The Public Interest and State Policies Affecting Academic Research in California

William Zumeta
THE PUBLIC INTEREST AND STATE POLICIES AFFECTING ACADEMIC RESEARCH IN CALIFORNIA

William Zumeta

Daniel J. Evans School of Public Affairs and College of Education,
University of Washington
Box 353055, Seattle, WA 98195 USA
zumeta@u.washington.edu

Prepared for the Project on the Academic Research Enterprise
University of North Carolina-Chapel Hill
December 2007

© 2008 William Zumeta
Abstract

This paper, part of a forthcoming comparative volume on “The Public Interest and the Academic Research Enterprise,” edited by David Dill (University of North Carolina-Chapel Hill) and Frans Van Vught (European Commission and University of Twente, the Netherlands), analyzes public policies toward academic research in the U.S. state of California. Taking a broad view of state research policies, it first surveys the history and recent trends in the state’s support of the research and graduate education missions of the University of California, identifying serious problems and emerging challenges plaguing the state’s prospects to sustain UC’s historic elite quality in these areas, which underpins the state’s research effort. Then, much of the paper is devoted to a survey and analysis of the political economy of California’s numerous state funded research programs, both those based at the University of California and the increasingly important ones (most notably the California Institute for Regenerative Medicine or CIRM) independent of UC. Broadly, the conclusion is that even a state as large and wealthy as California is poorly situated to develop coherent and independent research policies as states lack the necessary independent brokering institutions analogous to the National Science Foundation and National Institutes of Health at the federal level, and policymakers have fewer buffers against political influences. Moreover, in California particularly the populist, highly polarized and media-influenced political culture makes coherent state policymaking for research a major challenge. Finally, California policymakers have done little to build institutional expertise in this area in either the executive or legislative branch.
THE PUBLIC INTEREST AND STATE POLICIES AFFECTING ACADEMIC RESEARCH IN CALIFORNIA

William Zumeta

California is a vast state–some 800 miles from north to south–with a land area similar to Great Britain and including high mountains, vast deserts, a stunning coastline, and great, highly productive farmlands. It is home to more than 36 million people, about one-eighth of the U.S. population, and the number continues to grow rapidly. The demographics of this population have undergone remarkably rapid change in recent years. Whites now represent less than half the working age population (ages 25-64), down from 71% in 1980, and are projected to be below 40% by 2020 (Figure 1). By that year adults of Hispanic origin are expected to constitute about 38% of the California workforce (up from 16% in 1980) and Asian Americans 17% (up from 6% in 1980).

California’s economy is a dynamo. Its gross state product would make it the fifth largest in the world–similar to the GDP of France–were it a nation. In recent decades, the economy has become increasingly technology based, although agriculture remains very important. The “Silicon Valley” south of San Francisco, the city of San Francisco itself and its more immediate environs, the vast Los Angeles metropolitan area, and the San Diego area are meccas for firms in the electronics, communications, information technology, biotechnology and other life sciences, and most recently nanotechnology industries. The technology-based aerospace industry continues to be important in the Los Angeles area as well.

In the modern economy it is hardly surprising that these key industries are all knowledge based and research intensive. They have natural links to universities since many of their employees are highly educated, they recruit from the universities, and many of them seek direct connections to and even financially support university research.

* An earlier draft was presented at the Conference on The Public Interest and the Academic Research Enterprise at Seville, Spain, 11 November, 2006. I wish to acknowledge excellent and very diligent research assistance from Deborah Frankle.
Indeed, many of Silicon Valley’s early companies were spinoffs from Stanford University research and this pattern continues today there and in other locales with the ten-campus University of California and such academic powerhouses as the California Institute of Technology (Cal Tech) and the University of Southern California. The prosperous agricultural sector in California is also closely tied to university research and extension services, as has long been the case.

These two major trends—rapid population growth and demographic change and the shift in the economy toward knowledge- and technology-based industries—are key to comprehending the state’s future and so is their intersection or lack of it. In short, the state will be faced with a workforce crisis before long if it is not able to do a far better job than at present of educating the burgeoning population groups of color and preparing them for the jobs its economy is creating (National Center for Public Policy and Higher Education, 2005; Campaign for College Opportunity, 2006). But efforts to do this and to provide for the elements essential to the health of the economically crucial research mission in California’s universities must work through the state’s political and policymaking processes. Here there are serious shortcomings and major challenges to be explored.

In this paper I will analyze these several issues with a primary focus on the research mission defined broadly to include the fiscal health and prospects of the state’s public research university system, the University of California, and the status and future of its graduate programs, as well as issues surrounding the explicitly state-funded research programs in the University and outside it. I will proceed by first summarizing a bit of the relevant history of state policy toward public higher education in California including the continuing importance of the 1960 *Master Plan for Higher Education*. I will look next at the current strains and pressures facing the state that affect its support of higher education and the University of California in particular, as well as some relevant policies of the state and the University itself. Then comes a brief look at the emergence of California’s high tech economy and its connections to academe, followed by an analysis

---

1 Stanford, Cal Tech, and USC are all private institutions while the multi-campus University of California is public.
of specific policies toward financial support, faculty salaries, and especially graduate education, and prospects for future developments in these.

Next, a major part of the paper is devoted to a description and analysis of the political economy of the large volume and wide range of explicitly state-initiated and supported research programs. In the language of Roger Geiger (this volume), these are largely “upstream” policies designed to support broadly defined areas of research of interest to the state rather than “downstream” policies focused primarily on local technological applications. Most of the state research programs are based at the University of California but not all of them, including the unique new state entity called the California Institute for Regenerative Medicine (CIRM). Finally, I offer a concluding assessment of this odd assortment of historical legacies, current policies, and policymaking mechanisms giving attention to the factors underlying the challenges and prospects ahead for the state, the University, and its research mission. A key conclusion pertinent to the themes of this volume is that, large and resource-rich as it is, even California—a state in a large nation—cannot efficiently pursue research policies in the same way a nation can. Fundamentally, the state’s major research policies should be to maintain the quality and vitality of the University of California and the productive climate of interaction between UC, and other universities in the state, and research-intensive industries and employers. Secondarily, I also seek to point out how the state could take steps to improve its capacity to perform better in selected areas in which state-level policymaking makes sense.

THE HISTORICAL LEGACY AND CURRENT REALITIES

California has a proud history of commitment to broad access and excellence in higher education. Granted constitutionally autonomous status from its founding, the

---

2 The roots of this state institution’s remarkable academic prowess are often attributed to its constitutionally-guaranteed autonomy from the state government (Glenny and Dalglish, 1973; Pelfrey, 2004; Stadtman, 1970; Trow, 1993), which largely exempts it from direct state controls over personnel and contracting, allows the University’s Board of Regents to set tuition, and provides its operating appropriation with few direct fiscal controls. Of course there is some pragmatic negotiation with the state authorities over
University of California was a leader in public higher education from early on. Although based in Berkeley (near the large city of San Francisco), it began developing outposts around the huge state early in the twentieth century and these eventually grew into ten campuses, including eight “general campuses” offering a wide range of undergraduate, graduate and research programs, a specialized health sciences campus in San Francisco, and a new general campus recently launched in the agricultural Central Valley (at Merced). No other U.S. state has anything approaching this large array of research institutions. The central administration of the University, and particularly the systemwide Academic Senate, maintain and generally enforce common standards for faculty appointments and promotions and basic student qualifications throughout the system.

The standards are high and the results have been impressive. In the most recent professionally-based rankings of graduate program quality published by the National Research Council in 1995, more than half of UC’s 229 doctoral programs in the rated fields were ranked among the top twenty in the U.S. An aggregation of these discipline-based rankings found UC Berkeley placing higher than any other university, public or private, and both UC San Diego and UCLA were in the top twelve.

Figure 2 shows some more recent data pertinent to UC’s academic and research quality: the rankings of the UC campuses in obtaining federal research and development funds, the vast majority of which are competitively awarded. In fiscal year 2005 three UC campuses ranked among the top dozen U.S. universities by this measure and the recent trends in UC’s standing in these rankings over time are generally positive.

A key juncture in California higher education history is represented by the adoption by the state legislature of the Donahoe Higher Education Act, California’s

---

4 Cited in Pelfrey (2004: 77).
5 Cited in ibid. All the other universities in the top dozen were private.
6 It should be noted that Berkeley, Riverside, Santa Barbara and Santa Cruz are all hampered in these rankings by their lack of a medical school. Federal R&D support from the largest federal granting agency, the National Institutes of Health, increased much more than support in other scientific fields over most of the period shown.
famed *Master Plan for Higher Education*, in 1960. In response to rapid in-migration from other states and the coming graduation from high school of a “tidal wave” of postwar baby boom children, a political free-for-all among state institutions seeking authorization to serve them began. The University and the State Board of Education worked together to develop a plan for the orderly expansion of public higher education that became the Master Plan. This Plan codified a state commitment to provide free access to high quality public higher education to all who were deemed able to benefit from it.\(^7\)

In order to make these commitments manageable, the plan formally assigned the University of California, the State Colleges (now the California State University), and the California Community Colleges responsibility for educating different segments of the population. The University of California received responsibility for the most academically qualified undergraduates, for doctoral education, for professional education in the most prestigious fields such as law and medicine, and for academic research. The other segments of the statewide system were to handle the large bulk of undergraduate demand—the community colleges were to be accessible to all—and the state colleges would provide master’s degree programs in certain fields.\(^8\) Funding to achieve excellence in each segment’s mission would presumably be allocated accordingly by the state.

During the 1960s California’s economy surged and the state indeed funded a vast expansion of the public higher education system. During the late 1950s and the 1960s, the University of California in particular established three entirely new general campuses (Irvine, San Diego,\(^9\) and Santa Cruz) and made three more much smaller operations into full general campuses (Davis, Riverside and Santa Barbara). This was a remarkably ambitious effort to expand research-based public higher education throughout a large part of the state and to a substantial share of the population. It largely succeeded, although the

---

\(^7\) Good accounts of developments during this period are provided by Stadtman (1970); Kerr (2001); and Pelfrey (2004).

\(^8\) A student aid program was also established to support state resident undergraduates attending private colleges and universities. These “Cal Grants” served to divert a substantial number of students from the public systems at considerable savings to the state. California now has well over one hundred private colleges and universities including a number of very strong institutions.

\(^9\) San Diego had a long history as a UC research installation but had only begun to educate a few graduate students in the sciences when the decision to develop a full general campus (at a new site) was made (Kerr, 2001).
abrupt end of the baby boom and major political and economic changes\(^\text{10}\) in the late sixties and early seventies ended free tuition at UC and CSU and led to much slower growth of the new campuses than had been originally envisioned, especially in graduate programs. State policy, together with great economic prosperity, had permitted University leaders to expand greatly in a short period the base of the University of California, which the Master Plan called the “primary state agency for academic research.” During the 1970s and 1980s they were able to build substantially upon this base, albeit much more slowly, and they did it while maintaining high academic standards in both teaching and research.

**Recent Strains**

The rapid demographic change in California’s population that has already been described has had a number of indirect effects on the University of California. It has increased the state’s dependent population, which, together with the legacy of Proposition 13 and its aftermath, has strained the state government’s finances. The public schools have been largely overwhelmed by the numbers of students and the complexities of teaching large numbers from different language and low-income backgrounds (Schrag, 2006). Both resources per student and student achievement have slipped. Relatively small proportions of Latino students (as well as African Americans whose achievement has long lagged) are competitive for admission to the University of California and the problem carries over to the graduate level. The clear need for better early preparation of these students has reinforced other forces at work to shift relative policy focus, including within the University of California, over the past decade and more toward undergraduate and even K-12 education at the expense of graduate study.

Yet, increasingly necessary linkages between elementary and secondary (or “K-12”) education and the higher education segments remain weak and they are not much

\(^{10}\) Key were student unrest on the UC campuses, the election of Ronald Reagan as governor, and the recession of the early 1970s with its aftermath of slow growth and high inflation. By 1978 the state experienced the “tax revolt” and passage of the property tax limiting Proposition 13 ballot initiative that has hamstrung its finances ever since. See Schrag (2006), especially chapter 2, which is aptly titled, “Dysfunction, Disinvestment, Disenchantment.”
better across the several postsecondary components of the state’s educational system. The results are that California’s high school graduation rates are low compared to the rest of the country and stagnant at best (National Center for Public Policy and Higher Education, 2006). Most who do graduate are not fully prepared for college and require remedial classes. The vaunted community colleges enroll many students but graduate and transfer to universities distressingly few of them (Shulock and Moore, 2007). The University of California and CSU systems evidently continue to do a very good job with the students they accept\textsuperscript{11} but without much more state money than has been made available in recent years are not enthusiastic about taking a great many more. And no one at the state level has taken a statewide view of these problems and made system-level integration and performance, together with more funding, a political priority. An interested and determined governor could conceivably do this but none has shown such an inclination for decades.

