RESEARCH REVIEW

IN THIS ISSUE

"The gods did not reveal to men all things from the beginning," according to a fragment written some 2,600 years ago by the Greek philosopher Xenophenes, "but men through their own search find in the course of time that which is better." To the economist, social progress discussed by Xenophenes is captured statistically in measures of productivity; finding new ways of doing things leads to more output valued by persons per unit of input.

For U.S. agriculture, continued progress has been reflected in the increasing number of persons supplied with food and fiber per farmworker. There were 56 persons supplied per farmworker in 1974, compared with 15.5 in 1950 and 4.1 in 1820. The trouble is that this simple measure completely overlooks the nonfarm inputs that have become increasingly important in our food and fiber system since 1820. An alternative measure of productivity for the food and fiber sector is clearly needed.

In this issue, we offer two such measures. They indicate that about 16 or 17 persons are currently supplied per worker in the total food and fiber sector. One measure relies on the conceptual framework of input-output for which data are available at 5-year intervals with some lag. The other is based on a simpler concept, but data can be provided annually with a short lag. Both measures have advantages and disadvantages. Readers of this journal may want to react to these proposals or suggest further alternatives to the National Economic Analysis Division of ERS.

Empirical results of research in which nonlinear regression analysis is used vary according to assumptions made in specifying the error term. Some researchers give this little or no thought as they choose between nonlinear regression and a linear fit to the logarithms of the variates. A Monte Carlo simulation of the alternatives for fitting a Cobb-Douglas production function, reported in this issue, indicates that the choice may have sharp implications for the ultimate research findings.

Clark Edwards

THE FEAR OF KNOWLEDGE

Intellectuals have generally been held in relatively high esteem in our country, and we have placed heavy emphasis on higher education. The extent of this support, however, has varied sharply over the past 200 years.

Some of the greatest minds of 17th-century America—including Thomas Jefferson, Alexander Hamilton, and James Madison—once collaborated in preparing a speech for George Washington that, although never delivered, said:

> Promote then, as an object of primary importance, institutions for the general diffusion of knowledge. In proportion as the structure of a government gives force to public opinion, it is essential that public opinion be enlightened.

It is with considerable irony that we note that a society founded and nurtured by intellectuals, a society which has benefited so greatly from a spectacular development and utilization of knowledge, also is a society in which a spirit of anti-intellectualism has periodically slowed economic and social development. The early leaders of our country emphasized education and social enlightenment. They reconciled wide-ranging intellectualism with practical political activity. The fear, in that day, was of a lack of knowledge, not of its acquisition and use.

The initial intellectualism in American government lasted until the Jacksonian era, when it became resented as a boorish kind of excellence, as an unjustified claim to distinction, as a challenge to egalitarianism, and as a quality that somehow deprived a man or woman of what was known as the "common touch."

In the years between the Jackson and Lincoln administrations, there was a general intellectual reawakening. Part of this was attributed to the call for new knowledge to enhance industrial and agricultural expansion. There also was a spirit of intellectual liberality exemplified by such men as Emerson, Longfellow, and Hawthorne.

The lyceum movement provided a stimulus to intellectual curiosity, and the land-grant system emerged. The Land-Grant College Act of 1862 was passed during the administration of Abraham Lincoln, a president who exemplified the concept that intellectual development was democratic and egalitarian, and that it should be the universal aspiration of all men and women.

From Lincoln's time until after the turn of the century, our country underwent a great economic and industrial expansion and transformation. Politics and government were oriented toward the acquisition of wealth and power. Reorientation and growth occurred in our educational institutions. Indeed, the first thrust toward reform in scandal-ridden government in the late 1800's began on the college campuses, just as it did in the late 1960's.

Theodore Roosevelt was an intellectual who recognized that, in his time, only a leader who appealed to the people on the basis of physical and mental characteristics could be successful. Roosevelt was exceedingly well read and well informed. He initiated reforms that strengthened the Nation's economic development by changing its orientation toward the common good, rather than toward the benefit of the privileged few.

Following Woodrow Wilson's administration, the country went through the intellectual drought of the twenties and thirties. The Ku Klux Klan gained strength. The Scopes Trial comprised an all-out attack on intellectualism. And, the Depression years discouraged higher education.

