DOCUMENT RESUME

ED 293 457 HE 021 370

TITLE	Budgeting Faculty Instructional Resources in the University of California: A Report to the Legislature in Response to Supplemental Language in the 1987-88 Budget Act. Report 88-4.
INSTITUTION	California State Postsecondary Education Commission, Sacramento.
PUB DATE	Feb 88
NOTE	26p.
AVAILABLE FROM	Publications Office, California Postsecondary Education Commission, 1020 Twelfth St., Sacramento, CA 95814-3985.
PUB TYPE	Reports - Descriptive (141)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Facilities; *Faculty Workload; Financial Support; Higher Education; *Instructional Student Costs; *Resource Allocation; Services; *State Aid; *State Universities; *Teacher Student Ratio
IDENTIFIERS	*California State University; Formula Funding

ABSTRACT

The Legislature requested a study of the student-faculty ratio workload measure used by the University of California (UC) to determine if it results in excess instructional resources for the University. Following a statement of the purpose of the report, information on the background of the University's instructional resources formula is provided. Shifts in enrollment mix are discussed, and evidence from other states is included. Eight conclusions are listed, and from them two major recommendations are made: (1) the state should continue to fund faculty instructional resources in UC through its present formula budget approach, and (2) the state should establish a process for regularly reviewing the effectiveness of its formula for budgeting instructional resources in UC. Four appendices include: UC full-time equivalent conversion factor calculations and methodology; UC faculty workload policies; framework for considering instructional cost and resource issues at UC; and research literature on instructional costs and state formula budgeting methods. 18 references. (SM)

Executive Summary

This report responds to the Legislature's request in Supplemental Language to the 1987 Budget Act that the Commission examine the student-faculty ratio workload measure used by the University of California to determine if it results in excess instructional resources for the University.

In the report, the Commission (1) describes the formulas used by the State and the University prior to and after 1971, when the current budgeting approach was implemented; (2) identifies the major policy issues regarding the current formula; (3) examines shifts in the University's enrollment according to level of instruction and subject field as well as factors affecting instructional resources, such as teaching assignment loads, faculty salary levels, and class size; (4) summarizes research on the topic from other states; and (5) offers seven conclusions on methods of budgeting workload that serve the interests of both the State and the University. Based on those conclusions, the Commission offers these two recommendations (p. 6):

1. The State should continue to fund faculty instructional resources in the University of California through its current formula budget approach that provides the University with aggregate, lump-sum appropriations without differentiating by discipline area or level of instruction. Changes in this approach or the adoption of an alternative approach should be based on evidence that such changes will better achieve the State's priorities in budgeting instructional resources.

2. The State should establish a process for periodically reviewing the effectiveness of its formula for budgeting instructional resources in the University of California. A primary aim of this review process should be to identify the criteria needed to assess the effectiveness of the formula for achieving State policy priorities in the allocation of resources to the University.

The Commission adopted this report at its February 8, 1988, meeting on recommendation of its Policy Evaluation Committee. Additional copies of the report may be obtained from the Library of the Commission at (916) 322-8031. Further information about the report may be obtained from Martin M. Ahumada of the staff at (916) 322-8000.

BUDGETING FACULTY INSTRUCTIONAL RESOURCES IN THE UNIVERSITY OF CALIFORNIA

A Report to the Legislature in Response to Supplemental Language in the 1987-88 Budget Act

CALIFORNIA POSTSECONDARY EDUCATION COMMISSION
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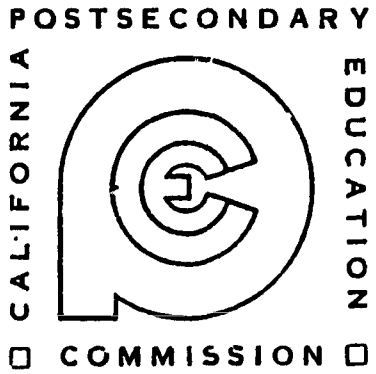

COMMISSION REPORT 88-4
PUBLISHED FEBRUARY 1988

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Budgeting Faculty Instructional Resources in the University of California

Purpose of the report

Item 6420-001-001 of the 1987 Budget Act contained the following Supplemental Language:

> 1. *UC Student/Faculty Workload Study.* The California Postsecondary Education Commission (CPEC) shall examine the student-faculty ratio workload measure used by the University of California (UC) to determine whether or not the formula has resulted in "excess instructional resources" on the campuses and recommend appropriate action as necessary. This report shall be submitted to the legislative fiscal committees and the Joint Legislative Budget Committee (JLBC) by January 1, 1988.

This Supplemental Language stemmed from the following concern of the Legislative Analyst as expressed in the 1987-88 *Budget Analysis* (p. 1084):

> *Historical Growth Rates.* Between 1972-73 and 1977-78, budgeted undergraduate enrollment at the university grew by 9.9 percent while budgeted graduate enrollment grew by 8.4 percent, keeping the composite ratio pretty much in balance. However, between 1977-78 and 1986-87, budgeted undergraduate enrollment grew by 21 percent while budgeted graduate enrollment grew by only 1.6 percent. We believe that this differential in enrollment growth over the last nine years has caused a distortion in the workload measure, resulting in excess instructional resources on the campuses. This is because undergraduate students require less work for the faculty (and therefore less resources) than that required for graduate students. We further believe that this may be the reason why the university has been able to overenroll graduate students for the past several years.

