Structural Change in Higher Education: Implications for Research

David B. Schweikhardt*

The political and economic environment in which agricultural research is conducted is changing. The methods of funding research are changing, food markets are international in scope, and the public is demanding greater accountability in higher education. These trends are creating new tensions within the agricultural research system, and the heightening of these tensions requires that a new equilibrium be established between the system's public mission and the competing public demands on the system (Danbom). This new equilibrium will determine the structure and performance of the agricultural research system in the coming decade.

Issues in Agricultural Research Funding

Two major issues dominate most discussions about research funding: What level of funding will be available for agricultural research and what mechanisms will be used to allocate these resources? The real rate of growth in agricultural research funding at the state agricultural experiment stations has slowed in recent years. Real expenditures for research grew by 1.6% per year between 1979 and 1990, compared to a real growth rate of 5.5% per year during 1970 to 1979. State appropriations constituted approximately 60% of total expenditures throughout this period, while federal funds from the USDA declined from 22% of total expenditures in the early 1970's to 18% in recent years. Federal funds from other sources have remained at 10% of total expenditures during this period, and industry funds have increased from 5% in the early 1970's to 8% in recent years (Schweikhardt and Whims).

Total funding per scientist year has grown at 0.7% annually in real terms since 1979 (figure 1). Federal funding from USDA-CSRS sources has remained at $25,000 per scientist year for the past 20 years. Funding from state appropriations has experienced a small amount of growth since 1982, but this growth has only managed to return total funding to its 1979 level.

A more significant change -- a change in how USDA funds are allocated to the experiment stations -- has also occurred during the past 20 years. The relative importance of the formula funding allocation mechanism has decreased since 1970, and the importance of special grants and competitive grants has increased during this period.[1] In 1970, nearly 98% of CSRS funds were allocated to the experiment stations through the formula funding system. By 1992 this share had declined to 50%, with special grants and competitive grants each accounting for approximately 25% of USDA funding to the states. Real formula funding per scientist year has declined by 3% per year since 1982, while special grant funds per scientist year have grown by 8% per year (figure 2).

The four regions of the U.S. received an approximately equal dollar value of special grants per scientist year throughout most of the 1980's (figure 3), but the distribution of competitive grants across regions is much more variable figure 4). This outcome is understandable when

*David Schweikhardt is an assistant professor of agricultural economics at Michigan State University, East Lansing, Michigan.

