effect and (ii) a taste effect. Increased human capital and the resulting higher income stream attributable to higher education may change an individual's effective demand for welfare services, parks and recreational services, and even the custodial services of prisons. The socializing experience of higher education may change an individual's tastes for libraries, theatre, and public education. While conceptually one can distinguish between income and taste effects, practically it is very difficult to derive empirical estimates of these separate effects, and in general we shall not attempt to do so in this paper. However, it should be noted that to the extent the change in use of some public good is attributed to the family or other non-school factors our empirical work imparts an upward bias to the independent effect of higher education.

A study by Benson and Lund [1969] provides us with some empirical evidence regarding the relationship between education and income and the use pattern of local government goods and services. From their data we can compare the use pattern of relatively low-income neighborhoods having median educational levels of approximately twelve years with the use pattern of high-income neighborhoods having median educational levels of

approximately sixteen years. Their results show that the low-income, low-education neighborhoods make very high use of health care facilities, police services, recreation centers, and special school programs for the educationally handicapped and mentally retarded, while making low use of libraries, vacation camps, elementary summer school, and special school programs in music and drama. On the other hand, the high-income, high-education neighborhoods make high use of libraries, vacation camps, elementary summer school, and special school programs in music, drama, and publications and low use of precisely those services which low-income neighborhoods use intensively.

Higher education not only influences the pattern of demand for governmental goods and services, it also influences the level of that demand. Neenan [1972] cites the results of several voter referenda concerning expenditure proposals of local government. Typically these referenda posit an increase in the local tax rate for an increase in the level of some locally provided public service. The results of these referenda typically indicate that the percent of yes votes (in favor of the expenditure and tax increase) increases with the average income level of the voting precinct.[15]

Obtaining a college education may lead to reduced use of some local and state publicly-provided goods and services; we consider two such services below--crime and welfare. To the extent that this reduction allows resources to be allocated to alternative uses, the regional society as a whole may benefit. For example, if crime can be reduced through increased education, society can use the resources previously employed in crime prevention for the attainment of other social objectives. Or, if increased education improves the employability of individuals, those individuals may begin contributing to the total material output of society;

[15] A study by Shapiro [1972] indicates that the demand for public goods of an environmental nature also varies by citizen income levels.

one measure of the potential contribution of education to regional welfare in this respect is the reduction in unemployment or welfare incidence attributable to the increased education.

b-1. Crime

The total costs of crime have been estimated at $21 billion for 1965 by the President's Commission on Law Enforcement and Administration of Justice [1967]. Not all these costs are social costs in terms of resources used; rather, some are simply transfers of incomes between groups of people, an enforced redistribution of income. However, the real costs of crime are not miniscule. For example, the President's Commission estimated that $4.2 billion was spent on law enforcement while close to $2 billion was spent on private crime prevention and insurance.

The probability that an individual will commit an economic crime is determined by many factors--social and religious values, probability of capture, probability of conviction if captured, income to be gained from committing the crime, opportunity cost of incarceration, and other private costs such as the price of counsel. Higher education is likely to influence the probability of an individual committing a crime largely through its effects on the income, occupational status, and employability of the individual which increase the opportunity cost of imprisonment.

Ideally, we would like to know the independent effect of level of education (E_i) on the probability (a_i) that an individual commits an economic crime (C), labeled

$$P(C/E_i) = a_i.$$

The contribution of additional increment of education to lowering the probability of criminal activity is then

$$B_i = a_{i+1} - a_i.$$

Data on these probabilities are nonexistent. However, we can approximate them by estimating the probabilities that individuals of different educational levels will end up in correctional institutions. The resulting estimates of the contribution of education to lowering the probability of being incarcerated are biased upwards due to the fact that high-education, high-income individuals can afford better legal counsel.

In Table IV we report the distributions of criminal (P_c) and non-criminal (P_{nc}) populations by level of education. From this data we calculate the probability that an individual falling into one educational class will commit a crime which rewards him with attendance in a criminal institution ($\hat{a}_i$). As expected, the probability of committing a crime decreases with increasing level of education. Furthermore, there are decreasing returns (to lowering the probability of criminal activity) associated with increasing levels of education. For example, between grade school and high school graduates, the change in probability is .003, whereas between high school and college graduates the change in probability is .001.

b-2. Unemployment and Welfare.

Government statistics consistently indicate lower rates of unemployment for college-educated persons. The causes may be that college instruction makes individuals more adaptable in terms of acquiring skills, teaches persons how to locate employment, and makes people more mobile and ready to move if the employment situation looks brighter elsewhere. In addition to increased social output resulting from employment, society benefits if employment flexibility alters the relationship between unemployment and price inflation (the so-called Phillips curve) for the economy, allowing a lower unemployment rate for a given rate of price change.

Society suffers materially when labor is unemployed and unproductive;

TABLE IV

Criminal Activity and Educational Levels

of the Criminal and Non-criminal Male Populace 25 Years and Older, United States, 1960.

Years of Education	P_{nc}(%)	P_c(%)	$\hat{a}_i$	$\hat{B}_i$	P_c/P_{nc}
0 - 8	41.7	57.5	.0045	------	1.38
9 - 11	18.7	27.0	.0047	-.0002	1.44
12	21.4	11.1	.0017	+.0030	.52
13 - 15	8.6	3.5	.0013	+.0004	.41
16	9.6	.9	.0003	+.0010	.09
Total Population:	47,930,569	156,280			

Source: United States Census Bureau, U.S. Census of Population 1960, "Volume 1, Characteristics of the Population, Part 1, U.S. Summary," Table 76 and "Inmates of Institutions," PC(2)8A, p. 24.

it also suffers when resources are used in the administration of programs designed to give assistance to the unemployed and welfare recipients. The total money costs of public assistance in 1970 were almost $6 billion for the nation as a whole. Both resource and money costs might have been lower if historically a larger proportion of children from poor homes had been able to obtain college educations.

As shown in Table V, the educational attainment of parents of families receiving AFDC (Aid to Families with Dependent Children) benefits is considerably lower than that for parents of non-recipient families. Furthermore, the incidence of AFDC status is lowest among families where women have had some college education.

Education, furthermore, appears to have some effect on welfare status which is independent of income or hourly wage, at least for families where the hourly wage earned by the head of household is low. In Table VI we report, by hourly wage and head of household sex for AFDC eligible families, the mean proportion of income which is derived from AFDC payments (AFDC/Y), that same proportion for nonwhites who are not high school graduates and have no preschool children (the base group), and the adjustment figure for the base group if the head of household has a high school education or better (high school). Having a high school education or better is associated with a lower proportion of income derived from AFDC payments. The independent effect of education may be a result of the socializing experience of education. In other words, people's values or attitudes may have been changed such that they are less likely to go on welfare if they are eligible.

b-3. Tax Payments.

As numerous studies have shown, years of education is clearly a

TABLE V

Percentage distribution of all women aged 20-54 in the United States, 1960, by years of schooling completed.