In this report, the Commission examines this concern of the Legislative Analyst and discusses these issues:

- What should the State's policy be for budgeting faculty instructional resources in the University?
- What method of budgeting resources in the University is most likely to serve the State's best interest over the long run?
- And on what basis should the State review its policy and methods for budgeting instructional resources at the University if it is to (1) provide adequate levels of annual appropriations to support the University's instructional requirements, (2) eliminate or minimize undesirable spending incentives for the University that are inconsistent with the State's long-range goals for higher education, and (3) preserve the University's flexibility to accommodate inevitable fluctuations in its enrollment mix -- that is, its enrollment by level of instruction and academic discipline?

Background on the University's instructional resources formula

The University of California has historically received instructional resources from the State on a formula basis, wherein new funds are provided to the system when enrollments increase. The new resources for instruction are given in the form of new faculty positions, and the State maintains position control for these positions, which are allocated to the central administration on the basis of systemwide student-faculty ratios, undifferentiated by campus, or level of instruction, or discipline where the enrollments actually occurred. The central administration then allocates the positions and the resources to the campuses, using student-faculty ratios and other criteria to make the internal allocation decisions.

Prior to 1971, the State funded faculty workload at the University through a budget formula that applied a weighted student value schedule designed to recognize the differential cost in faculty time for different levels of instruction. The formula interpreted one lower-division undergraduate student to be equal to 2.5 first-year graduate students and to 3.5 full-time third-year Ph.D. students. This meant that 3.5 times as many resources were generated for each advanced doctoral student than for each lower-division student or, in general terms, that proportionately a greater number of faculty were funded for the same number of graduate students than undergraduates.

Since 1972, the State has used a different formula for funding the University's faculty resources. That formula is based on a composite index that does not distinguish undergraduate from graduate workload and that funds or adds one full-time faculty position for every 17.61 undergraduate or graduate students. In other words, the State uses the composite student-faculty ratio of 17.61:1 to calculate the instructional resource requirements of additional enrollments at the University. (Although the current formula does not use a weighted student value schedule, student weights are used to calculate full-time-equivalent enrollment at different levels of instruction. For instance, full-time undergraduate students enroll for 15 units per quarter while first-stage and second-stage graduate students enroll for 12 and 9 units, respectively. Appendix A reproduces the University's current methodology for calculating a general campus full-time-equivalent student at the undergraduate level and the graduate level.)

DISPLAY 1 Budgeted General Campus Student-Faculty Ratios of the University of California, Fiscal Years 1966-67 Through 1986-87

Fiscal Year	Student/Faculty Ratio
1966-67	14.71:1
1967-68	15.35.1
1968-69	15.43:1
1969-70	15.88:1
1970-71	16.48:1
1971-72	17.40:1
1972-73	17.42.1
1973-74	17.41:1
1974-75	17.49:1
1975-76	17.49:1
1976-77	17.49:1
1977-78	17.48:1
1978-79	17.48:1
1979-80	17.48:1
1980-81	17.48:1
1981-82	17.48:1
1982-83	17.48:1
1983-84	17.48:1[a]
1983-84	17.61.1[b]
1984-85	17.61:1
1985-86	17.61:1
1986-87	17.61:1

a. Historical calculation method used prior to 1983-84.

b. New calculation method introduced in 1983-84, thereby increasing full-time-equivalent graduate enrollment base by 873 students. (No additional resources involved.)

Source: Office of the President, University of California.

The University contends that its student-faculty ratio increased steadily during the late 1960s and early '70s -- from 14.71 in 1966-67 to 17.49 in 1974-75, as shown in Display 1 at the right -- primarily because of a series of State budget cuts in the early '70s. Display 1 might suggest that the formula used before 1971 generated more instructional resources than the current formula, but in the absence of an understanding of how students are counted and of a detailed analysis of changes in the University's enrollment mix by academic department and level of instruction and of the cost implications of these changes, it is difficult to ascertain whether the University has gained or lost resources since then.

Appendix B reproduces the most recent of the annual reports that the University submits to the Legislature on its faculty workload policies and those of its eight comparison institutions used by the Commission for salary comparisons. In that report, the University notes that its practices regarding teaching assignments are largely similar to those at its comparison institutions. Throughout the various stages of resource allocation from its systemwide office to the campuses and then to the colleges and departments, the University exercises a considerable amount of flexibility to recognize the unique philosophy, role, and scope of each of its campuses, colleges, and departments. It bases this approach on the principles that the budget process should neither dictate program priorities at the campus level nor attempt to homogenize campuses or programs and that

the allocation process should protect campus participation in governance by maximizing the ability of campus leaders to pursue and protect local needs and interests.

Shifts in enrollment mix

The Commission agrees with the Legislative Analyst that changes have occurred in the University's enrollment by level of instruction. Display 2 at the right shows that over two seven-year periods -- 1971-72 to 1978-79 and 1978-79 to 1985-86 -- actual annual full-time-equivalent undergraduate enrollments increased at a faster rate than graduate enrollments. During the first period, undergraduate enrollments grew 18.9 percent, compared to 5.4 percent for graduate students; while similar increases of 15.6 and 6.5 percent occurred over the second period. These trends in actual enrollments show the recent steady growth in non-budgeted graduate enrollments at the University. According to the Legislative Analyst, the number of graduate students enrolled in 1986-87 was 1,180 above the budgeted level -- the highest number recorded in the past 15 years. The Analyst contends that this discrepancy is evidence that the University has obtained from the formula the additional resources needed for these graduate students.

