Investing in People: Assessing the Economic Benefits of 1890 Institutions.
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Abstract

The 1890 land-grant universities (1890s) have developed teaching, research, and extension programs that reach historically underserved students and communities. Many studies have described the programs of 1890s, but no systematic effort has measured their contribution to human capital development and to improving the well-being of the rural population. This report examines the historical USDA funding levels of the 1890 institutions; discusses the outcomes of these investments and potential measurable indicators of these outcomes; and outlines a conceptual model for estimating returns to investment in education tailored to particularities of the 1890s.

Keywords: 1890s, land-grant universities, human capital, extension service, agricultural research, research funding

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The 1890 land-grant universities help ensure a more equitable distribution of educational opportunities. Photo courtesy Keith Pope.

Foreword

To enhance the relationship between the U.S. Department of Agriculture and 1890 land-grant universities and colleges, the Economic Research Service (ERS) entered into cooperative agreements in 1997 with four 1890 institutions—Delaware State University, South Carolina State University, Tuskegee University, and Virginia State University. The purpose of this collaboration was to study outcomes and benefits of investments in the 1890s' programs in the food and agricultural sciences, to explore methods of better quantifying benefits, and to improve effectiveness of Federal (USDA) investments in the 1890s' programs and initiatives. To accomplish these goals, cooperators initiated an effort to design a framework for measuring USDA's investments and for identifying, classifying, and quantifying (or otherwise assessing) the outcomes of these investments.

As a first step, the cooperators posed a series of core questions, which form the focus of this report. How have the programs at the 1890s been funded? What have been the outcomes of these programs? What are the best indicators by which to measure those outcomes? And how can conceptual models best be developed for estimating future returns to investments in these programs? This report synthesizes a number of papers presented at a workshop held September 1 and 2, 1999, at USDA's Economic Research Service, drawing particularly from three studies—Essel, Clarke, and Tegene (1999); Norton and Tegene (1999); and Larson (1999).

Contents

Summary

The connections between education and the economy are complex and interdependent. The economy affects the attractiveness of education by creating incentives or disincentives to continue schooling. Family structure and emphasis on and access to learning resources and experiences also help determine educational success. The 1990s witnessed increasing rewards to higher education and heightened economic incentives for additional schooling. Given this increased demand for education, access to and supply of higher education underpin the future productivity of American workers and long-term economic health and growth of our country.

The 1890 land-grant universities (1890s) help to ensure a more equitable distribution of educational opportunities. They were established by the Second Morrill Act in 1890 to provide equal educational opportunities for African-American students who had been denied admission to their States' original 1862 land-grant universities. The 1890s have developed teaching, research, and extension programs that serve mainly rural communities. African-American students receive undergraduate and graduate education at the 1890 universities in an environment particularly attuned to the needs of minority students. Research and extension programs address issues of special interest to minority rural communities and small-scale and limited-resource farm operators, as well as more traditional topics reflecting the expertise and interests of the 1890 faculty and graduate students.

USDA has strengthened links to the 1890 institutions by building a stronger base of funding support. USDA's Economic Research Service (ERS) entered into cooperative agreements in 1997 with four 1890 institutions to study outcomes and benefits of USDA investment in the 1890 institutions' food and agricultural programs. The collaboration has explored core issues of the programs' funding and achievements, the best indicators by which to measure those achievements, and the development of conceptual models for estimating the future returns to investments in these programs.

Many studies have described the programs of the 1890s, but there has been no systematic effort to measure the economic contribution of their teaching, research, and extension programs to human capital development and to improving the well-being of the population they serve. As public funding of research and development falls under increasing scrutiny and worthy educational investment opportunities multiply, linking identifiable outcomes and measurable indicators with public investments in the 1890s is increasingly important.

The 1890 land-grant universities began receiving Federal funds for research in 1967, which totaled $283,000 per year through 1971. From 1972 to 1978, annual appropriations for research and extension increased from $12.9 million to $23.5 million; and they began to receive specifically authorized research formula funds (section 1445) and extension formula funds (section 1444) with the enactment of the National Research, Extension, and Technology Policy Act of 1977. This statute provided permanent formula funding authorization for research and extension in the 1890s similar to funding research and extension at 1862 land-grant universities. Total USDA funding of the 1890s—including funds for research, extension, and general support—rose from about $1.4 million in 1967 to about $100 million in 2000.

Federal research funding to land-grant universities has been through formula funds, which provide guaranteed funding according to a specified formula, special grant funds, and competitive grants. Federal sources constitute 83 percent of the total research funds at the 1890s; extension programs at the 1890 universities are almost entirely supported by Federal funding through the Cooperative State Research, Education, and Extension Service. Financial support for teaching has come largely from State governments. Federal support is still significant, however, for funding scholarships and for enhancing the capacity of 1890 institutions to develop and improve teaching programs.

Traditional administrative indicators of benefits associated with teaching, research, and extension require clear statements of expected outcomes and measurable indicators that allow monitoring of investments. Assessments of teaching programs in food and agricultural sciences have been limited to measuring the number of successful graduates that pursue further education and become leaders in their professions. Studies of research outcomes often use publication and/or patent counts. These methods may underestimate the research accomplishments of the 1890s. Research at the 1890s has focused on small-scale farmers and limited-resource families, including research on minor livestock species, such as goats and rabbits, that are suited to small-farm operations. Many of the research outcomes associated with the 1890 universities are not published or patented, and most institutions do not have a working paper series. Other indicators that better capture the contribution of the 1890s need to be designed. Ideally, these indicators would capture not only benefits to traditional agricultural stakeholders, but also impacts on economic development in the 1890s' target rural areas.

Similarly, improved indicators of extension programs are needed. Extension programs have typically documented and reported program inputs: the number of people participating, number of workshops and meetings held, number of educational materials distributed, and number of hours of volunteer service delivered. Extension programs, however, have not documented outcomes (e.g., changes in knowledge, skills, or aspirations; newer and more efficient methods adopted as a result of the program; or changes in social, economic, or environmental conditions).

The Human Capital Model (HCM) provides, at least for measuring benefits of teaching, an alternative to traditional administrative approaches. Education helps people capitalize on technological and social changes, making them more productive and efficient. It raises their incomes, thereby generating measurable impacts (e.g., earnings gaps between 1890 and high school graduates) that can be attributed to the colleges.

However, several issues must be addressed to apply such an approach to measuring human capital benefits of the 1890s. The models must be structured to disentangle the effects of inherent ability, other personal characteristics, and job location from the effects of an 1890 education, a challenge for any attempt to estimate the value of higher education. Also, because available data sets that cover earnings, level of education, personal characteristics, and other variables needed to estimate the value of higher education may not indicate the college attended, it may be necessary to survey 1890 graduates in order to complete an empirical evaluation.

Economic returns to investments in research and extension programs at the 1890s can be measured by estimating the value of productivity gains using one of two approaches: economic surplus analysis and production function estimation. The economic surplus approach evaluates productivity changes that can be attributed to research. The production function approach relies on statistical relationships between agricultural output and expenditures on research (and extension). However, the contribution to productivity change of a specific institution or group of institutions, which is needed to apply economic surplus analysis, is difficult to identify, particularly for small programs like those at the 1890s. Similarly, production function estimation would be difficult because research and extension at 1890s is a relatively small portion of total agricultural research and extension in the United States. Given the limitations of the two standard approaches, a more pragmatic approach to estimate economic impacts of research and extension at 1890s is to conduct case studies. These studies would rely on cost-benefit analyses of a sampling of specific programs or projects to draw broader conclusions.

As a next step in developing these frameworks for measuring investments in 1890 programs, a team of researchers from ERS, Virginia State University, Virginia Polytechnic Institute and State University, University of Arkansas – Pine Bluff, and Langston University has begun work, with the support of USDA's National Research Initiative, on further developing a human capital model applicable to the 1890s' teaching programs and on pursuing a series of cost-benefit analysis case studies of 1890s' research and extension projects.

The 1890 land-grant universities play a significant role in training students from various ethnic minorities in agricultural and food sciences, engineering, mathematics, and other disciplines. Photo courtesy Keith Pope.

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Introduction

The connections between education and the economy are complex and interdependent. The economy affects the attractiveness of education by creating incentives and disincentives to continue schooling. Family structure and access to learning resources and experiences also help determine educational success. The 1990s witnessed increasing rewards to higher education and, therefore, heightened economic incentives for additional schooling. Given this increased demand for education, access to and supply of higher education will underpin the future productivity of American workers and long-term economic health and growth of our country.

The 1890 land-grant universities (1890s) help ensure a more equitable distribution of educational opportunities. They were established by the Second Morrill Act in 1890 to provide equal educational opportunities for African-American students who had been denied admission to their States' original 1862 land-grant universities. The 1890s have developed teaching, research, and extension programs that serve mainly rural communities. African-American students receive undergraduate and graduate education at the 1890 universities in an environment particularly attuned to the needs of minority students. Research and extension programs address issues of special interest to minority rural communities and small-scale and limited-resource farm operators, as well as more traditional topics reflecting the expertise and interests of the 1890 faculty and graduate students.

USDA has strengthened links to the 1890 institutions by building a stronger base of funding support. USDA's Economic Research Service (ERS) entered into cooperative agreements in 1997 with four 1890 institutions to study outcomes and benefits of USDA investment in the 1890s' food and agricultural programs. The collaboration has explored core questions of how these programs have been funded, what have been the outcomes of these programs and what are the best indicators by which to measure those outcomes, and how to develop conceptual models for estimating the future returns to investments in these programs.

Many studies have described the programs of 1890s, but there has been no systematic effort to measure the economic contribution of the 1890s' teaching, research, and extension programs to human capital development and to improving the well-being of the population they serve. As public funding of research and development falls under increasing scrutiny and worthy educational investment opportunities multiply, linking identifiable outcomes and measurable indicators with public investments in 1890s is increasingly important.

Legislative History

Congress created the land-grant system of colleges and universities to make practical higher education accessible to working families. The land-grant system took shape through four pieces of landmark legislation, amended over time, that endowed the colleges and universities in the system with three missions: teaching, performing agriculture-related research, and providing extension services to farmers.

The first piece of legislation, the Morrill Act of 1862, provided a grant of public land to each State and U.S. territory to fund a perpetual endowment for at least one institution to teach "agriculture and the mechanical arts." The legislation established a network of public institutions still known as the 1862 land-grant colleges and universities. Every State has established at least one 1862 institution using the funds from the sale of its allotment of public land.

