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ABSTRACT

This study examines California's prospects for meeting the 1960 Master Plan goal of providing access to public undergraduate education to every Californian who could benefit from it in the context of the state's future demographic and fiscal environment. The study uses a dynamic simulation model to estimate the target level of education envisioned in the Master Plan and the levels likely to be attained under a range of scenarios. It finds that the state will not be able to meet even half of the target level demand overall. The study also finds that the prospects of closing this gap through increased revenues, increased fees, and increased productivity are not feasible. It concludes that the state must take two actions: (1) it must reevaluate the access goals of the Master Plan and focus on ways to maximize the return on its education investment; and (2) the three public systems should focus their resources on restructuring the way in which they deliver the education product to maximize the ability of the state to serve as many citizens as possible. (Contains 58 references.) (DB)

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THE MASTER PLAN REVISITED (AGAIN): Prospects for Providing Access to Public Undergraduate Education in California

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Abstract for

THE CALIFORNIA MASTER PLAN REVISITED (AGAIN):

Prospects for Providing Access to Public Undergraduate Education in California

by

MICHAEL ALAN SHIRES

In 1960, the California Master Plan for Higher Education set a goal of providing access to every Californian who could benefit from it. As a result of that commitment, California has developed one of the largest most successful public postsecondary education sectors in the nation. State fiscal constraints combine with exploding population growth, however, to call the state's ability to sustain that goal into question. Several studies have looked at this issue, including two reviews by the State Legislature. This dissertation examines the state's prospects for meeting the goal of the Master Plan in the context of its future demographic and fiscal environment. The research uses a dynamic simulation model to estimate the target level of education envisioned in the Master Plan and the levels likely to be attained under a range of scenarios. It finds that the state will not be able to meet nearly half of the target level demand overall. The study also finds that the prospects of closing this gap through increased revenues, increased fees, and increased productivity are not feasible. It concludes that the state must take two actions: (1) it must reevaluate the access goals of the Master Plan and focus on ways to maximize the return on its education investment; and (2) the three public systems should focus their resources on restructuring the way in which they deliver the education product to maximize the ability of the state to serve as many citizens as possible.

Preface

This report is an analysis of the prospects for providing access to public undergraduate education in California through the mechanism of the California Master Plan of 1960. It presents the results of a dynamic simulation to estimate both the demand and supply of public undergraduate education in California and the prospects for closing the gap between the two.

California education and training at all levels have become a case study for RAND's Institute on Education and Training (IET). This report focuses on the postsecondary portion of California's education and training sector. The author is an IET Fellow in the RAND Graduate School and the research contained herein was generously supported by the IET.

This report will be of particular interest to legislators and policymakers in the California postsecondary education sector as it presents an assessment of the magnitude and types of some of the challenges facing problems the state's sector today. It is also to be accessible to the general public and scholars as a starting point for further research. The model developed in the course of the research will be of use to policy analysts as they consider the implications of various policy alternatives in the future.

This dissertation serves completes one of the requirements for the author's doctorate degree in public policy analysis at the RAND Graduate School. In will also be published by the Institute on Education and Training as a Monograph Report, MR-561-LE. For further information on either the Ph.D. program in public policy analysis or the Institute on Education and Training, please call (310) 393-0411.

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Summary

In 1960 the state of California adopted the language of the California Master Plan for Higher Education as its policy and strategy for higher education. That plan had two major components: (1) i. specified the roles and missions of each of the four segments of the state's higher education sector; and (2) it stated that each Californian who could benefit from higher education should have access to it.

The Master Plan has successfully served as the model through which the state's higher education sector has grown and thrived. This growth has in turn provided the fuel for the state's economic engine and the seed underlying the growth of its high technology and aerospace sectors.

The recent recession in the state, has had a major impact on the state's three public university and college systems. Enrollments at these systems have dropped in a period when the state population has continued to grow. Increasing caseloads in mandated spending programs resulted in a significant reduction in state support of higher education during the early 1990s. The Master Plan goal of access has been sharply impacted in this period.

As the state economy begins to recover from the economic problems of the early 1990s, the question arises, "Can the state return to the levels of access envisioned in the Master Plan?" If so, then the state's higher education systems should map out a strategy for accomplishing this goal and enter a compact with the state legislature to fund that plan. If not, then the Master Plan as the document shaping the sector should be revisited and revised to reflect the realities that will shape the state's future.

This report is an effort to answer the fundamental question posed above. ***This research shows that there is an access crisis in California.*** As a consequence, the state must either find the resources to pay for the access goal or it must revise that goal downward to reflect reality and maximize its return on its limited resources.

It is important to note that this analysis errs on the side of underestimating these access deficits because it assumes that (a) the Master Plan goals for access were met in 1989-90, (b) the money spent on higher education in that fiscal year were adequate to sustain that year's supply, and (c) significant student fees, such as

those in effect in 1989-90 are acceptable over the long run.. All of these points are debatable.

Even with these broad assumptions and the use of a conservative methodology for estimating the level of services provided by the sector as envisioned by the Master Plan ("the ambient demand"), the state is expected to fall far short of this conservative standard. If the resources available to higher education in the state come in at expected levels, by 2010-11, the sector will be able to serve slightly more than half of the students called for in the Master Plan.

Even an optimistic fiscal scenario, a highly unlikely prospect given the mandated rival demands on General Fund revenues, does not close the deficit. In the optimistic scenario, only 58 percent of the overall desired student population (the ambient demand) will be served in 2010-11.

The physical capacities of the systems also call into question the state's ability to meet the Master Plan capacities. To meet ambient demand projections, the state will have to build additional capacity to accommodate nearly 720,000 additional students in its higher education sector. This during a time when the voters of the state routinely continue to reject bond issues for both K-12 and higher education.

If one sets aside the goals of the Master Plan, it is not clear that the sector will even be able to meet the level of demand expected over the next 15 years ("the expected demand"). In nearly all scenarios analyzed in this study, the state faces an operating shortfall where the expected demand exceeds the expected supply and—since that level of support is definitionally less than the ambient demand—an access deficit. Furthermore, rising fees have already excluded a significant number of students who should have been served under the Master Plan. Even with the "pricing out" of students through these higher fees, the state will be unable to meet the expected demand for public undergraduate education.

Access Deficits Here for the Long Run

The prospects for meeting these access deficits are not good. First and foremost, the rising levels of fees in the state are routinely pricing out students who, under the Master Plan, should be served by the state's higher education sector. Unless the price of higher education is reduced to earlier levels, the state will guarantee that a significant proportion of students will be denied access to the state's public undergraduate institutions.

Furthermore, it is clear that the state cannot afford to buy out of the current access crisis. It is estimated that it would cost the state an average annual total of $11.3 billion dollars a year[1] to meet the operating demands of the Master Plan. This represents an increase in the operating support of higher education from 11 percent today to more than 20 percent in 2010-11. While that share is not unreasonably high in historical terms, the increasing demands of the state's mandated spending programs, such as K-12 education, corrections, health, and welfare programs render it highly unlikely in the future context.

The costs associated with adding the necessary additional capital capacity are also formidable. Annual debt service and investment to fund the necessary capital program would exceed $1 billion per year in real terms. The associated bond requirements total more than $18.1 billion ($14.7 billion in real terms) through 2010-11. Consultations with several state experts in the bond markets estimate that California's total annual new issue capability is somewhere around $2 billion a year. Between the demand for new prisons (driven by three strikes) and the need for new K-12 facilities (which is driven by the same demographic forces as higher education), there is certain to be more than ample competition for the $30 billion dollars of state borrowing capacity available over the next 15 years.

Another strategy to closing the deficit is to cut the costs of producing higher education. This analysis shows that it would require significant cuts in the total production cost of education in order to produce an adequate number of educational opportunities to close the access deficit. If this strategy is pursued, it will have to be in the form of as yet nonexistent technologies that significantly increase the number of students that can be served by each campus. Because of the recent major reductions in operating costs in all three systems, it is unlikely that major productivity improvements can be made without seriously impacting the quality of the education provided. This is not to say that progress cannot be made, as will be discussed in the recommendations for immediate action below.

Finally, there are a range of other options and combination of the above options that the state can pursue. The decision to admit and enroll all eligible students regardless of capacity is not realistic and the sector and legislature rightly oppose this possibility. There has also been discussion of a three-year degree undergraduate degree as a solution to the state's problems. While it does offer potential to significantly reduce the access deficits (which could be met through

[1] This is average annual spending from 1995-96 to 2010-11 in current dollars. The amount is $8.0 billion a year in constant 1992-93 dollars.

other changes), the thinking on this approach has not yet been fully sounded out and it is not clear what the implications of such a degree would be on the quality of the overall education. This degree would also impose significant challenges logistically during the transition to such as system. Even so, full and immediate implementation would only reduce and not close the access deficit.

The Future of the California Master Plan for Higher Education

One conclusion is inescapable—the California Master Plan for Higher Education, in today and tomorrow's fiscal and demographic environments, is not viable in its current form. The state has little prospect for meeting the goals of the Master Plan and providing the level of public undergraduate access embodied therein. It is time for the state and policymakers to reconsider the Master Plan and to develop a new strategy for the state's higher education systems.

The fact of the matter is that this is already happening. But instead of resulting from well-thought, macro-level choices between alternative visions, the access provided by the state's higher education sector is being shaped by a mishmash of local factors and compounded by a highly uncertain budget picture. Students are being explicitly kept out of the system by price increases and capacity as a share of total ambient demand is decreasing with no explicit vision on where it is all headed.

The state is almost in a state of denial as to the ongoing viability of the Master Plan. Budgets are no longer considered from the perspective of what is required to support the needs of the state's higher education sector, but rather what is left that can be spend on it. And while everyone agrees on the goals of the Master Plan, everyone also agrees that it is not currently being met. This analysis shows that it will most likely not be met in the future either.

The time has come therefore, for the state to convene a new Committee on the Master Plan to address the state's goals for its public education sector into the future. This Committee will need to consider the capabilities and strategic role of the state's higher education sector well into the next century. It will also need to consider the fiscal and demographic context in which the state's higher education institutions must operate. It will need to consider the strategic alliances between higher education as an education and training mechanism for the private sector as well as the sector's role in producing a significant portion of the nation's basic research. The linkages between the state's public and

private education sectors will also have to be strengthened. The list of questions and issues goes on far beyond these and is formidable.

But the challenges are no more formidable than those 35 years ago. It is also important to remember that the current Master Plan was the product of a long process and the last in a series of efforts to consider the structure and character of the state's higher education sector. The new effort should also be the result of a carefully considered process. Participation should come from all aspects of the higher education sector and should include members of all four major higher education segments (private institutions constituting the fourth), members of the private and public sectors, lawmakers, and other leading policy players.

The current Master Plan is arguably a major reason for the state's tremendous success over the past 35 years. A new Master Plan will be the key to the state's next 35 years. The sooner such an effort can be undertaken, the sooner the sector's goals and objectives can be redirected to springboard the state into the next century.

The Sector's Immediate Response

Even as the reworking of the Master Plan is a crucial first step in the long-term solution to the sector's problems, restructuring is a crucial first-step in solving the sector's short-term problems. As indicated in this research, the sector will still face significant operating and capital capacity shortfalls, even if the goals of the Master Plan are set aside. As such, the sector must take immediate steps to maximize the level of access provided with the resources it has.

An important key is maximizing the quality and quantity of the education good produced by the sector with the resources it receives. The current structures and institutions are largely the product of long histories and often more focused on that structure than on the production of education. The three-year degree proposal is an example of how these histories and their underlying assumptions can be challenged.[2] Numerous other institutions, both public and private, have reassessed their institutional foci and reorganized their curricula, schools, information systems, and approaches to doing the business of higher education.

[2] This does not constitute an endorsement of this alternative, but merely shows it as an example of a restructuring initiative.

Restructuring for the sake of restructuring, however, should be avoided. The restructuring process should focus on innovation and mission within the institutional context. The author has co-authored a work on this topic and the reader is referred to that work for a more detailed discussion of this topic.[3]

Beyond overall restructuring initiatives, the systems must also work to achieve cost efficiency in their production process. As stated earlier, the emphasis should not come from the more traditional approaches to cost reduction—namely salary and staff reductions, although these may also be appropriate—but should be more on the potential of the information revolution. New technologies can significantly leverage the productivity of the higher education teaching process upward. Advances in systemic and institutional information systems can be used to strengthen and improve their decision processes.

In conjunction with these internal changes, the state *must* continue to fund the capital expansion of the systems. The current capacity is inadequate to today's needs, let alone to the state's future needs. Capital expansion takes significant time and resources and cannot be ignored. No matter what vision is adopted in a new Master Plan, the state's population is exploding and the state's higher education sector will need to grow to serve the state's future needs. The decision for expansion must be made in the long-term perspective and higher education cannot be left out of the equation when competing with K-12 and prisons.

Finally, the level of support to the sector must be maintained, whether through a sustained share of the public dollar or through new public/private partnerships. The failure of the state to provide on-going support to the state's higher education systems will be a costly failure indeed as a significant share of the state's burgeoning population will be denied access to higher education. In an increasingly technological society that demands an increasingly skilled workforce, such short-term policy choices could well leave the state unable to compete.

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[3] Roger Benjamin, Stephen Carroll, Maryann Jacobi, Cathy Krop, and Michael Shires, *The Redesign of Governance in Higher Education*, Santa Monica, CA: RAND, MR-222-LE, 1993.

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The California Postsecondary Education Commission provided key data for this analysis and I am indebted to their staff for their advice and especially Jan Taylor for overseeing the preparation of that data. In addition, I would like to thank the staff of the Demographic Research Unit at the Department of Finance, and especially Paula Flores, who provided invaluable assistance and information over the course of this project. Carol Bingham and Bob Loessberg-Zahl at the Office of the Legislative Analyst were also contributed advice and information to this effort.

I am also appreciative of the advice and assistance of the many individuals I have spoken with at the University of California Office of the President, the Chancellor's Office of the California State University, and the Chancellor's Office of the California Community Colleges. Dr. Frank Jewett at California State University deserves special mention, as it was a dialogue with him that served as the conceptual inspiration to this entire effort.

This section would be incomplete without acknowledging the extensive support I have received from my family and friends. Their moral support and patience with five years of graduate school and endless conversations about the policy issues surrounding higher education and state finance is greatly appreciated.

Without it, neither this work or the accomplishment that it represents would have been realized.

Finally, and most importantly, I would like to thank my wife for her support and patience through this effort. She deserves at least equal billing on the author page for all of those long hours and long, tedious conversations over the best approaches and the logistics associated with executing this research. Furthermore, she endured the trials and tribulations of this entire program and always managed to find a smile and a supportive word just when it was needed the most.

As can be seen here, this dissertation is the product of the efforts and support of a lot of people. At the same time, I would like to remind the reader that this research is represents the views of the author alone and not the views or opinions of any other individuals or their respective organizations.

1. Introduction

Higher education is an important part of today's society. It serves many important roles—including training a skilled workforce, providing a mechanism for upward social mobility, serving as an equalizing mechanism to historically underserved groups, producing basic research that has launched this country into space and the information age, training today's doctors, lawyers, bankers, and business people, and serving the public by training and providing a skilled set of expert analysts to inform and assist public policy at all levels.

It has been further linked to the economic performance of the nation.[4] Nowhere have the consequences of this link been more evident than in California. The state's Master Plan for Higher Education has been the cornerstone for the emergence of one of the world's premier higher education sectors. At the same time, the state has emerged as one of the most powerful economic entities in the world, with a gross state product that would rank it in the top ten worldwide if it were a separate country.

It is the future health of this Master Plan for Higher Education that this report addresses. The Master Plan is on the key concept of access to postsecondary education for every California who can benefit. It is this concept which this report addresses itself. The fundamental question is, "Can the state of California provide the levels of access envisioned in the Master Plan in the future?" If so, then the state's higher education systems should map out a strategy for accomplishing this goal and enter a compact with the state legislature to fund that plan. If not, the Master Plan as the document shaping the sector should be redesigned to reflect the realities that will shape the state's future.

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[4] See *How Do Education and Training Affect a Country's Economic Performance? A Literature Survey*, by Roland Sturm, Santa Monica, CA: RAND, MR-197-LE, 1993, for a more detailed analysis of this relationship.

California's Commitment to Access: The California Master Plan for Higher Education

In 1960, the legislature of the state of California passed the Donahoe Act (get cite here) which placed into effect the California Master Plan for Higher Education. In this document, each of the four segments in California's higher education sector was given a specific set of missions in educating the population of the state. The stated purpose of the legislation was to "provide every Californian who might benefit" with access to higher education.

The Master Plan addressed a wide range of issues. Most important was the definition of relevant student populations for each set of institutions and a formalization and differentiation of the missions of each set of institutions. The definition of student populations was in response to the competition between the various public institutions for the high caliber students. The Plan resulted in the University of California admitting only the top one-eighth of the high school population. The Plan also calls for the California State University system to admit students from the top one-third of the high school population. Junior colleges (now called community colleges) were to serve the needs of the remainder of the state population. The driving force behind the plan was that ALL Californians should have access to postsecondary education, irrespective of their level of preparation while balancing the different needs of the postsecondary institutions for high quality students.

The Plan also differentiated between the missions of the three groups of institutions. Each was allocated a specific set of roles within the overall objective to provide a postsecondary educational opportunity to all Californians. Each of these roles is a reflection of the institution's history, as well as the student population to which it is targeted.[5] The role of each of the institutions is discussed in further detail below.

California Community Colleges

Community colleges were three basic roles in the Master Plan, each of which can be traced, at least in part, to the history of the community college as an

[5]This relationship actually goes both ways, inasmuch as we pointed out above that the Plan balanced the needs of the institutions (including their student population they required) against the access objective.

institution. Community colleges are expected to "offer instruction but not beyond the fourteenth grade level, including, but not limited to the following:"[6]

Standard courses for transfer to higher institutions. The junior college is chartered to provide classes for individuals who will eventually transfer to other four-year institutions of higher learning. Historically, the junior college was an offshoot of high schools (with which they had their initial affiliations) and were modeled to provide the courses typically encountered in the first two years of college.

Vocational-technical courses in fields leading to employment. Vocational courses have long been a component of junior college programs, dating back to 1917 and the Smith-Hughes Act of 1917. The formalization of the community college's role as the sole provider of this type of training was important, however, inasmuch as it established a specialization within the postsecondary educational framework.

General or liberal arts courses. This category of courses exemplifies California's commitment to provide access to postsecondary education to ALL Californians. This particular category of courses allows individuals to pursue general courses in academic areas without having to make a long-term commitment to a full-fledged degree program. Incorporated with this role was the introduction of the Associate in Arts and Associate in Sciences degrees.

The local governance aspect of the community college system also brought the community college and its curriculum decisions much closer to the market it served. This allows local communities to establish their own priorities for programs of local community interest.

California State University

The role of the California State University system also was also revised and expanded in the Master Plan. To quote the Plan,

> The state colleges shall have as their primary function the provision of instruction in the liberal arts and sciences and in professions and applied fields that require more than two years of collegiate education and teacher education, both for undergraduate students and graduate students through the master's degree. The doctoral degree may be awarded jointly with the University of California, as hereinafter provided.

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[6]California State Department of Education, *A Master Plan for Higher Education in California, 1960-1975*, (Sacramento, 1960), p. 2.

> Faculty research, using facilities provided for and consistent with the primary functions of the state colleges, is authorized.[7]

Recall that the state colleges and universities started as "normal schools" (committed exclusively to training elementary and secondary teachers). This charter reflects both their origins in teacher preparation and the trend toward expansion and liberalization of their curricula. The expansion of the professional degrees to be offered reflected, in part, the changing demographics of a state undergoing massive population growth.

The University of California

The mission of the University of California is also explicitly defined in the Master Plan:

> The University shall provide instruction in the liberal arts and sciences, and in the professions, including teacher education, and shall have exclusive jurisdiction over training for the professions (including but not by way of limitation), dentistry, law, medicine, veterinary medicine, and graduate architecture. The University shall have the sole authority in public education to award the doctor's degree in all fields of learning, *except that* it may agree with the state colleges to award joint doctor's degrees in selected fields. The University shall be the primary state-supported academic agency for research, and the Regents shall make reasonable provision for the use of its library and research facilities by qualified members of the faculties of other higher educational institutions, public and private.[8]

This text almost exactly echoes the mission statements that go back to the University's nineteenth century inception as a land grant university.

The uniqueness of the California Master Plan arose from the integration of the diverse functions of the three previously independent systems into a single, intentional framework for meeting the needs and objectives of the people of California while simultaneously matching the needs of the institutions for high quality students. It was the departmentalization and formalization of the diverse roles of the constituent institutions that made the Master Plan unique, coupled with the overarching objective of providing access to postsecondary education to ALL Californians.

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[7] *ibid.*, p. 2.
[8] *ibid.*, pp. 2-3.

Private Colleges and Universities

Private colleges and universities were not left out of the state's vision for its higher education sector. Each of these institutions was enlisted to provide higher education in accordance with their several individual charters and missions. The Cal Grant aid program was instituted to provide lower-income students with the opportunity to attend these private institutions. Inasmuch as these specific missions and roles are beyond the control of public policy makers and the state fiscal resources committed to these institutions are significantly lower than those committed to public institutions of higher education, the focus is on public institutions in this analysis.

What is Access?

Access to education can be defined in a number of ways. For example, access could simply defined as the presence of the good itself—the existence of institutions of higher education in the state—hence, the opportunity. The opportunity to attend, however, can be defined in many other ways. Suppose the institution admits everyone, but does not provide enough classroom seats. As a consequence, it will take student who enter the institution an unacceptably long time to complete their degrees. It may also be that this institution charges a tuition or fee that makes the opportunity unaffordable to the overall population. The quality of the education provided could also be poor; in which case it could be argued that the opportunity provided is not really access to education.

The different conceptualizations can be summarized in the following five categories:

1. **Availability**: The existence of an adequate quantity of education opportunities.
2. **Affordability**: The opportunities must be affordable to the population that the institution is serving.
3. **Attainability**: The institution must maintain an environment which is conducive to the ultimate product of an undergraduate education—learning and, more quantifiably, a degree.
4. **Equity**: Inasmuch as education is considered an important social adjustment mechanism for historically suppressed groups, it mus be certain to provide opportunities for those individuals to attend institutions of higher learning. Because of the difficult social context of many of these

potential students, it is often considered incumbent on higher education institutions to provide special and additional opportunities for these students.

5. **Quality**: The opportunity to attend an institution whose curriculum and faculty reflect a certain level of quality is a crucial dimension of access. If everyone is provided access to a low-quality program, then there is a legitimate concern and issue whether the needs of society have been met.

Turning to the Issue of Access Today

Today access to undergraduate education is problematic in the context of the California Master Plan. The recent recession in California, coupled with a wide range of voter-approved ballot initiatives, have combined to bring about a crisis in California state finance.[9] For the first time in the history of the Master Plan, state funding decisions for the state's public higher education systems have recently been driven more by how much money was available than by the number of students they enrolled. Even in community colleges, where minimum funding guarantees were put into place with the passage of Proposition 98,[10] there have recently been years where the average per-pupil state support has fallen.[11]

Because of this shift in the funding paradigm, a wide range of significant changes has occurred in the three public systems. Fees charged to students have risen dramatically in all three systems. In the CSU system, each of the campuses have pursued different solutions to the reduction in funding, including such diverse approaches as laying off all part-time faculty or terminating all library acquisitions or sharply reducing support staff. One consequence of these changes has been the limitation of the number of students enrolled on the various campuses—both in response to the fee increases and through the offering of significantly fewer sections of courses. In the UC, the responses have taken a range of forms as well. One campus, UCLA, has

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[9] See Stephen Carroll, Peter Rydell, Eugene Bryton, Michael Shires, and Sugata Biswas, *California's Fiscal Future*, MR-570-IET (forthcoming) and Stephen J. Carroll, Kevin McCarthy, and Mitchell Wade, "California's Looming Budget Crisis," *RAND Research Review*, Fall 1994, Vol. 18, No. 2, for a more detailed discussion of these issues.

[10] Proposition 98, which was subsequently modified by Proposition 111, sets a floor on K-14 spending in the state and requires that, except in very bad economic years, the level of funding in to this sector shall not drop below the greater of a fixed share of General Fund revenues or a level that maintains the prior-year real per-pupil expenditure.

[11] Because Proposition 98 addresses K-14 finance, it is possible to meet the overall guarantee amount while decreasing the share of the combined share that goes to community colleges. This has been the case in fiscal years 1992-93 and 1993-94.

merged several schools and programs into a single school, while the system overall has encouraged the retirement of more expensive, senior faculty through attractive early retirement programs.[12]

Any and all of these changes could have been well overdue and that the changes seen in the public education sector may well represent market adjustments to activities that were oversubscribed and goods that were overproduced. This does not seem to be the perception of many leaders in the state today. In fact, there is a belief that much of California's success during the 1980s was directly attributable to its highly trained and educated workforce and the synergies that developed between its academic research institutions and its high-tech industries. Furthermore, as the state and nation's economies become more service and technology-oriented, it is likely that the demand for trained and skilled workers will increase. The Higher Education Members of the Education Roundtable point out that,

> ...California's emergence as one of the world's major economic powers did not occur by accident. It happened because the Golden State nurtured a work force that was among the best educated on earth. It happened because employers knew that California, through its higher education system, could be counted on to lead the world in both technologic and industrial innovation, as well as in the creation of a large, talented, and well-trained labor force. Recognizing the value of California's dominance in research, as well as the wisdom of locating in an area with well-developed human resources, native-born entrepreneurs as well as out-of-state and immigrant businesspersons flourished. They established small businesses and developed entire new industrial sectors, resulting in unprecedented prosperity for California's residents.[13]

In the 1970s and 1980s, the original master plan document was reviewed and revisited by committees appointed by the legislature. In each case, even though some of the specific mechanisms and missions were debated, the overall objective of the Master Plan was reiterated—to provide higher education to every Californian that may benefit therefrom. Today there is widespread discussion as to whether the state can afford to pay for that goal. The purpose of this report is to discuss California's prospects of funding the Master Plan into the future.

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[12] The implications of the early retirement of this large share of senior faculty may be long-lasting. These senior faculty account for a significant share of the extramural research monies raised by the university, which in turn contribute directly to the quality of the instructional programs as well as providing significant support for graduate students who in turn will become faculty. However, the direct implications to California are not clear because the market for faculty is national.

[13] Higher Education Members of the Education Roundtable, *A Joint Statement on the Crisis Facing Higher Education*, March 1993.

Other Research On This Topic

As the title of this report indicates, it is not the first effort to address the issue of access in California. The issue has long been one of great concern and attention for the decisionmakers in the state, as well the California Master Plan itself shows. In the past several years, even more attention has been turned to the subject.

One of the primary contributors to the discussion of the issue of access in the state is the agency which is charged with serving as a coordinating and reporting mechanism for the state's postsecondary sector—the California Postsecondary Commission. One of the milestone reports on the issue of access in the state's recent history was their January 1990 publication *Higher Education at the Crossroads* and its accompanying technical paper papers.[14] The illustration on the cover of that document, shown in Figure 1.1 below, typifies the concerns at that time. The statutory limits on state finances imposed by the Gann Initiative raised the concern that revenues to the sector would remain flat while projected enrollments were expected to skyrocket—all before the fiscal crisis of the early 1990s. The recommendations of the report focused on making special provisions for higher education under the state's spending limits and plans for growth in each of the systems.

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[14] CPEC, *Technical Background Papers to Higher Education at the Crossroads: Planning for the Twenty-First Century*, CPEC Report 90-2, January 1990. This is an excellent source of information regarding the finance and enrollments within the state's higher education sector.

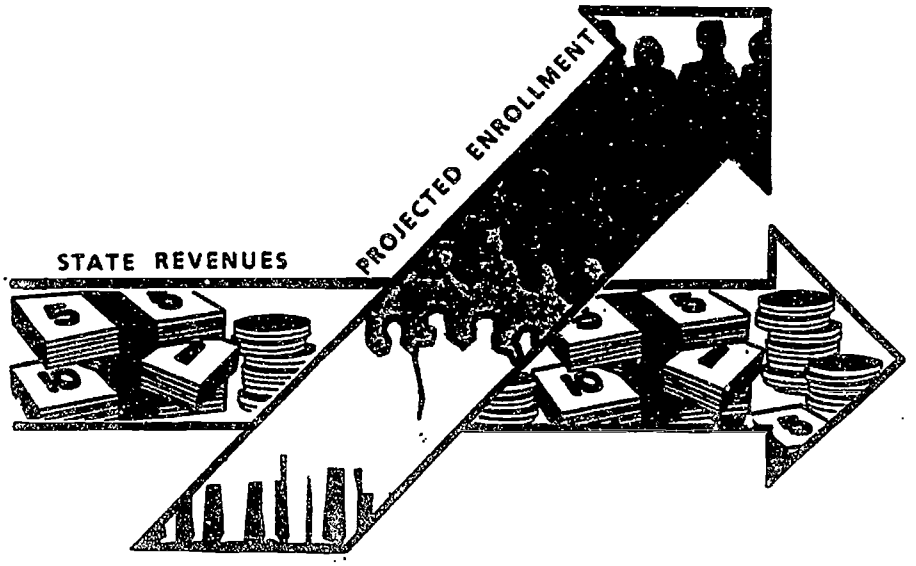

Figure 1.1--Cover Illustration from *Higher Education at the Crossroads*[15]

Subsequent to this report, a severe recession buffeted the state and drove the state revenues arrow downward, while census results indicated that the state population had and was expected to grow even faster than anticipated. As a result, CPEC Executive Director Warren Fox made the following statement in the 1992 report *Meeting the Challenge: Preparing for Long-Term Changes in California Higher Education*, under the heading "The Fundamental Issue:"

> The State of California alleges one set of commitments—access for all qualified individuals to a quality academic or vocational education—and in fact is delivering a very different product. For the first time in California's history, an ethnically and racially diverse population is graduating from high school academically prepared to meet the higher admissions standards at our public universities. ... Unfortunately, and also for the first time in California's history, the public's willingness to invest in higher education does not appear to be commensurate with the demand for academic and vocational education.[16]

The distinction between this report and these early CPEC efforts is that this report uses updated census and economic information and projections, different methodologies for estimating participation across the sectors, and focuses specifically on the access issue. It also presents an overall assessment of the

[15] CPEC, *Higher Education at the Crossroads: Planning for the Twenty-First Century*, CPEC Report 90-1, January 1990.