Like the rest of the U.S., California experienced two deep recessions in recent years, in the early 1990s and again in the early years of the current decade. These hit harder and the effects lasted longer in California than in most other states. In the latest recession, the state took drastic measures to keep afloat financially, including deep budget cuts and long term borrowing to balance its annual operating budget, the latter a highly unusual practice in U.S. state government finance. The service on this debt is a continuing obligation and a bad precedent has been set. According to the legislature’s fiscal analysis agency, the state faces a structural gap between projected expenditures and revenues of $4-5 billion per year through at least 2009-10 and a smaller deficit thereafter (California Legislative Analyst, 2006). Competition for state operating budget funds is thus quite fierce and entities like the University of California are poorly positioned structurally in this competition because the growth of other major state expenditure items are protected by statutory formulas (education spending for K-12 and community colleges under voter-enacted Proposition 98) or driven by federal and judicial

\textsuperscript{11} The undergraduate completion rates in these two systems are among the best in the country for public institutions of their type.
requirements to fully fund caseload growth (indigent health care, prisons) that do not apply to university enrollments.\textsuperscript{12}

**Figure 3** shows the dramatic impact of the recessions on state support and overall financing of the University of California and makes clear that the past decade and a half has not been a good one fiscally speaking. In fiscal year 1990, before California felt the impact of the U.S. recession that began later in the same year, UC received about $24,500 per full-time-equivalent student (FTES) from the state (in 2006 dollars). That figure dipped to $18,133 by 1995 and did not come close to the early 1990s levels again until 2001 ($22,916) at the height of the last economic boom. The subsequent downswing led to steady and cumulatively drastic cuts (-38\% from 2001 to 2005), so that state support in fiscal 2007 was less than 60\% of the 1990 level in real per student terms.

As Figure 3 illustrates, to mitigate the impacts of these swings, University policymakers, with the state’s encouragement, turned primarily to tuition (called “fees” in California). Fee revenue per student more than doubled in real terms between 1991 and 1995, but after that declined somewhat as state support recovered and then surged. But between 2003 and 2006 there were sharp increases again as the state budget plunged, a total of 58\% in fee revenue growth over just these three years. Thus, over the 15 years from 1990 to 2006, fee revenues as a percentage of the total (state plus fee revenues) grew from just 9.2\% to 29.3\%. This certainly raises the possibility that the University is fast approaching the political limits of tuition increases as a source to sustain revenue growth, at least for a while.\textsuperscript{13}

The fee increases clearly helped to stabilize the University’s finances but they did not fully stave off real declines in total revenue during the state’s economic downturns, particularly the most recent one. The sum of state and fee revenues fell from $30,200 per student in 2001 to a nadir of $23,635 in 2004 in constant dollars (-21.7\%). Total revenue per student in 2007 was 18.8\% lower than the 1990 figure. It should also be noted here

\textsuperscript{12} Other states are in a broadly similar predicament but California’s voters have created more than the typical amount of constraints.

\textsuperscript{13} This seems particularly likely in a state with a stronger than usual policy commitment to access and in particular to low tuition (fees). In fiscal year 2007, the governor used improved state revenues to “buy out” scheduled 8\% undergraduate fee increases for UC and the CSU system (Gledhill, 2005).
that about one third of the increased fee revenues generated in recent years have not been spent on instruction or other core academic needs but rather have been recycled into need-based student financial aid under the UC Grants program.\footnote{There have been some variations in this percentage over time but for most years since 1995, policy has been for the University to use one-third of incremental fee revenue for need-based financial aid. Overall, about 27% of tuition and fee revenue is spent on such aid (Alcocer, 2006).} The instability in available funding, almost as much as the level, is clearly a major challenge for institutional leadership seeking to maintain the University’s basic quality and effectiveness in all its areas of endeavor. The pattern of drastic increases in charges during hard times also impacts many students and their families adversely.

Although the fee increases described above have affected undergraduates the most, in recent years UC’s heavily oversubscribed professional schools, particularly in law, business and the health sciences, have also increased their charges substantially. In the arts and sciences, a standard, much lower graduate fee rate linked to the undergraduate rate applies.\footnote{In 2006-07, the general rate for California resident graduate students was $6,162 for the academic year, compared to $5,409 for undergraduates. Non-state resident graduate students nominally are charged much more, but what they actually pay varies greatly by field (see above).} The recent hikes in graduate fees affects some students but most graduate students in the arts and sciences have fees covered for at least part of their time in school by initial recruitment offers, fellowships, or as part of their compensation for service in teaching or research. Still, there are impacts on graduate students when they are not covered by one of these sources of support and there are effects on the sources as well.

In particular, graduate fees have been rising faster than agencies providing research and fellowship support are willing to pay in full, thus putting unfavorable competitive pressure on UC researchers or forcing them to consider cuts in graduate student salaries and stipends. Budgets for teaching assistants face similar dilemmas. If TA fees are fully covered from these sources, budgets for instruction go up without sufficient state funds to cover the increases. UC faculty and administrative officials are quite worried about the impacts of these pressures on the campuses’ ability to compete for the best graduate students, especially in a state with very high living costs.
California’s future fiscal outlook is not particularly positive. As mentioned, the state carries a kind of consumer debt forward from the last recession as a claim against future revenues. Its fiscal 2007 operating budget was balanced by one-time revenues and a substantial structural gap between recurring expenditures and revenues at current tax rates is projected through at least 2010 (California Legislative Analyst, 2006). And this projection does not take into account the likelihood of a considerable slowdown in the national economy widely expected by 2008 (National Conference of State Legislatures, 2006). Since the state has little political appetite for tax increases—indeed quite the reverse—higher education support seems likely to face continuing strong competitive pressures at best.

On the other hand, California’s political culture has become highly populist in orientation and hence unpredictable. A voter initiative could conceivably be mounted—with the support of a governor who chose to make higher education a political issue probably by linking it closely to economic competitiveness—to guarantee this sector a share of the state budget as many other functions now have.\footnote{Almost certainly though, such a guarantee would include the other public higher education segments and would require a commitment to additional undergraduate enrollments and moderation in student fees from UC as a \textit{quid pro quo}.} In this fiscal context, certain policies of the higher education segments themselves may work to divert some of what state resources are available from support of UC’s nine established campuses. First, the California State University (CSU) system has long sought to lift the Master Plan’s restrictions on its ability to offer doctoral degree programs on its own.\footnote{This would not be sound fiscal policy for the state’s General Fund budget is already excessively constrained by such “earmarked” fund streams.} For just as long the University of California has opposed this, fearing an expansion of CSU’s mission that would divert scarce resources for advanced education. CSU finally succeeded in getting legislative authority to offer Ed.D. degrees in 2005 and now seeks to broaden this to other types of professional doctorates. Ph.D. programs could be next and the ultimate result would probably be the fiscal dilution UC fears.

The Master Plan permitted joint doctorates with the University of California and private universities. Only a few such programs exist.
Another questionable policy decision was initiated by the University of California itself. For some years there has been concern inside and outside the system that the University was neglecting an important part of California where there was no UC campus: the Central Valley, the 400-mile long agricultural corridor whose population has been growing rapidly. Not coincidentally, many Latinos reside in this area and the University feels it can serve them better with a campus there. Hence UC began planning in earnest for a new campus at Merced in the late 1990s. The campus, though far from complete, opened its doors in 2005 with the blessing of state policymakers. Building a new general campus with programs at all levels is a very expensive undertaking and enrollments have so far fallen well below projections (Ashton, 2006). Ultimately the University’s strategy to go where the students are may be quite sound but one wonders about the priority of undertaking such a large and continuing financial commitment in the present fiscal context.

In the long run, if for no other reason than simply to sustain its political and financial support from the state, the University of California surely needs to find ways to ensure that its student bodies are much more reflective of the changing complexion of the state. Reflecting very mixed feelings among the citizenry about this emotional issue, in 1995 the Regents of UC (the system’s governing board) voted to end “affirmative action” policies that had permitted vigorous recruitment and acceptance of qualified students of color at both the graduate and undergraduate levels. Soon thereafter the voters of the state passed a similar ballot initiative (Proposition 209) that applied to all its public colleges and universities. At UC, enrollments of minority students (except Asians and Pacific Islanders) at both levels declined for a few years after this prohibition took effect. The University made great efforts to find legal ways to reach out to underrepresented groups of students—even to help improve their prior educational preparation—and to evaluate applicants more “holistically,” i.e., not relying so heavily on prior academic performance and test scores alone. After a few years, enrollments of minorities again began to increase. Figure 4 shows the trends in the major minority student categories from 1990 through 2005 separately for undergraduates and graduate students.

---

18 The ban took effect with the Fall 1998 entry cohort.
UC has made serious efforts to increase minority representation in its student body but it seems clear that the self- and then state-imposed inability to take race or ethnic origin into account in admissions has taken a toll on progress among Latinos and other seriously underrepresented groups such as blacks and Native Americans. Comparisons of enrollments of each of these groups as a percentage of all enrollments by level (Figure 5), shows that Latinos have gained only 2.1 percentage points at the undergraduate level since 1991 and just 0.4 points at the graduate level, while blacks have actually lost ground at both levels. Only Asian Americans and the small “other” ethnicity category have made strong gains. Clearly, more will have to be done to increase the rate of progress in the Latino category in particular if the University is to retain full political viability over time as California’s population changes and this group moves toward majority status.

CALIFORNIA’S ECONOMY AND ITS LINKS TO ACADEME

California is a research- and science/engineering-oriented state. Table 1 provides some statistics from the National Science Foundation that support this. The state ranks first among the fifty U.S. states in most gross measures of scientific and research and development activities and, even allowing for its large population (about one-eighth of the U.S. total) and economy (13 percent of U.S. GDP), nearly all of the indicators in this compilation show California to be well ahead of national norms. Thus, it is not surprising that California’s economy has long been linked to academe and public policies relating to it.

The State, the University, and California Agriculture

For much of the first century after statehood, agriculture was California’s leading industry and continues to be very important today owing largely to the state’s favorable climate and soils. In 1867, Governor Frederick Low helped bring together the supporters

19 The large percentage increase in the “other” category seems to reflect rapidly changing views about race and ethnicity in America with increasing immigration and intermarriage.
of the small, private College of California with the state officials responsible for the federal land grants under the 1862 Agricultural College Land Grant Act (Morrill Act) to form what became, in 1868, the University of California (Scheuring, 1995). The University has long had a close relationship to the state’s farmers and, more recently, its agribusinesses through research and development, degree-oriented education—both supported substantially by the state—and Cooperative Extension (originally the Agricultural Extension Service), which provides a variety of outreach services and is jointly supported by federal, state and local governments. While not unique to California, this extension model—taking university research findings directly to the users and maintaining close touch with their problems and needs—is generally considered a great success story in public science and technology policy (Rasmussen, 1989). Among the notable success stories of UC agricultural research was critical support of the now huge California wine industry through early research on grape diseases and the development of disease-free plants at UC Davis. Also, beginning in the 1940s, scientists at Berkeley developed very productive strains of strawberries that now represent the vast majority of those planted commercially. As of 1995, California strawberries accounted for about 80 percent of U.S. production (Farrell, 1995, ix).

In recent decades, in response to trends in environmental and social awareness and criticism that it was too focused on the needs of its agribusiness clientele, UC’s agricultural research and applied activities have shifted in significant measure away from pure production efficiency and toward development of sustainable practices and studies of the social impacts of technology and the problems of small farmers and low-income farm workers (Scheuring, 1995; Walker, 2004). Yet, stringencies in state and federal general funding have also cut in the other direction by pushing faculty to look more to private funding and governmental project grants, many of which emphasize production and efficiency issues.

**California’s High Tech Economy and Its Ties to Academe**

---

20 Federal and private funds are also important in supporting research in the agricultural sciences.
The roots of California’s high tech economy go back at least to early 20th century aviation when the likes of Glenn Curtis and Glenn Martin, Donald Douglas, the Lockheed brothers, John Northrop, and T. Claude Ryan were all pioneering in this field in southern California, Douglas with the aid of aeronautical research at Cal Tech (Starr, 2005, 254-256). The Los Angeles area in particular has become a world leader in what is now “aerospace” R & D and manufacturing. Southern California’s entertainment industry has also been a technology leader since the earliest days of both radio and television engineering, fields in which early pioneers had backing from members of the Stanford University community (ibid, 261).