The Hatch Act of 1887 created the State Agricultural Experiment Stations (SAESs) under the auspices of the

Table 1—Development history of 1890 institutions and Tuskegee University

Name of Institution	Year founded	Initiated 4-year program	Initiated graduate program	Regional accreditation
Alabama A&M University	1875	1939	1958	1963
Alcorn State University	1871	1871	1975	1961
University of Arkansas-Pine Bluff	1873	1929	NA	1933
Delaware State College	1891	1947	NA	1957
Florida A&M University	1887	1909	1951	1949
Fort Valley State College	1895	1945	1957	1957
Kentucky State University	1886	1929	1972	1939
Langston University	1897	1897	NA	1939
Lincoln University	1866	1935	1940	1945
University of Maryland-Eastern Shore	1886	1936	1978	1953
North Carolina A&T University	1891	1925	1939	1946
Prairie View A&M University	1876	1909	1954	1958
South Carolina State College	1872	1924	1948	1960
Southern University	1880	1922	1957	1958
Tennessee State University	1909	1922	1942	1946
Tuskegee University	1881	1928	1943	1933
Virginia State University	1882	1943	1937	1933

NA = Not available.

Source: Christy and Williamson (1990), p. 32.

land-grant universities. Research funded by the Hatch Act provided teaching material for professors and strengthened the scientific basis of the curriculum. Funds appropriated under the Hatch Act are allocated among the States according to a statutory formula based on each State's farm and rural population. In States having two experiment stations, funds are divided as determined by the State legislature (USDA, 1994).

The Second Morrill Act, passed in 1890, provided for annual appropriations to each State to support its land-grant college. The act also forbade racial discrimination in admission policies for colleges receiving these Federal funds, but granted States the right to establish separate colleges for Black and White students. The act required Federal funds to be divided between a State's land-grant colleges and universities in a "just," but not necessarily equal, manner.

Southern States established separate Black colleges. Maryland assigned its money to a private Black college that subsequently became a State institution. Alabama, Arkansas, Florida, Texas, Kentucky, Virginia, Mississippi, and Missouri gave portions of the funds to existing public Black schools. Delaware, Georgia, North Carolina, Oklahoma, South Carolina, Tennessee, and West Virginia created new land-grant schools for their Black residents (Huffman and Evenson, 1993).

Thus, the Second Morrill Act led to the establishment of land-grant colleges for African-Americans, which are known as the 1890s. Today, 17 institutions, located predominantly in the southeast region of the United States, are included in the 1890 system. Of the 17, Tuskegee University is the only private university. It is considered an 1890 because it was created by State legislation and has historically focused on agricultural research. In addition, beginning in fiscal year 2000, agricultural appropriations acts have provided that within the total appropriations for 1890 research and extension formula programs, $1 million shall be made available for both research and extension at West Virginia State College.[1]

Finally, the Smith-Lever Act, passed in 1914, created the Cooperative Extension Service as a joint effort of the U.S. Department of Agriculture, the State land-grant institutions, and individual county governments. The act provided for this partnership across Federal, State, and county levels to give instruction and practical demonstrations in agriculture and home economics in rural areas of the United States.

[1]West Virginia abolished the 1890 designation for West Virginia State College in the wake of Brown vs. Board of Education, the 1954 Supreme Court ruling that ended segregation in public education.

Chronology of Major Legislation Affecting 1890s

Year	Legislation	Purpose
1862	Morrill Act	Established the land-grant college system. Gave each State 30,000 acres of land (for each senator and each of its representatives in Congress) to endow colleges.
1887	Hatch Act	Provided annual grant for agricultural research, and established the State agricultural experiment stations.
1890	Second Morrill Act	Blacks were to be admitted to land-grant institutions. States could establish separate land-grant colleges—"the 1890s" were established.
1906	Adams Act	Provided each State additional Federal funding for agricultural research.
1914	Smith-Lever Act	Established the Cooperative Extension Service.
1917	Smith-Hughes Act	Established Federal grants for vocational education in agriculture, home economics, and industrial arts in public colleges and high schools.
1935	Bankhead-Jones Act	Established formula funding for research and Federal-State matching grants.
1965	Public Law 89-106	Established "Specific Research Grants" program and provided research funds collectively for 1890 institutions.
1977	Food & Agriculture Act	Provided formula funds to research at 1890 institutions.
1985	Food Security Act	Amended the 1977 act to provide not less than 6 percent of Smith-Lever funds to be allocated for extension work at the 1890 institutions.
1998*	Agricultural, Research, Extension, and Education Act	Established requirements for State matching of Federal formula, extension, and research funding of 1890 institutions.

Sources: Adapted from NRC (1995) and Christy and Williamson (1992).

*U.S. Department of Agriculture, Cooperative State Research, Education, and Extension Service

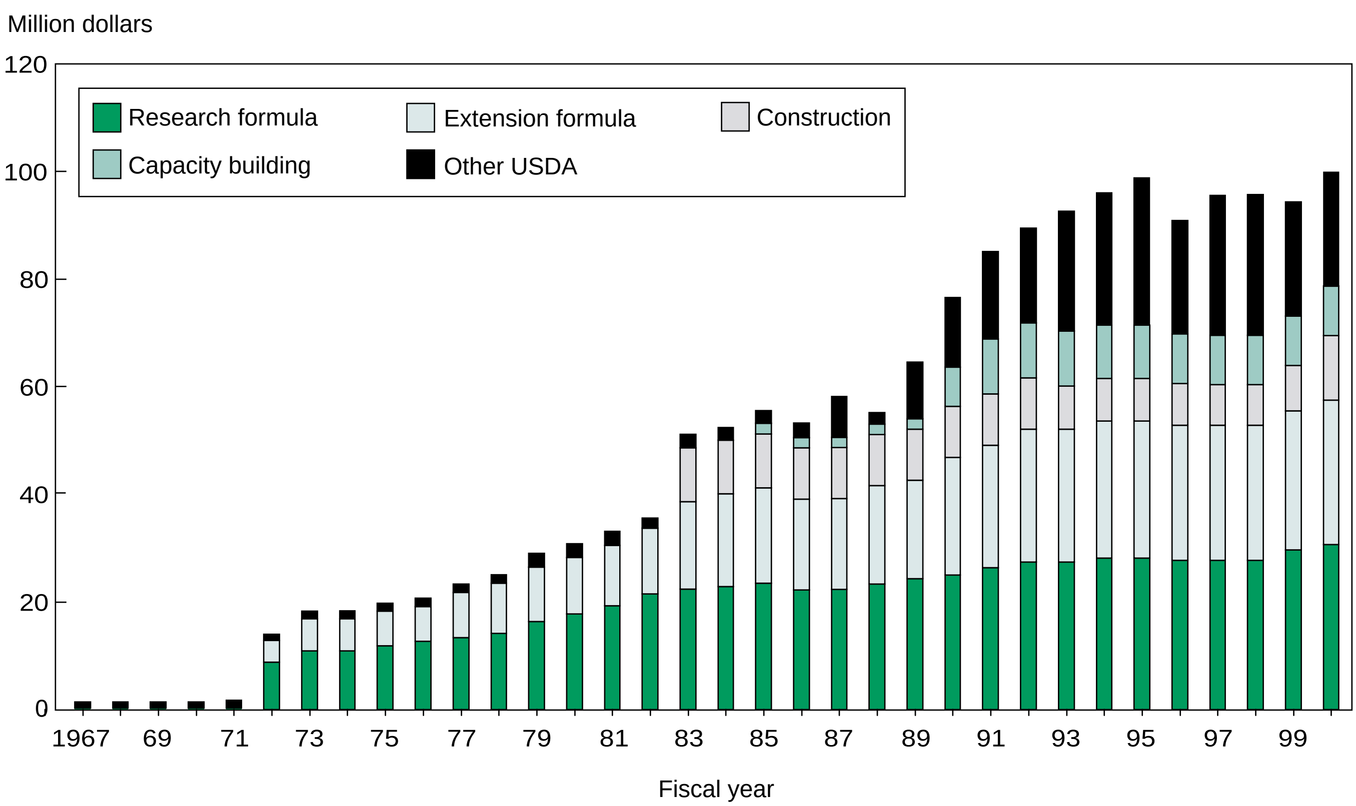
Funding the 1890 Institutions

Although the 1890s are part of the same system that authorizes and governs the 1862 land-grants, lack of financial resources slowed the 1890s' growth and development. For example, no Federal funds were available to these institutions until 1967 (figs. 1 and 2). While cross-institution comparisons are difficult to assess because of differences in missions, the 1890s have received far less funding relative to 1862 land-grant colleges on a per student basis (Huffman and Evenson, 1993). Legislatively established funding mandates for research and extension have not been appropriated. The actual funding for 1890 research and extension relative to the minimum amount required under sections 1445 for research and 1444 for extension is shown in figure 3. On the other hand, actual funding for extension fell far short of the mandate for most of the first 10 years, and has exceeded the mandate since 1990, albeit by a lesser amount than for research. In addition, some federally funded programs have never been established at 1890 institutions. For example, the Hatch Act of 1887 authorized funding to States for scientific research at agricultural experiment stations, which were to operate under the direction of an 1862 institution or other substantially equivalent arrangement (USDA, 1994); no State has established such an experiment station at an 1890 institution.

In 1967, through P.L. 89-106, a broad authority for research grants awarded on a discretionary basis, the 1890s began to receive Federal funds to support research (USDA, 1994). Funds granted to 1890s under this program totaled $283,000 per year through 1971 (see table 2). In fiscal year 1972, Congress appropriated $8.8 million for research grants to 1890 institutions. That same year, Congress appropriated $4.0 million under section 3(d) of the Smith-Lever Act for extension work specifically at 1890s (USDA, 1994), although these funds were distributed to the 1890s through the 1862 land-grants in each State.