The Commission also agrees with the Legislative Analyst that the State's formula appears to generate additional resources for the University when more students are added at the lower end of the cost scale while faculty are provided at the average. But while it is plausible that the formula has provided the University with "additional instructional resources" in recent years, such a conclusion cannot be drawn without consideration of the instructional costs associated with the changes in the University's overall enrollment mix. One cannot ascertain whether or not "additional" resources are generated without knowing if the University has experienced faculty turnover in areas of decreasing demand to allow the reallocation of resources to areas with increasing enrollments. If turnover has not occurred, or if there have been internal enrollment shifts to areas of relatively higher cost, then no "excess" resources have been generated.

Display 3 shows the University's undergraduate workload (as represented by full-time-equivalent en-

DISPLAY 2 Actual Annual Full-Time-Equivalent Enrollments by Level of Instruction at the Eight General Campuses of the University of California, 1971-72, 1978-79, and 1985-86

Period	Undergraduate	Graduate	Total
1971-72	70,573	22,559	93,132
1978-79	83,931	23,779	107,710
1985-86	99,392	25,440	124,440
Percent Growth, 1971-72 - 1978-79	18.9%	5.4%	15.7%
Percent Growth, 1978-79 - 1985-86	15.6	6.5	15.5

Source: Governor's Budgets for 1987-1988, 1980-1981, and 1973-1974.

DISPLAY 3 Undergraduate Workload by Academic Discipline as Measured by Full-Time-Equivalent Undergraduate Enrollments, 1971-72 and 1986-87

Period	Engineering and Sciences	Social Sciences	Arts and Humanities	Total
Workload				
1971-72	20,319	23,068	19,988	63,375
1986-87	29,921	30,316	24,408	84,645
Increase	9,602	7,248	4,420	21,270
Workload as Percent of Total				
1971-72	32.77%	36.40%	31.54%	100.00%
1986-87	35 35	35.82	28.84%	100.00
Increase	47.26	31.42	22.11%	33.56

Note: "Workload" equals the three-quarter average of actual credits accrued in undergraduate courses divided by 15 to determine full-time-equivalent undergraduate students. Two general campuses, Irvine and Santa Cruz, are omitted from this table because comparable data for 1971-72 were not available for t' ·.n. Postbaccalaureate credential student enrollments are not included.

Source: Adapted from *1988-89 Budget for Current Operations*. Office of the President, University of California, September 1987, p 43.

rollments) by academic discipline category from 1971-72 to 1986-87 as well as the percentage of these disciplines' workload as a share of total workload and their percentage increases in workload over the 15 years. As it shows, between 1971-72 and 1986-87, the largest increase in workload -- 9,602 students, or 47.26 percent -- was in engineering and the sciences where instructional resource requirements are typically high, followed by the social sciences with an increase of 7,248 students, or 31.42 percent. The increase in engineering and the sciences was more than one-third greater than in the social sciences and double that in the arts and humanities.

In other words, in response to student demand the University has had to provide a growing amount of instructional services in academic areas known to be expensive because of small average class sizes, low student-faculty ratios, and a separate salary schedule in engineering. Furthermore, this shift in enrollments has increased the University's need for support for teaching assistants and often expensive instructional laboratory equipment. Thus within the context of the production function in higher education, it is clear that the University has required additional instructional resources for its undergraduate programs, although the exact amount cannot be determined without more costing information.

Paralleling the changes in the University's undergraduate instructional resources over time, its graduate enrollments have shifted toward the comparatively more costly disciplines such as engineering and computer sciences. Display 4 at the right, which shows the University's graduate headcount enrollment by academic discipline for Fall 1969 and Fall 1986, indicates that while its greatest percentage increases have been in architecture and environmental design (89.2 percent) and business and management (52.6 percent), its largest numerical growth -- 1,187 headcount students -- has been in engineering and the computer sciences. Major percentage decreases have occurred in physical education (-52.4 percent), fine and applied arts (-30.9 percent), education (-30.6 percent), social sciences (-22.5 percent), and social work (-21.2 percent).

In short, although the imbalance in the University's mix of undergraduates and graduate students has generated additional instructional resources, these resources have most likely been absorbed to some extent by enrollment increases in costly disciplines at both the undergraduate and graduate levels.

DISPLAY 4 Graduate Headcount Enrollment by Academic Discipline at the Eight General Campuses of the University of California, Fall 1969 and Fall 1986

Discipline	Fall 1969	Fall 1986	Percent Change
Agriculture and Natural Resources	957	1,169	+22.2%
Architecture and Environmental Design	379	717	+89.2
Biological Sciences	1,592	1,919	+20.5
Business and Management	1,526	2,328	+52.6
Education	2,967	2,060	-30.6
Engineering and Computer Sciences	3,223	4,410	+36.8
Fine and Applied Arts	1,249	1,383	+10.7
Journalism	79	74	-6.3
Law	1,878	2,311	+23.1
Letters	3,502	2,421	-30.9
Library Sciences	349	365	+4.6
Mathematics	949	798	-15.9
Physical Education	84	40	-52.4
Physical Sciences	2,392	2,934	+22.7
Psychology	629	583	-7.3
Social Sciences	4,045	3,133	-22.5
Social Work	523	412	-21.2
Other [a]	223	530	--
Total	26,546	27,587	+3.9%

a. Unclassified and Interdisciplinary majors.