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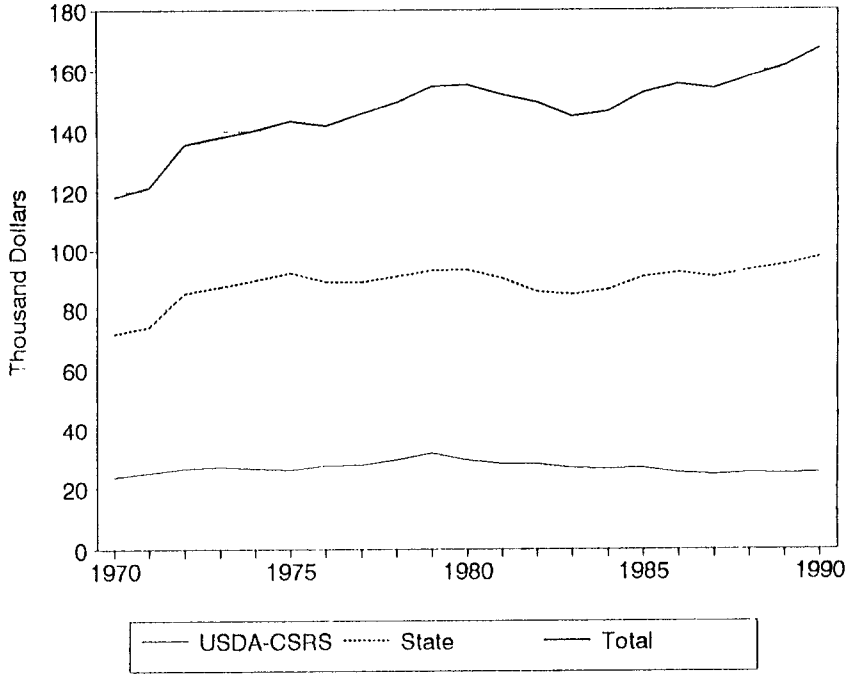
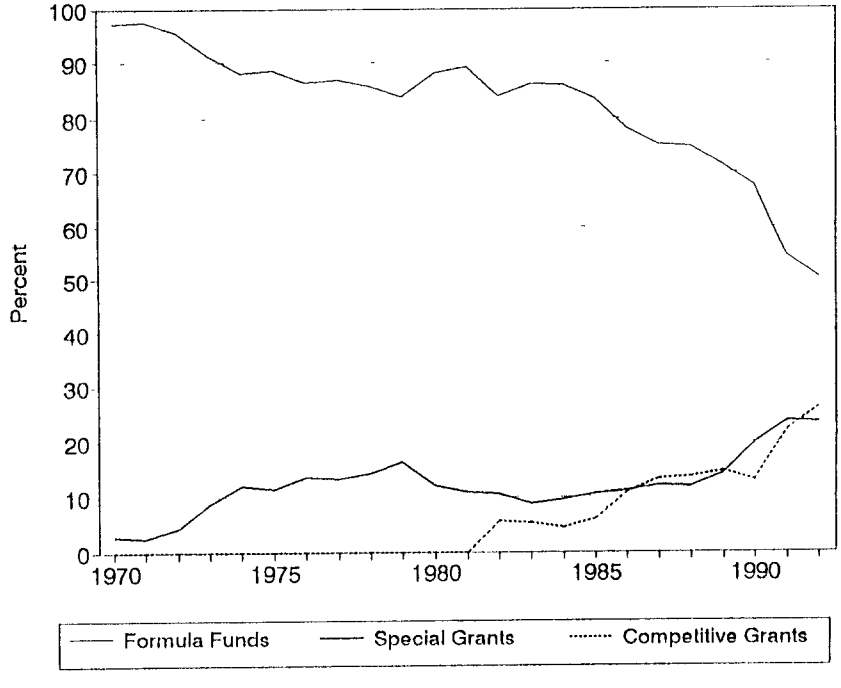
Figure 1. Funding Per Scientist Year at State Agricultural Experiment Stations (1983 Dollars)



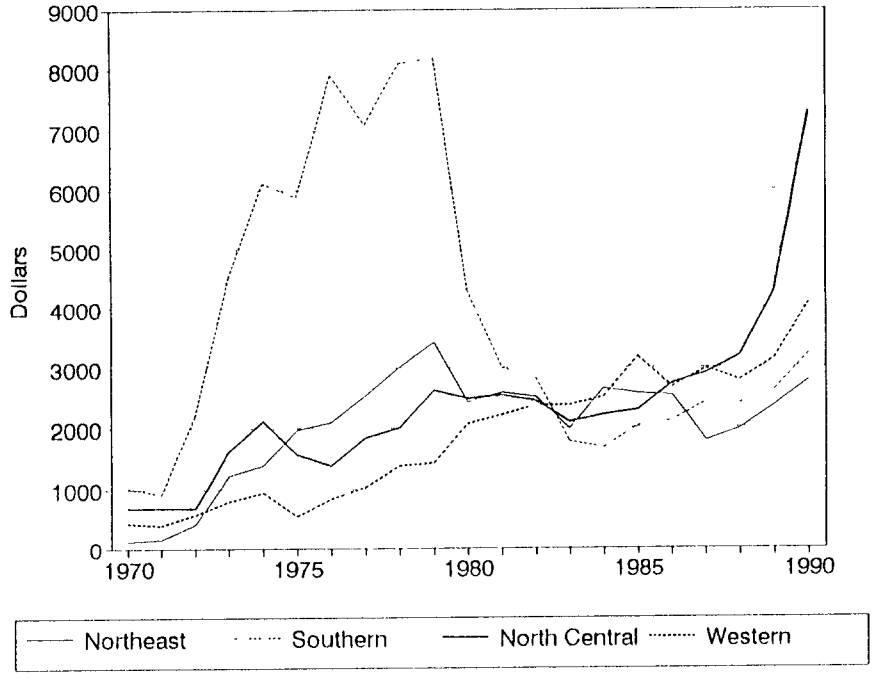
Sources: U.S. Department of Agriculture; Research Associates

