AGRICULTURAL ECONOMICS RESEARCH

OCTOBER 1971 • VOL. 23, NO. 4

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U.S. DEPARTMENT OF AGRICULTURE • Economic Research Service

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AGRICULTURAL ECONOMICS RESEARCH

A Journal of Economic and Statistical Research in the United States Department of Agriculture and Cooperating Agencies

OCTOBER 1971 • VOL. 23, NO. 4

General Cropland Retirement Programs: Response in Indiana With and Without Feed Grain and Wheat Programs

By G. D. Irwin, J. A. Sharples, and J. B. Penn

Estimates are made of possible effects in Indiana of a part-farm general cropland retirement program, operating with and without the type of commodity programs that existed until 1970. Conclusions are drawn from estimates for four major groups of crop and livestock farms in each of five areas of Indiana. Results showed, among other things, that percentages of total cropland in corn, soybeans, and wheat would probably increase with or without the commodity programs. The increase would be greater without the programs.

Key words: Indiana, cropland retirement, farm programs.

The overcapacity problem in U.S. agriculture has two parts. One part is long term, arising from the fact that production is increasing faster than effective demand. This technology effect tends to substitute for and reduce the need for land inputs in the long run. The other part is short run. Surpluses and shortages may happen because of weather or disease. They may happen because technological or market changes temporarily disrupt a foreign one-crop economy. Time is required to adjust the people and resources to the new situation. Or they may happen because previous domestic programs have caused imbalances. There may be other reasons.

A combination of commodity programs and general cropland retirement programs could deal with both the long-run and the short-run problems. Simply phasing out commodity programs and switching to general land retirement would imply that only the long-term problem requires a policy solution, and that no cushion is needed for the transitory problems after an initial adjustment period.

The Agricultural Act of 1970 provides for general cropland retirement with income support for specific commodities. The "set-aside" is general cropland retirement, but the price support and diversion payment features also allow the program to be used to ease adjustment to temporary situations. The amount of land a participating farmer must set aside would depend on the feed grain and wheat bases assigned his farm. But what he would plant on the remaining acres would be his decision. Thus the cropland retirement may be called general because, compared with past feed grain and wheat programs, it places fewer restrictions on acreage of specific crops.[1] However, the price support features of the program continue to be oriented toward the so-called problem crops—wheat, feed grains, and cotton.

In the past, we have had periods with both kinds of programs. Under the Soil Bank of the late 1950's, the Conservation Reserve was a form of long-term retirement, while the Acreage Reserve Program was based on an annual signup. The opportunity was available annually for payment rates to be altered to meet short-term problems with individual commodities. But to some extent, the Acreage Reserve also was viewed as a means of dealing with long-term problems.

The experimental Cropland Conversion Programs of 1963-65 and Cropland Adjustment Program of 1966-67 provided for long-term retirement of cropland. In contrast, the diversion programs of the 1960's for feed grain, cotton, and wheat took an annual, commodity-by-commodity approach to restraining production.

Experience with these various programs was built into the design of many proposals reviewed in the preparation of the 1970 legislation. We might have examined how farmers responded to various features of past programs that are similar to the main features of the new program. But we felt it might be more fruitful to modify a research model already in use[2] in attempting to

[1] The Act permits the Secretary of Agriculture to limit feed grain acres on participating farms through 1973, as a transition mechanism. This provision was not invoked for 1971, but could be for 1972 or 1973.

[2] The original model is found in J. H. Berry, A method for handling pecuniary externalities in relating firm and aggregate supply functions, unpublished Ph. D. thesis, Purdue Univ., 1969.

develop some quantity estimates of possible effects for major groups of Indiana farms. We used alternatives that do not match the 1971 program, although there are similarities. And the estimates make no attempt to evaluate the effects of corn leaf blight. However, the results provide benchmarks which may be useful in anticipating some future impacts of the 1970 legislation, even though no set of conditions used adequately describes its program features. The specific calculations, as well as the yields and prices behind them, may become outdated. But the issues are likely to remain important whenever new calculations are made.

Choices Considered[3]

The analysis covers 100-to-259-acre and over-260-acre grain farms and livestock farms, in each of five production areas covering the entire State. These 20 groups made up about half of Indiana farms in 1964, and produced about 80 percent of farm product sales. Dairy and smaller-than-100-acre farms were not examined. These have decreased in numbers rapidly since 1964, and do not sell much feed grain, corn, and wheat. Nor were direct comparisons made by age of farmer, equity position, or any other characteristic which might be especially relevant for whole-farm retirement programs. The estimates of land retired are on a part-farm bid basis, with payment varying according to productivity of the land. This implies a voluntary program with poorer and less intensively used land being offered at lower rates.

The results presented are totals by type of farm, by area, and by all farms of the 20 types in the State. Primary interest is in the aggregate production effects rather than adjustments on individual farms. Response would vary between farms in any one of the 20 groups, and so no general rules would be very useful. But by taking an average situation out of each of the 20 groups, we attempt to estimate general effects on each farm type and area, as well as the aggregate effect.

Three aspects were investigated:

(1) General cropland retirement (GCR) was analyzed under two alternatives: (a) with feed grain and wheat programs (FGW), and (b) without these or other programs. Under the first, diversion of 20 percent of feed grain base was assumed mandatory. Other features, based on the programs of 1968-69, are fixed-acreage wheat allotment and certificate payments equal to 50 cents per bushel on total allotment. These features differ from features in the 1970 and 1971 programs. The first benchmark situation is more restrictive than the 1971 set-aside because it assumes both wheat and corn acreages are limited by allotment, and it does not allow nonparticipation. The second benchmark is less restrictive because no conserving base or set-aside is required and there are no program payments or price supports. Thus the market prices, assumed to be closer to a world market level than in the first benchmark situation, were the sole guide to production.

(2) Two ways of defining land eligible for GCR were compared: (a) Any tillable land normally part of the crop rotation (TILL), and (b) acreage in row crops in an average year (ROW)—a sort of corn-soybeans base. Total acreages of each of the two types of land were based on proportions shown by the 1964 Census. Total signup in the GCR program was limited to no more than 30 percent of the eligible land in each of the five areas. The TILL program would affect feed grain and wheat acreage directly, by bidding land away, and would also get much acreage of lower valued soil-conserving crops at low payment levels. Because this land can be retired without much effect on grain output, and with only limited effects on livestock, there is slack between acres retired and production control. The ROW program is designed to avoid this problem. It requires a net reduction in row crops for each acre of participation in general cropland retirement, whether or not the FGW programs are available, but it has no direct effect on wheat production.

(3) The price relationships among soybeans, corn, and wheat were varied to appraise the impact of changing world price relationships. For most comparisons, wheat was priced at $1.30 for the situations assuming no feed grain or wheat programs, and the equivalent of $1.80 per bushel when the programs were included. The basic corn and soybean prices used were $0.92 and $2, with program payments added to corn price for the situations assuming FGW programs. Additional comparisons were made with $2.25 and $2.50 soybean prices. These prices were specified in early 1969. Since then market conditions have raised price levels considerably, but the relationships are similar. Price relationships rather than price levels influence results in this model. These variations allow us to examine likely effects of the rather wide fluctuations in soybean prices caused by the alternate surplus and deficit fears of the past few years. The effects both on

[3] We caution the reader that this is a report of research that required a very large number of simplifying assumptions. This leaves a big spread between the model and the real world where interpretation must be made. We have attempted to spell out these assumptions so the reader can critically evaluate and apply the results. The study should be used as a guide to thinking, and not accepted as established fact. A source of additional results is G. D. Irwin, J. A. Sharples, and J. H. Berry, Part-farm general cropland retirement: Effects of some alternate program specifications, Southern Jour. Agr. Econ., Dec. 1970, p. 97-101.

corn and soybean production and on the expected participation in the GCR and the FGW programs are of interest.

A linear programming analysis was made for the 20 groups of farms with various combinations of these three sets of alternatives.[4] Total land and other resources were projected for 1970 from census data, and agronomic limits were based on 1967 cropping patterns. These limits on acreage of row crops assume that soil conservation and cultural practices require the 1967 proportion of tillable land to be in nonrow crops each year. The assumption turned out to have a very important influence on the results. Crop yields and practices were what above-average farmers were accomplishing in the mid-1960's, as these were assumed to represent what the averages would be by 1970. Numbers of farms and assumed yields are presented in table 1.[5]

The Logic of Comparisons

Economic forces cause cropping patterns to adjust toward profitable combinations over the long run. But they need not reach the most profitable combination in any one year, especially when economic conditions are changing. But the computed results are as if the entire population of farmers maximized profits and completed adjustment to the assumed conditions.

Differences found by comparing the computed results with actual acreages grown in some recent year may be due to one of three reasons: (1) Farmers might not have completed their adjustment to conditions that have changed recently, (2) some of the assumptions about expected prices or yields in the model might be different from those in farmers' thinking, and (3) some farmers, especially in the short run, may be strongly influenced by nonprofit goals. These comparisons project the numbers and sizes of farms to 1970, and they exclude dairy farms and all other farms under 100 acres.

We have no accurate way to estimate effects of the above factors. Comparison with historical production can only verify that the estimates appear reasonable. On the other hand, comparison of one computed solution with another avoids these limitations, because the basic assumptions are identical throughout. Though such assumptions were based on the best information available, certain results depend upon their correctness. The most critical is the limit placed on the percentage of land permitted in row crops in an average year.

Adjustments Without General Cropland Retirement

What would be the effects of adjusting all farms to feed grain and wheat programs of the 1960's but under 1970 conditions? What would be the effects of dropping all programs? The answer to the first question represents an estimated adjustment to a mandatory 20 percent diversion feed grain program; the answer to the second represents a result for a free market. How have the varying price prospects for soybeans affected the direction of cropping patterns? These questions are guides to studying the results shown in table 2, which assume *no* general cropland retirement (GCR). They are our standards of comparison when the general cropland retirement program is considered.

Column 1 indicates assumed agronomic limits on acreage of three primary crops and limits on feed grain diversion on crop and livestock farms of over 100 acres. Column 2 shows estimated land use under the base solution with soybeans at $2, corn at $0.92 plus diversion payments, and wheat at $1.30 plus certificate payments. Columns 3, 4, and 5 show changes from the base situation with different relative soybean prices and farm programs. Since the benchmark solution and the three alternative solutions are derived from a common set of assumptions, we are interested in the differences between solutions.

The results require careful interpretation to identify which of the assumptions were limiting. This will enable the reader to reevaluate the assumption, and to adjust the results if he feels the assumption needs to be revised. Four main points may be made:

(1) Economic adjustments in all solutions would be toward a larger percentage of total cropland in the four uses—corn, soybeans, wheat, and feed grain diversion (bottom line, table 2)—than has been the case in recent years. The 1968 actual acreage was 12,376,000 for the four uses. At least 8,955,000 acres were on farms included in the analysis, and 7,140,000 acres were in row crops on included farms. Thus the assumptions allowed some increases in these uses, and they were found to be profitable.

(2) The switch toward these more intensive uses would be greater when commodity programs are not in effect, with nearly all the net increase being in wheat

[4] A multifirm, multiarea linear programming model was used to maximize net social product. See Berry (cited in footnote 2). Except for the 30 percent maximum participation in GCR, no area or statewide constraints were binding. Thus the monopoly solution bias, which is inherent in this kind of model, was not a serious problem.

[5] Farm numbers were projected using a Markov chain model on 1959-64 census data. Variable production cost per acre was varied by size and type of farm, and by area, based on machine complements determined by survey.

Table 1.--Projected numbers of farms and grain yields used in the model

Area and type of farm	Projected acreage	Projected farms	Average grain yields per acre		
			Corn	Soybeans	Wheat
	1,000 acres	*Number*	*Bu.*	*Bu.*	*Bu.*
Northwest:					
Small cash crop	313.6	1,895			
Large cash crop	1,349.7	2,700			
Small livestock	52.5	307			
Large livestock	75.9	148			
Area	1,791.7	5,050	115	30	45
Northeast:					
Small cash crop	1,015.0	5,800			
Large cash crop	884.0	2,906			
Small livestock	183.1	1,071			
Large livestock	193.4	606			
Area	2,275.5	10,383	105	28	45
Central:					
Small cash crop	1,216.3	6,860			
Large cash crop	3,960.3	8,840			
Small livestock	418.0	2,208			
Large livestock	481.0	1,055			
Area	6,075.6	18,963	115	35	45
Southwest:					
Small cash crop	493.8	2,941			
Large cash crop	1,171.3	2,668			
Small livestock	84.4	497			
Large livestock	115.8	255			
Area	1,865.3	6,361	115	30	45
Southeast:					
Small cash crop	762.3	5,200			
Large cash crop	515.3	1,733			
Small livestock	146.9	871			
Large livestock	138.5	466			
Area	1,563.0	7,270	100	28	40
Total	13,571.0	45,927	–	–	–

acres (col. 2 compared with col. 3, and col. 4 compared with col. 5, table 2). Some 2.2 to 2.4 million additional acres would be freed from the mandatory diversion requirement, and put into crops. The additional acres would go to soybeans and wheat, despite the fact that crop budgets for Indiana usually show corn to be a more profitable crop than either.

For several reasons, the acreage of corn and soybeans in 1967 can be considered as a practical limit on the acreage of row crops. Beginning in the fall of 1966, there was considerable concern about an adequate food supply. Voluntary diversion by farmers participating in the 1967 feed grain program was suspended. We have assumed that with all farmers participating in the program and desiring to maintain diversification and good farming practices, they would not plant more acreage to row crops than the acreage of corn and soybeans in 1967. The addition of soybeans and wheat acreage rather than corn acreage is sensitive to this assumption.

Land in feed grain diversion would be cropped when commodity programs are discontinued. The adjustment is mainly toward soybeans, with only slight increases in corn acreage. At the higher relative soybean price, substantial corn acreage also would be shifted to soybeans. It should be noted that this particular corn-soybean price ratio is 0.92/2.50, which is outside the range of recent experience. Wheat acreage also would increase with programs discontinued. Even at the free market wheat price of $1.30 assumed in the programming, wheat is more profitable than hay and pasture as a close-grown crop, and large acreages can be shifted without affecting livestock output. Since wheat usually can be planted after soybean harvest in the fall, but not after corn, there is a complementary "fit" between growing wheat and soybeans, which gives soybeans a stronger competitive position for row cropland than otherwise.

(3) The higher soybean-corn price ratios shift the row crop pattern away from corn (col. 4 compared with col. 2, and col. 5 compared with col. 3, table 2). The benchmark situation (soybeans at $2 and FGW programs) shows that profitable diversion would be above the 20 percent minimum of 998,000 acres. Corn acreage would be large, and soybeans would be cut back from recent State totals. An additional estimate we made suggests that the results of a $2.20 soybean price would be similar to the effects of a $2 price, though the acreage of soybeans would be slightly larger. Even with soybeans at $2.50, some optional diversion would be made under the feed grain program.

If the feed grain and wheat programs were dropped, the pattern of adjustment is similar—toward more intensive crops and also toward the soybean-wheat combination. With soybeans at $2.50, the land freed from diversion requirements would go mostly to soybeans. But with soybeans at $2, both corn and soybean acreage would expand to absorb diverted land.

(4) The no-programs situation would create substantial expansion in production which, if Indiana results were repeated elsewhere, could create substantial downward price adjustments in the short run. At the $2 soybean price, farmers expecting the prices assumed in the analysis could make profitable adjustments as shown in column 3 of table 2. In addition, they would be adjusting from the current situation rather than from the profit—maximizing benchmark situation shown in column 2. The no-programs output (col. 3) would be 97,000 more acres of corn, 2,155,000 more acres of soybeans, and 2,278,000 more acres of wheat, with elimination of 1,023,000 diverted acres. If farmers in other areas would tend to adjust in the same direction, prices could turn out to be much lower than expected and assumed in the calculations. The size of these potential increases in acreage suggests the seriousness of the permanent overcapacity problem.