Source: Office of the President, University of California.

(Appendix C explains the Commission's conceptual framework for interpreting these differences in costs among academic levels and programs.)

Evidence from other states

Research on costing and formula budgeting in higher education nationally is useful in interpreting the shifts in the enrollment mix of California's institutions, and the Commission reviews existing research

literature on this topic in Appendix D. It shows that instructional costs per full-time-equivalent student vary considerably by subject field and that these variations are influenced by differences in such production factors as size of class, faculty teaching assignments, and faculty salaries. It also shows that at the undergraduate level the hard sciences are about 33 percent to 55 percent more costly than the social sciences and that graduate instruction is two to three times more costly than undergraduate instruction.

The experience of other states also suggests that formulas should not be used to make state policy decisions and cannot easily redress imbalances that occur in institutions' enrollment mix. Even when formulas are adjusted to redress some imbalances, they may not recognize economies of scale, the fixed costs that remain long after major enrollment fluctuations have taken place, and changes in demand and price. For example, formulas ignore the reality that although aggregate instructional costs vary by academic program areas and levels, institutions are limited in their flexibility to match faculty and other instructional resources with short-term shifts in their enrollment mix. Faculty, laboratory, and library resources are usually invested over time cycles averaging about 30 years, while enrollment shifts occur over shorter time cycles. In the case of the University of California, this funding reality indicates that some excess instructional resources in the humanities and social sciences cannot be reallocated -- especially over the short term -- irrespective of the enrollment decreases in these areas.

Finally, the experience of other states indicates that efforts to predict institutional resource needs will be ineffective without extensive data on the factors influencing resource requirements among different institutions, subject fields, and academic levels.

Conclusions

Based on its examination of changes over time in the University's enrollment by level of instruction and academic discipline and of the research literature on state budgeting approaches and costing in higher education, the Commission concludes that:

1. Additional instructional resources are not necessarily generated when the University's enrollments shift toward the less expensive undergraduate level, nor do insufficient resources necessarily result as its enrollments shift toward the costlier disciplines.

2. The State's priorities in budgeting instructional resources in the University should be (1) to protect against unintended spending incentives aimed solely at obtaining more State revenues, (2) to protect local autonomy and flexibility to allocate resources according to new program needs and priorities, (3) to contain costs over time while appropriately reflecting actual costs, and (4) to promote program stability and quality by helping maintain the needed cadre of full-time permanent faculty.

3. The advantages of formulas that aggregate enrollment at undergraduate and graduate levels and across academic disciplines might outweigh those of differentiated formulas because they avoid institutional incentives to overenroll students in high-cost areas as a means of obtaining more State revenues and to transform normally low-cost programs into high-cost programs.

4. The available evidence indicates that the State's interest is served best over the long run if faculty instructional resources in the University of California continue to be funded through the current formula budget approach that provides the University with aggregate, lump-sum appropriations without differentiating by discipline area or program level. Not only is this funding approach least likely to provide the University with unintended incentives to overenroll students in high-cost programs, it also provides the University with some flexibility to accommodate short-term fluctuations in its enrollment mix while reallocating instructional resources that are invested over longer periods.

5. Without more complete data on the University's changing resource needs, no adjustment should be made in the State's current ratio of 17.61 full-time-equivalent students for every full-time faculty position at the University. Among the data needed for any change would be faculty data disaggregated by subject area and level of instruction regarding teaching assignment loads, rank, salary levels, and student-faculty ratios.

6. Like other states, California uses workload formulas based on student-faculty ratios as a relatively expedient and objective basis for linking State funding levels with its universities' resource requirements, but this practice lacks the support of clear and explicit assumptions about (1) what budgeting methods and objectives best serve the State's long-term interests, (2) how the State's budgeting approach can and should influence institutional decisions, and (3) what State issues should *not* be addressed through the budgeting mechanism. Concerns by State officials about controlling imbalances between undergraduate and graduate enrollments at the University should be addressed apart from the formula for funding instructional resources. The complexity of those issues requires solutions that go beyond simply manipulating the mechanism for linking State appropriations to institutional resource requirements.

7. The State should preserve the University's flexibility to determine its instructional resource needs and carry out needed internal allocation or reallocation of resources as dictated by funding realities and its long-range plans. The State also has a legitimate interest in understanding how the University plans to correct the imbalances that develop over time in its faculty resources by program areas and levels of instruction. This understanding should be based largely on cost data on the University's programs and on the University's long-range plan for meeting student demand and accommodating needed workload adjustments. Because there should be at least a plausible relationship between State appropriation levels and resource requirements in the University, the State should establish a process for periodically reviewing every five to seven years the effectiveness of its formula (the student-faculty ratio) for budgeting instructional resources in the University.

Recommendations

Based on its above conclusions, the Commission offers these recommendations:

1. **The State should continue to fund faculty instructional resources in the University of California through its current formula budget approach that provides the University with aggregate, lump-sum appropriations without differentiating by discipline area or level of instruction. Changes in this approach or the adoption of an alternative approach should be based on evidence that such changes will better achieve the State's priorities in budgeting instructional resources.**

2. **The State should establish a process for periodically reviewing the effectiveness of its formula for budgeting instructional resources in the University of California. A primary aim of this review process should be to identify the criteria needed to assess the effectiveness of the formula for achieving State policy priorities in the allocation of resources to the University.**

Appendix A

UNIVERSITY OF CALIFORNIA

Full-Time Equivalent (FTE) Conversion
Factor Calculations and Methodology

General Campus Undergraduate FTE Calculations

The number of undergraduate FTE students is derived by applying a conversion factor to the actual or proposed headcount enrollments supplied by the campuses. A separate factor is calculated for lower division and upper division students at each campus.