[16] CPEC Report 92-25, p. 11.

state's entire public postsecondary sector using consistent methodologies and assumptions for each. This integration allows the policy maker to assess the overall prospects of providing access.

The State Legislature has also commissioned two studies of the California Master Plan. In 1972-73, it was reviewed by a Legislative Joint Committee. In 1984, another study of the Master Plan was commissioned by the Legislature that was prompted by "a more general concern regarding the capacity of our institutions of higher learning to respond to California's rapidly changing demographics."[17] This study, which anticipated a state population of 35 million people by 2010, called for the opening of two CSU and one UC campuses by the year 2000 to accommodate demand. Since then, the state's expected population in 2010 has jumped by more than 20 percent to more than 42 million people and the participation rates by the population in higher education have jumped dramatically. While the machinery was put into motion to open the three new four-year campuses, only one, California State University San Marcos has actually opened. The other two campuses have been in hiatus because of the recession.

Another study which most closely parallels this analysis was commissioned by the California Higher Education Policy Center (CHEPC) and done by the National Center for Higher Education Management Systems (NCHEMS) in Boulder, Colorado. Using a similar methodology to estimate the expected demands on the state's public systems,[18] they found a growing access problem in the state as well. Whereas their model defined an expected level of demand and tested various fee and economic scenarios in the context of those demand levels, this analysis begins with separate estimates of both supply and demand and then consequences of those scenarios as measured by their results in the context of the access goals set by the Master Plan.

Finally, each of the systems have done internal estimates of their expected demands. The University of California system projects the demands for each of their campuses individually. The California State University system has

[17] Joint Committee for Review of The Master Plan in Higher Education, *California Faces... California's Future: Education for Citizenship in a Multicultural Democracy*, June 3, 1988, p. Ii. This report reviewed the report of the Commission for the Review of the Master Plan for Higher Education, *The master Plan Renewed: Unity, Equity, Quality, and Efficiency in California Postsecondary Education*, July 1987. Both reports were in response to the legislation passed in 1984.

[18] The NCHEMS study used 1990-91 as a base year and estimated enrollments at a more aggregate level. Their study makes many of the same assumptions used in this model and is described in Patrick M. Callan and Joni E. Finney, *By Design or Default?*, CHEPC, June 1993.

developed an elaborate life table model to project its expected enrollment.[19] The results of this demand model have not been updated since their development in 1989. In April 1992, the Board of Governors of the California Community Colleges, in response to a requirement of the Supplemental Language of the 1991 Budget Act, prepared a *Funding Gap Study* assessing the impacts of the several fee scenarios on their ability to meet their Master Plan mission. This study combined an analysis of expected supply and demand for the CCC system. This applicability of this analysis today, which is one of the few public efforts to assess both the supply and demand sides of the problem, is limited by its expectations of General Fund revenue growth in the years following 1991-92. The analysis projected, as did many others, a General Fund revenue total of $53.3 billion in 1995-96, while the most recent Department of Finance estimate $42.5 billion.

This report fills an important niche in the body of research available on the prospects of the state to meet the access goals of the California Master Plan for Higher Education. It combines recent demographic projections of the state's populations with projections of the state's fiscal resources to estimate these prospects.

Approach of This Report

To assess California's future prospects for providing access to higher education, a series of dynamic simulation models of the various components of the state's higher education sector was developed. There are two sides to the problem—understanding the demand for public education and estimating the supply of public education. By estimating these two series, the ability of the state to meet the goals of the Master Plan can be estimated.

This analysis focuses on the production of undergraduate education[20] because it is the basic policy goal of the Master Plan.[21] College and university graduates from the undergraduate level provide a significant source of the skilled labor

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[19] See Philip Garcia, *The California State University System: Projections of Enrollment Demand, 1990 to 2005*, Professional Paper from the Division of Analytic Studies, Office of the Chancellor, CSU System, Long Beach, CA, September 1991 and the accompanying report by the Office of the Chancellor, *Growth and Diversity: Meeting the Challenge, The 1989 California State University Growth Plan for 1990-2005*, Long Beach, CA, 1989.

[20] By undergraduate education, we mean enrollments that are in the freshman, sophomore, junior, and senior classes in the four-year institutions and only credit enrollments in the two-year institutions.

[21] Total enrollments, which include graduate enrollments in the four-year systems and non-credit enrollments in the two-year system, are discussed in Appendix G.

pool in the state and represent the vast majority of the student output of the state's higher education sector. A similar model could be generated for graduate education, but the policy issues and implications are different and are left for another study.

The general approach of this analysis, is to develop a projection of the demand for public undergraduate higher education, based on a certain set of assumptions described below, and to develop a projection for the supply of public undergraduate education that will be available to these students. In the context of this comparison, one can see whether there is likely to be a surplus of public capacity, an "access surplus," or a shortfall in capacity, an "access deficit."

Organization of this Report

The next chapter will discuss the projections of expected demand and supply of public undergraduate education in the state under several scenarios. Chapter Three combines these two dimensions of the access issue and discusses the resulting access deficits. Chapter Four discusses some of the various alternatives associated with addressing the identified access deficits and Chapter Five finishes with a summary of the findings and a discussion of their implications.

2. The Demand and Supply of Public Undergraduate Education

The first results of the simulation models of the demand and supply of public undergraduate education in California are presented. In each of the following sections, the results of the simulations will be discussed in the context of the relevant issues underlying the modeling of each. The detailed models, including their underlying assumptions, are presented in the Appendices A through E.

The Demand for Public Undergraduate Education

The demand for public undergraduate education is complex to define and estimate. Higher education is a complicated good. The choice to pursue higher education is couched in many opportunity-cost choices that are hard to measure. The opportunity costs associated with the decision to pursue higher education at all are also complex, trading off foregone years of income in the short-term for perceptions of higher income streams in the future for varying degrees of completion of higher education and even this tradeoff varying across systems and institutions.

In addition, the good itself is not homogenous—not all degrees from all institutions have the exact same comparative values. In addition, the actual purchase of the good is selective on both the demand and supply sides of the equation—even as students have a choice as to which higher education institutions they wish to attend, higher education institutions select which students they wish to accept. The difference in the demands for public and private institutions also add a degree of complexity to the problem. For example, while private institutions can be competitive and selective in their range of applications accepted, public institutions are explicitly there to serve the public and must instead accept all eligible students.[22]

In light of all of these difficulties, this analysis uses a more indirect approach to estimating the demand for public undergraduate education. Instead of

[22] This caveat has been recent violated as public institutions have turned away students, based predominantly on a first-come, first-served criteria, in recent years.

modeling each of these phenomena directly, the choices that are made as a result are measured for a baseline year. These measurements are in the form of the number of students who choose to attend the various systems, the number who chose to remain, and the number who choose to transfer between institutions. These choices are then converted to participation, retention, and transfer rates, respectively, by comparing them to the overall source pool for each decision. These rates are applied to projections of the source pools in a dynamic simulation model to estimate the demand levels. The next section briefly describes the major assumptions underlying the demand models and detailed descriptions appear in Appendices A through C.

There are two definitions of demand used throughout this report. The first definition, "ambient demand", refers to the estimated number of students who would be served by the sector if the Master Plan were fully implemented. This is the goal level of service. It represents a definition of demand in that it is the number of seats the Master Plan demands from the sector to meet its access goals.

The second definition of demand used in this report is "expected demand." This version of demand is the number of seats desired of the sector given the price conditions existent in a given system. This is the number of students knocking on the door at a given price level and is a function of the ambient demand levels. Prices, as described in Appendix A, include total fees within the systems, but not living costs.

Assumptions of the Demand Models

Underlying the demands presented in the balance of this chapter are a series of important assumptions. For the ambient demand model, the key assumption is that the baseline year, 1989-90, was a year when the goals of the Master Plan were being met. The reasons for choosing this year are: (1) state support of the systems was driven in significant part by the number of students expected; (2) fee levels at the public institutions had remained at approximately the same levels for several years; and (3) Proposition 98, which directly impacts funding for the California Community Colleges system, was in effect. This year was chosen over the following fiscal year, in which these conditions also held, to be conservative and to provide a level of tolerance to allow for the uncertainty in the other assumptions of the model. This model also conservatively uses the 1989-90 participation rates for all of its projections—conservative because there was a trend toward higher participation rates through the latter portion of the 1980s.

The expected demand model, which is n estimate of the number of students who would choose to attend if space was available, uses the ambient demand as an input and therefore its assumptions. The expected demand projections also assume that the fees proposed in and expected as a result of the 1995-96 Governor's Budget remain constant at those levels in real terms.[23] The relative responsiveness of expected demand to relative changes in the price of higher education (the price elasticity of demand) is also assumed to remain constant for all price levels.

The ambient and expected demand models do not estimate the impacts of price increases in one sector on enrollments in another (the cross-price elasticity). For example, an increase in UC fees could redirect students to the lower-price CSU and CCC systems. Results from non-California studies would not be appropriate to the specific details of this case and the data available were not robust enough to allow a reasonable estimate.

The difference between these two estimates of demand represents the number of people who decide not to attend the system due to the price of education. The Legislature adopted a policy in 1985 that the state should bear primary responsibility for the cost of higher education, but that students should be responsible for a portion of the costs and that increases in that portion should be "gradual, moderate, and predictable, and announced ten months in advance."[24] This policy also allowed for up to, but not more than, ten percent per year fee increases when revenues and expenditures were substantially imbalanced.

These fee increases are driven by California's recent fiscal crises. As a consequence, students who may otherwise have attended these institutions have selected other career and education alternatives. These alternative choices include not pursuing higher education, delaying pursuit at that time, attending private institutions (both within and without California), attending other, less expensive California public institutions,[25] and attending public institutions in other states. Note also that these effects can also be the result of a constrained supply of public undergraduate education in California.

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[23] The use of the term "real" throughout this report is reserved to refer to constant dollar amounts as measured in 1992-93 dollars, deflated by the California Consumer Price Index.

[24] California Postsecondary Education Commission, *The Master Plan Then and Now: Policies of the 1960-1975 Master Plan for Higher Education in Light of 1993 Realities*, Commission Report 93-6, April 1993, p. 8.

[25] This is an effect that is measured by the cross-price elasticity of demand. A section of Appendix A discusses this issue briefly.

Estimates of Ambient Demand

The ambient demand of education represents the students who would attend higher education institutions if the goals of the California Master plan were met. Figure 2.1 presents the projections of the ambient demand for public undergraduate education each of the three public systems, as well as an overall total in full-time equivalents.[26]

Table 2.1

Projections of Ambient Demand for Public Undergraduate Education (in FTEs)

Year	California Community Colleges	California State University	University of California	Total
1993-94	848,276	242,518	116,884	1,207,678
1994-95	870,662	242,723	117,355	1,230,740
1995-96	891,677	243,434	117,361	1,252,472
1996-97	911,898	244,905	118,097	1,274,900
1997-98	931,858	247,363	119,524	1,298,745
1998-99	952,310	251,015	121,807	1,325,132
1999-00	973,807	255,905	124,961	1,354,672
2000-01	995,376	260,982	128,153	1,384,512
2001-02	1,016,779	266,484	131,348	1,414,612
2002-03	1,038,472	272,015	134,353	1,444,839
2003-04	1,060,181	276,608	136,708	1,473,497
2004-05	1,082,222	281,218	139,096	1,502,535
2005-06	1,104,317	285,554	141,283	1,531,154
2006-07	1,126,362	289,523	143,224	1,559,109
2007-08	1,148,970	293,745	145,354	1,588,069
2008-09	1,172,798	298,261	147,814	1,618,873
2009-10	1,198,818	304,131	151,383	1,654,332
2010-11	1,226,419	310,762	155,501	1,692,683

SOURCE: Derived from this analysis. See Appendix A for details.

The ambient demands in this table are driven by demographic trends. The state population is expected to increase by 46 percent over the baseline period. Because of differences in the source populations and the shifting age distribution of the population, each of the systems grow at a different rate. Ambient demand for community colleges grows the fastest, rising 70 percent

[26] A full-time equivalent is a measure of the overall output of the higher education system. An FTE is defined as a courseload equal to that carried by one full-time student. It varies by system, but is typically 15 to 16 semester credits. As a result, a full-time student can count as less than one FTE because a courseload of only 12 units is required to be termed "full-time." The systems regularly publish detailed counts of enrollments, both in headcount (number of bodies) and FTE terms. The values used in this report are generated from these detailed counts.

between 1989-90 and 2010-11. CSU and UC grow at 35 and 36 percent, respectively, for an overall growth of 59 percent.[27]

Expected Demand

The expected demand for public undergraduate education reflects the effects of price increases on the ambient demand. As prices in the public undergraduate systems rise above the baseline (1989-90) levels, the number of students choosing to attend decline. Since prices have been rising in recent years and are expected to remain at these higher levels, the expected demand is less than the ambient demand. Figure 2.2 presents the expected demand for public undergraduate education.

Table 2.2

Projections of Expected Demand for Public Undergraduate Education (in FTEs)

Year	California Community Colleges	California State University	University of California	Total
1993-94	739,275	215,640	112,970	1,067,885
1994-95	766,286	213,682	113,157	1,093,124
1995-96	776,714	212,012	112,810	1,101,536
1996-97	794,329	213,294	113,516	1,121,139
1997-98	811,715	215,434	114,889	1,142,038
1998-99	829,530	218,615	117,082	1,165,227
1999-00	848,255	222,873	120,114	1,191,243
2000-01	867,044	227,295	123,183	1,217,522
2001-02	885,688	232,087	126,254	1,244,029
2002-03	904,583	236,904	129,142	1,270,629
2003-04	923,494	240,904	131,406	1,295,803
2004-05	942,693	244,919	133,701	1,321,313
2005-06	961,939	248,695	135,804	1,346,438
2006-07	981,142	252,152	137,670	1,370,963
2007-08	1,000,835	255,829	139,716	1,396,380
2008-09	1,021,591	259,762	142,081	1,423,435
2009-10	1,044,256	264,874	145,512	1,454,642
2010-11	1,068,299	270,650	149,470	1,488,419

SOURCE: Derived from this analysis. See Appendix A for details.

Not only are the expected demand levels lower than the ambient demand levels, but the growth in expected demand is slower than that of ambient demand. Using 1989-90 as the reference, expected demand is expected to grow 48 percent in the California Community Colleges system, 18 percent in the CSU system, 31 percent in the UC system, and 40 percent overall. This lower demand is due to

[27] These are undergraduate enrollments only.

different relative price changes within each of the systems and the differing sensitivity of the three systems to price changes.

The differences between the values in Tables 2.1 and 2.2 (between ambient and expected demand) represent the number of students denied access as a result of the expected fee changes. Table 2.3 shows the number of undergraduate students who are priced out of the public systems under the price assumptions of the expected demand scenario.

Table 2.3

Projections of Difference Between Ambient and Expected Demand for Public Undergraduate Education (in FTEs)

Year	California Community Colleges	California State University	University of California	Total
1993-94	109,001	26,878	3,914	139,793
1994-95	104,376	29,041	4,199	137,616
1995-96	114,962	31,422	4,552	150,936
1996-97	117,569	31,612	4,580	153,762
1997-98	120,143	31,929	4,636	156,708
1998-99	122,780	32,401	4,724	159,904
1999-00	125,551	33,032	4,846	163,429
2000-01	128,332	33,687	4,970	166,989
2001-02	131,092	34,397	5,094	170,583
2002-03	133,888	35,111	5,211	174,210
2003-04	136,687	35,704	5,302	177,693
2004-05	139,529	36,299	5,395	181,223
2005-06	142,378	36,859	5,480	184,716
2006-07	145,220	37,371	5,555	188,146
2007-08	148,135	37,916	5,637	191,688
2008-09	151,207	38,499	5,733	195,439
2009-10	154,561	39,257	5,871	199,689
2010-11	158,120	40,113	6,031	204,264

SOURCE: Derived from this analysis. See Appendix A for details.

One measure of the magnitude of this impact is to consider these numbers as a share of the overall goal levels of access—the ambient demand. Because the real price levels are held constant in the expected demand scenario, the share of the total ambient excluded by each of the systems remains constant over the period.[28] Thirteen percent of CCC and CSU students and four percent of UC ambient demand are expected to be priced out of the systems in the expected demand scenario. Overall, the effect is that 12 percent of the students targeted for service under the Master Plan will be denied access due to price effects.

[28] This is also due to the technical structure of the overall demand model used and documented in Appendix A.

The Supply of Public Undergraduate Education

The supply of public undergraduate education is also a complex phenomenon. The supply available is also dependent on a wide range of uncertain parameters, such as the state General Fund revenues, each system's share of those revenues, the cost of producing undergraduate education units in each of the systems, the expected level of property tax revenues, the ratio of undergraduate to graduate students, and the expected levels of other revenue sources such as lottery revenues and federal funds.

The supply of undergraduate education has two major dimensions—operating capacity and capital capacity. Operating expenditures are those that go to fund the day-to-day operations of the institution. Expenditures on the operating side of the equation include such things as faculty salaries, support staff, library acquisitions, administration, utilities, and general maintenance. Capital expenditures are those that expand the physical capacity of the system and include such things as new buildings and major repairs and upgrades of existing buildings.

The actual monies for capital expenditures generally come from bond issues that are then paid off in annual bond payments. These annual payments are the primary budgetary issue, because they represent a fiscal obligation of the state. The bond issues themselves, however, have become more problematic as California voters have recently refused to approve the necessary ballot initiatives to authorize the education bonds. While the focus here is on the budgetary dimensions of the capital, the hesitance of the people of the state to approve such capital investments must also be considered.

In addition to the concerns about the availability capital resources, the fiscal context of the state's primary source of operating resources to the sector, General Fund revenues, is uncertain. The next section will discuss some of the issues associated with the state's fiscal context.

The State Budgetary Picture

California's budget has suffered a long series of setbacks in recent years. Although the recent severe recession in California has had a tremendous impact on the future prospects for revenues, the forces that have precipitated the crises began in the mid-1970s with the passage of Proposition 13 by the voters of California. This initiative rolled back local property taxes and made it much more difficult to institute tax increases. Because of the major fiscal impacts of

this initiative on local districts and governments, the state replaced much of the lost local funding dollars out of its General Fund coffers. As a consequence, the support of many local programs and activities was removed from the local government and placed, indirectly through the purse strings, in the hands of the state government. In the times when the state budget was robust, this was not an issue.

In recent years, however, and especially in the context of the recent recession, the competition for the state's General Fund revenues has become quite intense. Additional voter approved initiatives, such as Propositions 98[29] and the "three strikes initiative"[30] have increased the demands on the state's General Fund revenues. Rapidly rising caseloads in numerous federally mandated programs have also caused an explosion in the demand for state monies.

Current estimates from RAND research indicate that these demands will rapidly outstrip the availability of resources.[31] The growth in just a few of these mandated programs will more than outstrip the future availability of funds. Table 2.4 represents an estimate of the future program expenditures in California. In that analysis, a caseload-based estimate of the demand for mandated and constitutionally defined programs has been prepared.

In this table, state General Fund expenditures separated into five categories corresponding to the major budget spending areas. The amounts for K-12 education are constitutionally mandated by the provisions of Propositions 98 and 111 and the amounts used in this table represent actuals for 1994-95 and the projected *minimum* amount required to be funded to K-12 education, given what is expected to happen with the state's demographics and finances, for 2002-03.

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[29] This initiative, approved by the voters in 1988, established minimum spending levels for K-14 education.

[30] The so-called "Three strikes initiative" set drastically increased minimum sentencing guidelines for convicted felons. When taken in conjunction with the court-determined requirements for prison over-crowding, this initiative will result in a significant increase in the demand for state funds to support prison construction and operations.

[31] See Stephen Carroll, Peter Rydell, Eugene Bryton, Michael Shires, and Sugata Biswas, *California's Fiscal Future*, MR-570-IET (forthcoming) and Stephen J. Carroll, Kevin McCarthy, and Mitchell Wade, "California's Looming Budget Crisis," *RAND Research Review*, Fall 1994, Vol. 18, No. 2.

Table 2.4

Overall Share of State Expenditures, By Program (percent of General Fund Revenues)

Headings	1994-95	2002-03
K-12 Education	37	47
Health and Welfare	34	34
Corrections	9	15+
Higher Education	11	17
Other	9	9
Total	100	122+

SOURCE: 1994-95: Office of the Legislative Analyst, *Focus Budget 1994: Highlighting Major Features of the 1994 California Budget*, July 13. 1994; 2002-03: Carroll, *et.al.*, *California's Fiscal Future*, RAND MR-570-IET (forthcoming).

The "health and welfare" category includes the range of state-supported health and welfare programs mandated by federal law.[32] Large ticket items in this category include the state Medi-Cal program, Supplemental Security Income (SSI), and Aid to Families with Dependent Children (AFDC). While the detailed analysis of the caseloads and costs associated with "health and welfare" is not yet complete, preliminary estimates indicate that these amounts are unlikely to decrease as a share of state General Fund budget and, if anything, are expected to increase. The current fiscal year share of the General Fund budget is therefore retained as an estimate of the 2002-03 budget share.

The "corrections" figures reflect the consequences of the "Three Strikes" law and the figures used here are from RAND's recent report on the consequences of this law.[33] It is important to remember that this law was approved by the voters as a ballot initiative in the November 1994 election and will subsequently require a similar vote or finding of unconstitutionality to reverse it. Readers are referred to this report for a more detailed review of the implications and details of this law. The 2002-03 amounts are derived from the RAND report amounts for necessary General Fund expenditures to implement the "Three Strikes" law.

"Higher education" includes state support of the three public systems as well as its support for a range of other institutions such as the state library, the California Maritime Academy, and the California Postsecondary Education

[32] Note that Medicare is not included in this account because the federal government provides the funding for this program and the monies are passed directly to the service providers, bypassing the state.

[33] Peter W. Greenwood, C. Peter Rydell, Allan Abrahamse, Jonathan P. Caulkins, James Chiesa, Karyn E. Model, and Stephen P. Klein, *Three Strikes and You're Out: Estimated Benefits and Costs of California's New Mandatory-Sentencing Law*, Santa Monica, CA: RAND, MR-509-RC, 1994.

Commission. The three public systems account for 95 percent of total state support for higher education.

"Other" includes all other spending categories in the state, including, amount others, the legislature, the courts (not included under corrections), the California Environmental Protection Agency. The 1994-95 share has been carried over to 2002-03 for comparison.

The table shows that estimated demand for spending outstrips the resources available. The state would spend 122% of its revenues,[34] equivalent to more than an eight billion dollar deficit in the current fiscal year. Obviously the state cannot outspend its revenues at this level and will have to cut back somewhere—but where?

The first three categories listed in Table 2.4 (K-12 education, health and welfare, and corrections) are currently mandated either by state constitutional provisions or federal law. In 1994-95, they account for 78 percent of the General Fund budget. In 2002-03, these three mandated categories account for 96 percent of the expected revenues. This leaves only four percent of the general fund revenues to pay for both higher education and the operation of the state government and many important agencies.

Since higher education must compete with the legislature, the courts, the EPA, and other important state agencies for the remaining four percent,[35] its prospects to sustain its current revenue share, absent a significant constitutional revision or federal welfare reform, is bleak. These latter issues—the possibility of a state constitutional reform or a major federal welfare reform—are important possibilities to consider. Given this fiscal scenario, it is clear that something will have to change or give. Because of the highly speculative nature of the possible forms that these reforms could take, this analysis does not address them but instead analyzes the problem only in the context of the current structures existing in state finance.

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[34] These are shares and the author readily recognizes that the total shares cannot exceed 100 percent. The 122 percent figure was derived by estimating the total demands for General Fund revenues in 2002-03 based on caseloads and other assumptions and dividing by the expected General Fund revenues. This dilemma is precisely the issue.

[35] The exception to this situation are the California Community Colleges, whose revenues are at least in part guaranteed by the provisions of Propositions 98 and 111. Note however, that this protection is not guaranteed, as history has shown. In the 1993-94 fiscal year, the community college share of Proposition 98 monies was decreased in order to maintain a higher per-pupil expenditure level in the K-12 sector.

Assumptions of the Supply Models

Since state support is an important element of the finance of public undergraduate institutions, and the level of that support is uncertain, two scenarios are calculated for estimating the supply of education available in the future. The first scenario, the "expected supply" scenario, reduces the higher education share of General Fund revenues for the two four-year systems linearly over ten years to half their share in 1993-94. The minimum levels of state support for the California Community Colleges system are set by the provisions of Propositions 98 and 111 and kept at these levels in the expected supply scenario.

The optimistic supply model is identical to the expected supply model except that the share of state General Fund revenues going to UC and CSU are held constant at their 1993-94 levels. In light of the discussion, this prospect is highly unlikely, but it is a useful bound for sensitivity analysis. These changes affect only the operating side of the supply equation. The capital dimension is handled differently , as described below. The results of the expected and optimistic operating supplies will therefore be described separate from the capital results, which remain constant.

The unit operating cost per FTE associated with producing operating capacity in both models is assumed to grow at between 1.4 and 2.0 percent annually in real terms. This cost is based on historical levels and is based on the last year for which detailed actual information regarding resources and enrollments were available (1992-93). The costs in this reference year reflected the effects of significant budget cuts from the prior two fiscal years and, hence, a lean cost structure.[36]

Capital capacity in both the expected and optimistic supply scenarios is held at current estimated capacities. While all three systems have plans on paper for significant expansions, the resources to fund them are not expected to be available. As an example, the Central Valley campus of the University of California has been under consideration for several years. The exception to this is the Monterey Bay campus of the California State University system, which will be funded largely by federal base conversion dollars. The additional capacity represented by this campus is included in the initial number.

[36]Community colleges were not completely immune from this effect. The language enacted by Proposition 111 provides for reductions in the Proposition 98 guarantee in bad budget years for the state. See Appendix E for a detailed discussion of these provisions.

The Expected Operating Supply

The expected operating supply of public undergraduate education an estimate of the operating capacity of the systems in light of the state's decreasing ability to sustain its level of support for higher education. Table 2.5 presents the projections of expected operating supply.

Table 2.5

Projections of Expected Operating Supply for Public Undergraduate Education (in FTEs)

Year	California Community Colleges	California State University	University of California	Total
1993-94	739,275	215,640	112,970	1,067,885
1994-95	793,956	219,240	109,879	1,123,075
1995-96	776,550	216,925	108,724	1,102,199
1996-97	806,906	211,490	106,128	1,124,525
1997-98	827,459	205,590	103,255	1,136,304
1998-99	844,327	198,915	99,937	1,143,179
1999-00	861,091	192,544	96,756	1,150,392
2000-01	875,580	185,364	93,097	1,154,041
2001-02	889,506	178,043	89,284	1,156,833
2002-03	902,851	170,417	85,246	1,158,515
2003-04	913,409	162,360	80,964	1,156,734
2004-05	922,436	162,671	81,295	1,166,402
2005-06	928,327	162,918	81,599	1,172,844
2006-07	928,253	163,034	81,842	1,173,129
2007-08	921,808	163,038	82,030	1,166,876
2008-09	910,910	163,033	82,237	1,156,181
2009-10	899,320	163,239	82,581	1,145,140
2010-11	887,461	163,524	82,970	1,133,955

SOURCE: Derived from this analysis. See Appendix A for details.

The fall off in expected operating capacity for the CSU and UC systems is driven by both the assumed decreasing share of state General Fund revenues and the slight expected increase in costs. The initial rise in CCC enrollments is due to the funding levels required by Proposition 98. The decrease in later years is attributable to expected slower K-12 enrollment growth (which is a key determinant of CCC support) and increasing costs.

The Optimistic Operating Supply

The optimistic operating supply is identical to the expected operating supply, except it incorporates the optimistic possibility that the state will be able to sustain its current level of General Fund support for the sector in future years. Projected optimistic operating supply is given in Figure 2.6 below.

Table 2.6

Projections of Optimistic Operating Supply for Public Undergraduate Education (in FTEs)

Year	California Community Colleges	California State University	University of California	Total
1993-94	739,275	215,640	112,970	1,067,885
1994-95	793,956	226,705	113,899	1,134,559
1995-96	776,550	232,218	116,980	1,125,747
1996-97	806,906	234,965	118,836	1,160,708
1997-98	827,459	237,509	120,580	1,185,548
1998-99	844,327	239,327	121,931	1,205,586
1999-00	861,091	241,740	123,603	1,226,435
2000-01	875,580	243,254	124,774	1,243,608
2001-02	889,506	244,715	125,864	1,260,085
2002-03	902,851	245,867	126,755	1,275,473
2003-04	913,409	246,614	127,441	1,287,464
2004-05	922,436	247,346	128,131	1,297,913
2005-06	928,327	248,041	128,809	1,305,177
2006-07	928,253	248,588	129,420	1,306,261
2007-08	921,808	248,878	129,895	1,300,581
2008-09	910,910	249,106	130,361	1,290,378
2009-10	899,320	249,472	130,925	1,279,716
2010-11	887,461	249,855	131,499	1,268,815

SOURCE: Derived from this analysis. See Appendix A for details.

Because of the assumptions above and the provisions of Propositions 98 and 111, CCC operating capacity remains unchanged. CSU and UC operating capacities rise markedly in relation to the expected scenario show in Table 2.5, increasing 53 and 58 percent respectively in 2010-11. This increase in capacity directly reflects the purchasing power of the increased state dollars.