Stanford played a leading role in the origins of the uniquely vibrant innovative complex of technology-oriented firms and spinoffs known as Silicon Valley. As early as 1909 Stanford was involved financially in the creation of a significant small company, eventually named Federal Telegraph Corporation, led by one of its recent engineering graduates (Sturgeon, 2000). A Stanford professor, Frederick Terman, worked on vacuum tubes and supported with about $100 worth of university resources the work of a graduate named Russell Varian whose discoveries ultimately led to the radar used in World War II. Terman also taught and advised two young engineers named William Hewlett and David Packard. After the war, Terman became Stanford’s dean of engineering and later its provost and senior vice president. Key policies of his were to bring promising inventors into contact with Stanford faculty, the creation of the Stanford Industrial Park in 1951—the first tenant was Varian and Associates from whom Stanford earned more than $2.5 million in licensing fees on patented inventions from its $100 investment—and the establishment of the Stanford Research Institute (Starr, 264).

Terman’s fertile mind in both engineering and institutional design played a significant role in the creation of the hotbed of technology-oriented entrepreneurialism around

---

21 Lockheed Corporation also has substantial R & D and manufacturing operations in the Silicon Valley area of northern California.

22 The company developed some of the technology for wireless telephone and telegraph services on the west coast of the United States and became an important Navy contractor before and during World War I. Stanford’s High Voltage Laboratory and several of its professors played important roles and in turn the lab received donations from the company (ibid, 21-22), an early example of a mutually productive relationship between academe and corporate R&D.
Stanford and environs that is Silicon Valley. Stanford had an indirect role in the development of silicon-based semiconductor and microprocessing technology developed by new companies like Fairchild Semiconductor and later Intel (265-266). Thus, a private university played an important part but state policy had little to do with the emergence of Silicon Valley.

Meanwhile, UC Berkeley contributed to the development of useable atomic energy under the leadership of physicists Ernest Lawrence and J. Robert Oppenheimer (263), but was not much involved in its commercialization. The San Diego area was an early player in biotechnology and this had much to do with the presence of the scientific prowess of the University of California’s campus there. The rapid development of this campus in the 1960s at a very high level of quality from the outset and with a focus on the life and other sciences was a deliberate public policy step by the state and University leadership (Kerr, 2001). Biotechnology companies have since sprung up as well around the University’s Bay Area campuses (UC San Francisco and Berkeley) and in the sprawling Los Angeles metropolitan area where several UC campuses are located. Early in the 21st century California boasted no less than 40 percent of the nation’s research and manufacturing in biotechnology (Starr, 267).

It is no accident that research- and technologically-oriented industries tend to locate in proximity to leading research universities. Firms in these industries seek such proximity in order to facilitate access to relevant academic research and, even more important, to university researchers and students. Firms may employ faculty members as consultants and occasionally lure one away to lead a corporate lab or project, but the real prize is often access to students and new graduates with fresh ideas and entrepreneurial zeal. As in the early days in Silicon Valley, in crucial fields like computer software and biotechnology small firms begun by academics and/or recent graduates have played a key role in the development of new products and processes and thereby affect regional economic development. Thus, beginning in the 1980s, state policymakers around the country have taken a renewed interest in trying to seed these kinds of developments in

---

23 To be sure, the state and Regents acted in response to aggressive prompting from business and scientific leaders in San Diego led by Roger Revelle (Kerr, 2001; Starr, 2005).
various direct ways with mixed results (see Geiger chapter, this volume). Here, as Geiger and other analysts suggest is important in understanding long-term impact, I will first take a broad view of the role of state policy in supporting the research base.

It is important to remember, though, that California is increasingly a bifurcated society. Its high tech economy is becoming increasingly dependent upon immigrants from Asian countries some of whom probably will not stay as opportunities improve in their home countries. Critically, most of the large and fast growing Latino population group sees only a very distant connection between the elite universities such as UC and its own immediate needs. The University and the state need to break out of the Proposition 209 straitjacket to begin building deeper bonds with this group and prepare them for the contemporary economy and society. Yet, as Schrag’s (2006, chapter two) analysis suggests, whites will likely continue to resist competition for prized University spaces from both Asians and eventually Latinos, especially when anything that could be interpreted as ethnic preference is involved. Unless successfully addressed, these demographic cleavages will eventually erode support for the University and thus for a key engine of research-based growth in the state’s economy.

STATE POLICIES OF DIRECT IMPORTANCE TO ACADEMIC RESEARCH CAPACITY

The Historical Legacy

Very likely, the state’s earlier support of the development of the University of California’s eight general research university campuses and the health sciences campus (UC San Francisco) at a high level of academic quality is the most important policy underlying the state’s academic research capacity. As suggested above, the key policy challenge now is how the state can afford to continue to sustain this base adequately while also supporting the development of a tenth campus, UC Merced, and without resorting to tuition escalation that would be risky to both its commitment to broad citizen access to higher education of the highest quality and to its political standing in an increasingly diverse state.
Another core state policy with a long history is the autonomy of the University of California, which was enshrined in the state constitution when the University was founded (Stadtman, 1970). Many observers believe that the legal independence of UC from the state and the tradition of providing most of the institution’s annual state appropriation in a single, or a few, budget line item(s)—albeit with many specific expectations and understandings underlying—have played a key role in supporting the University’s high academic quality standards (Douglass, 2000; Glenny and Dalglrish, 1973; Trow, 1993). These basic academic autonomy norms in regard to the state’s research university appear to remain strong, a good thing for the nimbleness required in an era of heightened global academic competition. This is all the more true in a polity characterized by tendencies toward political meddling and overregulation that are clearly manifested in state budgetary and other relations with the other segments of public higher education.

More broadly, this autonomy has been interpreted to permit the University substantially more control over its finance, purchasing, contracting, and personnel policies than is typical of American public universities. Of particular importance are two major finance policies: the University’s appropriation from the state and its tuition-setting authority. The University of California’s state appropriation is provided with very few line items directing how the money is to be spent, although there are negotiations with state officials that create understandings about this and the institution is subject to state audits. The University’s Board of Regents retains the authority to set tuition (called fees in California) rates even for state resident students. Although there are discussions with state officials about fee rates in the context of negotiations about state appropriations, its legal control of fee setting gives the University considerable leverage because elected officials generally do not wish to see fees rise too fast, as usually occurs when state support is considered inadequate. While this tactical game applies most prominently to undergraduate fees, graduate and professional fees are also part of the negotiations.

**Faculty Salaries**

The most basic resource for developing and maintaining academic quality and research capacity is of course a quality faculty. The state and the University of California
developed such quality in large part by being willing to pay premium salaries to attract and retain top faculty (Kerr, 2001). This aspiration is nicely illustrated by the official institutional comparison group that UC and the state use to calibrate where average UC salaries should be. Unlike most public research universities, the University of California’s official peer group includes four of the top private universities (Harvard, Yale, MIT, and Stanford) in addition to several strong public universities (Illinois, Michigan, SUNY-Buffalo, and Virginia).  

The peer group is indeed strong but the state’s recent performance in actually funding the University’s faculty salaries to this level is another matter. **Figure 6** shows the actual percentage salary increases provided in each year from 1990-91 through 2005-06 against the percentage that would have been needed to attain parity with the average faculty salaries in the peer group. After a much better performance in the 1980s, in only four years of the most recent sixteen was the actual increase equal or nearly so to the parity level: in 1990-91 and in three years during the state’s economic boom in the late 1990s and very early 2000s. In all the other years, the peer parity target was substantially higher than the amount the state provided for faculty salaries. Since 2000-01, the gap has widened considerably so that, as of 2006-07, a 14.5% increase would have been needed to reach parity with the average of the eight official peer universities’ salaries. It is also worth noting that UC faculty received no salary increase at all for three consecutive years in the early 1990s and did little better during the economically difficult years from 2001-02 to 2004-05. These trends are cause for concern about the University’s ability to continue to attract and retain faculty equal to the best in the country.

**Graduate Enrollments**

Strong graduate programs and abundant graduate students are crucial to the success of university research programs. For many years though, the University of California was unable to expand graduate enrollments as it wished because of financial constraints imposed by the state and pressures to expand undergraduate enrollments as

24 The inclusion of SUNY-Buffalo in the group is the only one that seems somewhat anomalous. It ranks far below the others in receipt of federal research and training funds.  
25 The parity levels are estimates necessarily made before some of the schools have announced their annual salary increases, so there is some inaccuracy.
the higher priority. During the halcyon days of the University’s expansion, the state paid a premium in its appropriation for each additional graduate student enrolled, i.e., a substantially larger amount than for undergraduates. Although this premium was eliminated by the state budget authorities in the 1970s, the UC administration, with its constitutional autonomy and independent funding sources, was able to continue it at a reduced level for considerably longer. Eventually, in the 1990s, the premium payment for graduate enrollments was eliminated entirely. That, plus the state’s fiscal travails already recounted, made it virtually impossible to expand graduate programs substantially.²⁶

Figure 7 illustrates the stagnancy in systemwide graduate enrollments during the 1990s while undergraduate numbers grew by 16%, all in the middle and latter parts of the decade (1994-2000). From 2000 to 2005 however, graduate enrollments started climbing for the first time in decades, increasing nearly 20% over these five years, compared to 12.7% for undergraduates. Much of this increase was the product of two initiatives, one to double graduate enrollments in engineering and computer science—inspired by then-governor Pete Wilson with considerable corporate encouragement—and the second, also largely externally driven, to sharply increase the University’s output of teachers and administrators for the public schools.²⁷ In many other fields there was little change even in the recent period. UC administrators think that the fiscal and political climate is such that new graduate programs and substantial enrollment increases need strong external interest to generate the political and financial support to be viable. This usually means

²⁶ California’s historic ability to import highly educated people could conceivably have played a role in the state’s unwillingness to finance expansion of costly graduate programs. (In general, the state-dominated U.S. system of financing public research and graduate universities with a national reach may suffer from tendencies toward underinvestment by state patrons who feel they cannot capture all the benefits of their investments.) At present, there is more concern that historic patterns of in-migration of the highly educated may be stifled by a combination of federal immigration restrictions and the state’s high urban cost of living.

²⁷ Other fields with notable increases over this period were health sciences and professions, business, and both the physical and life sciences (California Postsecondary Education Commission On-Line Data System, accessed October 18, 2006).
that specific fields, often those of clear economic relevance (see fields mentioned in previous footnote), must be emphasized.  

In addition to some targeted state support and reallocations from other parts of the budget, the recent gains in graduate enrollment have been financed in part by increased fee (tuition) revenue, from undergraduates as well as graduate students and particularly graduate professional students. Faculty and administrators generally feel that the limits of this strategy have been reached. The necessary cross subsidies among fields are unpopular internally and those from undergraduates to graduate programs could become politically problematic. Also, grants and instructional budgets must be charged for much of the higher fees, which these budgets must cover for graduate student research and teaching assistants. Finally, graduate students who are unsupported must pay the higher fees, which usually means higher loan debt and eventually will make recruiting the best students difficult.

**SCOPE AND RANGE OF STATE-SUPPORTED RESEARCH IN CALIFORNIA**

Having provided essential background on California’s historic policies with regard to higher education and UC, including its recent challenges that have led to flagging support of the core human infrastructure underlying the research mission, we now turn to the examination of the state’s policies toward research *per se*. While nearly all of these involve the University of California in some way, not all of the state’s academically oriented research is now overseen by UC, which is a relatively new departure. The entire picture is a fascinating one and in many ways very typically Californian.