Then came the administration of Franklin Roosevelt, and the country, for the first time since the days of Jefferson and Hamilton, saw a major influx of intellectuals into Federal service. They aroused much antagonixm but they changed the shape and direction of Government.

The pendulum again swung full circle when, in the early part of the fifties, the country was subjected to

the "great inquisition" of Joseph McCarthy. Probably the most intense surge of anti-intellectualism since the Jacksonian era, it subjected intellectuals in Government to a frustrating suspicion.

The "GI" Bill had a major impact upon higher education following World War II, making opportunities for higher education a reality for millions of young men and women. But the educational system in America did not progress as rapidly as it did in some other countries. We became painfully aware of our complacency about education when the implications of Sputnik became obvious. Immediately, Dwight Eisenhower moved to improve our educational system.

John Kennedy gave strength and purpose to intellectual ideals. The stream of academics to Washington during this period was great. The Kennedy administration expanded the Nation's educational programs and committed vast amounts of new funding to scientific and technological research. Faced with the commitment to solve complex problems and the necessity of having access to the best available knowledge, the Government turned increasingly to the universities. Among academicians there was a growing feeling that knowledge was useful, that new knowledge was needed, and that the search for it would be supported.

Yet, the American people are impatient. Expectations were developed that could not be fulfilled. Many of the goals proved elusive. Enchantment with research diminished and investment in research was increasingly questioned. While the results of research formed the guiding assumptions for many ventures by Government, the ties between the ideas of the scholars and public policy often proved to be tenuous. There was a distinct difference in the orientation of the scientist and that of the policymaker. The strain between academicians and policymakers was magnified by a serious mismatch between the time required to carry out creative research and the attention span of politicians. As the decade of the 1960's drew to a close, the ties between the intellectuals and the Government had weakened substantially. During Richard Nixon's administration, the President's Science Advisory Council was abolished. Increasingly, people questioned the utility of knowledge.

Today, attacks against knowledge are coming from the left as well as from the right. The recurring resentment against intellectuals, which we have come to expect in our history, has been transformed into a fear of new knowledge. It is sometimes expressed in a wistful desire to return to simpler days. Intellectuals are resented for the changes they have created and feared for those they will create in an uncertain future. More knowledge is equated with the decline in moral standards, the disasters of runaway technology, and the growing complexities of all aspects of human life.

Perhaps even more significant is the growing concern of scientists and academicians over the expansion of knowledge. An increasing number are questioning whether we wish to know more. The fear of knowledge, however, is misplaced. Our fear is not of knowledge, *per se*. It is a fear of how knowledge would be used. Underlying this fear, therefore, is a concern for our own moral weakness and for the possibility that knowledge will not be used for the benefit of society.

What are the lessons to be gleaned from the changing relationships between intellectuals and the public? First, what our society expects of its universities remains unclear. The utilitarian ideas of Franklin and Jefferson concerning the university's services to the community and to the Nation have not been universally accepted either on university campuses or in government. There is, however, a general feeling that the interrelated functions of research, instruction, and public service should continue. Increasing emphasis is being placed upon innovative ways of testing ideas and making the results available.

Second, the knowledge base of the university is lacking relative to the complexity of the problems faced. Our academic base has been noticeably detached from the world around us, giving rise to the outcry of students and the public for more relevancy in higher education. Most professors contend that teaching students how to think is infinitely more important than teaching them what to think about. Emphasis upon theory continues to be necessary in teaching how to acquire knowledge, hypothesize about it, assess it, and integrate it into our thinking. But it is increasingly apparent that students and the public generally desire a better balance between theoretical and empirical analysis.

Third, we are becoming more mindful of unanticipated consequences of new knowledge developed under controlled conditions but applied under general conditions. Concern over research and technological development derives in part from a growing feeling that important secondary effects often are not given due consideration in policy decisions.

Fourth, public policy is controversial. Its essence involves conflict, compromise, and consent. The free flow of new knowledge should help to create citizen awareness of issues and participation in democratic processes. But, given the same data, analyses, and scientific conclusions, individuals and groups may arrive at different decisions.