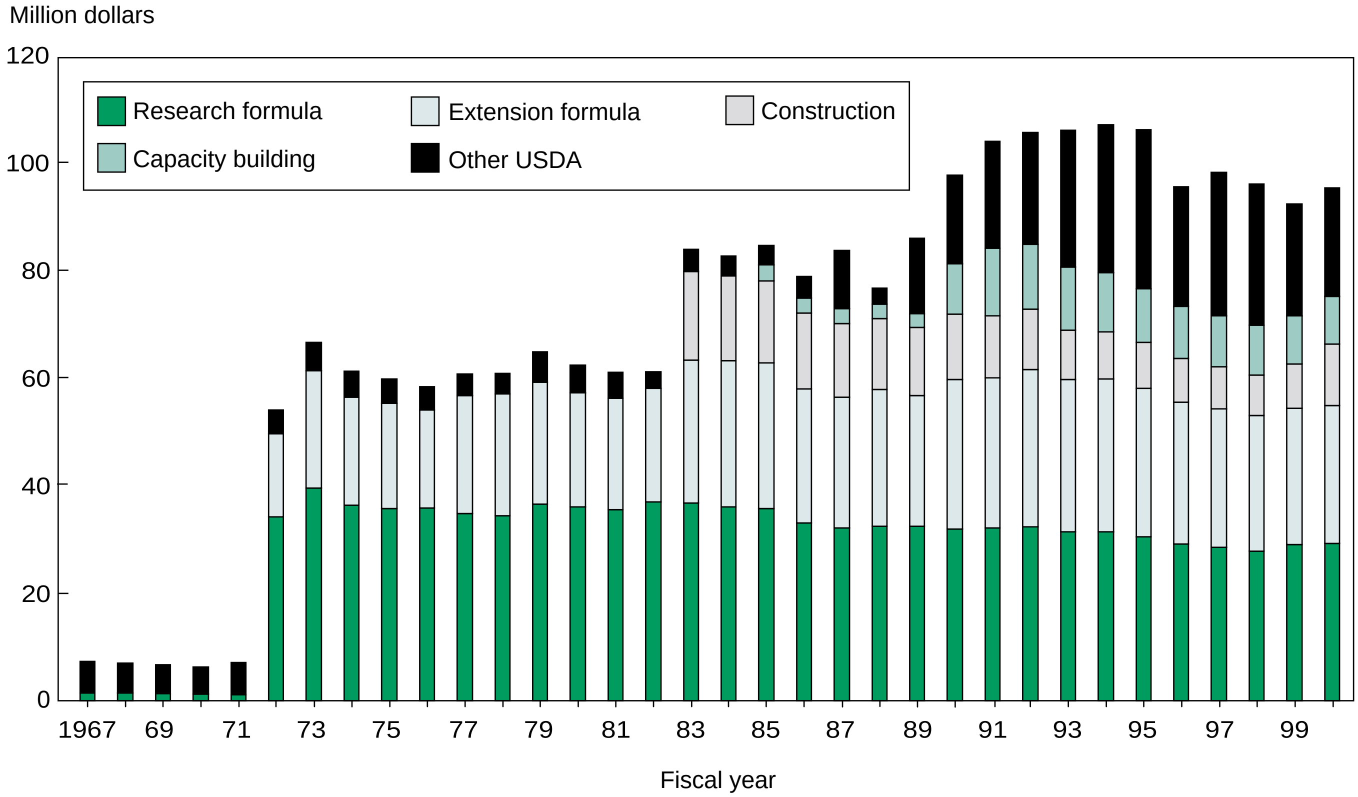
Direct appropriations to support agricultural research at 1890s started with the enactment of the Evans-Allen Act as section 1445 of the National Research, Extension, and Teaching Policy Act (NRETPA) of

Figure 1
USDA support for 1890s
Funding by program, fiscal year 1967-2000



Source: USDA, Office of Budget and Program Analysis.

Figure 2
USDA support for 1890s in constant dollars
Funding by program, fiscal year 1967-2000



Source: USDA, Office of Budget and Program Analysis.

1977. This statute provided a permanent funding authorization for the 1890s similar to the Hatch Act authorization under which formula funds for research at 1862 land-grants have been appropriated since 1887 (McDowell and Evans, 1990). Under section 1445, 1890s receive an amount equivalent to no less than 15 percent of the funds appropriated under the Hatch Act each year (see table 3).

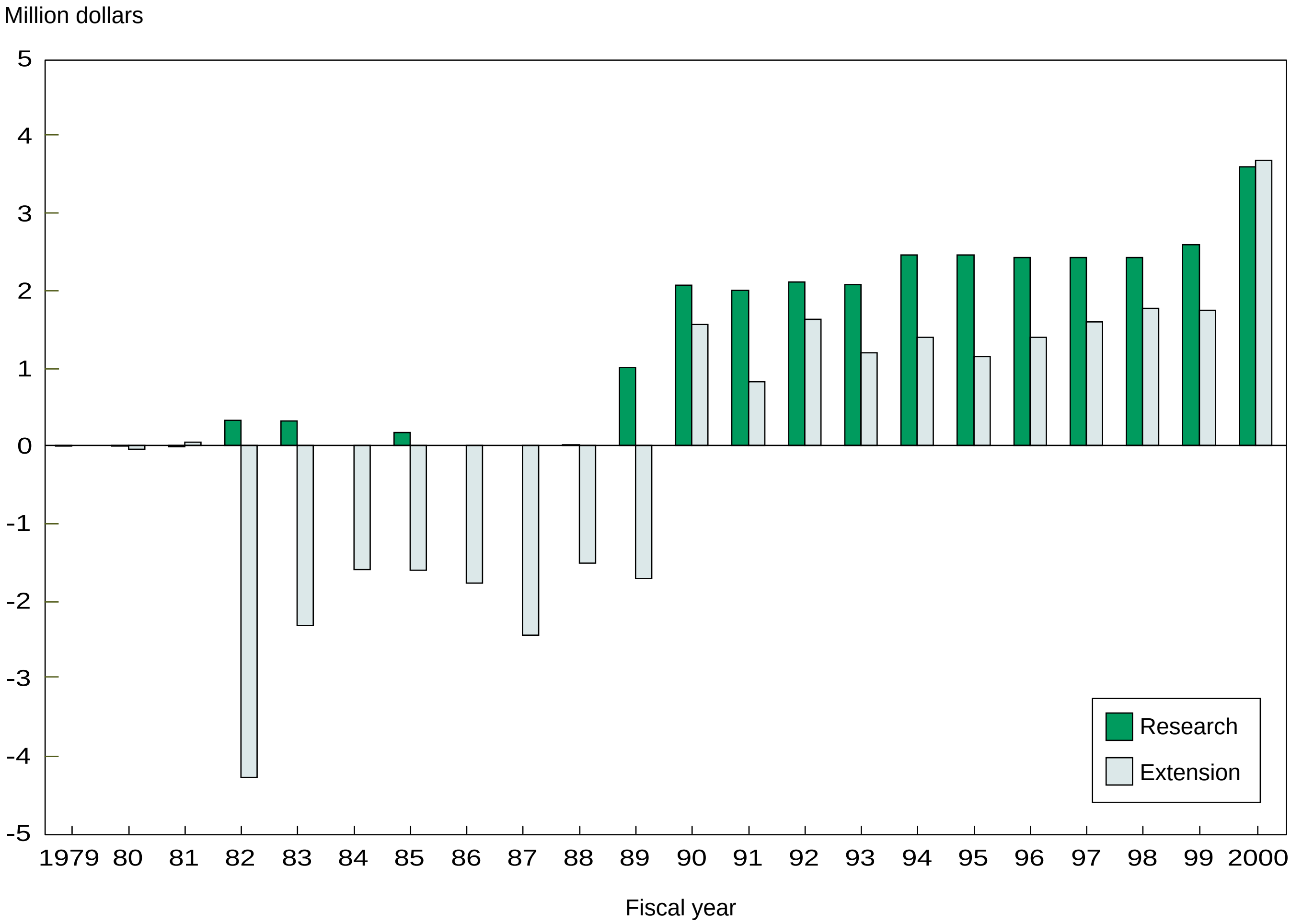
From 1972 to 1978, annual appropriations to 1890s (under the Special Grants authority for research and Smith-Lever 3(d) for extension) increased from $12.9 million to $23.5 million. Two-thirds of the funds were reserved for supporting research in an effort to integrate these institutions into the public agricultural research system (see table 2).

The 1890s began to conduct extension and outreach programs, with emphasis on underserved populations and communities, shortly after their establishment under the Second Morrill Act of 1890. However, they did not receive specifically authorized Federal extension formula funds until enactment of section 1444 of the National Agricultural Research, Extension, and Teaching Policy Act of 1977. This act provided for extension funding directly to the 1890s instead of through the 1862s as had been done since 1972 under Smith-Lever 3(d). Under section 1444, 1890s receive an amount equivalent to no less than 6 percent of funds appropriated under Smith-Lever annually (see table 3).

Total USDA funding of 1890s for the 34 years from fiscal year 1967 to 2000, including funds for research, extension, and general support, rose from about $1.4 million in 1967 to about $100 million in 2000. For the period 1972 through 2000, the average rate of increase in total funding was 7.3 percent per year. Funding for research grew at an annual rate of 4.5 percent, while funding for extension grew at an annual rate of 7.05 percent (see table 2).

The National Research, Extension, and Teaching Policy Act of 1977 and subsequent Federal legislation in 1981, 1985, 1990, and 1996 enhanced Federal financial support to the 1890s. State support for 1890s'

Figure 3
Funding for 1890 research and extension relative to mandates in 1977 farm bill, 1979-2000



Source: USDA, Office of Budget and Program Analysis.

research and extension programs was further strengthened by the Agricultural Research, Extension, and Education Reform Act of 1998, which required States in which 1890s are located to phase in, over a 3-year period (FY 2000-FY 2002), a 50-percent non-Federal match for each Federal dollar received for research and extension programs under section 1444 (which funds extension) and 1445 (which funds research).[2] Prior to this legislation, Federal law required State governments to match the Federal formula-based contributions to research conducted at the experiment stations located at 1862 institutions; in fact, States contributed far more than their match requirements (National Research Council, 1995). However, no such requirements applied to Federal contributions to research based at 1890 institutions until the 1998 legislation was enacted.

In fiscal year 2000, the first year of the matching fund phase-in period, States were required to match 30 percent of the Federal allocation for research and extension programs. In total, States provided a 27-percent match, and 7 States took advantage of the opportunity to request a waiver, which was available for fiscal year 2000 only (see tables 3, 4, and 5). Preliminary information for fiscal year 2001 indicates that most States will have met the applicable 45-percent requirement (Larson, 2001).

[2]The matching requirement is for 30, 45, and 50 percent for fiscal years 2000, 2001, and 2002. States could ask for a waiver only for fiscal year 2000.