For example, the 1988-89 conversion factors were based on six successive quarters of data, Fall, 1985 through Spring 1987. The total units attempted as of the third week of classes for all six quarters are totaled, and divided by 15. (A full-time student takes an average of 15 units per quarter). The result is then divided by the six quarter total headcount to produce the factor. The factor is carried out three decimal places, truncated at 1.000, and multiplied times the actual or proposed headcount to determine the FTE. The following is a sample calculation:

Total lower division units attempted for 6 qtrs. Divided by 15 units $\frac{676,658.5}{15} = 45,100.6$

Divided by headcount for 6 qtrs. $\frac{45,110.6}{49,451.0} = .912$

Factor times actual or proposed headcount equals FTE .912 X 5,440 = 4,961

General Campus Graduate FTE Calculations

A separate factor is calculated for first stage students (master's, doctor--not advanced to candidacy).

For example, the 1988-89 conversion factors are based on six successive quarters of data, Fall 1985 through Spring 1987. For first stage students, the total units attempted for all six quarters are totaled and divided by 12 to determine the FTE. (A full-time graduate student takes an average of 12 units per quarter.) The result is then divided by the six quarter total headcount to produce the factor. The factor is carried out three decimal places, truncated at 1.000, and multiplied times the actual or proposed headcount to determine the FTE.

For second stage students, each registered student is counted as 1 FTE until the number of quarters registered as a candidate exceeds 9, at which time FTE becomes 0. Thus, the difference between headcount and FTE is equal to the number of students who have exceeded 9 quarters as a candidate. Total FTE is divided by total headcount to produce the factor. The factor is carried out three decimal places, truncated at 1.000, and multiplied times the actual or proposed headcount to determine the FTE.

Health Sciences FTE

Headcount is equal to FTE for health sciences students, since they are all enrolled as full-time students.

Appendix B

UNIVERSITY OF CALIFORNIA

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DAVID PIERPONT GARDNER
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December 16, 1986

Ms. Elizabeth Hill
Legislative Analyst
Joint Legislative Budget Committee
925 L Street, Suite 650
Sacramento, California 95814

Dear Ms. Hill:

Pursuant to the Supplemental Report of the Committee of Conference on the Budget Bill for 1985-86, I am pleased to enclose our annual report on "Faculty Workload Policies."

Please let me know if you have any questions about this report.

Sincerely,

David Pierpont Gardner

Enclosure

cc: The Honorable Walter W. Stiern
Chairman, Joint Legislative Budget Committee, and
Chairman, Senate Budget and Fiscal Review Subcommittee #1
The Honorable Robert Campbell
Chairman, Assembly Ways and Means Subcommittee #2
(Attn: Ms. Pamela Spratlen)
(Attn: Mr. William Furry)
Senate Budget and Fiscal Review Subcommittee #1
(Attn: Mr. Paul Holmes)
(Attn: Ms. Glee Johnson)
Mr. Jesse Huff, Director of Finance
Mr. Robert Harris, Department of Finance
(Attn: Mr. Stan Lena)
(Attn: Ms. Judy Day)
Mr. Harold Geiogue, Legislative Analyst's Office
(Attn: Mr. Stuart Marshall)
Mr. William Pickens, Director, California Postsecondary Education Commission
Senior Vice President William Frazer
Vice President William Baker
Director Stephen Arditti

Office of the President
December, 1986

University of California
Faculty Workload Policies

This report is submitted in response to Item 6440-001-001 of the Supplemental Reports of the Committee of Conference on the 1985-86 Budget Bill:

> It is the intent of the Legislature that the University of California (UC) report annually on its workload policies for full-time tenure-track faculty and on the faculty workload policies for its salary comparison institutions. The University may also include in this report faculty workload policies from other universities that it deems appropriate. The initial workload policy report shall be submitted to the legislative fiscal committees and the Joint Legislative Budget Committee (JLBC) by February 1, 1986, and by December each year thereafter. Beginning with the 1985 budget year, the University is no longer required to annually submit the faculty time-use survey.

Faculty workloads in the University of California are established by departments, subject to administrative review at the college and campus levels. Practices vary among the departments and campuses, although within a fairly narrow range. Because departmental policies are similar within disciplines across the campuses, they have been grouped into major discipline categories for purposes of this report. UC's salary comparison institutions (Harvard, Yale, Stanford, Cornell, Illinois, Michigan, Wisconsin, and SUNY-Buffalo) do not have written workload policies, but have established norms such that actual practices are similar to those of the University. The data in this report were originally collected for the 1985-86 Supplemental Report. Each institution was recontacted for the current report and verified that there has been no substantive changes in formal workload policies either for the University of California or for its comparison institutions.

The University's teaching workload assignments specify the number of courses that full-time, tenure-track faculty are expected to teach per year. They include regularly-scheduled courses only; common additional instructional activities, such as supervision of independent study and graduate students' research, advising students, and participation in informal departmental seminars are not included in determining teaching workload. Surveys of faculty time use conducted annually through 1983-84 showed that, on the average, faculty devote about 60 hours per week to their professional activities. They devote an average of about 26 hours to instructional activities, including class meetings, preparation for classes, grading papers, and meeting with students outside class; about 23 hours to research; and about 12 hours to University and other professional service.