Fifth, university programs may be out of phase with public support and public needs at any time. The scientist must reserve the right to fail. The policymaker, on the other hand, is not likely to be accorded this privilege. It is important, therefore, that the role of the academician serving as policy advisor be clearly differentiated from that of the policymaker, and that the public continue to support the universities during periods of estrangement between scientists and government.

Sixth, the academician must link the university to other institutions. A gulf has existed between the academician and those who make public policy.

The problems of the complex society in which we live require that the knowledge base be expanded and that access to the best knowledge available be facilitated. The trend toward alienation of the academic community from the policy arena must be halted and reversed. The initiative for this reversal must come from those who are committed to the life of the mind. Only in this way can the stream of knowledge coming from the universities be perpetuated and integrated into the central institutional system of our country.

This note summarizes the ERS Bicentennial Lecture delivered by Charles E. Bishop on June 15, 1976. Dr. Bishop is president of the University of Arkansas.

POLICIES FOR EQUITABLE GROWTH IN DEVELOPING COUNTRIES

After two decades of attempts at raising per capita GNP in developing countries, the development community has recently shifted its focus to the challenge of increasing the equity of income distribution. This shift in emphasis was needed. Empirical studies showed that benefits from economic growth did not trickle down. More serious, economic growth has sometimes resulted in a systematic worsening (both relative and absolute) in the position of persons receiving the least amount of income.

The accompanying table tests major growth and equity hypotheses generated by each of three recent studies:

1. A cross-sectional, statistical analysis (AM in the table) of the sources of differences among countries in the relative amount of income received by the poorest 60 percent of households[1]
2. A historical analysis (Hist in the table) of processes and initial conditions leading to extreme poverty in 24 countries in the middle of the 19th century[2]
3. A model (A-R in the table) of the South Korean economy developed and used to explore the effects[3] of various major (but nonrevolutionary) strategies, policies, and programs on poverty.

In the following table, the interaction with income distribution of each variable or influence is described; the studies on which the description is based are noted; and the reasons for the impact on income distribution are summarized.

All three studies differ completely in methodology and in the settings in which the relationships between poverty and growth are investigated. Yet, all three lead to the following remarkably consistent and reinforcing set of policy conclusions:

[1] Irma Adelman and Cynthia Taft Morris. *Economic Growth and Social Equity in Developing Countries*. Stanford Univ. Press, Stanford, Calif. 1973.

[2] Irma Adelman and Cynthia Taft Morris. "Economic Growth and Impoverishment in the Middle of the Nineteenth Century." *Econ. Jour.* (forthcoming).

[3] Irma Adelman and Sherman Robinson. *Planning for Equitable Development*. Stanford Univ. Press, Stanford, Calif., (forthcoming).

Hypotheses concerning the impact of economic processes on income distribution

Variable or influence	Impact and supporting studies	Reasons for impact
Per capita GNP and level of socioeconomic development	For poorest 60 percent of population, their relative share shows U-shaped relationship to per capita GNP (A-M). Relationship between absolute per capita income and income distribution complex; very large differences in development levels positively related to both average income and reduction in poverty; but rapid growth tends to increase poverty even when average income rises (Hist and A-M).	At very low levels of development, a small number of growth points leads to concentration of benefits of economic change in hands of oligarchy of merchants, industrialists, and plantation owners; indirect effects of economic change tend to hurt the very poor by displacing and marginalizing their activities. Only beyond a threshold determined by extent and spread of expansion of economic opportunities is the trickle-down effect sufficient to raise average incomes of urban wage earners and agricultural laborers; even then, extreme poverty is reduced very slowly because the labor market is segmented; human skills lack adaptability.
Short-term rate of growth of per capita GNP	No simple association with income distribution; structure and composition of the increase in income, not average degree of income change, determines impact (A-M and A-R).	Nature, extent, and rapidity of *structural* change govern the direction and magnitude of the net balance of the processes of displacement, absorption, and social adaptation.
Economic innovations	At low and medium-sized levels of development, net impact of structural change of any kind on the poor is systematically unfavorable, even when average incomes rise.	The poor do not have resources and skills to take advantage of expanding economic opportunities; the operation of product and factor markets tends to marginalize their earnings or displace their skills. Once skills have been permanently marginalized or products displaced, the poor lack human and financial capital for adaptation.
Socioeconomic dualism	Sharply dualistic growth favors the rich and harms the relative and absolute position of the poor more than do lesser degrees of dualism (whether at very low or higher levels of development).	Concentration of growth in limited sectors or regions, in the presence of segmented labor markets characteristic of underdeveloped countries, aggravates displacement and marginalization of skills, thus contributing to pools of surplus labor.