First, it is important to note again that the Master Plan designated the University of California as the primary academic research agency of the state. This has been taken quite seriously over the years so that the University has been assigned a number of research-related tasks—only partially compensated financially—that might best be described as technical assistance to state agencies. Two prominent examples are

---

28 Faculty, i.e., the Academic Senate, are more wary though, preferring that the University set its own academic priorities in this matter as in others.
assistance with various aspects of the research program of the state environmental protection agency and participation in regular review of the impacts of proposed changes in health benefits in the state’s public assistance and social services programs (Auriti, 2006). This role appears to be more extensive than that typical of public research universities in the U.S. The University and the state have gone as far as to set up a California Policy Research Center that performs over $1 million per year on research and policy analysis for the state and gets considerable attention from the UC Vice Provost for Research who sits on its board. Within the Center are several ongoing applied research programs on such topics as access to health care for low-income populations, the Welfare Policy Research Project, and the UC Latino Policy Institute. The Center also maintains a technical assistance capability for responding to policymaker requests in a wide range of fields and supports an annual grants competition for UC faculty interested in researching topics of importance to the state.\textsuperscript{29}

As described earlier, the University of California is also the state’s land grant university under the federal Morrill Act and thus has special responsibilities and resources for agricultural research and extension services. While many other states also have a land grant university with such responsibilities, the function is quite important in California given the continuing importance of its agricultural sector. Moreover, in California these activities are not limited to a single campus as is usually the case elsewhere.\textsuperscript{30}

According to UC figures, the University received about $189 million in state support for research\textsuperscript{31} in fiscal year 2006, of which $173 million was for direct research costs (\textbf{Figure 8}). The total peaked at $201 million in FY 2002, but in the subsequent state budget reductions, was cut back to a low of $186 million in FY 2005 before recovering a

\textsuperscript{29} See \url{http://www.ucop.edu/cprc/pubs2.html}.
\textsuperscript{30} Although the center of UC’s agricultural research and education activities long ago migrated from the Berkeley campus to UC Davis (originally the site of the University Farm), Berkeley continues to house programs in the agricultural sciences and there remains considerable activity at the Riverside campus in southern California, originally the site of UC’s Citrus Experiment Station.
\textsuperscript{31} As is customary, this does not count the less targeted but in all much larger state support for research that is built into the workload expectations (i.e., division of time between research and teaching) of state-supported faculty.
bit. Using 2004 for comparison purposes since it was the latest year for which federal data were available at the time of writing, UC’s state research support represents almost 8% of its federal plus state R&D funding.

A very wide range of research programs receives state support across the vast ten-campus University of California system. Of course, mission-oriented state agencies, like the state department of agriculture and the environmental protection agency, support specific research studies. But much of the state money goes to support substantial, ongoing research programs. A number of these were initiated by the legislature or by ballot initiative.

The “Special Research Programs”

One important and long-standing set of state research programs is dubbed the Special Research Programs and includes three specific state supported programs on HIV/AIDS (established in the early 1980s), tobacco-related disease (established in 1988), and breast cancer (approved in 1993). The HIV/AIDS program was begun in the early years of what was to become the AIDS pandemic on the initiative of UC San Francisco and UCLA medical school faculty who recognized that research was needed to understand and combat the new scourge. California’s effort largely predated research support on this topic by the National Institutes of Health, the nation’s major medical research support agency. These faculty then worked with the very powerful Speaker of the Assembly, who was from San Francisco, to get legislation passed authorizing and funding a research program at the University. Aware that the problem was beyond solution by faculty at two campuses alone and to ensure that the highest quality research was funded, the University initiated an external competition, with peer review processes, to fund AIDS research at California universities and institutes. They also used the state support as seed funding to begin developing proposals for larger scale federal support. The state’s support has now continued for a quarter century and, unlike in the other two

---

32 The total will likely rise substantially now that the California Institute for Regenerative Medicine (CIRM) is fully operational and releasing its grant funds (see below).
33 This estimate is derived by dividing the figure for state support in Figure 8 by the sum of that figure plus the federal support for the same year shown in Figure 2.
34 The Assembly is the lower house of the bicameral state legislature.
Special Research Programs, provides core institutional support for centers as well as project grants.

Much of the funding for the tobacco-related disease and breast cancer programs comes from statutorily designated shares of state cigarette excise tax revenues. The tobacco disease program was created as part of a ballot initiative in 1988 and the breast cancer program five years later by the legislature as a result of advocacy by breast cancer activists and a key legislative champion. The same powerful Assembly Speaker who championed the HIV/AIDS program became a supporter and pushed through the legislature a further increase in the cigarette tax to fund the breast cancer program. Its first grants were made in 1994.

Collectively, the three Special Research programs received some $37 million in state funds in 2006-07.\textsuperscript{35} At the peak in 1997-98, their total state support was more than $80 million (Figure 9). Over their lifetime the Special Research Programs have received more than $700 million in state support and awarded close to 3,000 grants.\textsuperscript{36} As the graph shows, however, the support for the tobacco-related disease program has been subject to dramatic swings and all three programs have experienced erosion of the real value of their state support over time.\textsuperscript{37} The funding problems of the tobacco and breast cancer programs are largely attributable to the erosion of cigarette tax revenue as anti-smoking programs in California have proven remarkably effective.\textsuperscript{38} A proposed tripling of the state cigarette tax (from $.87 to $2.60 per pack) was on the November 2006 general election ballot, which if passed, would have provided a large infusion of funds to

\textsuperscript{35} It should be noted that researchers at other California universities and nonprofit institutions receive many of the grants under these UC-run programs. As of 2007, the share of SRP grants held by non-UC institutions was just under fifty percent (Gruder, 2007).

\textsuperscript{36} Moreover, since one explicit purpose of many of the grants is to “seed” projects that will attract larger scale federal or private funding, the total expended on the projects is likely considerably larger. The data cited came from the UC Office of the President through Charles L. Gruder, executive director of the Special Research Programs (ibid).

\textsuperscript{37} The data in Figure 9 have not been adjusted for inflation.

\textsuperscript{38} The tobacco-related disease program has also been adversely affected by the state’s diversion of a portion of the funds earmarked for research to the state Department of Health Services to support the department’s cancer registry database (ibid).
these two research programs and created yet another program.\textsuperscript{39} The measure failed by a 52%-48% margin.

The HIV/AIDS program’s budgetary ups and downs and general slow decline in real terms are a function of its having to compete for state general funds in the face of much larger, often formula-driven budget competitors and the vicissitudes of the state’s economy. It never had a designated revenue stream like the two excise tax-supported programs. The SRP reports that the programs are all actively involved now in efforts to either broaden their revenue sources or restructure their strategies to ensure continuing impact with declining constant dollar budgets (Gruder, 2007).

**Industry-University Cooperative Research Programs (IUCRP)**

In 1996, driven largely by an initiative of then UC President Richard Atkinson,\textsuperscript{40} a new program was created with both state ($5 million in the first year) and UC ($3 million) support.\textsuperscript{41} It is called the Industry-University Cooperative Research Program, or now more commonly “UC Discovery Grants.” The idea is to leverage corporate support in five targeted research areas by offering the state-UC funds as a match for corporate grants to UC researchers working closely with industrial partners. The purpose of the grants is less seed funding than support for projects with discrete targeted outcomes which may range across the spectrum from basic research to “proof of concept” as a prelude to new product or process development.\textsuperscript{42} The targeted areas are biotechnology,

\textsuperscript{39} The executive director of the Special Research Programs reported that the tobacco program would have particularly benefited from additional funding as its support has declined more while proposals received have increased sharply in recent years. He asserted that the quality is such that the program could readily fund at least twice the current number of grants to support scientific projects that peer reviews of applications indicate are rated “outstanding” or “excellent” in NIH terms (\textit{ibid}).

\textsuperscript{40} Atkinson had formerly been director of the National Science Foundation and also chancellor of the UC San Diego campus, a university with a strong science and engineering emphasis and close ties with industry.

\textsuperscript{41} History and data in this paragraph and the next came from an interview with Julie Stein, acting director, IUCRP (2006).

\textsuperscript{42} In terms of Geiger’s upstream-downstream distinction, the IUCRP is probably the one California research policy that strays somewhat from the general upstream policy thrust but it would still best be classified as mid-range rather than downstream in its primary orientation.
electronics manufacturing technology, digital media, network communications, and information technology for the life sciences. In addition, a much earlier state-corporate research matching program in microelectronics (“MICRO”), dating back to the early 1980s, was brought loosely under the IUCRP umbrella.

MICRO receives about $5 million in state funding per year. State funding for the other programs was quickly ramped up from the initial $5 million in 1996, when only the biotechnology program existed, to a peak of $17 million in 1999 for all the programs. The University’s contribution, having served its initial purpose of helping to bring in state funding, remained at its original $3 million level. The IUCRP suffered cutbacks in its state support in the economic downturn of the early 2000’s, so that currently it receives about $14.7 million from the state while UC support remains at $3 million annually. Corporate support overall has more than matched the state and UC contributions. According to the IUCRP leadership, all the programs continue to attract many quality grant applications from UC-industry partners except that the IT in the life sciences program, the one most recently developed, has had some trouble attracting the expected level of interest.

California Institutes for Science and Innovation

Still another notable state venture into research at UC is the program called California Institutes for Science and Innovation, or “Cal ISI’s.” This effort was begun officially in 2000 as an initiative of then Governor Gray Davis with important support from influential corporate leaders and at least one UC regent acting independently. The state’s economy was riding very high at the time and the governor was intrigued by the idea of developing at the University large-scale interdisciplinary research programs relevant to the state’s economy. The result was a proposal for substantial state support for three such multi-campus institutes in specific fields identified by the governor and the key supporters. The University insisted on a broader competition with campuses or combinations of them submitting proposals which then went through both external and internal peer review processes. Initially three institutes were approved and funded with a fourth following soon thereafter. The four California Institutes for Science and Innovation now operating are:
• California Institute for Quantitative Biological Research- lead campus is San Francisco with collaboration from Berkeley and Santa Cruz.
• California Nanosystems Institute- lead campus is Los Angeles with collaboration from Santa Barbara.
• California Institute for Telecommunications and Information Technology- lead campus is San Diego with collaboration from Irvine.
• Center for Information Technology Research in the Interest of Society- lead campus is Berkeley with collaboration from Davis, Merced, and Santa Cruz.

State funding for the four institutes totaled $400 million over four years, which went mostly toward buildings and other capital assets. Acquisition of federal and private gifts and grants was a requirement for receiving the state funds and the Institutes have built substantial physical and human infrastructure and supported considerable research. As the main institute buildings neared completion, concerns arose on the affected campuses and in the systemwide Academic Senate about the institutes’ ongoing operating funding, however, since the state has provided only about $5 million annually for this.\footnote{Coleman, 2007. The University’s Office of the President also provides about $5 million from internal funds.} Somewhat surprisingly in light of the history of the institutes as a Davis Administration initiative,\footnote{Governor Gray Davis, a Democrat, was recalled (turned out of office) by voter referendum in 2003 after which Republican movie star and former world champion body builder Arnold Schwarzenegger was elected governor. Evidently, the University considered the Institutes’ operating costs item a high priority in its budget request and Schwarzenegger was able to package this support as part of a “Governor’s Research and Innovation Initiative” in his FY 2008 budget proposal (see http://gov.ca.gov/index.php/?press-release/5004.).} the University persuaded Governor Schwarzenegger to seek $19.8 million in his fiscal 2008 budget proposal for core operating support for the four institutes. The University hopes eventually to see the state’s core support increase to around $35 million per year but the 2008 budget passed by the Legislature again provided about $5 million (UC Office of the President, 2007).

**Other State-funded Research Programs**
Although it is difficult to compile a complete inventory, there is certainly a substantial list of other state funded research programs within the UC system including several often politically controversial labor studies centers, occupational health research centers, the Ernest Gallo Clinic and Research Center at UC San Francisco (named for the famous vintner), and the MIND Institute at UC Davis. The last is illustrative of the way new state research programs are often initiated. It is a multi-million dollar institute created in 1999 for research on neurodevelopmental disorders largely through the efforts of affluent and influential parents of autistic children.\(^{45}\) They had help from campus leaders and a key supportive legislator (Associated Press, 1999). There was also for a few years a program of state support for research at UC San Diego on the medicinal uses of marijuana but this politically controversial effort has fallen out of favor and is no longer funded by the state.

In addition to research programs run through the University of California, the state has in recent years created other mechanisms for administering certain research programs that utilize UC researchers to carry out some of their work. In these cases researchers at other California universities and nonprofit institutions are also eligible for grants, which is only true in some of the UC-run programs. One example was a program created with state general funds in the booming nineties to research “gender-related cancers” other than breast cancer. This program was established as a result of lobbying from advocates for research on particular types of cancer (e.g., ovarian cancer but not cervical cancer). Prostate cancer was included before passage in part to broaden political support. Then-Governor Pete Wilson, who had to sign the legislation to make it law, directed that the program be administered by the State Department of Health Services rather than the University of California. The program ran for several years and UC researchers received grants from it but its funding was eliminated during the state budget retrenchment in the first years of the present decade. It was slated for a rebirth had the ballot initiative to raise the tobacco excise tax, Proposition 86, been passed by the electorate in November 2006.