Years of Schooling Completed	Women Aged 20-54 in the General Population 1/	Mothers in the Home in AFDC Families 2/
Total Number	39,990,513	773,000
Total Percent	100.0	100.0
Elementary School	24.4	53.2
None or Less Than 5 Years	3.5	13.7
5 - 7 Years	9.0	20.6
8 Years	11.9	18.9
High School	58.2	44.9
1 - 3 Years	22.2	30.8
4 Years	36.0	14.1
College	17.2	1.9
1 - 3 Years	10.8	1.7
4 Years or More	6.4	.2
Median Years Completed	12.1	8.8

1/ Source: United States Census of Population, 1960 P.C. (1), ID, U.S.

2/ Excludes Guam, Puerto Rico, and the Virgin Islands; unknown cases are distributed.

Source: Mugge, Robert. "Education and AFDC." Welfare in Review, Vol. 2, No. 1, January 1964, p. 2.

TABLE VI

Family AFDC Choices by Education and Hourly Wage Rate

	Female Head of Household		Male Head of Household		
Hourly Wage	$0. - 2.00	$2. - 3.50	$2. - 3.50	$3.50 - 4.50	$4.50 - 5.50
AFDC/Y	84.02	73.13	61.66	45.20	16.92
Base Group	77.30*	40.80*	17.36*	0.59	4.95
High School	-9.45*	-17.00*	-11.49*	-1.93	3.30

*Statistically significant at the .05 level or better.

Source: Barr, Nicholas A. Public Assistance and Family Behaviour in the Urban United States. Unpublished Ph.D. Dissertation, University of California, Berkeley, 1971. Table 8-4, page 286.

component of human capital and thereby affects income levels. For example, Table VII reports expected annual earnings of college and non-college educated individuals by age and race for the northern United States. These data were computed by Hanoch [1967] in an analysis of 1960 census data.

As a result of higher incomes, college-educated individuals in general pay higher state and federal taxes than persons who have not attended college. Furthermore, if the particular tax structure is progressive, college-educated individuals will pay a higher proportion of their income in taxes. For example, using Hanoch's figures it has been estimated that the increase in federal income tax payments attributable to a college education for northern whites is $42 at age 27, $258 at age 37, and $406 at age 47.[16]

State governments also on the average receive larger tax revenues from college educated than from non-college educated individuals. To the extent the additional taxes paid by college educated persons exceed the value of the public services they use, the tax payments of other members of society will be reduced. In this redistributive sense, society as a whole benefits from the increased tax payments of highly educated, high-income individuals.

We can compute the additional taxes paid by college-educated persons for individual states; we use California as an example. Using the 1965 tax burdens by income classes for the state of California and adjusting Hanoch's income figures to account for price changes between 1959 and 1965, we obtain the results given in Table VIII.[17]

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[16] Mundel [1972], p. 430.

[17] Changes in the California tax structure since 1965 may make these numbers a poor picture of additional taxes paid by college-educated persons in 1973.

TABLE VII

Expected Annual Earnings at Selected Ages

by Level of Schooling and Race for the Northern United States

Age	Years of School Completed			
	8	12	16	17+
	Whites			
14				
18	1174			
22	2301	2930		
27	3498	4461	5602	
37	4809	6052	8713	9578
47	4967	6281	10,109	12,138
57	4506	6023	9677	11,398
	Non-Whites			
14				
18	646			
22	1529	2122		
27	2337	3201	3249	
37	3197	3989	5146	7834
47	3412	3205	4480	9129
57	3674	3361	2543	6561

Source: Hanoch [1967], pp. 316-7.

The results indicate that at age 47 a white male with a four-year college education is likely to pay $141 more in state taxes and $265 more in state and local taxes combined than does a high school graduate. Graduate work beyond the B.A. degree results in $100 more in state taxes and $169 more in state and local taxes than those taxes paid by individuals with B.A. degrees only. The additional tax payments attributable to higher education are smaller for non-whites than for whites and even become negative for non-whites aged 57. However, these figures are derived from cross-sectional, not longitudinal, data and may not accurately predict changes in tax payments by young people currently attending institutions of higher education. It is quite plausible that, compared to whites or younger non-whites, older non-whites have, by and large, attended lower-quality institutions of higher education, which is reflected in their productivities and earnings, and have encountered more racial discrimination in employment, which has reduced their earnings below their contributions to output.

b-4. A Caveat.

Our analysis of the impacts of college education on public expenditures and public revenues has assumed that an increase in education results in increased productivity which is rewarded in the market. However, to the extent a college-educated person "bumps" a non-college-educated person into a lower-paying job, we would expect no change in public expenditures or public revenues unless there was a strong shift in tastes on the part of the college-educated person. Unfortunately, there is little evidence as to the validity of our assumption.

TABLE VIII

Average California State and Local Taxes, by Level of Education*

	Years of School Completed						Changes in Tax Payments			
	12		16		17+		16 - 12		17+ - 16	
Age	State	State & Local	State	State & Local	State	State & Local	State	State & Local	State	State & Local
				Whites						
27	128	515	142	505	---	---	+14	-10	---	---
37	153	545	230	737	284	800	+77	+192	+54	+63
47	159	566	300	844	400	1013	+141	+278	+100	+169
57	152	543	287	808	374	952	+135	+265	+87	+144
				Non-Whites						
27	183	833	186	846	---	---	+3	+13	---	---
37	114	460	147	593	207	663	+33	+133	+60	+73
47	123	497	128	517	271	763	+5	+20	+143	+246
57	192	875	145	662	166	591	-47	-213	+21	-71

Source: Calculated from Table VII income figures, adjusted for price changes between 1959 and 1965, and California 1965 tax burdens by income class as reported in Hansen and Weisbrod [1969], Table 9.

*See footnote 17.

Socialization

a. Value and Attitude Changes

College appears to have substantial impact on the values and attitudes of students. For example, individuals having completed college tend to be less authoritarian and exhibit less dogmatism and prejudice than they did as entering freshmen. In their exhaustive review of studies on the impact of college on students, Feldman and Newcomb [1969] draw the following conclusions:[18]

* The degree and nature of different colleges' impacts vary with their student inputs--that is, entering students' charateristics, which differ among types of colleges in patterned ways.
* Within the same college, experiences associated with the pursuit of different academic majors typically have effects over and beyond those that can be accounted for by initial selection into those major fields.
* The conditions for campus-wide impacts appear to have been most frequently provided in small, residential, four-year colleges.
* In addition to the effects of campus-wide influences and the pressures of subenvironments, college impacts are conditioned by the background and personality of the student.
* Attitudes held by students upon leaving college tend to persist thereafter, particularly as a consequence of living in post-college environments that support those attitudes.

Although it is quite evident that individuals change their values and attitudes while in college, two other questions remain largely unanswered:

(i) Would college-educated persons have developed similar attitudes if they had not attended college; and

(ii) Are the changes in values and attitudes which take place of benefit to society?