Adjustments to General Cropland Retirement

What happens when a general cropland retirement

Table 2.—Program bases and computed acreages in selected uses: Effects of feed grain program and soybean price, Indiana crop and livestock farms of over 100 acres

Uses of land	Assumed program bases and agronomic limits with FGW programs (1)	Benchmark solution[1] (2)	Change from benchmark solution		
			Soybeans at $2, no program (3)	Soybeans at $2.50	
				With program (4)	No program (5)
	1,000 acres	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*
Corn	4,990	4,977	+97	- 2,791	- 2,760
Soybeans	–	905	+ 2,155	+ 3,414	+ 5,012
Feed grain diversion	[2](998-2,494)	2,252	- 2,252	- 623	- 2,252
ROW crop uses	8,134	8,134	0	0	0
Wheat	1,161	1,161	+ 2,278	0	+ 2,437
TILLable land uses	[3](9,295-11,877)	9,295	+ 2,278	0	+ 2,437

[1] Soybeans at $2 with feed grain and wheat programs (FGW).

[2] The first figure represents the minimum 20 percent diversion; the second includes the optional 30 percent additional.

[3] The first figure is the limit with FGW programs, which assume a 20 percent mandatory diversion; the second applies with no FGW program.

plan is created to draw out some of this permanent overcapacity? The program must, of course, compete with farmers' other alternatives. These depend on the type of land that is eligible for retirement, as well as on the income opportunities from cropping, nonfarm activities, and any other land retirement programs that are in effect.

Amount of Land Retired

Figure 1 summarizes the effects of several possible kinds of part-farm general cropland retirement, with soybeans priced at $2. The top half of the figure (part A) is for general cropland retirement programs with all tillable land eligible (TILL), and the bottom half (part B) for a program restricted to a row land base (ROW). Each part has three curves. I is for acreage in a general cropland retirement (GCR) program operated alone; the curves marked II are for the jointly operated GCR and feed grain-wheat programs; IIa is only that part of acres retired due to the general cropland retirement part of the program; and IIb is the total of feed grain diversion and GCR. Each curve is a land-offered-for-retirement curve, since moving up the left axis indicates higher and higher GCR payment rates. At zero rate, no land is offered. As price is increased more land is offered.

Several points should be noted in figure 1:

(1) The general (GCR) and commodity-oriented (FGW) land retirement programs may compete with each other for the same land. Participation in the GCR is higher without the feed grain program to compete for land, when a ROW land base (part B) is used, and at payments of $45 or higher when a TILL base (part A) is used (curve IIa compared with curve I). A whole-farm GCR is often proposed in an attempt to minimize such competition. In designing a combined program, the relationship between commodity-type diversion payments and GCR rates would thus be crucial.

The lines trace out acres, not costs. The figures assume the same feed grain payment rate, regardless of variations made in the GCR payment rate. In one of the five areas, feed grain payments averaged $82.90 per acre for the first 20 percent and $66.51 per acre for an additional 30 percent. This rate was applied to all such diversion in the area. The GCR rate was as if on a "bid" basis, so that some acres received $15, others $30, and so on. Thus, the average payment for retiring all cropland in line IIb is higher than the average for all acres in line I.

(2) With either TILL or ROW land base, more total acreage is retired with the combined programs (curve IIb compared with curve I).

(3) For a GCR program operated alone, increasing payment rates in the $15-$45 range obtain additional land (line I). Some rate above $60, probably close to feed grain diversion payment levels, would undoubtedly draw still more land. The curves provide an estimate of what the land is earning in other uses, because they indicate the cost of bidding it away from those uses.

(4) For a GCR program in combination with FGW programs, land is attracted only at the extremes of the payment rates considered (line IIa). With a ROW land base, response is only above $45. With TILL land base, response is at both ends of the range. Low payments draw slack land[6] from low-productivity uses, while high ones draw row cropland.

(5) Some complementarity between the FGW and GCR programs exists at the lower GCR rates when a TILL land base is assumed. This is shown by the crossing of lines I and IIa, part A. At GCR payment rates of $30 and below, acres put in GCR are greater when the FGW programs are in effect. The programs complement each other, rather than compete.

The complementarity depends on two facts: (1) Allotments limit the acreage devoted to wheat, and (2) some land is eligible for a TILL general cropland retirement program but not for feed grain diversion. When a GCR program is run in combination with FGW programs, a low payment draws in much of this noncompetitive land. But if FGW program limits are removed, much of this land goes to wheat instead of general cropland retirement. So, for a TILL base GCR without FGW program limits (line I, part A) it is necessary to bid the land away from wheat production. This requires between $30 and $45 per acre in several of the 20 farm situations.

(6) A GCR program attracts little land in a combined program if it draws on the same land base as the feed grain program (part B, line II). Unless rates are set higher than $60, they would be competitive with neither the feed grain program, nor with growing soybeans on the remaining land.

Land Use Patterns

As GCR payments are raised to get progressively more land, how is crop production affected? Figure 2 reveals some of the effects for a TILL-base general cropland retirement program. Part A is for a combined GCR-FGW program, part B for a GCR program operated alone. The leftmost line in part A corresponds to line IIa

[6] Acres retired without achieving significant production control. See point 2, p. 78.

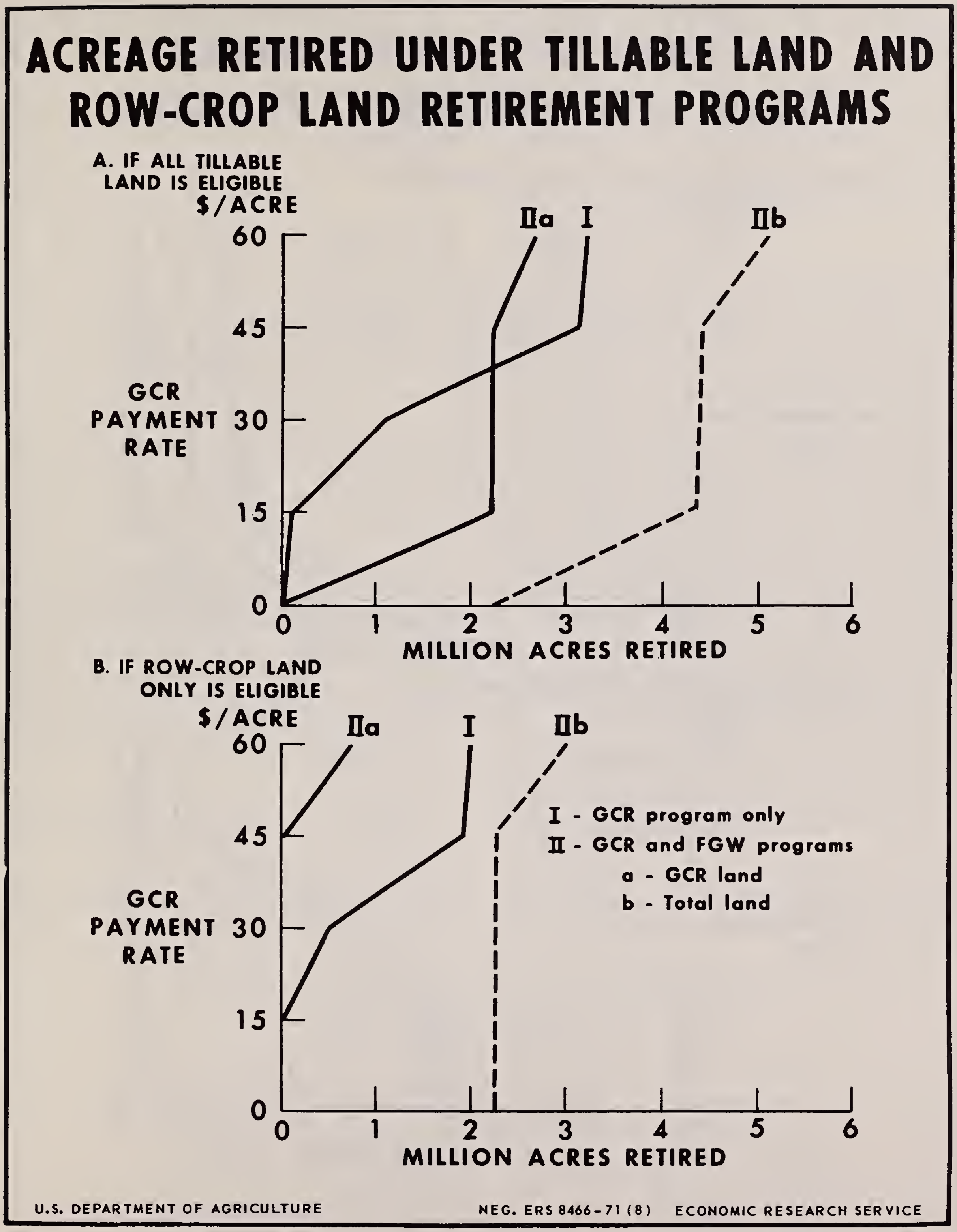
ACREAGE RETIRED UNDER TILLABLE LAND AND ROW-CROP LAND RETIREMENT PROGRAMS
A. IF ALL TILLABLE LAND IS ELIGIBLE
$/ACRE
GCR PAYMENT RATE
60
45
30
15
0
IIa
I
IIb
0
1
2
3
4
5
6
MILLION ACRES RETIRED
B. IF ROW-CROP LAND ONLY IS ELIGIBLE
$/ACRE
GCR PAYMENT RATE
60
45
30
15
0
IIa
I
IIb
I - GCR program only
II - GCR and FGW programs
a - GCR land
b - Total land
0
1
2
3
4
5
6
MILLION ACRES RETIRED
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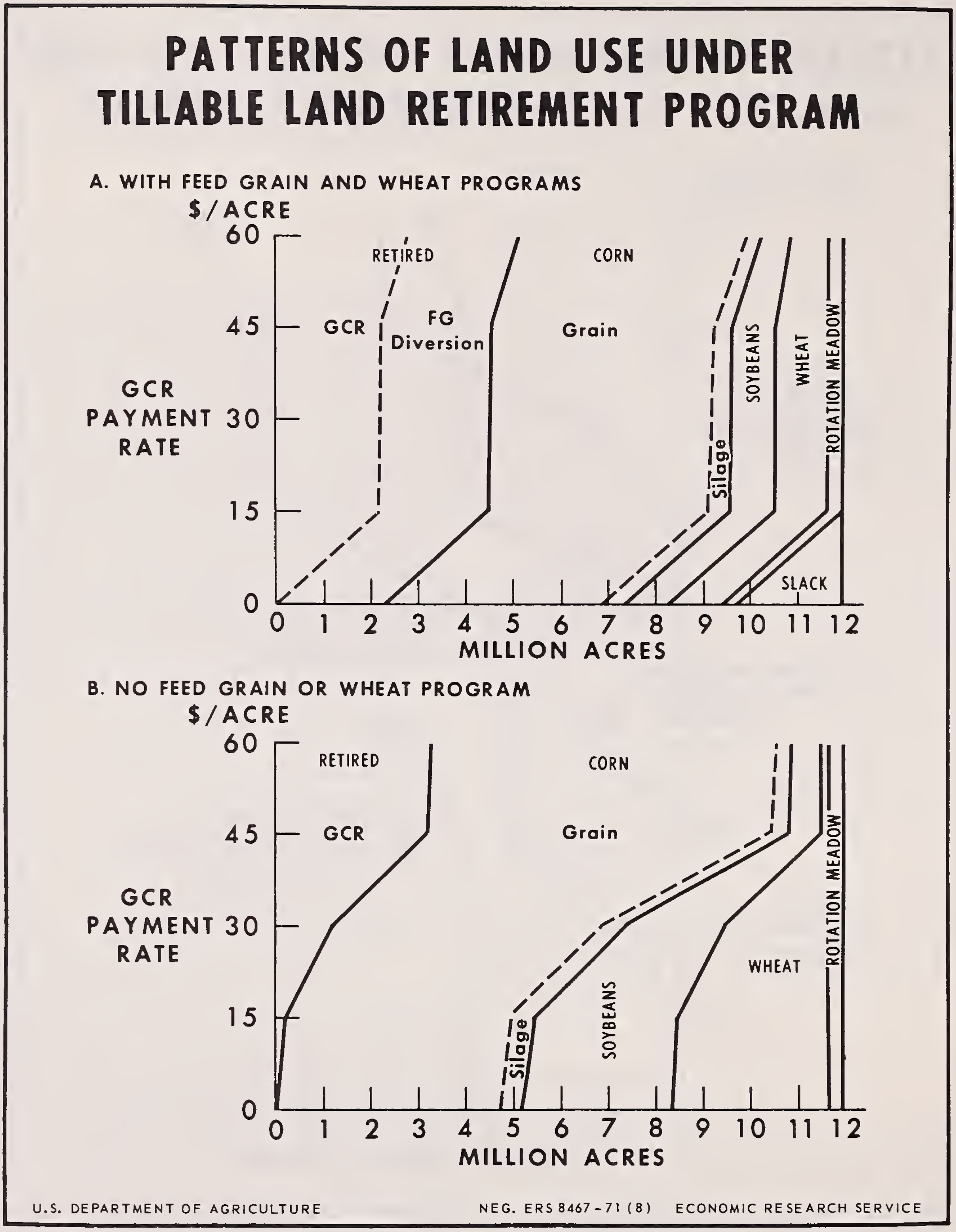
Figure 1


PATTERNS OF LAND USE UNDER TILLABLE LAND RETIREMENT PROGRAM
A. WITH FEED GRAIN AND WHEAT PROGRAMS
$/ACRE
GCR PAYMENT RATE
RETIRED
CORN
GCR
FG Diversion
Grain
Silage
SOYBEANS
WHEAT
ROTATION MEADOW
SLACK
60
45
30
15
0
0 1 2 3 4 5 6 7 8 9 10 11 12
MILLION ACRES
B. NO FEED GRAIN OR WHEAT PROGRAM
$/ACRE
GCR PAYMENT RATE
RETIRED
CORN
GCR
Grain
Silage
SOYBEANS
WHEAT
ROTATION MEADOW
60
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MILLION ACRES
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Figure 2

in part A of figure 1, and the leftmost line in part B to line I in part A, figure 1 (both drawn to a closer scale on the acres axis). The width of various crop sections in figure 2 indicates profit-maximizing land use of the approximately 11.7 million acres of cropland (TILL-base) at the various GCR payment rates. Moving from bottom to top of each part, we see which crops are affected as participation in GCR increases.

Several points are significant:

(1) The pattern for combined FGW and GCR programs (part A) shows that some acres are obtained at minimum payment rates. These are mostly the part of cropland that must be rotated out of row crops in any given year. The total amount of such land assumed in the analysis exceeds acres that can go into wheat and those needed for livestock, hay and pasture. It is slack, available to a GCR program at low rates.

(2) At GCR rates above $45, with combined programs, the expansion of GCR acres comes from wheat and soybeans at the $2 soybean price (at $2.50 it would come from corn). The two crops are cut back about equally.

(3) With GCR program operating alone (part B), expansion of GCR also comes from wheat and soybeans. But without wheat allotment restrictions, the starting level is much higher, the cutback is much more, and the response is largely in the $15-$45 range.

(4) With GCR program operating alone, as wheatland goes into GCR, the complementary situation for soybeans disappears. So corn acreage also increases.

Total Production and Returns

Since a combined program would pick up fairly large amounts of land currently in low-productivity uses for conservation or rotation, some payments wouldn't buy much production control. Most of the additional land retired would be from soybeans and wheat production. Table 3 summarizes the effects on program costs and production with a TILL-base general cropland retirement program. The numbers are indexes of the output and program cost with the benchmark situation (FGW, but no GCR) equal to 100. The benchmark situation involves program payments of $189 million, and returns to farm resources of $631 million (from livestock as well as crop production).