\(^{45}\) The 2000-01 state budget included $34 million for capital and other costs of the institute (http://www.ucdmc.ucdavis.edu/mindinstitute/newsroom/newsletter/va_n2_MIND_News_winter00.pdf).
The California Institute for Regenerative Medicine

The most notable case of a state research program operated outside the auspices of UC however is that of CIRM, the California Institute for Regenerative Medicine. This institute is an autonomous state agency created by a November 2004 ballot initiative the campaign for which was spearheaded by Robert Klein II, a wealthy real estate developer who is for personal and family reasons a strong supporter of stem cell research. He had the support of a small group of very wealthy and influential friends including corporate leaders. Since the Bush Administration has largely stymied federal support for this potentially medically path-breaking work, with typical California hubris Klein and his supporters felt that the huge state should take the matter into its own hands.46

In media-frenzied California, it is now not at all unusual for wealthy, media-savvy individuals with an issue that can appeal to the public to propose ballot initiatives and pay much of the costs to get them on the ballot, advertised widely, and, sometimes, approved by the voters. The stem cell research initiative was a tall order for the topic was controversial and the bill to the taxpayers would be $3 billion over ten years, funded by bonds to be serviced from the state’s general funds. Yet, it was approved by a substantial margin (59%-41%). Significantly, the initiative’s drafters did not propose that the institute be part of the University of California but rather chose to set up a new public entity, i.e., CIRM, in order to maintain more control. Klein himself is chairman of the board and is widely reported to “effectively manage the agency,”47 although a respected neuroscientist served as president and chief scientific officer until recently.48

The emotional politics surrounding stem cell research in the U.S. largely hamstrung the fledgling institute for more than two years. Both anti-stem-cell-research advocates and fiscal conservatives challenged CIRM in court and prevented it from

---

46 The states of Connecticut, Illinois, Maryland, New Jersey, and New York have launched stem cell research efforts of their own, though on a smaller scale (Hamilton, 2006; Schwarzenegger Orders…(2006); Fischer (2007).
47 Hamilton (2006).
48 Dr. Zach Hall resigned in April 2007. One reason he cited was the ill will created by disagreements within CIRM’s complex governance bodies over the extent of public involvement in processes for oversight of capital projects (Somers, 2007c).
utilizing any state funds beyond an initial $3 million loan. Yet, during this period the institute managed to hire a staff of 19, occupy a headquarters building in San Francisco and, in late 2006, to make $12.1 million in training grants to 169 young researchers at 16 California institutions, the majority at nine different UC campuses. All this was made possible by multi-million dollar private gifts raised by founder Klein and his friends. Later, they raised larger sums, some $32 million, from philanthropists by issuing with the state treasurer’s approval “bond anticipation notes” to be repaid to the lenders from the state’s bond proceeds once the bonds are sold and the funds released.

Anticipating successful resolution of opposition lawsuits, Governor Schwarzenegger ordered the state’s finance officials to provide the institute with a $150 million loan early in 2007 in anticipation of release of the bond funds. CIRM officials initiated their first research grant competition in autumn 2006 and awarded $45 million in grants in February 2007. Shortly thereafter, CIRM awarded another $75.7 million in research grants and $48.5 million in capital funding was expected to be awarded in June 2007. A further $220 million in capital grants was expected to follow shortly after the sale of the first set of bonds authorized by the initiative and now freed up by the courts.

49 Hamilton (2006); Schwarzenegger Orders… (2006). CIRM’s two-year courtroom odyssey likely came to an end in May 2007 when the California Supreme Court declined to review a lower court decision upholding its constitutionality (Somers, 2007b). Under the U.S. legal system, however, creative legal assaults on different grounds cannot be ruled out.

50 Fifty-four of the researchers supported are graduate students (CIRM, 2006b).


52 Hamilton op cit.


54 Somers (2007a).

55 Somers (2007b). The State Treasurer announced the sale of the first $250 million in bonds in early October 2007 (California State Treasurer, 2007). However, after the legal triumph there remained disagreement within the CIRM governance structure about how much should be spent on capital grants to universities and how such grants should be distributed (Brainard, 2007). In December 2007, CIRM was forced to disqualify ten grant applications because letters of support for them were written by deans who also serve as CIRM board members, which was judged to be an unacceptable conflict of interest. Another case of intervention by a board member in a grant application has provoked audits by the Fair Political Practices Commission and the State Auditor (California Rejects…, 2007).
So, the flow of new state funds for research in this field has begun and it will be very substantial.

In addition to the lawsuits—claiming among other things that the line of stem cells CIRM proposed to acquire have patents too broad to be legal and that its operations as an independent state agency are illegal—CIRM’s critics dogged its processes for developing intellectual property policies and ethical guidelines for the research. State legislators and agencies have become involved as many seem to feel that revenue from intellectual property, such as new pharmaceuticals, stem cell lines and processes that could be used in R&D or manufacturing, resulting from research supported by the state should be owned by the state at least to the point of recouping its investment (Somers, 2007d).

CIRM officials feel that such claims by the state would be unrealistic in the marketplace and that research and corporate partners would be unlikely to participate on this basis. The University of California, which has played a role in helping CIRM establish policies, generally agrees with CIRM’s position.56 One knowledgeable UC official even expressed concern that some state officials and the press seem to believe that revenues from CIRM’s future intellectual property should play a very substantial role in paying off the Proposition 71 bonds that finance CIRM. The insiders think that this is unrealistic to plan on given past experience with unpredictable and uneven intellectual property revenue streams. Another politically potent expectation is that any new drugs or treatments resulting from CIRM’s research be affordable to Californians (Somers, 2007d), also a demand that could deter potential partners.

CIRM’s intellectual property policies, adopted in 2006, reflect a compromise position in which CIRM is free to grant intellectual property rights to its grantees (as is the case with federally funded research grants to universities) but retains rights and responsibilities to the public interest such as “march in” rights where a licensee is slow to develop useful products with the CIRM-funded intellectual property (IP), requirements for publication and sharing of biomedical materials, and requirements that nonprofit grantees use their share of IP revenues for scientific research or education (CIRM, 2006a, Streitz (2006). She suggested that a state policy of outright ownership would deter corporate interest in partnering with CIRM or licensing intellectual property resulting from its research in the same way that such efforts at the federal level did when they were attempted.
Also, the IP policies require that exclusive licenses to CIRM-funded IP be granted “...only to organizations with plans to provide access to resultant therapies and diagnostics for uninsured California patients. In addition, such licensees will agree to provide to patients whose therapies and diagnostics will be purchased in California by public funds the therapies and diagnostics at a cost not to exceed the federal Medicaid price” (17).

In short, the CIRM venture is highly politicized. Yet, the University of California, like the leading private universities in California, is clearly anxious to participate. UC San Francisco and UC Irvine, as well as private Stanford University and the University of Southern California (USC), have already made large capital and hiring commitments in order to be prepared for the time when the spigot of CIRM grants opens up fully (Hamilton, 2006).

**STRATEGY AND POLITICS IN STATE-SUPPORTED RESEARCH**

**The State of California**

The state seems to have no overall plan or strategy in research and technology development and does not appear to be capable or much interested in developing one. The variety of programs described above, developed in a more or less ad hoc fashion and accreted over time with some signs of overlap and no real coordination or apparent overarching strategy, are suggestive evidence of this. When one looks inside California government, there is little in the way of institutional structures supportive of strategic or even coordinated policymaking in this area to be found. The legislature has no science and technology policy committees or specialized staff resources that might facilitate taking a broad, strategic view. Facing strict term limits, California legislators have little time to learn about complex S&T and research policy issues and have generally weak political incentives to specialize in this area.

---

57 The discussion on institutional structures over the next several paragraphs draws on Barbour (2005). The general finding of lack of capacity for science policymaking is consistent with Geiger’s (this volume) characterization of state incapacity in this area.
Business, a logical ally, tends to be fragmented in California and surprisingly weak in influence in the capital. Rather, to make a mark in a few years before being forced “up or out” by term limits, legislators are often better advised to focus on fields like health or education that are more easily understood and can produce tangible benefits for constituents regularly. These more established policy arenas also provide more valuable political resources such as a potential committee chairmanship, access to a well-informed staff cadre, and more or less guaranteed media coverage.

A similar gap in appropriate institutional structures appears in the executive branch. In the budget crisis of the early 2000’s, the state eliminated its Technology, Trade and Commerce Agency, which had included, for a few years, a Division of Science, Technology and Innovation.58 Only a small remnant remains of this unit at the state Department of Business, Transportation and Housing. The only other science and technology oriented agency is the California Commission on Science and Technology, a small, state chartered but privately funded entity with an advisory role but limited capacity and visibility.59 The Governor’s Office itself has never had a formal science and technology strategy or analysis capability, depending instead largely on input from stakeholders.

Governors have evidently only rarely shown an interest in broad strategic thinking about S&T or research issues. The current governor, Arnold Schwarzenegger, has shown some interest, especially once it became clear that the state’s economy had fully recovered from the recession-induced budget straits that dogged his predecessor. Governor Sewarzenegger has advocated strongly for stem cell research and been supportive of CIRM, and recently has shown considerable interest in environmental issues, alternative energy sources, and nanotechnology. His signature initiative is an ambitious greenhouse gas reduction program enacted into law as Assembly Bill 32 in 2006. He has asked the University of California to work with the California Energy

58 Ibid. Barbour reports that during its brief life this unit had a mandate to “track, support, inform, and provide coherence to state S&T policy” and “guided initiatives in biomass, next-generation Internet, rural e-commerce, high-tech manufacturing, and aerospace, among others” (22).
59 CCST depends on membership dues provided by major scientific institutions and corporations in the state, together with foundation grants solicited for some individual projects.
Commission and the State Air Resources Board to develop targets and benchmarks for emissions reductions.\(^{60}\)

In 2007, Schwarzenegger packaged as a “$95 million Research and Technology Initiative” his support of $19.8 million in increased state operations support for the California Institutes for Science and Technology; $30 million in lease revenue bond funding for a new energy/nanotechnology building for Lawrence Berkeley Laboratory’s Helios project (a solar energy technology project); $40 million in similar bond funding for Berkeley’s Energy Biosciences Institute, which helped the campus win a $500 commitment over 10 years for this from the energy giant, British Petroleum; and a $5 million commitment of matching funds for the University of California’s bid for federal support to build the world’s first Petascale computer, a project expected to cost $200 million in total.\(^{61}\) It appears that this was less an executive initiative in the classic sense than a way of packaging the governor’s responses to the University of California’s requests for modest support of its research funding priorities in what was then a relatively favorable budget climate.\(^{62}\)

A few years earlier Schwarzenegger’s predecessor, Gray Davis, had access to a large budget surplus and became interested–with no small help from individuals connected to the University of California–in the California Institutes for Science and Innovation (Cal ISI) initiative, which could be considered a strategic research initiative. But, the vicissitudes of the California economy and politics being what they are, nearly all the money and the governor himself were gone within a few years. It is notable, though, that Governor Schwarzenegger supported this initiative in his fiscal 2008 budget proposal rather than allowing it to wither as often happens when gubernatorial administrations change.

\(^{60}\) CCST (2007b).
\(^{61}\) “Governor Schwarzenegger’s State of the State” (2006); CCST (2007a). UC San Diego was also a finalist for the BP Energy Biosciences Institute and would have received the $40 million in bond funding had it been successful. UC’s Lawrence Berkeley and Lawrence Livermore Laboratories and the San Diego campus are all involved in the Petascale computer bid.
\(^{62}\) Geiger suggests that such gubernatorial behavior in S&T policy is typical (see pages 8-9 of Geiger chapter, 9/06 draft).
The impact of ups and downs in the economy on state budgets is one important factor that makes it harder for states than for the federal government to develop consistent science policies: states face much stronger norms of budget balance than does the national government often necessitating deep cuts in “nonessential” state programs in downturns. The political vicissitudes, at least in their intensity, are more specific to the California environment. Governors in California can be recalled by the voters (although Davis’s recall was the first one in the state’s history) and the state’s politics are generally more polarized and mercurial than is true elsewhere.\footnote{63 See Schrag (2006, chapter 2) for an insightful analysis of the reasons for this. He ties much of it to the rapidity of massive demographic and economic changes as described earlier.}

Indeed, one aspect of the state’s politics makes coherent S&T and related policymaking arguably nearly impossible: the ascendancy of the initiative process. California voters can make their own policies at the ballot box trumping any carefully laid plans of the governor, the legislature or the University of California. The number of such ballot initiatives has grown dramatically in recent decades and many of them bear little or no relation to the programs of leading elected officials. Examples directly affecting academic research go back at least to the cigarette tax initiatives of the 1980s and early 1990s that provided the (not very satisfactory) funding source for UC’s tobacco-related disease and breast cancer research programs, and include both CIRM itself and the failed 2006 initiative to raise more revenue for research from higher cigarette taxes.