While studies to date do not provide a satisfactory answer to the first question, we can at least compare the values of college graduates with those of non-college graduates. As an example, consider the difference in political participation between these two groups. The 1968

[18] Feldman and Newcomb, pp. 325-338.

national election study by the Survey Research Center at the University of Michigan found for its sample of respondents that 47% of college graduates had at one time written to a public official compared to 13% of respondents having no college education. 21% of college graduates and 6% of non-college graduates had given money for political campaigns. 89% of college graduates and 72% of non-college graduates reported voting in the 1968 elections. Last, 10% of college graduates and 5% of non-college graduates reported having worked for a political party or candidate.[19]

Assuming that the college experience does in fact result in values and attitudes different from what they would have been in the absence of that experience, some of the value changes may be of social benefit. Certainly political participation is positively valued in a democratic society and the evidence cited above suggests that college is likely to increase that participation.

Other attitude changes may also be of social benefit, especially attitude changes of students from low-income backgrounds. The size of change in attitudes and values may be larger for low-income students; such students report being less influenced by their families while in college than do students from middle or high income families.[20] Hence, while value changes of middle-income students are in part likely to be due to the home influence, value changes of low-income students may be more completely due to the college experience. While Feldman and Newcomb indicate that the evidence regarding college impacts and student socio-economic status is quite mixed, one study they cite is of particular

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[19] Taylor and Wolfe [1971], pp. 114-119.

[20] Feldman and Newcomb, p. 278.

interest. Working class students attending a Catholic women's college in the Midwest were discovered to be more likely than other students to adopt a more liberal and less moralistic religious orientation.[21]

While changes in religious preferences are unlikely to be of social benefit, other value changes may be. We hypothesize that, compared to their non-college peers, graduates from low-income backgrounds may feel a greater faith and stake in the system and, hence, independent of income effects, may be less likely to impose costs on society in the form of violence or crime and more likely to offer positive leadership. For example, Chapman [1971] found that independent of income, there is a negative association between median years of education in a community and number of crimes committed; furthermore, the elasticity of crime with respect to education is greater than one.

The evidence suggests that values and attitudes change while in college, those changes persist after college, and low-income students may experience larger changes than high-income students. From this incomplete and inconclusive information we venture to make two propositions. The first is that the marginal attitude changes and, hence, social benefits of a given year of education decrease with the income level of the recipient of that education. The second is that the marginal attitude changes and social benefits of education are likely to be decreasing functions of the number of years of education obtained by the individual. In other words, we believe it is unlikely that graduate education results in many social benefits in the form of changing values and attitudes.

b. Intergenerational Effects.

The intergenerational effects of higher education are of two varieties,

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[21] Feldman and Newcomb, p. 281.

intra-familial and inter-familial effects. Intra-familial effects of higher education correspond to the private benefits of higher education, except in this case the family is the unit of analysis and the intra-generational benefits of higher education are appropriable by the family, although not by the person who received the higher education. Parental education has a strong independent effect on (i) the quality of student achievement as measured by standardized test scores and (ii) the years of education received by children. Bowles [1970] and others have found a strong relationship between years of parental education and student reading scores for a national sample of black males; Winkler [1972] found for a sample of sixth grade whites that, ceteris paribus, having a college-educated father is associated with a better than eight percentile point advantage in reading scores over students having fathers with less than a college education.

The major inter-generational social benefit is a result of the impact that offspring of well-educated parents have upon their school and neighborhood peers. These are the inter-familial effects. Winkler found the socio-economic composition of the school peer group to be one of the most important determinants of student scores on reading and I.Q. tests. For example, in terms of eighth grade percentile reading scores, having a school peer group composed of more than 45% low peers (as opposed to one of fewer than 15% low socio-economic status peers) reduces levels of achievement by more than 14 points for Blacks and more than 22 points for Whites.

To the extent that receipt of a college education is attributable to parental education, the social benefits associated with higher education of the next generation are attributable to the higher education of the present generation. Of course, this means that to avoid double-counting one should then discount social benefits attributable to higher education

of the present generation for the influence of their parents' education. The net change in social benefits from higher education of any one generation is very small unless the proportion of college graduates varies greatly over time.

Certification

Higher education certifies the competence and performance of students by giving them three labels, name of the college or university, major in school, and rank in class. All three factors are important determinants of one's future income stream and may reflect worker productivity.[22] Certification also results in private non-monetary benefits; for example, it matches student interests with occupational training.

Higher education thus performs an important function, which is to provide employers with information about job applicants and thereby contribute to the efficient allocation of resources. Improved economic efficiency, like improvements in technology, can be a public good.

Of course, business and government employers might be expected to gather information on prospective employees in the absence of the university certification process. However, higher education may provide information which is more complete and less costly. Furthermore, the information gathered by one employer may not be easily transferable to another employer, either because the information is not equally useful to both firms or because one firm is not willing to provide another with a free good.

To the extent it results in improved general economic efficiency and is less costly in terms of resource use than private evaluations, the

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[22] For example, see Razin and Campbell [1972], Weisbrod and Karpoff [1968], and Wise [1973].

higher education certification process generates positive externalities.

Critics of the thesis that certification results in improved economic efficiency argue that employers oftentimes impose educational requirements which are unrelated to the task the employee performs. For example, Berg [1971] has stated:

> This purposeless credential consciousness further handicaps education, especially higher education, in the pursuit of its promise to liberate people and to help preserve for a society its better traditions and commitments. [p. 190]

In addition it is argued that higher education may certify social class or family background as well as performance and competence. To the extent this is true, upward social mobility may be lessened.

Migration of College Graduates

The distribution of social benefits associated with the instructional component of higher education is of course, integrally linked to the residential location choices of the individuals having received that education.[23] Perhaps the best measure of the distribution of these social benefits is then the proportion of college graduates leaving the state of education to seek employment in another state or region.

No readily available sources of data classify migrant subgroups according to the location of high school and college attendance. Hence, with respect to recipients of bachelors or masters degrees, we are unable to determine what numbers or proportions of graduates leave the state or region of education to seek employment in another state or region. However, the decennial Census of Population does provide data on the educational attainment of flows of migrants between census divisions.

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[23] This point was first developed with respect to elementary education by Weisbrod [1965].

Table IX provides the following migration ratio for each level of education, by census division:

$$\frac{\text{number of migrants with X years of education leaving the region between 1955 and 1960}}{\text{number of residents with X years of education living in the region as of 1960}}$$

The resulting ratios clearly indicate that the probability of an individual migrating from a given state increases with the level of education. For example, for the Northeast, the probability of a college graduate moving out of the region is almost three times the probability of a high school graduate moving, and more than seven times the probability of an elementary school graduate moving.