Table 2—USDA funding for 1890 land-grant institutions and Tuskegee University, fiscal year 1967-2000

Fiscal year	Research formula payments[1]	Extension formula payments[2]	Research extension construction[3]	Strengthening/ capacity building grants[4]	Other CSRS[5]	Other USDA[6]	Total
				$1,000			
1967	283	0	0	0	1,150	NA	1,433
1968	283	0	0	0	1,150	NA	1,433
1969	283	0	0	0	1,150	NA	1,433
1970	283	0	0	0	1,150	NA	1,433
1971	283	0	0	0	1,150	NA	1,433
1972	8,833	4,000	0	0	1,150	NA	14,033
1973	10,883	6,000	0	0	1,150	NA	18,033
1974	10,883	6,000	0	0	1,150	NA	18,033
1975	11,824	6,450	0	0	1,150	NA	19,424
1976	12,706	6,450	0	0	1,150	NA	20,306
TrQr	3,176	1,373	0	0	292	NA	4,841
1977	13,352	8,400	0	0	1,150	NA	22,902
1978	14,153	9,333	0	0	1,150	NA	24,636
1979	16,360	10,115	0	0	1,176	NA	27,651
1980	17,785	10,453	0	0	1,174	NA	29,412
1981	19,270	11,250	0	0	1,177	NA	31,697
1982	21,492	12,241	0	0	270	NA	34,003
1983	22,394	16,241	10,000	0	821	NA	49,456
1984	22,844	17,241	10,000	0	610	NA	50,695
1985	23,474	17,741	10,000	2,000	598	NA	53,813
1986	22,320	16,887	9,508	1,902	1,071	NA	51,688
1987	22,320	16,877	9,508	1,902	5,901	NA	56,508
1988	23,333	18,291	9,508	1,902	499	NA	53,533
1989	24,333	18,291	9,508	1,902	521	6,300	60,855
1990	25,012	21,836	9,508	7,308	888	8,200	72,752
1991	26,346	22,794	9,508	10,250	1,989	10,300	81,157
1992	27,400	24,730	9,508	10,250	1,652	11,800	85,340
1993	27,400	24,730	8,000	10,250	1,302	16,609	88,282
1994	28,157	25,472	7,901	9,917	1,844	16,200	89,491
1995	28,157	25,472	7,901	9,207	1,634	18,700	91,781
1996	27,735	25,090	7,782	9,200	5,242	15,859	90,908
1997	27,735	25,090	7,549	9,200	4,757	21,224	95,555
1998	27,735	25,090	7,549	9,200	4,479	21,696	95,749
1999	29,676	25,843	8,426	9,200	4,844	16,366	94,355
2000	30,676	26,843	12,000	9,200	4,879	16,319	99,917

[1] Research formula payments have been made under sec. 1445 of P.L. 95-113 since 1979; payments were made under P.L. 89-106 from 1967 to 1978.
[2] Extension formula payments have been made under sec. 1444 of P.L. 95-113 since 1979; funds were provided under Smith-Lever sec. 3(d) from 1972 to 1978.
[3] Research/Extension Construction grants were provided through Cooperative State Research Service (CSRS) for research facilities for 1983 to 1987; and through ES for extension facilities from 1988 to 1992 and for research and extension facilities since 1993.
[4] Strengthening grants were funded from 1985 to 1991. Capacity building grants were begun in 1990.
[5] Other CSRS includes Morrill-Nelson payments (through 1994); Bankhead-Jones payments (through 1981), and grants under various special and competitive grant authorities.
[6] Other USDA includes work under cooperative agreements, support for students under cooperative education authorities, and liaison officers at 1890 institutions.
NA = Not available.

Sources: USDA budget reports and appropriation history records. Amounts shown in other CSRS and other USDA categories are based on available records, which are incomplete for years prior to 1989.

Table 3—Comparison of matching requirements and actual match for research at 1890 institutions[1], fiscal year 2000

Institution	State	FY 2000 allocation	30 percent required match	Actual match	Difference
			Dollars		
Alabama A&M University	AL	1,619,671	485,901	485,901	0
Tuskegee University	AL	1,600,501	480,150	108,893	(371,257)*
University of Arkansas-Pine Bluff	AR	1,421,565	426,470	441,830	15,360
Delaware State University	DE	547,577	164,273	203,600	39,327
Florida A&M University	FL	1,201,936	360,581	360,581	0
Fort Valley State University	GA	1,828,727	548,618	0	(548,618)**
Kentucky State University	KY	2,124,022	637,207	637,207	0
Southern University	LA	1,295,569	388,671	0	(388,671)**
University of Maryland-Eastern Shore	MD	958,815	287,645	0	(287,645)**
Alcorn State University	MS	1,638,116	491,435	3,600,000	3,108,565
Lincoln University	MO	2,031,558	609,467	609,467	0
North Carolina A&T State University	NC	2,618,586	785,576	500,012	(285,564)*
Langston University	OK	1,337,442	401,233	401,233	0
South Carolina State University	SC	1,406,226	421,868	0	(421,868)**
Tennessee State University	TN	1,995,099	598,530	0	(598,530)**
Prairie View A&M University	TX	2,664,999	799,500	799,500	0
Virginia State University	VA	1,716,752	515,026	515,026	0
West Virginia State College	WV	975,000	–	–	0
Total payments to States		**28,982,161**	**8,402,151**	**8,663,250**	**261,099**

Note: Funding is provided under section 1445 of the National Agricultural Research, Extension, and Teaching Policy Act of 1977 (NARETPA).

[1] Includes Tuskegee University and West Virginia State College.

Section 1449 of the NAREPTA does not apply to West Virginia State College.

* Waiver requested for the difference.

**Waiver requested.

Source: USDA, Cooperative State Research, Education, and Extension Service.

Table 4—Comparison of matching requirement and actual match for extension at 1890 institutions[1], fiscal year 2000

Institution	State	FY 2000 allocation	30 percent required match	Actual match	Difference
			Dollars		
Alabama A&M University	AL	1,328,487	398,546	398,546	0
Tuskegee University	AL	1,328,487	398,546	91,677	(306,869)*
University of Arkansas-Pine Bluff	AR	1,199,632	359,950	547,383	187,433
Delaware State University	DE	433,652	130,096	159,900	29,804
Florida A&M University	FL	1,117,451	335,235	335,235	0
Fort Valley State University	GA	1,600,131	480,039	0	(480,039)**
Kentucky State University	KY	2,004,220	601,266	601,266	0
Southern University	LA	1,101,869	330,561	0	(330,561)**
University of Maryland-Eastern Shore	MD	847,013	254,104	0	(254,104)**
Alcorn State University	MS	1,311,143	393,343	586,861	193,164
Lincoln University	MO	2,002,099	600,630	699,000	98,370
North Carolina A&T State University	NC	2,384,762	715,429	500,000	(215,429)*
Langston University	OK	1,196,996	359,099	359,099	0
South Carolina State University	SC	1,162,178	348,653	0	(348,653)**
Tennessee State University	TN	1,802,935	540,881	0	(540,881)**
Prairie View A&M University	TX	2,466,029	739,809	1,546,215	806,406
Virginia State University	VA	1,521,996	456,599	456,599	0
West Virginia State College	WV	1,000,000	--	--	0
Total payments to States		**25,809,080**	**7,442,786**	**6,281,781**	**(1,161,003.00)**

Note: Funding is provided under section 1444 of the National Agricultural Research, Extension, and Teaching Policy Act of 1977 (NARETPA).
[1] Includes Tuskegee University and West Virginia State College.
– – = Section 1449 of the NAREPTA does not apply to West Virginia State College.
* Waiver requested.
**Waiver requested for the difference.

Source: USDA, Cooperative State Research, Education, and Extension Service.

Table 5—Required and actual match for 1890 research and extension, fiscal year 2000

Program	Allocation	30-percent match	Actual match	Waiver*
		Thousands of dollars		
Research (section 1445)	28,982	8,402	8,663	7
Extension (section 1444)	25,809	7,443	6,282	7
Total	54,791	15,845	14,945	7

*Seven States requested waivers in matching requirements for both research and extension funding.

Source: USDA, Cooperative State Research, Education, and Extension Service.

Funding for Teaching Programs

Although the original driving force for the land-grant system was the need for higher education for the majority of the U.S. population, financial support for the teaching component of the land-grant mission has since been largely relegated to States. The Federal Government's financial support to the land-grant system has been centered on funding research and disseminating research-based knowledge through extension (National Research Council, 1996). In 1995, for example, while USDA allocated $406 million for research and $439 million for extension, the allocation for higher education grants was only $18 million (of which more than half was for institutional capacity building in both teaching and research at 1890s) (National Research Council, 1996).

The Second Morrill Act did not endow the 1890 institutions with the public land and other resources appropriated for the 1862s, and they were not compensated in subsequent legislation (National Research Council, 1996). For example, the Morrill-Nelson grants, which provided $50,000 annually to each State for land-grant academic programs, were not accessible to 1890s for many years, and when they became available the amounts were minimal. Compensatory efforts have been made through strengthening and capacity building programs initiated in 1985, which were designed to enable the 1890s to meet the needs of an expanding student population (National Research Council, 1996).

Currently, the majority of funds for undergraduate and graduate instruction at the 1890s come from State governments. However, Federal support is still significant for funding scholarships and enhancing the capacity of 1890 institutions to develop and improve teaching programs. The major Federal support programs for 1890 land-grant teaching are administered by the USDA Cooperative State Research, Education, and Extension Service Office of Higher Education. Federal support for teaching programs includes:

(1) The teaching components of 1890 Institution Capacity Building Teaching and Research Grants Program,

(2) The USDA/1890 National Scholars Program, a cooperative education program, and

(3) Higher Education Multicultural Scholars Program.

The Capacity Building Grants Program that began in 1990 has become the most significant of these three Federal sources of funds. USDA awarded 429 Capacity Building Grants between 1990 and 1999, of which 242 (56 percent) were for teaching projects.[3] The teaching grants awarded $41.6 million to strengthen teaching capacity at 1890s (Hood, 1999). USDA investments made through these programs help to advance the quality of teaching programs in food, agriculture, and natural resources at 1890 universities.

Funding for Research Programs

Research at land-grant colleges and universities is supported by funds from Federal, State, and private sources. Federal support for research at land-grant colleges is primarily financed through four funding mechanisms (National Research Council, 1995):

(1) formula-based grants administered through USDA,

(2) special grants earmarked by Congress for specific institutions and administered by USDA,

(3) competitive grants awarded and administered by USDA, and

(4) cooperative agreements with USDA and other Federal agencies.

While Federal sources constitute only 30 percent of the 1862 land-grant universities' total research funds, Federal sources make up 87 percent of total funds for research at the 1890s (table 6). Federal formula funds constitute approximately 90 percent of the CSREES-administered research funds for 1890s, while the corresponding figure for 1862s is 44 percent. Non-Federal sources contribute 19.5 percent of total research funds at 1862s; private sources of research funds at 1890s are very small (1 percent). State funding is the single largest source of research funding for 1862s, accounting for 47 percent of funds, while States' contribution to research at 1890s is only 12 percent. State funding of 1890s' research will likely increase with passage of the Agricultural Research, Extension, and Education Reform Act of 1998, which requires States to match 50 percent of Federal formula funds for 1890s' research and extension.

Over the last four decades, the types of Federal funding to land-grant universities have changed, with a decreasing share of research dollars awarded through formula funds and an increasing share awarded through competitive grants and special grant funds (Huffman and Just, 1999). Moreover, the funding bases for agricultural research have been shifting recently away from public sources and toward private. These developments put 1890s at a comparative disadvantage to 1862s, since most 1890 universities are comparatively small and more dependent on Federal formula funding than the 1862s. Thus, even small changes in USDA funding for research play a much larger role in the 1890s than in 1862s.

[3]During the same period, 44 percent of USDA's Capacity Building Grants were for research projects.