Continued

Hypotheses concerning the impact of economic processes on income distribution—Continued

Variable or influence	Impact and supporting studies	Reasons for impact
Natural resources	A favorable ratio of agricultural land to population, with family-size holdings prevalent, restricts extreme poverty; abundant natural resources are associated with extreme concentration of income (A-M and Hist).	Availability of reserve of unappropriated agricultural land restricts numbers of extremely poor; presence of abundant natural resources fosters exploitation and appropriation of the benefits by small elites, foreign and indigenous.
Rate of population growth	Past patterns of population growth are an important determinant of resource-population ratios and thus a key initial condition determining extent of extreme poverty (Hist and A-M). In the medium run, population growth affects significantly the net balance of displacement and absorption processes (Hist and A-R). In the short run, population growth is insignificant to income distribution (A-R and A-M).	Extremely long lag (50 years or more) occurs before changes in rate of population growth affect extent of extreme poverty significantly; medium run effects depend on interaction of population and migration given the availability of resources.
Rural-urban migration	Rural-urban migration reduces rural poverty and increases urban poverty; up to a point, it reduces overall poverty (Hist and A-R).	Rural-urban migration in labor market reduces urban wages or increases urban unemployment, while decreasing rural underemployment or increasing wages of agricultural labor; in commodity markets, such migration shifts the terms of trade in favor of agriculture, thus favoring the more numerous and poorer rural low-income groups; extremely rapid migration leads unfavorable impact on the urban poor to dominate favorable rural effects.
Education	Widespread education and literacy are associated with larger share of income of middle quintile; no systematic association occurs with other features of income distribution (A-M and A-R).	Widespread education spreads ownership of human capital, distribution of wage income, and increases rural-urban migration; thereby shifting population to higher income areas and improving agricultural terms of trade.
Land tenure and holdings	Impact of change on the poor critically depends on distribution of landownership; prevalence of subsistence farming where land is abundant favors distribution of income; parcelization of land or marked concentration of ownership with cultivation by either landless laborers or subsistence tenants contributes directly to poverty; widespread owner-operation of commercial farms favors distribution of income, although it may not help the very poor (A-M and Hist).	Concentrated ownership where cultivators face lack of alternative employment permits high rate of appropriation of surplus product; opening up of new opportunities in presence of unequal abilities to respond widens inequality; processes conducive to dispossession of land or marginalization of economic activities tend to be irreversible.
Modernization of agricultural techniques	Increases in agricultural productivity tend to worsen the position of the rural poor, while benefiting better off farmers and the urban poor (A-R and Hist). No significant cross-sectional relationship exists.	Access to complementary resources (held only by better off farmers) is necessary for adoption of improvements; increases in output worsen terms of trade, harming rural poor and benefiting urban poor; no cross-sectional relationship exists due to interdependence between impacts of agricultural technology and land tenure.
Size of subsistence agriculture sector	Total absence of commercialization of agriculture favors distribution of income (Hist). Among countries with some commercialization, no systematic relationship exists between commercialization and distribution of income (Hist and A-M).	Impact on income distribution of commercialization of agriculture depends on land tenure and concentration of ownership. It also depends on the course of terms of trade; short-term and medium- or long-run impacts may diverge, depending on demand and supply elasticities.