For combined programs, the total acreage retired runs up to 5 million at $60 per acre, with slightly over half the retired acreage in the GCR. The effects of slack land, and of GCR competing with cropping for use of other land, can be seen by comparing the figures in columns 1 and 2. At rates between zero and $15, the cost of the programs jumps 17 percent, with a reduction of less than 1 percent in production. In the $15-$45 price range, response is slight. But between $45 and $60, the cost goes up 13 percent for a 4 percent production cut. Over the entire range, a 34 percent increase in costs caused by GCR would affect production about 6 percent. The combined program is thus rather inefficient in production control when all TILL land is eligible to participate.

For the GCR program alone, program costs range from zero if no land is retired, to 52 percent of present levels (col. 3) at the $60 rate. But crop output is consistently higher than with FGW programs, ranging from 13 to 30 percent above. With a low elasticity of demand for farm production, the same type of result over a large area would translate to much lower farm income from production. The same conclusion has been reached in several other recent studies on effects a free market would have.

The results in table 3 emphasize how labor and capital resources can be shifted within the farm to maintain total value of production, even though some

Table 3.—Index of cost and production effects, TILL land GCR program with and without FGW programs
(Combined programs at $0 GCR rate = 100)

GCR payment rate per acre	Combined FGW and GCR programs		GCR program alone	
	Cost of programs (1)	Production (2)	Cost of programs (3)	Production (4)
0	100	100	0	130
$15	117	99	1	130
$30	118	99	16	126
$45	121	98	48	114
$60	134	94	52	113

land is withdrawn. Production of specific crops may be reduced, but the impact on total output is less substantial.

Excluded Farms and Production

Our analysis was limited to effects on Indiana crop and livestock farms of over 100 acres. This excludes about half the farms and around one-fifth of the crop and livestock sales. In the 1964 Census figures, the excluded farms had a larger portion of their cropland in uses other than grain crops. They also had a much higher proportion of part-time and older farmers. This might lead us to expect that participation rates would be higher, that required payment rates per acre would be lower, and that production control would be small if a part-farm, TILL-base GCR were offered these excluded farms. However, participation in programs in 1964 was actually much smaller for this group than for larger farms.

Variations Among Farms and Areas

The proportion of land that would be in the less productive uses varies among the individual farms in the 20 groups studied. Crop returns, and thus rates required to attract land into the GCR, vary among farms. And the number of farms is different for each of the 20 groups. The impact of a part-farm GCR in which lowest bids per acre were accepted would fall unequally on areas and on types of farms, with heavier participation in the least productive soil areas, and those with predominance of crop farms.

With combined GCR and FGW programs, about three-fifths of the estimated acreage in GCR would be from grain farms over 260 acres, another one-third from 100-to-259-acre grain farms, and 2 to 6 percent from livestock farms in each size group, regardless of the GCR payment rate. These numbers reflect the fact that there are more of the large grain farms than any other category, but also that participation would be more attractive to them.

In contrast, a GCR program operated alone shows considerable variation in payment distribution among farm types as the rate is varied. At $15, participation would be low, and fairly equally distributed among the four classes of farms. As rates were increased, participation would expand greatly, and almost 94 percent would be from grain farms. At $30, it would be equally split between small and large farms. But at higher rates, the large farms would increase participation and claim nearly three-fifths of the payments.

By areas, the less productive southwestern, southeastern, and northeastern parts of Indiana would reach the 30 percent participation limits at GCR payment rates of $60 or lower. The southeastern area would reach the limit with a $15 GCR payment with combined programs, or a $30 GCR payment for GCR alone. The southwestern and northeastern areas would reach 30 percent limits at $45 for GCR alone, or $60 with combined programs. Even so, the number of acres participating would be greatest in the 32-county central area, which has the largest land area.

Summary

Estimates of the effects of a part-farm general cropland retirement (GCR) program were made for four size-types of farms in five areas of Indiana, which included all farms over 100 acres except dairy farms, or about half of all farms, and four-fifths of the crop and livestock sales. Two definitions of land eligible for GCR were compared, with participation limited to 30 percent of eligible land in any area. Estimates were made with and without the recent type of feed grain and wheat programs (FGW), and effects of varying soybean prices were studied.

Under a part-farm GCR program, a considerable part of the cost would be incurred before very much grain production is retired. This is true especially for a program permitting retirement of any tillable land (TILL). With only row cropland eligible (ROW), the GCR program would reduce production of corn and soybeans, but not wheat, and then only when the GCR program was operated alone rather than in competition with FGW programs. At any payment rate, participation would be greatest on crop farms and in the least productive soil areas, and would vary significantly between separate and combined programs.

Farm Size and the Distribution of Farm Numbers

By Robert F. Boxley[1]

Size-of-farm data for 1964 were fitted to the function ln Y = ln a-bX. Results showed that the percentage distribution of farms by size classes tends to follow the distribution of an inverse exponential function. Furthermore, empirical size distributions seem to have an underlying stability across time and geographic areas. These features have several applications, one of which is prediction of future size distributions of farms. A method of making such a prediction is illustrated with census data on farm numbers in 1935 and 1964.

Key words: Farms; distribution by size; Gini ratio.

One standard measure of the economic status of the farm sector is average size of farm. Despite the shortcomings of land area as a measure of economic well-being, changes in farm size are closely followed in both popular and technical farm literature. The doubling of average farm size between 1935 and 1964, for example, was classified by writers for the Bureau of the Census as "one of the significant developments in agriculture in the United States in the twentieth century" (*5*, p. 242).[2]

Despite the interest popularly attached to farm size measured in acreage, it is not immediately obvious how changes in this parameter should be interpreted or, indeed, whether much importance should be attached to it. Average farm size for the conterminous United States rose from 154.8 acres in 1935 to 350.8 acres in 1964 (while total acreage of land in farms remained about constant); Nikolitch and McKee note that one interpretation would attribute the change to "an ever-decreasing number of increasingly larger farm organizations" (*3*, p. 1549). Yet such a change in farm size could have been achieved in several ways: By the expansion of a relatively few 1935 farms into giant operations; by the outmigration of every other 1935 farm operator across all size classes (which would leave concentration, in the Lorenz curve sense, unaffected); or by outmigration of all of the smallest farm operators (requiring proportionately modest expansion by the farms remaining to absorb the land thus freed). In truth, elements of all three explanations appear involved in the farm size changes of 1935-64 and, depending upon which explanation is favored, the distributional consequences can be interpreted about as ominously or as auspiciously as one likes.[3]

This observation is, of course, generally true. Most statistical measures such as averages or medians have economic or social meaning only within some distributional context. Thus, we are interested in changes in farm size not in some absolute context but in relation, say, to access to farming opportunities or competitive structure of the industry. In a similar manner, we are interested in projected capital needs as they relate to special requirements of the very large or very small farms. Or, we may be less interested in explaining why median income is at some level than we are in explaining why a particular group, with incomes below that level, persists.

The purpose of this paper is to explore some of the statistical relationships involved in the concepts of average farm size and the distribution of farm numbers and, from these relationships, infer some distributional consequences of changes, past and future, in U.S. farm sizes. Farm size measures are given particular attention

[1] The patient assistance of Lynn Pollnow, Economic Research Service, in working out concepts used in this paper is gratefully acknowledged.

[2] Italic numbers in parentheses refer to the Literature Cited, p. 94.

[3] A significant part of the change in average size was largely the statistical consequence of a very high rate of outmigration by farmers in the smallest size classes. Another, smaller part of the growth was attributable to an absolute increase in the number of farms of 500 acres or more. Finally, there was a very general outmigration of farm operators (out of agriculture or into other size classes) across the remaining size classes of less than 500 acres. See, for example, (*4*). Because of this general outmigration, the relative distribution of farmland among farm operators in 1964 was not greatly changed from the distribution in 1935. The concentration ratio for the conterminous United States was 0.65 in 1935. It rose to 0.67 in 1940 and 0.70 in 1945 and remained at that approximate level, being 0.71 in 1964. (All calculations are based on data obtained from (*5*) or equivalent earlier census volumes.)

because physical limitations on possible configurations of farms within a finite space suggest that the distribution of farm numbers is characterized by a specific functional form. (There is some evidence that this particular function also describes a broader class of property and wealth distributions.) Finally, we illustrate a specific application of a distribution function as a means of predicting future farm size distributions.

Functional Distribution of Farm Numbers

Past processes of fragmentation and consolidation of farms have resulted in a distribution of farm sizes ranging from very small to very large acreages, even in States that were originally homesteaded in quarter- or half-section units. It is obvious, however, that these processes have not been completely random. In general, any change in the number of farms of a given size requires either a change in the land base or offsetting changes in other size categories. If the changes occur over a constant land base, the possible farm size combinations are physically constrained by that land base and by the fact that the maximum number of farm units that can be created of a given size is inversely related to that size. Additional constraints on possible size combinations are imposed as other parameters (e.g., total farm numbers, median farm size) of the distribution are specified.

The inverse relationship between frequency and farm size categories has led Folke Dovring (*1*,*2*) to suggest that a "normal" size distribution of farm numbers should resemble the inverse exponential function, e^{-x}. This function can be viewed as representing a decumulative size distribution by writing $Y = e^{-x}$, where Y equals the percentage remaining above a given size limit, x. At $x = 0, e^{-x} = 1.0$ (or 100, if interpreted in percentages). As the size limit increases ($x > 0$), values of the function decline smoothly, becoming infinitesimal in the vicinity of $x = 10$. Exponential functions, as the antilogarithm of a natural logarithm, plot as a straight line on semilogarithmic paper (figure 1). On logarithmic paper, the functions plot as a curve (figure 2). The latter representation is a particularly convenient form for graphic analysis of distributive phenomena.

One reason to consider farm size distributions as exponential functions is that some State distributions coincide with or closely follow the e^{-x} distribution. An example is the 1964 farm size distribution for Indiana, which is also plotted on figures 1 and 2.[4] An evaluation

[4] The distribution for Indiana was fitted by defining x as relative farm size and setting it equal to 1.0 at average size

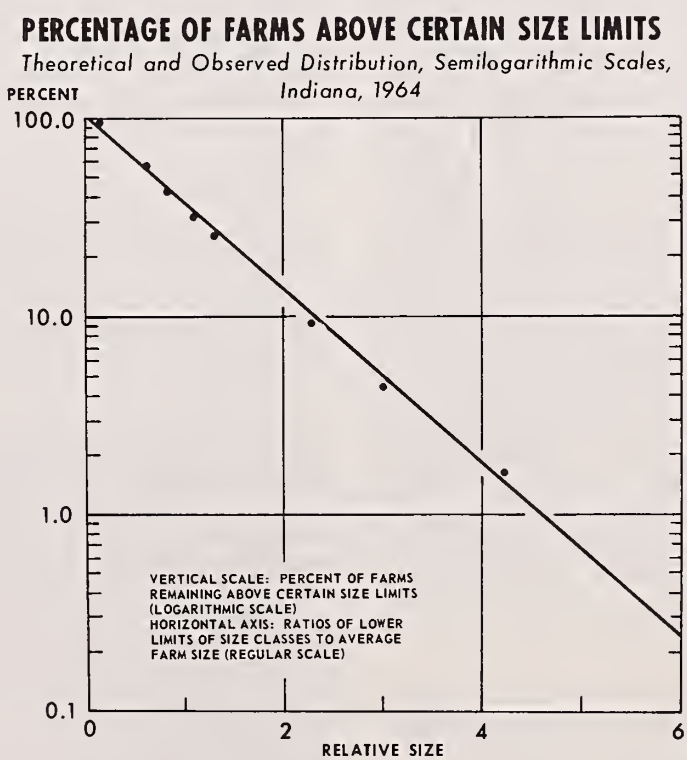

Figure 1

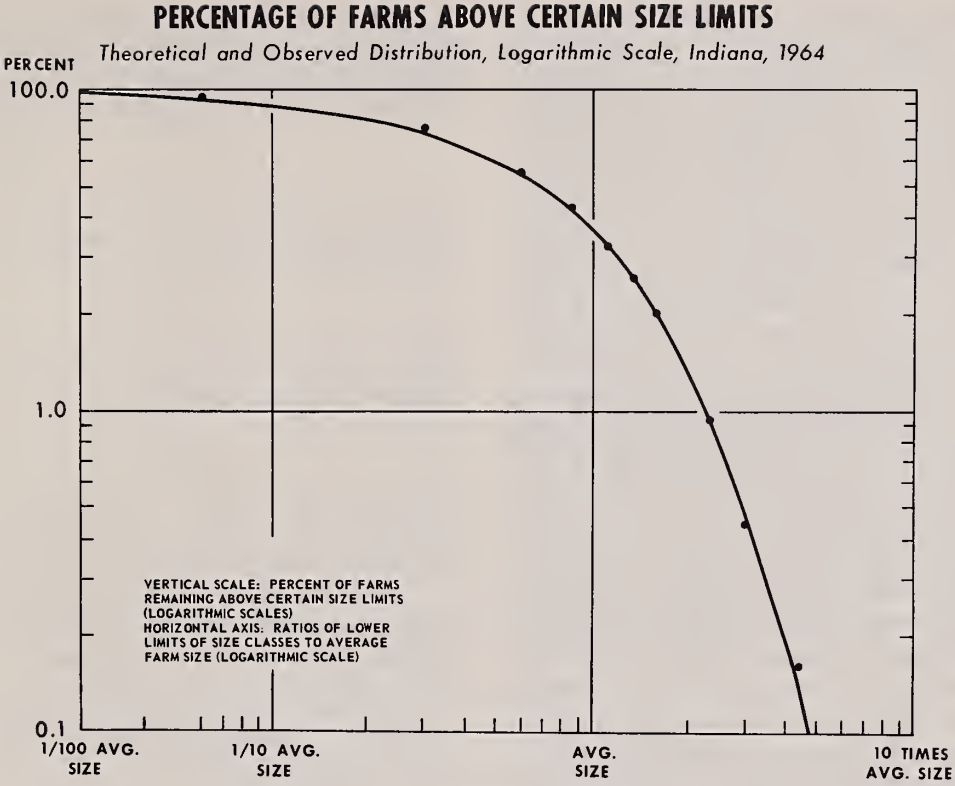

Figure 2

of the agreement between the exponential distribution and the 1964 farm size distribution for Indiana can also be obtained by comparing actual and indicated class frequencies (table 1). The largest difference between actual and estimated frequency (obtained by reading directly from a table of the inverse exponential distribution) occurs for the 50-to-99-acre class and is equivalent to underestimating by 1,800 the 22,600 farms in this class.

Indiana in 1964 illustrates a particularly close agreement between the exponential and empirical distributions of farms by size. Some other States—notably Maine, New Hampshire, New York, Pennsylvania, Ohio, Kentucky, Kansas, and Missouri—also closely follow (but do not exactly coincide with) the exponential distribution. While there may be no reason to expect exact coincidence,[5] viewing the exponential distribution as a

Table 1.—Actual and estimated percentage of farm numbers by size class, Indiana, 1964

Size class	Actual[1]	Estimated[2]	Difference
Acres	*Percent*	*Percent*	*Percent*
Under 10	4.5	5.8	- 1.3
10-49	19.0	20.1	- 1.1
50-99	20.9	19.2	+1.7
100-139	12.5	11.7	+0.8
140-179	10.1	9.2	+0.9
180-219	7.2	7.3	- 0.1
220-259	5.8	5.9	- 0.1
260-379	10.7	10.7	—
380-499	4.8	5.2	- 0.4
500-699	2.9	3.4	- 0.5
700-999	1.1	1.3	- 0.2
1,000 and over	0.5	0.2	+0.3

[1] Computed from 1964 Census of Agriculture data (*5*).
[2] Computed from a table of values for e^{-x} at selected values of x.

(165.9 acres). Points on the x axis were then located by expressing the lower limit of the census size categories as fractions or multiples of average size and plotted against the decumulative percentage distribution of farm numbers by size categories.