More precise data are available with respect to Ph.D. migration alone. That data is given in Table X and shows that the fraction of Ph.D.'s trained in a given state who leave to take jobs elsewhere varies from 42.1% in California to 91.5% in New Hampshire. The number of Ph.D. immigrants as a proportion of Ph.D.'s trained in the state varies from a high of 1,787.5% for Nevada to a low of 28.9% for Iowa.

Some states losing large proportions of the Ph.D.'s they train probably do not offer sufficient employment opportunities to keep them, but in general there appears to be no straightforward correspondence between percent of Ph.D.'s leaving to take jobs and the percent of Ph.D.'s migrating into the state to take jobs. For example, while Nevada has a very high proportion of Ph.D. inmigrants, which probably indicates good employment opportunities, it also loses 87.5% of the Ph.D.'s it trains.

All this serves to point out two facts. First, college graduates--B.A.'s and Ph.D.'s--are mobile and more mobile than the population as a whole. Second, mobility appears to increase with the level of education. A state should take into consideration the proportion of college graduates

TABLE IX

Numbers of Outmigrants as a Percentage of Numbers of Residents with Given Levels of Education, by Region.

Region	Educational Level		
	16 Years	12 Years	8 Years
Northeast	13.96	4.98	1.88
Middle Atlantic	11.52	4.20	1.62
East North Central	11.99	5.13	2.41
West North Central	17.22	7.82	3.03
South Atlantic	12.76	7.41	3.54
East South Central	17.82	14.09	4.34
West South Central	13.29	8.15	4.19
Mountain	18.24	11.08	6.79
Pacific	7.13	4.66	2.40

Source: U.S. Department of Commerce, Bureau of the Census, Lifetime and Recent Migration, Table 7, pp. 426-429, and U.S. Summary, Table 115, p. 260.

TABLE X

Ph.D. Outmigration, Inmigration, and Net Migration by State for the Period 1957-1967.

(1) State	(2) Ph.D.'s Trained in State of Origin	(3) Outmigration of Ph.D.'s Trained in State of Origin	(4) $\frac{(3)}{(2)}$ x 100%	(5) Inmigration of Ph.D.'s	(6) $\frac{(5)}{(2)}$ x 100%	(7) Net Migration (5) - (3)	(8) $\frac{(7)}{(2)}$ x 100%
Alabama	493	- 293	-59.4	+ 585	+ 118.7	+ 292	+ 59.3
Arizona	578	- 402	-69.6	+ 571	+ 98.8	+ 169	+ 29.2
Arkansas	344	- 258	-75.0	+ 324	+ 94.2	+ 66	+ 19.2
California	8768	- 3693	-42.1	+4936	+ 56.3	+1243	+ 14.2
Colorado	1735	- 1269	-73.1	+1028	+ 59.3	- 241	- 13.8
Connecticut	2125	- 1606	-75.6	+1220	+ 57.4	- 386	- 18.2
Delaware	208	- 160	-76.9	+ 722	+ 347.1	+ 562	+ 270.2
D. of C.	1520	- 1008	-66.3	+1658	+ 109.1	+ 650	+ 42.8
Florida	1546	- 1034	-66.9	+1005	+ 65.0	- 29	- 1.9
Georgia	743	- 459	-61.8	+ 893	+ 120.2	+ 434	+ 58.4
Idaho	41	- 36	-87.8	+ 278	+ 678.0	+ 242	+ 590.2
Illinois	6299	- 4427	-70.3	+2668	+ 42.4	-1759	- 27.9
Indiana	4231	- 3322	-78.5	+1408	+ 33.3	-1914	- 45.2

TABLE X

Ph.D. Outmigration, Inmigration, and Net Migration by State for the Period 1957-1967.

(1) State	(2) Ph.D.'s Trained in State of Origin	(3) Outmigration of Ph.D.'s Trained in State of Origin	(4) $\frac{(3)}{(2)} \times 100\%$	(5) Inmigration of Ph.D.'s	(6) $\frac{(5)}{(2)} \times 100\%$	(7) Net Migration (5) - (3)	(8) $\frac{(7)}{(2)} \times 100\%$
Iowa	2566	-2017	-78.6	+ 741	+ 28.9	-1276	- 49.7
Kansas	929	- 709	-76.3	+ 900	+ 96.9	+ 191	+ 20.6
Kentucky	429	- 269	-62.7	+ 652	+ 152.0	+ 383	+ 89.3
Louisiana	951	- 596	-62.7	+ 876	+ 92.1	+ 280	+ 29.4
Maine	25	- 19	-76.0	+ 282	+1128.0	+ 263	+1052.0
Maryland	1636	-1072	-65.5	+1679	+ 102.6	+ 607	+ 37.1
Massachusetts	5896	-3599	-61.0	+2292	+ 38.9	-1307	- 22.1
Michigan	4546	-2927	-64.4	+1802	+ 39.6	-1125	- 24.8
Minnesota	1798	-1224	-68.1	+1007	+ 56.0	- 217	- 12.1
Mississippi	263	- 162	-61.6	+ 387	+ 147.1	+ 225	+ 85.5
Missouri	1666	=1091	-65.5	+1170	+ 70.2	+ 79	+ 4.7
Montana	140	- 102	-72.9	+ 238	+ 170.0	+ 136	+ 97.1

TABLE X

Ph.D. Outmigration, Inmigration, and Net Migration by State for the Period 1957-1967.

(1) State	(2) Ph.D.'s Trained in State of Origin	(3) Outmigration of Ph.D.'s Trained in State of Origin	(4) $\frac{(3)}{(2)}$ x 100%	(5) Inmigration of Ph.D.'s	(6) $\frac{(5)}{(2)}$ x 100%	(7) Net Migration (5) - (3)	(8) $\frac{(7)}{(2)}$ x 100%
Nebraska	692	- 435	-62.9	+ 399	+ 57.7	- 36	- 5.2
Nevada	8	- 7	-87.5	+ 143	+1787.5	+ 136	+1700.0
N. Hampshire	94	- 86	-91.5	+ 317	+ 337.2	+ 321	+ 245.7
N. Jersey	2040	-1364	-66.9	+2842	+ 139.3	+1478	+ 72.4
N. Mexico	278	- 162	-58.3	+ 724	+ 260.4	+ 562	+ 202.1
New York	11316	-5854	-51.7	+4046	+ 35.8	-1808	- 15.9
N. Carolina	1969	-1376	-69.9	+1107	+ 56.2	- 269	- 13.7
N. Dakota	147	- 113	-76.9	+ 183	+ 124.5	+ 70	+ 47.6
Ohio	3431	-1988	-57.9	+2415	+ 70.4	+ 427	+ 12.5
Oklahoma	1281	- 837	-65.3	+ 626	+ 48.9	- 211	- 16.4
Oregon	1048	- 735	-70.1	+ 693	+ 66.1	- 42	- 4.0
Pennsylvania	4902	-2711	-55.3	+2685	+ 54.8	- 26	- 0.5

TABLE X

Ph.D. Outmigration, Inmigration, and Net Migration by State for the Period 1957-1967.