Figure 2. Distribution of USDA-CSRS Funds by Method of Allocation



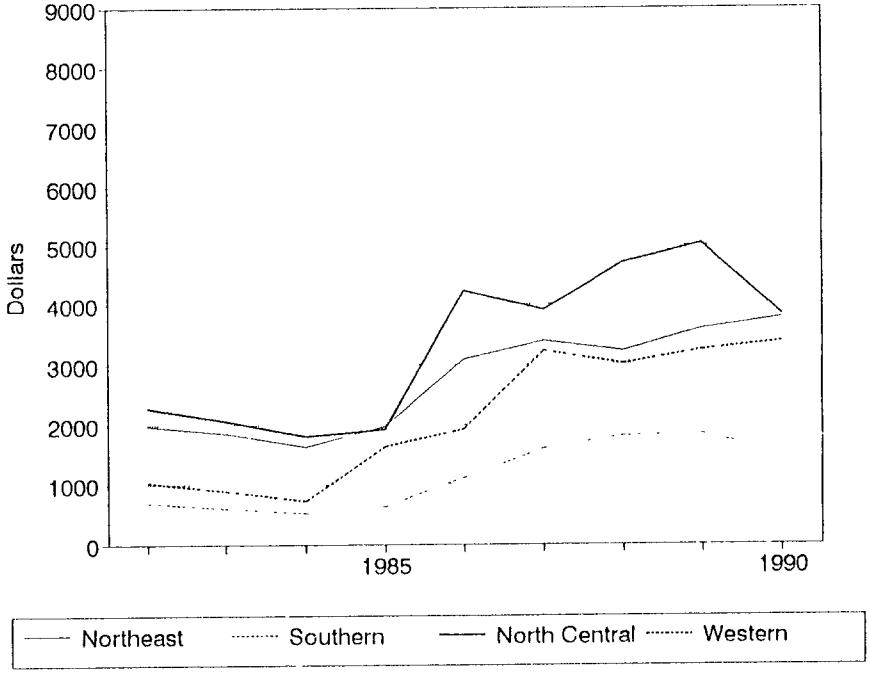
Source: U.S. Department of Agriculture.

Figure 3. Special Grants per Scientist Year by Region (1983 Dollars)



Sources: U.S. Department of Agriculture; Research Associates

Figure 4. Competitive Grants per Scientist Year by Region (1983 Dollars)



Sources: U.S. Department of Agriculture; Research Associates

the allocation mechanisms used in these programs are considered. Special grants are allocated in the Congressional appropriations process, and competing political demands can be expected to result in a reasonably equal distribution of such grants across regions. Competitive grants, on the other hand, are allocated by disciplinary peers through a peer review process, and available evidence suggests that a wide variation exists in institutions' ability to obtain competitive grants. In 1989, for example, twelve states obtained over 60% of the total competitive grants obtained by all experiment stations in the U.S. (Office of Technology Assessment, 1992, p. 414). As a result, it should be expected that there would be much greater variation in the distribution of competitive grants across geographic regions than exists for special grants.The establishment of the National Research Initiative competitive grants program will accelerate the growth in competitive grants funding and may widen the funding disparity between those institutions capable of obtaining competitive grants and those less able to attract such funds.