[5] In the distribution of $Y = e^{x}$, the median occurs at $x = 0.69$. Whenever data series are found in which the median is 0.69 of the average ($x = 1.0$), the rest of the series distribution tends to be identical with that of the inverse exponential function. The distributions of data series for which the median/mean ratios vary from 0.69 tend to vary also from the inverse exponential distribution in predictable ways (*2*, p. 3).

norm can still be instructive. In Indiana, for example, the positive discrepancy between the actual and estimated distribution in table 1 occurs in the range of 50 to 179 acres. This "heaping" may be observed generally for the Midwestern States and appears to be a residual from the original settlement patterns which favored farms of this size under the rectangular survey (*2*, p. 9). The negative discrepancies are then explicable as offsets. The positive discrepancy for the 1,000-acre-or-larger class, on the other hand, presumably reflects some other past or present force at work at this level.

There may also be reason to view the exponential distribution as a limiting distribution for farmland and farm numbers. States with empirical farm size distributions relatively close to an exponential form are generally found in the long-settled areas east of the Mississippi. This geographical distribution has led Dovring to advance the hypothesis that the resemblance of the size distribution to an exponential distribution comes about only over time and through the processes of farm consolidation and division which smooth irregularities associated with the original settlement patterns (*2*, p. 9). There have been very few studies of the dynamics of farm size changes, but Walrath's work (*6*, *7*) indicates that the processes of farm consolidation and fragmentation are complex and that major but offsetting changes may occur simultaneously in a given area. From his studies, it is possible to see how the smoothing might come about.

Classes of Distributions

Although it is intriguing to compare empirical distributions with the inverse exponential distribution, it is probably more useful to view these distributions as members of a class that might be described as exponential-type distributions. Members of this class—which includes a number of measures of income or wealth in addition to farm size—are characterized by the general functional relationships plotted in figures 1 and 2 (i.e., linear in semilog, curvilinear in double-log), indicating that they are of the same family as the e^{-x} distribution.[6]

Dovring has done considerable work in classifying distributions and in developing transformations of empirical distributions as an analytical tool by which phenomena can be gaged relative to the function, e^{-x}. For the purposes of this paper, however, it may suffice to use some simple measures of farm size distributions. One means of doing this is to view the function:

$$Y = e^{-x}$$

as a special case of the class of functions:

$$Y = ae^{-bx}$$

where a and b both equal 1.0. By taking natural logarithms the general function can be expressed as:

$$\ln Y = \ln a - bX.$$

An appropriate measure of goodness of fit for this function is the simple correlation coefficient, r^2.[7]

Size-of-farm data for 1964 for the 48 conterminous States were fitted to the general function and the following distribution of r^2 was obtained:[8]

r^2 range	Number of States
0.980 - 1.000	10
.950 - .979	11
.900 - .949	11
.800 - .899	12
.730 - .799	4

The lowest r^2's were obtained from West Coast and Rocky Mountain States—Oregon, California, Washington, Arizona, Utah, and Nevada. For these States, the exponential-type distribution gives the poorest fit, but this perhaps should not be surprising, since the land-in-farm base is still expanding in these areas and the size distributions are relatively new. Thus,

[6] This statement is based partially on some cursory investigations of data from various sources but is largely drawn from Dovring's work which indicates that exponential-type distributions may characterize a wide range of income and wealth distributions and, thus, have a number of important analytical applications.

[7] In this paper we interpret r^2 as a measure of goodness of fit for the general function in an absolute sense (a perfect fit having an r^2 of 1.0). We have also compared r^2 for alternative functions fitted to the farm size distributions namely: $y = a + bX$ and $y = aX^b$. The arithmetic form gives the uniformly poorest fit. The logarithmic form fits best in those States where the semilogarithmic form fits least well, but it is generally inferior to the semilogarithmic function.

[8] The empirical farm size distributions tend to depart significantly from linearity at the upper limits of the distribution (approximately, values of $x > 10$). To maintain comparability in the regression measures for Eastern and Western States, the State regressions were computed using only values of $x < 10$. Practically, this means that the upper limit of the size distribution for States east of the Mississippi was the class of 1,000 acres or more and, for States west of the Mississippi, the class of 2,000 acres or more.

the experiences in the Western States do not necessarily contradict broader statements of functional size relationships. Florida was next in the ranking of States with low r^2 (0.853), and it too has experienced recent increases in its land-in-farm base.

The next group of distributions with low r^2's include the States of Louisiana, Mississippi, Alabama, and South and North Carolina. The regionalism of this grouping suggests that the relatively poor fit (all r^2's less than 0.90) may reflect some remnant of former sharecropping and plantation systems. The best fits (highest r^2's) were found, generally, in the Midwestern and Northeastern States.

These patterns reflect another characteristic of the farm size distributions: A tendency for State distributions to fit into groupings on a geographic or regional basis.[9] The regional similarities can be noticed in graphic comparisons, as well as in the regression parameters for the individual State distributions. One possible set of regional groupings, put together from consideration of both sources, is listed in table 2. This grouping varies in several instances from more commonly used regionalizations based on type of farm or other geographic considerations.[10] Presumably, these regional similarities reflect the common influence of factors such as time and pattern of original settlement, topography, and various institutional factors.

The general form of the exponential distribution was also fitted to the regional groupings (table 2). The r^2's indicate the strength of the regional associations, while the intercept and slope coefficients provide measures of regional differences in the farm size distributions. These regressions were computed with logarithms to base 10. By way of comparison, a regression of $Y = e^{-x}$ to a $\log_{10}$ base, scaled in the same manner, should have an r^2 of 1.00, an intercept of 2.00 ($\log_{10}$ 100), and a slope coefficient of -0.434 ($-1.0 \log_{10} e$).

[9] For simplicity we report only work using State distributions as the basic unit of observations. In practice, better fit on a unit or regional basis can be obtained by using counties as the basic unit of observation and splitting States on the basis of known intra-State differences in types of farming or farm organization, topography, or other features. For example, fits for several Great Plains States can be improved by an east-west split reflecting the transitional nature of agricultural production in the region.

[10] Our criterion was to arrange the States in a "reasonable" way to minimize the number of regions while maintaining contiguity within regions.

Table 2.—Regional groupings of farm size distributions and measures of fit by regression analysis, 1964

Region and States	r^2	Intercept	Beta (standard error)
New England (Maine, N.H., Conn., Mass., R.I.)	0.970	1.830	-0.314 (.018)
Northeast and Lake (Vt., N.Y., Pa., Ohio, Mich., Ind., Ill.)	.988	1.965	- .414 (.015)
Mid-Atlantic (N.J., Del., Md., Va., N.C.)	.929	1.683	- .241 (.022)
Southeast (S.C., Ga., Ala., Miss., La.)	.890	1.681	- .257 (.030)
Florida	.853	1.632	- .426 (.059)
Appalachia (W.Va., Ky., Tenn.)	.943	1.739	- .270 (.022)
Upper Central (N. Dak., Minn., Wis., Iowa)	.939	1.870	- .328 (.026)
Lower Central (S.Dak., Nebr., Kans., Mo., Okla., Ark.)	.942	1.868	- .350 (.028)
Texas	.894	1.803	- .451 (.049)
Mountain (Mont., Idaho, Wyo., Colo.)	.914	1.871	- .593 (.058)
Arid (Nev., Utah, Ariz., N.Mex.)	.780	1.746	-1.076 (.181)
West Coast (Calif., Oreg., Wash.)	.776	1.547	- .259) (.044)

Distributional Shifts, 1935-64

Analytically, one potentially useful characteristic of the State distributions of farm numbers is the relative stability of many of these distributions over time. The lack of major shifts in the size distributions is especially remarkable in view of rates of change and outmigration that, in New England for example, resulted in only a fourth as many farms in 1964 as existed in 1935. Several States had size-of-farm distributions in 1964 that were virtually unchanged from their 1935 distributions. This was true of States that have experienced only small changes in their land base, notably Illinois, Iowa, and North Dakota, as well as some Northeastern States—New Hampshire, New York, and Vermont—which experienced substantial declines in their land-in-farm base

Most States did experience some shifts in the distribution over the three decades—as evidenced by the previously noted increase in concentration ratios and in absolute numbers of farms of more than 500 acres. On the other hand, part of the aggregate change in both of these measures was due to the westward migration of farm production and farm numbers that also occurred during the three decades. In table 3, we have attempted to quantify these distributional shifts, on a regional basis, between 1935 and 1964. For this table the 1964 distribution of farm numbers was estimated from the 1935 curves, using known 1964 total farm numbers and average size. The regions in table 3 correspond generally to those in the 1964 Census of Agriculture.[11]

The estimated distributions by regions in table 3 indicate how the actual number of farms in 1964 would have been distributed if average farm size in each region were at the 1964 level and farm numbers were functionally distributed as in 1935. This implies that any changes in the land base occurred in such a way as to leave the 1935 distribution unchanged.[12]

One implication of table 3 is that a researcher in 1935, who correctly predicted 1964 regional farm numbers and average size, could have further estimated 1964 size distributions within a range of 88 to 128 percent of actual class numbers for the conterminous United States—an average error of estimate of 12.4 percentage points.[13] By way of contrast, a "naive"

[11] Estimates were made on the basis of the previously identified regional groupings and then aggregated to the three census regions. This resulted in New Jersey being included in the South rather than the North.

[12] The land-in-farm bases for 1964 were 94, 92, and 146 percent of the base in 1935 for the North, South, and West, respectively.

[13] Most of the difference between actual and estimated class numbers is due to shifts in the distribution between 1935 and 1964. However, some interpolation error between adjacent classes may have been generated in reading from the 1935 curve (the estimates were derived using graphical techniques).

Table 3.—Actual and estimated number of farms by size category, conterminous United States, 1935 and 1964, and regions, 1964

Size class	Farm numbers									Ratio, estimated to actual[1]			
	United States			North		South		West					
	Actual 1935	Actual 1964	Estimated	Actual 1964	Estimated	Actual 1964	Estimated	Actual 1964	Estimated	U.S.	North	South	West
	Thou.	*Thou.*	*Thou.*	*Thou.*	*Thou.*	*Thou.*	*Thou.*	*Thou.*	*Thou.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
0-99	4,138	1,358	1,197	440	376	769	696	149	126	88	85	90	84
100-139	754	325	337	163	173	145	147	17	16	104	106	101	98
140-179	684	308	286	187	169	104	109	17	11	93	90	104	64
180-219	294	191	245	116	146	66	83	9	10	128	126	125	112
220-259	212	164	187	109	114	47	65	8	12	114	105	138	146
260-379	473 (260-499)	297	348	192	209	89	118	17	21	117	108	134	123
380-499		154	190	97	113	46	61	11	15	123	117	132	143
500-699	167 (500-999)	124	137	69	80	42	42	12	16	111	115	99	130
700-999		87	90	45	45	30	27	12	17	103	101	89	145
1,000 and over	89	145	137	51	44	46	37	48	56	95	87	80	116
Total[1]	6,812	3,153	3,153	1,469	1,459	1,383	1,383	300	300	–	–	–	–

[1] Computed from unrounded data.

projection of the 1964 size-of-farm distribution at the same percentage distribution as in 1935 yields an average error of 38.4 points and, more importantly, completely fails to anticipate either the large decline in numbers of small farms or the increase in the very large farms.

Divergencies between actual and estimated farm numbers by size classes provide a general indication of regional shifts in the size distribution over the three decades and are consistent with the earlier observation that changes have occurred mainly at the extremes of the distribution. The actual numbers of farms in 1964 of less than 100 acres or more than 1,000 acres were more than expected on the basis of functional estimates derived from the 1935 distribution, and the numbers of farms in the intermediate classes were consequently fewer. The only regional exception to this pattern was in the West, where a significant part of the increase in average size came about through additions to the land base. Excluding the West, however, the net differences between the actual and estimated 1964 distributions are remarkably small. In the North, for example, only 89,000 farms were misclassified on net[14]—less than 6 percent of the 1.5 million farms of the region in 1964. Results were nearly identical in the South, involving 85,000 of a total of 1.4 million farms.

Future Size Distributions

As the above exercise suggests, one useful application of knowledge about the current size distributions of farms is the estimation of probable future size distributions. For any given unit of observation (county, State, region), this requires, basically, estimating the expected number of farms and land in farms and then extrapolating the future distribution from the current one. Based on past changes, we may have more confidence in projections for some regions than others but, in general: "It remains a sound proposition to say that if the same kind of economic and related forces are at work in the future as in the past, further development over the foreseeable future should be such that it could be projected by extrapolating the experience of recent past. In the projection of farm size *distribution*, it is not even necessary to pin down any particular year when such a structure will have taken the place of the present one. Assuming that some time in the near future farm numbers will have declined to the point where a certain average size has been attained; it is then possible to project, approximately, how farms and farmland will be distributed by size classes at that time" (*1*, p. 8).

As an example of this application, we have extrapolated from the aggregate U.S. distribution of 1964, two possible future distributions when, it is assumed, farms will average 500 and 700 acres (table 4). Aggregate farm numbers would be 2.2 and 1.6 million, respectively, assuming that total farm acreage remains in the vicinity of 1.1 billion acres.

The "potential distributions" of table 4 illustrate one way in which the assumed farm-size increases can be accommodated within the present distributional framework. Under ceteris paribus conditions, the extrapolation indicates that another doubling of average farm size for the Nation can occur without either the complete disappearance of small farms or the overwhelming dominance of giant-sized farms. Farms in the medium-size categories could continue in the majority (albeit of a much diminished number). The doubling of average size, given the assumed distribution, could be effectuated largely through a continued decline (but not disappearance) in the number of farms of less than 500 acres, and would entail only a moderate increase in the number of farms of more than 1,000 acres.

The above exercise is not a specific projection since we do not take into account even obvious regional differences in farm size distributions, nor have we considered the difficulties of projecting farm numbers or land in farms. As a practical matter, we would more likely have reason to project farm numbers or land in farms at some point in time (rather than a projection of a distribution per se). Nevertheless, many projected trends or trend changes may carry important distributional consequences and this technique would seem to provide one useful means for specifying them.

Conclusions

The percentage distribution of farms by size classes during 1935-64 remained relatively stable despite large increases in average size of farm. The rapid increase in farm size can be explained primarily by the outmigration of farm operators over a wide range of size classes (with subsequent consolidation of the agricultural lands thus released) and—of lesser importance—by a westward shift in farm numbers and the agricultural land base.

Work with the exponential-type distribution function indicates that farm size distributions—at least at the State level—are characterized by an underlying regularity. This is illustrated by both (a) the relative stability of the actual distributions over time for a large number

[14] This is the sum of the differences between estimated and actual numbers for either all classes where actual > estimated or all classes where actual < estimated.

Table 4.–Land in farms and number of farms by size, conterminous United States, 1964 and projections

Item	1964 (average farm size 350.8 acres)	Potential distributions if average farm size becomes–	
		500 acres	700 acres
Land in farms . . . . 1,000 acres	1,105,866	1,100,000	1,100,000
Number of farms . . . . farms	3,152,611	2,200,000	1,571,000
Size class:			
Under 10 acres . . . . farms	179,967	99,000	53,400
10-49 acres . . . . do.	635,824	354,200	198,000
50-99 acres . . . . do.	542,157	277,200	168,200
100-139 acres . . . . do.	324,543	204,600	103,700
140-179 acres . . . . do.	308,104	162,800	100,600
180-219 acres . . . . do.	191,199	162,800	122,600
220-259 acres . . . . do.	164,151	121,000	72,300
260-499 acres . . . . do.	451,144	426,800	380,300
500-999 acres . . . . do.	210,378	233,200	199,600
1,000-1,999 acres . . . . do.	84,971	96,800	97,400
2,000 acres and over . . . . do.	60,173	61,600	75,400

of States and (b) the apparent smoothing over time of the distribution toward an exponential-type curve for other States. This tendency toward stability suggests a number of useful analytical and predictive applications. The projection of future size distributions is one example. The stability also suggests that a certain amount of determinism may exist in the distribution of land, conditioned on the initial distribution. Perhaps this may hold also for other forms of wealth. Finally, it may be possible to use the technique to evaluate the impact of exogenous factors, such as farm programs, on the size distribution of farm numbers.