(1) State	(2) Ph.D.'s Trained in State of Origin	(3) Outmigration of Ph.D.'s Trained in State of Origin	(4) $\frac{(3)}{(2)} \times 100\%$	(5) Inmigration of Ph.D.'s	(6) $\frac{(5)}{(2)} \times 100\%$	(7) Net Migration (5) - (3)	(8) $\frac{(7)}{(2)} \times 100\%$
Rhode Island	429	- 358	-83.4	+ 336	+ 78.3	- 22	- 5.1
S. Carolina	147	- 95	-64.6	+ 488	+ 332.0	+ 393	+ 267.4
S. Dakota	78	- 61	-78.2	+ 261	+ 334.6	+ 200	+ 256.4
Tennessee	1221	- 800	-65.5	+1054	+ 86.3	+ 254	+ 20.8
Texas	2886	-1400	-48.5	+2117	+ 73.4	+ 717	+ 24.9
Utah	657	- 412	-62.7	+ 452	+ 68.8	+ 40	+ 6.1
Vermont	35	- 30	-85.7	+ 190	+ 542.9	+ 160	+ 457.2
Virginia	752	- 531	-70.6	+1134	+ 150.8	+ 603	+ 80.2
Washington	1426	- 986	-69.1	+1119	+ 78.5	+ 133	+ 9.4
W. Virginia	136	- 93	-68.4	+ 349	+ 256.6	+ 256	+ 188.2
Wisconsin	2869	-2225	-77.6	+1433	+ 49.9	- 792	- 27.7
Wyoming	205	- 146	-71.2	+ 124	+ 60.5	- 22	- 10.7

Source: National Academy of Sciences, Office of Scientific Personnel, Mobility of Ph.D.'s Before and After Doctorate, 1971, pp. 182-191.

who leave the state to take employment because the higher that figure is, the lower is the proportion of social benefits which residents of the region are able to capture. However, there may also be some causal relationship between the existence of high quality institutions of higher education and the probability that a college-trained individual will move to the state. If that relationship is strong, the relevant migration figure for policy purposes is total out-migration net of in-migration attributable to the existence of high quality colleges and universities.

The fact that substantial numbers of students in post-graduate study take positions of employment outside the state in which they are studying does not necessarily imply that the state should cease those training operations. Held [1972] examined the patterns of physician migration from locus of origin to locus of training to locus of practice, using American Medical Association data on U.S. medical graduates from 1955 through 1965. Some regions of the country, e.g., the North Central, have been large "losers" of the doctors they have trained while others such as the Pacific have been large "winners".

It has been argued, with respect to the Pacific region, that expanding the medical schools and increasing the number of M.D.'s trained in the region would merely discourage an equal number of potential immigrant M.D.'s from other regions. After analyzing the determinants of M.D. migration, Held concluded that while some of the additional trainees would migrate to other regions, and some potential inmigrants would be discouraged by the competitive effect of local production, the net number of new doctors who establish practices in this region would still increase. Hence, a state or region interested in increasing the supply of M.D.'s or other professional manpower within its boundaries can do so through expansion of local production.

The costs to the state, however, of the net increase in skilled manpower could conceivably be quite high. Since graduate manpower is so highly mobile, the logical and appropriate source of subsidized financing is the federal government. However, if, as at present, the federal government does not provide this funding or does not provide it in large enough amounts to suit regional needs or tastes, a state government can increase supplies of graduate manpower through its own subsidized operations.

Research

Research activities which are carried on in the university can be categorized into at least three types:[24]

(i) basic research which largely consists of discovering new knowledge and relationships;

(ii) applied research which entails the application of existing knowledge to new problems;

(iii) development which has the immediate objectives of changing production technology or creating new products.

These categories are arbitrary and to some extent reflect the research orientations of the different disciplines. In practice, the distinction between basic and applied research is often not so easy to make.

These research activities may be sponsored by the university or outside agencies, and may be performed by faculty, research staff, or graduate students. The private and social returns to investment in research are likely to vary widely depending on the category and exact nature of the research project.

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[24] These categories are the ones adopted by the National Science Foundation [1972].

Of all university activities, basic and informational research probably generate outputs which are most like pure public goods. Unless the research findings are secret, it is neither possible to exclude consumers nor is the condition of joint consumption violated. The findings of these research activities are likely to be quickly and widely disseminated. Because of their public good aspects, private industry is unlikely to undertake such research in socially desirable amounts. On the other hand, the distribution of benefits is oftentimes wide enough to warrant federal, as opposed to regional, financing. However, as in the case with public goods, there are no market forces aside from the political system to determine the amount of such which should be undertaken.

Policy-oriented research and research and development activities both generate benefits which are more visible and likely to be more localized in distribution.[25] The findings of such research may again be disseminated nationwide, but the rate of diffusion of those findings is not instantaneous, and the region may gain some sort of technological advantage. Furthermore, productivities in doing basic and applied research may be inter-related and thereby warrant regional finance of basic as well as applied research. Public subsidy of research may also be warranted to the extent that the results of research and the results of teaching are joint products.

A study by Griliches [1958] is one of the few which has attempted to estimate rates of return to public investment in research activities.

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[25] Research and development activities may also contribute to economic growth; see Mansfield [1972].

Griliches estimated the social returns to research in hybrid corn and related innovations. The costs of research in hybrid corn were the expenditures on research and development by agricultural experiment stations, including the cost of "dry holes." The social returns of that research were in the form of lower prices and higher output. Griliches conservatively estimated the rate of return to that investment at 700%.

The development of hybrid corn is one of the outstanding technological successes of the century; hence, the return on that investment is not indicative of the social returns to research undertaken in universities. However, Griliches also reports social returns to investments in other areas, which may be more relevant for university research. Using figures provided by Schultz, he estimated the rate of return to agricultural research as a whole at 36-171%. These figures are comparable to those reported by Ewel [1955] for the economy as a whole (100-200%) and to figures quoted by major industrial companies.

The divergence between social and private rates of return is one of the major arguments for public investment in research, whether carried out in universities or elsewhere. However, this is not a sufficient reason, for the private return alone may be high enough to induce private investment in research even though the firm cannot capture the social returns.

Public Service

The third university activity is public service, which may be thought of as having two major components: (i) the preservation of knowledge and (ii) patron of the arts. The university as a storehouse of knowledge benefits local residents who have a demand for knowledge not usually

obtainable in municipal libraries; these residents can consult the faculty of the university or use the institution's library facilities. The university also oftentimes satisfies the demand for knowledge by operating a speakers' bureau.

The university also acts as a patron of the arts, sponsoring and oftentimes subsidizing cultural events which would not otherwise be available to residents of the locality or region. Non-student use of both library and cultural facilities can be easily estimated to give some idea of the size of benefits accruing to regional residents.

It is likely that these benefits accrue to a region more narrow in scope than that which does the financing, the state. However, if universities are reasonably evenly distributed with respect to population throughout the region, such activities could be financed regionally instead of locally.