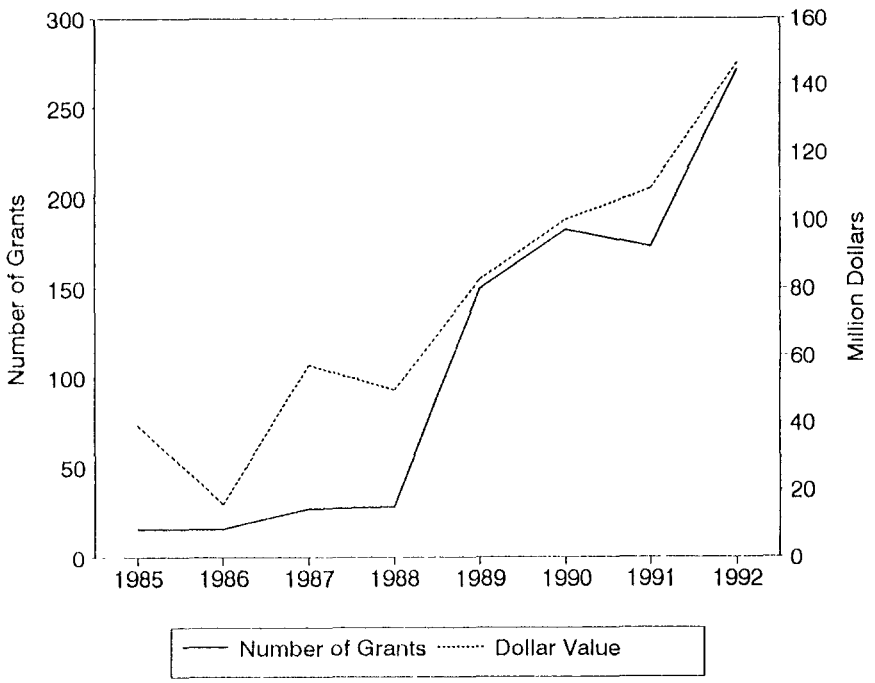
The use of Congressionally earmarked special grants to finance research has become an increasingly contentious policy issue as both the number of earmarked grants and the total dollar value of such grants have increased rapidly in recent years (figure 5) (Marshall; Congressional Research Service, 1992a and 1992b; Savage; Cordes, 1989a and 1989b). Critics of special grants view such grants as politically allocated funding distributed without regard to scientific quality. Defenders contend that special grants provide a means of directing research resources to problems faced by research users and see the legislative process as an additional means by which users can articulate their preferences for research about relevant problems (Chubin and Hackett, pp. 153-162; Browning).

What is really interesting to ponder, however, is the question of why we have seen such growth in special grants in recent years. There are at least two possible explanations. The first is that this growth is a consequence of a breakdown in the research system. Research users have found that the legislative process is more responsive to their problems than is the agricultural research system. According to this view, the growth in special grants is a symptom of larger problems in the management of the agricultural research system and the failure of the system to respond to the needs of research users.

A alternative explanation is that interest groups and/or experiment station administrators are simply making a rational calculation in bypassing traditional funding mechanisms and seeking special grants as a means of gaining additional funding. Interest groups or administrators know that the odds of gaining a significant increase in formula funds are slim and, even if such an increase were forthcoming from Congress, each state would receive a small increase by the time it was divided among all states. Consequently, it is rational for each state to seek special grants that it can claim as its own rather than pursue an increase in formula funding that will yield a smaller increase in funding for its efforts.[2] Regardless of what has caused the growth in special grants, the use of special grants will remain a contentious policy issue in future years.

As more federal funds have been allocated through competitive and special grants, the federal government's effort at matching state appropriations with formula funds has declined. In the parlance of public finance theory, the Hatch and McIntire-Stennis programs are matching grants -- the federal government matches each dollar appropriated by the states with a dollar of federal funds (up to the limit imposed by the allocation formula). Public finance theory suggests that matching grants should be used to finance a good such as agricultural research which creates significant benefit spillovers outside the state in which the research is conducted (Boadway and Wildasin; Schweikhardt), and many observers believe that the states' inability to capture the full benefits of research has caused underinvestment in agricultural research (Ruttan; Bonnen, 1985). Empirical evidence suggests that 33 to 66% of the benefits of agricultural research spill across state borders (Evenson, Waggoner and Ruttan), indicating that agricultural research should be funded through a matching grant program with the federal government matching each state dollar with somewhere between 50

Figure 5. Number and Value of Earmarked Academic Grants in USDA Appropriations Bills