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Estimating Production Potentials of Agricultural Areas[1]

By James O. Wise and Harold B. Jones, Jr.

Variations in individual farm characteristics and behavior of farm operators are taken into account in a procedure for estimating production potentials of agricultural areas. The procedure combines sampling and programming techniques. It differs from the purely synthetic approach, or the representative firm approach, in that the programmed or budgeted results are adjusted for changes in individual farm situations on the basis of the socioeconomic characteristics of individual farmers and their resource base. Aggregate output is shown by a case study to be influenced by variables other than those normally included in budgeted linear programming models.

Key words: Production potentials; estimates; linear programming; aggregate supply; sampling.

Possible variations in individual farm characteristics and the behavior of farm operators continue to be important when analyzing aggregate output for an agricultural area. The relationship between individual behavior and aggregate output is important when considering ways of improving individual farm income, the economic development of agriculture and agribusiness in an area, and possible improvements in agricultural policies and programs. Much of the current work in supply response does not adequately consider individual farm characteristics and firm interdependencies as a part of the aggregation and estimation procedure. Instead, the emphasis has been on analysis of firms with typical or representative sets of homogeneous resources. Since individual differences in managers and resource mixes do in fact exist and are explanatory variables in firm behavior, the absence of them in our models results in biased estimates. This bias has recently been examined by Barker and Stanton (*1*),[2] Frick and Andrews (*3*), Lee (*4*), Miller (*5*), Sheehy and McAlexander (*6*), and Stovall (*7*), among others.

Many current methods of estimating production potentials also lack adequate procedures for estimating statistical error terms for aggregate figures. This deficiency occurs mainly because of the nature of the representative firm approach in which results are based on synthesized coefficients and restrictions rather than on observation of actual farms. Thus, there is no way to compute error terms by the usual statistical techniques.

The primary objective of this article is to present a method for improving the realism and accuracy of our estimates of production potentials. The procedure could also be used to develop better information for decisions on agricultural adjustment problems in local areas. Basically the methodology described is a combination of area sampling and linear programming. In addition to providing individual farm output and aggregate supply estimates, the method allows for (1) specifying individual farm resource quantities and qualities, alternative enterprises, constraints imposed by personal characteristics of farm operators such as age, health, education and preferences, and constraints due to firm interdependencies; (2) adjusting the aggregate results obtained from optimal farm solutions for past practices and production patterns due to individual behavioral patterns of farmers; and (3) estimating error terms and ranges of error for aggregate supply estimates. The procedure presented here is illustrated by an application to an agricultural county. In this particular application, estimates were made of resource requirements and use, incomes, and production for two situations: (1) The prevailing situation with current technology, and (2) the potential situation with improved technology and three assumptions about the future number of farms.

[1] The empirical results in this article are taken from the senior author's Ph.D. dissertation submitted to North Carolina State University.

[2] Italic numbers in parentheses indicate items in the References, p. 99.

Procedure and Results

The general procedure used, with illustrative results, was as follows:

(1) An area sample was taken to provide basic data for the analysis. The sample was designed as a stratified random sample with proportional allocation to the strata. The county was divided into four strata on the basis of soil types and kinds of enterprises produced. A sample unit size of approximately 15 occupied dwelling units was selected so that the interdependency of the various farm units could be studied. For example, this sample unit size permitted the observation of labor movements among farms, the availability of rented land, etc. Out of a total of 244 sample units in the county three units were drawn from each stratum for a total of 12 units. This resulted in a sample total of 102 farm units and 269 families.

(2) County estimates of resources available, farm production, incomes, and other characteristics were made for the situation at the time of the survey. Data from the sample were supplemented with data from secondary sources when necessary.

(3) Linear programming and budgeting techniques were used to determine optimum long-run plans for each farm in the sample, assuming improved levels of technology. There were three assumptions with respect to future farm numbers:

(a) Assuming existing numbers of farms and resources.

(b) Assuming that 25 percent of the farm families either retire or obtain nonfarm opportunities and that the remaining farm units are combined into larger units.

(c) Assuming that 50 percent of the farm families leave farming and that the remaining farm units are recombined into larger units.

The choice of families who would presumably retire or accept nonfarm employment was based on the household head's age, tenure status, capital position, education, nonfarm experience, preferences, and farm income. Generally, the procedure used resulted in those families with household heads 60 years of age or older retiring and those who would have a better opportunity in nonfarm employment leaving agriculture. Thus, younger families without much farm experience or capital investment were assumed to accept other opportunities. These assumed shifts are consistent with actual migration patterns.

After reducing the number of families, the land and other resources of these farms were combined to form larger farm units, or in some instances the procedure simply resulted in less labor per farm due to a reduction in the number of tenants or hired workers. In recombining land and other resources, consideration was given to geographic proximity, interdependencies of farms with respect to land, labor, and other resources, and to the family characteristics mentioned above such as age and health.

Table 1 shows some of the characteristics of the farm household heads and the results of applying the criteria and procedures to the farms in one of the sample units. Complete information such as that presented in this table is essential if the complexities of firm behavior and their consequent effects on area production potentials are to be adequately analyzed. Data of this type are also essential in the evaluation of nonfarm opportunities or policy alternatives.

(4) The results from step 3 were extrapolated to the county level by two methods. The first method recognizes that potential production is related to past production because of traditional patterns of behavior, nonmonetary incentives, and risk aversion. Enterprise aggregates by this method were obtained by adjusting the linear programming results by the amounts of the actual enterprise in the sample and the county at the time of the survey. Estimates by this procedure, referred to as ratio estimates, were obtained by using the following formula:

$$(1) \qquad ECA = \frac{\sum_{hi=1}^{n} Y_{hi}}{\sum_{hi=1}^{n} X_{hi}} T_x$$

where ECA = estimated county aggregate total; Y_{hi} = the totals for a given enterprise in a sample unit obtained from programming (where h = a particular stratum and i = a particular sample unit); X_{hi} = the sample unit values for a given enterprise which were actually produced at the time of the survey, and T_x = the actual population or county total for a given enterprise at the time of the survey.

This procedure for "weighting" potential production by past output increases the accuracy of our estimate, compared with estimates based purely on profit maximization procedures. In cases where new enterprises were being considered or past production data were not complete for other reasons, the following alternative formula was used:

$$(2) \qquad ECA = \frac{N}{n}(t) = \frac{244}{12}(t) = 20.333(t)$$

where N = the total number of sampling units in the county; n = the number of sampling units in the sample;

Table 1.—Characteristics of farm household heads and estimates of farm income and total farm acreage, survey and programmed situations 2 and 3, sample unit

Farm		Characteristics of present resident								Acreage and income per farm[1]					
					Nonfarm experience					Survey		Situation 2		Situation 3	
Ident. No.	Tenure	Age	Education	Health	Type	Status[2]	Ownership status[3]	Opportunity cost of labor[4]	Interests	Size of farm	Net farm income	Size of farm	Net farm income	Size of farm	Net farm income
	Yrs.	*Yrs.*	*Yrs.*					*Dol.*		*Acres*	*Dol.*	*Acres*	*Dol.*	*Acres*	*Dol.*
1	NR	61	9	Fair	Fertilizer dealer	A	O	NR	NR	544	7,416	467	6,690	467	6,095
2	NR	24	3	Fair	NR	C	t	NR	Prefer farm	–	2,757	–	3,347	–	4,222
3	2	54	7	Fair	NR	C	t	NR	NR	–	2,410	–	5,533	–	–
4	1	35	9	Good	Mechanic	B	t	400	Mechanic	–	2,717	–	3,782	–	–
5	5	51	7	Fair	Brickyard	B	t	([5])	NR	–	2,315	–	4,316	–	5,546
6	16	42	13	Good	Fishery	A	O	NR	NR	408	10,181	467	6,983	467	8,424
7	10	48	8	Good	NR	C	t	NR	Farm	–	3,127	–	4,051	–	5,889
8	2	25	7	Good	Fishery	B	t	250	NR	–	1,954	–	4,647	–	–
9	2	24	5	Good	Sheet metal shop	B	t	360	Factory	–	2,052	–	–	–	–
10	1	25	9	Good	Peanut factory	B	t	320	Construction	–	1,827	–	–	–	–
11	14	47	7	Fair	NR	C	t	NR	NR	–	1,902	–	5,981	–	–
12	18	54	12	Good	Merchant	A	O	NR	Merchant	69	2,453	–	3,142	69	2,598
13	18	50	5	Good	Sawmilling	B	t	NR	Farm only	–	2,087	–	3,172	–	5,314
14	9	48	10	Fair	NR	C	O	NR	Farm	84	4,484	97	6,922	69	6,360
15	NR	56	10	Fair	Carpenter	B	O	NR	NR	54	3,971	54	5,214	252	9,416
16	15	31	9	Fair	NR	C	O	300	None	40	2,675	60	5,314	69	6,360
17	32	54	8	Poor	Construction and garage	B	t	NR	NR	200	2,052	200	7,789	–	–
18	4	29	12	Good	None	C	t	NR	NR	–	2,052	–	–	–	–
19	6	40	6	Good	None	C	L	NR	NR	–	–	–	–	–	–
20	3	51	11	Good	None	C	O	NR	NR	270	7,777	249	7,008	249	4,227
21	4	28	6	Good	Fishery	B	t	320	NR	–	2,216	–	4,932	–	–
22	8	38	4	Good	None	C	t	NR	Farm only	–	3,293	–	4,469	–	5,869
23	2	39	6	Poor	None	C	t	250	None	–	1,866	–	–	–	–
24	12	40	5	Good	None	C	t	340	NR	–	2,145	–	4,998	–	–
25	4	25	6	Good	Logging	A	L	NR	NR	–	–	–	–	–	–
26	30	71	4	Good	None	C	O	NR	Farm	285	7,594	249	4,127	249	4,531
27	11	51	4	Good	None	C	t	NR	NR	–	2,379	–	6,317	–	–
28	10	51	4	Poor	Peanut factory	B	t	260	Peanut factory	–	2,088	–	–	–	–
29	5	51	4	Good	NR	C	t	NR	Farm only	–	2,259	–	4,541	–	5,565
30	7	36	0	Fair	Logging	B	t	NR	NR	–	1,356	–	6,458	–	–
31	38	40	10	Good	Electrician helper	B	O	300	Shipfitter	100	5,847	97	3,805	121	5,544
32	4	28	6	Fair	None	C	t	NR	Prefer farm	–	1,579	–	4,566	–	5,476
33	20	56	11	Poor	Merchant	A	O	NR	Farm	73	2,390	60	1,979	121	4,084
34	1	40	6	Good	None	C	O	NR	Farm	–	1,915	–	4,235	–	6,936
35	4	43	8	Good	Carpenter	A	R-t	([6])	NR	–	–	–	–	–	–
36	9	35	12	Good	Merchant	A	R-O	([6])	Merchant and buyer	–	–	–	–	–	–

[1] Situations 2 and 3 represent 25 and 50 percent reductions in the number of farm families, respectively. Differences in acreage occur because (1) farms may be combined when families leave the farm and (2) similar farms were averaged together before programming. Dashes indicate no acreage or zero income from given enterprise situation.

[2] A = Presently in indicated nonfarm employment, B = at least 1 year previous experience in indicated nonfarm employment, C = not applicable or none.

[3] O = Owner, t = tenant, L = Laborer, R-t = rural resident-tenant, R-O = rural resident-owner.

[4] Monthly take home pay required by husband and wife before they would leave the farm.

[5] According to living costs.

[6] Now working off farm.

Note: NR = not reported or nonresponse.

and t = the sample total of the item being estimated. The sample totals for the various items were obtained by summing the linear programming results of the individual farms in each of the situations.

Standard error estimates were computed for each enterprise total estimated by the first procedure shown above. The following formula was used in computing the standard errors (2):

$$S.E.(t) = \sqrt{N_h^2(1 - f_h)\frac{\sum s_h^2}{n_h}}$$

where t = the sample total of the enterprise being estimated, N_h = total number of sample units in each stratum, f_h = the sampling rate in each stratum, n_h = number of sample units actually drawn in each stratum for the sample, and s_h^2 = the variance for a given enterprise for each stratum and is estimated by the following formula:

$$s_h^2 = \left(\sum Y_{hi}^2 - 2\hat{R}\sum Y_{hi}X_{hi} + \hat{R}^2 \sum X_{hi}^2\right),$$

where

$$\hat{R} = \frac{\sum_{i=1}^{n} Y_{hi}}{\sum_{i=1}^{n} hi}$$

Confidence intervals were then calculated at the 95

Table 2.—Enterprises at the time of the survey and in three programmed situations, county level

Item and unit	Survey situation	Programmed situations[1] 1	2	3
Tobacco . . . . acres	7,250	6,700	7,200	6,600
		[2](481)	(642)	(1,369)
Confidence intervals . . . . . do.	–	5,774-7,626	5,916-8,484	3,862-9,338
Cotton . . . . do.	6,210	0	0	0
Corn . . . . do.	33,500	4,100	20,400	62,600
		(2,886)	(12,645)	(11,101)
Confidence intervals . . . . . do.	–	0-9,872	0-45,690	40,398-84,802
Peanuts . . . . do.	26,200	26,000	24,800	17,200
		(3,820)	(4,151)	(1,313)
Confidence intervals . . . . . do.	–	18,360-33,640	16,498-33,102	14,574-19,826
Soybeans . . . . do.	6,900	0	0	5,044
Sweetpotatoes . . . . . . do.	425	0	1,026	0
Oats . . . . do.	500	0	0	0
Oats-soybeans . . . . . . do.	0	43,600	36,500	4,900
		(7,007)	(13,647)	(5,089)
Confidence intervals . . . . . do.	–	29,586-57,614	9,206-63,794	0-15,078
Beef . . . . head	[3]2,047	0	0	0
Hogs . . . . do.	39,650	457,792	206,867	12,830
Pasture and hay . . . . . . acres	7,809	19,024	8,274	513
Temporary grazing . . . . . do.	0	11,890	6,206	384

[1] Situation 1 represents all farms as they existed at the time of the survey. Situation 2 represents an assumed 25 percent reduction in the number of farm families. Situation 3 represents an assumed 50 percent reduction in the number of farm families.

[2] Numbers in parentheses are standard errors of the estimates.

[3] Breeding stock.

percent significance level by the following formula:

$$Y \pm u\ .95\ (S.E.(t))$$

where Y = estimated county aggregate, u .95 = value of u corresponding to the 95 percent significance level, and $S.E.(t)$ = standard error of the total.

Table 2 shows the results of applying the above method. The value of having estimates of error is illustrated by looking at the tobacco enterprise. Even though the acreage estimates from the survey situation appear to be different from those in the programmed situation 3, we find that when sampling error is considered they are not significantly different. Thus, we project no change in the production of tobacco, whereas with other methods we would have projected a decline. Although not shown here, results of this procedure provide individual optimum farm plans, individual and aggregate resource requirements and use, and individual and aggregate farm income estimates.

Summary and Conclusions

The need for reliable estimates of individual firm and aggregate production response continues to be a major concern for agricultural economists. It is recognized that the key to estimating production potentials depends on the characteristics of the individual farm and the behavior of the farm manager. Yet the complexities that arise when we attempt to consider individual behavior in aggregate production estimates continue to be a challenge.

The sampling and programming procedure developed in this study enables us to take account of some of the complexities of individual firm behavior. Consideration was given to past production patterns, individual farm resource situations, and the personal characteristics and preferences of the individual farmer. Thus, the constraints, alternatives, and coefficients appropriate to individual farms are more completely defined. When properly designed and implemented, the method used should help reduce the aggregation bias, discussed by Barker and Stanton (*1*), which arises when resource situations rather than managers are assumed to respond to economic stimuli. The use of observed data from a sample of actual farms enabled us to deal with the bias resulting from inadequately representing technical coefficients and resource situations by the representative firm method, a problem which Stovall (*7*) has suggested is more serious than other sources of error. The sampling procedure used in this method permits the estimation of the magnitude of error in our estimates arising from the fact that we are not observing the whole population. The critical nature of the magnitude of error in our estimates is widely recognized, but it cannot be estimated by the representative firm approach.