Table 6—Source of funds for research to 1890 and 1862 institutions, fiscal year 2000

Funding mechanism	1890s		1862s	
	$1,000		*$1,000*	
Formula funding	28,311	(75.8%)	186,915	(7.9%)
Special research grants	714	(1.9%)	58,727	(2.5%)
Competitive research grants	0	(0%)	40,877	(1.7%)
Other CSREES	2,812	(7.5%)	34,472	(5.7%)
Other USDA	89	(.2%)	75,022	(3.2%)
Other Federal	512	(1.4%)	285,379	(12%)
State appropriations	4,548	(12.2%)	1,117,819	(47.4%)
Other non-Federal	370	(1%)	458,912	(19.5%)
Total	37,356	(100%)	2,258,123	(100%)

Source: USDA, Cooperative State Research, Education, and Extension Service.

Funding for Extension Programs

The 1890 extension service programs are funded almost entirely by USDA through the Cooperative Extension Service. The Smith-Lever Act established the Cooperative Extension Service as a joint effort of USDA and the land-grant institution in each State, and also provided for county-level participation. The 1890s were directed to work in cooperation with their 1862 counterparts to extend the benefits of the Cooperative Extension System to their States' Black populations (USDA, 1988). This arrangement lasted until the mid-1960s, when charges of discrimination brought a reevaluation of the dual program.

Beginning in 1972, Congress provided direct funding (as well as funding to be administered by each State's Cooperative Extension Service) to 1890 extension programs. Funds were provided under Smith-Lever section 3(d) from 1972 to 1978, and increased from $4 million in 1972 to $9.3 in 1978. The 1977 Food and Agriculture Act eliminated the role of the Extension Service in distributing funds to the 1890 Extension program in those States with two land-grant colleges (Godfrey and Franklin, 1992); since 1979, extension formula funds have been made under section 1444 of P.L. 95-113. These formula funds increased from $10.1 million in 1979 to $26.8 million in 2000 (see table 2). Extension facility construction grants were also provided for extension facilities from 1988 to 1992 and for extension and research facilities since 1991 (USDA, 1994).

Identifying Measurable Administrative Indicators

It has been argued that through all three of their mission programs—*teaching, research, and extension*—the 1890s build human capital in traditionally underserved areas (see, for example, Williams, 1973; Brazziel, 1983; Parks, 1985; Williams and Williamson, 1985; Allen, 1990; Davis, 1992; Evans et al.; and Polopolus, 1990). Yet, little measurable empirical evidence exists of the private or social benefits generated by teaching, research, or extension activities of the 1890 universities. There has been no systematic effort to measure the economic contribution of the 1890s' programs to human capital development or to improving the well-being of the population they serve.

In the parlance of some management systems, outcomes are benefits that accrue to individuals and society when people participate in a program. They may take the form of enhanced learning (knowledge, perceptions/attitudes, or skills); increased income; or a change in conditions, such as improved health, from the adoption of a desired behavior or practice. Indicators are measurable events accepted as evidence that an outcome has been achieved.

Contributions to social welfare made by educational institutions are difficult to measure. For example, a college or university may create an atmosphere that is especially welcoming to minority students, thereby encouraging some students to attend college who otherwise might not (LeBlanc, 1996). Usual indicators of educational output such as test scores may not capture such contributions. Similarly, not all R&D contributions may be captured by standard measures of research output such as patent or publication counts. Indicators that do not take these types of contributions into account may underestimate total benefits.

Teaching Outcomes and Indicators

In 1993-94, the Historically Black Colleges and Universities (HBCUs) awarded 28 percent of bachelor's, 15 percent of master's, 9 percent of doctorate, and 16 percent of first-professional degrees to Blacks in the United States (National Center for Education Statistics, 1996). The 1890s institutions are a subset of the HBCUs and play an important role in educating African-Americans.

The 1890 land-grant universities account for a third of all African-American students enrolled in HBCUs and have played a significant role in training students from various ethnic minorities in agricultural and food sciences, engineering, mathematics, and other disciplines. In 1993 about 20 percent of minority students pursuing bachelor's degrees in agriculture and natural resources specializations were enrolled at 1890 colleges (National Research Council, 1995). Moreover in 1994, 16 percent of all African-American students enrolled in U.S. institutions of higher education were enrolled at 1890s.

The 1890 land-grant institutions play a significant role in educating minority students for professions in agriculture and related fields. During the 1970s, approximately 80 percent of the students enrolled in agriculture at the 1890 institutions were non-White, compared with only 5 percent at 1862 institutions (Hytche, 1992). In the 1980s, the 1890 institutions accounted for about 35 percent of all minorities enrolled in agriculture-related

Table 7—Administrative outcomes and indicators for teaching

Outcomes	Indicators
Matriculation	Numbers and proportions of: ▪ students who return to complete their degree program ▪ students graduating with different levels of degrees ▪ ethnic minorities graduated
Employment	Income earned by graduates Numbers and proportions of: ▪ graduates employed in USDA ▪ graduates employed in agriculture ▪ graduates employed in their field
Professional/ leadership achievement	Numbers and proportions of graduates: ▪ pursuing graduate or professional studies ▪ with advanced degrees in leadership roles ▪ active in their professional and/or community organizations ▪ indicating education key to contributions as citizens and or in their professions
Personal satisfaction	Number and proportion of graduates who: ▪ return to the same institution at a higher program level ▪ are active in alumni associations ▪ recruit and/or recommend others to their alma mater ▪ contribute financially to alma mater

Source: Essel, Clarke, and Tegene, 1999.

fields and graduated about 65 percent of African-American recipients of bachelor's degrees in agricultural sciences. The 1890 institutions continued to be a significant source of minority graduates in the 1990s.

The schools and colleges of agriculture, forestry, and renewable natural resources at these institutions offer both undergraduate and graduate degree programs. Minority students in baccalaureate programs at these schools and colleges specialize in a wide range of areas, although many seem to find a few areas, such as animal sciences and agricultural business and management, most attractive (see appendix tables B6-B7).

The specific outcomes of teaching programs at the schools/colleges of agriculture in the 1890 land-grant institutions depend on the particular goals and objectives established for these programs by the institutions, by State and Federal agencies funding the programs, and by stakeholders. However, based on the fundamental objective of the 1890 land-grant teaching program—to prepare students to become productive citizens capable of reaching their full potential—the outcomes of USDA-supported 1890 teaching programs in food and agricultural sciences could be measured by the number of graduates who obtain degrees in food and agricultural sciences; gain admission to graduate/professional school; secure employment; attain career/professional goals; and become leaders in their professions, communities, country, and the world.

Each of these outcomes can be measured by a number of indicators. For example, matriculation can be measured by the number and percent of students graduated with different levels of degrees and/or the number and percent of African-American and other ethnic minorities graduated. Outcomes are often multi-dimensional and not easily represented by a single indicator. Table 7 provides some examples of potential outcomes and indicators that might be used to measure the performance of 1890 institutions in the area of teaching. Most outcomes and indicators should be compared to graduates from similar programs in other institutions and graduates from 1862 and non-land-grant institutions adjusted for regional and social differences.

Research Outcomes and Indicators

Agricultural research at the 1890 institutions is facilitated by the Association of Research Directors, Inc. (ARD), a federation of the research directors from the seventeen 1890 land-grant universities that provides coordination of research initiatives among member institutions in cooperation with Federal, State, and private partners. ARD partners with USDA's Cooperative State Research, Education, and Extension Service (CSREES) and holds membership in the State Agricultural Experiment Station System (SAES) of the National Association of State Universities and Land-Grant Colleges (NASULGC). It also cooperates with other regional, national, and international committees, organizations, and groups in developing programs and legislation affecting the food and agricultural research needs of the Nation.

Table 8—1890s research expenditures by ESCOP[1] Program areas, 2000

Research area	$1,000	Percent
Environment and natural resources	6,171	16.5
Plant systems	8,975	24.0
Animal systems	9,241	24.7
Food and non-food products	2,129	5.7
Engineering	846	2.3
Economics, markets, and policy	2,544	6.8
Human nutrition and food safety	4,901	13.1
Family and community systems	1,628	4.4
Research support, administration	920	2.5
Total	37,355	100

[1] Experiment Station Committee on Organization and Policy.

Sources: Cooperative State Research, Education, and Extension Service (CSREES). Data based on USDA's Current Research Information System (CRIS).

Research priorities at 1890s are determined by Federal, State, and local priorities and needs, which are heavily influenced by stakeholders. However, the fundamental food and agricultural research mission of the 1890s is to ensure a safe, affordable, and ample food and fiber supply; to promote a sustainable environment; to conserve natural resources; and to contribute to the improvement in the socioeconomic well-being and overall quality of life of diverse rural and urban populations (Mayberry, 1976; and Mayes, 1992).

The 1890s have developed research programs in animal science, crop science, natural resources, human health and nutrition, and rural development. In addition, research at the 1890s has addressed the problems and concerns pertinent to small-scale farmers and limited-resource families, including, for example, research on minor livestock species, such as goats and rabbits, that are particularly suited to small-farm operations.

Current primary research areas at 1890 institutions include economically competitive and sustainable small-scale production systems; improved plant, animal, and aquaculture production systems; crop diversity and alternative crops and marketing strategies for farmers; food safety and quality; family and community development; protection and improvement of water quality and quantity; environmental pollution and waste management, value-added plant and animal products, and improved nutrition and health (Mayes, 1992).

Apportioning credit for observed changes to research conducted at specific institutions, or even to research in general, is difficult. For example, how might one partition the value of an increase in the agricultural productivity in the United States among contributions from 1862 land-grants, 1890 land-grants, and other public and private research institutions? Particularly for the 1890s, because research and development expenditures are relatively small portions of total agricultural R&D expenditures in the United States, estimating a statistical relationship between agricultural productivity or other advancements in the agricultural sector and funding in these institutions becomes nearly impossible.

It may be difficult to estimate the contribution of 1890s to changes like overall productivity growth, but each institution's output or research outcome can be identified. In one approach, the Experiment Station Committee on Organization and Policy (ESCOP) has designed 9 general areas to identify research outcomes: environment and natural resources; plant systems; animal systems; food and non-food products; engineering; economics, markets, and policy; human nutrition and food safety; family and community systems; and research support and administration. Since 1890s spend about 65 percent of their research funds in the areas of animal/plant systems and environmental and natural resources research (table 8), outcomes in these research areas are particularly important.

Within these broad categories of research, potential outcomes include new understanding of efficient use of land and water resources with environmentally friendly farming practices; new information on healthy and optimal nutritional requirements of individuals and knowledge of enhanced food safety measures; new and/or improved byproducts; new knowledge of effective strategies for strengthening communities and improving quality of life for rural communities; new information on profitable use of feed grains, pasture, forage, and other crop byproducts for producing minor livestock species particularly suitable for small farmers; improved quality of animal production systems and animal food products; and knowledge of new and cost-effective techniques for plant breeding, sustained productivity of plants, and improved plant management systems.

Traditional indicators of research outcomes depend heavily on publication and/or patent counts. Common indicators of research outcomes include the number of products/patents produced; number of journal articles, books, and monographs published; number of research reports, staff papers, or working papers written; number of conference papers presented; number of copyright notices filed; and/or number of refereed journal articles identified in citation indexes.