The Expected and Optimistic Capital Supply

As described above, the capital capacities are held constant for the three systems for the expected and optimistic supply scenarios. In addition to reflecting a plausible set of realities, this convention will be convenient later in subsequent analysis for quantifying the costs associated with capital capacity expansion.

The credit capital capacity of the California Community College system is 762,589 FTEs. Since no official estimates of the CCC capital capacity exist, several experts were consulted and the median of those values was used. The undergraduate capacities in the CSU and UC systems are 224,491 and 117,460 FTEs, respectively, for an overall total of 1,104,541 FTEs. These estimates are based on official estimates of the system's capital capacities and expert opinion.

As the next chapter will discuss, these capital capacity numbers are very important.

3. Access to Public Undergraduate Education: Integrating Supply and Demand

Detailed estimates of the supply and demand of public undergraduate education in California are important, but a more fundamental question can be addressed: what are the state's prospects for providing the level of access to undergraduate education envisioned in the California Master Plan? To answer this question, the estimates of the ambient and expected demand for public undergraduate education are combined in this chapter with the three estimates of supply of public undergraduate education described in Chapter Two.

Combining Demand and Supply Projections

To understand the supply and demand implications of the expected and optimistic supply scenarios, the series in Chapter Two are combined. Figure 3.1 is an example of this effort for the expected supply scenario, looking at the overall total of public undergraduate education.

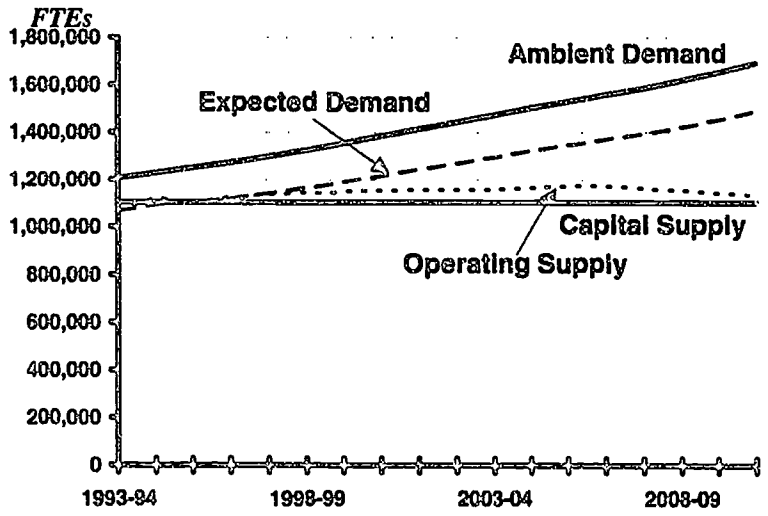

Figure 3.1—Demand and Supply of Public Undergraduate Education in an Expected Supply Scenario

The four series in this figure represent are the ambient demand (Table 2.1), the expected demand (Table 2.2), expected operating supply (Table 2.5), and expected capital supply (described in the last section of Chapter Two). In any given year, the quantity of education actually produced and consumed will be marked by the lowest of these four lines. For example, in Figure 3.1 it is clear that capital capacity is the smallest quantity, and so overall in the expected supply scenario, it is expected the sector's capital capacity will be the binding constraint on how many students can attend.

It cannot be the level represented by a line above the bottom. If it were represented by the expected operating capacity line, for example, which is above the expected capital capacity, the systems would be providing operating capacity for students that could not physically be accommodated on the campuses. Similarly, if one of the two demand series was the lowest line, then it would be the binding constraint. If this were the case, the quantity of education consumed/produced would be the amount demanded and building more capacity, whether operating or capital, would not impact it.

The difference between the ambient demand, which represents the sector's goal level of production, and the binding constraint, is a deficit in the access to public undergraduate education or, as termed in this report, an "access deficit." In Figure 3.1, the access deficit is the number of students represented by the difference between the ambient demand and the binding constraint (in this case expected capital capacity).

A similar figure can be produced for the optimistic operating capacity scenario and is presented in Figure 3.2 below. The two demand series are the same as those in Figure 3.1 (we changed a supply assumption, not demand) and the optimistic operating capacity is assumed to be the same for both the expected and optimistic scenarios. The optimistic operating supply series is from Table 2.6.

In the optimistic supply scenario, the operating supply shifts upward in response to the increased fiscal resources. The capital supply remains the binding constraint overall and the access deficit is the gap between ambient demand and capital supply. If one reconsiders the assumption that capital capacity is not expected to expand and assumes that capital capacity does expand through productivity changes and investments in capacity, there will still be an access deficit—defined instead by the optimistic operating capacity. Waiving the capital constraint does not eliminate the access deficit, although it does reduce it. Using the constant capital capacity assumption will also provide an estimate of the cost of expanding that capital capacity.

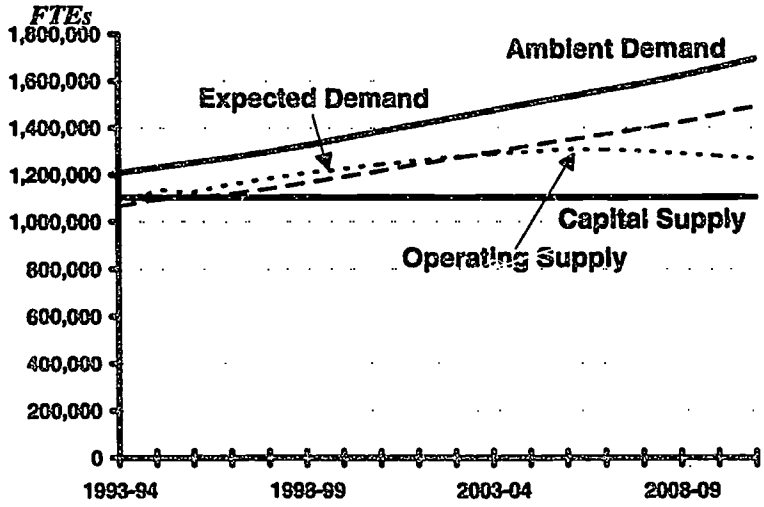

Figure 3.2–Demand and Supply of Public Undergraduate Education in an Optimistic Supply Scenario

While Figures 3.1 and 3.2 portray the overall production of public undergraduate education in the state, a system-by-system comparison yields some interesting distinctions in the problems facing the three systems. In the following two sections, the corresponding figures for the individual systems are presented for the expected and optimistic supply scenarios, as well as additional discussions regarding the accompanying access deficits.

Access in the Expected Supply Scenario

Figures 3.3 through 3.5 present the overall supply and demand maps under the expected supply scenario for the three systems individually. Figure 3.3 presents the series for the California Community Colleges system and closely resembles the overall map presented in Figure 3.1 above. This is because the California Community Colleges system serves the large proportion of the state's undergraduate population and hence the factors that shape it will have a greater impact on the state's overall picture.

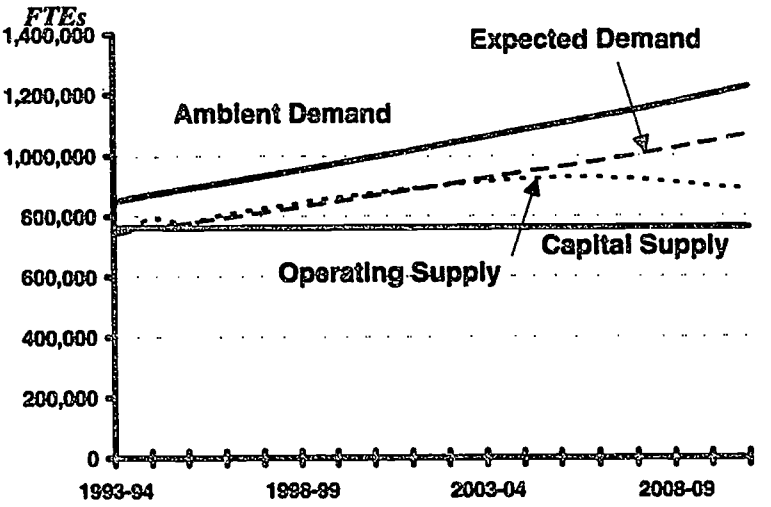

Figure 3.3--Demand and Supply of Public Undergraduate Education in the California Community Colleges System in the Expected and Optimistic Supply Scenarios

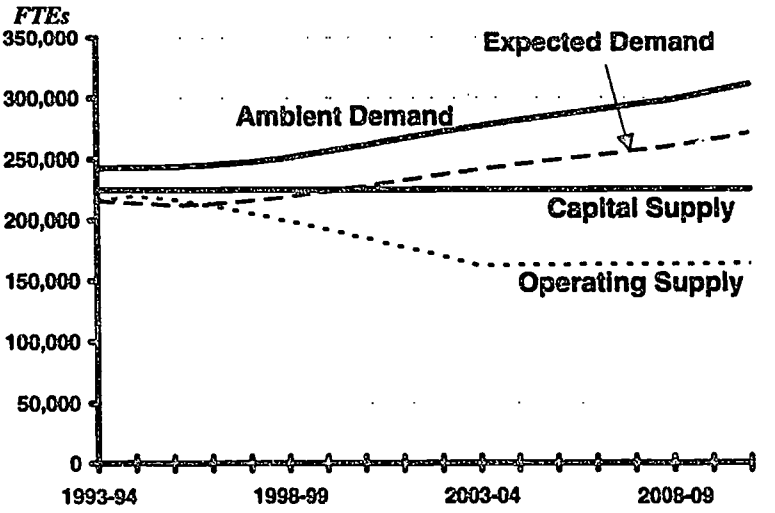

Figure 3.4--Demand and Supply of Public Undergraduate Education in the California State University System in the Expected Supply Scenario

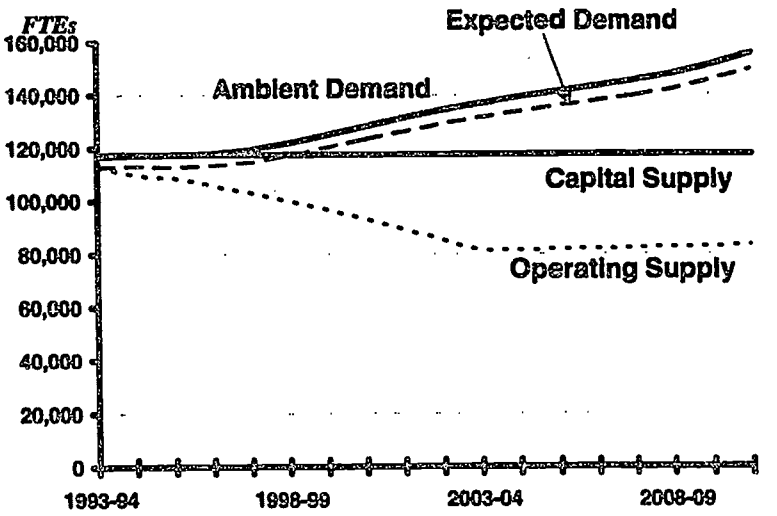

Figure 3.5—Demand and Supply of Public Undergraduate Education in the University of California System in the Expected Supply Scenario

Figures 3.4 and 3.5, which present the CSU and UC systems, however, show different trends. In both of these systems, the binding constraint is not the expected capital capacity of the system, as is the case with the CCC system, but the expected operating supply of the systems. In fact, the downward sloping line in each of these figures represents the assumption that overall level of state support will decline linearly over a ten-year period. The flattening out of this decline and subsequent slight growth is due to the expiration of the phase-in period for the lower level of state support.

Returning to the definition of access deficits as the difference between the binding constraint and ambient demand, Table 3.1 provides a time series of these access deficits. The access deficits presented here are the result of the consequences of the policy choices that have been made at all levels in the state government and the systems. A value greater than zero represents a failure by the state's public systems to meet the access goals of the Master Plan.

In all three systems, even if all of the supply constraints were somehow raised to the ambient demand levels, there would still be an access deficit caused, in this case, by the expected demand function—which would be the lowest of the four lines. The distinction between ambient demand and expected demand, as discussed in Chapter Two, is largely a function of price effects. To fully meet ambient demand, price levels would have to be restored to baseline (1989-90) levels in order to allow the sector to meet the full ambient demand.

As can be seen in this table, the state is expected to fails to meet the goals of the Master Plan over the entire time period of this analysis. Starting, by definition, with no access deficits in 1989-90,[37] the state's production of public undergraduate education increasingly fails to meet the ambient demand, arriving at a total access deficit of nearly 700,000 FTEs by 2010-11. These deficits are constrained initially by price increases and then later by an insufficient supply.

Table 3.1
Access Deficits in Public Undergraduate Education in California: Differences between Ambient Demand and Expected Supply

Year	California Community Colleges	California State University	University of California	TOTAL
1989-90	0	0	0	0
1990-91	68,910	0	0	68,910
1991-92	85,466	9,435	3,135	98,036
1992-93	62,737	20,896	1,624	85,257
1993-94	109,001	26,878	3,914	139,793
1994-95	108,073	18,232	6,643	132,948
1995-96	129,087	18,943	7,690	155,720
1996-97	149,309	23,499	11,028	183,836
1997-98	169,268	31,921	15,331	216,520
1998-99	189,720	42,267	20,926	252,914
1999-00	211,217	53,500	27,250	291,967
2000-01	232,787	65,725	34,091	332,604
2001-02	254,190	78,506	41,089	373,784
2002-03	275,882	91,622	48,122	415,626
2003-04	297,591	104,270	54,756	456,617
2004-05	319,633	108,569	56,809	485,011
2005-06	341,727	112,670	58,692	513,089
2006-07	363,772	116,550	60,389	540,712
2007-08	386,381	120,788	62,330	569,498
2008-09	410,208	125,321	64,580	600,110
2009-10	436,228	130,956	67,795	634,979
2010-11	463,830	137,252	71,511	672,592

SOURCE: Derived from this analysis. See Chapter Two and Appendices A through E for details of underlying models.

As discussed above, the CCC deficits are constrained by the expected capital capacity, while the CSU and UC deficits are constrained by expected operating supply. These deficits represent a significant portion of the total student population that the master plan seeks to serve. While 672,592 FTEs (in 2010-11)

[37] This is attributable in part to the selection of 1989-90 as the baseline year (see Appendix A for a discussion of the reasons). If a much earlier year was used as the baseline, such as 1980-81, then the fee increases of the early 1980s would have produced an access deficit that would carry over until today and produce an even more severe deficit.

represent a significant failure of the state's higher education sector to meet its Master Plan goals, just how large of a failure is it? Figure 3.6 presents one measure of the magnitude of the problem, plotting the access deficit as a share of total ambient demand for each of the three systems. This is a measure of the proportion of students who should be served who are not served by the systems.

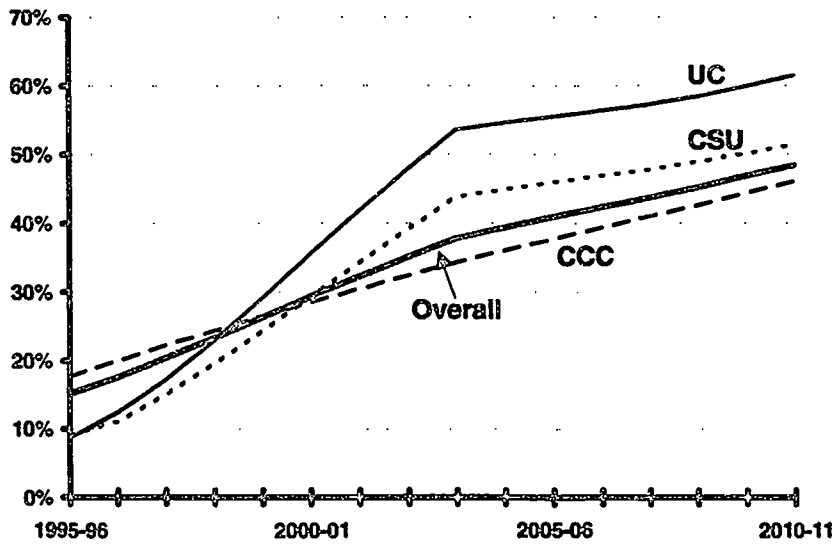

Figure 3.6--Access Deficits as a Share of Total Ambient Demand Under Expected Supply Conditions

By 2010-11, more than half of the populations which UC and CSU should serve and nearly half of CCC's will not be able to attend these institutions because of supply constraints and price constraints. The community colleges are insulated from some of the supply-side constraints because their enrollment formula is, at least in part, enrollment driven (see Appendix E for a detailed discussion of Proposition 98). At the same time, on the California Community Colleges system's share of higher education spending rises from its current 24 percent to 46 percent.

This scenario defines the basic "access deficit" that the state faces. To meet the goals of the Master Plan, the state must find a way to close this gap. Some possible approaches to closing this gap are discussed later in Chapter Four of this report.

Access in the Optimistic Supply Scenario

Some would respond to the above analysis by arguing that the state support assumptions are too conservative—the state is not going to reduce its level of support of the sector as much or as rapidly as defined in the "expected" scenario. For this reason, the analysis was repeated keeping the state's support levels for higher education at current levels—the optimistic scenario.[38]

Even in one takes the optimistic fiscal scenario where the state retains its current share of revenues in support of CSU and UC, access deficits form. Because the optimistic supply scenarios are the same for community colleges, Figure 3.3 presents the community college results for this scenario. Figures 3.7 and 3.8 below present the findings for the CSU and UC systems, respectively under the optimistic supply scenario.

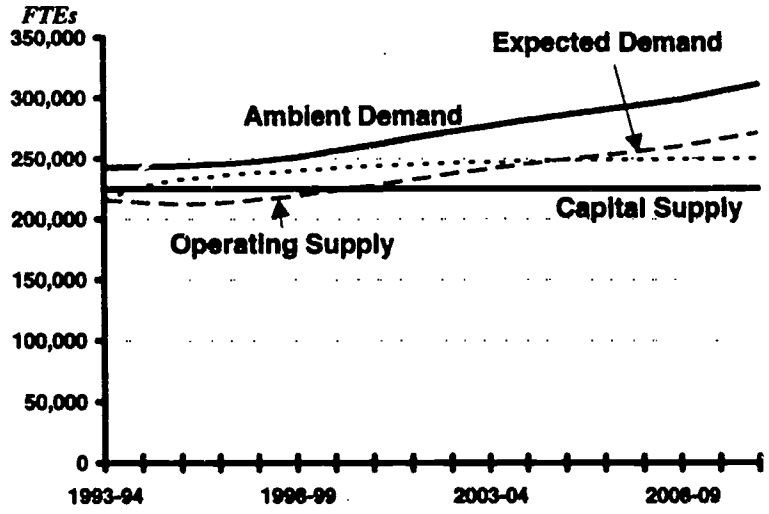

Figure 3.7--Demand and Supply of Public Undergraduate Education in the California State University System in the Optimistic Supply Scenario

[38] This approach keeps the share of the state's General Fund revenues for the CSU and UC systems constant. The state level of support for the CCC system, driven by the provisions of Proposition 98, remains the same in both the expected and optimistic scenarios. See Appendix D for a more detailed description of the specific models.

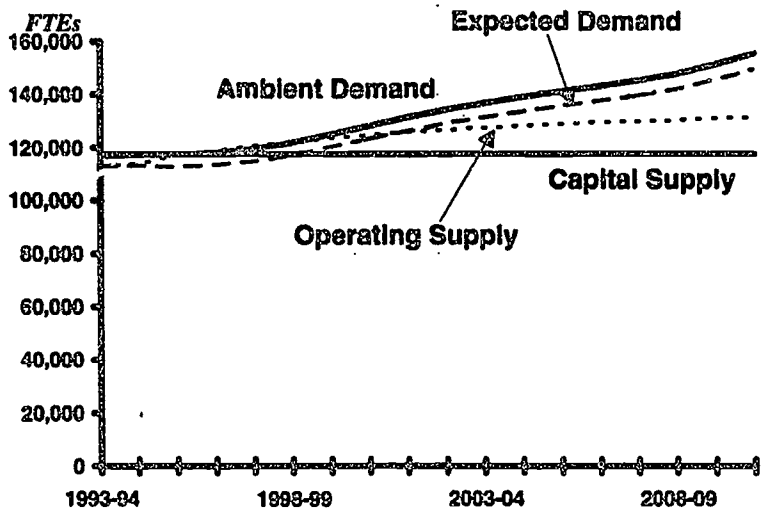

Figure 3.8--Demand and Supply of Public Undergraduate Education in the University of California System in the Optimistic Supply Scenario

In both cases, the long-term binding constraints have shifted from operating capacity to capital capacity. Both also exhibit a price-related constraint in the short-term as expected demand falls below both supply levels. The actual access deficits (ambient demand less the binding constraint quantity) are given in Table 3.2 below. The California Community Colleges deficit remains the same while the deficits for CSU and UC fall as a result of the increased state funding. In this case, the expected total deficit in 2010-11 is *only* 588,142, the majority of which is from the community college system.[39]

[39] One limitation of this model is that it does not directly track the internal dynamic effects of the change in community college enrollments on the public four-year institutions. Ambient demand is not affected by this limitation and the primary impact of this concern is on expected demand. Consequently, expected demand may be slightly overestimated by this model for the two four-year systems. At the same time, these institutions are influenced by the same forces as the two-year colleges and almost always face an access deficit. In light of these deficits, it is unlikely that the reduced transfer pool could eliminate the shortfalls encountered.

Table 3.2

Access Deficits in Public Undergraduate Education in California: Differences between Ambient Demand and Optimistic Supply

Year	California Community Colleges	California State University	University of California	TOTAL
1989-90	0	0	0	0
1990-91	68,910	0	0	68,910
1991-92	85,466	9,435	3,135	98,036
1992-93	62,737	20,896	1,624	85,257
1993-94	109,001	26,878	3,914	139,793
1994-95	108,073	18,232	2,624	128,929
1995-96	129,087	18,943	0	148,030
1996-97	149,309	20,414	637	170,360
1997-98	169,268	22,872	2,064	194,205
1998-99	189,720	26,524	4,346	220,591
1999-00	211,217	31,414	7,501	250,132
2000-01	232,787	36,491	10,693	279,971
2001-02	254,190	41,993	13,888	310,071
2002-03	275,882	47,524	16,893	340,299
2003-04	297,591	52,117	19,248	368,956
2004-05	319,633	56,727	21,635	397,995
2005-06	341,727	61,063	23,823	426,613
2006-07	363,772	65,032	25,764	454,569
2007-08	386,381	69,254	27,894	483,528
2008-09	410,208	73,770	30,354	514,333
2009-10	436,228	79,640	33,923	549,791
2010-11	463,830	86,271	38,041	588,142

SOURCE: Derived from this analysis. See Chapter Two and Appendices A through E for details of underlying models.

Figure 3.9 duplicates the broad measure of the sector's success at meeting the Master Plan goals shown in Figure 3.6 for the optimistic supply scenario. While the share of ambient demand turned away for the CSU and UC systems fall dramatically, the sector still fails to serve more than 40 percent of the Master Plan target, mostly in community colleges.

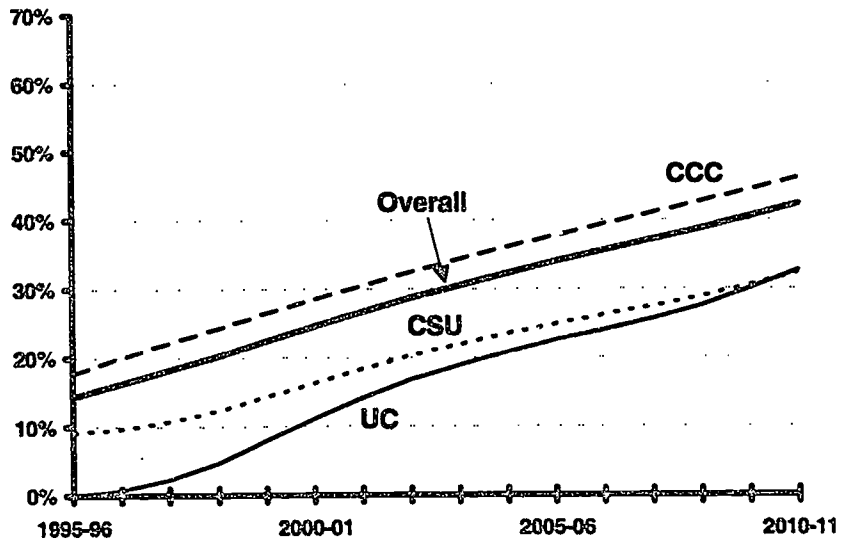

Figure 3.9--Access Deficits as a Share of Total Ambient Demand Under Expected Supply Conditions

So even under optimistic budgetary assumptions, the state's higher education sector will not be able to accommodate the levels of demand envisioned in the Master Plan. It should be pointed out that the state's current investment of approximately 9 percent in higher education is significantly lower than historical levels. In 1969-70, the state spent nearly 15 percent of General Fund revenues on higher education and as recently as 1990-91 the state spent 15 percent of its General Fund revenues on higher education.

Setting Aside the Master Plan: Meeting Expected Demand

Even if the state decided that meeting the California Master Plan was not its policy goal, the surging population is likely to bring about a supply shortage. Reviewing each of Figures 3.3, 3.4, and 3.5, a gap is evident between the expected demand and the binding constraint in each case (the lowest line). in the state and is compared to the expected supply of education, the resulting difference is still a shortage of operating capacity. The number of FTEs represented by this shortfall are given in Table 3.3. The amounts in this table represent the number of seats of capacity the systems will have to add to accommodate the expected demand.

Table 3.3
Meeting Expected Demand: The Supply Shortfall in Public Undergraduate Education in California Under the Expected Supply Scenario (in FTEs)

Year	California Community Colleges	California State University	University of California	TOTAL
1989-90	0	0	0	0
1990-91	0	0	0	0
1991-92	0	0	0	0
1992-93	0	0	0	0
1993-94	0	0	0	0
1994-95	3,697	0	3,277	6,974
1995-96	14,125	0	4,086	18,210
1996-97	31,739	1,804	7,388	40,931
1997-98	49,125	9,844	11,634	70,603
1998-99	66,941	19,700	17,145	103,786
1999-00	85,666	30,329	23,358	139,353
2000-01	104,455	41,931	30,086	176,472
2001-02	123,098	54,044	36,970	214,112
2002-03	141,994	66,486	43,896	252,376
2003-04	160,904	78,544	50,442	289,890
2004-05	180,104	82,248	52,406	314,757
2005-06	199,350	85,777	54,205	339,332
2006-07	218,552	89,118	55,827	363,498
2007-08	238,246	92,791	57,686	388,723
2008-09	259,002	96,729	59,844	415,574
2009-10	281,667	101,635	62,931	446,233
2010-11	305,710	107,126	66,500	479,335

SOURCE: Derived from this analysis. See Chapter Two and Appendices A through E for details of underlying models.

Table 3.4 presents these expected operating shortfalls under the optimistic supply scenario. We see that the systems are closer to meeting the expected demand, accommodating nearly 100,000 more students in 2010-11, but still far short, missing by almost 400,000 FTEs. In light of these findings, that prospects for meeting even the expected demand for public undergraduate education are not good. It is also important to consider that the expected demand still falls short of the ambient demand goal of the Master Plan.

Table 3.4
Meeting Expected Demand: The Supply Shortfall in Public Undergraduate Education in California Under the Optimistic Supply Scenario (in FTEs)

Year	California Community Colleges	California State University	University of California	TOTAL
1989-90	0	0	0	0
1990-91	0	0	0	0
1991-92	0	0	0	0
1992-93	0	0	0	0
1993-94	0	0	0	0
1994-95	3,697	0	0	3,697
1995-96	14,125	0	0	14,125
1996-97	31,739	0	0	31,739
1997-98	49,125	0	0	49,125
1998-99	66,941	0	0	66,941
1999-00	85,666	0	2,654	88,320
2000-01	104,455	2,804	5,723	112,982
2001-02	123,098	7,596	8,794	139,488
2002-03	141,994	12,413	11,682	166,088
2003-04	160,904	16,413	13,946	191,263
2004-05	180,104	20,428	16,241	216,772
2005-06	199,350	24,204	18,344	241,898
2006-07	218,552	27,661	20,209	266,423
2007-08	238,246	31,338	22,256	291,840
2008-09	259,002	35,271	24,621	318,894
2009-10	281,667	40,383	28,052	350,102
2010-11	305,710	46,159	32,010	383,878

SOURCE: Derived from this analysis. See Chapter Two and Appendices A through E for details of underlying models.

Having laid out the scope and magnitude of the potential access deficits that lie in the state's future, the next step is a set of estimates of what it will take to meet these deficits and the implications of a series of policy proposals that have been advanced to close this deficit.

4. Eliminating the Access Deficit: An Analysis of Several Options

The state's postsecondary sector, absent substantial changes, cannot hope to meet the goals of the California Master Plan or the expected demand for education. What form should these changes take and how much will it take? This chapter focuses on this issue, evaluating several approaches to closing the access deficit. Since the thrust of this paper is meeting the access goals of the Master Plan, the access deficits used are those presented in Table 3.1 and represents the gap between ambient demand and expected supply.[40]

Closing the deficit can take several forms. Both the operating and capital definitions of the supply of higher education are functions of the number of dollars available and the cost of providing the higher education product. Therefore, varying either of these inputs directly impacts the supply of education available. The dollars available to education take several forms, but two are of particular policy relevance in the debate surrounding the higher education policy—state appropriations and student fees. An increase in state appropriations provides a corresponding increase in the operating capacity of the system.

An increase in student fees has two impacts; one is that the revenues per student to the system increases; second, the number of students expected to attend the system decreases. In assessing the impact and implications of this approach, the simultaneous impacts of the increasing price of education on both the supply and demand sides of the equation must be assessed. If the next revenue impact of these offsetting impacts is positive, then the fee increase expands the supply of higher education available—but also reduces the total number of students that the system will potentially be able to reach because some students are priced out of the system.