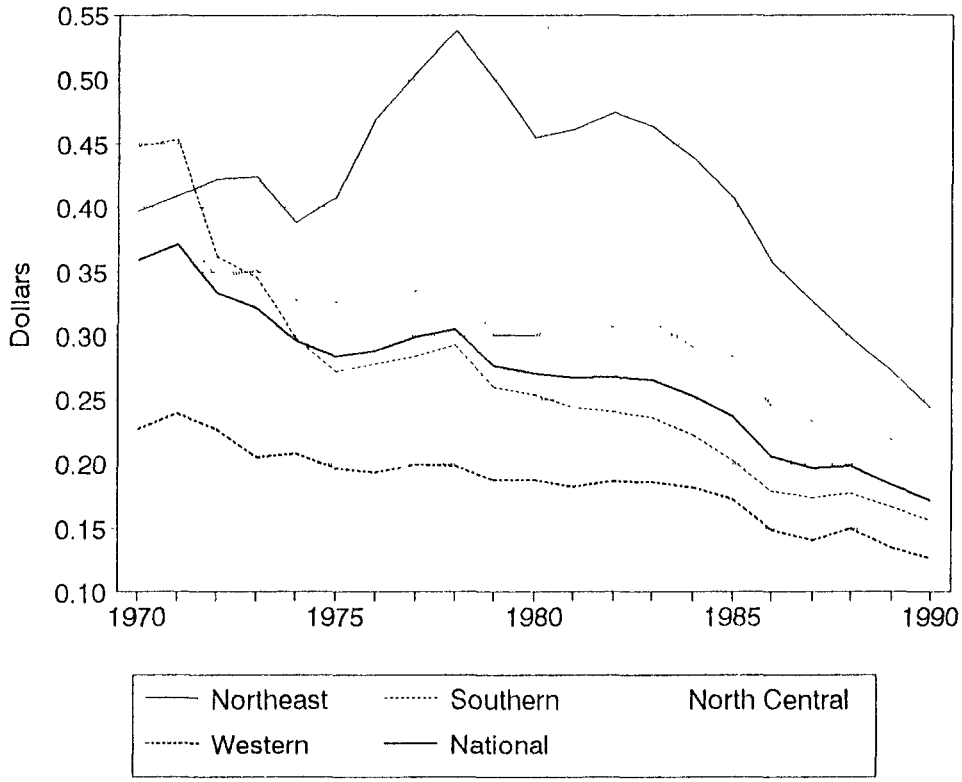
Source: Congressional Research Service.

cents to $2.00 of federal funds. The federal government's matching effort in financing research through formula funds has declined from 37 federal cents per state dollar in 1971 to 17 federal cents per state dollar in 1990 (figure 6). This decline in the federal government's effort at matching state expenditures for research indicates that an increasing share of the cost of agricultural research is being funded by the states. As a result, states are receiving less compensation for the research benefit spillovers they create and have less of an incentive to invest in a nationally optimal level of agricultural research, thereby perpetuating, or perhaps worsening, the underinvestment problem.

When considering the role of formula, competitive, and special grants in financing agricultural research, we should also consider the administrative and managerial costs of these funding mechanisms. Agricultural research is unlike other fields of science because research problems in agriculture are generally location specific, requiring attention to the particular climatic or agronomic factors that define the unique problems of a particular production region (Ruttan, p. 250-251). As a result, resource allocation decisions in agricultural research require a significantly higher level of information about local problems and conditions than do other fields of science (Schultz, p. 16).

Economists define the cost of making decisions -- including the cost of collecting and analyzing information and the cost of negotiating group decisions -- as transaction costs (Williamson). Because agricultural research decisions require more information about local problems and conditions than do decisions in most other fields of science, the transaction costs of soliciting and transferring information from research users to research managers are higher than other fields of science. One must ask: What are the transaction costs of operating a competitive grant system versus the costs of operating a formula funded system, and how are

Figure 6. Federal Matching Dollars Per State Dollar Appropriated



Source: U.S. Department of Agriculture

these costs distributed across research users, scientists, and administrators? Furthermore, are the costs of acquiring and transferring information from research users to decision makers under a competitive grant system a serious obstacle to the establishment of a research agenda that is in concert with the needs of research users? Similarly, what are the transaction costs generated by the pursuit of special grants? One advantage of a decentralized agricultural research system supported primarily by state appropriations and formula funds is that such a system minimizes the transaction costs of transferring knowledge about problems from research users to administrators. At the same time, such a system allows research administrators to communicate with users about emerging research opportunities relevant to users' problems.

