Chapter 8

Emerging Technologies, Public Policy, and Various Size Crop Farms

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Chapter 8

Emerging Technologies, Public Policy, and Various Size Crop Farms

The size, and therefore the survival, of farms is affected by several factors. Clearly, there are economies of size in many of the crop areas covered by farm policy, These economies motivate further concentration of resources. In addition, present farm policy, more than any other policy tool, makes major impacts on farm size and survival. Although very large farms can survive without these farm programs, moderate farms are very dependent on them for their survival.

Given these realities, an important question arises: What combination of policy and technology advances will encourage each size farm to grow, or at least maintain itself? To answer this question, this chapter and the next will present findings of an analysis of selected regions in the United States that represent significant agricultural production regions for dairy, corn, cotton, soybeans, rice, and wheat. The analysis is presented in two parts. First, the results of an analysis of size economies is presented for each commodity. This is followed by the findings from an analysis of the economic impacts of emerging technologies and selected public policies for crop farms of various sizes.

SIZE ECONOMIES AND COMPARATIVE ADVANTAGE IN CROP PRODUCTION IN VARIOUS AREAS OF THE UNITED STATES

A major question asked throughout this study is what is the impact of resource concentration in U.S. agriculture. Very little is known about the process of resource concentration. Willard Cochrane states that:

> ... we are almost totally ignorant regarding the shape of the long-run planning or cost curve at very large volumes of output. Thus, we don't know whether we are working with one economic force that is so powerful that there is little or no possibility of controlling it with public policies or whether the force has largely expended itself and with some intelligent policy action we could slow the process of resource concentration to a walk (Cochrane, 1983).

The intent of this section is to provide policymakers with an overview of variation in cost of production by enterprise size and geographic location for corn, soybeans, wheat, rice, and cotton. This information should improve understanding of the process of resource concentration in American field crops.[1]

The concept of economies of size is defined as the relationship between enterprise size (measured in acres) in combination with other productive services, and the rate of output of the enterprise. Three enterprise size categories are used: very large, large, and moderate. If enterprises are arranged in increasing order by planted acreage, very large enterprises are those enterprises in the 90th percentile. Large enterprises comprise the 70th and 80th percentiles, and moderate enterprises comprise the 40th through the 60th percentiles. The evidence for size economies is based on a weighted average of measures outlined in appendix D. These measures include production cost, use of harvesting machinery, and the Herfindahl indices. In addition, a structural elasticity measure of internal size economies is applied to the percentage increase in enterprise size in acres relative to a l-percent decrease in production costs. The geographic locations of the selected pro-

I Information presented in this section is based on the OTA paper "Size Economies and Comparative Advantage in the Production of Corn, Soybeans, Wheat, Rice, and Cotton in Various Areas of the United States, " prepared by Stephen C. Cooke, 1985.

ducing areas for the five field crops are identified in table 8-1 and shown in figure 8-1. These production areas have been designated by the U.S. Department of Agriculture (USDA) on the basis of soil types and/or levels of rainfall.

Corn

In corn production, very large enterprises of about 1,000 acres have an n-percent cost advantage over 250-acre, medium-size enterprises (table 8-2). The change in relative production and resource concentration between 1978 and 1982 is positive for very large corn enterprises and is increasing at a rate of about 10 percent a year. The structural elasticity measure is — 15. This indicates that each 15-percent increase in enterprise acreage (between the 250- and 1,000-acre range) results in a l-percent decrease in corn production costs. There is strong evidence to argue for the existence of increasing internal economies of size in corn production across the selected producing areas.

Table 8-1 .- Homogeneous Production Areas for the Various Commodities

Description	Abbreviations and FEDS[a] designation
Corn:	
East Central Illinois	IL 300
Central Indiana	IN 101
North Central Iowa	1A 201
South Central Nebraska	NE 400
Soybeans:	
East Central Illinois	IL 300
North Central Iowa	1A 201
Mississippi Delta	MS 100
Western Ohio	OH 101
Wheat:	
Western Kansas	KS 100
Northeast Montana	MT 200
Central North Dakota	ND 200
Eastern Washington	WA 400
Wee:	
North Central California	CA 400
Texas Upper Gulf Coast	TX 100
Mississippi and Arkansas Delta	DLT 100 & 300
Northeast Arkansas	AR 200
Cotton:	
Northern Alabama	AL 600
South Central California	CA 500
Mississippi Delta	MS 100
Texas High Plains	TX 200

[a]Firm Enterprise Data System.