This chapter addresses the question, "What can the state do to address this problem and close the gap it represents?" It examines this scenario along the three dimensions discussed above: (1) how much additional state (or other) support would be necessary to provide the capacity to meet the ambient

[40] The expected supply is defined by the lesser of the expected operating capacity or the expected capital capacity.

demand; (2) what level of fees would bring the supply and demand into equilibrium and how much of the ambient demand would be addressed by this policy alternative; and (3) what level of productivity enhancements would be necessary to close the deficit. In addition, this section discusses the tradeoffs between theses alternatives and provides an analysis of the joint tradeoffs between the state revenue and fee increase alternatives.

"Buying Out" of the Access Deficit

Buying out of the deficit has two dimensions—operating and capital capacity. If the operating resources are provided to the systems but the state fails to provide the physical space to accommodate the students, little has been accomplished because the students have nowhere to go to hear the instruction provided. If the new physical capacity is provided but the operating resources that fund the professors and instructors are not provided, then again demand for education is not met and resources are wasted in the process.

In this scenario, the costs of buying out the total deficit to the ambient demand level is considered. This has the effect of moving the three lines in Figure 3.1 upward to the ambient demand. Moving the two supply lines, operating and capital supply lines upward is solely a matter of providing the additional resources to expand supply to those levels. If these two lines were moved outward to the ambient demand, however, higher education would be produced at the lowest line which would be expected demand. To attain ambient demand, the fees which distinguish expected demand from ambient demand must also be returned to the baseline levels (i.e. they must be set to the real fee level in 1989-90). This will have a depressing effect on total system revenues, because fees per FTE will decline as the price decreases. More resources will then be required to replace these lost fee revenues.

Figure 4.1 presents the total dollars necessary to buy out the access deficits presented in Figure 3.1, assuming the state is the source of the additional revenues necessary.[41] Note that this table starts in 1995-96. The focus in this chapter is on the future ability of the state to address the access deficit.

[41]These represent total state appropriations to the systems, including both the amounts currently expected and the additional revenues necessary to close the gap.

Table 4.1
Real State Revenues Necessary to Expand Expected Supply to Close the Access Deficit (thousands of 1992-93 dollars)

Year	California Community Colleges	California State University	University of California	TOTAL
1995-96	1,726,630	1,960,011	2,034,411	5,721,053
1996-97	1,854,981	2,014,712	2,087,192	5,956,886
1997-98	1,980,446	2,077,900	2,152,260	6,210,606
1998-99	2,107,554	2,153,515	2,232,949	6,494,018
1999-00	2,242,226	2,238,869	2,330,233	6,811,328
2000-01	2,375,446	2,326,102	2,426,310	7,127,859
2001-02	2,512,071	2,420,905	2,524,585	7,457,560
2002-03	2,653,476	2,516,578	2,621,621	7,791,675
2003-04	2,800,378	2,606,781	2,708,960	8,116,119
2004-05	2,953,818	2,699,419	2,802,730	8,455,966
2005-06	3,114,348	2,795,592	2,894,669	8,804,609
2006-07	3,281,009	2,892,655	2,991,761	9,165,425
2007-08	3,426,077	2,981,862	3,074,392	9,482,330
2008-09	3,580,915	3,076,305	3,165,464	9,822,684
2009-10	3,749,066	3,186,274	3,280,800	10,216,140
2010-11	3,928,775	3,306,756	3,410,052	10,645,582

SOURCE: Derived from this analysis. See Appendix F for details of the calculations used to derive these amounts.

This table contains an estimate of additional dollars necessary for the state to provide a capacity equal to ambient demand. While the state is considered the most likely candidate for providing these dollars, they do not have to come from the state. They can come from state, local, federal, or private sources and fill this role, as long as they do not come directly from the students themselves (these would represent fees and would affect both the supply and demand for public undergraduate education).

While these funds are generic in character, it is unlikely that any other organization or agency will provide these operating funds on an annual basis. The federal government is the most likely prospect and the federal deficit seems to preclude any significant revenues there and local government in California is increasingly scrambling just to make its own ends meet, let alone take on the additional burden of financing higher education. This leaves the state budget as an unlikely savior.

Let us assume for a moment that the state does decide to finance this entire amount. What are the implications of this on the state's level of financial support to higher education? One measure of this support is the total share of the overall General Fund budget that goes to higher education. Figure 4.1 shows both the expected levels of support over the next fifteen years (the

expected supply scenario) and the level that would be necessary for the state to buy out of the access deficit (providing the amounts detailed in Table 4.1).[42] As can be seen in this diagram, the trend of this line does not agree with the direction of the level of support expected over the period. In light of the fiscal and budgetary trends introduced in Chapter Two, even the prospects of buying out the deficits associated with expected demand seem limited at best.

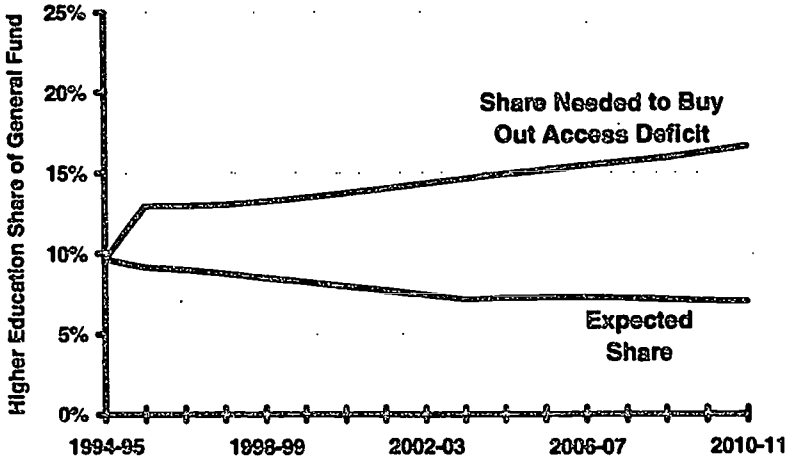

Figure 4.1–Share of State General Fund Budget Committed to Higher Education Necessary to Buy Out Access Deficit

Even if the state chooses not to fund the Master Plan-defined ambient demand, there is still the issue of the operating supply shortfall detailed in Table 3.3. Table 4.2 details the increased revenues necessary to the systems to accommodate that demand. As the table shows, the amounts are significant just to meet the expected demand without worrying about the larger issue of meeting the demand characterized by the Master Plan.

[42] Remember that the amounts in this figure represent *only those amounts necessary to buy out the deficits related to public undergraduate education.* The comparable amounts and shares for meeting the overall demand, holding the shares of undergraduate enrollments (credit enrollments in community colleges) constant are given in Appendix G.

Table 4.2
Total Real State Revenues Necessary to Expand Capacity To Close the Operating Shortfalls (thousands of 1992-93 dollars)

Year	California Community Colleges	California State University	University of California	TOTAL
1995-96	1,299,369	1,431,990	1,732,090	4,463,449
1996-97	1,409,194	1,475,330	1,781,837	4,666,362
1997-98	1,514,761	1,528,427	1,842,044	4,885,232
1998-99	1,621,281	1,589,331	1,915,602	5,126,213
1999-00	1,734,372	1,656,970	1,999,429	5,390,772
2000-01	1,846,552	1,727,576	2,089,830	5,663,958
2001-02	1,960,650	1,802,696	2,178,358	5,941,704
2002-03	2,078,859	1,878,306	2,266,066	6,223,231
2003-04	2,202,021	1,952,093	2,345,719	6,499,833
2004-05	2,329,921	2,027,983	2,427,663	6,785,568
2005-06	2,465,380	2,105,971	2,516,204	7,087,555
2006-07	2,606,413	2,185,431	2,602,527	7,394,372
2007-08	2,728,131	2,257,933	2,677,797	7,663,861
2008-09	2,858,277	2,334,650	2,760,540	7,953,466
2009-10	2,999,760	2,423,240	2,864,446	8,287,446
2010-11	3,151,116	2,520,056	2,980,659	8,651,831

SOURCE: Derived from this analysis. See Appendix F for details of the calculations used to derive these amounts.

If the state is to be the source of these funds, these needs will again require a significantly higher proportion of General Fund revenues than anticipated. Figure 4.2 reproduces Figure 4.1 and shows the level of state General Fund support necessary just to meet the expected demand. While certainly not as much as the share necessary to buy out the access deficit, the 14 percent of General Fund revenues is still twice the expected level seven percent in 2010-11.

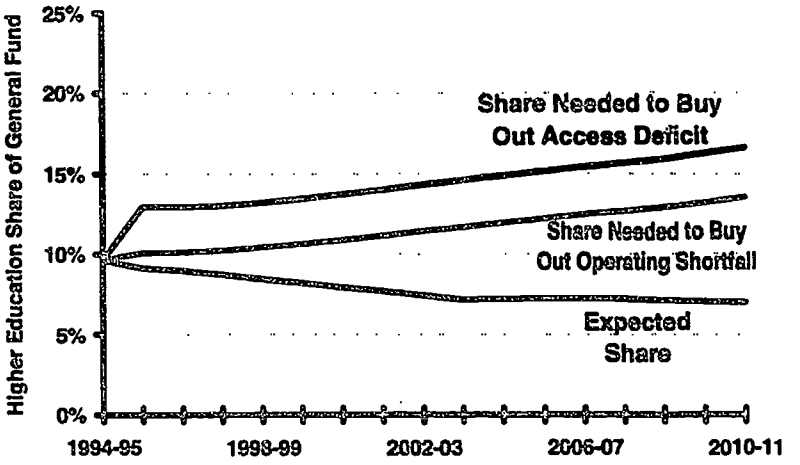

Figure 4.2--Share of State General Fund Budget Committed to Higher Education Necessary to Buy Out Operating Shortfall

Included in these calculations are the annual debt service costs associated with maintaining the current infrastructure of the systems plus estimates of the new construction costs to accommodate increasing demand. To finance this new capacity, a significant quantity of new bond issues will be necessary. Table 4.3 details the corresponding bond issues that must occur[43] in order to meet the capital capacity demands for the period 1995-96 to 2006-07.[44] While all the other numbers presented here are real, both real and nominal dollars are included in Table 4.4 to give the reader an understanding of the magnitude of total bond issues necessary.

[43] For the purposes of this analysis, it is assumed that the state will issue 20-year general obligation bonds for this capacity expansion with a nominal interest rate of six percent. The key issue is the total quantity of dollars necessary to accomplish the necessary expansion. In the case of the University of California system, an allowance has been made for expected private donations. The numbers used in the development of this model were from published reports of the California Postsecondary Education Commission. See Appendix F for details.

[44] The total bond amounts include both undergraduate and other education. The total quantity is included because it is assumed that campuses will be constructed as integral units and that the proportion of undergraduate education will remain constant as a share of the whole.

Table 4.3
Total Bond Issues Needed to Expand Capital Supply to Accommodate Ambient Demand, 1995-96 to 2006-07

Year	Total Bonds Required (thousands of 1992-93 dollars)	Total Bonds Required (thousands of Current dollars)
California Community Colleges	8,996,268	10,940,474
California State University	2,688,148	3,315,682
University of California	3,021,126	3,833,094
TOTAL	14,705,541	18,089,250

SOURCE: Derived from this analysis. See Appendix F for details of the calculations used to derive these amounts.

In addition, a significant portion of these bond issues are required immediately just to bring the systems to the capital capacity to accommodate today's ambient demand. For example, in the California Community Colleges system, total ambient demand for 1995-96 is 1,087,425 FTEs and yet the system only has a capacity of 930,000 FTEs—a difference of 157,425 FTEs or nearly 17 percent of current capacity. The cost of expanding the system just to serve the ambient demand in 1995-96 is nearly $2.7 billion (current dollars).[45] The state would have to invest this amount immediately (and have it in place by 1995-96) to ramp up capital capacity adequately to meet the ambient demand levels. The University of California and California State University systems do not have such initial capacity shortfalls in 1995-96.

In addition to the problem of initial shortfalls, new capacity takes time to build (four years is assumed). As a result, the immediate round of construction must expand to meet the needs for the next four years. All three systems face this issue. The California Community Colleges system requires another $1.7 billion current dollars in bonds in 1995-96 to meet these demands, while the University of California and California State University systems require another $0.7 billion and $1.1 billion dollars respectively, for a total of $6.2 billion dollars in new construction bond issues.

Increased state borrowing of this magnitude is highly unlikely, even if the voters decided to approve such bond levels. The demographic trends that are shaping higher education are also shaping the state's other major expenditure categories, resulting in increased capital demands in corrections, K-12 education, and general infrastructure. The state has also recently taken to borrowing from future years to fund current operations, although continued state economic growth and hesitant financial markets will likely reverse this trend.

[45] Current dollars are used when discussing bonds in order to provide an understanding of the amounts which would have to be financed in the bond markets in each case.

Furthermore, the costs associated with this borrowing are likely to rise (interest rates), increasing the debt service amounts listed in Table 4.3, as the state's borrowing levels grow.

Raising Fees to Close the Deficit

Another approach to addressing the access deficit is to increase the cost of education to students through higher fees. When higher fees are discussed in this context, the reference is to the price of higher education to the student (or family). A price increase in this context should also be thought of as net price increase—the change in the price (increased fee) net of the increase in financial aid. Suppose a student was currently paying $5,000 per year in fees and that fees rose to $6,000 a year in the next year and the student received an aid increase from the institution of $500. The net price to the student in the next year, therefore is $5,500, not $6,000. Likewise, the corresponding net revenues to the institution are $500 ($1,000 fees less $500 aid expenditure). If this is averaged across all people, an estimate of the net average fees and net average revenues is obtained.

This section considers the policy option of charging a net average annual fee in each of the systems that results in the operating supply of that system equaling the quantity of seats demanded—an economic equilibrium. For each net average annual fee increase, a certain number of additional dollars will be available to the institution (the change in net average annual fee times the number of enrollees) and the number of students expected to attend the institution will decrease (in response to the higher price). As fees become higher and higher, the difference between these two the quantity supplied and the expected demand (the operating shortfall from Chapter 3) will decrease.

At a certain point, the two will be equal and there will be no operating shortfall. Table 4.4 shows the total fee amounts, in constant dollars, where this equilibrium occurred. The details of how these fee amounts were calculated is included in Appendix F.

Table 4.4
Real Total Fees at which Operating Equilibrium is Achieved
(constant 1992-93 dollars)

Year	California Community Colleges	California State University	University of California
1995-96	1,604	2,480	7,559
1996-97	1,487	2,629	8,088
1997-98	1,467	2,815	8,835
1998-99	1,472	3,049	9,767
1999-00	1,483	3,304	10,771
2000-01	1,503	3,593	11,851
2001-02	1,524	3,900	12,947
2002-03	1,542	4,225	14,019
2003-04	1,574	4,556	15,111
2004-05	1,614	4,636	15,410
2005-06	1,678	4,715	15,731
2006-07	1,784	4,793	16,077
2007-08	1,926	4,880	16,316
2008-09	2,112	4,972	16,578
2009-10	2,321	5,078	16,899
2010-11	2,549	5,193	17,250

SOURCE: Derived from this analysis. See Appendix F for details of the calculations used to derive these amounts.

These prices represent the real net average annual fee experienced by the individual. The 1995-96 amounts are based on the expected amounts from the *1995-96 Governor's Budget*.[46] These series represent 15-year real increases of 59 percent for the California Community Colleges system, 109 percent for the California State University system, and 128 percent for the University of California system or real average annual growth rates of 3.1, 5.1, and 5.7 percent for each system, respectively. These are real fees and that the current dollar increases would be much higher.[47]

One important consideration is whether the systems could charge these prices. As the public institutions' real price increases, they will eventually come up against another constraint representing competition from the private sector. The model underlying this analysis also assumes a constant demand price elasticity. This means that the percentage change in demand for a given

[46] The *1995-96 Governor's Budget* only specified the fees for the California Community Colleges system. The CSU and UC amounts are from estimates that these fees will rise about ten percent in response to the state resources provided and to be consistent with prior stated legislature intent that increases should be held to ten percent per year.

[47] In current dollars, the fee increases would total 148 percent for CCC, 226 percent for CSU, and 255 percent for UC. The nominal average annual growth rates would be 6.2 percent, 8.2 percent, and 8.9 percent for each system, respectively.

percentage change in price is constant over the entire range of prices it is possible that, for very high price levels, the number of people who decide not to attend increases. If this is the case, then equilibrium could be reached at a lower price, but the number of people served would be significantly lower because there would be fewer revenues per FTE.

The most important consequence of this policy choice is that you have chosen to reject the fundamental objectives of the California Master Plan for Higher Education. By simple economic definition, you will have excluded a population of students from higher education through higher prices. Higher prices will suppress the demand for higher education, but the new selection criteria for who will attend the institutions and who will not will no longer be a direct policy option, but a *de facto* result of the individual's ability to pay the higher prices.

Another problem is that unless fees are returned to the baseline levels,[48] the institutions will never be able to fully close the access deficit. The students listed in Figure 3.4 in Chapter Three represent the students that currently are expected to be excluded from higher education due to price effects. These students will not be served unless fees decline.

Even so, as described above, fees can be used to close the operating shortfall. Table 4.5 shows the size of the access deficits[49] resulting from pursuing the fee structures described in Table 4.4. This is not to say that creative financial aid paradigms cannot mitigate some of this impact. The bottom line, however, is that if the net average fees per student rises,[50] some quantity of students, who should have attended under the Master Plan definition of education, will not be able to attend.

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[48] The baseline in this analysis is the real total fees in the 1989-90 year.

[49] Remember that access deficit refers to the difference between the ambient demand (demand under the Master Plan) and the supply provided by the systems.

[50] The net total average fee would represent the average total fee less the average increase in financial aid. The per student revenue to the institution would also be this amount, since the increase in financial aid would represent an expenditure of the system (or the state on the system's behalf).

Table 4.5
Access Deficits Under a Full-Fee Scenario (FTEs)

Year	California Community Colleges	California State University	University of California	TOTAL
1995-96	210,988	42,104	8,046	261,138
1996-97	207,678	44,683	8,470	260,831
1997-98	210,666	47,827	9,064	267,557
1998-99	215,736	51,696	9,803	277,235
1999-00	221,426	55,903	10,622	287,950
2000-01	227,942	60,349	11,455	299,746
2001-02	234,457	64,909	12,271	311,638
2002-03	240,926	69,470	13,039	323,435
2003-04	248,533	73,694	13,732	335,949
2004-05	256,834	75,620	14,095	346,549
2005-06	267,141	77,479	14,449	359,069
2006-07	280,447	79,240	14,788	374,475
2007-08	296,122	81,147	15,104	392,373
2008-09	314,475	83,189	15,466	413,130
2009-10	334,103	85,736	15,970	435,809
2010-11	354,419	88,587	16,549	459,554

SOURCE: Derived from this analysis. See Appendix F for details of the calculations used to derive these amounts.

Comparing these access deficit levels to the overall ambient demand, 27 percent of the ambient demand for undergraduate education is still unmet in 2010-11. As Figure 4.4 shows, the full-fee approach allows the sector to close a significant portion of the access deficit, but the levels in the full-fee scenario are locked in and cannot be eliminated through supply expansion.

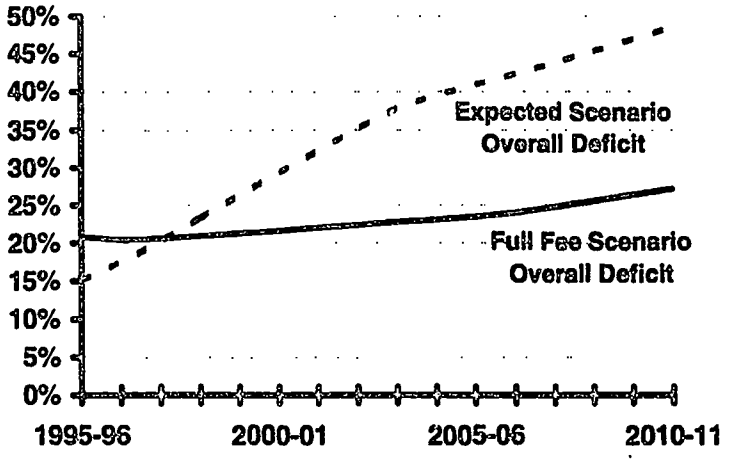

Figure 4.3--A Comparison of Access Deficits as a Share of Ambient Demand Under Two Scenarios

Since the goal, under the California Master Plan, is to have these lines go down to zero percent and stay there, the state is far from realizing its goal under this policy option. Raising tuition will close the supply shortfall, but not close the access deficit. For the most part, the initial difference in Figure 4.3 (the y-intercept) represents the proportion of ambient demand that the fee increases since 1989-90 have excluded from the systems.[51] The failure of the systems to reduce fees to baseline levels guarantee that the ambient level of demand will *not* be met and any increases will only exacerbate the problem.

Eliminating the Deficit through Productivity Changes

Another approach to resolving the access is to reduce the operating cost of producing education. Since this model incorporates a very broad definition of cost, this could be accomplished by any of several means. This definition includes all dimensions of the operating costs necessary to bring about the production of the good called higher education—including salaries and benefits for faculty, administrative and support staff, library acquisitions, office supplies, student services, etc. As is the case in the buy-out scenario above, the price of education must be set to baseline levels.

A systematic reduction in any of these categories while maintaining the same FTE output would be a way of decreasing the per unit cost of education, or in economic terms—increasing the productivity of the assets used in the production of education. In either case, a reduction in the cost of production would increase the number of units to be produced by a given amount of revenues. If costs were cut enough, then the total ambient demand for public undergraduate education could be met by current resources. Table 4.6 presents the percentage by which operating costs would have to be slashed in order to accommodate the ambient demand.[52]

[51] Some portion of it also represents students excluded due to the unavailability of seats in the systems.

[52] These estimates include provisions for both operating and capital capacity.

Table 4.6
Percentage Cost Reductions Necessary to Meet Ambient Demand
(Percentage of Expected Costs)

Year	California Community Colleges	California State University	University of California
1995-96	35.5%	35.8%	33.6%
1996-97	34.1%	38.5%	36.5%
1997-98	33.8%	41.6%	40.0%
1998-99	33.9%	45.3%	44.2%
1999-00	34.0%	49.0%	48.5%
2000-01	34.4%	52.9%	52.9%
2001-02	34.8%	56.8%	57.1%
2002-03	35.2%	60.6%	61.3%
2003-04	35.9%	64.2%	65.2%
2004-05	36.7%	64.7%	65.8%
2005-06	37.8%	65.3%	66.4%
2006-07	39.4%	66.0%	67.1%
2007-08	40.8%	66.2%	67.3%
2008-09	42.6%	66.5%	67.5%
2009-10	44.4%	67.0%	67.9%
2010-11	46.4%	67.4%	68.4%

SOURCE: Derived from this analysis. See Appendix F for details of the calculations used to derive these amounts.

As can be seen, real operating costs would have to be slashed nearly in half from expected levels in 2010-11 in order for productivity increases to close the access deficit. These productivity improvements can come from either operating or capital productivity improvements, although the direct benefits of the latter are mitigated by amortization of up-front capital costs over 20 years.

The starting point for these cuts is also an important aspect of this policy choice. Because of the dire state financial condition since 1991-92, the systems have already implemented major cost reduction efforts. Over the three-year period from 1989-90 to 1992-93, each of the systems cut their real operating cost per FTE significantly: CCC by 15.8 percent, CSU by 8.0 percent, and UC by 9.1 percent. The two years since then have been marked by a continuation of the state economic crisis and real costs have remained flat for all three systems.

This means that the cost cuts shown in Table 4.6 must come from systems that have already faced five years of no or negative growth in costs. This cost performance is the result of almost heroic efforts to affect cost reductions in the context of the current structure of the institutions. In the University of California senior (usually more expensive faculty) have been lured to leave with three early retirement incentive programs. At the same time, those faculty remaining have received no salary raises for two of three years and a 3.5 percent

salary reduction in the third.[53] Some campuses have significantly reorganized and eliminated entire schools to reduce costs. In the California State University and California Community Colleges systems, a range of effects, including wholesale layoffs of part-time faculty have occurred. In one case, all library acquisitions were terminated and in numerous other examples, administrative cutback took the forms of support and administrative staffs, frequently having negative impacts on instruction itself.

It is from this starting point that these costs must depart. A significant portion of the operating costs goes toward salaries and especially faculty salaries.[54] If the costs were to come from decreasing the systems' pay scales, there is an increasing concern that the systems will not be able to attract faculty of high quality and thereby reduce the quality and value of the education, as well as the quality of the research and public service provided.

This does not mean that at least part of the answer to bridging the access deficit does not lie in productivity improvements. All three systems and many individual campuses within the systems are pursuing technology-oriented solutions to providing the higher education good to a larger student population with many fewer resources.

Other Policy Proposals

Numerous other policy initiatives have been put forth to address the access deficit. One proposed solution is to let all eligible students into the systems, no matter what the capacity of that system is. Another idea put forth is to implement a three-year undergraduate degree. Both of these proposals is discussed below. Both would require significant reworking of the modeling underlying this report and the discussion is consequently limited to a more general level.

Universal Access: Let Them All In!

In this approach, every eligible student is admitted to the system, whether there is space for them or not. The consequence of this is that much larger numbers of students are competing for the same number of slots and, consequently, a smaller share of the total student population get all the courses they require to

[53] *Los Angeles Times*, January 14, 1995.

[54] One system administrator estimated this to be in excess of 80 percent of operating costs.

complete the program in a timely manner. As this number becomes large enough, the opportunity cost of pursuing a higher education will increase (as a function of time-to-completion) and the economic conditions that are assumed to be constant over the fifteen year period will no longer be constant. This would require not insignificant expansion of demand model to include time-to-completion as an independent variable.

The estimated time to completion for some undergraduate programs already exceeds 6 years. The entry of students into systems in which there is already constrained capacity will exacerbate this problem, and with the scale of deficits portrayed in Chapter Three, completion times of more than ten years could occur. This outcome is clearly undesirable. In the *Supplemental Report of the 1994 Budget Act*, the California Legislature expressed its intent that both the UC and the CSU "establish four-year degree pledge programs on all campuses by 1995-96."[55] Such a pledge would commit the institution to providing enough course sections for the enrolled student population that they could finish within four years. Since average times-to-completion have in fact ranged above four years, this Legislative initiative requires that the systems admit even fewer students per supply unit available, or in the language of this analysis, effectively increases the cost of production. Full implementation of this policy would exacerbate the access deficit problems documented in this report.

The Three-year Degree

Another approach that has been proposed is the adoption of a three-year undergraduate degree. Proponents of this approach argue that the general education portion of the curriculum could be concentrated into fewer courses, freeing up capacity to teach more upper division courses and accommodate more students. The impacts of this model for undergraduate education are not clear. It would affects all dimensions of the demand for higher education. Participation, transition, and transfer rates would change. Responsiveness to price changes (as the cumulative price of the overall degree) would also change.

A crude way of estimating the effects of this approach is to look at overall the overall quantities demanded. Implementing a three-year degree would decrease overall demand (assuming participation, transition, and transfer rates do not change) by 25 percent in four-year colleges. Depending on the actual implementation of the program, it could decrease demand for community

[55] Office of the Legislative Analyst, *Focus Budget 1994: Highlighting Major Features of the 1994 California Budget*, July 13. 1994, pp. 8-9.

colleges by up to 50 percent (if the entire year was removed from the first two years). Turning back to Figure 3.6, the access deficits in the later years for the CSU and UC systems are considerably higher than 25 percent of ambient demand and, hence, it does not appear that a three-year degree would address the entire problem. In the CCC system, however, the entire access deficit could be addressed by this approach if the dropped portion of the curriculum was concentrated in the first two-years of instruction.

There are many other issues that cloud the viability of the three-year degree concept, not the least of which is several centuries of inertia in the nation's higher education sector. There are also concerns regarding the quality of the overall baccalaureate education that a student would receive in the shorter program. Even if the quality was held constant, a student would receive 25 percent less of it. There would also be a large number of logistical and procedural issues that would have to be addressed in order to transition to such a system, such as the recognition of the shorter degree both nationally and internationally. Prospects for a three-year degree, at least in the near term, seem weak.

Combinations of Policy Initiatives

The most likely solutions will include some combinations of the policy proposals included in this report. Increased dollars, fees changes, and increased productivity can all be combined to reduce the access deficit expected in the state. In addition, different policies can be pursued in each of the systems.[56] The inescapable fact, however, is that the scale of the problem is large. Even in combination, exploratory runs of the simulation model the challenges involved in the sheer size of the student populations to be accommodated to be nearly insurmountable if the Master Plan goal of access is to be achieved.

[56] The simulation model used in this research has the capability to address these possibilities.

5. Conclusions

There is an access crisis in California—even with the assumption in this analysis that the state of California was attaining the goals of the California Master Plan in 1989-90. Many would that the level of service and access provided by the higher education sector then was already below those envisioned in the Master Plan. This approach also argues that the level of resources committed to systems and institutions in that year were adequate and that the cost of producing education was characteristic of a sustainable level. It also presumes that other factors, such as fee levels and time-to-completion were at acceptable levels—a debatable assertion at best.

Even with these broad assumptions and the use of a relatively conservative methodology for estimating the ambient demand, the state is expected to fall far short of this conservative level. In the resources available to higher education in the state come in at expected levels, by 2010-11, the sector will not be able to serve nearly half of the students called for in the Master Plan. The access deficit for one of the state's four-year systems in that year exceeds 60 percent of the goal levels.

Even an optimistic fiscal scenario, a highly unlikely prospect given the mandated rival demands on General Fund revenues, does not close the deficit. In the optimistic scenario, only 58 percent of the overall desired student population will be served in 2010-11. In this case, it is the community colleges that suffer the most, turning away more than 42 percent of the ambient demand.

The physical capacities of the systems also call into question the state's ability to meet the Master Plan capacities. To meet ambient demand projections, the state will have to build additional capacity to accommodate nearly 720,000 total students in its higher education sector. This during a time when the voters of the state routinely continue to reject bond issues for both K-12 and higher education.