The average expected formal course workload in the various major disciplines is as follows (in quarter courses per year or their approximate equivalent in semester courses, in the case of the Berkeley campus):*

Humanities: five to six
Social Sciences: four to six, generally five
Mathematics and computer science: four to five, generally five
Engineering: four
Biological Sciences: three to four
Physical Sciences: three to four

Science and engineering faculty teach fewer courses, on the average, for two reasons: many of these courses are laboratory courses which meet for longer hours and require more extensive supervision of students and teaching assistants, and much of their graduate-level teaching involves working with individual students in a laboratory setting (which is not included in calculating workload), rather than in regularly scheduled classes.

Faculty members may be granted reduced course assignments under certain circumstances. Most departments allow reduced course assignments for faculty serving as department chairs, deans, chairs of major Academic Senate committees, and other major administrative assignments. About one-quarter to one-third of the departments permit a reduced course load for new assistant professors during their first year, to allow them additional time to prepare courses and establish themselves in their new positions; a smaller number reduce the number of courses for faculty who are teaching very large classes involving the supervision of teaching assistants or who are engaged in major new course development or curriculum revision. In rare cases, faculty are given reduced teaching assignments for unusual professional service, such as heading a professional association or serving on a major national commission. The normal reduction is one course per year.

To gain comparative information about faculty teaching assignments, the University's eight comparison institutions were surveyed. All cooperated in the survey, with the stipulation that specific data not be identified by institution. Assignment of teaching responsibilities is a sensitive issue at most institutions, because policies tend to be poorly articulated and vary by discipline. Therefore, all information on comparison institutions is reported in aggregate form. Since their practices are quite similar, however, reporting averages does not distort the situation at individual universities.

The major difficulty in drawing parallels between the UC and its comparison institutions is that all but one of them are on the semester system, while eight of UC's nine campuses operate on the quarter system. A direct conversion of semester courses to quarter courses is problematic, in part because semesters are shorter at the comparison institutions than at the Berkeley campus. Where Berkeley has 15 weeks of instruction each semester and the other UC campuses have ten weeks per quarter, the comparison institutions average about 13½ weeks per semester (14 weeks at the public universities and 12 at the private schools). In addition, quarter courses may be more

*The Berkeley campus operates on a semester system. All other University of California campuses have three quarters per academic year.

intensive than semester courses, in some cases meeting longer hours and covering more material per week. For these reasons, the average teaching workloads in the comparison institutions are presented below in terms of semester courses per year, without attempting to convert them to quarter equivalents. In general, however, there are very close parallels in teaching workload between 1) the seven UC general campuses and the one comparison institution on the quarter system; and 2) the Berkeley campus and the seven comparison institutions on the semester system.

As in the University, course loads at the comparison institutions vary by discipline. The average number of semester courses taught per year is as follows (excluding the one institution on the quarter system):

Humanities and Social Sciences: four (five institutions); four to five (two institutions)
Sciences (including physical and biological sciences, mathematics, and computer science): two to three
Engineering: two to three

Similar exceptions to the normal course assignments are made by the University's comparison institutions, primarily for major administrative assignments and, less frequently, for new faculty members in their first year.

In conclusion, the data indicate, in spite of the difficulties inherent in making a comparison, that practices related to teaching assignments in the University of California closely parallel those of its comparison institutions.

Appendix C

Framework for Considering Instructional Cost and Resource Issues at the University of California

THE Commission approached this study of faculty workload at the University of California with the realization that it is not possible to evaluate the effectiveness or the quality of the learning environments created by the University's campuses, colleges, and departments. A plausible option, however, is to examine those factors that, required for the creation of a learning environment, can be viewed in quantitative terms.

For example, it is possible to quantify the number of faculty or the student-faculty ratio involved in the learning environment of a department or college. These factors provide a rough measure of the "inputs" or resource requirements of an academic unit. A corresponding output (proxy educational outcome), then, could be the number of full-time-equivalent students taught by a mathematics department or a college of engineering. The process that transforms input factors into educational outcomes has been described by Cohn (1979, p. 164) as the "production function of higher education."

Some of the earlier landmark studies on higher education costing, such as the California and Western Conference Cost and Statistical Study (Middlebrook, 1955), were built solely on a production function framework. However, in the more recent literature, such as in Carlson (1972), Robinson, Roy, and Turk (1977), and Leslie and Brinkman (1980), somewhat broader conceptual frameworks have been used. These broader frameworks have focused not only on the 'production function" of an institution or academic program but on its "cost function" as well. The latter, which is described in the following paragraph, evolved from microeconomic cost theory. An important contention in such frameworks is that sufficient similarities exist between a business firm and a college or university to permit the use of microeconomics in examining university costs (a more detailed explanation can be obtained from Maynard, 1971, and Carlson, 1972).

Within a microeconomics context, the "cost function" of the University's academic programs, which describes the relationship between their costs (resource requirements) and output levels, is dependent not only on the University's production function but upon its "market supply function" as well. According to Brigham and Pappas (1972, p. 211), the market supply function specifies the prices of the inputs used in the production process. The average salaries paid to full-time faculty or to department heads are examples of related "input prices."

What the broader conceptual frameworks connote for this study, then, is that variations in the instructional costs or resource needs among the University's academic units or disciplines can be interpreted as departmental or "academic discipline" differences in the production and market supply functions. A major objective for this study, therefore, is to provide an enhanced understanding of the costs or resource inplications associated with the production and market supply functions of the University's academic disciplines.