6. Social Benefits of Higher Education Operations

The mere existence and operation of a university generates external effects, which are independent of the external effects associated with the outputs of university activities. For example, it provides a nucleus of scholars, scientists, and artists who can have an impact on the economic, social, political, and cultural life of the region. While one may conjecture as to the nature and size of those impacts, there are no recent studies which systematically attempt to identify and estimate them.

The sizes and kinds of regional impacts obviously depend on the size and nature of the educational institution. For example, one might expect a liberal arts college to have a greater impact on the cultural life of the locality than would an institute of technology. Impacts on the regional culture and polity are difficult to identify and evaluate. We limit our attention to a discussion of the impact of a university upon the regional economy.

Economic Impacts

We distinguish between the short-term and the long-term regional economic impacts of an institution of higher education. The short-run impacts of a university on the regional economy can be understood by considering two regions, A and B, which are identical in all respects except that A has a university while B does not.[26] Let us further assume that the university in A imposes full-cost user chargers upon purchasers of instructional and research services. The regional economy

[26] A recent publication by Caffrey and Isaacs [1971] describes how the short-run impacts are actually estimated.

of A can then be expected to benefit from two components of aggregate demand not existent in region G: (i) the university exports instructional and research services to the citizens of other regions, including region B, and the federal government and (ii) the university also provides import substitutes to residents of A wishing to purchase educational services. These initial demands, via the Keynsian income multiplier, result in a higher regional income for A than B, which has no university.

Of course, the fact that exports and import substitutes generate income and employment no more warrants subsidies of higher education than it does subsidies of mining operations or manufacturing activities. On the other hand, many cities, states, and nations do explicitly subsidize private industry to locate within their boundaries, and one could argue that the primary reasons they do so are that local income and employment are thereby generated. Furthermore, the argument for regional subsidy of higher education may be stronger than that for subsidy of private industry on several grounds.

First, to the extent that federal and private foundation research grants are received, other university activities receive an explicit subsidy (i) via overhead costs paid by research grantors to recipient institutions in excess of true overhead costs and (ii) via reduced costs of providing instructional outputs if to some extent instruction and research are joint-products. The people of a state can be viewed as competing with residents of other states for the largest possible share of such explicit subsidies.

Second, the people of a given state can also shift implicit federal subsidy to themselves by increasing the taxes they pay to local and state jurisdictions, taxes which in this case are used to support higher education

operations within the state or region. The reason for this is that such local and state taxes are treated as deductions from federal tax liability. If, instead, citizens kept their taxes low in the state and accepted the higher taxation liability at the federal level, they might or might not get inflows of federal funds to be spent within the state. To make this kind of regional income-generating strategy really worthwhile, the citizens of the state would have to want the local and state services which their increased taxes, and the implicit federal subsidies flowing with these increases of taxes, would buy. Higher education is only one of the local or state program areas which would serve as a candidate for this kind of increased expenditure.[27]

Furthermore, a relatively wealthy state with high proportions of itemizing taxpayers with high per capita incomes and, therefore, a large aggregate tax liability at the federal level due to the progressiveness of the federal income tax, has a special interest in this strategy. The percentage implicit federal subsidy of public state-provided goods is higher than would be the case for a low per capita income state.[28]

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[27]This point is made in more detail by Balderston [1972] in comments prepared for the California Joint Legislature Committee on the Master Plan.

[28]Indeed, the people of a high per capita income state have a significant relative incentive to pay for such goods as higher education by means of taxation at the state level as compared with either of two other alternatives: (1) shifting the financing of higher education on a broad national basis to the federal level; or (2) shifting its financing to the purely private market. If the financing is shifted to the federal level, the people of a high income state pay a more proportionate share of federal personal income taxes in relation to what they are likely to get back through the application of a national policy for the support of higher education, because of their more than proportionate burden of the total federal tax liability and also because a national policy is very likely to embody redistribution objectives from the well-off to the education of the poor--and the poor are more heavily concentrated in the low income states. Shifting from state level tax payment to the private market for these higher education services would mean that the implicit federal subsidy of paying for the same services through state tax receipts would be lost, because payments by the household for educational services of a private nature are not tax deductible at the federal level.

Third, higher education operations are labor as well as human capital intensive. Income and employment impacts associated with expenditures in higher education are likely to be considerably larger than those associated with value-added in manufacturing or other industrial enterprises. We can explore this matter in more depth by drawing from an input-output study of the Boulder, Colorado, region which included the University of Colorado as one sector.[29] Ideally, we would like to know the regional economic impacts associated with each of the university's major activities--teaching and research. University of Colorado activities were not disaggregated in the original study. However, the separate influences of those sectors can be approximated by looking at the income and employment impacts for the space sector which is similar to the research sector of the university and the local government sector which is labor intensive like the teaching sector of the university. The manufacturing sectors, which are physical-capital intensive, are included as a contrast to the university.

The results of the Boulder input-output study are reported in Table XI. The coefficient given in column A shows what proportion of the value of sector output goes directly to labor. The coefficient given in column B shows, ceteris paribus, what the eventual increase in local labor income is when the value of sectoral output increases by one dollar; we would expect this coefficient to be larger if the input-output model were for the state instead of the locality. The coefficient in column C indicates the proportion of the sector output which is exported from the locality; column D indicates the proportion exported from the state.

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[29] Miernyk, et al. [1967].

TABLE XI

Sectoral Income Impacts for Boulder, Colorado

Sector	A Direct Income Effect	B Direct + Indirect + Induced Income Coefficient	C Export Coefficient (Locality)	D Export Coefficient (State)
University of Colorado	.57	.80	.67	.30
Local Government	.56	.80	.63	.04
Space	.27	.44	.96	.95
Food Manufacturing	.24	.42	.32	.00
Machine Manufacturing	.29	.44	.87	.80

Source: Miernyk, et al. [1967], pp. 82-90.

The university income coefficients are underestimated because with every dollar of university expenditure, there is associated an export of community services to students originating from without the community and from without the state. In the case of Boulder there are no estimates as to the size of the downward bias as students were not considered as a separate household sector.

For purposes of comparison, we computed comparable coefficients for the Berkeley campus of the University of California. There the direct income coefficient is .63 and the coefficient for instructional services only is .87. The export coefficient (state) for the campus as a whole is .40; broken down by destination of export, we find that 90% go to the federal government. The absence of an input-output table for the Bay Area prevents a more detailed analysis of the impacts of the Berkeley campus.

Associated with the income impacts of universities are the effects on regional employment. Table XII displays the employment effects of the University of Colorado on the Boulder region. The coefficients given in column A show the change in employment resulting from a one unit change in value-added produced by the sector at the left. Column B shows the regional employment effects after the income multiplier has worked its course.

Last, it should be noted that the above-cited calculations of the income and employment impacts of the University of Colorado are for the Boulder region only. We can assume that in general the income and employment effects of university exports and import substitutes are larger for the state than the locality; this is because the leakages are smaller.