Continued

Hypotheses concerning the impact of economic processes on income distribution—Continued

Variable or influence	Impact and supporting studies	Reasons for impact
Trade and industrialization strategy	More diversified labor-intensive exports are associated with a larger share of income to both the poor and the middle classes (A-M and A-R).	Agricultural terms of trade improve and rural-urban migration is more easily absorbed.
Level and change in industrialization	U-shaped relationship is evident in cross-sectional and historical studies. Major differences in level of industrialization are negatively associated with extent of poverty, but among more industrialized countries, poverty is greater in those at higher levels which industrialized most rapidly (A-M and Hist).	The relationship is complicated: interdependence exists between level and rate and threshold effect.
Market socialism	Share of income of top 5 percent is reduced; share of next 15 percent is increased (A-M and A-R). Overall growth rate and overall mean incomes are reduced but relative and absolute incomes of lowest 70 percent are higher in the medium run (A-R).	Profits and interest accruing to top 5 percent are reduced; technocrat and bureaucrat incomes are increased. Given nationalized firms which are less dynamic, absolute gains to the poor evident in the medium run are eventually eroded, but distributional gains increase.
Effectiveness of and improvements in financial institutions	No systematic association with income shares of the poor exists even though the effects are important for growth (A-M and A-R).	Spread of financial institutions even in rural areas tends to benefit primarily those who are better off. Improved access to credit for poor farmers is only beneficial when combined with improved access to technology and knowledge. Increases in investment, even in small-scale industry, tend to work through their impact on economic growth (relationship of latter to income distribution is complex).
Effectiveness of and improvements in tax systems	No systematic association with distribution in cross-sectional study exists (A-M). Little impact emerges in the model (A-R).	Structure of tax system influences who is poor and who is rich rather than how many; tax base is sufficiently low so that there is little scope for impact.

1. Intervention to improve the distribution of income is extremely difficult. The Korean policy model experiments emphasized both the stability of the size distribution of income despite policy interventions and also the ephemeral nature and inefficiency of most single-pronged antipoverty programs. The cross-sectional study indicated how few potentially effective policy instruments existed and what difficulties their very makeup posed for persons intent on purposive change.
2. Within a given set of structural conditions, it is strategy and process which determine the impacts of economic change on the poor. The historical study indicated, for example, that countries sharing a particular mix of poverty also shared a set of historical processes of change. The Korean policy model experiments showed that as long as policy interventions were tacked onto a given strategy which remained unchanged, the distribution of income tended to revert to the pattern it would have had in the absence of interventions.
3. Successful antipoverty policy does not merely entail choosing the right development strategy. In the cross-sectional study, for example, some policy variables proved important only when countries had achieved minimal levels of education and spread of economic modernization. The historical study also showed that the impact of economic change on the poor depends critically on the type of social structure and social responses to economic change—such as social constraints on population growth, the response of fertility and migration rates to changing economic opportunities, legal and customary barriers to the subdivision of land, arrangements for land tenure and holding, and the strength of extended family protection of the unemployed and underemployed.
4. Unbalanced growth strategies are bad for the poor. Historically, the concentration of growth in a few sectors or regions has had backwash effects that have accentuated the overall displacements of economic activities arising from commercialization and industrialization.
5. A systems or general equilibrium approach is required to design a strategy which predictably improves the position of the poor in the medium

term. Both the historical and South Korean modeling studies emphasize the importance of indirect effects and dynamic interactions. Not infrequently, the indirect effects of an initial impact of change swamp the direct effects and even reverse their direction.

Taken together, results of the three studies underline the great difficulty which planners face in finding policy instruments that effectively bring about more equitable paths of economic growth.

This note summarizes the ERS Bicentennial Lecture delivered by Irma Adelman on May 17, 1976. Dr. Adelman is a professor in the Department of Economics at the University of Maryland.

REGIONAL POLICY: READINGS IN THEORY AND APPLICATIONS

John R. Friedmann and William Alonso, eds. The MIT Press, Cambridge, Mass. 808 + xxi pages. 1975.

The growing body of literature by regional scientists has spawned a number of anthologies around the world. Friedmann and Alonso's updating of their 1964 reader[1] is a useful addition. The editors culled 37 articles from 27 disparate sources and arranged them under 5 headings. Thirty-five authors are represented, including the editors. The readings are generally current; more than half were published during the 1970's.

The 15 readings comprising part 1, on concepts of space and development, fill nearly half the volume. These include basic references on micro and macro aspects of location, on motion within spatial systems, and on bases for growth. Several have the stature of classics, such as Losch's 1938 article, "The Nature of Economic Regions," and North's 1955 article, "Location Theory and Regional Economic Growth."