If one sets aside the goals of the Master Plan, it is not clear that the sector will even be able to meet expected demand. In nearly all of the operating scenarios, the state faces an operating shortfall and—since that level of support is definitionally less than the ambient demand—an access deficit. Furthermore, rising fees have already excluded a significant number of students who should

have been served under the Master Plan. Even with these higher prices, it is clear that the state will be unable to meet the expected demand for public undergraduate education.

Access Deficits Here for the Long Run

The prospects for meeting these access deficits are not good. First and foremost, the rising levels of fees in the state are routinely pricing students who, under the Master Plan, should be served by the state's higher education sector. Unless the price of higher education is reduced to earlier levels, the state will guarantee that a significant proportion of students will be denied access to the state's public undergraduate institutions.

Furthermore, it is clear that the state cannot afford to buy out of the current access crisis. It is estimated that it would cost the state an average annual total of $11.3 billion dollars a year[57] to meet the operating demands of the Master Plan. This represents an increase in the operating support of higher education from 11 percent today to more than 20 percent in 2010-11. While that share is not unreasonably high in historical terms, the increasing demands of the state's mandated spending programs, such as K-12 education, corrections, health, and welfare programs render it highly unlikely in the future context.

The costs associated with adding the necessary additional capital capacity are also formidable. Annual debt service and investment to fund the necessary capital program would exceed $1 billion per year in real terms. The associated bond requirements total more than $18.1 billion ($14.7 billion in real terms) through 2010-11. Consultations with several state experts in the bond markets estimate that California's total annual new issue capability is somewhere around $2 billion a year. Between the demand for new prisons (driven by three strikes) and the need for new K-12 facilities (which is driven by the same demographic forces as higher education), there is certain to be more than ample competition for the $30 billion dollars of state borrowing capacity available over the next 15 years.

Another strategy to closing the deficit is to cut the costs of producing higher education. This analysis has shown that it would require significant cuts in the total production cost of education in order to produce an adequate number of educational opportunities to close the access deficit. If this strategy is pursued,

[57] This is average annual spending from 1995-96 to 2010-11 in current dollars. The amount is $8.0 billion a year in constant 1992-93 dollars.

it will have to be in the form of as yet nonexistent technologies that significantly increase the number of students that can be served by each campus. Because of the recent major reductions in operating costs in all three systems, it is unlikely that major productivity improvements can be made without seriously impacting the quality of the educations provided. This is not to say that progress cannot be made in this area, as will be discussed in the recommendations for immediate action below.

Finally, there are a range of other options and combination of the above options that the state can pursue. The decision to admit and enroll all eligible students regardless of capacity is not realistic and the sector and legislature rightly oppose this possibility. There has also been some talk of a three-year degree undergraduate degree as a solution to the state's problems. While it does offer potential to significantly reduce the access deficits (which could be met through other changes), the thinking on this approach has not yet been fully developed. This degree would also impose significant challenges logistically during the transition to such as system. In any event, full and immediate implementation would only reduce and not close the access deficit.

The Future of the California Master Plan for Higher Education

One conclusion is inescapable—the California Master Plan for Higher Education, in today and tomorrow's fiscal and demographic environments, is not viable in its current form. The state has little or no prospect for meeting the goals of the Master Plan and providing the level of public undergraduate access embodied therein. It is time for the state and policymakers throughout the sector to reconsider the Master Plan and to develop a new strategy for the state's higher education systems.

The fact of the matter is that this is already happening. But instead of resulting from well-thought, macro-level choices between alternative visions, the access provided by the state's higher education sector is being shaped by a mishmash of local factors and compounded by a highly uncertain budget picture. Students are being kept out of the system by price increases and capacity as a share of total ambient demand is decreasing with no explicit vision on where it is all headed.

The state is almost in a state of denial as to the ongoing viability of the Master Plan. Budgets are no longer considered in the context what is required to support the needs of the state's higher education sector, but rather what is left

that we can spend on it. And while everyone agrees on the goals of the Master Plan, everyone also agrees that it is not currently being met. This analysis shows that it will most likely not be met in the future either.

Therefore, the state should convene a new Committee on the Master Plan to address the state's goals for its public education sector into the future. This Committee will need to consider the capabilities and strategic role of the state's higher education sector well into the next century. It will also need to consider the fiscal and demographic context in which the state's higher education institutions must operate. It will need to consider the strategic alliances between higher education as an education and training mechanism for the private sector as well as the sector's role in producing a significant portion of the nation's basic research. The linkages between the state's public and private education sectors will also have to be strengthened. And these are just the first order questions to address.[58]

But the challenges are no more formidable than those 35 years ago. It is important to remember that the current Master Plan was the product of a long process to consider the structure and character of the state's higher education sector. The new effort should also be the result of a carefully considered process. Participation should come from all aspects of the higher education sector and should include members of all four major higher education segments (private institutions constituting the fourth), members of the private and public sectors, lawmakers, and other leading policy players.

The current Master Plan is arguably a major reason for the state's tremendous success over the past 35 years. A new Master Plan will be the key to the state's next 35 years. The sooner such an effort can be undertaken, the sooner the sector's goals and objectives can be redirected to springboard the state into the next century.

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[58] The concepts of institutional reform, improved linkages between the public and private sectors, and rethinking the roles defined in the California Master Plan are not new. In *A Fresh Look at California Higher Education: A Discussion Paper Focusing on the Future* the staff of CPEC raise and discuss many of these issues, proposing some possible approaches to the problems documented in this report. The California Higher Education Policy Center has also raised and discussed many of these issues in its works. Examples include Jack McCurdy and William Trombley, *On the Brink: The Impact of Budget Cuts on California's Public Universities*, August 1993; Clark Kerr, *Preserving the Master Plan*, October 1994; Patrick Callan and Joni Finney, *By Design or Default?* June 1993; and *Time for Decision: California's Legacy and the Future of Higher Education*, March 1994.

The Sector's Immediate Response

Even as the reworking of the Master Plan is a crucial first step in the long-term solution to the sector's problems, restructuring is a crucial first-step in solving the sector's short-term problems. As indicated in this research, the sector will still face significant operating and capital capacity shortfalls, even if the goals of the Master Plan are set aside. As such, the sector must take immediate steps to maximize the level of access provided with the resources it has.

An important key to maximizing the quality and quantity of the education good provided. The current structures and institutions are largely the product of long histories and often more focused on that structure than on the production of education. The three-year degree proposal is an example of how these histories and their underlying assumptions can be challenged.[59] Numerous other institutions, both public and private, have reassessed their institutional foci and reorganized their curricula, schools, information systems, and approaches to doing the business of higher education.

Restructuring for its sake alone, however, should be avoided. The restructuring process should focus on innovation and mission within the institutional context.[60]

Beyond overall restructuring initiatives, the systems must also work to achieve cost efficiency in their production process. As stated earlier, the emphasis should not come from the more traditional approaches to cost reduction—namely salary and staff reductions, although these may also be appropriate—but should be more on the potential of the information revolution. New technologies can significantly leverage the productivity of the higher education teaching process upward. Advances in systemic and institutional information systems can be used to strengthen and improve their decision processes.

In conjunction with these internal changes, the state *must* continue to fund the capital expansion of the systems. The current capacity is inadequate to today's needs, let alone to the state's future needs. Capital expansion takes significant time and resources and cannot be ignored. No matter what vision is adopted in a new Master Plan, the state's population is exploding and the state's higher education sector will need to grow to serve the state's future needs. The decision for expansion must be made in the long-term perspective and higher

[59] This does not constitute and endorsement of this alternative, but merely shows it as an example of a restructuring initiative.

[60] Benjamin, Carroll, Jacobi, Krop, and Shires, *The Redesign of Governance in Higher Education*, Santa Monica, CA: RAND, MR-222-LE, 1993.

education cannot be left out of the equation when competing with K-12 and prisons.

Finally, the level of support to the sector must be maintained, whether through a sustained share of the public dollar or through new public/private partnerships. The failure of the state to provide on-going support to the state's higher education systems will be a costly failure indeed as a significant share of the state's burgeoning population will be denied access to higher education. In an increasingly technological society that demands an increasingly skilled workforce, such short-term policy choices could well leave the state unable to compete.

Next Steps

There is a limited literature on the approaches and consequences of institutional and systemic restructuring efforts that have already been undertaken. Higher education as a sector studies itself less than almost any other enterprise—this must change. The effectiveness of restructuring process and strategies must be understood. The needs for information systems and the appropriate architectures to facilitate these efforts must be understood.

New education technologies must be developed that can enhance the quality and quantity of education produced by higher education institutions. The linkage between higher education and the private sector must also be expanded and the areas for joint effort must be built upon. Toward this end, the areas of mutual interest must be identified and developed.

Finally, the role and missions of higher education in the modern postindustrial society must be studied. No historical precedent exists for tomorrow's information-rich and technology-based world. The needs and demands of that society are not clear and yet the higher education sector must anticipate and respond to those needs and demands. It is only by looking well into the next century that today's higher education systems will be able to best serve the citizens of California.

Appendix

A. Modeling the Demand for Public Undergraduate Education

The demand for public undergraduate education is a very difficult system to model directly. There is a range of issues that complicate estimating the demand for higher education. Since one chooses higher education over other career options, one component of a direct demand model would have to be an estimate of the direct opportunity costs of pursuing higher education. These costs must be offset by an estimate of the direct benefits of higher education. Most of these studies are carried out at the national level and contain significant quantities of private institutions. The applicability of these studies is often limited to the specific context and institutions included in the data set. The focus here is a very limited context—public institutions in California.

Since the objectives are more specific than just estimating overall demand for higher education, there is an alternative to estimating that demand from scratch, as these models attempt to do. Ample information is available, in the form of historic participation rates, as to the demand for public undergraduate education in California under a variety of circumstances. This information can be combined with projections of demographic information to estimate the future demand for undergraduate education in California.

Our approach to modeling it, therefore, is to use a dynamic simulation model to addressing the demand behaviors indirectly. To implement this concept, a period of time is selected when the supply-side constraints were widely perceived as harmless (a "baseline period") and use the population participation rates at that time applied to future population estimates to project enrollment demands into the future.

For example, take a student that is graduating from hi sch:ol. That student is undergoing all of the decisions and processes described in the Chapter Two—choosing between career alternatives, weighing the relative returns on investment (in both time and money) of various education choices, and weighing personal preferences for a host of factors, such as size, location, expected time to completion, etc. The end result, however, is that that student decides to enroll in one of the public education systems or to not enroll. The

historical record of that decision in the past is available in the form of enrollments in the various systems.

As a consequence of that decision and its accompanying record, the data contains information on which, if any, system that student chose to enroll. By aggregating this information across the population, a profile of the participation rate of that student's population subgroup in each of the public systems can be generated. If this information is aggregated across all of the public education institutions and across all of the population's subgroups, a map of participation and nonparticipation in the state's public higher education systems is developed. It is through the development of this type of a participation matrix that projections of the state's demand for public undergraduate enrollment are developed.

Important Underlying Assumptions

This approach, referred to here as the "baseline approach," contains some important assumptions. Each of these assumptions represent decisions and choices in the model that can be revisited in subsequent iterations of the model.

The Baseline Period

The first assumption of this approach is that the baseline period is a period that is representative of a time when there were not any significant supply-side constraints. It further presumes that the sector was indeed providing the desired level of opportunities for education within the sector. In the context of the California Master Plan, it presumes that the state's public systems were operating in accordance with their missions under the Master Plan and that each Californian that could benefit was indeed benefiting under the conditions exhibited at that time.

For the purposes of this model, the 1989-90 fiscal/academic year has been chosen as the baseline period. This period represents one of the last years before the state's fiscal crisis caused a shift in the budgetary process whereby public system funding was based heavily on expected enrollments. In 1991-92, the state generally decreased the funding for the public postsecondary systems and funding was separated from expected enrollments.

The exception to this was the Community College system which was protected by the provisions of Propositions 98 and 111. This year serves as a good

baseline for this system because it was one of the first years that the provisions and funding mechanisms of Proposition 98 was in effect.

Another reason for the selection of 1989-90 as the baseline year was that real fees to the students were at stable and relatively low levels.[1] Figure A.1 below presents the real total fees for the CSU and UC systems. While comparable series were not available for the CCC system, state enrollment fee remained at $100 from 1984-85 to 1990-91.[2]

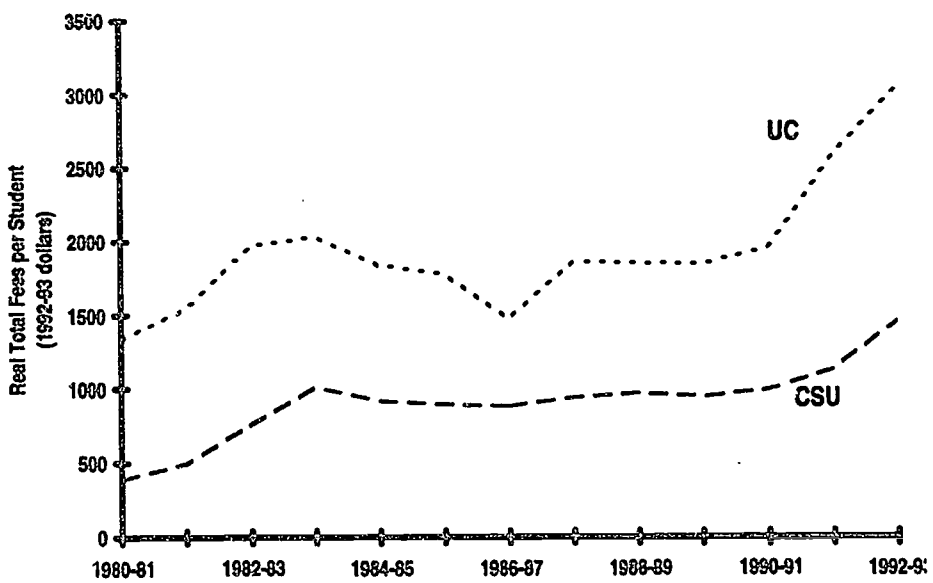

Figure A.1–Real Total Fees[3] per Student in the California State University and the University of California[4] Systems

As this figure shows, real total fees for CSU were relatively flat from 1983-84 until 1991-92, while UC fees were somewhat more variable, peaking around 1982-84 and falling until the mid-1980s, at which time total fees resurged to near

[1] Fees were at low levels relative to the fees in subsequent years and comparable to real fees in the preceding ten years.

[2] California Postsecondary Education Commission, *Fiscal Profiles 1992*, CPEC Report 92-9, Display 26.

[3] Total fees includes systemwide fees and estimates of campus-based charges for health, student union, parking and other fees. The non-system fees for the California Community Colleges system were estimated using the average non-system fee portion of the California State University system costs for that year.

[4] From California Postsecondary Education Commission, *Fiscal Profiles 1992*, CPEC Report 92-9, Display 29.

1982-83 levels. UC total fees also show a sharp increase in 1991-92. Since 1989-90 was one of the last years before the separation of enrollments from the funding decision, it is an appropriate choice.

Comparability of the Baseline Period

Another important assumption of the baseline approach is that the period's economic opportunities must be comparable to those of the future projection period. Some would argue that the state's severe economic recession in the early 1990s was a harbinger of hard times to come, but none would argue that it is indeed permanent.[5]

Since the model is aggregated across a wide range of subpopulations,[6] the model presumes that the economic alternatives and choices remain the same for each of the demographic subpopulations used in the model. For example, the model at one point calculates a participation rate of female Hispanics, 18-19 year olds in 1989-90. In using this participation rate for the projections, the model presumes that the economic opportunities and the relative returns of the various career choices for this subpopulation will remain the same over the entire projection period as it was in 1989-90. While this is a big assumption, the projection range of the model is fairly limited (through 2009-2010) and there is not enough information available to assume otherwise.

Cross-price Elasticity of Demand

One important issue that is not included in this model is an estimate of the cross-price elasticity of demand between the various institutions. For example, suppose someone is currently considering attending the University of California but fees rise rapidly next year and fees at the California State University or the Community College do not rise as quickly. There is an increased probability that they will attend one of the other two systems because their relative price is lower. The change in demand for one system because of price changes in another is called the cross-price elasticity of demand.

This model does not include this aspect of the analysis. It was omitted in part because of a desire to make this research available as quickly as possible and in part because it was not clear that there would be adequate degrees of freedom

[5] Most would agree that its impact on the future growth prospects is long-lasting. The state has a long way to climb just to return to pre-recession levels of economic output.

[6] Specifically the model uses gender, ethnicity, and age as drivers.

in the data available to make any reasonable estimates of the actual value and magnitude of these elasticities.

Defining and Understanding the Components of Demand for Public Undergraduate Education

In this analysis, the demand for public undergraduate education for each of the systems is modeled separately. The general form of the demand equation is given in Equation (A.1) below.

$$Q_D = Q_0 P^{\varepsilon} \qquad \text{(A.1)}$$

Q_D is the quantity demanded in each system, Q_0 is the ambient demand for the system, P is the price of education, and ε is the demand price elasticity for the system. The assumptions surrounding each of these values will be discussed below.

The Expected Demand for Public Education, Q_D

The expected demand for public education represents the number of people who would attend public undergraduate education in the system under consideration under the conditions specified in the equation. This is the number of bodies in the classroom who wish to be in the classroom under the specified conditions. For the baseline years, it represents the actual number of students enrolled in the respective systems. For years in which supply exceeds demand, this will be the number of students who actually show up in the system. For years in which demand exceeds supply, this is the number who would like to attend. The number enrolled in these years would be the number of seats supplied.

The Ambient Demand, Q_0

The basic assumption of this approach is that the 1980s represent a period in recent history when the public education systems were indeed operating in a manner consistent with the California Master Plan and the state's intent to provide access to undergraduate education in each of the three public segments. The term *ambient demand* refers to the quantity of people who, under the auspices of California's Master Plan, and consistent with my assumption above, are pursuing undergraduate education in California's public education systems.

For the baseline years, therefore, it is the number of people who attended the institutions as undergraduates. This model produces a set of participation rates, which are calculated at the detail levels along the dimensions of status, gender, and ethnicity and then aggregated to the highest level. A detailed discussion of the modeling of the ambient demand is included in Appendix B. Appendix C then discusses the methodology whereby the theoretical framework described in Appendix B was operationalized.

The Price of Education, P

The price of higher education can be defined in many ways. The level of tuition and fees are one choice for the price of higher education. In order to fully reflect the demand-side issues, however, the price of education can be expanded to reflect the overall cost of education, including books, fees, and living expenses. This first definition of the price of higher education is used in this report.

There is a further dimension of the price of education that includes the opportunity cost of education and which argues that the cost of education must also include an estimate of the earnings and income foregone to pursue the education. This additional cost, however, must be offset, however, by the marginal increase in lifetime earnings that the student will enjoy. While this definition is much more complete, it includes many very difficult to measure dimensions: such as the average expected earnings for California high school graduates and for students which drop out of higher education at various levels of completion; the perceptions of the value of education; social value of education; etc. Because of the measurement difficulties and variance associated with this components of this definition of education, this definition is not used.

The implication of this choice is that these several influences on the economics of the choice to pursue are presumed to be constant to the baseline period, which in this case is 1989-90. As a result, this model assumes that the opportunities available to the student outside higher education and the relative lifetime returns to those earnings are the same as they were in 1989-90.

Returning to the cost of education, the real total fees[7] associated for each of the three public institutions is divided by the value of real total fees in 1989-90 to produce an indexed price series. Since 1989-90 is the baseline year, the ambient demand equals the quantity demanded in that year and the P^c term in equation

[7] The total fees measures includes such costs as health, student union, parking, and other fees in addition to the systemwide registration fees.

(A.1) equals 1 and $P_{1989\text{-}90}$=1.000. As this table shows, these fees have risen significantly in the past several years. For years after 1995-96, real total fees are held constant.

Table A.1
Total Price Indices for California Public Institutions
(1989-90 = 1.000)

Year	California Community Colleges	California State University	University of California
1980-81[a]	0.383	0.409	0.722
1981-82[a]	0.354	0.522	0.837
1982-83[a]	0.383	0.808	1.068
1983-84[a]	0.930	1.068	1.099
1984-85[a]	0.914	0.964	0.996
1985-86[a]	0.908	0.942	0.964
1986-87[a]	0.954	0.931	0.946
1987-88[a]	0.996	0.989	1.006
1988-89[a]	0.986	1.020	1.004
1989-90[a]	1.000	1.000	1.000
1990-91[a]	1.041	1.041	1.058
1991-92[a]	1.136	1.192	1.398
1992-93[a]	1.728	1.714	1.653
1993-94[a]	2.340	1.809	1.940
1994-95[a]	2.300	1.909	2.063
1995-96[b]	2.460	2.016	2.196
1996-97	2.460	2.016	2.196
1997-98	2.460	2.016	2.196
1998-99	2.460	2.016	2.196
1999-00	2.460	2.016	2.196
2000-01	2.460	2.016	2.196
2001-02	2.460	2.016	2.196
2002-03	2.460	2.016	2.196
2003-04	2.460	2.016	2.196
2004-05	2.460	2.016	2.196
2005-06	2.460	2.016	2.196
2006-07	2.460	2.016	2.196
2007-08	2.460	2.016	2.196
2008-09	2.460	2.016	2.196
2009-10	2.460	2.016	2.196
2010-11	2.460	2.016	2.196

SOURCE: Derived from this analysis. Total fees for 1980-81 to 1991-92 are from CPEC, *Fiscal Profiles 1992*, CPEC Report 92-9, Display 29. 1992-93 to 1994-95 are from the *Governor's Budget*, various years.

[a]Denotes years for which data are actual amounts.

[b]CCC fee is amount proposed in *1995-96 Governor's* Budget. CSU and UC amounts are 1994-95 actuals plus ten percent.

The Demand Price Elasticity, ε

There is a certain level of price responsiveness of public undergraduate enrollments to increases in the price of education. For the purposes of this model, the elasticities of demand were calculated when appropriate and estimated when they could not be calculated. A recent meta-analysis of the literature cites demand price elasticities ranging from +.41 to -.74,[8] when adjusted for differing measures and depending on the context of the analysis and how price is defined.

Especially in the case of community colleges, whose funding is largely enrollment-driven, the past several years[9] provide an excellent source of calibration of the demand price elasticity. The demand price elasticity used for the California Community Colleges, -0.1533, was derived by inserting the actual Q_D, ambient demand Q_o, and price into equation (A.1) and solving for ε. Equation (A.2) shows the calculation done to derive ε. **This coefficient is consistent with those values proposed by the literature for two-year institutions.**

$$\varepsilon = \frac{\ln Q_D - \ln Q_o}{\ln P} \qquad \text{(A.2)}$$

A similar exercise was performed for the University of California system because it also has not turned away any students due to capacity constraints.[10] The calculated elasticity, -0.0503, was also within the ranges found in the

[8] Larry L. Leslie and Paul T. Brinkman, "Student Price Response in Higher Education: The Student Demand Studies," *Journal of Higher Education*, Vol. 58, No. 2, March/April 1987, pp. 181-204. Several of the studies referenced were review for comparability for this study, including Stephen Hoenack and William Weiler, "The Demand for Higher Education and Institutional Enrollment Forecasting," *Economic Inquiry*, Vol. 28, January 1979, pp. 89-113; Michael McPherson and Morton Owen Shapiro, "Does Student Aid Affect College Enrollment? New Evidence on a Persistent Controversy," *American Economic Review*, March 1991, pp. 309-31; and Julia Heath and Howard Tuckman, "The Effects of Tuition Level and Financial Aid on the Demand for Undergraduate and Advanced Terminal Degrees," *Economics of Education Review*, Vol. 6, No. 3, pp. 227-238.

[9] The years 1991-92 to 1993-94 were used to calibrate these elasticities for all three systems. Beyond the desire for consistency, these are years in which *all* of the components of the demand model are presumed known, except for the price elasticity. Since the model assumes a baseline of 1989-90, the ambient demand quantity Q_o is assumed to be known for these years. While the model could have been back-cast for these earlier years, there variability was considered too high in some of the detailed participation factors especially the early 1980s.

[10] Some of these admissions are redirected to later quarters, thereby increasing the overall price of attending the University of California by forcing the student to wait. Since there seems to be a strong bias for students to want to attend school starting in the fall quarter, and possible costs in terms of acclimatization to the university environment, this decreases the attractiveness of the University of California as an choice. Subsequently, some of the change attributed to fee increases could actually be a consequence of an increased number of students put on the "waiting list."

general literature. It can also be observed that California Community Colleges system students are more sensitive to price than UC students.

Equation (A.2) is also used to estimate the demand elasticity for the CSU system, calibrated in the same manner as the CCC and UC systems. The resulting elasticity of -0.1971 indicates that CSU students are the most reactive to price changes of the three systems. Because this elasticity also includes some supply effects, it will produce conservative (lower) estimates of the number of students expecting to desire to attend the system under various pricing alternatives.

Appendix

B. Modeling the Ambient Demand for Public Undergraduate Education

The ambient demand for public undergraduate education represents the volume of students who would attend the state's public education institutions if the goals of the California Master Plan for Higher Education were fully implemented. In this model, it is the level of demand for public undergraduate education if there are no supply constraints in place and only the price effects are those existent in the baseline period. In this appendix, a detailed theoretical explanation of the model and its underlying assumptions is presented. In Appendix C, a discussion of how this theoretical model was operationalized is provided.

The Detailed Model

The general form of the model assumes a systems approach to mapping the transitions between each of the classes (states). In general, for all classes, a student can either remain in the current class, pass on to the next stage, or drop from the model entirely, as shown in Figure B.1. Similarly, the students in each state are either holdovers from the prior period, new arrivals from the prior class, or arrivals from the outside of the system.

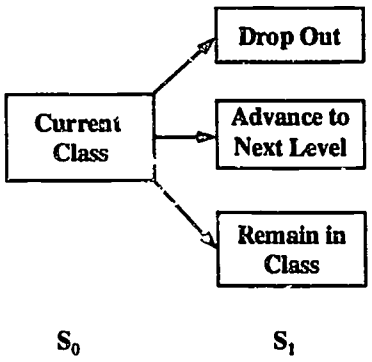

Figure B.1--Student States

Equation (B.1) captures this relationship.

$$Class = Advancing\ Cohort + External\ Arrivals + Holdovers \quad \text{(B.1)}$$

In general, the holdovers would be recognized to the group who were in the same class in the prior time period; the advancing cohort represents students who were in the next lowest class the prior year; and external arrivals would be those students who arrive from outside the system itself—what would be called transfers students in the higher education example. Equations (B.2) to (B.5) define this more formally for the four undergraduate classes:

Freshmen:

$$F_t = R_t + X_t^F + \rho^F F_{t-1} \quad \text{(B.2)}$$

Sophomores:

$$P_t = \alpha^P F_{t-1} + X_t^P + \rho^P P_{t-1} \quad \text{(B.3)}$$

Juniors:

$$J_t = \alpha^J P_{t-1} + X_t^J + \rho^J J_{t-1} \quad \text{(B.4)}$$

Seniors:

$$S_t = \alpha^S J_{t-1} + X_t^S + \rho^S S_{t-1} \quad \text{(B.5)}$$

where the variables are defined as follows:

- F_t: The number of freshmen in year t.
- P_t: The number of sophomores in year t.
- J_t: The number of juniors in year t.
- S_t: The number of seniors in year t.
- R_t: The number of first-time freshmen in year t.
- X_t^C: The number of transfers into class C in year t.
- ρ_t^C: The proportion of the class C who *remain* in class C in year t.
- α_t^C: The proportion of the prior year class C-1 who advance to class C in year t.

This represents a fully specified version of the undergraduate enrollment within a system. For freshmen, the number of freshmen is equal to the number of advancing students (from high school—first-time freshmen) plus the number of external entries (transfers) plus a certain share of the prior freshman class who remained in the freshman class. Similarly, the sophomore class is composed of

students who advanced from freshman status in the prior year plus transfers plus a certain proportion of sophomores from the prior year who did not advance to junior status and did not drop out. The junior and senior constructs are similar to that of the sophomores.

Unfortunately, the data regarding who stays and who advances, which is necessary for the full implementation of this model, is not available. Instead, the available data includes only the number of students in each class in each year. As a result, the model given in equations (B.2) to (B.5) has been modified to become the model shown in (B.6) to (B.9) below:

Freshmen:

$$F_t = R_t + X_t^F + \rho^F F_{t-1} \tag{B.6}$$

Sophomores:

$$P_t = \gamma^P F_{t-1} + X_t^P \tag{B.7}$$

Juniors:

$$J_t = \gamma^J P_{t-1} + X_t^J \tag{B.8}$$

Seniors:

$$S_t = \gamma^S J_{t-1} + X_t^S \tag{B.9}$$

where γ_t^C represents a combination of the coefficients α_t^C and ρ_t^C in equations (B.2) to (B.9). Notice that the relationship for freshmen [given in (B.2) and (B.6)] remains the same, while the forms specifying the other classes change. The relationship between γ_t^C in this set of equations and α_t^C and ρ_t^C are given by equation (B.10) below.

$$\gamma_t^C = \alpha_t^C + \rho_t^C \frac{C_{t-1}}{(C-1)_{t-1}} \tag{B.10}$$

where C_{t-1} represents the number of students in class C in year t-1 and $(C\text{-}1)_{t-1}$ represents the number of students in class below C in year t-1. Remember that ρ represents the proportion of students who remain in a given class from the prior year. In the special case where $\rho=0$, note that $\gamma=\alpha$; which says that if everyone either advances or drops out, this factor will correspond to the advancement rate. It is also important to note that this aggregate measure responds to changes in the remaining rate (the rate at which people remain in class C) as well as to the ratio of the size of the class and the next lower class in a given

year. It would be expected, for example, that ρ is a direct function of the estimated time-to-completion for a degree.[11] As time to completion increases, so will the proportion of each class remaining behind. Another consequence of this relationship is that γ can be greater than one. While α and ρ are, by definition, proportions and must be less than one, γ is a ratio and can be greater than one. In fact, if C_{t-1} is much greater $(C\text{-}1)_{t-1}$ and α is close to one, then the ratio can be much greater than one.