Appendix D

Research Literature on Instructional Costs and State Formula Budgeting Methods

IN the United States, considerable attention has been given to cost information and cost analysis in higher education, as evidenced by an existing body of literature that spans more than 85 years. Issues of costs and efficiency in educational institutions have attracted the attention not only of college and business administrators but of educators, researchers, and state higher education and political leaders. As a result, the contributions made to the field of cost analysis in higher education have been numerous and diverse. Considering the diversity of methods and objectives involved in the higher education costing process, this review of the literature on costing is approached with caveats. The following review focuses on those costing studies that are directly relevant to the purpose of this study, especially to identify consistent differences in instructional costs by level of instruction and academic discipline.

One of the better known and more widely quoted unit cost studies has been the *California and Western Conference Cost and Statistical Study for the Year 1954-55*, Middlebrook (1955). This study examined the variations in instructional costs among institutions, levels of instruction, and subject fields. Moreover, this study aimed at determining the relationship of these variations to variations in the factors presumed to affect institutional costs, namely (1) size of class, (2) method of instruction (laboratory or non-laboratory), (3) total volume of teaching activity, (4) faculty teaching assignment, (5) faculty salaries, and (6) teaching expenditures other than teaching salaries (e.g., expenditures for secretarial assistance, supplies, and others). Among the conclusions arrived at for the instructional part of this study were the following (pp. 30-31):

- In the institutions studied, the number of weekly student-class-hours per full-time-equivalent teaching-staff member is the most important factor in explaining variations in unit costs. This is basically a measure of teaching assignment; it also reflects class size. A generalized conclusion may be drawn that unit costs can be most easily changed by changing the ratio of students to staff in the specific subject field. The effect of such changes upon the learning environment is not, however, taken into account.

- Total volume of teaching activity if extremely low, prevents much increase in class size or teaching load, thus making cost adjustments difficult.

- Cost per student is affected not only by the number of students, but also by the composition of the student body in terms of instructional level, curriculum, and so on: the so-called "student mix."

- Methods of instruction definitely affect cost. Their effect, however, is in terms of their influence upon class size, teaching load, and other factors bearing upon costs. Where the measure of costs is indicated in terms of the student-class-hour per week, attention must also be given to the number of weekly meetings of the class.

The Middlebrook study found that although costs varied among subject fields, levels of instruction, and institutions, it was possible "to isolate the causes of these variations and explain them in terms of influences which exerted themselves regardless of subjects of institutions" (p. 31). As indicated in this study, it was also possible to examine the effects of various policies upon the costs of a specific type of learning environment. This policy issue is addressed in a few of the more current studies reviewed below.

In much of the unit cost literature published since World War II, considerable interest has been shown in knowing the cost associated with the education of one student in a specific academic level or subject field. Moreover, much of this literature has given particular attention to economy of scale issues. Williams' (1961) study reported that at the University of Michigan the mean cost ratios among freshmen, juniors, and graduate students averaged about 1:2:6, respectively. He found that, depending upon the school or college the student was enrolled in, the cost of one freshman and sophomore student ranged from $534 to $1,865 and averaged $656, while the cost of one junior and senior student ranged from $636 to $1,877 and averaged $990 (p. 324). In his study titled "Proved at Last: One Physics Major Equals 1.34 Chemistry Major or 1.66 Economics Major," Hyde (1974) reported that, when compared to the costs of producing an upper-division FTE chemistry or economics major, the high cost of an upper-division FTE physics major was chiefly a diseconomy of scale problem since student enrollment in this major was usually small. The high cost of a physics major, he added, may be explained by the high diversity in some physics departments, resulting in numerous specialties with low enrollment.

The studies by Beatty, Gulko, and Sheehan (1974) and Leslie and Brinkman (1980) are among the most recent to examine the factors accounting for instructional cost differences among levels of instruction, academic disciplines, and methods of instruction. An overview of these studies provides an understanding of the numerous factors influencing unit instructional costs in higher education.

Beatty, Gulko, and Sheehan (1974) pointed out that the minimum set of policy variables required for an analysis of direct instructional costs included (1) faculty compensation, (2) relative faculty effort, (3) class section size, (4) faculty teaching load, and (5) instructional support programs. The authors contended that by assigning a numerical value to these variables, it was possible to characterize institutional academic and resource allocation policies that influenced the direct cost of instruction. They added that the purpose of the policy variables was "to provide numerical information to help decision makers focus on probable causes of differences in instructional cost indices" (p. 8). Beatty *et al.* demonstrated the application of an instructional cost index using data collected from five sample academic departments (business, biological sciences, humanities, engineering, and social sciences) from the University of Massachusetts at Amherst. Their work served to identify the policy variables causing major differences in the instructional cost indices:

> For example, the Instructional Cost Index for Engineering is approximately 2.5 times greater than that for Humanities. The average class size in Engineering is approximately one-half that of Humanities, and can be identified as a major cause of the index differential. Although slight differences are discernible in faculty load, relative faculty effort, and faculty compensation, the two largest contributors to the differential are class size and support expense (pp. 16-17).