Whether these transaction costs are a serious barrier to the operation of a centralized competitive grant program is a question worth considering. If so, can a competitive grant program operate in a manner that avoids an excessive level of transaction costs and a worsening of the information transfer problem? The answers to these questions are unclear, but these questions are relevant to future decisions on research policy and deserve investigation by agricultural economists.

In a similar vein, what are the costs of grantsmanship -- defined as the costs or writing and reviewing grants -- under each of these funding mechanisms? These costs could also be considered part of the transaction costs of operating the research enterprise. The general science community is increasingly concerned about the rising costs of grantsmanship in their competitive grant programs. Twenty-two percent of the proposals submitted to the USDA competitive grants program were funded in 1992 (Abelson), and a similar acceptance rate is reported by other funding agencies (Chubin and Hackett, p. 25-28). Were the scientist years embedded in rest of these proposals a sunk cost of

operating a competitive grant system and, if so, how much of a cost does it represent? Once again, these are research questions that should be examined by agricultural economists.[3]

The issue is not whether one these mechanisms should be the sole mechanism used to finance agricultural research, but is instead a question of what mix of these mechanisms can most effectively accomplish the varied objectives of the agricultural research system. This issue can only be addressed by considering the following questions:

> What incentives does each mechanism create for state support of research and how do each of these mechanisms affect research funding at the state level?
>
> What are the transaction costs of operating each funding mechanism, who bears these costs, and how do these costs affect communications between research users, scientists, and administrators?
>
> What is the capacity of each of these mechanisms to allocate resources to emerging fields of science with long-term importance?
>
> What is the capacity of each of these mechanisms to respond to problems of immediate importance to research users?

Finally, it should be noted that the changing status of intergovernmental relations in the U.S. may be affecting agricultural research funding at the state level. Program mandates established by judicial decisions or federal legislation are consuming an increasing share of state budgets, leaving less funding for non-mandated program (Conlan; Hamilton and Wells, pp. 87-90; Stiles).[4] As Martha Derthick has observed:

> Congress loves action -- it thrives on policy proclamation and goal-setting -- but it hates bureaucracy and taxes, which are instruments of action.... [As a result], there is a danger that Congress, in striving to close the gap between its large goals and its unwillingness to provide the administrative means to achieve them, will try to conscript the states. That is, it will give them orders as if they were administrative agents of the national government while expecting state officials and electorates to bear whatever costs ensue (Derthick, p. 36).

The implication of such trends should be clear. The 1990's will be an era of fierce competition for state budget resources, during which agricultural research could be at a political disadvantage relative to both mandated programs and programs with wider constituencies.

The International Scope of Food Markets

I would add only one comment to Schuh's discussion of the impact of internationalization on higher education. When markets are international in scope, research will often create benefits for consumers (in the form of lower prices) or producers (if they can adopt the results) outside the nation conducting the research. As a result, the same spillover problem that exists among states within the U.S. will occur among nations and research will be underfunded because an individual country that cannot capture the full benefits of research. The growth of this problem, prompted by the integration of food markets at the international level, will require institution innovations capable of funding cooperative research efforts on the international level (Schweikhardt and Bonnen).

Accountability and Productivity

It is now clear that the public will demand greater accountability in higher education during the coming decade, but it is not yet clear how accountability will be defined. This much is clear: Anyone in academia who believes that accountability will be defined simply as preventing recurrences of the "Stanford overhead

case" is not paying attention to the public debate. The public is demanding an explanation of how we do our jobs and what benefits they are receiving from our research and teaching efforts. These demands began with the publication of a series of books on higher education whose general theme was that professors neglect teaching -- particularly undergraduate teaching -- to focus on research that is trivial and irrelevant (Sykes; Anderson). While some will dismiss such attacks as misinformed, the public is listening to these critics with great interest. A recent survey revealed that sixteen states are considering some form of legislative or administrative policies governing faculty workloads and productivity (Mooney; Lively, Mercer and Whitfield).