Because this ratio is so important, its stability over time is presented in Figures B.2 to B.4. As these figures show, the ratios are generally stable over the period of the model.

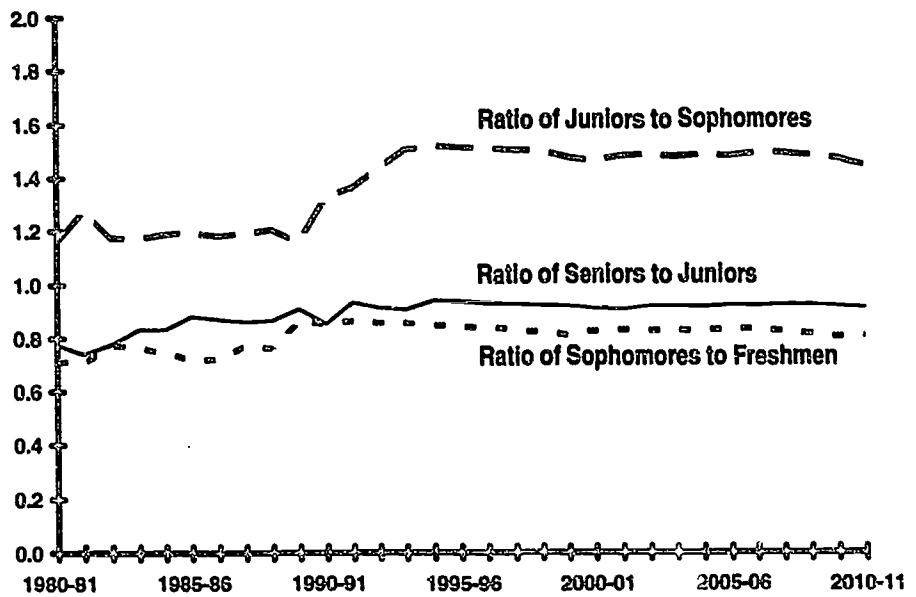

Figure B.2–Ratio of the Number of FTEs in Sequential Classes for the University of California System

[11] This is because, as time-to-completion increases, the number of units completed in a given year on average decreases, and hence the number of students completing enough units to advance will also increase.

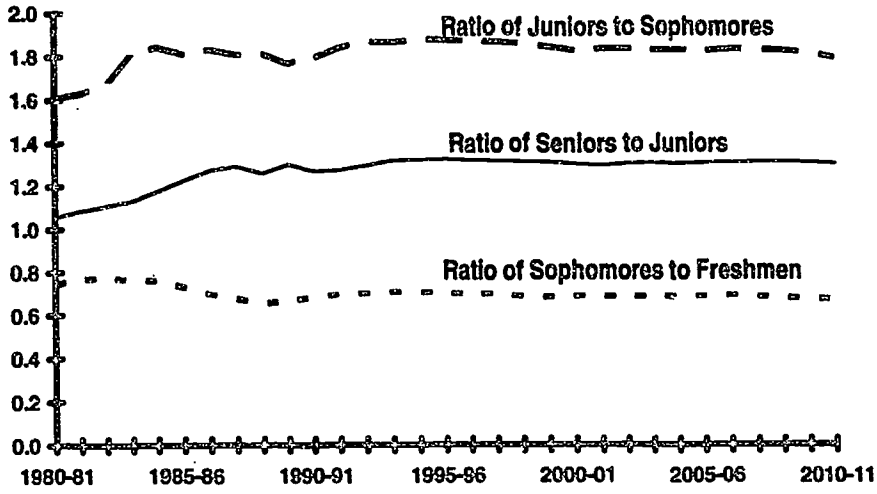

Figure B.3--Ratio of the Number of FTEs in Sequential Classes for the California State University System

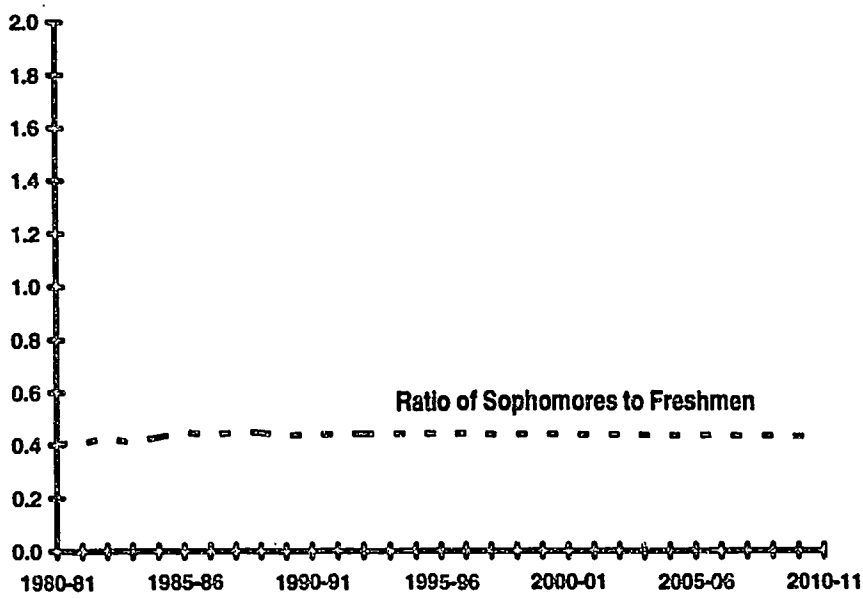

Figure B.4--Ratio of the Number of FTEs in Sequential Classes for the California Community College System

In the each figure, the ratios are actuals through 1989-90 and estimates from our model thereafter. In the University of California, Figure B.2, all of the class-to-

class ratios rose mildly during the early 1980s and then remained relatively flat in the late 1980s. In the 1990s, the series are relatively flat, except for the senior-to-junior ratio. This is the result of the UC's increased success in attracting California Community College students into the system.[12] The California State University and California Community College figures (Figures B.3 and B.4, respectively) show a similar pattern to the University of California series—mild growth in the early 1980s and a flattening out in the late 1980s.

The actual values for the participation, transition, and transfer factors were estimated from raw summary data provided by the California Postsecondary Education Commission. The detailed mechanics of this estimation process are provided in Appendix C.

For the purposes of this analysis, it is assumed that this relationship is relatively constant into the future with respect to the base year (see next section for a discussion of the base year). Another set of issues is the stability of the relationship between α and ρ. For purposes of this analysis, the variations in α are assumed to be proportionately reflected in ρ and that the ratio between the two is constant. Since this model uses a base-year approach to assessing future outcomes, it assumes that this ratio remains what it was in the base year.[13] There is some evidence that the time-to-completion overall is increasing over the baseline 1980s, which would mean that an increasing share of the variation in γ may well be explained by changes in ρ rather than α.

Selecting a Set of Coefficients

One of the important assumptions of this model is the set of coefficients (participation and retention rates) which will be used to estimate the future. The coefficients were derived for the years 1980-81 to 1989-90, which represent one possible baseline period discussed in the assumptions above. The model has been estimated using both the average coefficients over the period and those from the last year of this period. Because of a minor trend toward increasing participation rates over the period (this varies by detailed cohort, but appears prevalent in the larger groups driving the enrollment levels, namely white students), the coefficients based on the averages over the period produce a "step-down" in the estimates for the ensuing years of the model.

[12] This is discussed in more detail Appendix C below.

[13] Note that even though we assume that this ratio is constant, we do not have a direct mechanism of ascertaining exactly what that ratio is or the value of either of the coefficients

For this reason, and the reasons described above, 1989-90 has been chosen as the baseline period of the model. This also has the inherent result of giving us a specific reference point against which to compare the implications of various policy actions, instead of the a period of time. Since there also appears to be somewhat of an upward trend over time in the coefficients, this represents a reasonably conservative estimate of the coefficients into the future.[14]

As a consequence of this assumption, the estimated level of ambient demand in the estimated years represents the number of people who the system should expect to enroll, given the economic assumptions and conditions existent in 1989-90. The price parameter will also be driven by the price relative to the price in 1989-90.

Selecting the Dimensions Along Which to Divide the Population

The model used in this analysis is dependent on participation rates of specific population cohorts in the higher education system. This segregation is important because it allows the model to be sensitive to the various demographic shifts in the state's population. For purposes of this model, participation and transition rates were calculated along six dimensions: age,[15] gender,[16] ethnicity,[17] enrollment status,[18] program,[19] and system.[20] These dimensions were selected because they represent standard delineations of the population and they were the primary delineations found in the primary data for this analysis: state public institutional enrollments and state population.

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[14] This is because our model applies participation rates to Department of Finance population estimates. Higher participation rates produce larger ambient demand levels. Since the trends in some population subgroups were toward increasing participation rates, our model may well underestimate the ambient demand for these subgroups.

[15] This category was not directly available for all of the information. It was used primarily for the initial enrollment of freshmen into the system.

[16] This category had two possible levels: Female and Male.

[17] This category had five possible levels: African-American, Asian, Hispanic, White, and Other.

[18] This category had two possible levels: Full-time and Part-time.

[19] This category had two possible levels: Regular and Non-credit.

[20] This category had three possible levels corresponding to each of the three public systems: the University of California, California State University, and California Community Colleges.

C. Implementing the Ambient Demand Model for Public Undergraduate Education

This appendix describes the practical issues associated with implementing the theoretical model given in Appendix B. It describes the steps that were used to move from the raw data sets to the final models and results.

The Raw Data

There are two sets of raw data used in this model. The first data set was demographic projections of the state's population, produced by the Department of Finance. The state population includes population projections separated into individual by gender, ethnicity, and age cohorts. This series was produced after the 1990 census and reflects an official estimate of the state's population from 1970 to 2040. Although the data is available on the county level, this model used only the state totals. The state population projections are given below in Table C.1.

Table C.1

Estimates and Projections of California Population

Year	Population	Year	Population
1980-81^	23,782,003	1996-97	33,863,639
1981-82^	24,279,565	1997-98	34,524,435
1982-83^	24,804,003	1998-99	35,182,776
1983-84^	25,335,828	1999-00	35,824,238
1984-85^	25,815,852	2000-01	36,443,857
1985-86^	26,402,649	2001-02	37,055,570
1986-87^	27,052,139	2002-03	37,665,930
1997-88^	27,716,977	2003-04	38,252,427
1988-89^	28,393,148	2004-05	38,837,978
1989-90^	29,142,279	2005-06	39,424,114
1990-91^	29,976,003	2006-07	40,011,306
1991-92	30,646,076	2007-08	40,602,861
1992-93	31,300,134	2008-09	41,201,498
1993-94	31,906,302	2009-10	41,800,987
1994-95	32,520,134	2010-11	42,408,137
1995-96	33,188,930		

SOURCE: California Department of Finance, June 1993.

^Denotes actual values.

The second set of data came from the California Postsecondary Education Commission. There were four parts to this data set: (1) enrollments by program;[21] class level, full or part-time status, ethnicity, and gender; (2) enrollments by program, class level, status, ethnicity, gender, and age; (3) first-time freshmen by program, class level, status, ethnicity, gender, and source;[22] and (4) transfer students into the systems by program, class level, status, ethnicity, gender, and source institution. These four data sets were provided for each of the public systems of higher education in California. The information in these data sets was used to calibrate the participation and transition rates for the model specified in Appendix B.

Cleaning the Data

The institutional enrollment and transfer data provided the CPEC was the result of aggregation of original information provided at the student level by the separate systems. The system information was, in turn, the result of aggregations of the information provided by each system's member institutions. This data are consequently subject to the problems of misidentification that plague all data collection efforts. In consultation with individuals in each of the institutions, however, it is believed that the data are reasonably clean.[23]

The greatest problem plaguing this data was incomplete reporting of information. There were records in all of the systems that indicated "Unknown" (or "DTS") in response to one or more of the relevant categories. The incidence of this problem was infrequent.[24] While these records represent missing information, these individual cases do represent students attending public institutions in California. In order to model full enrollment levels, therefore, it was important not to exclude these students.

The data set was cleaned by allocating these students proportionately across all other student group categories at that level. For example, the category segregation for the enrollment data set was, in this order, institution, class level, enrollment status, ethnicity, and gender. If there were 10 students included in the group "community college enrollments, freshmen, full-time, Hispanic,

[21] Regular or non-credit.

[22] The source information included details of whether the individual came from a public or private California high school, from other states, or from other countries.

[23] In addition, the identifying information used in this analysis has been routinely collected for some time and is reasonably unambiguous.

[24] 96 percent of the University of California students, 93 percent of the California State University students, and 84 percent of the California Community Colleges students were fully identified in the data.

unknown gender," and 60 percent of "community college freshmen full-time Hispanics were male (totaling 155) and 40 percent were female (totaling 103), then six would be allocated to the male subcategory and four to the female subcategory, for a total of 161 males and 107 females. This cleaning technique was implemented from the lowest detail upward in order to retain as much of the information in the data as possible.

This distinction could bias the information that goes into the determination of the various coefficients if there were systematic patterns in the missing information. For example, if, at the ethnicity level, white students had a greater predilection to state "Decline to state" as their ethnicity, then all of the unknowns should have gone to the white category instead of being proportionately distributed across all the ethnic categories. This would understate the actual number of white students and overstate the number of students in other categories.

Since there is no clear information available regarding possible patterns in the nonresponse rates of the various specific subgroups used in this analysis, the proportionate distribution approach was selected. This makes the best use of the data available.

The data provided by the Department of Finance required no additional cleanup. There were no missing data points in this data set.

The Data Sets

The data were organized and segregated into the following detail. The general form of each listed record is: (1) the name of the data set; (2) a description of the data set; and (3) detail categories, in order of detail.

Enrollments by program. A data set that lists the number of students enrolled in each class of the system. Detail, in descending order, included program, class level, enrollment status, ethnicity, and gender

Age-delineated enrollments. A data set that lists the number of students enrolled in each class of the system, including age detail. Detail in descending order was program, class level, enrollment status, ethnicity, gender, and age.

First-time freshmen enrollments. Enrollment of first-time freshmen in each system. Detail, in descending order, included program, enrollment status, ethnicity, gender, and source institution.

Transfer students enrollments. A data set that details the number of transfer students into each system, including information on source institution. Detail included detail, in descending order, by program, class level, enrollment status, ethnicity, gender, and source institution.

California state population. A data set that lists the total number of people in California. The data include the following detail, in descending order: ethnicity, gender, and age.

Developing the Components of the Model

There are several sets of coefficients that were necessary to implement the ambient demand model. The details of the derivation of each is given below.

Derivation of First-time Freshmen

First-time freshmen can only arrive from one source—from the general population outside all systems. First-time freshmen, by definitions, are individuals who enroll in the system for the first time. Furthermore, these individuals represent the key link between the general population and higher education enrollments.

In modeling the number of first-time freshmen, indicated as R_t in equations (B.2) and (B.6), a traditional approach has been to estimate the number of incoming proportion as a share of prior year high school graduates (or those graduating two years prior). A second, almost equivalent approach, uses the "high school-age population," usually listed as 17-19 year olds, as the denominator in the calculation. Both of these methodologies will work well for institutions whose primary source pool for undergraduate students are students coming directly or almost directly from high school—the University of California, for example. For the other two institutions, however, this is not necessarily the case. Both the California State University and California Community College systems enroll significant numbers of older students who do not fall in this particular designation. Furthermore, the California Community College system also enrolls students who do not necessarily have their high school diplomas.[25]

[25] They enroll some students who attend for remedial training in preparation for their high school diploma, students attending vocational education programs, and high school students taking college-level classes concurrent with their high-school enrollment. The University of California and the California State University both have concurrent high school enrollment students, but in much smaller numbers.

An alternative methodology was therefore sought this analysis. The selected methodology focuses on age as a the primary determinant of an individual's likelihood of attending the various institutions. This analysis estimates an age distribution for first-time freshmen and then develops participation rates for these students as a proportion of the age-specific general population groups.

Since the specific age breakdown of first-time freshmen was not available, the age distribution of freshmen overall was used, broken down into subgroups by ethnicity and age. This was accomplished by multiplying the percentage of each age category in each ethnicity and gender subgroup [defined in equation (C.1)] times the number of first-time freshmen in that particular ethnicity and gender subgroup. The formulation is given in equation (C.2).

$$a_{t,s,e,g,a} = \frac{N_{t,s,e,g,a}}{\sum_{i=all\ ages} N_{t,s,e,g,i}} \qquad \text{(C.1)}$$

where, for all enrollment status categories *s*, ethnicity categories *e* and gender categories *g*:

$a_{t,s,e,g,a}$: The percentage of individuals in enrollment group *s*, ethnicity group *e* , and gender group *g* who fall in age group *a* in year *t*.

$N_{t,s,e,g,a}$: The number of freshmen in the age-delineated enrollment data set that fall in enrollment group s, ethnicity group *e* , and gender group *g* and who fall in age group *a* in year *t*.

$$R_{t,s,e,g,a} = a_{t,s,e,g,a} \times FTF_{t,s,e,g,a} \qquad \text{(C.2)}$$

where, for all enrollment status categories *s*, ethnicity categories *e* , and gender categories *g*:

$R_{t,s,e,g,a}$: The number of first-time freshmen in enrollment group *s*, ethnicity group *e* , and gender group *g* that fall in age group *a* in year *t*.

$FTF_{t,s,e,g}$: The number of first-time freshmen in enrollment group *s*, ethnicity group *e*, and gender group *g* in the first-time freshmen data set in year *t*..

This number of first-time freshmen, $R_{t,s,e,g,a}$, are then used to calculate the participation rates of first-time freshman, by age, in the overall population. This relationship, $r_{t,s,e,g,a}$, will be used to determine the baseline coefficient $r_{base,s,e,g,a}$, which will be used to estimate the flow of first-time freshmen into

the various systems in future years, where *base* represents the baseline year(s). The equation for the derivation of $r_{t,s,e,g,a}$, is given in equation (C.3) below.

$$r_{t,s,e,g,a} = \frac{R_{t,s,e,g,a}}{POP_{t,e,g,a}} \qquad \text{(C.3)}$$

where, for all enrollment status categories s, ethnicity categories *e* , and gender categories *g*:

$r_{t,s,e,g,a}$: The participation rate of first-time freshmen in ethnicity group *e* and gender group *g* and age group *a* in year *t*.

$POP_{t,e,g,a}$: The number of people in California in ethnicity group *e*, gender group *g*, and age group *a* in year *t*.

This relationship is only used to calculate r for years in which R and POP are known. The values of *r* are then used to determine a base rate. In this analysis, two values for r_{base} were computed. The first value was the average of the *r* values for years 1980-81 to 1989-90. The second was the *r* for 1989-90. In the final model the r from 1989-90 is used as r_{base}. In all years after the base year, the relationship in (C.3) is rearranged into the relationship shown in (C.4) and used to estimate R_t for all prediction years.

$$R_{t,s,e,g,a} = r_{base,s,e,g,a} \times POP_{t,s,e,g,a} \qquad \text{(C.4)}$$

$R_{t,s,e,g,a}$ is then aggregated up on the age detail level to produce $R_{t,s,e,g}$. Throughout all of the subsequent models, the detail is retained at the t,s,e,g level.

Transfer Students

The transfer students model involved a simple calculation of the proportion of students in class C-1 transferring to class C in another institution in year t. This transfer rate is calculated using equation (C.5), where ξ is the rate of transfer of students in class C from the source institution to the institution I, X is the number of transfers in year t into class C from the source institution to destination institution I, and C-1 represents the class before class C. In the case of freshmen, the freshmen were used as the base for $(C\text{-}1)_{t-1}$.

$$\xi^{C,I}_{t,s,e,g} = \frac{X^{C,I}_{t,s,e,g}}{C^{C-1,I}_{t-1,s,e,g}} \qquad \text{(C.5)}$$

Once the baseline criteria hare selected, the appropriate values of ξ are used to generate an X for each year from each of the three public source institutions to

each of the three public destination institutions according to equation (C.6) below.

$$X^{C,I}_{t,s,e,g} = \xi^{C,I}_{base,s,e,g} \times C^{C-1,I}_{t-1,s,e,g} \qquad (C.6)$$

Once the number of students transferring from one institution to another are known, these amounts are used within the institutions to determine transition rates and overall enrollments as described below. Again the detail is retained at the t,s,e,g level.

To account for transfers from non-California public institutions and private institutions, the average number of transfers from these institutions over the period 1980-81 to 1989-90 was used. An alternative approach to this was to hold the proportion of transfers from these institutions constant as share of all transfers. Using this approach at the detailed level did not significantly alter the overall results of the overall model. Furthermore, to the extent that these students represent services to non-California residents, it was felt that serving them was not a policy of the state or the Master Plan.[26]

Participation of Freshmen

Once students have been pulled into the system from the general population, through the derivation of R_t, they are three possible outcomes for them in the next year—they either finish their freshman year and become sophomores, they remain freshmen, or they drop out. The number of freshmen who remain freshmen in the next year is represented by the quantity ρF_{t-1} in equation (B.6). To estimate ρ, using the R_t and X_t values derived according to the descriptions above and combine them with the number of freshmen in year t, according to (C.7) below.

$$\rho^{F}_{t,s,e,g} = \frac{F_{t,s,e,g} - R_{t,s,e,g} - X^{F}_{t,s,e,g}}{F_{t-1,s,e,g}} \qquad (C.7)$$

This value is then applied to future populations to predict F_t according to equation (B.6). As with all other components of the ambient demand model, two versions of these coefficients were generated for the baseline model, using both the average of the coefficients for the years 1980-81 to 1989-90 and the

[26] This argument ignores the extent to which these individuals remain in California after completing their education and contribute to the state.

1989-90 year alone. The final model used the 1989-90 version, as described above.

The Transition Between Classes

Similarly, the transition factors[27] between the sophomore, junior, and senior classes are calculated according to equation (C.8) below. These factors, called γ, are then inserted into equations (B.7) through (B.9) to estimate the number of students in each class.

$$\gamma^{C}_{t,s,e,g} = \frac{C_{t,s,e,g} - X^{C}_{t,s,e,g}}{(C-1)_{t-1,s,e,g}} \qquad \text{(C.8)}$$

Putting It All Together

At this point, estimates of the enrollments in each of the classes— freshmen, sophomores, juniors, and seniors—detailed by system, program,[28] enrollment status, ethnicity, and gender have been produced. These detailed groups were then aggregated across gender and age to get estimates of students by system, class level, program, and enrollment status (part-time and full-time). For the system-wide analyses used in this analysis, these amounts were aggregated across classes to have systemwide enrollments by program and status.

These full and part-time enrollments were then combined into full-time equivalents. This was done by calculating a part-time factor for each of the systems using equation (C.9), where FTE is the number of full-time equivalents enrolled, FT is the number of full-time students, and PT is the number of part-time students. These coefficients were calibrated using the years for which information was available and were consistent over time for all three systems.[29]

$$\phi = \frac{FTE - FT}{PT} \qquad \text{(C.9)}$$

[27] These are factors, not rates. A rate would measure the proportion of students in class C that move on to class C+1. Instead, it computes the sum of the effects described in equation (B.10) in Appendix B.

[28] Only the California Community Colleges had other than regular enrollments. CCC included both credit and non-credit enrollments.

[29] The University of California factor varied somewhat, but was reasonably stable over the latter portion of the 1980s.

This factor was then used in the future projections to convert full and part-time enrollments into FTEs using equation (C.10).

$$FTE = FT + \phi PT \qquad \text{(C.10)}$$

These result time series is the number of undergraduate FTEs in each of the state's public systems who would have attended the system under the conditions existent in the base year absent price effects and supply constraints—the ambient demand.

D. Modeling the Supply of Public Undergraduate Education

There are two aspects of the supply of public undergraduate education in California—the number of seats funded on an operational level and the number of seats that are physically available. The former is the operational definition of supply and the latter the capital definition. Both of these dimensions of supply are addressed in this model.

Both of the following models were developed and implemented in real terms using the California Consumer Price Index (CCPI) to deflate historical amounts and an estimated inflation rate of three percent to deflate predicted values. The CCPI is converted to a 1992-93 base year by dividing the CCPI time series values by the 1992-93 value.[30] All rates generated and used in the model are real. When necessary for presentation, the real values are converted to nominal amounts using the CCPI.

Operational Supply Model

The general form of the operational supply of undergraduate education for each system is given in equation (D.1) where Q_s is the number of undergraduate seats provided by the system, u is the undergraduate proportion of total enrollments,[31] OR represents the operating revenues of the system, and C represents the cost per FTE for that system.[32]

$$Q_t^s = u_t \frac{OR_t}{C_t} \qquad \text{(D.1)}$$

It states that the undergraduate quantity supplied equals the proportion of total seats that are preserved for undergraduates times the total number of seats

[30] This does not directly convert the CCPI to a new base year because it does not reflect changes in the "goods basket" that would be associated with such a true conversion. The original CCPI series used a 1982-84 base year period.

[31] In the case of the California Community Colleges, this proportion is actually the credit (vs. noncredit) proportion of total enrollments. This proportion functions the same for California Community Colleges as the undergraduate proportion does for the UC and CSU.

[32] This model assues that the costs associated with the production of undergraduate and graduate instruction (or credit and non-credit in the case of community colleges) are equal.

provided, which equals the total dollars provided divided by the per-unit cost. The methodologies used to estimate each of these values is presented below.

The Ratio of Undergraduates to Graduates

In this model, the proportion of total enrollments represented by undergraduates[33] is a policy variable. For the general purposes of the model, it is assumed to remain constant over time.[34] For instance, one or more of the systems could choose to increase their share of undergraduate education while decreasing the quantity of graduate education they produce, or visa versa.

While this policy lever has been included in the model, for the purposes of this analysis, it is held constant into the future. It was estimated by calculating the proportion of FTEs in the past that were undergraduates. For all three systems, these shares were relatively constant during the 1980s. The University of California showed the most change over this period, rising from 71 to 75 percent. The latter value was used.[35] Values of 82 and 86 percent were used for the CCC and CSU systems, respectively.

Total Operating Revenues

The estimation of total operating revenues for each system was an important decision in the process. Much of the work and decisions used in this analysis to develop the model of total resources was based on the California Postsecondary Education Commission's publication *Fiscal Profiles, 1992*, from which some of the information is taken. Other sources, such as the *Governor's Budgets* and individuals within the staff of the respective systems were also contacted.

The California Community Colleges System

There are several sources for the operating funds that support the California Community Colleges system. State General Funds account for the largest share,

[33] In the case of California Community Colleges, this proportion indicates the share of credit enrollments, not undergraduates.

[34] This is the case for the four-year institutions. In the case of community colleges, a similar distinction could be made between credit and non-credit enrollments.

[35] Graduate enrollments in this calculation included the health sciences student enrollments. The author recognizes that the decision process behind funding these FTEs is different. Even as the state, in the face of increasing population, has need of a increasing pool of trained undergraduate and graduate students, it will also need an increasing quantity of health practitioners and thus, these enrollments are included. The issue of health science enrollments will be revisited in the capital model below.

followed by (in decreasing order) property taxes, student fees, lottery funds, other funds, and the State School Fund. Table D.1 presents the history of these funds and the projections for each of these series.

Table D.1

Expected Operating Revenues for the California Community Colleges System
(thousands of 1992-93 dollars)

Year	General Funds	Property Taxes	Fees	State School Fund	Lottery Revenues	Other Funds	TOTAL
1980-81*	1,874,075	556,981	0	4,512	0	900	2,436,468
1981-82*	1,659,927	613,259	0	4,881	0	1,796	2,279,863
1982-83*	1,630,134	590,540	0	6,579	0	8,595	2,235,848
1983-84*	1,583,866	583,065	0	6,938	0	7,567	2,181,436
1984-85*	1,572,891	599,066	91,623	6,938	0	1,432	2,271,950
1985-86*	1,600,079	666,052	89,008	4,207	114,335	43,560	2,517,241
1986-87*	1,613,139	706,267	86,807	2,510	74,400	1,090	2,484,213
1987-88*	1,651,259	749,905	81,868	2,633	120,255	44,626	2,650,546
1988-89*	1,739,649	773,935	77,250	2,375	150,317	40,745	2,784,271
1989-90*	1,762,971	803,327	73,314	2,367	143,223	33,418	2,818,620
1990-91*	1,856,637	846,541	77,335	2,479	103,867	31,288	2,918,147
1991-92*	1,766,511	874,507	91,037	2,636	78,547	2,538	2,815,776
1992-93*	1,263,000	1,010,367	122,575	1,986	85,479	7,010	2,490,417
1993-94*	908,738	1,255,340	206,664	2,649	89,623	25,534	2,488,548
1994-95	1,040,626	1,333,773	216,436	2,649	91,566	25,534	2,710,585
1995-96	933,759	1,340,720	221,660	2,649	94,644	25,534	2,618,966
1996-97	1,083,801	1,339,331	226,687	2,649	98,078	25,534	2,776,080
1997-98	1,196,755	1,345,593	231,649	2,649	101,872	25,534	2,904,053
1998-99	1,297,390	1,354,466	236,733	2,649	105,687	25,534	3,022,460
1999-00	1,400,883	1,363,430	242,077	2,649	109,655	25,534	3,144,229
2000-01	1,492,707	1,379,077	247,439	2,649	113,622	25,534	3,261,028
2001-02	1,585,863	1,394,742	252,759	2,649	117,560	25,534	3,379,107
2002-03	1,679,952	1,410,425	258,152	2,649	121,647	25,534	3,498,359
2003-04	1,766,721	1,426,128	263,549	2,649	125,436	25,534	3,610,016
2004-05	1,850,441	1,441,851	269,028	2,649	129,065	25,534	3,718,569
2005-06	1,924,590	1,457,595	274,520	2,649	132,241	25,534	3,817,129
2006-07	1,977,038	1,473,361	280,000	2,649	134,550	25,534	3,893,133
2007-08	2,004,370	1,489,149	285,621	2,649	136,090	25,534	3,943,413
2008-09	2,013,078	1,504,961	291,544	2,649	136,957	25,534	3,974,724
2009-10	2,017,978	1,520,797	298,012	2,649	137,662	25,534	4,002,632
2010-11	2,020,801	1,536,658	304,873	2,649	138,332	25,534	4,028,848

SOURCE: 1980-81 to 1991-92: California Postsecondary Education Commission, *Fiscal Profiles 1992*, CPEC Report 92-9, March 1992, Display 64; 1992-93 to 1993-94: Pete Wilson, *Governor's Budget 1994-95*, 1994, pp. E-1 to E-120; 1994-95 and thereafter from this analysis.
*Denotes years for which data are actual amounts.