Seven articles in part 1 were in the first edition and two are in another reader.[2] All four articles on growth also appeared in the first edition; none of the vast growth literature since 1961 has been included in the current edition. A more up-to-date selection of readings on regional growth is available in *Regional Economics: Theory and Practice.*[3] Theoretical aspects of spatial concepts are probed more deeply in the reader by Dean, *et al*, and a broader collection of readings on location is available in the reader by Smith, Taaffe, and King.[4] The duplication of this first half, not only with the first edition but also with other available readers, suggests that the success of this new volume must depend on what the editors accomplish in the second half.

The six readings in part 2, on the role of cities, are introduced with the observation that:

> Cities play a preeminent role as the nodal points in [the structure of space], as the holders of power, and as the seedbeds of change. They are also seats of learning, engines of production, and confluences of power and control. In developed countries . . . the cities relate primarily each to each . . . .

Several of the subsequent articles consider whether cities are too large or too alienating, whether developing countries are "overurbanized," and whether urban problems are likely to develop into political upheaval. However, the several authors manage, by and large, to find satisfactory answers to these questions. Generally, they appear to support the editors' urban point of view. An exception is the 1954 article by anthropologists Redfield and Singer on the cultural role of cities. They challenge the view that there is a one-way flow from urban to rural areas, and they trace vital interactions and feedbacks between the two sectors. This urban bias did not exist in the first edition, which contained four articles on "Problems of the Rural Periphery."

The eight readings in part 3, on formulating issues in regional policy, are more what one would expect from the book's title. It is here that this volume of readings comes into its own. The authors grapple with means for achieving a number of ends, including the geographic distribution of population and income. Conflicts are probed such as the trade-off between equity and efficiency, and between improved welfare and the status quo. Methodological approaches are examined. The scholarly article by Darwent clears up much confusion about the terms "growth pole" and "growth center." The author relates these concepts not only to economic growth theory, but also to applied regional policy.

These policy readings reflect the fact that the regional dimensions of national purpose in the United States are not well articulated, and that strong regional impacts of national policy tend to be experienced as unintended side effects rather than as purposive ends.

The seven readings in part 4 deliver the "applications" promised in the subtitle of the book. The authors present case studies of regional planning in Turkey, Israel, Italy, Spain, and France. In view of the current debate on centralization versus decentralization in regional planning, Tekeli's dramatic description of central control of regional allocation in the Ottoman Empire is fascinating. Tekeli takes us back to the 16th century when the Empire was at its height. Central policy spelled out the crop to be grown in each region and the allocation of the product among cities; a central documentation system specified laborers by region, skill, and name. This degree of meticulous and broad detail occurred long before the advent of computers and linear programming.

The idea presented by one of the editors, that regional science is an increasingly international field, is borne out not only by the international flavor of part 4, but is also evidenced throughout the volume. More than half the

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[1] Friedmann, John R. and William Alonso, eds. *Regional Development and Planning: A Reader.* Cambridge, The MIT Press, 1964.

[2] Needleman, Lionel, ed. *Regional Analysis: Selected Readings.* Baltimore, Penguin Books, Inc., 1968.

[3] McKee, David L., Robert D. Dean, and William H. Leahy, eds. *Regional Economics: Theory and Practice.* New York, The Free Press, 1970.

[4] Dean, Robert D., William H. Leahy, and David L. McKee, eds. *Spatial Economic Theory.* New York, The Free Press, 1970.

Smith, Robert H. T., Edward J. Taaffe, and Leslie King. *Readings in Economic Geography: The Location of Economic Activity.* Chicago, Rand McNally, 1968.

articles apply specifically to countries other than the United States, or depend heavily on international experience. One out of every five authors listed in the introductory material has an address outside the United States.

Part 5 is a bibliographical essay by editor Friedmann. He reviews progress in theoretical knowledge, policy analysis, empirical experience, and regional planning, as reported in the literature during the decade following the first edition.