Researchers within academia have also begun to examine the output of university research. A recent study of research citations revealed that a surprising number of publications are not cited during the four years after publication (figure 7), and 5 to 20 percent of all citations are made by authors citing their own work (David Hamilton, 1990 and 1991). Although such results may be sensitive to the data base employed to conduct this research, these results are reason to ponder a question now on the public's mind: Of what value is our work to the public? Our response to this question and, more importantly, our willingness to focus our research efforts on the real problems faced by private and public decision makers, will be critical in determining the level of financial support we receive during the coming decade.

We are also learning more about the productivity of alternative research funding mechanisms. Recent studies reveal that there are differences in the outputs of the various research funding mechanisms (table 1). Research funded through competitive grants tends to generate outputs that are more likely to be read by disciplinary peers, while research funded by formula funds or other funding mechanisms is more likely to generate outputs relevant to research users among the general public. This suggests -- as do previous empirical studies of the returns to research and the interaction of disciplinary and applied research (Evenson, Waggoner and Ruttan) -- that it is critically important that a balance be maintained between disciplinary and applied research and between the mechanisms used to finance research.

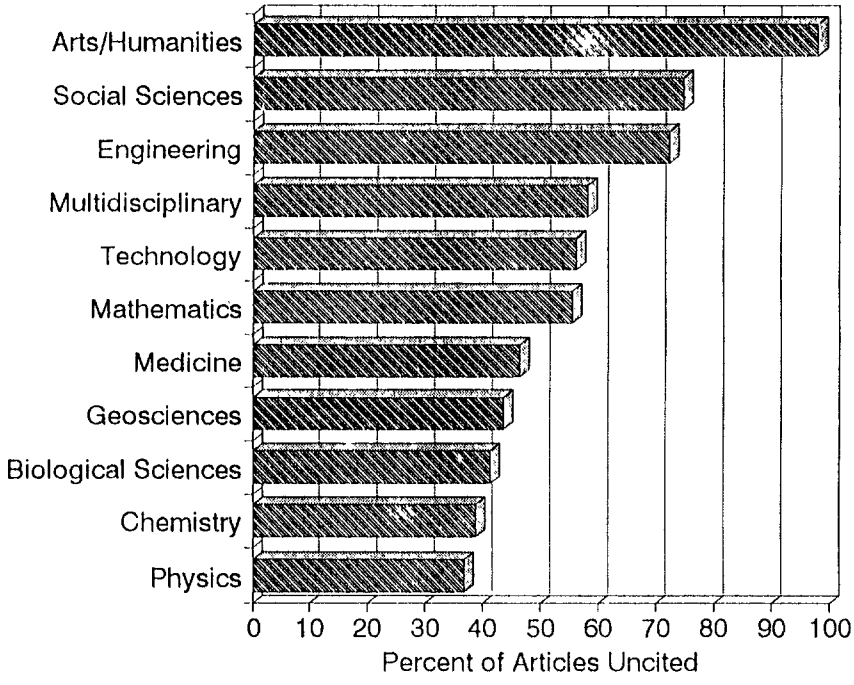
When we examine the productivity of the land grant system, we must also be concerned about the integration of our research and extension priorities. Henry Wadsworth compared the priorities of the National Extension Initiatives with those of National Agricultural Research Committee and found that nearly half of the extension priorities had no counterpart in the research priorities (Wadsworth; Office of Technology Assessment, 1990). James Bonnen (1992) notes that the results of the Social Science Agricultural Agenda Project found a similar dissonance between extension and research priorities in the social sciences. Are these observations an indication that the problems faced by research users and the research opportunities seen by scientists and administrators are not being articulated through the system? If so, what is the cause of such dissonance and how can it be remedied? The coming decade will see a continuing effort to define the public's expectations for university research and the faculty's responsibility to meet those expectations.