Whether the initiative route is used or not, the policymaking vacuum created by the lack of legislative or executive strategic capacity in S&T and research policy sets the stage for ad hoc and often politically-driven policymaking processes to hold sway. In the majority of cases it seems that the state supported research programs at UC were created more by the impetus of individual legislators and citizen advocacy groups, often with the help of individual faculty members operating outside the purview of established University review and priority-setting processes, than as part of either state or UC strategic thinking.
STRATEGY, POLITICS, AND CHALLENGES WITHIN UC’S STATE-SUPPORTED RESEARCH PROGRAMS

The University of California is populated by smart people who very much want to do serious science and institution-building. In dealing with the state in cases where the latter offers, by ballot, gubernatorial or legislative initiative, a new research program not necessarily high on UC’s priority list, the University’s administration seems to make an effort to shape the terms of the program to be compatible with academic norms and values. The early history of the HIV/AIDS research program already recounted is one such example. The insistence by President Atkinson on an open competition for the California Institutes for Science and Innovation, complete with several stages of peer review of proposals, rather than simply accepting the ideas for the institutes of Governor Davis and the project’s early supporters, is another. Most recently the University has sought to influence the governance arrangements and basic policies of CIRM to help ensure appropriate scientific and ethical review procedures in this controversial area of research as well as what it regards as realistic policies around intellectual property. In at least one important case, UC itself took the initiative when President Atkinson developed the basic idea for the Industry-University Cooperative Research Program and, with industry help, persuaded the state to help fund it.

Although sometimes the parameters of state-funded programs are not subject to much negotiation, as in the case of initiative-created programs and some others that have aspects of a crusade in their enactment (e.g., the breast cancer research program), the University tries to guide even these as best it can to produce quality science and useful results for the state. Where the enabling legislation and the politics of oversight permit, University program managers generally seek to devise, or guide oversight boards toward, strategies that emphasize gaps in the federal research portfolio in the field or topics of special interest to the state’s population groups, industry mix or natural systems. This is

---

64 On occasion the University has even turned down state offers of support for research programs it did not feel were a good fit, but this would be unlikely once a program is legislatively enacted. The University of California is after all the primary state agency for academic research according to the Master Plan and is also dependent to a certain degree on legislative good will for its general financial support.
not made easier however by mandates such as one of those of the breast cancer program: to find a *cure* for this affliction.⁶⁵ Some programs explicitly seek to broaden their impact by emphasizing seed grants (or institutional support for research centers in the case of the HIV/AIDS program or Cal ISI’s) that can be used to support competitive proposals for much larger federal funding. Others, such as the IUCRP and the ISI’s, seek to maximize their impact by requiring corporate funding matches and active partnerships.

Serious challenges for research managers are created however by California’s mercurial, polarized and increasingly populist-oriented politics and the intense glare created by its media, not to mention its fiscal roller coaster. New mandates for research programs can emerge unpredictably out of the political process and so can sharp budget cuts or even program eliminations that have little to do with the quality or productivity of the research. Thus program managers must spend a good deal of effort on managing publicity and relations with key stakeholders and keeping tabs on external politics. The state-supported research programs are thus subject to a high degree of political accountability but remarkably little *performance* accountability.⁶⁶ Not only is it hard to find any sign of serious performance oversight from Sacramento—which might not be desirable anyway in regard to academic research if not very expertly done—but the University itself seems to have done little to evaluate these programs through its normal periodic academic review processes.⁶⁷ The IUCRP is not subject to 5-year academic reviews normally required of UC’s multicampus research programs.⁶⁸

It may well be that, in some cases, this lack of oversight makes it possible for good R&D managers, working with a well constructed structure of advisory boards, peer

---

⁶⁵ An interviewee told of a conversation at the outset of this program in which the legislative champion asked a University vice president whether he judged that the cure would take three years or four. The program spends about $15 million per year (see Figure 9), a very small amount in comparison to the sum of federal and private efforts.

⁶⁶ This is not to say that the programs themselves do not make efforts to measure their performance. The IUCRP maintains an Economic Research Unit that surveys companies, researchers, and students about the impacts of its grants and publishes the results.

⁶⁷ A recent exception is the process for academic reviews of the Institutes for Science and Innovation that is now underway after considerable agitation by the Academic Senate.

⁶⁸ There is some internal accountability however in that IUCRP has members of the University’s committees on research and budget planning on its steering committee (Stein, 2007).
review panels and high quality researchers, to simply do their work efficiently with UC’s strong internal academic quality standards serving as the primary form of accountability. Yet, it is clear that in some cases the political pressures have permeated rather deeply into these structures. A case in point is the breast cancer research program. Created by ballot initiative, the statute specifies some of the research priorities, including the mandate to seek a cure, and disease advocates (along with scientists) serve not only on the advisory body that determines broad priorities but also on the panels that review individual research proposals. They may bring not only unrealistic expectations but also nonscientific penchants about causes and remedies that they want to see researched. Although they are supposed to defer to scientific reviewers on questions of pure scientific merit in proposals, the odd mix of scientists and passionate advocates with political and media connections on the boards and panels is a very considerable challenge to manage while ensuring that the most significant and sound science is pursued.

Yet, the breast cancer program has faced fewer budget challenges than either the HIV/AIDS or the tobacco program in part because the advocates are so committed to the program and are seen as a formidable bloc. The tobacco program has been less able to ward off attacks on its budget. The HIV/AIDS research program has experienced attempted raids on its budget and successful skewing of its research priorities by pressures to allocate large resources to the testing of drugs for treating patients and the investigation of a particular, very high cost treatment approach, organ transplantation, that was not widely accepted as a high scientific priority.

The California Institutes for Science and Innovation face the usual types of questions about skewing of academic research priorities to meet the interests of industry but the issues became more acute as the Institutes built substantial infrastructures needing ongoing financing while lacking much ongoing, earmarked state operating support. If the latest efforts by the University and governor had been successful in securing this, the tensions would likely have been considerably alleviated. Faculty concerns about these institutes have been manifest in the Academic Senate and it will be illuminating to see how the Senate program reviews of them now begun turn out.

69 Such advocates must be from outside California but their local counterparts are invited to observe the panel meetings.
The UC Discovery Grants (IUCRP) program faces a different kind of internal management problem. California, however large, is a state not a nation. Under some pressure to see that its long-stagnant state dollars are spent mostly on grants, the program uses only peer reviewers from within the University of California who serve without compensation. Since three rounds of grants are made each year within fairly narrowly specified fields, this makes it hard to vary the peer review panels sufficiently. It also makes for some potentially serious compromises with the assumption of anonymity at the heart of the peer review system, an assumption that is much more plausible in a more broadly based, i.e., national, system. Thus, reviewers are provided access to the applicant’s vitae and grant track record. It is also likely to be possible in many cases for applicants to surmise who their reviewers are likely to be. Over time, even without any explicit collusion, a mutual “back scratching” pattern of application approvals could easily develop within this closed system. Also, individual judgments by one or two researchers about the merits of another or of a particular research direction or approach may come to play too great a role. These potentially serious problems are difficult to avoid given the constraints the program faces.

THE STATE ROLE IN TECHNOLOGY TRANSFER

The University of California, which performs some $3 billion worth of externally funded R&D each year, has a substantial technology transfer operation as would be expected. The University grossed about $110 million per year in revenue from patent-related activities in 2005-06 of which more than $52 million was distributed as discretionary revenue to the campuses (UC Office of the President, 2007, 10, 13). The balance goes to cover technology transfer legal and administrative costs and reward inventors and their departments by established formulas. These are fairly modest amounts in relation to UC’s total research budget but all significant discretionary revenue is especially valuable when budgets are tight. According to technology transfer officials, the

---

70 Discovery Grant applicants must also have a liaison and at least a one-for-one dollar match from a California firm.
71 This is not to say that these negative consequences are presently discernible, just that the potential is there.
University’s goals in its technology transfer policies are not primarily financial but rather are to ensure that University research benefits the public and fosters the advancement of nonprofit research generally, for example, by permitting other researchers to use data, methods, cell lines, software and the like on reasonable terms.

Until fairly recently, the state of California was not a large player in UC research and did not have much to say about technology transfer policies which were largely seen as between UC, the federal government and corporations. Recently, as state research support has grown, there has been much more state interest in intellectual property and related issues and the associated potential revenue streams. There is no overarching state policy however. Different supporting agencies ask for different things and are not necessarily consistent over time. The legislature has become involved at times but there is still no consistent policy. The Davis Administration authorized a commission to study what the state’s policies should be. This commission reported shortly after Governor Davis was removed from office and Governor Schwarzenegger has evidently not paid much attention. The legislature subsequently requested a report from the California Council on Science and Technology, which sought to “…lay the groundwork for an informed discussion on building a comprehensive set of state policies governing the creation and administration of IP developed with state support” (CCST, 2006, 1). These reports generally make sensible suggestions about standardizing state intellectual property policies. The problem seems to be that there is no body competent to receive them or motivated to act on them at the state level.

As a result of the debates surrounding CIRM’s intellectual property policies, UC officials fear that the state may become increasingly aggressive in asserting ownership rights to inventions and copyrights derived from research it has funded. The state seems to be moving toward seeking a guarantee of “recoupment” of its costs on projects that generate significant revenues. The University is concerned about this trend for it feels it needs this revenue to help fund the costs of technology transfer efforts—which as

---

72 An exception was in agricultural research, which, as explained earlier, has a long history of state involvement.
74 It should be noted that this thrust runs generally counter to the post-Bayh-Dole Act policies of the federal government.
noted are designed more to achieve public diffusion goals than to make money–on the many projects with public benefits from such transfer that do not generate revenues.\textsuperscript{75} State agencies also sometimes seek to assert ownership of data generated in state funded research projects. The University has resisted this vigorously in order to be able to utilize such data in future research–either its own or that of other nonprofits–but results of negotiations with state agencies have varied as to precise terms.

Of particular concern to the University are some of the technology transfer related issues recently debated in the context of getting CIRM up and running. Although ballot Proposition 71 that created CIRM does not state that revenues from its intellectual property must be dedicated to helping service the state general obligation bonds that support it, such an expectation has evidently grown up in political and media circles. The University of California, in providing comments to CIRM and its advisers regarding intellectual property policies for the Institute, has sought to damp down this expectation fearing that it will create unrealistic expectations, undesirable incentives, and difficulties in securing private sector participation. The University may also be concerned that it might find itself subject to similar pressures in regard to its own state-supported research. Further, political efforts to ensure that pharmaceuticals and therapies created from CIRM research are judged affordable to Californians could, if regulations are too tightly drawn, also deter corporations seeking to license CIRM technologies. Finally, although CIRM is planning to assert “march in” rights (to declare licensees in noncompliance with terms of their license agreements\textsuperscript{76}) similar to those in federal law, UC is concerned that CIRM may come under political pressure to interpret these more aggressively than federal agencies have, thus creating further hesitancy in the minds of potential licensees. These concerns may apply specifically to CIRM at the moment but, given the scope and visibility of that enterprise, its policies in this fluid field could easily influence those of the state and even federal governments.

\textsuperscript{75} The state has long declined to pay for any of the costs of the technology transfer function.

\textsuperscript{76} Examples of such terms might include: due diligence by the licensee in utilizing the technology to create therapeutic products; requirements to provide Californians with “affordable” prices for such products; and requirements for payment of specified percentages of license revenues in royalties to the state.
ASSESSMENT OF THE PLUSES AND MINUSES OF THE STATE-SUPPORTED RESEARCH PROGRAMS IN CALIFORNIA

California is a large, varied and complex state so it is to be expected that the state has particular research needs on which it turns to its world-renowned public university for help. Forty-seven years ago the state’s Master Plan for Higher Education declared the University of California the state’s primary agency for academic research and this designation has been taken seriously. While some of the research on broad human afflictions like breast cancer and tobacco-related diseases that the state pays for might in an ideal political economy be financed at the federal level, there is little doubt that the considerable additional state investment adds social value, even if not exclusively for Californians. In this huge and traditionally optimistic state, Californians often have the hubris to think that they can cure cancer or AIDS or develop powerful new therapies from human stem cells on their own—and indeed perhaps they will. In reality, most of the state research programs give particular attention to state needs and to the fact that they can often best serve by strategically complementing much larger federal efforts in their fields.