In the long run the presence of a university in a region may both affect the rate of economic growth of a region and influence the pattern

TABLE XII

Sectoral Employment Impacts for Boulder, Colorado

Sector	A Direct Employment Effect	B Direct + Indirect + Induced Employment Coefficient
University of Colorado	.06	.09
Local Government	.10	.13
Space	.06	.08
Food Manufacturing	.03	.05
Machine Manufacturing	.06	.07

Source: Miernyk, et al., pp. 117-128.

of that growth. The availability of business consultants, highly skilled wives, and a student labor force may be important in attracting business to the local or regional economy. If the supply of highly-skilled manpower is a bottleneck to the economic development of a region, the presence of a university may alleviate that problem both by supplying such manpower and by making the region more attractive for inmigrants with those characteristics. On the other hand, a region may wish to stimulate economic development by a policy of unbalanced growth; specifically, it may create or expand a university in a depressed area.

Planners, economists, and citizens are increasingly questioning whether the benefits of economic growth exceed the costs, many of which are external to the agents creating growth. The answer to this question may depend on the pattern of economic development. Universities may play an important role in determining a pattern which does not produce many of the negative externalities usually associated with growth. In particular, the existence of a university may be most attractive to high-technology, human capital intensive industries, which do not pollute the air, are visually attractive, and do not require the agglomerative economies of large urban areas in order to survive.

The kind of industry which comes most quickly to mind is one characterized by the research and development centered firm, one which gains market advantages for its products or services on the basis of some sort of technological lead. The goods and services produced by firms of this type have very low transportation costs in relation to their value, and they are not dependent on a raw material base which compels the industry to be located near the source of that input. The primary input to the production processes of such firms is, of course, highly trained

professional and technical manpower.

The presence of universities could be important to such industries in at least a couple of ways. First, the libraries, research institutes, and flows of on-going research in the universities provide stimuli to the innovational activities of these industries. Furthermore, the rate of diffusion is by no means instantaneous, and research and development firms may obtain a comparative advantage through close connections to universities where new knowledge of both basic and applied natures is being produced and organized.

Second, the flow of highly trained local manpower into these industries enables them to avoid large interregional wage differentials in attracting new employees. In addition, the continuing need of professional manpower of this kind for updating of technical proficiency provides a demand for the continuing formal and informal education services of universities. In other words, not only does the supply of regional manpower in part determine the kind of economic growth which will occur in the area, but the economic growth itself may generate a demand for the services of the university and in this way influence the kinds of activities undertaken by the university.

While there is the theoretical argument that universities can effect the pattern of growth in the way described above, no one has employed anything more than casual empirical methods in attempting to verify that argument. However, the argument is likely to apply most strongly to technical institutes and universities with large and strong graduate departments in the physical and social sciences. It is unlikely that small liberal arts colleges would provide the necessary attractions for research and development industries.

Educational Opportunity

The citizens of a region may benefit from the existence of a public university if it offers them or their children the opportunity for higher education. In the same sense that citizens of an urban area may perceive a benefit from the fact that cultural and other facilities are available if they wish to exercise their option to use them, so, too, citizens may perceive benefits from the availability of higher education facilities even if they or their children are not currently enrolled in those facilities. The size of this option demand for higher education may depend on the extent and equality of opportunity for higher education in the region. That opportunities for public higher education vary widely among states is evidenced by the data in column (1) of Table XIII.

One way of thinking about the perceived benefits of the opportunity for education is that parents wish to support higher education in the region as a means of insuring against the possibility of having a bright child who will wish to attend college. The benefits to the family are then the amount it would be willing to pay for an insurance contract to know a university slot exists when and if they have a bright child who wishes to purchase the instructional services of higher education.

The perceived benefits of educational opportunity may well be larger for a low-income family, which may have no alternatives to regionally-provided higher education, than for a high-income family, which can import instructional services from outside the state (i.e., send the child to an out-of-state school). On these grounds, it could be argued that providing equality of educational opportunity within the state would tend to increase public demand for and support of higher education. Of course, the usual qualifying criterion for college attendance--performance at the secondary school level--is highly correlated with income, education, and socio-economic status of parents. Hence, to make higher education equally

TABLE XIII

Higher Education Participation Rates

and the Demand for Higher Education, by State, 1968

State	Participation Rates		Per Capita Expenditure
	Public	Public and Private	Public
	(1)	(2)	(3)
Alabama	0.22	0.32	22.18
Alaska	0.08	0.14	57.70
Arizona	0.30	0.48	47.57
Arkansas	0.24	0.34	29.12
California	0.26	0.50	41.49
Colorado	0.30	0.43	50.38
Connecticut	0.18	0.51	32.58
Delaware	0.18	0.31	37.26
D. of C.	0.09	0.30	-----
Florida	0.22	0.38	36.18
Georgia	0.16	0.25	33.09
Hawaii	0.22	0.32	73.70
Idaho	0.30	0.51	45.12
Illinois	0.24	0.47	43.52
Indiana	0.22	0.36	33.83
Iowa	0.27	0.46	36.42
Kansas	0.31	0.45	36.91
Kentucky	0.19	0.31	31.23
Louisiana	0.26	0.35	34.18
Maine	0.15	0.26	28.43
Maryland	0.19	0.36	31.22

TABLE XIII

Higher Education Participation Rates

and the Demand for Higher Education, by State, 1968

State	Participation Rates		Per Capita Expenditure
	Public	Public and Private	Public
	(1)	(2)	(3)
Massachusetts	0.17	0.49	20.62
Michigan	0.26	0.41	39.16
Minnesota	0.32	0.45	38.07
Mississippi	0.26	0.33	33.44
Missouri	0.25	0.40	28.38
Montana	0.34	0.45	42.74
Nebraska	0.30	0.45	32.96
Nevada	0.20	0.27	33.01
N. Hampshire	0.18	0.35	15.13
N. Jersey	0.15	0.46	21.78
N. Mexico	0.28	0.39	41.71
New York	0.19	0.52	41.52
N. Carolina	0.14	0.24	35.46
N. Dakota	0.40	0.48	38.07
Ohio	0.21	0.38	24.73
Oklahoma	0.33	0.46	27.80
Oregon	0.31	0.48	46.64
Pennsylvania	0.18	0.40	30.25*
Rhode Island	0.17	0.39	34.05
S. Carolina	0.10	0.20	27.26

*Estimate

TABLE XIII

Higher Education Participation Rates

and the Demand for Higher Education, by State, 1968

State	Participation Rates		Per Capita Expenditure
	Public	Public and Private	Public
	(1)	(2)	(3)
S. Dakota	0.34	0.47	32.06
Tennessee	0.19	0.31	25.68
Texas	0.24	0.37	31.26
Utah	0.32	0.33	42.73
Vermont	0.19	0.34	33.71
Virginia	0.15	0.26	29.96
Washington	0.30	0.46	56.94
W. Virginia	0.23	0.33	34.50
Wisconsin	0.30	0.44	41.27
Wyoming	0.38	0.52	44.65

Column (1): Ratio of residents of state enrolled as undergraduates in public institutions of higher education in state to the number of 18-21-year-olds in state. Source: George H. Wade, U.S. Department of Health, Education, and Welfare, Residence and Migration of College Students, Fall, 1968: Analytic Report. U.S. Government Printing Office, 1970.