Extension Outcomes and Indicators

The Cooperative Extension Service is an outreach and education program designed to enable people to improve their lives through scientific knowledge adapted and applied to their everyday issues and needs (National Research Council, 1995: p. 68). The impetus for the Federal extension initiative stemmed from concerns in the early 1900s that knowledge and technologies being developed at the State agricultural experiment stations and USDA were not reaching those farmers and citizens not enrolled in the land-grant colleges. Congress addressed these concerns with the passage of the Smith-Lever Act of 1914 that established the Extension Service as a cooperative effort among Federal, State, and county governments on a nationwide basis.

The 1890 universities began their outreach program for Black farmers shortly after the universities' establishment. The "farmers conference" in 1892 and the "short course in Agriculture" offered by Tuskegee (and soon followed by other 1890s) are considered to be the beginning of Black agricultural extension work (Neyland, 1990, p. 149-151). As early as 1906, Tuskegee's "movable school" or "traveling school" taught Black farmers better ways of farming by using field demonstrations, a model soon adapted for use across the Cooperative Extension System. Today, the 1890 extension system is part of a nationwide Cooperative Extension System that encompasses the land-grant universities, the U.S. Department of Agriculture, and county governments.

Table 9—Extension outcomes and indicators

Outcomes	Indicators
Farmers make decisions that enhance profitability.	Number of informal small-farm profitability and sustainability education programs conducted, number of producers and landowners participating in non-formal educational program, and number of producers adopting recommended farm business management practices such as strategic planning and risk management.
Farmers adopt production practices that enhance income, environmental quality, and their communities.	Number of producers adopting production practices and alternatives that are profitable and promote quality of soil, water, and air resources; number of farmers adopting new and value-added enterprises; number of farmers adopting cost-saving practices; and number of farmers developing and implementing marketing plans. Dollar value of new and value-added products produced, savings from adopting improved management practices, and additional income from farming.
Households have increased knowledge of family resource management and childcare providers improve the quality of care given to children.	Number of childcare providers receiving training, number/percent of participating childcare providers adopting recommended quality childcare practices, number of participants starting new childcare business as a result of training, number of people participating in household resources/financial management program, and dollars saved by adopting the new resource/financial management strategies.
Farmers are more knowledgeable about government, education, strategic planning, and their communities.	Number of participants in the community leadership programs, number of participants who serve (attend) and/or plan to serve (attend) community activities such as school board, governing board, or planning commission board in their community, number of participants who are appointed to leadership roles at all levels of the community, and number of participants who report increased knowledge and understanding of the economic development plan for their community.

Source: Essel, Clarke, and Tegene, 1999.

The 1890 institutions have targeted their extension programs toward limited-resource and underserved populations. Historically, these audiences lacked access to other non-formal educational opportunities because they were hard to reach; had distinct problems associated with their poverty, minority status, and scale of farming; and presented little or no economic incentives to private sector suppliers. In 1998, the Association of Extension Administrators (AEA) published a strategic plan to guide extension work at the 1890 institutions in the 21st century. In this plan, the AEA identified the special mission of the 1890 Extension System as assisting “diverse audiences, with emphasis on those who have limited social and economic resources, to improve their access to positive opportunities through outreach education.”

Extension programs commonly focus on seven base areas (National Research Council, 1995): agricultural competitiveness and profitability, community resource and economic development, family development and resource management, 4-H and youth development, leadership and volunteer development, natural resource and environmental management, and nutrition, diet and health.

The customer needs of each State determine the areas of each land-grant institution’s educational priorities, but many 1890 institutions offer extension programs in most of these areas. For each area, institutions develop program plans that identify goals and objectives, including activities needed to achieve them. Ideally, for each objective, the program plan defines outcomes desired, indicators for measuring these outcomes, and evaluation methods that may be used to gather information.

Extension programs help a target audience find solutions to a defined problem in a systematic and sequential educational process. They create opportunities for people or communities with a problem to progress from awareness to increased knowledge and skills to adoption of a desired behavior. To meet the educational mandates of stakeholders and funding sources, extension programs must establish goals and objectives that stimulate outcomes which ultimately result in a desired personal and societal change. These outcomes may include improved quality of life for individuals and families, more productive farms and forests, and enhanced environmental conditions in urban and rural communities.

Determining the value of extension programs will require the collection of quantitative and qualitative data on outcomes and indicators. Rennekamp, Warren, and Maurer (1996) have listed seven levels of data that can be collected about outcomes of an Extension program, in order of their usefulness in documenting outcomes. These levels are changes in social, economic, or environmental conditions; things participants are doing differently as a result of the program; changes in knowledge, opinions, skills, or aspirations; participants' feeling about the program; number of people who participated in the program; what was done and the interactions of the participant with the educator; and resources expended for the program. The highest levels reflect changes in participant behavior and social impacts. However, as noted by the Greater Kalamazoo Evaluation Project (Spring 1998), measuring behavioral changes of program participants poses serious challenges. At best, any such behavioral outcome measurements are only approximations.

In the past, the Extension Service has been effective in documenting and reporting program inputs, activities, and outputs (number of people participating, number of workshops and meetings held, number of educational materials distributed, number of hours of volunteer service delivered, etc.), but have been less effective in documenting outcomes. With increased demands for accountability from governments, other funding agencies, clients, and stakeholders, Extension is challenged to develop meaningful outcomes and measures for its programs that allow for adequate determination of their effectiveness and returns on public investments (National Research Council, 1996).

Valuing the economic benefits of 1890 extension programs will require collecting data on inputs, activities, outputs, and outcomes of all the different outreach and educational programs offered by the 17 institutions that comprise the 1890 Extension System. Rennekamp, Warren, and Maurer (1996) provide a detailed description of some of the methods and approaches that can be used in gathering such data.

Because quantitative data are easier and more amenable to mathematical analysis, program planners and evaluators tend to prefer to obtain such data for measuring educational impacts. For example, the number of people affected by an extension program is usually used as a gauge for the program's effectiveness. Unfortunately, this method often leaves out qualitative impact information. In addition, it may not necessarily provide a good guide in determining which projects are having the largest impacts. A program that affects 100 people significantly (however significance is measured) may be a better use of funds than a program that affects 1,000 people only slightly. Just focusing on quantitative data and modeling may fail to capture the greatest outcomes that extension programs can have on people's quality of life. Although qualitative measures are imprecise and difficult to evaluate economically, valuing the return on investment in 1890 extension programs must inevitably include a qualitative component.

Exploring Conceptual Frameworks

Attempts to evaluate the impacts of these institutions may consider various types of outputs, but the educational mission has probably generated the greatest returns. Because education is embedded in the individuals who receive it, economists often refer to educational investments as generating human capital (Becker, 1980). Human capital, like other forms of capital, provides a service that pays off over a period of time. And, it is the product of deliberate investment decisions, both public and private. In the next sections, we focus on the role of the 1890s in developing human capital. We discuss how economists conceptualize the link between resources that flow into human capital development and benefits that flow out. We also indicate what might be involved in estimating the net economic benefits from human capital development at the 1890 institutions.

Human Capital Theory

The concept of human capital has been around for centuries. However, about 40 years ago, the study of human capital increased, in part due to the realization that growth in physical capital explains a relatively small part of income growth in most countries. The search for better explanations of income growth led to improved measures of physical capital as well as to interest in technological change and in human capital and its measurement (Becker, 1980).[4]

The incentive for acquiring human capital through a college education is based largely on technological and other changes in the economy. If technology and the economy as a whole were to remain stagnant, incentives for higher education would be minimal. Education increases society's ability to adjust to ramifications of technological and economic change by helping people figure out how to allocate resources better given the new environment (Huffman, 1977; Schultz, 1975; and Welch, 1970). If they allocate better, they are more productive and efficient, and incomes rise. Students expect to capture the value of their productivity gain in the form of higher wages. Of course, education can also help people make better consumption decisions and improve their productivity in home production, child rearing, and other ways that benefit the individual and society (Michael, 1972).

[4]Much of the conceptual work on the value of human capital was contributed to or stimulated by economists T. W. Schultz and Gary Becker (Schultz, 1961, 1971, 1975; Becker, 1962, 1980, among many other papers and books). A large literature of empirical studies has followed (e.g., Hansen, 1963; Hanoch, 1967; Welch, 1973, 1975; Cain, 1976; Huffman, 1977; Psacharopoulos, 1981; McMahon, 1991; Cohn and Hughes, 1994).

Table 10—Percent of White college-graduate earnings earned by Black, Latino, and Asian-American college graduates

Category	1939	1949	1959	1969	1973	1979	1982	1989
				Percent				
Male:								
Black	59	72	67	68	90	82	81	70
Latino	61	66	78	76	97	88	90	83
Asian-American	73	85	85	110	--	91	--	100
Female:								
Black	67	89	71	101	97	95	92	94
Latino	--	--	--	99	102	94	97	98
Asian-American	--	--	--	104	--	110	--	106

Source: Carnoy, 1995.

Table 11—Private rates of return to college education

Category	1939	1949	1959	1969	1973	1979	1982	1987
				Percent				
White male	10.9	9.1	10.4	10.8	8.6	9.5	9.8	11.0
Black male	5.7	5.8	6.1	10.2	9.8	8.6	8.5	12.7
Latino male	7.2	7.1	8.6	7.9	10.2	8.7	11.7	12.2

Source: Carnoy, 1995.

And as an economy grows, the value of human time increases, increasing the value of human capital and stimulating demand for it in many forms.

Demand for less discrimination in access to schooling and higher education may also increase with economic growth. Discrimination in education and in the workplace reduces the returns to education, both for the individual and for society, and retards economic growth. Evidence indicates that returns to schooling during the first half of this century were significantly less for Blacks than for Whites and were also less for Blacks than they are today (Becker, 1980; Welch, 1973; and Carnoy, 1995), although Black male college graduates still earn significantly less than White, Latino, or Asian-American graduates (see table 10).

Similarly, historical discrimination in education and extension service available to Black farmers hindered their productivity. Huffman (1981), using 1964 data from southern States, showed that Black farmers in the U.S. South obtained lower quality and fewer years of schooling than White farmers, and that the extension services provided to Black farmers were fewer and of lower quality than those provided to White farmers. He estimated an econometric model that identified the quantity and quality of Black farmers' education and extension services as the primary source of their lower productivity relative to White farmers. Huffman (1981) concluded that this lower productivity contributed to the exodus of Black farmers from southern agriculture at double the rate of White farmers during the 1950s and 1960s, when agricultural technology was changing rapidly.