The fact that the passions and priorities of the public can be made known directly at the ballot box in California has almost certainly generated more state tax money for research than would have been forthcoming through more conventional political processes, especially in light of the limited capacity of the state’s governmental institutions in this sphere. In the unique case of stem cell research where ideological disputation has stymied the federal effort, California voters have performed a valuable function by stepping into the breach. The sheer size of their contribution may well move the field forward significantly, and also help retain leading researchers in the country, until the federal government is ready to assert its customary leadership role.

On the negative side of the ledger regarding the state’s role in supporting research, there are a number of points to make. Feller (1997), Geiger and Sa (2005), and

---

77 This of course could only be true in a limited sense for even a “breakthrough” advance would owe much to the published science from all over the world that has gone before.
Geiger (chapter in this volume) have pointed out some of the limitations of states as instruments of science and technology policies and California’s efforts seem to suffer from all of these in addition to unique challenges of its own. Most fundamental perhaps is that California, like other states, lacks “honest broker” institutions comparable to the National Science Foundation or National Institutes of Health at the federal level with strong norms of scientifically based selection of both priorities and projects within broad research fields. After long and generally very successful experience, these norms are widely accepted by political leaders, sufficiently so as to create a strong counterweight to the inevitable political pressures that tend to distort priorities and push toward excessive, politically driven geographic spread of grants at the expense of peer review processes.  

The presence of respected oversight agencies with such norms also makes it more difficult to deemphasize or terminate sound research programs when administrations change than is the case when research programs are less insulated from politics. The University of California seems to do its best to perform this broker role but cannot be fully effective when it is a research performer as well as a broker and is so dependent upon the good will of state politicians for its core institutional financial support. 

A second major challenge for state research and science policies is the instability in state budgets which, combined with structural rigidities that work against research programs in budgetary competition, can often lead to abrupt cuts or even elimination of them for reasons unrelated to their value or productivity. While the fluctuations of capitalist economies are at the root of budget instability, state supported programs suffer more from ups and downs than federally supported ones simply because there are laws and, usually, strong norms against deficit spending in state finance that do not apply at the federal level. California’s revenue structure, with its heavy dependence on volatile capital gains taxes, is particularly prone to dramatic fluctuations. Political polarization and legal limits on the length of service of elected officials (just six years in the Assembly and eight years in the Senate) in California add to instability and generally

The growth of non-peer-reviewed earmarks in the federal academic and science budgets in recent years is, to be sure, a worrisome trend. Notably though, the Democratic Congressional majority elected in November 2006 largely rejected such earmarks in its first major appropriations legislation.
make it more difficult to sustain a stable environment for complex programs with long-term horizons such as those that support research.

Feller and Geiger both suggest that states are much less well equipped than are national authorities to demand accountability from science and technology programs, which at the state level are driven largely by the priorities of the politically influential. This is certainly the case in California where the pressures on research programs for political accountability are all too clear but the constituency for substantive accountability is remarkably weak.\(^79\) Even the University of California has done relatively little to formally review the performance of state supported research programs to date and there seems to be little or no pressure from Sacramento to change this.

Unlike at least a few other states, California seems particularly unable to generate broad strategic—as opposed to ad hoc and politically driven—thinking about state research policy. Surely high-technology-oriented California could benefit from such thinking. While occasionally governors have moved in this direction and could do so again—indeed, Governor Schwarzenegger has recently shown some such inclinations—there is little guarantee that a governor’s plan, however well conceived, would long survive his term of office. And, there are no permanent, competent institutional structures in either the executive or legislative branch to help develop or sustain any such hypothetical state strategy. Interestingly, the initiative process could conceivably help with continuity in the sense that an initiative can provide a permanent statutory basis and revenue source for a program as well as a sense of political mandate that may survive quite a while. In general though, the politically saturated initiative process would seem an unlikely vehicle to enact a comprehensive research or science policy strategy for the state.

Finally, as the discussion of the challenges facing peer review in the UC Discovery Grants program suggested, even a state as large as California faces difficulties in sustaining sufficiently broadly-based peer review processes, which are fundamental to effective research programs. CIRM plans to work around such problems by utilization of national (and even international) advisory groups and peer review panels. This may

\(^79\) This seems all the more paradoxical in light of the professionalism of the state governmental staff and the high level of sophistication of the state’s intelligentsia generally.
prove expensive to this now well-funded agency but is surely well worth the expense. It may not be practical for many state research programs however where the funding involved is small and there are powerful incentives to spend most of it on the research itself, narrowly defined.

CONCLUSION

California’s policies toward research and the academic infrastructure that largely supports it are clearly a mixed bag. They certainly reflect both the history and current fiscal and political climate in the state. The latter are both volatile and problematic for the academic enterprise and the state’s research initiatives.

In terms of core financial support for the University of California, the historical legacy has created an unusually strong base but recent trends have been corrosive at the edges and probably beyond. The immediate future is problematic as the state’s general fiscal policies are probably unsustainable and the University may be near the political limits of large tuition increases and cross subsidization, particularly of graduate education by undergraduate tuition revenue. Although recent, widely publicized accountability concerns related to executive compensation do not help, the more serious long term threats to the University in light of this sober fiscal environment may be the financial dilution threatened by the need to develop the new Merced campus and the aspirations in doctoral education of the much larger California State University system. Most importantly, it can be persuasively argued that the state’s highest priority needs in education policy are at the K-12 and undergraduate levels where the performance of the burgeoning populations of color is seriously lagging. If not corrected this weakness will ultimately impact the University’s graduate programs and research capacity. In this rapidly changing demographic environment, UC’s medium- and long-term capacity to serve the state is further hindered by the limitations created by the voters in Proposition 209, which severely hamper its ability to move its student bodies, both undergraduate and graduate, in the direction of the ethnic composition of the state’s young population.

Given this context, it is not clear that UC’s graduate programs will be able to get much additional priority even in the face of real concerns about their competitiveness in
funding graduate students. Programs that can best compete for emphasis and funding will likely be those demonstrably closely connected to state workforce and economic needs, which may mean that those in science and technology oriented fields will do tolerably well. This would support the research mission in those fields at least but may lead to seriously uneven health and development of graduate fields within the institution.

The research programs that the state explicitly funds are, overall, impressive in range and level of state support. Many undoubtedly produce significant results in scientific terms and progress on certain state objectives, although evaluation mechanisms are very weak outside of traditional scholarly assessments. Besides lack of evaluation, the main problem with these programs is their politicization. Although the politically driven birthing processes of most of the state research programs may produce more resources for research, at least for a while, than would otherwise be forthcoming, they also create serious challenges for ensuring strategic prioritization, sensible allocations within programs, and even on occasion for appropriate peer review of individual project proposals.

For all its problems the University of California remains a great and very broad and deep system of public research universities infused by strong quality norms and academic values. The taxpayers—not limited to residents of California—doubtless get their money’s worth from the vast bulk of the state-funded research at the University. There are many ways in which the results could be made still more impressive but progress is mainly dependent upon more effective state political leadership and institutional reform—especially building of state science and technology policymaking capacity—on research and related matters. It is far from clear that this will be forthcoming any time soon.

---

80 Of course these two shortcomings are related. The political stakes undermine incentives for objective evaluation.
REFERENCES


Gruder, Charles L. (2006, September 14). Executive Director, Special Research Programs, University of California. Interview by author.


Streitz, Wendy. (2006, September 15). Director, Office of Technology Transfer Policy, Analysis, and Campus Services, University of California. Interview by author.


Table 1: Science and engineering profile: California

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>State</th>
<th>U.S.</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doctoral scientists, 2003</td>
<td>76,410</td>
<td>566,330</td>
<td>1</td>
</tr>
<tr>
<td>Doctoral engineers, 2003</td>
<td>22,650</td>
<td>118,540</td>
<td>1</td>
</tr>
<tr>
<td>S&amp;E doctorates awarded, 2004</td>
<td>3,499</td>
<td>26,275</td>
<td>1</td>
</tr>
<tr>
<td>Engineering (percent)</td>
<td>22</td>
<td>22</td>
<td>na</td>
</tr>
<tr>
<td>Life sciences (percent)</td>
<td>22</td>
<td>27</td>
<td>na</td>
</tr>
<tr>
<td>Social sciences (percent)</td>
<td>17</td>
<td>16</td>
<td>na</td>
</tr>
<tr>
<td>S&amp;E and health postdoctorates in doctorate-granting institutions, 2003</td>
<td>7,693</td>
<td>46,807</td>
<td>1</td>
</tr>
<tr>
<td>S&amp;E and health graduate students in doctorate-granting institutions, 2003</td>
<td>51,989</td>
<td>507,247</td>
<td>1</td>
</tr>
<tr>
<td>Population, 2004 (thousands)</td>
<td>35,894</td>
<td>297,550</td>
<td>1</td>
</tr>
<tr>
<td>Civilian labor force, 2004 (thousands)</td>
<td>17,552</td>
<td>148,769</td>
<td>1</td>
</tr>
<tr>
<td>Personal income per capita, 2004 (dollars)</td>
<td>35,172</td>
<td>33,041</td>
<td>12</td>
</tr>
<tr>
<td>Federal spending</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total expenditures, 2003 (millions of dollars)</td>
<td>219,706</td>
<td>2,024,246</td>
<td>1</td>
</tr>
<tr>
<td>R&amp;D obligations, 2003 (millions of dollars)</td>
<td>17,410</td>
<td>91,359</td>
<td>1</td>
</tr>
<tr>
<td>Total R&amp;D performance, 2003 (millions of dollars)</td>
<td>59,664</td>
<td>277,577</td>
<td>1</td>
</tr>
<tr>
<td>Industry R&amp;D, 2003 (millions of dollars)</td>
<td>47,142</td>
<td>198,244</td>
<td>1</td>
</tr>
<tr>
<td>Academic R&amp;D, 2003 (millions of dollars)</td>
<td>5,363</td>
<td>40,055</td>
<td>1</td>
</tr>
<tr>
<td>Life sciences (percent)</td>
<td>58</td>
<td>59</td>
<td>na</td>
</tr>
<tr>
<td>Engineering (percent)</td>
<td>13</td>
<td>15</td>
<td>na</td>
</tr>
<tr>
<td>Physical sciences (percent)</td>
<td>11</td>
<td>8</td>
<td>na</td>
</tr>
<tr>
<td>Number of SBIR awards, 1999–2004</td>
<td>6,476</td>
<td>31,847</td>
<td>1</td>
</tr>
<tr>
<td>Utility patents issued to state residents, 2004</td>
<td>19,488</td>
<td>84,268</td>
<td>1</td>
</tr>
<tr>
<td>Gross state product, 2004 (billionls of dollars)</td>
<td>1,551</td>
<td>11,744</td>
<td>1</td>
</tr>
</tbody>
</table>

na = not applicable.
S&E = science and engineering.
SBIR = small business innovation research.

Notes: Rankings and totals are based on data for the 50 states, District of Columbia, and Puerto Rico. Reliability of estimates of industry R&D and of doctoral scientists and engineers varies by state, because sample allocation was not based on geography. Rankings do not take into account the margin of error of estimates from sample surveys. Data on doctoral scientists and engineers include only recipients of doctoral degrees from U.S. institutions in S&E and health fields. The field percentages represent the largest three fields within the state.

Source: National Science Foundation/Division of Science Resources Statistics, Science and Engineering State Profiles: 2003-04
Notes: Population projections are based on historical rates of change for immigration, birth, and death. Projections for Native Americans are based on 1990 Census. The Census category “other races” is not included.