Werner Hirsch, in the December 1965 *American Economic Review*, labeled the first edition of Friedmann and Alonso's reader a potpourri. Hirsch observed the first volume had little structure or discipline. The editors have not changed their approach much in 10 years. Introductions to each section do help users find their way through the loose structure and overlapping categories. An index would have helped even more.

This new potpourri contains many excellent ingredients and a few of doubtful value. It omits many fine articles that would have improved the mixture. But, on balance, the readings form a worthwhile collection for regional scientists.

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A NOTE ON THE RECENT DECLINE IN THE AVERAGE AGE OF FARMERS

As soon as the number of farms began to decline in the United States—which was at the time of World War I—the average age of farmers began to rise. This change was very logical, for an occupation that decreases in number of workers typically does so mainly because young persons fail to enter that line of work. Thus, the average age of those remaining gradually increases. The average age of all farm operators rose from 43.5 years in 1910 to 51.3 years in 1965. In the same period, the proportion of farmers who were less than 35 years old dropped from 29 percent to 11.5 percent.

Adjustments in agriculture to the declining need for workers brought about by mechanization and other labor-saving developments have stretched out over two generations since World War I. In public debate and commentary on American agriculture in the 1950's and 1960's, it was common to encounter concern over the advancing age of farmers. Where would it all end? Who would take over when today's farmers died or retired? But the long decline in number of young farmers seems to have ended since 1970.

Yearly statistics collected by the Bureau of the Census from national sample surveys show that the median age of persons self-employed in agriculture reached a peak of 53.1 years in 1970. This figure differs somewhat from the data cited above in that it includes a small percentage of people who are not farm operators (such as those in veterinary work, crop dusting, and cotton ginning), and it includes only persons whose sole or principal job is in agriculture. But these differences do not affect the validity of the conclusion.

From 1970 to 1975, the average age of self-employed persons in agriculture dropped from 53.1 to 50.4 years. The number of self-employed agricultural workers under 35 years old rose from 265,000 to 358,000, a gain of 35 percent. At the same time, the number aged 60 years or over dropped from 601,000 to 461,000, a decrease of 23 percent.

Persons self-employed in agriculture by age, annual averages, 1967-75[a]

Age categories	1967	1968	1969	1970	1971	1972	1973	1974	1975
					Number (thousands)[b]				
Total	1,996	1,985	1,896	1,810	1,748	1,789	1,776	1,752	1,715
16-34 years	284	295	272	265	274	295	298	329	358
35-59 years	1,124	1,097	1,011	944	926	932	929	914	896
60 years and over	590	593	613	601	549	562	548	510	461
Median age	52.2	52.2	52.9	53.1	52.6	52.3	52.3	51.5	50.4
					Percentage distribution				
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
16-34 years	14.2	14.9	14.4	14.6	15.7	16.5	16.8	18.8	20.9
35-59 years	56.3	55.3	53.3	52.2	53.0	52.1	52.3	52.2	52.2
60 years and over	29.6	29.9	32.3	33.2	31.4	31.4	30.9	29.1	26.9

[a]Persons 16 years and over. [b]Numbers are rounded to nearest thousands without adjustment to group totals.

Source: *Employment and Earnings*, Bur. Labor Statistics, U.S. Dept. Labor. 1968-76, January issues.

The figures are mute, of course. One can only conjecture about the circumstances that have finally halted the rise in the age of farmers at this time. But it was known that the aging process could not go on forever. Agriculture was not disappearing. Rather, it was simply going through a transition, and the day had to come when the number of workers reached some stabilization and the age composition began to normalize.

Talks with local agricultural officials have indicated for several years that the new trend is recognized in prime farming areas of the Midwest. In this writer's experience, the most commonly suggested reasons offered are the improved profit picture in farming, a change in attitude of farm youth toward agriculture and rural life compared with city life, and the entry of urban-reared young adults into farming, based partly on philosophical considerations. We lack systematic evidence and specific details on the trend. It can also be said that the trend is currently helped by the large number of young adults available—the "baby boom" children.

Whatever the details to be filled in, the existence of the new trend is definite. If there were two demographic articles of faith in modern times for those engaged in rural policy or research, they were the advancing average age of farmers and the high rate of rural-to-urban migration. Now, both of these trends have changed in the 1970's.