Many empirical studies provide estimates of economic rates of return to schooling, including higher education, and some disaggregate those rates by gender and race (e.g., Psacharopoulos, 1994; Constantine, 1995; and Carnoy, 1995). The rates vary over time with the health of the economy and as structural changes increased job access for minorities and women. Estimated rates of return to a college education have averaged from 9 to 15 percent with a dip in the 1970s (Cohn and Hughes, 1994; Carnoy, 1995; and table 10). Rates of return to a college education for the African-American population were lower than those for the White population for several years (see table 10); job discrimination (Becker, 1980) and lower quality of education (Card and Krueger, 1992b) may have led to lower earnings of Black graduates.[5]

The rates of return to non-White male graduates were in the 6-10-percent range just before U.S. entry into World War II, depending on location, compared to 10-12 percent for white males. These lower rates of return prevailed despite lower forgone earnings (income students might have earned had they been working rather than attending college) of Blacks while they attended college. Even at 6-10 percent, however, college was a good investment for Blacks. By the mid-1980s, it appears that racial differences in rates of return to a college education had essentially disappeared (Carnoy, 1995 and table 11). Although earnings after college remained lower for Blacks than for Whites, the costs of attending college remained lower also, especially the forgone earnings.

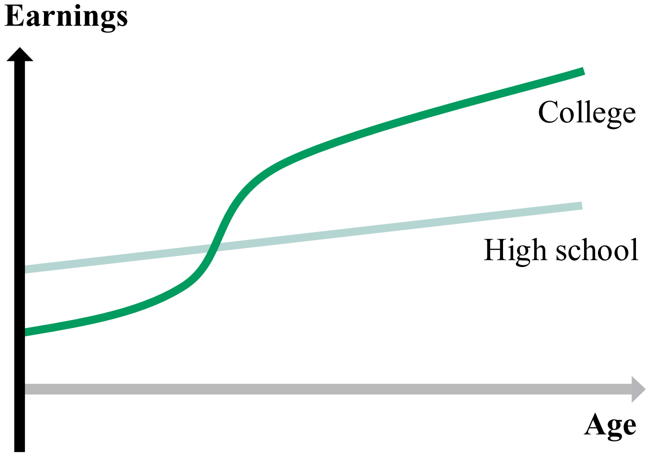
Measuring the Returns to Human Capital

How rates of return to college education are calculated is relevant for estimating impacts of the 1890 institutions. When economists refer to an expenditure on higher education as an investment in human capital, they are implying it is possible to measure a return on this investment. The return is based on the future income streams generated by the capital, compared to the costs of acquiring it. Cost-benefit techniques can be used to make this comparison, taking into account that costs and benefits occur during different time periods. The typical pattern of earnings for college versus high school graduates is illustrated in figure 4. College graduates receive earnings lower than high school graduates while in college, but receive higher wages when they are older.

Investment in human capital provides net returns to the individual and to society. Individuals benefit from increased lifetime earnings. Earnings after taxes, with and without the education, can be compared with direct and indirect costs of the education borne by the individual. Direct costs include tuition, fees, books, supplies, unusual transportation and lodging costs, and other expenses, while indirect costs include primarily the income forgone while going to school. As indicated in figure 4, even if a student works while in school, his or her earnings are usually less than if he or she were not in school.

[5]Card and Krueger (1992a) found that people educated in States with high-quality schools (as measured by student-teacher ratio, average term length, and the relative pay of teachers) exhibit higher returns to additional years of schooling. In another paper, Card and Krueger (1992b) found that improvements in the quality of education Blacks receive explain 20 percent of the narrowing of the Black-White earnings gap during 1960-80.

Figure 4
Earnings profiles for college versus high school graduates



Source: Norton and Tegene (1999).

Society benefits from the increased productivity of the worker. Therefore, society typically bears some of the costs of the investment through subsidized tuition or other means. By accounting for these costs, and by measuring earnings differentials before taxes as well as forgone earnings (before taxes) while in college, an estimate of the social rate of return can be obtained through social cost-benefit analysis. However, some of the benefits to society remain outside this analysis, leaving the estimated returns likely an underestimate of total gains from education.

An alternative way to measure the social rate of return to human capital investments related to education is to estimate a model that relates productivity changes in a country (or to a particular sector such as agriculture) to changes in land, labor, capital, and education.[6] Education might be measured by a variable such as years of schooling. Such models have been estimated both in the United States and in several other countries (see Welch, 1970, for a classic paper related to U.S. agriculture). The difficulty in using this approach for estimating returns to investments in the 1890 universities, however, is that their educational programs have relatively small impacts on the economy or on the agricultural sector (compared to the impacts of higher education as a whole), making their impacts hard to detect empirically.

[6] Likewise, education can be included as a variable in a model that assesses its impact on household productivity or consumption efficiency (see, for example, Michael, 1972).

A human capital approach that focuses on earnings gaps between 1890 graduates and high school graduates is likely to be more fruitful. However, several issues must be addressed in any meaningful attempt to apply such an approach to measuring human capital benefits of the 1890s. First, the models used must be structured to disentangle the effects of inherent ability, other personal characteristics, and job location from the effects of an 1890 education, an issue of concern for any attempt to estimate the value of higher education. A statistical analysis that accounts for the various factors influencing earnings gaps could handle this problem.

A second issue more specific to the 1890s is the need to capture how the returns have changed over time as the degree of discrimination in labor markets has changed. As noted earlier, several studies have found lower returns to education of African-Americans for earlier periods when labor markets were more severely segmented into Black and White than they are today (Becker, 1980; Hanock, 1967; and Welch, 1973), although forgone income while going to college was also low for Blacks in earlier periods. Unless a student prepared for a profession such as medicine or law and subsequently served the African-American community, wage differentials due to a college education were small simply because many jobs that brought returns to greater education were not available to African-Americans, especially in the South. This problem might be handled by measuring only the value of an 1890 education over a more recent period, during which discrimination in the labor market is less pronounced.

A third issue, again more specific to the 1890s, is whether their particular contribution to education is creating a welcoming atmosphere for minority students that encourages students to attend college who otherwise might not. If this contribution is significant, the analyst must decide whether the relevant comparison for measuring the benefits of an 1890 degree is to other colleges attended by Black students, or to benefits of a high school diploma only. Because continued availability of 1890s may be most important for their ability to increase the total number of minority students attending college, the most appropriate comparison may be between an 1890 degree and a high school diploma.

A fourth issue concerns the availability of data sources for estimating a human capital model for the 1890 institutions. Data sets are available that contain information on earnings, level of education, personal characteristics, and other variables needed for estimating the overall value of higher education as a form of human capital. While these data sets are disaggregated by race, they usually do not include the college attended. It may be necessary to survey 1890 graduates in order to complete an empirical evaluation. The issue will then be whether to survey a comparison group or whether to rely on census data to create that group.

This combination of issues has implications for the human capital models and data needed to effectively evaluate the 1890s as human capital "producers." More details of an empirical model that might be used to accomplish this task are presented in appendix A.

Returns to Research and Extension

While education is the primary activity of the 1890 land-grant universities, these institutions undertake significant research and extension (R&E) activities with potentially measurable impacts. Economic benefits of investments in research and extension are often estimated by using one of two approaches: economic surplus analysis and production function estimation (see for example, Fuglie et al., 1996 and Alston et al., 1998).

Economic surplus analysis incorporates estimated demand and supply elasticities and changes in productivity that can be attributed to R&E to estimate the benefit of research and extension to consumers and producers (consumers' and producers' surplus). To obtain an estimate of rate of return, the changes in consumer and producer benefits are compared to the cost of the research. This approach is most often used for individual innovations or individual commodities for which the productivity change can be easily attributed to specific research funding (Fuglie et al., 1996). The contribution to productivity change of a specific institution or group of institutions is more difficult to identify.

Production function estimation relies on statistical estimation of a production function that contains expenditure on research and/or extension as explanatory variable(s). With this method, productivity growth is related to past investment in R&E and other variables, and an attempt is made to estimate econometrically the part of total output or total factor productivity growth that can be attributed to research and extension. Because R&E at 1890s is a relatively small portion of total agricultural R&E in the United States, it is difficult to estimate a statistical relationship between, for example, agricultural productivity change and funding at these institutions. Of the $6.3 billion expenditure on agricultural research by Federal and State governments and the private sector in 1992 (Fuglie et al., 1996), expenditure on the1890s' R&E was less than 1 percent ($51.1 million) (USDA, 1994).

Given the limitations of the two standard approaches, a better way to estimate economic impacts of R&E at the1890s is to conduct case studies. The case studies would conduct a benefit-cost analysis of a sampling of programs or projects. The sample could either be random or based on a selection of particularly successful programs or projects. Focusing on successful projects often makes sense when it appears that a few projects have impacts so substantial that they more than pay for the funds invested in the entire program. Market data and expert opinion on the effects of projects on yield or costs, adoption of results, and other factors can be used in the benefit-cost analysis. Adequately capturing non-market benefits, such as to the environment and health, can be difficult, particularly for limited-resource farmers, but estimates are possible.

Next Steps for the Partnership

The 1890 land-grant universities have developed teaching, research, and extension programs that reach historically underserved students and communities. Research and extension programs address issues of special interest to minority rural communities and small-scale and limited-resource farm operators, as well as a range of more traditional topics reflecting the expertise and interests of the 1890 faculty and graduate students.

The collaboration reflected in this report explored the best ways to measure returns to investments in teaching, research, and extension programs, with the ultimate goal of improving the effectiveness of these investments. This report focused on the core questions of how 1890 institutions have been funded, what are the best indicators by which to measure program outcomes, and how to develop conceptual models for estimating future returns to investments. Further research will continue work on identifying the most reliable measures of outcomes and on assessing the adaptability of available conceptual models to the particular parameters of the 1890 programs. Research will also begin on case studies of individual 1890 programs to explore methods of assessing program outcomes using a combination of measurable, quantitative indicators and qualitative data gathered through interviews and observation.

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Appendix A—Human Capital Model

The human capital model that may be used will have components that (1) capture the time patterns of earnings and costs, with and without college, to take into account that earnings that come earlier are worth more than earnings that come later, and (2) account for factors unrelated to a college degree that may be causing part of the earnings differential, such as age, experience, location, gender, and race. The data will need to indicate not only whether individuals graduated from college or not and their race, but also whether the college was an 1890.