Figure 2:

Federal R&D Spending and National Ranking of UC Campuses
1997, 2000, 2004

(Dollars in thousands)

<table>
<thead>
<tr>
<th></th>
<th>1997</th>
<th>Rank</th>
<th>2000</th>
<th>Rank</th>
<th>2005</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>UC San Diego</td>
<td>238,569</td>
<td>6</td>
<td>326,037</td>
<td>5</td>
<td>463,946</td>
<td>8</td>
</tr>
<tr>
<td>UC Los Angeles</td>
<td>215,937</td>
<td>10</td>
<td>274,162</td>
<td>12</td>
<td>469,889</td>
<td>6</td>
</tr>
<tr>
<td>UC San Francisco</td>
<td>206,749</td>
<td>12</td>
<td>248,878</td>
<td>14</td>
<td>438,988</td>
<td>12</td>
</tr>
<tr>
<td>UC Berkeley</td>
<td>159,275</td>
<td>22</td>
<td>208,338</td>
<td>21</td>
<td>290,960</td>
<td>26</td>
</tr>
<tr>
<td>UC Davis</td>
<td>104,943</td>
<td>38</td>
<td>141,740</td>
<td>35</td>
<td>240,003</td>
<td>38</td>
</tr>
<tr>
<td>UC Irvine</td>
<td>64,293</td>
<td>74</td>
<td>88,274</td>
<td>67</td>
<td>161,524</td>
<td>56</td>
</tr>
<tr>
<td>UC Santa Barbara</td>
<td>64,915</td>
<td>73</td>
<td>80,754</td>
<td>69</td>
<td>103,955</td>
<td>88</td>
</tr>
<tr>
<td>UC Santa Cruz</td>
<td>24,005</td>
<td>132</td>
<td>25,959</td>
<td>135</td>
<td>62,301</td>
<td>121</td>
</tr>
<tr>
<td>UC Riverside</td>
<td>24,006</td>
<td>131</td>
<td>21,085</td>
<td>147</td>
<td>52,919</td>
<td>129</td>
</tr>
<tr>
<td><strong>UC Total</strong></td>
<td>1,102,692</td>
<td></td>
<td>1,415,227</td>
<td></td>
<td>2,285,004</td>
<td></td>
</tr>
</tbody>
</table>

Note: UC Total for 2005 includes $519,000 appropriated to the University of California Office of the President (UCOP).

<table>
<thead>
<tr>
<th>Year</th>
<th>State General Funds</th>
<th>Student Fees</th>
<th>General University Funds</th>
<th>State % of Total</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>24,498</td>
<td>2,712</td>
<td>2,396</td>
<td>83%</td>
<td>29,606</td>
</tr>
<tr>
<td>1991</td>
<td>23,473</td>
<td>2,763</td>
<td>2,325</td>
<td>82%</td>
<td>28,561</td>
</tr>
<tr>
<td>1992</td>
<td>22,722</td>
<td>3,475</td>
<td>2,506</td>
<td>79%</td>
<td>28,253</td>
</tr>
<tr>
<td>1993</td>
<td>19,585</td>
<td>4,868</td>
<td>2,481</td>
<td>73%</td>
<td>26,934</td>
</tr>
<tr>
<td>1994</td>
<td>18,319</td>
<td>5,311</td>
<td>2,279</td>
<td>71%</td>
<td>25,909</td>
</tr>
<tr>
<td>1995</td>
<td>18,133</td>
<td>5,773</td>
<td>2,445</td>
<td>69%</td>
<td>26,351</td>
</tr>
<tr>
<td>1996</td>
<td>18,252</td>
<td>5,550</td>
<td>2,371</td>
<td>70%</td>
<td>26,173</td>
</tr>
<tr>
<td>1997</td>
<td>18,843</td>
<td>5,466</td>
<td>2,475</td>
<td>70%</td>
<td>26,784</td>
</tr>
<tr>
<td>1998</td>
<td>18,993</td>
<td>5,374</td>
<td>2,456</td>
<td>71%</td>
<td>26,823</td>
</tr>
<tr>
<td>1999</td>
<td>20,945</td>
<td>5,337</td>
<td>2,512</td>
<td>73%</td>
<td>28,794</td>
</tr>
<tr>
<td>2000</td>
<td>21,109</td>
<td>4,812</td>
<td>2,649</td>
<td>74%</td>
<td>28,570</td>
</tr>
<tr>
<td>2001</td>
<td>22,916</td>
<td>4,622</td>
<td>2,661</td>
<td>76%</td>
<td>30,199</td>
</tr>
<tr>
<td>2002</td>
<td>21,175</td>
<td>4,524</td>
<td>2,728</td>
<td>74%</td>
<td>28,427</td>
</tr>
<tr>
<td>2003</td>
<td>18,430</td>
<td>4,478</td>
<td>2,810</td>
<td>72%</td>
<td>25,718</td>
</tr>
<tr>
<td>2004</td>
<td>15,580</td>
<td>5,840</td>
<td>2,984</td>
<td>64%</td>
<td>24,404</td>
</tr>
<tr>
<td>2005</td>
<td>14,205</td>
<td>6,565</td>
<td>2,865</td>
<td>60%</td>
<td>23,635</td>
</tr>
<tr>
<td>2006</td>
<td>14,299</td>
<td>7,070</td>
<td>2,741</td>
<td>59%</td>
<td>24,110</td>
</tr>
<tr>
<td>2007</td>
<td>14,562</td>
<td>6,803</td>
<td>2,662</td>
<td>61%</td>
<td>24,027</td>
</tr>
</tbody>
</table>

Figure 3: UC State, University, and Fee Revenues per FTES, FY 1990-2007

Note: Revenues for FY 2006 and FY 2007 are estimates. Total revenue excludes lottery funds.
Figure 4a: Undergraduate Enrollment Trends for Selected Ethnic Groups, 1991-2005

Indexed to 1991 = 100

Notes: Whites, Native Americans, non-residents, and non-respondents are not shown. The "other" category includes only those denoting an ethnicity other than these or those shown above.

Figure 4b: Graduate Enrollment Trends for Selected Ethnic Groups, 1991-2005

Indexed to 1991 = 100

Notes: Whites, Native Americans, non-residents, and non-respondents are not shown. The "other" category includes only those denoting an ethnicity other than these or those shown above.

**Figure 5a:**


<table>
<thead>
<tr>
<th>Year</th>
<th>Asian/Pacific Islander</th>
<th>Latino</th>
<th>Black</th>
<th>Native American</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>25.3%</td>
<td>11.9%</td>
<td>4.3%</td>
<td>1.0%</td>
<td>1.2%</td>
</tr>
<tr>
<td>2000</td>
<td>34.8%</td>
<td>12.3%</td>
<td>3.2%</td>
<td>0.7%</td>
<td>2.0%</td>
</tr>
<tr>
<td>2005</td>
<td>37.0%</td>
<td>14.0%</td>
<td>3.0%</td>
<td>0.5%</td>
<td>2.0%</td>
</tr>
</tbody>
</table>

Notes: Whites, Non-residents, and non-respondents are not shown. The "other" category includes only those denoting an ethnicity other than these or those shown above.


**Figure 5b:**


<table>
<thead>
<tr>
<th>Year</th>
<th>Asian/Pacific Islander</th>
<th>Latino</th>
<th>Black</th>
<th>Native American</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>11.9%</td>
<td>6.4%</td>
<td>3.4%</td>
<td>0.6%</td>
<td>0.9%</td>
</tr>
<tr>
<td>2000</td>
<td>16.6%</td>
<td>6.5%</td>
<td>2.7%</td>
<td>0.5%</td>
<td>2.1%</td>
</tr>
<tr>
<td>2005</td>
<td>17.6%</td>
<td>6.8%</td>
<td>2.6%</td>
<td>0.7%</td>
<td>4.3%</td>
</tr>
</tbody>
</table>

Notes: Whites, Non-residents, and non-respondents are not shown. The "other" category includes only those denoting an ethnicity other than these or those shown above.

Figure 6:
UC Salary Increases Compared to Parity With Official Peer Group, 1991-92 to 2005-06

<table>
<thead>
<tr>
<th>Peer Parity Figure</th>
<th>Actual Salary Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991-92</td>
<td>3.5% 0.0%</td>
</tr>
<tr>
<td>1992-93</td>
<td>6.7% 0.0%</td>
</tr>
<tr>
<td>1993-94</td>
<td>6.5% 0.0%</td>
</tr>
<tr>
<td>1994-95</td>
<td>12.6% 3.0%</td>
</tr>
<tr>
<td>1995-96</td>
<td>10.4% 3.0%</td>
</tr>
<tr>
<td>1996-97</td>
<td>10.3% 5.0%</td>
</tr>
<tr>
<td>1997-98</td>
<td>6.7% 5.0%</td>
</tr>
<tr>
<td>1998-99</td>
<td>4.6% 4.5%</td>
</tr>
<tr>
<td>1999-00</td>
<td>2.9% 2.9%</td>
</tr>
<tr>
<td>2000-01</td>
<td>3.0% 3.0%</td>
</tr>
<tr>
<td>2001-02</td>
<td>3.9% 0.5%</td>
</tr>
<tr>
<td>2002-03</td>
<td>6.9% 0.5%</td>
</tr>
<tr>
<td>2003-04</td>
<td>9.2% 0.0%</td>
</tr>
<tr>
<td>2004-05</td>
<td>9.3% 0.0%</td>
</tr>
<tr>
<td>2005-06</td>
<td>13.9% 2.0%</td>
</tr>
</tbody>
</table>

Source: California Postsecondary Education Commission, *Faculty Salaries at California’s Public Universities, 2006-07*, p.3
Figure 7: Trend in UC Undergraduate and Graduate Enrollments, 1991-2005
Indexed to 1991 = 100

Figure 8: University of California Research Expenditures and Indirect Costs Recovered from State Agencies, 1998-2006

Note: Data is limited to National Science Foundation Science and Engineering disciplines.

Figure 9: Annual Special Research Programs (SRP) Appropriations, FY1984-2006

Source: University of California, Office of the President.

1984-1991

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>University AIDS Res.</td>
<td>2,900,020</td>
<td>3,010,334</td>
<td>7,309,376</td>
<td>8,066,660</td>
<td>9,596,309</td>
<td>13,099,398</td>
<td>10,426,131</td>
<td>10,475,000</td>
</tr>
<tr>
<td>Tobacco-Rel. Res.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>31,949,000</td>
</tr>
<tr>
<td>California BCancer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total, all 3 prog.</td>
<td>2,900,020</td>
<td>3,010,334</td>
<td>7,309,376</td>
<td>8,066,660</td>
<td>9,596,309</td>
<td>13,099,398</td>
<td>10,426,131</td>
<td>42,424,000</td>
</tr>
<tr>
<td>Universitywide AIDS</td>
<td>2.90</td>
<td>3.01</td>
<td>7.31</td>
<td>8.07</td>
<td>9.60</td>
<td>13.10</td>
<td>10.43</td>
<td>10.48</td>
</tr>
<tr>
<td>Tobacco-Rel. Disease</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>31.95</td>
</tr>
<tr>
<td>California Breast C.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Continued on next page …
Figure 9 continued

1992-1999

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>University AIDS Research Program</td>
<td>8,239,440</td>
<td>8,239,440</td>
<td>7,971,937</td>
<td>7,971,937</td>
<td>7,920,841</td>
<td>8,079,000</td>
<td>8,079,000</td>
<td>8,545,715</td>
</tr>
<tr>
<td>Tobacco-Related Diseases Research Program</td>
<td>26,852,000</td>
<td>23,704,000</td>
<td>5,348,000</td>
<td>3,650,000</td>
<td>4,000,000</td>
<td>60,422,000</td>
<td>32,950,000</td>
<td>11,661,000</td>
</tr>
<tr>
<td>California Breast Cancer Research Program</td>
<td>5,392,000</td>
<td>14,706,000</td>
<td>14,706,000</td>
<td>14,706,000</td>
<td>14,706,000</td>
<td>16,706,000</td>
<td>16,706,000</td>
<td></td>
</tr>
<tr>
<td>Total, all three research programs</td>
<td>35,091,440</td>
<td>31,943,440</td>
<td>18,711,937</td>
<td>26,327,937</td>
<td>26,626,841</td>
<td>83,207,000</td>
<td>57,735,000</td>
<td>36,912,715</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
</table>

2000-2007

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>University AIDS Research Program</td>
<td>13,214,990</td>
<td>14,535,310</td>
<td>14,006,571</td>
<td>12,201,920</td>
<td>12,284,962</td>
<td>12,910,219</td>
<td>12,371,757</td>
<td>9,554,270</td>
</tr>
<tr>
<td>Tobacco-Related Diseases Research Program</td>
<td>36,726,000</td>
<td>22,627,000</td>
<td>19,434,000</td>
<td>19,434,000</td>
<td>21,625,000</td>
<td>14,253,000</td>
<td>14,253,000</td>
<td>14,553,000</td>
</tr>
<tr>
<td>California Breast Cancer Research Program</td>
<td>16,706,000</td>
<td>16,706,000</td>
<td>14,729,000</td>
<td>14,729,000</td>
<td>15,346,770</td>
<td>15,351,925</td>
<td>13,249,000</td>
<td>13,249,000</td>
</tr>
<tr>
<td>Total, all three research programs</td>
<td>66,646,990</td>
<td>53,868,310</td>
<td>48,169,571</td>
<td>46,364,920</td>
<td>49,256,732</td>
<td>42,515,144</td>
<td>39,873,757</td>
<td>37,356,270</td>
</tr>
</tbody>
</table>

Figure 9