Sample design and size are of critical importance in determining the accuracy and cost of this method. In this application, the sample size was designed to give a high degree of accuracy for a small geographic area, which resulted in a relatively high cost. However, the required sample size and the degree of accuracy are a function of the purpose of the study. For example, when estimating the production potential in a given area for a crop for processing, the accuracy of the estimate would be extremely important. However, if policy alternatives were the main objective, a larger error in the estimates may be tolerated.

Modifications of the approach used in this study are also a function of purpose. One approach that would be especially beneficial is that of incorporating dynamics into the system. This could be achieved, as Barker and Stanton (*1*) suggest, by using a combination of recursive programming and a producer panel. Such a system would provide researchers an opportunity to study how producers actually behave under changing economic and technological conditions, and it would also givc us an opportunity to apply and modify analytical models which indicate how firms ought to behave, given their goals. In addition, this system could be a useful educational tool for extension economists. Modifications to the approach presented in this paper must obviously be made on an individual project basis after consideration of the purpose of the study; the time, cost, and accuracy constraints; and the indirect benefits such as those from an extension educational program.

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Hospital Sizes for Rural Areas When Patient Arrivals Are Poisson Distributed

By Clark Edwards and Neville Doherty[1]

This study applies the logic of queuing theory to the availability of hospital services in a rural-oriented, multicounty planning district in northwestern lower Michigan. The seven hospitals in the area had 611 beds and provided services for 489 patient-days in 1 year. The study found that the seven hospitals apparently cooperate with one another, at least partially, in providing services, because if they operated independently they would not have sufficient capacity for peak loads. The observed number of beds, which is about 5.5 standard deviations above the expected number of arrivals, is almost certainly adequate for peak loads if the hospitals cooperate fully.

Key words: Rural development; rural and health services; health facilities; statistical methods.

In rural areas, difficulties related to distance, sparse population, interjurisdictional rivalries, and low average incomes create problems in delivering certain community services. As a consequence, services that might feasibly be delivered efficiently to residents of a multicounty area by a single organization are frequently divided among several. This results in higher costs and poorer services than might be attained. Delivery of hospital services is an example. Below, we illustrate a method of appraising the availability of hospital services to residents of an eight-county, rural-oriented area in the northwestern portion of lower Michigan.

The study area is called the Grand Traverse Region. The counties are Antrim, Benzie, Crawford, Grand Traverse, Kalkaska, Leelanau, Missaukee, and Wexford. The area was selected because it forms a readily identifiable geographic and economic region functioning as a relatively closed trading and commuting area.

The region, with a population of 110,000, depends on fruit farming and tourism for most of its economic activity. It has some manufacturing in its main towns, Traverse City and Cadillac. Traverse City is the region's health services center. One of the region's six general hospitals and an osteopathic hospital, as well as a State psychiatric hospital, are located there. The psychiatric hospital was not included in the study.

In general, the region evinces an air of apparent prosperity, but behind this front lie many typical rural problems: Low incomes, high unemployment, high proportions of old people, and emigration of young people.

Grand Traverse County contains two hospitals. Benzie, Crawford, Kalkaska, Leelanau, and Wexford each have one. And Antrim and Missaukee have none. Occupancy rates in the five larger hospitals were close to 80 percent in 1967 (table 1, col. 3). An average of 80 percent of the beds in use during a year is considered by many hospital planners as about optimal. A higher average occupancy rate might indicate inadequate emergency capacity. The two smaller hospitals in Kalkaska and Leelanau had occupancy rates of 58.3 percent and 66.1 percent respectively. Kalkaska's hospital, which had 20 beds and 4,259 patient-days, needed only 15 beds to obtain the 80 percent occupancy rate; Leelanau's, with 29 beds and 6,995 patient-days, would have had an optimum rate with 24 beds.

This criterion suggests that there were possibly 10 excess beds in the region in 1967, five in each of the two small hospitals in Kalkaska and Leelanau. These 10 excess beds are a small number from which to draw conclusions about underutilization. Moreover, the simple criterion used above implies that the preferred rate of occupancy is independent of hospital size. An alternative criterion used below suggests that small hospitals require more excess capacity than large ones.

[1] The application of Poisson analysis developed in this article was used by Doherty in the section on optimal hospital size in: Efficiency in the distribution and utilization of hospital services: A case study in rural Michigan. U.S. Dept. Agr., (unpublished).

Table 1.—Hospital size and occupancy rates, Grand Traverse Region, 1967, with comparisons

County with hospital	Actual				If each hospital operated independently		
	Beds (1)	Patient-days (2)	Occupancy rate (3)	Mean patient-days (4)	Probability of overflow with actual beds (5)	Needed beds[1] (6)	Implied occupancy rate (7)
	No.	*No.*	*Pct.*	*No.*		*No.*	*Pct.*
Benzie	43	12,342	78.6	34	0.0618	57	59.3
Crawford	68	20,561	82.4	56	.0526	86	65.2
Grand Traverse:							
General	250	73,730	80.8	202	.0004	259	78.0
Osteopathic	73	22,643	85.0	62	.0808	93	66.3
Kalkaska	20	4,259	58.3	12	.0104	26	46.4
Leelanau	29	6,995	66.1	19	.0110	36	52.1
Wexford	128	37,946	81.2	104	.0094	145	71.8
Total	611	178,476	80.0	489	–	702	69.7

[1] Calculated as: $m + 4\sqrt{m}$, see text, to reduce probability of overflow to less than .0001.

Sources: Hospitals, Jour. Amer. Hospital Assoc., Vol. 42, Aug. 1968; Michigan State Plan for Hospital and Medical Facilities Construction, Mich. Dept. Public Health, Lansing, 1968-69.

If each of the seven hospitals in the multicounty area functions as an independent unit, it must have sufficient capacity in terms of staff and equipment to handle its own peak load. For example, the general hospital in Benzie County had 43 beds and 12,342 patient-days in 1967 (table 1, col. 1 and 2). The expected number of patients on a random day was 34 (table 1, col. 4). If the arrival of patients is distributed by a Poisson distribution, then the probability of having *n* patients on a given day is

$$P_n = \frac{m^n e^{-m}}{n!}$$

where *m* is the expected number of patients. A Poisson assumption is appropriate when arrivals are distributed independently over time and we are concerned with the total number of arrivals during a time interval. That is, when we assume the probability of an arrival on one day is the same as the probability for any other day and is independent of the number of arrivals on a previous day.

The variance of the Poisson distribution is equal to the mean. Hence, for the Benzie County hospital, the mean number of patients is

$$m = 34$$

and the standard deviation is

$$s = 5.8$$

When *m* is large, the Poisson distribution is approximated by a normal distribution.[2] Hence, for the Benzie County hospital operating as an independent service center, we can expect between 28 and 40 patients two-thirds of the time. The 43-bed hospital has a capacity which is 1.54 standard deviations above the mean. Given the assumptions, we can expect the number of arrivals to exceed 43 patients with a probability of .0618 (table 1, col. 5). This indicates overcrowding possibly once every 2 weeks; it does not allow much safety margin. To insure that the number of arrivals does not exceed the number of beds more than once every 3 years or so, we would want to provide 51 beds, a capacity about three standard deviations above the mean. Four standard deviations extend the period to 30 years. Using four deviations, the Benzie County hospital would require 57 beds instead of 43 (table 1, col. 6). It would then have an occupancy rate of only 59 percent instead of 79 (table 1, col. 7).

Extending the analysis to all seven hospitals, we see that the needed number of beds in the eight-county area is 650 if each hospital operates independently, and if its capacity is such that the number of arrivals exceeds the number of beds only about once in 3 years for each hospital; or, 702 beds are needed as insurance against

[2] Feller, W. Probability theory and its applications. John Wiley and Sons, Inc., New York, 1950, p. 143-144.

overcrowding once in 30 years (table 1, col. 6). Either of these are more than the 611 beds available in 1967. A bed capacity four standard deviations above the mean for each hospital would result in an average occupancy rate of only 70 percent for the area as a whole (table 1, col. 7). This suggests that the seven hospitals do not operate independently; that efficient utilization of available facilities is gained by sharing services among hospitals in the commuting area. The general hospital in Traverse City is most likely to be able to function independently according to the probabilities in column 5 of table 1. It has the least likelihood of overflow. The most dependent hospitals in this sense are the osteopathic hospital in Traverse City and the general hospitals in Benzie and Crawford counties.

A widely held view in hospital planning is that hospital costs would be lower if there were greater cooperation among hospitals in the same area with a given population. Because maximum patient demands are unlikely to occur in all hospitals at once, the census for a group of hospitals functioning as a unit, or for a single large hospital, would vary less than for smaller independent hospitals. That is, fewer beds would be needed in the unit concept to provide the same level of protection as could be provided with a given number of beds in several independent hospitals.[3] As independent units, each hospital must have the capacity, in terms of staff and equipment, to handle its own maximum load. In cooperation, however, all hospitals are open to all patients and practitioners, and consciously avoid unnecessary duplication of services and equipment. Large hospitals tend to offer more services than small hospitals. For many of these services the small hospital is an unsatisfactory substitute. But there are other services which can be adequately provided at both large and small hospitals. With full cooperation, each hospital requires less staff and equipment, compared with independent hospitals, because patients could be transferred to other hospitals in emergencies or for specialized treatment.

In the Grand Traverse region, the implications of cooperation for bed saving are as follows: The average daily census in the region's hospitals in 1967 was 489 patients. With the assumption that the demand for hospital facilities has a Poisson distribution, a single large hospital, or a group of fully cooperating hospitals, with 577 beds ($489 + 4\sqrt{489}$) would meet expected needs with the probability of less than .0001 that demand would exceed 577 on any given day. The expected occupancy rate would be 84.7 percent. The actual number of beds in the region was 611, indicating 34 excess beds in 1967 by this criterion. This suggests that full cooperation among the seven hospitals could safely allow a modest reduction in plant and equipment.

We infer it is almost certain that the number of hospital beds in the Grand Traverse multicounty area is adequate to meet patient needs providing the hospitals cooperate fully, because the observed number of available beds is about 5.5 standard deviations above the expected number of arrivals. The analysis suggests that under the assumption of full cooperation, these seven hospitals may be paying a little more for capacity than they need to. They could have 34 fewer beds and an occupancy rate of around 85 percent compared with the observed rate of 80 percent and still have a very small probability of being overcrowded. A defense of the current capacity could be in terms of (1) the high cost of crowding in the sense that 5.5 standard deviations provide a more adequate safety margin than 4 deviations, or (2) the cost of full cooperation, which might be more than the cooperation is worth. We also infer that the hospitals must necessarily cooperate at least partially to take care of the local demand for hospital beds, otherwise there would not be enough bed capacity in the area to take care of emergency needs during peak loads.

The method used to appraise the availability of hospital services in the Grand Traverse multicounty area

[3] Long, M. F. Efficient use of hospitals. In: Economics of Health and Medical Care, Univ. Mich., 1964, p. 214.

Table 2.—Hypothetical optimal hospital sizes for alternative expected patient-days[1]

Patient-days	Required beds[2]	Occupancy rate
	No.	*Pct.*
1	7	14.3
5	16	31.3
10	24	41.7
15	32	46.9
20	37	53.5
50	77	64.6
100	139	72.0
200	255	78.5
300	367	81.7
400	478	83.8
500	587	85.2
1,000	1,123	89.1

[1] Optimal means the probability that the number of arrivals exceeds the number of beds is .0001. For the normal distribution, this is calculated as: $m + 3.88 \sqrt{m}$; see text.

[2] From cumulative Poisson distribution tables for 1 to 15 patients per day. From cumulative normal distribution tables for 20 to 1,000 patient-days.

can be used to appraise the availability of other kinds of community services to residents of rural areas. There are many community services for which a rural-oriented, multicounty planning district needs only one facility such as a public building, a community college, a shopping center, or an industrial park. Dividing a commuting and trade area into isolated markets with separate facilities may be less efficient than letting all residents of the area function as a single market using a single facility. The method would apply to a single facility for an area, providing the demand for use of the services may be assumed to be independently distributed over time. (A service for which demand is not independent is snow plowing.) The general principle involved is an aspect of economies of scale and of the kind of efficiencies associated with agglomeration. One source of service for all the customers in an area has economies not available if the market is divided into two or more sectors each with its own service channel. This is a well-known conclusion from the queuing theory problem; it deserves to become a widely applied principle of area development.

Table 2 illustrates the extent to which economies of scale are attained. If a hospital expects an average of only one patient per day when arrivals are governed by the Poisson distribution, seven beds are needed to insure that the arrivals will exceed capacity only once in 1,000 chances. The occupancy rate in this extreme case is only 14 percent.

The data in table 2 are taken from a table of cumulative probabilities for the Poisson distribution for values from 1 to 15. The data for values from 20 to 1,000 were taken from probability tables for the normal distribution. To maintain comparability of calculated probability of .0001 throughout table 2, the required number of hospital beds is calculated to be 3.88 standard deviations above the expected number of patients. Notice that as the size of the delivery system expands to handle a mean of one to 1,000 patients per day, the occupancy rate rises from 14 to 89 percent. The norm of 80 percent occupancy frequently used in hospital planning is seen from this analysis to be optimally associated with a hospital of 301 beds handling an average of 241 patients per day. Lower occupancy rates should be expected for smaller independent hospitals, higher rates for larger ones.

BOOK REVIEWS

Markets, Prices, and Interregional Trade

By R. G. Bressler, Jr., and R. A. King. John Wiley & Sons, Inc., New York. 426 pages. 1970. $13.95.

Professors Bressler and King have written a first-class textbook. But this journal does not review texts. For a discussion of its merits in serving its primary purpose, the reader is referred to other scholarly journals. In keeping with the orientation of this journal toward research, this review deals only with the research-related questions which are discussed in the final chapter.

After a discussion of the efficiency of marketing firms and industries, which draws heavily on the approach of M. J. Farrell, the authors give us a viewpoint on research in market organization. They decry the plenitude of market structure studies which engage in the "numbers game" in an attempt to reach conclusions about desirable policy on the basis of concentration ratios or changes therein. They voice strong doubt that one can reach useful conclusions about the performance of marketing systems solely on the basis of inferences from concentration ratios. They urge an alternative approach in which performance is studied directly. If the investigator then finds less-than-optimal performance, he would investigate the structural characteristics of the industry, in particular the institutional factors that might properly be called "structure."

They would measure performance in two dimensions: (1) Productive efficiency, and (2) pricing efficiency. The important measures of productive efficiency are (1) the "load" factor, or the amount of excess or unutilized capacity, and (2) the "scale" factor, the extent to which firms and/or plants are organized to take full advantage of economies of scale. Pricing efficiency is to be measured by comparing actual prices with those generated by an efficiency model which comes from the theory of the perfect market in space, form, and time. They urge that such models "can often be used to spot distortions in pricing performance."

While Bressler and King have not attempted to give us a complete prescription for economic research in the marketing of agricultural products in the course of one short chapter, they have strongly urged a point of view that comparisons of "ideal" marketing systems, based on the perfect market in space, form, and time, with the performance of the existing marketing system is the most productive route for marketing research. Certainly, one cannot quarrel with the general proposition that such an approach is often useful and often the only available approach. However, a piece of advice to which this reviewer would give more weight than do our authors is that one should be equally alert for the opportunity to make comparative studies of the performance of marketing systems where the key structural variables (including the institutional factors) vary significantly. In such studies, one would look for differences in performance accompanying differences in the internal structure of the industry and the institutional framework.

Their discussion of the efficiency of marketing systems omits one major aspect which has come increasingly into prominence as the environmental urge has swept the Nation. This has been called "social efficiency" and revolves around the question of externalities. One presumes that if Bressler and King were writing such a chapter today they would include some mention of these matters. Measures of the incidence of the costs of pollution are quite possible these days and should certainly be considered as important aspects of the performance of any production and marketing system.