Column (2): Ratio of residents of state enrolled as undergraduates in any state to number of 18-21-year-olds in state. Source: Carnegie Commission on Higher Education, The Capitol and the Campus. San Francisco: McGraw Hill, April 1971, Appendix C.

Column (3): State per capita expenditures on higher education. Source: Carnegie Commission on Higher Education, The Capitol and the Campus, Appendix H.

available to all necessitates the existence of compensatory education programs for overcoming the income and class barriers to college attendance [Pechman, 1972].

Tastes for Higher Education

Regionally-supported universities have another advantage to residents of the region. As opposed to a system of federal finance which might distribute higher education facilities equally among the states, regional finance allows the citizens of the region to express their tastes for higher education. Citizens can indirectly control the level of educational services as well as the composition of those services (e.g., liberal arts vs. technical, graduate vs. undergraduate instruction) within the region. Increased federal funding is very likely to be reflected in increased federal control of spending, a prospect which may not be appealing to the regional citizenry.

Furthermore, if citizens are mobile, they may "vote with their feet" and attempt to find the region where citizens' preferences for higher education are most similar to their own. The result will be that the levels of higher education services provided will be more optimal than those which would be likely to exist under a central provision. Citizens of all regions will be better off in a welfare sense.

The demand for higher education, as reflected in higher education participation rates of the college-age population, varies widely among states. Column (2) of Table XIII indicates the proportion of the college-age population in each state that elects to attend some institution of higher education in the United States. This proportion, the higher education participation rate, in 1968 varied from a low of .14 in Alaska to a high of .52 in New York and Wyoming.

Regional support of public higher education also varies considerably. Column (3) of Table XIII shows that state per capita expenditures on higher education varied from a low of $20.62 in Massachusetts to a high of $73.70 in Hawaii. Of course, these figures reflect differences in income, opportunities for private higher education, and other factors as well as differences in pure tastes.

7. The Rationale for Regional Finance

Higher education generates regional social benefits by (i) producing outputs which remain in the region and (ii) providing an operating university with its highly skilled employees and accompanying opportunities for education of regional residents. While we have enumerated many possible social benefits, it is difficult to assess the relative sizes of total or marginal benefits of outputs and activities in the absence of a numeraire for non-monetary benefits. Ideally, such a numeraire would exist, and we could construct an analogue of the input-output model to illustrate how total regional benefits are affected by changes in university activity levels.

It has not been our purpose to estimate the dollar value of higher education externalities, although it is feasible to estimate possible ranges of values for some specific social benefits. Such an exercise might be useful to university administrators attempting to justify their budgets to legislative bodies. However, a much higher research priority should be attached to the determination of what proportion of changes in individual productivities, incomes, values, and attitudes is really attributable to the higher education experience. Another much needed piece of research is a study of how universities affect the kind of economic growth

which occurs around them. Many questions remain unanswered with respect to the size, distribution, and kinds of social benefits associated with higher education.

We have found that the case for regional subsidies is not equally strong for all higher education activities or all students in higher education. In terms of teaching, the case appears to be strongest for undergraduate instruction of low-income students and weakest for graduate instruction of Ph.D.'s likely to be in a national job market.[30] The social benefits of educating low-income, and possibly low-ability, youth are likely to be large and warrant a considerably higher subsidy than that received by middle and high income students. Such a subsidy may take the form of scholarships, lower tuition rates, low interest loans, or even remedial and compensatory education.

The high outmigration rates of Ph.D. recipients weaken the case for regional subsidization of graduate education and, in fact, argue for federal subsidization. Universities seem to operate in accordance with this fact by strictly limiting graduate enrollments. However, if universities are attempting to maximize regional social benefits, they might better attain their objectives by reducing average graduate student subsidies, which is equivalent to raising graduate tuition, and allowing the market to ration graduate slots.

In terms of research, the case for regional subsidies is strongest for research with a regional orientation and weakest for basic research

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[30] It should be noted, however, that we have not explored the nature of joint production relationships in higher education. Graduate programs may enable colleges and universities to produce undergraduate degrees at a substantially lower cost. Hence, indirectly, graduate programs may generate sizeable social benefits by enabling colleges to enroll larger numbers of undergraduates.

of the sort that is quickly and widely disseminated.[31] What proportion of the faculty's non-teaching time is spent doing regionally-oriented research is simply not known; however, it is known that the federal government provides the bulk of research funds for the sponsored research which is carried on in the halls of academia.

While this study has provided some information as to the relative sizes of social benefits of different university outputs with implications for the appropriate relative subsidies to be given to different outputs, it has said nothing about the appropriate absolute size of subsidy for any given output. Indeed, as we have stated earlier in this paper, it is not possible to attach a dollar figure to the value society puts on all the social benefits of higher education. As a result, while we can conclude that subsidies to low-income students should be higher than those for high-income students, we are not able to say what the sizes of either of those subsidies should be. Given our present state of knowledge, that is a decision which must be largely left to the political arena.

If there is a surprising result to this study, perhaps it is that the apparent paradox stated in the introduction is not necessarily valid. There is little evidence to indicate that the present pattern of public subsidies is not justified by the pattern of social benefits of higher education. We have indicated where it might be desirable to change this pattern--subsidies to low income students should be increased; subsidies to graduate students should be reduced. However, research activities of universities receive substantial funding from the federal government,

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[31] Again, one could argue the opposite--that regional subsidies of prestigious basic research may generate large amounts of research funds from the federal government and private institutions, and the region may benefit from such research grants both by sharing in the results of the projects and by capturing the economies which result from joint production of research and teaching.

which is appropriate for an activity which generates social benefits of very wide distribution.

Furthermore, while there is currently a popular feeling that students should be given control over their own subsidies by use of an educational voucher system, there are arguments for retaining at least part of this control in the institution of higher education. As we have seen, institutions of higher education in and of themselves can generate regional social benefits, and possibly they should be maintained and continue to be subsidized irrespective of student preferences. The rationale for regional finance does not rest solely upon the existence of social benefits of the outputs of higher education. Indeed a strong reason for maintaining a high degree of regional as opposed to federal finance of higher education is that the source of funding is also the source of institutional control, and thus regional funding allows the expression of local tastes for the outputs of higher education.

While the federal government should assume increasing responsibility for financial support of graduate education and some changes should be made in the pattern of subsidies across outputs, the regional social benefits generated by universities and colleges argue for continued regional finance of higher education.

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