Conclusion

We are entering an era when every aspect of higher education will face increased public scrutiny. Those institutions willing to serve the needs of their states will be rewarded with the resources to do the job, but we will gain these resources only if we earn them by delivering knowledge that is relevant to the real problems faced by public and private decision makers. Slow growth in our resource base will require the establishment of a well defined set of research priorities that addresses these problems. This pressure to define our research mission will probably lead to increased heterogeneity among departments of agricultural economics as each department seeks to establish a market niche that satisfies unique local, regional or national opportunities.

The ongoing debates over the future direction of higher education and of this profession are healthy and, I believe, will ultimately lead to a clarification of the social contract between our institutions and the public

Figure 7. Proportion of Papers With No Citations Four Years After Publication



Source: David Hamilton, 1991.

we serve. Many of the problems facing decision makers, including many of the issues facing the agricultural research system, will require contributions from agricultural economists if these problems are to be addressed. We can succeed in capturing these opportunities if we retain our commitment to relevance in research.

Table 1. Mean Values of Selected State Agricultural Experiment Station Outputs by Type of Funding Grant

	Hatch	Competitive	Other
Citations per article[a]	1.70	3.98[b]	1.82
Articles per grant	2.47	2.14	2.24
Weighted articles per grant[a]	4.83	8.33[c]	4.74
Journal publications per grant	4.70	4.52	3.68
Weighted publications per grant[a]	7.07	10.62[d]	6.58
Bulletins per grant	0.35	0.09[b]	0.28

[a]Weighted by number of citations. Publications includes articles submitted, articles published, articles in press, and abstracts in peer reviewed journals.
[b]Significantly different from other two groups at 95% confidence level.
[c]Significantly different from other two groups at 94% confidence level.
[d]Significantly different from other two groups at 92% confidence level.

Source: Marie Walsh, "Factors Affecting the Cost and Productivity of Biotechnology Research at the State Agricultural Experiment Stations," Ph.D. Dissertation, University of Minnesota, in progress. Cited in Office of Technology Assessment, 1992, p. 423.

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Endnotes

1. Formula funded grants allocate research funds to the states based on a legislatively-mandated formula. Competitive grants are allocated by a panel of scientific peers who select research projects based on the quality of the research proposals submitted to the review panel. Special grants are allocated by legislative mandate in Congressional appropriations bills and provide funding for a specific research project at a specific institution (National Research Council, 1989, p. 34).

2. Similar explanations of "rent-seeking" behavior have been used to analyze a wide variety of political decisions (Mueller, pp. 242-244), but have not been used to analyze earmarking of research funds. It should be noted, however, that simple rent-seeking theories cannot provide a complete explanation of the growth in special grants. It has always been true that an individual state could gain an advantage by seeking special grants outside the formula funding system, yet growth in these grants did not accelerate until recent years. Consequently, other factors must have changed to permit this growth to occur. Penner and Hardin both suggest that the decentralization of power in Congress, combined with a weakening of the Congressional leadership's control of the budget process, have provided greater access for interest groups seeking increased spending. This greater access increases the probability that such rent-seeking behavior, including the pursuit of special grants for research, will succeed. Such behavior is visible in the establishment of international agricultural trade centers financed by special grants. Congress passed legislation supporting such centers, but did not establish a means of selecting the recipients of these funds. After some centers had been established through special grants, Congress was

inundated with proposals for centers, including proposals from universities that had previously refused to accept earmarked grants. As a result, Congress was forced to halt the funding of additional centers until its staff could review the requests. Critics of earmarked grants continue to contend that such reviews do not provide an adequate assessment of scientific quality (Cordes, 1989a and 1989b).

3. Existing estimates of the cost of writing and reviewing research grants suggest that such costs could be significant. Some estimates indicate that as much as 50% of research resources are spent on writing, reviewing, and reporting on grants (Office of Technology Assessment, 1990, p. 22). Other estimates indicate that one dollar of resources is spent to obtain three dollars in grant funding (Richards and Davis). No empirical estimates of the costs of pursuing special grants are available. Further research is needed to assess the administrative and transaction costs associated with all three funding mechanisms.

4. Medicaid and corrections are the two fastest growing items in the budgets of many states. Much of the increase in these categories is a result of legislative or judicial mandates beyond the control of state legislatures (Gold, p. 111).