In one of the few major unit cost studies carried out in the 1980s, Leslie and Brinkman (1980) explored the reasons for cost variations among 20 public and 11 private institutions designated as "Research Universities I" by the Carnegie Commission on Higher Education (1976). The authors reported that among the variables having the highest influence on unit instructional costs were average faculty compensation, percent of graduate students, curriculum breadth, and the student-faculty ratio. Unfortunately, the authors did not report differences in cost ratios among the academic disciplines.

Costing information and cost analysis have been essential properties of the formula budgeting approaches taken by various states to determine funding levels for their public colleges and universities. About half of the states have been known to base their appropriations on formula budgets. Because most formula budgets have been based on costs, they therefore have tended to be based heavily either on past behavior or on meeting current fiscal needs -- irrespective of changes in program needs or priorities -- rather than truly predicting budgetary requirements. Yet in spite of the linear approach used in most formulas to estimate resource requirements -- one based on the linear relationship between enrollments and appropriations -- formulas have been reformed in recent years so as to buffer the effects of enrollment fluctuations and to contend with the problems of fixed and variable costs in certain programs. Among the newest trends in formula budgeting is differentiation by academic discipline and levels of enrollment. For example, at the core of the Minnesota formula is a differential, buffered, av-

erage-cost funding approach. Brinkman (1984, p 38) elaborates on this:

> The buffering is accomplished by relating requested resources to a previous level of full-year equivalent enrollments. The enrollment figures used are those recorded two years prior to the year being funded; for example, 1983 enrollments are used in determining the funding level for 1985. Costs and enrollments are differentiated by program type (12 categories) and by level of instruction (four categories).

Minnesota's formula budgeting method is based on instructional funding matrices in which average costs are differentiated on the basis of low, medium, and high cost academic programs and levels of instruction in each of the state's four segments of public higher education. The method combines enrollments with average costs to determine future instructional funding levels. For example, in 1985, the University of Minnesota's "medium cost" programs averaged $3,725 per full-time-equivalent lower-division student, with 2,765 students enrolled in those programs in that year. By combining these enrollments and average per-student costs, a future (1987) instructional funding level of $10,295,900 for the programs was estimated.

Lamb (1986) conducted perhaps the most recent review of budget formulas used by other states to estimate the instructional resource requirements of their institutions of higher learning. From this study, the following are a few examples of those for-mulas that use student-faculty ratios as a mathematical means of linking state appropriations to the instructional workload of the institutions' varied academic programs at the undergraduate and graduate levels.

In Connecticut, the state budget formula funds instructional workload according to different categories of institutions, academic programs, and instructional levels. For example, in the "social science" programs at the "four-year institutions," the state formula recognized student-faculty ratios of 30.0:1 at the "lower-division" level, 21.0:1 at the "upper-division" level, 14.0:1 at the "master's only" level, and 8.0:1 at the "master's and doctoral" level. By contrast, in the category of programs containing the engineering and physical sciences disciplines, the ratios by instructional level were 19.0:1, 12.0:1, 10.0:1, and 8.0:1, respectively. These differences in the ratios would indicate that, at the lower-division level, workload in engineering and the physical sciences is about 33 percent greater than workload in the social sciences, with the latter's workload being almost half as much at the upper-division level. While the social sciences have a 40 percent lighter workload at the "master's only" level, they have the same workload as engineering and physical sciences at the "master's and doctoral" level.

In Kentucky's universities [which are classified as "other universities by Lamb (1986) because Kentucky State University is not included] the student faculty ratio at the "lower-division" level ranged from a high of 22.5:1 in the liberal arts and education programs to a low of 7.5:1 in the health sciences. In these institutions, the "doctoral" level ratios were highest in education (5.2:1) and lowest in fine arts and in pharmacy (3.0:1). For the engineering programs, the student faculty ratio was 14.1:1 at the lower-division level, 11.7:1 at the upper-division level, 8.0:1 at the master's level, and 3.8:1 at the doctoral level.

In a final example, at the South Carolina institutions conferring the doctoral degree (Clemson University, the University of South Carolina at Columbia, and the Medical University) the student-faculty ratios used in the formula were highest in the business and management disciplines -- at both the undergraduate level (24.0:1) and the graduate level (17.0:1). By way of comparison, engineering had an undergraduate ratio of 19.0:1 and a first-level graduate ratio of 11.0:1, which connotes that the latter's instructional workload is about one-fourth greater at the undergraduate level and about one-third greater at the graduate level.

The above research on costing and formula budgeting in higher education provides evidence that instructional workload requirements, as measured in per-student costs, vary considerably among academic levels, subject fields, and types of institutions. The Middlebrook (1955) study, which was the first to focus on the technical relationships in the production process in higher education, noted that unit cost variations among campuses, level of instruction, and subject field were influenced by variations in such production factors as size of class, faculty teaching assignment, and faculty salaries. The more recent studies have provided an enhanced understanding of the production function in higher education by stressing that the market supply function, as reflected by

market-based faculty salaries, must be taken into account. The literature shows that state formula budgeting approaches rely heavily on costing information to determine funding levels for higher education institutions. These formulas frequently use a student-faculty ratio to link state appropriations to the differential workload needs of the states' varied institutions and their varied academic programs at the undergraduate and graduate levels.

Based on these differences in workload, the tentative assertions can be made that *collectively* (1) graduate instruction is likely to be two to three times as expensive as undergraduate instruction, (2) at the undergraduate level the hard sciences can be about 33 percent to 55 percent more costly than the social sciences, and (3) while average unit costs among subject fields vary the least at the graduate level, engineering and the hard sciences are the most costly.

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