The following is a slightly modified version of the human capital approach employed by Cohn and Hughes (1994). Several steps are involved to control for earnings differences for high school versus college graduates that are related to non-college sources such as native ability, location, and personal characteristics. The first step is to account for differences in the college and high school groups using a self-selection technique such as the Heckman (1979) procedure. Probability of college attendance is estimated using a probit equation of the form:

$$CD=f(Z) \qquad (1)$$

where CD is a zero-one variable that indicates whether or not the individual has a college degree, and Z is a vector of variables that is expected to influence college attendance (such as education of the father and mother, one- versus two-parent family, number of siblings, location, rural/small town/big city, race, and economic conditions at the time of college decision). The equation is estimated with maximum likelihood (ML). The following earnings equation is then estimated, first for high school graduates and then for college graduates:

$$\ln Y = a + b_1A + b_2A^2 + c_1T + c_2T^2 + \sum d_iX_i + e \qquad (2)$$

where Y represents hourly earnings, A = age, T = tenure in employment, and X is a vector of relevant labor-market and personal characteristics such as marital status, location, race, and sex. The coefficients a, b, c, and d are scalars and e is a random error term. The X vector also includes a "selectivity" variable, LAMBDA, which is derived from the ML estimation of equation 1 using the inverse of Mill's ratio. After this estimation, in order to take account of the differences between the X vectors of the two groups in one time period, as well as differences in the X vectors over time, the means of the attributes of the college graduates for one time period are substituted for the X vector for all years and for both college and high school graduates. Let

$$B = a + \sum d_i \overline{X} \qquad (3)$$

where a is taken from the estimates of equations 2. Then substitute B into equations 2.

$$\ln Y = B + b_1A + b_2A^2 + c_1T + c_2T^2 \qquad (4)$$

Because age and tenure are correlated, it is necessary to estimate the age-related values of tenure. A regression of age on tenure (T = f(A)) is estimated, and the estimated f(A) is substituted for T in equation 4. After this substitution, lnY is a function of A only. Age earnings profiles are then calculated on the basis of equation 4 for each age. Next, the adjusted earnings (E) are obtained using equation 5 as follows:

$$E = [\mathrm{Exp}(\ln Y)] * H \qquad (5)$$

where H is the number of hours worked per week (which might be assumed to be 2,000 for 40 hours per week for 50 weeks, or it could be based on actual data for high school and college graduates). The next step is to use ordinary least squares to derive age earnings profiles separately for college and high school graduates using an equation such as:

$$E = f + g A + h A^2 + v \qquad (6)$$

where f, g, and h are partial regression coefficients and v is a random error term. The two age-earnings profiles provide estimates of E_{ct} for college graduates and E_{ht} for high school graduates, to be used in estimating a rate of return to education. The following equation is used to estimate that rate of return:

$$\sum_{t = 1 \ldots n} (E_{ct} - E_{ht} - C_t)/(1 + r)^t = 0 \qquad (7)$$

where C_t are the direct costs of college education at age t and r is the internal rate of return.

Appendix B—Tables

Appendix table B1—Student enrollment in 1890 land-grant universities, fall 1990-98

	1990	1992	1994	1998
Alabama A&M University	4,886	5,068	5,543	5,128
Alcorn State University	2,863	2,919	2,742	2,847
University of Arkansas-Pine Bluff	3,672	3,709	3,823	3,069
Delaware State College	2,606	2,936	3,381	3,320
Florida A&M University	8,344	9,487	10,084	11,956
Fort Valley State College	2,158	2,537	2,823	2,847
Kentucky State University	2,506	2,541	2,563	2,299
Langston University	2,792	3,315	3,408	4,012
Lincoln University	3,619	4,030	3,512	3,214
University of Maryland-Eastern Shore	2,067	2,430	2,925	3,305
North Carolina State College	6,595	7,723	8,136	7,354
Prairie View A&M University	4,990	5,660	5,849	5,995
South Carolina State College	4,822	5,071	4,693	4,657
Southern University	8,941	10,403	9,904	9,567
Tennessee State University	7,393	7,591	8,180	8,750
Tuskegee University	3,510	3,598	3,322	3,090
Virginia State University	3,988	4,435	4,007	4,272
Total	75,752	83,453	84,895	85,682

Sources: National Center for Education Statistics (NCES) and 1890 Land-Grant System, Strategic Plan.

Appendix table B2—Student enrollment in 1890 land-grant universities, 1998-99

	Undergraduate	Graduate	Total
Alabama A&M University	3,903	1,225	5,128
Alcorn State University	2,533	314	2,847
University of Arkansas-Pine Bluff	3,004	65	3,069
Delaware State College	3,057	263	3,320
Florida A&M University	10,711	1,245	11,956
Fort Valley State College	2,407	440	2,847
Kentucky State University	2,203	96	2,299
Langston University	3,969	43	4,012
Lincoln University	2,959	255	3,214
University of Maryland-Eastern Shore	2,984	321	3,305
North Carolina State College	6,367	987	7,354
Prairie View A&M University	4,738	1,257	5,995
South Carolina State College	3,875	782	4,657
Southern University	8,023	1,544	9,567
Tennessee State University	7,021	1,729	8,750
Tuskegee University	2,932	158	3,090
Virginia State University	3,341	931	4,272
Total	74,027	11,655	85,682

Source: 1890 Land-Grant System, Strategic Plan.

Appendix table B3—Number of students graduated by 1890 land-grant universities, fall and spring 1997-98

	Undergraduate	Graduate	Total
Alabama A&M University	544	375	919
Alcorn State University	523	212	735
University of Arkansas-Pine Bluff	371	9	380
Delaware State College	409	101	510
Florida A&M University	1,450	821	2,271
Fort Valley State College	557	289	846
Kentucky State University	328	25	353
Langston University	558	9	567
Lincoln University	456	92	548
University of Maryland-Eastern Shore	415	76	491
North Carolina State College	2,075	2,215	4,290
Prairie View A&M University	720	357	1,077
South Carolina State College	561	256	817
Southern University	948	274	1,222
Tennessee State University	822	260	1,082
Tuskegee University	416	101	517
Virginia State University	421	126	547
Total	11,574	5,598	17,172

Source: 1890 Land-Grant System, Strategic Plan.

Appendix table B4—Summary of minority baccalaureate enrollment in colleges of agriculture, renewable natural resources and forestry classified by academic area in 1890 land-grant institutions, 1993-96

Academic area	1993 (n=13)	1994 (n=12)	1995 (n=13)	1996 (n=15)
General Agriculture	95	185	176	180
Animal Sciences	422	384	390	508
Plant Sciences	106	55	87	69
Horticultural Sciences	12	23	20	55
Soil Sciences	33	34	41	55
Agricultural Business & Management	561	549	426	489
Education, Comm., Social Sci.	92	61	94	85
Natural Resources	98	73	79	124
Forest Sciences	131	109	89	153
Ag. Eng./Mechanization	0	24	21	30
Food Sciences/Human Nutrition	42	38	45	94
Related Biological/Physical Sci.	0	0	173	184
Total	1,592	1,535	1,641	2,026
Nonagricultural programs	147	300	640	732
Total (all programs)	1,739	1,835	2,281	2,758

Note: n denotes the number of institutions reporting for the indicated year.
Source: Food and Agricultural Education Information System (FAEIS).

Appendix table B5—Master's student enrollment in 1890 land-grant colleges of agriculture, renewable natural resources, and forestry classified by academic area, ethnicity, and citizenship, fall 1998

Academic area	African-American	Hispanic	Native American	Caucasian	Foreign students	Master's total
General Agriculture	0	0	0	0	0	0
Animal Sciences	6	0	0	1	1	8
Plant Sciences	18	1	0	4	3	26
Horticultural Sciences	0	0	0	0	0	0
Soil Sciences	12	0	0	0	0	12
Agricultural Business & Mgmt.	23	0	1	5	10	39
Educ., Comm., Social Sci.	15	0	0	17	0	32
Natural Resources	20	0	1	33	3	57
Forest Sciences	0	0	0	0	0	0
Ag. Eng. Mechanization	0	0	0	0	0	0
Food Sciences/Human Nutrition	13	0	0	3	7	23
Related Biological/Physical Sci.	13	0	0	1	3	17
Total	120	1	2	64	27	214
Nonagricultural Programs	27	0	0	2	2	31
Total (all programs)	147	1	2	66	29	245

Note: Data represent only 8 of the 1890 land-grant institutions.
Source: Food and Agricultural Education Information System (FAEIS).

Appendix table B6—Fall 1998 graduate and undergraduate enrollment in 1890 land-grant colleges of agriculture, renewable natural resources, and forestry classified by level, gender, and academic area

	Enrollment report by program area and level																			
	Forestry				Natural Resources				Agricultural Sciences				Non-Ag Programs				Total Fall enrollment			
Region & Institution	2 year	Bac.	Mas.	Ph.D.	2 year	Bac.	Mas.	Ph.D.	2 year	Bac.	Mas.	Ph.D.	2 year	Bac.	Mas.	Ph.D.	2 year	Bac.	Mas.	Ph.D.
North Central:																				
Lincoln University	0	0	0	0	0	0	0	0	0	125	0	0	0	3	0	0	0	128	0	0
North Eastern:																				
Delaware State University	0	0	0	0	0	31	0	0	0	86	0	0	0	25	0	0	0	142	0	0
U. of Maryland-Eastern Shore	0	0	0	0	0	50	10	17	0	84	21	0	0	125	0	0	0	259	61	17
Southern:																				
Alabama A&M University	0	53	0	0	0	57	0	0	0	139	69	33	0	124	31	0	0	373	100	33
U of Arkansas at Pine Bluff	0	0	0	0	0	23	2	0	0	89	5	0	0	121	0	0	10	233	7	0
South Carolina State University	0	0	0	0	0	0	0	0	0	59	10	0	0	0	0	0	0	59	10	0
Fort Valley State University	0	0	0	0	0	0	0	0	10	127	0	0	0	0	0	0	0	127	0	0
Tuskegee University	0	7	0	0	0	19	15	0	0	495	52	0	0	0	0	0	0	531	67	0
Total (All reporting institutions)	0	60	0	0	0	180	27	17	10	1,204	157	33	0	398	31	0	10	1,852	245	50

Source: Food and Agricultural Education Information System (FAEIS).

Appendix table B7—Fall 1998 graduate and undergraduate enrollment in 1890 land-grant colleges of agriculture, renewable natural resources, and forestry classified by level, gender, and academic area

	Baccalaureate			Masters			Doctoral		
Academic area	Male	Female	Total	Male	Female	Total	Male	Female	Total
General Agriculture	157	99	256	0	0	0	0	0	0
Animal Science	103	194	297	6	20	8	0	0	0
Plant Sciences	11	13	24	17	9	26	11	2	13
Horticultural Sciences	10	1	11	0	0	0	0	0	0
Soil Sciences	13	2	15	7	5	12	8	2	10
Agricultural Business & Mgmt.	119	66	185	22	17	39	0	0	0
Education Comm. & Social Sci.	31	12	43	29	3	32	0	0	0
Natural Resources	97	83	180	22	35	57	12	5	17
Forest Sciences	47	13	60	0	0	0	0	0	0
Agricultural Engineering/ Mechanization	14	0	14	0	0	0	0	0	0
Food Science/Human Nutrition	8	40	48	14	0	23	3	7	10
Related Biological/ Physical Sci.	77	234	311	11	0	17	0	0	0
Total	687	757	1,444	128	89	214	34	16	50
Nonagricultural programs	66	342	408	20	11	31	0	0	0
Total (all areas)	753	1,099	1852	148	100	245	34	16	50

Source: Food and Agriculture Education Information System (FAEIS).