The proposed measures of productive efficiency present considerable difficulties. The existence of unused capacity is extremely difficult to identify and measure. So many arbitrary decisions are required to make measurement possible that the results become highly suspect. For example, when does capacity cease to exist—when the plant is closed? When it is dismantled? Evaluation of the performance of a marketing system in terms of excess capacity is not unambiguous. If a new, technologically modern plant is built and takes volume away from a number of older, less modern plants, thus creating excess capacity, is the result to be judged as an improvement in performance?

While the definition of the scale factor refers to both plant and firm economies of scale, the discussion covers only plant economies and is limited to physical production processes. This, of course, reflects the ability of the profession to quantify scale economies, but many observers are firmly convinced that the economies of scale of the firm are much more important than those of the plant and that the neglected nonproduction aspects are the most important. A. C. Hoffman, who has had more opportunity to observe such matters than most economists, is most eloquent on this topic. It is clear that the matter is important, that agricultural economists have neglected it, and that further continued neglect will involve serious error.

Alden C. Manchester

Toward Policies for Balanced Growth

Edited by Donald L. Nelson. Graduate School Press, U.S. Department of Agriculture, Washington, D.C. 88 pages. 1971. $2.75.

E. J. Mishan concluded a recent essay with the following words: "The more 'affluent' a society becomes, the less important is allocative merit narrowly conceived. And in any society in the throes of accelerating technological change. . .complacency on the part of any economist, guided in his professional decisions by considerations alone of allocative merit or economic growth potential, is both to be envied and deplored." (E. J. Mishan, "The Postwar Literature on Externalities: An Interpretative Essay," Jour. Econ. Lit., Vol. 9, No. 1, p. 1-28, Mar. 1971.)

This booklet carries the reader past the purely allocative framework into the equity arena. It draws the line for debate on the concept "balanced growth," which turns out to be population and employment distribution despite protests of some of the participants. The material consists of a series of speeches sponsored by the USDA Graduate School. Topics are the need for action, population balance, regional development resources and technology, and the place of the citizen.

But when the practicing economist steps into the arena of equity, he is immediately confronted by the "political bulwark." Anthropologists would term it institutional inertia. The bulwark is composed of an impervious constituency welded together by the conceptual paradigm of economic doctrine.

Debate of the innovative ideas and concepts contained in this material reveals the mortar which holds together the political bulwark protecting the status quo of an economic system and its auxiliary distribution of rewards. Indeed, the volume was meant to do just that: To debate the President's call for "the development of a national growth policy to bring balance and order to the great changes in population, industry, and patterns of education and training that would affect the quality of life in the decades ahead."

On the one hand, doctrinal anachronisms vaguely seep through. Foremost is the doctrine that what's happening must be for a good reason; that is, there is a functional reason for extreme urbanization forms. Another is the sanctity of the market. Yet another is the benefit-cost judgment someone else places on my preferences for quality-of-living attributes versus my tax dollar. At times we see statements not backed by facts, such as towns in America are dying or the continued attrition of farms will still be a drain on rural towns.

On the other side of the bulwark, the debate is kept alive by perceptive and knowledgeable discussants. Americans are so mobile that labor is a flow resource from the standpoint of any one town; and if the town can bundle opportunity along with quality of life, then people will gravitate to it. For the most part, rural towns have already attracted population in spite of a large loss in their farm support function. National programs have largely determined where population moved, but without a design. And access to national programs related to transportation, housing, banking, and health has been less than equal.

Success of an outright population distribution policy can't really be judged yet. Regional development has yet to be funded enough to provide a clue. Really innovative approaches are still sidelined. A sampling of ideas ranges from a differential regional individual income tax to a limit of city sizes, a broad range of grants, equality of access to Federal programs, and progressive rates for automobile and energy use in congested regions.

Various themes of a debate are noteworthy by their absence. National no-growth policies are absent, as are the materials balance and fiscal integrity models emphasizing that he who creates waste (cost) must arrange for its disposition (tax) within his political jurisdiction. Communities, each with different functions and quality, can be fostered to give citizens an opportunity for choice—a concept of planned diversity. Lastly, national programs were emphasized and regional differences in resource base and needs were overlooked.

So the debate will continue. Indeed, Dr. Paarlberg in his summary of the discussions said it should continue.

Lloyd D. Bender

Decline and Fall?—Britain's Crisis in the Sixties

By Paul Einzig. Macmillan, St. Martin's Press, New York. 244 pages. 1969. $7.50.

In his preface, Paul Einzig explains the question—"decline and fall?"—which he has posed for Great

Britain. Later in his book he explains that if Britain were to "fall," that is, disappear as an international force, it would be one of the outstanding mysteries of the ages as to how a major world power could disappear so quickly. Einzig goes on, however, to explain how this might be precipitated by economic factors.

The issue of fiscal crisis has intermittently plagued Great Britain for the last 50 years, but chroniclers have noted a significant deepening of this trend since World War II. Paul Einzig, one of the best of the chroniclers, dissects the British character through history and relates it to the current crisis. He makes a strong case for the argument that it is not the "wicked bankers or speculators, nor ultra conservative Treasury officials" who may bring back mass unemployment to Britain, but the British industrial worker and his union which will drive the country to this "suicidal course."

Throughout the book, Einzig speaks of his hopes for a national regeneration. He cautions that "gimmicks or remedies" aren't the answer, however, and the British will need to work hard, live within their means, and become public spirited once more. He notes that as the age of World War II becomes more remote, Britain cannot use the excuse of war-inflicted economic dis location to explain her current troubles. He cites the phenomenal economic regeneration of Western European countries, specifically Germany and France, as the proof of this proposition. France is cited to show that even a country losing its colonial dependencies is not consigned to economic insignificance.

He will not, however, place the blame for the sluggish British economy on strictly technological changes. Rather than take the easy approach of placing the entire blame on current capital shortages and obsolescence of existing equipment, Einzig says that what is now called for is a more productive use of existing capital to reduce inflationary pressures and make it possible to increase investment in modern equipment without placing undue pressure on sterling balances.

Einzig lays bare the truth that looming over the outward trappings and manifestations of prosperity and a booming economy in Britain is the shadow of further crisis and long-run fiscal disequilibria. He argues that increases in productivity are being "gobbled up" by labor as soon as they are created, instead of helping to build a greater long-run competitive advantage for the economy.

If trade unionism is the major culprit, Einzig indicts both of Britain's major political parties for only slightly lesser crimes in terms of their economic responsibilities. He thinks the Tories are only marginally less unfit to rule because of their greater tendency to be more "public-spirited." He points out that Harold Wilson tried to tread a path between needed tough economic policies and complete concessions to the trade unions. According to Einzig, Wilson tried for the best of both worlds and got the worst of both. Although the book was written in 1969, Einzig predicted the defeat of the Labour Party if it pursued the programs prevalent in 1964-68. It is ironic that the defeat came one year in advance of the expected general elections of 1971. Einzig believes that the Labour Party's insistence on disarmament and global policies that weaken Britain's financial, political, and military powers has ensured that she will not be in a position to enforce her views in the Vietnam war or in any other international political sphere.

Einzig has written an excellent book. Those who are interested in the problems of inflation and declining productivity in mature economies will find it particularly interesting. He is perhaps too pessimistic about prospects for the future of the British economy and society. He hedges his bets in the preface, however, by noting that he has had the good fortune to witness Britain's national regeneration twice in his lifetime and if he were doomed not to witness a third, he would prefer being doomed in Britain than blessed anywhere else.

The United States and the rest of the world have a great stake in a "third regeneration" of Great Britain. Also, a world without Britain would be dull, indeed.

Dwight M. Gadsby

Politics and the Stages of Growth

By W. W. Rostow. Cambridge University Press, Cambridge, England. 410 pages. 1971. $9.50.

This book would make a perfect companion volume for a course on the process of economic development. Interesting summaries showing the political and economic histories of numerous countries with different paths of development are included. These are classic examples of clear, concise writing and are in themselves a useful research tool.

The author does a certain amount of behind-the-scenes explanation of policies that prevailed when he was a close adviser to President Johnson. As would be expected, Rostow has considerable commentary on the rationale for the war in Vietnam. Some of his comments are interesting, particularly in light of the recent publication of The Pentagon Papers. Partisan political sniping is largely absent.

Agriculture's role in economic development is discussed on several occasions. The author concludes that the failure of communism to stimulate agricultural production is the key liability of that system in providing economic development. He gives proper weight to the role which agriculture must play, but does not detail specific methods.

Regional summaries are provided concerning the varied development problems of Asia, Africa, and Latin America. The economic and political problems which beset each of these regions individually and collectively are discussed with reasons for specific success and failure in individual countries. This discussion is well reasoned and useful.

The last two chapters, one on war and peace and another entitled Politics and Democracy in the Contemporary World. . . , and particularly an appendix dealing with views of history with specific reference to the new left, stand apart from the main body of the book. While interesting, they do not fit any economic development study and should not be regarded as doing so.

One ERS economist (not the reviewer) suggested that a greater readership would be insured if this book had been limited to the 167 pages of his earlier study, *The Stages of Economic Growth*, rather than the present 360 pages plus notes. That may be so, but I think most of us can profit from *Politics and the Stages of Growth.*

John D. McAlpine

San Miguel: A Mexican Collective Ejido

By Raymond Wilkie. Stanford University Press, Stanford. 190 pages. 1971. $7.50.

Pioneer Settlement in Northeast Argentina

By Robert C. Eidt. University of Wisconsin Press, Madison. 277 pages. 1971. $15.

The theoretical yet ever practical Latin American problem of bringing together surplus populations and underdeveloped land are dealt with in the two publications reviewed here. Although Professor Wilkie is an anthropologist and Professor Eidt a geographer, both authors use a historical approach to introduce survey data and personal observation over an extended period—13 years in Mexico and 9 years in Argentina. The problems were apparently different in the two studies—one study is concerned with irrigated land given to a collective ejido (a type of communal landholding under Mexican land reform) close by the Mexican city of Torreon, and the other, with colonization of public and private land in the forested wilderness frontier of northeast Argentina. Both studies show that technological ignorance and lack of capital, linked with cultural and social patterns, determine the relative success or failure of such ventures; that success or failure must be judged in the context of contribution to national output, development of natural resources, and establishment of healthy, viable communities, as well as in the success and progress of the individual participants; and that alternative development opportunities in other urban and rural areas provide the new landholder a measure of his progress and affect his decision to remain or migrate again.

Only about 10 percent of Mexico's ejidos were set up as collectives. In this and in other ways, San Miguel is not representative, but for the same reason its study may be more valuable.

Early in San Miguel's experience, collective land was parcelized to increase work incentives by distributing income in line with effort. Cultivation of corn for subsistence was completely individualized; planting of cotton remained collectivized, but cultivation, irrigation, and harvesting were individualized.

More recently, as a result of wide variation in yields, ejidatarios (members of the ejido) demanded that each receive the yield from his own wheat plot. All marketing and cotton ginning, however, remain collectivized, as does ownership of machinery and transport.

San Miguel, more fortunate than many ejidos, took over productive land which was already under irrigation in 1936. Since ejido profits (in effect the land rent) provided them an adequate living, many ejidatarios hired labor to carry out their collective duties. Inmigration and a high birth rate combined to produce a large labor force, dependent on the product of the ejido but without a say in the economic or political organization. The ejido has not provided each peasant the right to the product of the land but, through sometimes extralegal means, the ejidatario has become the new landholding class, living off land rent while a largely disenfranchised new landless class has grown up waiting for a second land reform.

The collective ejido exhibits considerable flexibility and efficiency compared with the completely parcelized ejido. According to Wilkie, however, this flexibility has been restricted by the Government Ejido Bank's credit and technical assistance program. The familiar cost-price squeeze and population growth have sharply reduced profits and per capita income (the situation among Mexico's noncollectivized ejidos is not much different). To increase ejido income, greater flexibility in the Bank's policies is necessary.

The Argentine study also deals with the dynamic situation, comparing two styles of land settlement over a long period, in their rate of development and their maturity. Eidt finds the government's cadastral survey (damero), so effective on the pampas, unsuited to the hilly and even mountainous lands of the Misiones province; the square 25-hectare farms isolated the new colonists and made roads and other services more difficult and expensive to provide. He finds progress in the early stages of this type of colony unnecessarily slow. On the other hand, spontaneous settlement of public lands before government survey teams arrived resulted in European-type settlement patterns of long narrow lots, with settlers close together along the road; this provided greater community solidarity and a more rapid rate of development in early years. Without provision of land for the growth of villages or towns, such communities eventually faced the same private landholding barriers to logical development that are present in older, rapidly developing communities, as in the United States. Eidt's solution would be to reserve land for community purposes rather than allocate all land for private agricultural development.

Both these books are rich in insights into land reform problems that often evade the agricultural economist, whose viewpoint of "efficiency" of production may not recognize the second- and third-stage inefficiencies that sometimes follow the first-stage "efficiency" in the inherent dynamism of the resettlement process. In the face of new technology, traditional land reform concepts can provide only temporary solutions until the nonfarm sector is capable of absorbing agriculture's surplus labor.

Howard A. Osborn

The Water Resources of Chile—An Economic Method for Analyzing a Key Resource in a Nation's Development

By Nathaniel Wollman. Johns Hopkins Press, Baltimore. 279 pages. 1968. $7.50.

The main objective of the author was to formulate a methodology that could be adapted to a water development program in any developing country. Recognizing that progress toward the solution of major problems is often impeded by a lack of communication between physical scientists, economists, and policymakers, Nathaniel Wollman treats his subject in such a way as to narrow this gap.

While the inefficient use of water is not a priori more detrimental to an emerging nation's growth process than waste of land, labor, or capital, careful consideration is merited for other reasons. First, most future development will probably be financed by the public sector. Second, the public utility aspects of water supply lend legitimacy to state power over private property and hence offer an approach to agrarian reform. Finally, the geographic distribution of water resources narrows the range of interregional output possibilities in the framework of national growth.

The selection of Chile is fortunate for several reasons, not the least of which is availability of the "best" hydrologic data in Latin America, with the possible exception of Mexico. More important, perhaps, is the Chilean Government's continued interest in the rational exploitation of this resource.

Very long and narrow, this Andean country experiences a wide variety of climates ranging from extremely arid desert in the north to rainforest in the south. Less than 1 percent of the land in the northernmost water resource zone is cultivated, but the zone yields the bulk of Chile's foreign exchange from copper and nitrate mining. Proceeding south, mineral processing becomes important and agriculture is a primary activity. The next region, the "north central," is also a major agricultural center, in spite of being the most highly populated, with the cities of Santiago and Valparaiso. The province of Santiago has the greatest amount of irrigated land. Agriculture predominates in the "central central" region. North of this part of Chile, inadequate water supply is considered an obvious hindrance to economic growth. The southernmost "south central" zone has an abundance of water and if any problem exists, it is one of too much rather than too little.

Projected water use depends on the output of goods and services which have a water input. Assuming 2.4 percent and 5.5 percent rates of growth in population and GNP, respectively, sectoral outputs are projected through 1985. Demand for agricultural products is expected to expand 86 percent with an implied increase in irrigated land from 1.2 million to 216 million hectares. The ability to do this is not supported by the sector's past performance, and failure to expand output has meant spending scarce foreign exchange on agricultural imports. Even assuming that all irrigable land will be irrigated and all arable land cultivated, an increase in output per hectare of 50 to 100 percent is still needed to meet the 1985 demands. The other major uses of water considered are manufacturing, mining, thermal power, and municipal uses. Waste dilution requirements were computed for several treatment levels necessary to maintain a satisfactory dissolved oxygen content of streamflow.

Comparison of projected water requirements and average supply indicates that the provinces north of and including Santiago will be in a net deficit area. The agricultural sector will be responsible for 91 percent and 98 percent of total intakes and losses, respectively. This suggests that very small changes in the extent of irrigated agriculture can have a very large effect on the relative quantities of water available for other uses. The probability of being able to transfer water from agricultural to nonagricultural uses, without a reduction in irrigated area, is relatively low.