The minimum level of state funding for the CCC system is set, along with K-12 funding, under the provisions of the State Constitution as defined by the voter-approved Propositions 98 and 111. Appendix E describes the detailed model for these provisions. The property taxes are projected based upon internal RAND estimates produced in conjunction with a forthcoming RAND report on the state fiscal crisis and the reader is referred there for the details of this modeling.[36] Lottery revenues are grown from the most recently available datum by the annual growth in per capita personal income. State School Fund revenues and "Other Funds" were held constant in real terms at their average value over the 1985-86 to 1991-92 period.[37]

Fees revenues are estimated by multiplying the expected number of students (in FTEs) times the average fee revenue per FTE. This quantity is determined by estimating the real total fees[38] and increasing the fees per FTE for the most recent known year annually by the relative increase in fees used in the price model.[39]

The California State University System

The major sources of operating revenues for the CSU system include the state General Fund, fees, federal funds, the Continuing Education Revenue Fund, lottery funds, and other funds. Of these, two do not directly fund general undergraduate education and are consequently omitted from out projections. The Continuing Education Revenue Fund reflects funds that come from extension, concurrent enrollment, and external degree programs and the "Other Funds" category includes funds that are predominantly self-funding enterprises, such as dormitories. Table D.2 shows the time series for these revenues for the CSU system.

State General Fund support of the system is estimated by multiplying the CSU share of General Fund revenues times the General Fund revenues. For years prior to 1993-94, the General Fund revenue support amounts are actuals. For

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[36] Stephen Carroll, Peter Rydell, Eugene Bryton, Michael Shires, and Sugata Biswas, *California's Fiscal Future*, Santa Monica, CA: RAND, MR-570-IET, (forthcoming).

[37] This period was selected because structural changes were made in the rules affecting the State School Fund in 1984-85. Simultaneously, "Other Funds" increased and remained at the higher level for most of the years following.

[38] Total fees include such things as parking, registration fees, and books, but excludes room and board. See the section on price in Appendix A for a more detailed explanation of the price index model.

[39] This effectively assumes that the relationship between total fees per student and the fee revenues per FTE remains constant. This has been the case in recent years, but was not as strong for the period through 1989-90 when fees for the CCC were nominally constant.

subsequent years, the share is estimated by reducing the most recent actual share available (1993-94) by five percent of the 1993-94 share through 2003-04.[40]

[40] This choice in the expected scenario is driven by the increased competition for scarce state resources. See the discussion of the supply of public undergraduate education in Chapter Two for a more elaborate discussion of the reasons underlying this adjustment.

Table D.2

Expected Operating Revenues for the California State University System
(thousands of 1992-93 dollars)

	General Funds	Student Fees	Lottery Funds	Federal Funds	Capital Outlay Funds	TOTAL
1980-81*	1,631,616	140,760	0	96,747	5,542	1,874,665
1981-82*	1,478,510	181,775	0	65,019	8,954	1,734,257
1982-83*	1,373,544	253,027	0	88,689	14,063	1,729,323
1983-84*	1,386,995	324,330	0	89,382	8,858	1,809,566
1984-85*	1,584,246	301,206	0	90,513	1,529	1,977,494
1985-86*	1,684,453	291,568	17,026	101,291	10,468	2,104,805
1986-87*	1,743,658	311,096	41,972	94,898	7,549	2,199,173
1987-88*	1,767,113	333,379	25,261	96,751	-648	2,221,856
1988-89*	1,780,785	360,000	43,864	112,464	2,412	2,299,525
1989-90*	1,853,618	368,870	62,907	117,083	8,636	2,411,114
1990-91*	1,769,448	388,254	52,382	115,488	3,844	2,329,416
1991-92*	1,698,742	423,111	27,556	112,138	3,709	2,265,256
1992-93*	1,503,445	502,884	47,129	91,195	0	2,144,653
1993-94*	1,449,213	501,763	18,641	93,048	5,763	2,068,427
1994-95	1,415,921	511,112	19,045	93,048	5,763	2,044,888
1995-96	1,396,839	512,610	19,685	93,048	5,763	2,027,944
1996-97	1,372,552	515,709	20,399	93,048	5,763	2,007,470
1997-98	1,339,272	520,884	21,188	93,048	5,763	1,980,154
1998-99	1,292,902	528,575	21,982	93,048	5,763	1,942,269
1999-00	1,244,538	538,871	22,807	93,048	5,763	1,905,027
2000-01	1,185,014	549,562	23,632	93,048	5,763	1,857,018
2001-02	1,120,661	561,148	24,451	93,048	5,763	1,805,071
2002-03	1,050,559	572,794	25,301	93,048	5,763	1,747,464
2003-04	975,825	582,466	26,089	93,048	5,763	1,683,191
2004-05	997,040	592,173	26,844	93,048	5,763	1,714,868
2005-06	1,018,998	601,304	27,505	93,048	5,763	1,746,617
2006-07	1,041,210	609,662	27,985	93,048	5,763	1,777,668
2007-08	1,062,076	618,552	28,305	93,048	5,763	1,807,743
2008-09	1,082,687	628,062	28,486	93,048	5,763	1,838,046
2009-10	1,102,759	640,422	28,632	93,048	5,763	1,870,624
2010-11	1,122,389	654,387	28,772	93,048	5,763	1,904,358

SOURCE: 1980-81 to 1991-92: California Postsecondary Education Commission, *Fiscal Profiles 1992*, CPEC Report 92-9, March 1992, Display 61; 1992-93 to 1993-94: Pete Wilson, *Governor's Budget 1994-95*, 1994, pp. E-1 to E-120; 1994-95 and thereafter from this analysis.
*Denotes years for which data are actual amounts.

In the optimistic scenario, the share is maintained at the 1993-94 level over the entire period. The General Fund revenue amounts are from RAND internal projections. A summary of the General Fund revenues, CSU revenues, and model projections are presented in Table D.3.

Student fees are calculated in the same manner as those in the California Community Colleges system. Lottery funds are grown by the same methodology as well. Federal funds and capital outlay funds[41] are held constant, in real terms, at their average real levels during the period 1980-81 to 1992-93.

[41] This represents the portion of capital outlay funds that are available for operating expenses.

Table D.3

Assumptions Supporting Alternative Scenarios for General Fund Support of the California State University System
(thousands of 1992-93 dollars, unless otherwise indicated)

Year	General Fund Revenues	Expected Share	Expected CSU General Fund Revenues	Optimistic Share	Optimistic CSU General Fund Revenues
1980-81*	32,601,511	5.00%	1,631,616	5.00%	1,631,616
1981-82*	32,427,149	4.56%	1,478,510	4.56%	1,478,510
1982-83*	32,143,183	4.27%	1,373,544	4.27%	1,373,544
1983-84*	34,762,330	3.99%	1,386,995	3.99%	1,386,995
1984-85*	36,782,528	4.31%	1,584,246	4.31%	1,584,246
1985-86*	37,573,619	4.48%	1,684,453	4.48%	1,684,453
1986-87*	42,151,977	4.14%	1,743,658	4.14%	1,743,658
1987-88*	40,401,098	4.37%	1,767,113	4.37%	1,767,113
1988-89*	43,757,676	4.07%	1,780,785	4.07%	1,780,785
1989-90*	43,681,826	4.24%	1,853,618	4.24%	1,853,618
1990-91*	40,895,658	4.33%	1,769,448	4.33%	1,769,448
1991-92*	43,527,439	3.90%	1,698,742	3.90%	1,698,742
1992-93*	40,946,452	3.67%	1,503,445	3.67%	1,503,445
1993-94*	41,325,030	3.51%	1,449,213	3.51%	1,449,213
1994-95	42,500,725	3.33%	1,415,921	3.51%	1,490,443
1995-96	44,257,301	3.16%	1,396,839	3.51%	1,552,043
1996-97	46,045,884	2.98%	1,372,552	3.51%	1,614,767
1997-98	47,737,516	2.81%	1,339,272	3.51%	1,674,090
1998-99	49,156,988	2.63%	1,292,902	3.51%	1,723,869
1999-00	50,698,033	2.45%	1,244,538	3.51%	1,777,911
2000-01	51,986,565	2.28%	1,185,014	3.51%	1,823,098
2001-02	53,260,365	2.10%	1,120,661	3.51%	1,867,769
2002-03	54,467,650	1.93%	1,050,559	3.51%	1,910,106
2003-04	55,652,286	1.75%	975,825	3.51%	1,951,650
2004-05	56,862,198	1.75%	997,040	3.51%	1,994,080
2005-06	58,114,483	1.75%	1,018,998	3.51%	2,037,996
2006-07	59,381,285	1.75%	1,041,210	3.51%	2,082,421
2007-08	60,571,245	1.75%	1,062,076	3.51%	2,124,151
2008-09	61,746,757	1.75%	1,082,687	3.51%	2,165,375
2009-10	62,891,471	1.75%	1,102,759	3.51%	2,205,518
2010-11	64,011,000	1.75%	1,122,389	3.51%	2,244,779

SOURCE: General Fund Revenues: *Governor's* Budget, various years to 1993-94 and RAND projections thereafter. CSU Shares of General Fund Revenues: This analysis. CSU General Fund Revenue Support: California Postsecondary Education Commission, *Fiscal Profiles 1992*, CPEC Report 92-9, March 1992, Display 61 for 1980-81 to 1991-92; Pete Wilson, *Governor's Budget 1994-95*, 1994, pp. E-1 to E-120 for 1992-93 to 1993-94; this analysis for 1994-95 and thereafter.
*Denotes years for which data are actual amounts.

The University of California System

Overall operating revenues for the University of California system include state General Fund revenues, General University Funds,[42] Student Fees, Lottery

[42] These represent funds from a variety of sources which the University of California system receives for administration of contracts, application fees, and non-resident tuitions. Because the

Funds, University Special Funds, Extramural Funds, and Other Funds. Of these sources, two have been omitted from this model—University Special Funds and Extramural Funds. University Special Funds are revenues from such activities as hospitals, the direct sale of educational activities and services, extension courses, and other auxiliary activities and as such, are not directly related to providing resources to teach undergraduate students. Extramural Funds are predominantly federal research dollars and the Department of Energy contract for the UC's management of its laboratories.

The expected real revenue streams for the other sources are presented in Table D.4. below. State General Fund support is estimated in the future using the same methodologies employed in the California State University system estimates. Student fees are also calculated in the same manner as the CSU and CCC systems. Lottery Funds are grown from 1993-94 levels at the same rate as those in the California Community Colleges system model. Because they had shown a marked increase in the early 1990s and then remained at that level, University General Funds are held constant at the average level of the years 1991-92 to 1993-94. The Other Funds category included two one-time transfers of capital funds to operating accounts (1983-84 and 1989-90). Because these are the only two instances, and, as will be seen in the capital model, there are not significant excess capital resources available, it is assumed that there will be no additional revenues from this source in the future.

As in the case of the California State University system, the main source of operating funds is the state General Fund. In the expected resources scenario, the UC share of General Fund revenues is expected to drop by 50 percent (five percent of the 1993-94 share) over the next ten years. Table D.5 presents these expected General Fund revenue stream, the projected shares of state General Fund revenues under each of the scenarios, and expected state support of the University of California under the two scenarios.

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specific uses of these monies are left to the discretion of the system, they can and are used to supplement the undergraduate teaching enterprise and are consequently included in the operational model.

Table D.4

Expected Operating Revenues for the University of California System
(thousands of 1992-93 dollars)

	General Funds	Student Fees	Lottery Funds	University General Funds	Other Funds	TOTAL
1980-81*	1,841,610	166,697	0	113,485	0	2,121,792
1981-82*	1,697,590	185,695	0	144,267	0	2,027,552
1982-83*	1,703,688	219,726	0	130,717	0	2,054,131
1983-84*	1,620,639	246,675	0	141,177	94,609	2,103,100
1984-85*	2,019,790	231,607	0	123,504	0	2,374,901
1985-86*	2,197,407	226,043	23,096	160,530	0	2,607,076
1986-87*	2,318,056	226,621	16,388	126,333	0	2,687,398
1987-88*	2,345,627	241,631	25,023	157,549	0	2,769,830
1988-89*	2,332,826	249,329	30,769	190,084	0	2,803,008
1989-90*	2,340,993	259,112	27,174	194,655	64,481	2,886,415
1990-91*	2,285,636	267,163	19,885	178,087	0	2,750,771
1991-92*	2,180,759	355,510	15,037	245,512	0	2,796,818
1992-93*	1,919,476	465,115	16,285	246,452	0	2,647,328
1993-94*	1,842,967	524,331	15,938	242,624	0	2,625,860
1994-95	1,800,629	522,837	16,283	244,863	0	2,584,613
1995-96	1,776,363	522,864	16,831	244,863	0	2,560,921
1996-97	1,745,477	526,140	17,441	244,863	0	2,533,921
1997-98	1,703,155	532,501	18,116	244,863	0	2,498,635
1998-99	1,644,186	542,668	18,795	244,863	0	2,450,511
1999-00	1,582,682	556,720	19,500	244,863	0	2,403,764
2000-01	1,506,985	570,944	20,206	244,863	0	2,342,998
2001-02	1,425,147	585,177	20,906	244,863	0	2,276,094
2002-03	1,335,998	598,564	21,633	244,863	0	2,201,057
2003-04	1,240,959	609,056	22,307	244,863	0	2,117,184
2004-05	1,267,938	619,693	22,952	244,863	0	2,155,446
2005-06	1,295,862	629,440	23,517	244,863	0	2,193,682
2006-07	1,324,110	638,088	23,928	244,863	0	2,230,988
2007-08	1,350,644	647,574	24,201	244,863	0	2,267,282
2008-09	1,376,856	658,536	24,356	244,863	0	2,304,610
2009-10	1,402,381	674,437	24,481	244,863	0	2,346,162
2010-11	1,427,345	692,782	24,600	244,863	0	2,389,590

SOURCE: 1980-81 to 1991-92: California Postsecondary Education Commission, *Fiscal Profiles 1992*, CPEC Report 92-9, March 1992, Display 59; 1992-93 to 1993-94: Pete Wilson, *Governor's Budget 1994-95*, 1994, pp. E-1 to E-120; 1994-95 and thereafter from this analysis.
*Denotes years for which data are actual amounts.

Table D.5

Assumptions Supporting Alternative Scenarios for General Fund Support of the University of California System
(thousands of 1992-93 dollars, unless otherwise indicated)

Year	General Fund Revenues	Expected Share	Expected UC General Fund Revenues	Optimistic Share	Optimistic UC General Fund Revenues
1980-81*	32,601,511	5.65%	1,841,610	5.65%	1,841,610
1981-82*	32,427,149	5.24%	1,697,590	5.24%	1,697,590
1982-83*	32,143,183	5.30%	1,703,688	5.30%	1,703,688
1983-84*	34,762,330	4.66%	1,620,639	4.66%	1,620,639
1984-85*	36,782,528	5.49%	2,019,790	5.49%	2,019,790
1985-86*	37,573,619	5.85%	2,197,407	5.85%	2,197,407
1986-87*	42,151,977	5.50%	2,318,056	5.50%	2,318,056
1987-88*	40,401,098	5.81%	2,345,627	5.81%	2,345,627
1988-89*	43,757,676	5.33%	2,332,826	5.33%	2,332,826
1989-90*	43,681,826	5.36%	2,340,993	5.36%	2,340,993
1990-91*	40,895,658	5.59%	2,285,636	5.59%	2,285,636
1991-92*	43,527,439	5.01%	2,180,759	5.01%	2,180,759
1992-93*	40,946,452	4.69%	1,919,476	4.69%	1,919,476
1993-94*	41,325,030	4.46%	1,842,967	4.46%	1,842,967
1994-95	42,500,725	4.24%	1,800,629	4.46%	1,895,399
1995-96	44,257,301	4.01%	1,776,363	4.46%	1,973,737
1996-97	46,045,884	3.79%	1,745,477	4.46%	2,053,502
1997-98	47,737,516	3.57%	1,703,155	4.46%	2,128,944
1998-99	49,156,988	3.34%	1,644,186	4.46%	2,192,248
1999-00	50,698,033	3.12%	1,582,682	4.46%	2,260,974
2000-01	51,986,565	2.90%	1,506,985	4.46%	2,318,438
2001-02	53,260,365	2.68%	1,425,147	4.46%	2,375,246
2002-03	54,467,650	2.45%	1,335,998	4.46%	2,429,087
2003-04	55,652,286	2.23%	1,240,959	4.46%	2,481,918
2004-05	56,862,198	2.23%	1,267,938	4.46%	2,535,876
2005-06	58,114,483	2.23%	1,295,862	4.46%	2,591,724
2006-07	59,381,285	2.23%	1,324,110	4.46%	2,648,220
2007-08	60,571,245	2.23%	1,350,644	4.46%	2,701,288
2008-09	61,746,757	2.23%	1,376,856	4.46%	2,753,712
2009-10	62,891,471	2.23%	1,402,381	4.46%	2,804,763
2010-11	64,011,000	2.23%	1,427,345	4.46%	2,854,690

SOURCE: General Fund Revenues: *Governor's* Budget, various years to 1993-94 and RAND projections thereafter. CSU Shares of General Fund Revenues: This analysis. CSU General Fund Revenue Support: California Postsecondary Education Commission, *Fiscal Profiles 1992*, CPEC Report 92-9, March 1992, Display 59 for 1980-81 to 1991-92; Pete Wilson, *Governor's Budget 1994-95*, 1994, pp. E-1 to E-120 for 1992-93 to 1993-94; this analysis for 1994-95 and thereafter.
*Denotes years for which data are actual amounts.

The Operating Cost per Student

Since the total operating budget of the system is divided by this factor to estimate the total number of FTEs, this is also an important issue for calculating the cost of producing students. The operating costs per student used in this model are presented in Table D.6 below.

Table D.6
Real Operating Costs per FTE Assumptions (1992-93 dollars)

Year	California Community Colleges	California State University	University of California
1980-81*	2,850	7,843	16,824
1981-82*	2,585	7,228	15,836
1982-83*	2,621	7,164	15,844
1983-84*	2,797	7,478	16,076
1984-85*	3,002	8,146	17,762
1985-86*	3,360	8,472	19,040
1986-87*	3,192	8,700	18,955
1987-88*	3,324	8,604	18,974
1988-89*	3,321	8,598	18,632
1989-90*	3,190	9,018	18,882
1990-91*	3,457	8,364	17,656
1991-92*	3,256	8,388	18,619
1992-93*	2,685	8,301	17,160
1993-94*	2,738	8,439	17,398
1994-95	2,793	8,580	17,640
1995-96	2,849	8,723	17,886
1996-97	2,906	8,868	18,135
1997-98	2,964	9,015	18,387
1998-99	3,023	9,166	18,643
1999-00	3,084	9,318	18,902
2000-01	3,146	9,473	19,165
2001-02	3,208	9,631	19,432
2002-03	3,273	9,791	19,702
2003-04	3,338	9,954	19,976
2004-05	3,405	10,120	20,254
2005-06	3,473	10,288	20,536
2006-07	3,542	10,460	20,822
2007-08	3,613	10,634	21,111
2008-09	3,685	10,811	21,405
2009-10	3,759	10,991	21,703
2010-11	3,834	11,174	22,005

SOURCE: Values for actual years derived by dividing total revenues by total FTEs. Estimated values are estimated by growing last known amounts by rates described below.
*Denotes years for which revenue and FTE data are actual amounts.

For each of the systems, an estimate of this amount for the years in which actual data are available was developed by dividing the total resources estimated above by the total number of FTEs (both undergraduate and undergraduate) in the institution in that year. This amount was then grown by the average annual growth amount for the period 1980 to 1989. The resulting annual real cost growth rates were 1.4 percent for the University of California system, 1.7 percent for the California State University system, and 2.0 percent for the

California Community Colleges system. The cost values used are presented in Table D.6. The values for the CSU and UC systems are close to those identified in unpublished studies.

This measure is consistent with other information on real price increases in the higher education sector. For example, the Higher Education Price Index, which measures the year-to-year changes in the prices of goods consumed by the higher education sector outgrew the California Consumer Price Index by approximately 1.2 percent per year. Since this is a national price measure, and it is know that prices in California generally outstrip the national prices (e.g. the CCPI outstrips the national Consumer Price index), the average annual growth rates used here for the three systems seem altogether reasonable.

Since this treats the cost of all FTEs the same, it presumes that the operating cost of producing undergraduate student units is equal to the cost of operating cost of producing graduate student units. It is likely that graduate students cost more than undergraduates because of smaller class sizes, greater laboratory costs, the necessity of more direct faculty involvement, etc. However, these graduate students generally receive significant support from extramural sources of revenues, such as research grants. Since these extramural funds are intentionally omitted from the model, the decision to hold these two operating cost factors constant is reasonable.

It is critical to understand that this definition of "cost per student" does not imply that this is some real measure of the direct cost of producing a FTE of instruction within the system. It is intentionally broad and the spending amount used produces a range of products, including student support services, public service, research, and a range of other community resources. This model presumes, however, that the institution will wish to continue to provide these services in quantities proportionately comparable to the level of production of these services currently provided.

Capital Supply Model

Another dimension of the supply of higher education is the amount of space available for students to attend. In order to model this dimension, a simplified model of the costs of developing new physical capacity was developed. It divides the total annual cost into two components: (1) the cost of renovation and repairs and (2) the cost of new capacity. The former is a former represents the maintenance of the current physical plant. The latter represents the costs

associated with expanding that plant to accommodate the demand for public undergraduate education.

An important caveat to the discussion of capital capacity in this report is that this analysis focuses on the capital costs that are associated with the provision of undergraduate education over the next 15 years. The sector *must* maintain an even *longer* view. This study has narrowly defined the issues around the 15 years, but the trends that shape the conclusions in this analysis are expected to continue well into the next century and the systems' capital plans must consider this when setting up their capital plans.

Renovation and Repair Costs

The estimates of the future costs of maintaining the current physical plant are based upon the CPEC publication *Prospects for Long-Range Capital Planning in California Public Higher Education: A Preliminary Review.*[43] In this report, CPEC prepares a summary of the future capital needs of the three public systems. Because this model estimates the future demand for new capacity, it was necessary to identify the difference between the renovation and repair costs and the costs of new capacity.[44] This was done by combining the expected real annual capital requirements of the three systems stated in the document with the estimated proportion of these expenditures that are associated with renovation and repairs.

The expected average real annual capital requirement for the University of California was listed at $493.5 million constant 1992-93 dollars.[45] The discussion further states that renovation will account for "about 58 percent of the capital outlay budget."[46] Multiplying these two amounts together, an estimate of $286.2 million constant dollars per year in renovation costs results. This amount

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[43] CPEC, *Prospects for Long-Range Capital Planning in California Public Higher Education: A Preliminary Review*, CPEC Report 92-4, 1992.

[44] In this way, we could adapt the capital costs to reflect the new capacities projected in our study.

[45] CPEC, *Prospects for Long-Range Capital Planning in California Public Higher Education: A Preliminary Review*, CPEC Report 92-4, 1994, Display 4, page 4. The $493.5 total was derived by adding the needed state amount of $393.5 million to the $100.0 million expected from nonstate sources. The use of the total amount is appropriate in this case because it is very difficult to attract funds from private donors for repairs and renovations. Most of the capital funding raised from nonstate sources is used in the construction of new facilities.

[46] *ibid.*, p. 3.

is used into the future for the renovation and repair portion of the total capital costs.[47]

Similar assessments of the information for the California State University and California Community Colleges systems produced estimates of real annual total capital needs of $462.5 million[48] and $430.9 million,[49] respectively. Combining this with renovation shares of 45[50] and 46 percent,[51] respectively, yielded real annual renovation costs of $208.1 million for CSU and $198.0 million for CCC. These amounts are used in the repair and renovation estimates in the model.

New Capacity Costs

The model first ascertains how much new capacity it needs to build this year by looking four years into the future[52] and estimating the amount by which demand will outstrip the current expected capital capacity for that year, as described in equation (D.2), where Q^D is the quantity of space demanded and Q^K is the physical capacity of the institution.

$$Q_t^{New} = MAX[\,(Q_{t+4}^D - Q_{t+4}^K)\,,0] \qquad \text{(D.2)}$$

If new capacity is necessary, then the model estimates the cost of that new capacity according to the relationship given in equation (D.3), where K_t is the total cost of the new capacity and M^C is the marginal cost per FTE of new capital capacity in system C.

$$K_t = Q_t^{New} \times M^C \qquad \text{(D.3)}$$

The values for the marginal cost of new capital capacity was derived from Display 1 of the CPEC report. The startup and buildout sizes and costs of new capacity in each system were combined to produce estimates of the estimates of the capital cost per FTE of new facilities. For the CSU and CCC systems, this produced values of 26,615 and 15,894 constant 1992-93 dollars, respectively.[53] The University of California cost was revised to reflect the expected private

[47] In a more elaborate model, one may wish to link this amount to the total size and age of the overall capital base. This is left to future steps in this research.

[48] *ibid.*, p. 5.

[49] *ibid.*, p. 6.

[50] *ibid.*, p. 6.

[51] *ibid.*, pp. 5-6. The actual share was calculated based on the information presented in Displays 6 and 7 on page 6.

[52] This lag time is put into place to allow the systems to plan and build the new capacity.

[53] Display 1 is in 1990 dollars.

contributions. This adjustment was derived by calculating the expected state share of the balance of the total $493.5 million average annual capital outlay, after removing the renovation and repair portion. The resulting real state capital cost per FTE in the UC system is 59,238 1992-93 constant dollars.

The model also assumes a minimum new capacity increment of 1,000 for planning purposes and the following initial capacities for the systems—UC: 157,000 FTEs;[54] CSU: 280,000 FTEs; and CCC: 950,000 FTEs. These amounts were obtained from the data available and from conversations with numerous experts, both within and without the systems.

It is important to recognize that these new construction costs include full-fledged campuses and may well include a range of services and facilities that do not fall directly under the instructional mission. This approach is consistent with the model's goal of holding the composition and structure of the system intact.

At this point, the model assumes that the system issues bonds and begins payment in that year. For purposes of this analysis, the bonds are amortized over 20 years at an annual real interest rate of three percent. The annual cost of this new capital is accumulated over the time horizon of the model. The model also estimates the total real and nominal costs of the new construction bond issues.

[54] This includes health sciences enrollments. Even though these enrollments are managed and funded somewhat differently, they represent important products of the University of California. Since this is the only point in the model where the "Total FTEs" (including graduates and health sciences enrollments) is used, they were included. This assumes that the state will wish to produce a proportionately higher quantity of these individuals in response to the same forces that drive the enrollment expansion mapped in the overall model.

E. Modeling Proposition 98

The first major task in the simulation of K-14 finance is to model the provisions of the California Constitution and Education Code, which are defined by Propositions 98 and 111.[55] Proposition 98 provides a minimum floor for the funding levels of K-14 education.

Conceptually, Proposition 98 creates a *baseline* level of funding for K-14 education in California. Without the advent of bad economic times, the state education spending floor remains on this baseline, which is defined by Tests 1 and 2 of State Constitution, Section 8, subdivision (b).

When the state encounters bad times, however, Test 3 of the same section takes over and allows the state to spend less than the baseline amounts. When this happens, the shortfall between what is actually spent and the baseline is called the *maintenance factor*. When the bad times pass, provisions kick in that cause the state to return to the baseline and repay the maintenance factor. This process is called *restoration*.

Turn now to describing the formal model, it is important to remember that the goal of this analysis is to estimate the future prospects for K-14 finance in California. Because the Proposition 98/111 calculation uses a different deflator than the California Consumer Price Index,[56] all calculations are done in nominal dollars and the results then converted to constant dollars using the CCPI to assure comparability.

Historically, the split between K-12 and community colleges has been approximately 90-10 and, absent any choices by the state to act otherwise, it will presumably remain so over the balance of this decade. The specific details regarding the implementation of this assumption in this model will be presented below.

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[55] The initial version of this model was designed for RAND's analysis of the California Voucher Initiative, Proposition 174, which appeared on the California ballot in November 1993. In that version of this model, the emphasis was on K-12 finance and it included only K-12 finance. The model is since expanded here to include the entire range of K-14 education. Much of the documentation in this appendix can also be found in Appendix D of the RAND IET Monograph Report *The Effects if the California Voucher Initiative on Public Expenditures for Education*, (Shires, et. al.), RAND MR-364-LE, 1994, pp. 69-78.

[56] In uses the change in per capita personal income as an inflation index.

Variables and Conventions

The mathematical forms of this model and its underlying equations are presented in this appendix. To facilitate understanding, the following variables throughout the appendix will be used throughout this appendix. All terms are nominal for the purposes of executing the simulation model. Results are subsequently deflated by the appropriate inflation rate for reporting in this analysis.[57]

- t: This is an index for the given year.
- α: This coefficient represents the required minimum proportion of the state's General Fund revenues that must go to K-14 education under Proposition 98 under Test 1.
- $A1_t$: This is the Test 1 calculated amount used for calculating the actual Proposition 98 minimum funding guarantee.
- $A2_t$: This is the Test 2 calculated amount used for calculating the actual Proposition 98 minimum funding guarantee.
- $A3_t$: This is the Test 3 calculated amount used for calculating the actual Proposition 98 minimum funding guarantee.
- $A3a_t$: This is the Test 3a calculated amount used for calculating the actual Proposition 98 minimum funding guarantee.
- $A3b_t$: This is the Test 3b calculated amount used for calculating the actual Proposition 98 minimum funding guarantee.
- B_t: The state and local commitment to education in year t. It equals the K-14 portion of state General Fund and those local property taxes allocated for K-14 education.
- E_t: Total K-12 average daily attendance (ADA) enrollment in public schools in year t.
- G_t: The state General Fund in year t.
- H_t: The per capita state General Fund in year t, arrived at by dividing G_t by P_t.
- I_t: Total personal income in California in year t.