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TECHNOLOGY ASSESSMENT WORKSHOP

Technological advance has been considered a source of progress over the centuries. In recent times, we have become increasingly aware of the indirect and delayed impacts of such advance on society. Frequently, they can be undesired and unintended. A systematic study of these impacts is coming to be known as "technological assessment."

ERS sponsored a workshop on technology assessment (TA) at the National 4-H Center in Chevy Chase, Md., April 20-22, 1976. There were three main purposes:

- To brief researchers on new concepts and developments in technology assessment;
- To review the status of ERS research and methods in relation to new technological concepts;
- To determine the needs for expansion of ERS work in technology assessment.

Although most of the participants came from ERS, representatives also participated from the Agricultural Research Service (ARS), Foreign Agriculture Service, Congressional Research Service (CRS), Office of Technology Assessment (OTA), Midwest Research Institute, and National Science Foundation (NSF).

In the opening paper, Quentin M. West (ERS) gave two major reasons why ERS should expand its work in technology assessment: (1) to perform the ERS mission better and (2) to enhance contributions of new technology to societal objectives of increasing productivity while reducing adverse environmental, physical, and social impacts. Joseph F. Coates (OTA) followed this presentation with a discussion of the inevitability of TA, and explained how technology can become part of the problem instead of the solution. Anticipating future impacts of current technological advance, he said, is as important for what he called "social technology" as it is for physical technology. Papers by Marshall E. Miller and W. B. Back (ERS) and Glen E. VandenBerg (ARS) focused on the interdependence of research and technology assessment and on how TA can contribute to research planning. TA's reliability depends largely on the soundness of a knowledge base developed through research. In turn, technology assessment contributes information useful for making decisions about research resource allocation.

In his account of major technological developments and their impacts over the past two centuries, Wayne D. Rasmussen (ERS) reminded us of agriculture's neglect of the social effects of technology. He constructed a hypothetical chain of events that showed how Eli Whitney's invention of the cotton gin could have contributed, indirectly, to the Civil War nearly 70 years later. The cotton gin was a prerequisite for the profitable expansion of cotton production. Without such expansion, slavery might have disappeared. Without slavery, there might not have been a Civil War.

Richard G. Stuby (ERS) made two main points in his paper on conceptualizing and measuring social impacts of technology. First, social impacts are not what remains when the economic factors are removed; rather, they encompass economic impacts. Second, the usual distinctions between qualitative and quantitative measurement obscure the differing, significant mathematical properties of phenomena.

On the second day of the workshop, speakers addressed the status of agricultural and rural technology assessment. Topics included the flue-cured tobacco harvester, the new 4-wheel drive tractor, integrated hog farming, twinning in beef cattle, coal mining in the Great Plains, boll weevil management, and irrigation technology. Midwest Research Institute, under contract from NSF, conducted the study on integrated hog farming. A major finding was that hog production will probably not be integrated as rapidly as poultry production was. The other studies were carried out by ERS researchers.

These papers showed where we stand in TA—the progress made and in the making. But, as a whole, they exhibited a major weakness of agricultural TA to date. It continues to stress feasibility of new technology for adoption within the food and fiber industries instead of addressing the broad social impacts of such technology.

Participants examined the utility of various TA methods on the third day of the workshop. Jean M. Johnson (NSF) presented a paper on "Role of Models in Technology Assessment." Papers followed on simulation, scenario writing, the Delphi technique, statistical methods, input-output analysis, parametric and linear programming, forecasting adoption, and benefit-cost analysis. Most papers included examples or illustrations of methods in studies completed or in progress. In the paper on Delphi, Douglas McNiel and Yao-Chi Lu (ERS) described how

the technique was being used to forecast new technologies in meatpacking. Barry Carr (CRS), in his paper on scenario writing, gave many examples of the use of this approach in TA, including studies on alternative futures of U.S. agriculture and on minimum tillage. Apparently, no unique methods exist, judging from the papers, of making technology assessments. Rather, the existing research methods have varying degrees of utility within the several operations of technology assessments.

Proceedings of the workshop will be published and will include reviews and appraisals by two groups.

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