Three conclusions emerge: (a) The seasonal and annual variability of flows must be modified to avoid periods of shortage from the "central central" region south of Santiago north to Peru; (b) to bring water supply and demand into balance, streamflows will have to be regulated and northward basin transfer movements undertaken; (c) if these measures are not adopted, the only other way to meet projected outputs would be to increase agricultural productivity beyond that assumed above.

The range of choices regarding water use, as both land and water resources become increasingly scarce, is great. However, the author makes a final caution that if economic decisions are to be made, considerable efforts need to be expended in providing reliable data.

John Sutton

Symposium on Food Grain Marketing in Asia

By Asian Productivity Organization, Tokyo, Japan. 145 pages. 1971.

The Asian grain market is sure to receive considerable attention in the next few years. Two perspectives will dominate the interest of the U.S. student of markets. A traditional view considers Asia as a market for our grain. The emerging view considers the Green Revolution, no matter how pessimistic or optimistic one is about its magnitude, as generating market forces that could result in considerable trade in grain between and among Asian countries. The present volume, the proceedings of a 1970 Symposium of the Asian Productivity Organization (APO) in Tokyo, gives a taste of the latter perspective. Implications for U.S. exports are omitted from this review but their neglect should not obscure their existence or significance.

The stated purpose of APO, an intergovernmental regional organization with more than a dozen members, is to increase productivity and accelerate economic development of the region by multilateral cooperation. The publication serves the organization's purpose well. Mutual recognition of common problems often is a necessary prerequisite to lasting advancement. And the volume provides scarce information about fundamental aspects of marketing grain in some of the member countries. Still, like most proceedings issues, it is somewhat uneven and duplication is not entirely avoided. Neither does it pretend to answer the questions discussed.

Presentations address "Second Generation marketing systems that would sustain and assist First Generation production systems and efficiently utilize their output." Contributions are generally of two types: Some recite on the nature and extent of problems different countries face in marketing their grain, others demonstrate techniques for quantitatively evaluating markets and for assessing the probable impact of proposals designed to improve their performance.

Application of the techniques to the projected Second Generation problems was not accomplished at the conference, so is not in the proceedings. Completing this third step would provide valuable information for participants in the Asian grain market. The primary result would be an indication of the economic pressure for trade between Asian countries caused by various magnitudes of the Green Revolution. For example, each country could better evaluate whether to maintain its own buffer stocks or to participate in a joint venture where necessary reserves were at least in part carried by the market.

Generally the contributions provide a good benchmark for further work. An exception involves transportation, a significant cost in the marketing of grain. An early section presents "First Generation" information on what is paid to transport grain by road, rail, and water in the member countries. Little uniformity is shown in charges for the same mode in different countries and in charges for different modes in the same country. Such observations need description. if not rationalization. Some of the differences are likely to reflect policies being used to achieve national development goals. If so, planned "Second Generation" transportation systems need more explicit recognition in the development of "Second Generation" marketing systems.

The prospects for an Asian grain market, to summarize the feelings of some of the contributors, are accurately portrayed by the Venn diagrams on the cover of the present volume. The union of sets labeled Politically Acceptable, Technically Possible, and Economically Feasible is but a fraction of their individual domains. But that a union exists seems to me to be sufficient justification for an organization like the APO to address itself to identifying an efficient system of trade in grain for the region.

Bruce H. Wright

The Frontier Challenge: Responses to the Trans-Mississippi West

Edited by John G. Clark. University Press of Kansas, Lawrence. 307 pages. 1971. $10.

To someone suckled on Friday night horse operas and weaned on Saturday afternoon double features, the West is a peculiarly American place. The good guys may not have always won out there beyond the Platte and the Missouri, but they always had flair, and for better or worse, they were what the country was all about.

Myths like that turn into prejudices after a few years, and prejudices are not supposed to be the stuff of history. But they tend to survive, even if modified, and might as well be confessed if they can't be exorcised. My particular prejudice requires historians who write about the West to people their accounts with characters who are three-dimensional human beings, or at least more than digits in an academic analysis.

Ideally, of course, all history should be written that way. The majority is not, as members of the profession are fond of pointing out in periodic bursts of self-flagellation. Since most of us sin in about equal proportion, it is probably unfair to single out Western historians for special criticism. Nevertheless, I always find it especially disappointing to come across a treatment of the frontier that is more clinical than human.

This collection of 10 essays published in honor of George L. Anderson, late chairman of the University of Kansas History Department, is a solid, scholarly book that deserves the praise it will undoubtedly receive in the regular historical journals. The pieces, which deal with racial and economic aspects of Western settlement, are written by a distinguished group of authors. None of the included items are potboilers and several are unusually good in comparison with the run-of-the-mill academic essay.

Three in particular stand out. Earl Pomeroy's study of the role of Western cities in the settlement of the country puts a new perspective on the frontier story. Allan Bogue's treatment of the ways Kansans tried to attract capital to their State between 1865 and 1893 turns up some conclusions worth exploring in the context of other trans-Mississippi States. George Anderson's essay on the relationship between banks, mails, and railroads is a sorely needed analysis of institutional interrelationships, likely to please economists as well as historians.

In book review language, *The Frontier Challenge* is a "valuable contribution to the field." On the whole, it fulfills editor John Clark's promise to show something of the way people adapted to the new and constantly changing environment of the West.

The problem with most of these essays is that their literary style marks them as average historical efforts. And as Harvard's Oscar Handlin pointed out to the American Historical Association last year, the average historical effort has the impersonality of a competently edited laboratory report.

Style, Handlin remarked, is not just a matter of form. It is intricately involved in what the historian has to say. It indicates how well he understands the warp and woof of his subject, how sensitive he is to the complexities of the age he writes about—in short, how well he follows the dictum to read the sources until he can hear them talk. The trick is not just to analyze, but to inject imagination and empathy into the analysis and then communicate the results to the rest of humanity.

This is a hard task under the best of circumstances, especially if the findings have to be presented in the relatively restricted form of an essay. The job is doubly demanding in the field of Western history once a scholar extends his investigations to topics more complicated than the usual tales of wagon trains, Indian fights, and cattle drives.

The authors of *The Frontier Challenge* do push beyond what Clark calls " 'chuck wagon' and 'war bonnet' history," which is all to their credit. If they had somehow managed to present their findings in a more satisfactory fashion, they would have turned an acceptable book into an outstanding one.

David Brewster

Farm Appraisal and Valuation

By William G. Murray. The Iowa State University Press, Ames. Fifth edition. 534 pages. 1969. $10.50.

A substantial change in the organization of this book has taken place since the fourth edition. The earlier edition was divided into chapters on the basis of three parts, including an appendix. In this edition, there are eight parts (exclusive of an appendix), containing varying numbers of chapters. In addition to the changes in format, the book contains new photos, maps, supplementary materials, and an up-to-date bibliography of current research findings.

The Introduction contains such basic information as explanations of concepts of farm appraisal value, procedures involved in making an appraisal, and a discussion of farm real estate legal descriptions. This is followed by a part called Comparable Sale Approach.

A third part of the book is called Income Appraisal. A significant point is noted by comparing the first through the fifth editions of this book; the use of the farm mortgage interest rate as a capitalization rate has been progressively deemphasized. This no doubt reflects a change in general conditions throughout the money market and the market for farms.

As a possible alternative to the pitfalls in the determination of a capitalization rate, Murray gravitates towards a sale value capitalization rate resembling that referred to as a "tornaconto" equation by Italian appraisers. In that equation, a synthetic rate is calculated by determining an average ratio of estimated incomes to market values, using a group of farms similar to the one being appraised.

An additional feature of the fifth edition is the special emphasis Murray places on the importance of buildings in farm appraisal by setting off this discussion as the fourth of the eight major groupings of this book.

A fifth part of the book, called Sales Values vs. Income Value, is one of the most interesting. It is here that the author presents a middle ground between the two polarized views and is perhaps presenting some of his philosophy of appraisal.

A new part of this edition is called Statistical Approach to Appraisal. Here the author discusses historical and current research that has been developed to show the use of statistics in the research of appraisal problems. This is easily the most interesting part of the book and contains the author's view that more of this kind of research will be forthcoming as the science of appraisal advances.

The seventh part, Farm Productivity Analysis, as previously mentioned, contains information that is fairly standard and, although it has been placed near the end of the text, it represents a necessary checklist which must be considered before one can effectively deal with the issue of capitalization. While many appraisers today would discount the importance of these steps, they are necessary stages in arriving at an estimate of income to be capitalized. This procedure is often necessary when one must make an approximation of the market in the absence of comparable sales.

The eighth and last part of the new edition covers Appraisal Types. This unit discusses tax assessment, condemnation, loan, and special enterprise appraisals. Chapter 28 of this part, entitled Special Enterprise Appraisals, is a significant addition since the fourth edition. It covers appraisals relating to ranches, vineyards, timber, and—perhaps the most significant—crop allotments. This chapter is excellent, but the treatment of allotments is all too brief.

The appendix, as in the other editions, provides a useful array of supplemental materials on appraisal.

Like all of Murray's books, this one is interesting, clear, concise, and well written. There is little doubt it will replace its predecessor as a "must" with both practitioners and students in the field of farm appraisal. In a sense, the evolution of this book through five editions follows a trend in the appraisal profession itself, a trend towards more technology and less philosophy. We as readers may be the losers, for Murray is well qualified to provide us a balance between these different, but necessarily opposing, approaches. This does not, however, minimize the quality of usefulness of this text or its value as a first-order reference in the field of farm appraisal.

Dwight M. Gadsby

Praeger Library of U.S. Government Departments and Agencies, Praeger Press, Washington:

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By W. Wendell Blancke. 286 pages. 1969. $7.95.

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By Percival Flack Brundage. 327 pages. 1970. $10.

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By John C. Chommie. 267 pages. 1970. $9.50.

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By Ewan Clague. 271 pages. 1968. $7.95.

The Bureau of Land Management

By Marion Clawson. 209 pages. 1971. $8.50.

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By Edwin Fitch. 326 pages. 1967. $7.95.

The Bureau of Outdoor Recreation

By Edwin Fitch and John E. Shanklin. 227 pages. 1970. $7.95.

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By Thomas B. Marvell. 291 pages. 1969. $7.95.

The Agricultural Research Service

By Ernest G. Moore. 244 pages. 1967. $7.95.

The Smithsonian Institution

By Paul Oehser. 275 pages. 1970. $8.95.

The National Science Foundation

By Dorothy Schaffter. 278 pages. 1969. $7.95.

The Soil Conservation Service

By D. Harper Simms. 238 pages. 1970. $8.50.

The Federal Trade Commission

By Susan Wagner. 261 pages. 1971. $9.

Praeger Publishers has undertaken a mammoth task in its series on the Federal departments and agencies. Such a project has been long overdue. Many changes have taken place since the last of the Institute for Government Research Service Monographs for the U.S. Government came out in 1931. The Institute, which in 1927 had become a part of the then newly chartered Brookings Institution, intended to revise and update the studies. However, only the basic 64 book-length studies of bureaus, offices, and commissions were completed. Authors of the new Praeger series include many who have retired from key positions after years of service in the agencies they describe; some who have had an academic background in a related field of interest; and professional writers with a wealth of experience in the subject area with which the agency described dealt.

The studies, like the earlier series, have a fairly set pattern: A historic chapter is followed by chapters on various phases of current operations, relations with other agencies, Congress, and the public. Each volume concludes with a summary chapter that sometimes has a prophetic note. Appendixes include information on career opportunities, lists of laws or legislation, personnel, field offices, or lists of heads of agencies. The bibliographies vary in scope, sometimes with no reference to the earlier parallel series.

The style of writing varies from one volume to another. Some, such as *The Foreign Service of the United States* and *The Alaska Railroad*, are quite enjoyable reading. A few are somewhat pedantic factual productions. Naturally, the interests of the authors are reflected throughout the books, as they place current operations in their historic setting.

A number of the authors discuss relationships with the Department of Agriculture, its personnel, or the agrarian population. In some instances, this is misleading. In *The Patent Office*, for example, Stacy Jones states that "in 1862, when Congress created an agricultural agency with bureau status, its first head and other personnel were drawn from the Patent Office." Actually, the "agency" was created as a Department and only a few people were transferred with the work from the Patent Office. In other instances, no doubt, the limits of time and space precluded what we, in the Department, might consider a minimal treatment. For example, *The Smithsonian Institution* has no reference to the dual capacity of some employees who served both the Department of Agriculture and the Institution, leaving records of their achievements among the archives of the latter.

On the other hand, Marion Clawson, in *The Bureau of Land Management*, gives the legislative background of that agency and discusses its activities in grazing and forestry, which naturally involved USDA's Forest Service. Robert Carey, in his interesting *Peace Corps*, shows a minimum of the channels of cooperation between the agencies. Edwin Fitch and John Shanklin in *The Bureau of Outdoor Recreation* show some of the struggles of that Bureau within the Federal framework that included the Department of Agriculture and its Forest Service.

At the present time, the series includes only two studies of USDA agencies; *The Agricultural Research Service* by Ernest G. Moore was released in 1967, and *The Soil Conservation Service* by D. Harper Simms came out in 1970. Both have been well received in the Department. Two more studies, one on the Department in general and another on the Forest Service, are to be published later this year.

Ernest Moore, retired Director of Information and earlier entomologist in the Agricultural Research Service, has a well-rounded study. From the vantage point of retirement, he was able to write, uninhibited by official restrictions, of administrative changes within the Department; relations with other agencies, Congress, and the public; and the impact of scientific advances. After outlining briefly, but with a remarkable inclusiveness, the development of scientific work in the various bureaus that were brought together to form the Agricultural Research Service, Moore told of the functions of each of the subsequent divisions. Looking to the future he concluded with:

"It has been said that the future belongs to those who prepare for it. The Agricultural Research service is in a most strategic position to join with agricultural scientists in the states, in industry and private foundations, and in other countries to help shape the future for the benefit of all people everywhere."

In *The Soil Conservation Service,* D. Harper Simms wrote of the roots, development, and present activities of one of the "action" agencies that evolved during the 1930's, when the dust of the Dust Bowl hid the sun as Congress was considering crucial legislation. Under the tutelage of Hugh Bennett, the Soil Conservation Service became a "permanent and respected part of the governmental structure." Then it went on to serve suburban areas, as well as the strictly rural. Simms, again from the vantage point of retirement, discussed the current situation; conflicts and controversies, including Benson's proposal to "emasculate" the SCS; problems between the Soil Conservation Service and the Extension Service; and the efforts of SCS to serve the public and get along with Congress.

Simms' study was published before the President's Advisory Commission on Executive Organization, under the chairmanship of Roy L. Ash of Litton Industries, made its report, that would affect most civilian Departments, other than State, Treasury, and Justice. As the Ash Council has placed great stress on the importance of natural resources, so did Simms when he wrote:

"The United States has come to the brink of an era when its resource problems will be greatly accentuated—but when public sentiment for resource protection and improvement will be stronger than ever. The responsibilities of the several resource agencies of federal and state government, to say nothing of many excellent private organizations, will be heavy, and challenges will not be easy to meet. The Soil Conservation Service seems destined to play a leading role in that era."

In view of the possible widespread effect of the President's Reorganization Plan, this series should be invaluable in the transitional period and serve as documentation of agencies that may lose their separate identity. Future volumes, instead of becoming obsolete soon after publication, may become basic tools. Thus it would seem that other areas of USDA's functions should be included in the series, such as extension, credit, and foreign work.

Vivian Wiser

U. S. GOVERNMENT PRINTING OFFICE : 1971 O -448-185

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AGRICULTURAL ECONOMICS RESEARCH

Is published quarterly by the Economic Research Service, U.S. Department of Agriculture. Use of funds for printing this publication approved by the Director of the Office of Management and Budget, February 12, 1970.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. 30 cents a single copy, $1.00 a year domestic, $1.25 foreign.