[57] The symbols and abbreviations used in this appendix relate to the calculations in this appendix only do not correspond directly to those used in any other appendix. For example, J_t in Appendix B refers to the number of juniors enrolled in year t. For the purposes of this appendix alone, it refers to the California *per capita* personal income in year t.

J_t: Per capita state personal income in year t, derived by dividing I_t by P_t.

N_t: The "hypothetical baseline" in year t. The hypothetical baseline is a value used in calculating the restoration of the maintenance factor in post-Test Three (see below) or post-suspension years.[58] It is equal to the level of the minimum funding guarantee in year t if the suspension or Test Three had never occurred in a prior year.

$N1_t$: This is the Test 1 calculated amount used for calculating the baseline.

$N2_t$: This is the Test 2 calculated amount used for calculating the baseline.

$N3_t$: This is the cap by which Test 2 baseline amount is allowed to grow after a Test 1 year.

R_t: The amount of the maintenance factor to be restored in a year t (see below for discussion of restoration of maintenance factors).

S_t: The state General Fund budget for K-14 education in year t also equal to $(B_t - X_t)$.

X_t: The portion of local property taxes allocated to K-14 education in year t.

In addition, the calculations to derive the Proposition 98/111 guarantee amount associated with each of the three tests will be calculated. The result of the Test 1 calculation is designated A1, the result of Test 2 is A2, the result of Test 3a is A3a, and the result of the Test 3b calculation is A3b.

The first stage in this analysis is to calculate the baseline floor for K-14 spending. Two terms with similar, but very specific meanings will be used in this appendix—baselines and budgets. The baseline represents the hypothetical level of spending that would occur for K-14 absent any interruptions due to poor economic years and suspensions.[59] The budget represents the *actual* spending in a given year. If a Test 3 year never occurs, then the two are equal.

[58]The state has the option of suspending the Proposition 98 funding requirements in a given year.

[59]Most of the provisions of Proposition 98 can be suspended for one year. This analysis does not consider the effects of suspensions of these provisions.

The Baseline

The first step in the analysis is to calculate the baseline amounts for K-14 education over the next decade. In spirit, this baseline is what the education budget would have been if the General Fund had grown enough to support the "Test 1-Test 2" amounts. The specific language guiding the calculations for the baseline amounts for Tests 1 and 2 are provided in California Constitution Article XVI, Section 8, subdivision (b), paragraphs (1) and (2), respectively. The baseline amount in any year is given by the greater of Test 1 and 2 amounts as they are specified in Section 8. The details of these two amounts are presented below.

Test 1

Test 1 requires that a minimum proportion of the California General Fund be allocated to K-14 education. The total[60] baseline amount allocated to K-14 education under this scenario is then given in Equation (E.1).

$$N1_t = \alpha G_t + X_t \qquad \text{(E.1)}$$

For K-14 education, the share of the General Fund α was 40.737 percent in 1988-89 to 1991-92, 37.719 percent in 1992-93, and 34.004 percent in 1993-94 and thereafter.[61] The changes are the result of adjusting to the increased use of local property taxes to fund education.

Test 2

The Test 2 amount is defined by the language in Article XVI, Section (8)(b)(2). It requires that real per-pupil expenditures[62] this year at least equal the prior year's expenditures. Equation (E.2) presents that calculation.

$$N2_t = N_{t-1}\left(\frac{E_t}{E_{t-1}}\right)\left(\frac{J_t}{J_{t-1}}\right) \qquad \text{(E.2)}$$

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[60]The state commitment to K-14 refers to the total state General Fund commitment plus total local property tax proceeds allocated to K-14 education. The explanation for this as a unit of analysis is included in the introduction to Chapter Four.

[61] This amount was determined as the "percentage of General Fund revenues appropriated for school districts and community college districts, respectively in fiscal year 1986-87." [State Constitution, Article XVI, Section 8 (b) (1)]

[62] The provisions of the law require that the enrollment growth factor used here is the change in *K-12 enrollments*, not K-14 enrollments.

Note that, in general, this year's Test 2 amount is a function of last year's baseline amount (N_{t-1}), not the prior year's baseline Test 2 amount, $N2_{t-1}$. If, in the prior year, N_t was determined by Test 1 (N1>N2) and Test 1 represented extraordinary growth levels, then the potential would exist for a significant "ratcheting up" of the baseline amount. The state took this into account in implementing Proposition 98 and included a 1.5 percent growth cap on Test 1 in a given year.[63] This cap is implemented in Equation (E.3).[64]

$$N3_t = (0.015)G_{t-1} \qquad \text{(E.3)}$$

Putting these all together produces Equation (E.4) for the final determination of the baseline amount. This equation says that the hypothetical baseline amount in year t equals at least the Test 2 amount plus some other amounts. If Test 1 is greater than Test 2, the equation adds either the difference between the Test 1 and Test 2 amount (resulting in the full Test 1 amount) or the 1.5 percent cap on baseline growth, whichever is smaller. If Test 1 is smaller than Test 2, then it adds zero to the Test 2 total, resulting in the Test 2 amount.

$$N_t = N2 + \min\left\{\max\left[(N1_t - N2_t), 0\right], N3_t\right\} \qquad \text{(E.4)}$$

It is important to remember that this baseline amount is the hypothetical amount that K-14 education would receive in a world where the General Fund always grows faster than inflation. With this baseline in hand, one can now turn to the actual amounts guaranteed to K-14 education.

The Budget for K-14 Education

The next step, determining the minimum budget for K-14 education, follows a methodology similar in many respects to the baseline. The difference is that it also allows fo low-growth years through the introduction of Test 3 calculations. In a given yea., one of the three tests specified in Section 8, subdivision (b) will apply. The approach used here is to calculate all three amounts and then ascertain which amount actually applies.

[63]See subdivision (c) of Section 8, Article XVI.

[64]Remember that this calculation is for the hypothetical baseline amount. The actual Proposition 98 guarantee in a year can exceed this cap because of Test 1.

The Test 1 Amount

The budget may be represented by a linear function of the General Fund as in the Test 1 calculation above. Equation (E.5) shows the linear relationship between the General Fund and the Test 1 budget amount.

$$A1_t = aG_t + X_t \tag{E.5}$$

The Test 2 Amount

Similarly, the Test 2 budget might be last year's budget increased by enrollment growth[65] and inflation (per capita personal income) growth (the Test 2 amount), as given in equation (E.6).

$$A2_t = B_{t-1}\left(\frac{E_t}{E_{t-1}}\right)\left(\frac{J_t}{J_{t-1}}\right) \tag{E.6}$$

It is important to point out that B_{t-1} ,last year's state and local spending on K-14 education, in this equation represents the prior year's actual spending—the budget—and not the baseline. In periods of state economic prosperity, $A2_t$ is subject to the same growth constraints as $N2_t$ and therefore B_{t-1} cannot exceed N_{t-1}.

The Test 3 Amount

In low General Fund revenue growth years, the budget is determined by Test 3. Under one provision of this test, the budget is last year's budget increased by enrollment growth and General Fund (per capita) growth plus one-half of one percent (the "Test 3a" amount), as described in Section (8)(b)(3). It is given mathematically in Equation (E.7). Note that B_{t-1} in the equations in this section represent the actual spending, the budget, from the prior year.

$$A3a_t = B_{t-1}\left(\frac{E_t}{E_{t-1}}\right)\left[\left(\frac{H_t}{H_{t-1}}\right) + 0.005\right] \tag{E.7}$$

Test 3 is further constrained by Section 41203.5 of the Education Code, which requires that K-14 education, on a per-pupil basis, do no worse than

[65]There is a constraint that, in years of declining enrollment, the enrollment adjustment cannot serve to reduce the funding amount *unless* there were also enrollment decreases in the prior two years. This applies in both Tests 2 and 3a.

noneducation categories within the General Fund, on a per capita basis.[66] This is "Test 3b." Another way of stating this is that this year's budget might be last year's budget increased by enrollment growth and the growth in noneducation spending from the General Fund. This is given in Equation (E.8).

$$A3b_t = B_{t-1}\left(\frac{E_t}{E_{t-1}}\right)\left(\frac{(G_t - S_t) / P_t}{(G_{t-1} - S_{t-1}) / P_{t-1}}\right) \quad \text{(E.8)}$$

Recognizing that $S_t=B_t-X_t$ and $S_{t-1}=B_{t-1}-X_{t-1}$ in general, and that $B_t=A3b_t$ in this formula, one can solve for $A3b_t$, defining an intermediate variable, Z_t, to make the final formula more compact. This is done in equations (E.9) and (E.10) below. Explanation will be limited to the fact that they represent the algebraic solutions of Equation (E.8), solving for $A3b_t$.

$$Z_t = \left(\frac{P_{t-1}}{P_t}\right)\left(\frac{1}{G_{t-1} - B_{t-1} + X_{t-1}}\right) \quad \text{(E.9)}$$

$$A3b_t = \frac{B_{t-1}\left(\frac{E_t}{E_{t-1}}\right)Z_t(G_t + X_t)}{1 + Z_t B_{t-1}\left(\frac{E_t}{E_{t-1}}\right)} \quad \text{(E.10)}$$

The final Test 3 amount is equal to the greater of $A3a_t$ or $A3b_t$, as long as it does not exceed $A2_t$. In equation form, one gets Equation (E.11).

$$A3_t = \min\left[\max(A3a_t, A3b_t), A2_t\right] \quad \text{(E.11)}$$

Moreover, if one is in a Test 3 world, then the budget is below the baseline. The difference between the two is called the maintenance factor. Since the model keeps the baseline from year-to-year, the difference between the baseline and the budget is always the maintenance factor. A final footnote in the description of these tests is the role of maintenance factors.

Maintenance Factors

Maintenance factors serve to keep a running record of where K-14 education should be under Proposition 98 (the baseline) and where it is after the addition

[66]Since we are assuming that community college budgets and enrollments will move similarly to K-12, we can execute this test using only K-12 numbers.

of the low-growth provisions included in Proposition 111 (the budget). In years where the General Fund grows faster than inflation, a portion of this shortfall (the maintenance factor) is restored to the minimum K-14 education budget until it gets back to baseline levels of funding. This restoration takes place in any year where the per capita General Fund outgrows inflation (per capita personal income) and a maintenance factor exists ($A2_t<N2_t$). In these years, one-half of the difference in growth rates between the per capita General Fund and inflation, times the General Fund is required to be allocated to K-14 education in addition to the Test 1 or Test 2 amount. Equation (E.12) described this relationship mathematically, where R_t is the amount to be restored to the budget in year t.

$$R_t = \max\left[\min\left\{0.5\left(\left(\frac{H_t}{H_{t-1}}\right) - \left(\frac{J_t}{J_{t-1}}\right)\right)G_t,\ N2_t - A2_t\right\},0\right] \quad \text{(E.12)}$$

All of the tests and their related pieces have now been covered and it is time to see how they interact in a given year.

Selecting the Correct Budget Amount

From the preceding part of the analysis, three amounts have been, one from each test—$A1_t$, $A2_t$, and $A3_t$. Which of these possibilities actually happens in a given year is governed by the following logic. The test that determines which equation to use compares growth in the General Fund per capita with growth in personal income per capita. If the General Fund growth is large by this test, then the budget equals the larger of amount $A1_t$ versus amount $A2_t$ plus the restoration R_t. If the General Fund growth is small by this test, then the budget equals the amount $A3_t$, represented in equations (E.13) through (E.15).

$$\text{If} \quad \left(\frac{H_t}{H_{t-1}}\right) > \left(\frac{J_t}{J_{t-1}}\right) - 0.005 \quad \text{(E.13)}$$

$$\text{Then} \quad B_t = \max(A1_t, A2_t + R_t) \quad \text{(E.14)}$$

$$\text{Else} \quad B_t = A3_t \quad \text{(E.15)}$$

One of the crucial aspects of California's K-14 finance structure is that it is dynamic—that is to say, each year is dependent on what happens in the prior year. This means that changes in any given year, such as those associated with the voucher initiative, can have effects on the baseline and budget numbers across all succeeding years. This is why it is necessary to develop a full

dynamic simulation model, as done here, to assess the prospects for K-14 education under different scenarios.

Allocating the Resources

The total Proposition 98/111 minimum budget must then be allocated between K-12 and community colleges.[67] A straight 90-10 split, K-12 to community colleges, was used to allocate the total minimum budget between the two segments. The historical average has been very close to this amount over the five-plus years that Proposition 98 has been in force. Property taxes were then netted from this amount to derive the state General Fund support amount for community colleges listed in Table D.1 in Appendix D.

Inputs into the Model

The calculations in of the minimum budget allocation for K-14 is dependent on several inputs—the state General Fund SAL revenues (see Table D.3),[68] K-12 (see Table E.1) and community college (see Table D.1) property taxes, the state population (see Table C.1), state personal income (see Table E.1), K-12 ADA enrollments (see Table E.1), and community college FTE enrollments (see Table 2.3). While the last set of information is developed in the context of this model, all of the other inputs for this model were obtained from other sources. Table E.1 presents a summary of the values used for each of series not found elsewhere in this report.

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[67] The actual allocation is significantly more calculated as K-12 districts take on a range of shapes and sizes. For this model, they are taken in aggregate.

[68] These are state revenues under the "State Appropriations Limit" imposed by voters through the Gann Initiative.

Table E.1

Inputs into Proposition 98/111 Minimum K-14 Finance Model

Year	K-12 Property Taxes ($millions)	K-12 ADA Enrollments (thousands)	General Fund SAL Revenues ($billions)	California Personal Income ($billions)
1987-88*	3,772	4,395	32.5	491.4
1988-89*	4,097	4,518	35.9	531.0
1989-90*	4,487	4,681	37.5	576.5
1990-91*	4,950	4,860	37.0	616.7
1991-92*	5,239	5,016	40.8	624.0
1992-93*	6,399	5,102	39.5	641.4
1993-94*	8,415	5,127	38.5	684.4
1994-95	8,892	5,257	40.4	717.7
1995-96	9,200	5,436	42.1	757.2
1996-97	9,466	5,693	45.1	805.8
1997-98	9,796	5,879	48.2	855.3
1998-99	10,156	6,058	51.1	908.7
1999-00	10,530	6,237	54.3	963.1
2000-01	10,970	6,419	57.3	1,018.7
2001-02	11,428	6,603	60.5	1,076.4
2002-03	11,903	6,793	63.7	1,135.8
2003-04	12,397	6,964	67.0	1,197.3
2004-05	12,909	7,124	70.6	1,262.1
2005-06	13,442	7,257	74.3	1,330.8
2006-07	13,995	7,341	78.2	1,402.9
2007-08	14,569	7,382	82.1	1,476.5
2008-09	15,166	7,386	86.2	1,553.2
2009-10	15,785	7,381	90.5	1,632.6
2010-11	16,428	7,374	94.8	1,715.0

SOURCE: All Projections through 1995-96: Office of the Legislative Analyst. All Projections 1996-97 to 2010-11: RAND internal projections. Please see Carroll, *et.al.*, *California Fiscal Future*, MR-570-IET, (forthcoming) for details on the methodologies to develop these series.

*Denotes years for which data are actual amounts.

F. Modeling the Various Deficit-Closing Scenarios

In this appendix, the details of the methodologies used to assess the findings reported in Chapter Four are detailed. In this chapter, several alternatives to closing the access deficits described in Chapter Three were discussed. The scenarios presented were: (1) buying out the access deficits; (2) raising tuition to close the deficit; (3) increasing productivity to close the deficit; (4) letting all students in; and (5) implementing a three-year degree. No numeric results were presented in conjunction with the universal access option (number four above) and so no detailed description is provided in this appendix.

Buying out the Access Deficits

The methodology associated with this scenario presumes that the quantity supplied will equal the appropriate demand level. For purposes of addressing the access deficits, the quantity supplied Q_s was set to the ambient demand level Q_0. In analyzing the operating shortfalls, this quantity supplied Q_s was to the expected Q_D under the particular demand scenario in question. Given a level of Q_s, the annual cost of expanding the capital capacity, K_t, was calculated using the methodologies described in Appendix D is equations (D.2) and (D.3), setting the desired capital capacity levels in year t equal to ambient demand, Q_0 in the access deficit scenarios and Q_D in the operating shortfall scenarios. Equation (D.1) was re-written to solve for the need operating revenues OR_t as shown in equation (F.1) below, using the same naming conventions as in Appendix D.

$$OR_t = \frac{Q_t^s \times C_t}{u_t} \qquad \text{(F.1)}$$

The total revenues required by the system (for both operating and capital capacity), were then calculated as the sum of K_t and OR_t. This total revenue was used to ascertain the amount of support necessary to meet the specified demand level.

In the case where these revenues are construed to come from General Fund revenues, the total General Fund revenues to the systems were the difference between the total required revenue amount and revenues from all other sources.

Since, as described in Chapter Four, it is necessary to set the price level back to 1989-90 levels in order to close the access deficit, it is important to note that expected revenues from one source, fees, declines, thereby increasing the amount of revenues from other sources, such as the General Fund, necessary to close the gap. The share of General Fund revenue calculations were derived by dividing this amount by expected total General Fund revenues in that year.

Raising Fees to Close the Deficit

In this scenario, the price of education was raised until an equilibrium was achieved between supply and demand. The price of education impacts both the supply and demand sides of the problem. On the demand side, the quantity demanded is given in equation (A.1). On the supply side, fees are part of the total operating revenue of the system and are multiplied times the actual quantity demanded to determine total fee revenues for the system. Additionally, any gaps caused by the capital capacity constraint must also be addressed in that year. To address this problem, the capital resource requirements, as calculated in equations (D.2) and (D.3) and using the quantity demanded estimates from the demand side of the equation, were netted from the total revenues available for providing operating capacity before the operating capacity was calculated.[69]

Since fees affect both price and demand, the problem had to be solved dynamically. Both the supply and demand sides of the model were built around a single definition of price (see Appendices A and D). In addition, the relationship is non-linear and no easy formulation of the equilibrium could be obtained. As a result, the equilibrium value of price in this scenario was found iteratively by substituting alternative values for fee levels into the price estimation until the Q_D equaled the Q_S. Operationally, this was accomplished using the "Goal Seek" tool in Microsoft Excel 5.0, varying fees and setting the operating deficit $Q_D - Q_S$ as the dependent variable to be set to 0.

[69] This has the effect of forcing the capital supply available to equal the quantity demanded in any given year and leaves the residual for operating capacity. In the final equilibrium solution, when this operating supply equals the quantity demanded, all three quantities will be equal—the desired result.

Increasing Productivity to Close the Deficit

This scenario, which estimates the cost per FTE, as defined in the supply model, necessary to meet the specified demand level. As in the case of the "buying Out" scenario above, the quantity supplied Q_s was set equal to the appropriate demand level. The capital cost was also netted from total revenues (effectively holding capital productivity constant) before the productivity calculation below was made. The necessary cost per FTE was calculated by manipulating equation (D.1) again, this time producing equation (F.2) below.

$$C_t = u_t \frac{OR_t}{Q_t^S} \qquad \text{(F.2)}$$

This relationship was used to derive a new level of C_t for each year. This value was compared to the original values for presentation in the text.

G. Results of Analysis for Total Public Enrollments

The thrust of the analysis in the main body of this dissertation has been the prospects for undergraduate education in California. Since the models in this analysis assume the proportion of relevant undergraduate populations is a constant share of total enrollments (still in FTE terms), comparable results for each of the findings in this paper could be presented in total enrollment terms. This appendix presents selected findings of this paper in total enrollment terms, *for informational purposes only*. No discussion of the implications of these total numbers is provided. Tables G.1 and G.2 below map the references for the major undergraduate results provided to the appropriate tables and figures in this Appendix. The complete set of tables are presented and then the complete set of figures.

Table G.1

Map of Selected Tables in Report to Their Counterparts in this Appendix

Chapter Table Reference	Corresponding Appendix G Table
2.1	G.3
2.2	G.4
2.5	G.5
3.1	G.6
4.1	G.7

Table G.2

Map of Selected Figures in Report to Their Counterparts in this Appendix

Chapter Figure Reference	Corresponding Appendix G Figure
3.1	G.1
4.1	G.2

Tables

Table G.3

Projections of Ambient Demand for Total Public Education (in FTEs)

Year	California Community Colleges	California State University	University of California	Total
1993-94	1,034,497	282,174	157,006	1,473,677
1994-95	1,061,798	282,413	156,860	1,501,071
1995-96	1,087,425	283,240	156,868	1,527,534
1996-97	1,112,086	284,953	157,851	1,554,890
1997-98	1,136,427	287,812	159,759	1,583,999
1998-99	1,161,370	292,062	162,809	1,616,241
1999-00	1,187,585	297,751	167,025	1,652,362
2000-01	1,213,890	303,658	171,293	1,688,841
2001-02	1,239,992	310,060	175,563	1,725,615
2002-03	1,266,446	316,495	179,579	1,762,520
2003-04	1,292,921	321,839	182,727	1,797,488
2004-05	1,319,801	327,203	185,918	1,832,922
2005-06	1,346,747	332,248	188,843	1,867,837
2006-07	1,373,631	336,866	191,437	1,901,934
2007-08	1,401,202	341,778	194,283	1,937,264
2008-09	1,430,261	347,033	197,572	1,974,866
2009-10	1,461,993	353,862	202,342	2,018,198
2010-11	1,495,654	361,579	207,846	2,065,079

SOURCE: Derived from this analysis. See Appendix A for details.

Table G.4

Projections of Expected Demand for Total Public Education (in FTEs)

Year	California Community Colleges	California State University	University of California	Total
1993-94	901,567	250,902	151,748	1,304,217
1994-95	934,508	248,623	151,248	1,334,379
1995-96	947,226	246,680	150,784	1,344,690
1996-97	968,707	248,171	151,729	1,368,607
1997-98	989,910	250,662	153,563	1,394,135
1998-99	1,011,636	254,363	156,495	1,422,494
1999-00	1,034,472	259,318	160,547	1,454,337
2000-01	1,057,386	264,462	164,650	1,486,497
2001-02	1,080,122	270,038	168,754	1,518,914
2002-03	1,103,165	275,642	172,615	1,551,422
2003-04	1,126,227	280,297	175,640	1,582,164
2004-05	1,149,642	284,968	178,708	1,613,317
2005-06	1,173,113	289,362	181,519	1,643,993
2006-07	1,196,531	293,384	184,012	1,673,928
2007-08	1,220,548	297,662	186,748	1,704,958
2008-09	1,245,860	302,239	189,909	1,738,008
2009-10	1,273,501	308,186	194,495	1,776,182
2010-11	1,302,822	314,907	199,785	1,817,514

SOURCE: Derived from this analysis. See Appendix A for details.

Table G.5

Projections of Expected Operating Supply for Total Public Education (in FTEs)

Year	California Community Colleges	California State University	University of California	Total
1993-94	901,567	250,902	151,748	1,304,217
1994-95	978,508	265,463	147,980	1,391,951
1995-96	958,872	264,056	146,589	1,369,517
1996-97	995,923	257,611	143,110	1,396,645
1997-98	1,021,010	250,671	139,267	1,410,949
1998-99	1,041,604	242,884	134,839	1,419,326
1999-00	1,062,079	235,503	130,602	1,428,184
2000-01	1,079,772	227,185	125,726	1,432,683
2001-02	1,096,774	218,717	120,643	1,436,134
2002-03	1,113,065	209,891	115,258	1,438,213
2003-04	1,125,951	200,519	109,539	1,436,009
2004-05	1,134,162	200,881	109,986	1,445,029
2005-06	1,134,162	201,154	110,394	1,445,710
2006-07	1,134,162	201,257	110,720	1,446,139
2007-08	1,134,162	201,239	110,972	1,446,373
2008-09	1,122,926	201,219	111,253	1,435,398
2009-10	1,108,817	201,492	111,726	1,422,036
2010-11	1,094,391	201,883	112,264	1,408,537

SOURCE: Derived from this analysis. See Appendix A for details.

Table G.6
Access Deficits in Total Public Education in California: Differences between Ambient Demand and Expected Supply

Year	California Community Colleges	California State University	University of California	TOTAL
1989-90	83,852	0	0	83,852
1990-91	103,724	10,978	4,152	118,854
1991-92	76,018	24,313	2,190	102,522
1992-93	132,929	31,273	5,258	169,460
1993-94	83,290	16,950	8,880	109,120
1994-95	128,554	19,184	10,279	158,017
1995-96	116,163	27,341	14,741	158,245
1996-97	115,417	37,141	20,492	173,050
1997-98	119,766	49,178	27,971	196,915
1998-99	125,507	62,248	36,423	224,178
1999-00	134,118	76,473	45,567	256,158
2000-01	143,218	91,343	54,920	289,481
2001-02	153,382	106,604	64,321	324,307
2002-03	166,970	121,320	73,188	361,479
2003-04	185,639	126,322	75,932	387,894
2004-05	212,584	131,094	78,449	422,127
2005-06	239,469	135,609	80,718	455,795
2006-07	267,040	140,539	83,311	490,891
2007-08	307,335	145,814	86,319	539,468
2008-09	353,176	152,370	90,616	596,162
2009-10	401,263	159,696	95,583	656,541
2010-11	463,830	137,252	71,511	672,592

SOURCE: Derived from this analysis. See Chapter Two and Appendices A through E for details of underlying models.

Table G.7
Real State Revenues Necessary to Expand Expected Supply to Close the Access Deficit
(thousands of 1992-93 dollars)

Year	California Community Colleges	California State University	University of California	TOTAL
1995-96	2,001,707	2,235,658	2,608,147	6,845,512
1996-97	2,158,652	2,299,630	2,678,656	7,136,938
1997-98	2,310,774	2,373,476	2,765,588	7,449,838
1998-99	2,467,270	2,461,490	2,873,400	7,802,160
1999-00	2,630,621	2,559,338	2,999,411	8,189,370
2000-01	2,793,268	2,663,244	3,129,131	8,585,643
2001-02	2,960,068	2,772,085	3,261,788	8,993,941
2002-03	3,132,697	2,882,234	3,392,791	9,407,722
2003-04	3,311,796	2,987,806	3,510,830	9,810,432
2004-05	3,498,634	3,096,210	3,632,145	10,226,988
2005-06	3,693,649	3,208,144	3,758,975	10,660,768
2006-07	3,898,043	3,320,819	3,882,049	11,100,911
2007-08	4,074,957	3,424,614	3,992,495	11,492,066
2008-09	4,263,787	3,534,500	4,114,225	11,912,512
2009-10	4,468,852	3,662,451	4,268,386	12,399,688
2010-11	4,688,012	3,802,634	4,441,146	12,931,793

SOURCE: Derived from this analysis. See Appendix F for details of the calculations used to derive these amounts.

Figures

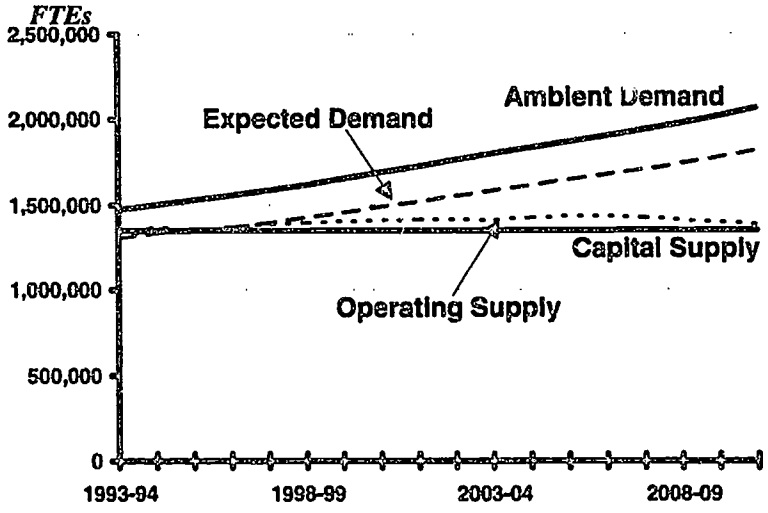

Figure G.1--Demand and Supply of Total Public Education in an Expected Supply Scenario

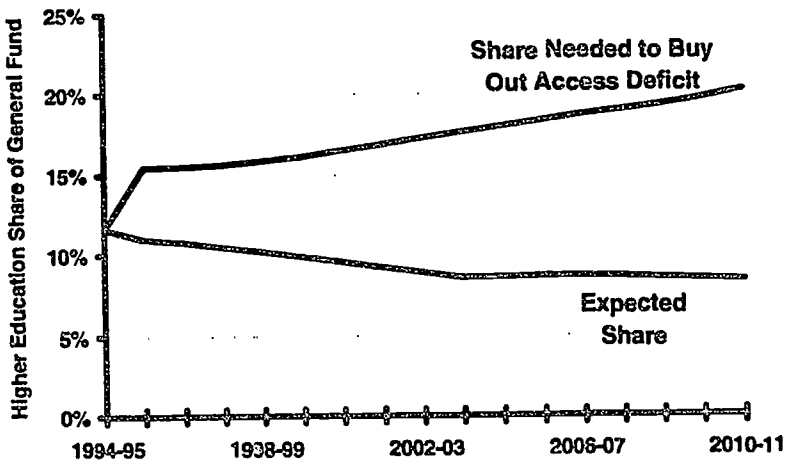

Figure G.2–Share of State General Fund Budget Committed to Higher Education Necessary to Buy Out Access Deficit

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