SOURCE: Office of Technology Assessment

In general, the sources of internal size economies among the selected corn-producing areas are as follows. Corn yields are from 3 to 10 percent higher on very large enterprises than on medium-size enterprises. Very large corn enterprises spend less on fertilizer, fuel, lubrication, repairs, and custom harvesting than do medium-size enterprises. Finally, very large corn enterprises consistently use some combination of fewer and/or more efficient machines and tractors that go over the field fewer times.

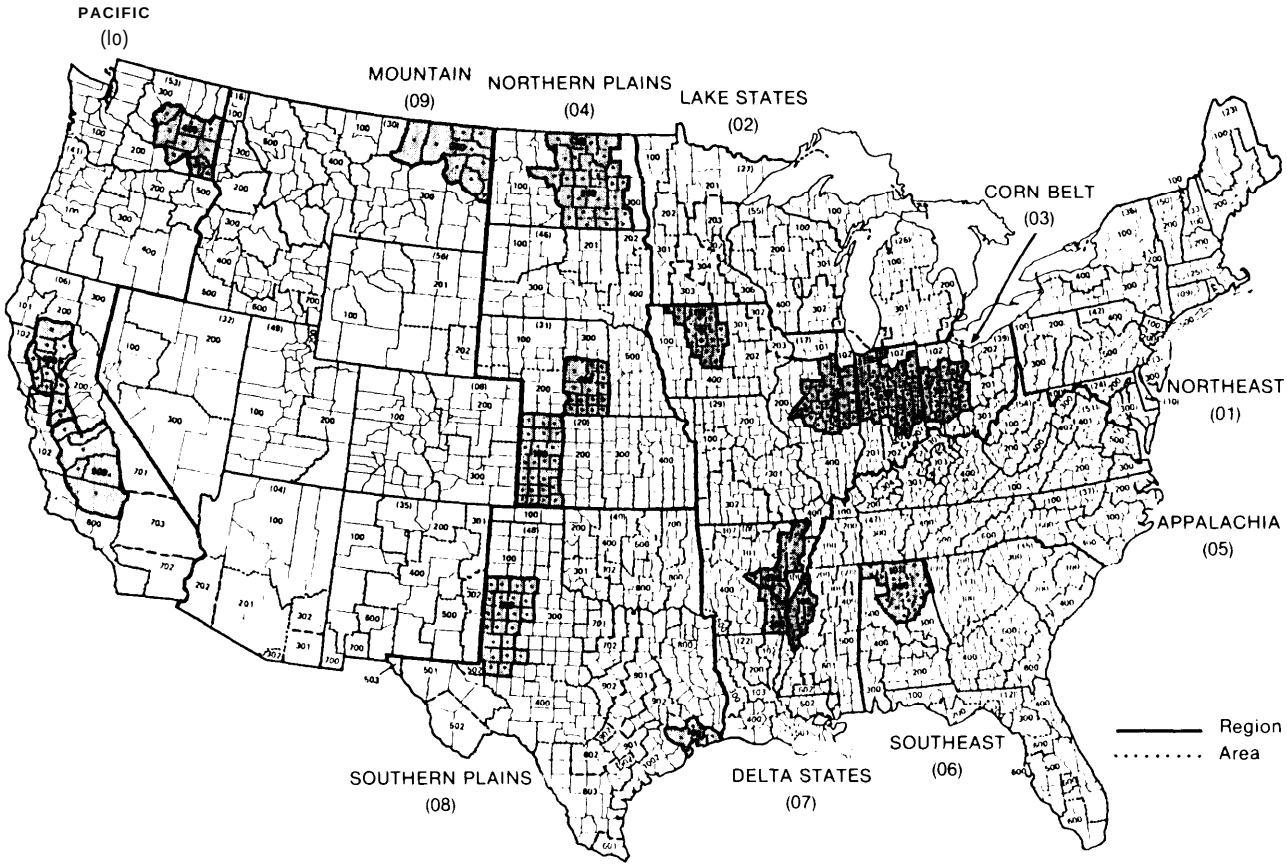
Of the areas studied, Iowa has a comparative advantage in corn production (table 8-3), regardless of whether the return to land is assumed to be 10 or 5 percent of its 1982 value. Iowa also has the smallest average corn enterprise size, the lowest level of resource concentration, and the lowest percentage of change in resource concentration of the selected corn-producing areas studied. The trends in relative yield and land values indicate that the comparative advantage in corn production in Iowa will continue in the future, other things being equal. There are also size economies that can be exploited. Therefore, the data suggest that corn producers in Iowa are not operating at the least-cost production point. The quality of initial resource endowment in Iowa provides producers with the ability to remain highly competitive in corn production without fully exploiting size economies.

The comparative disadvantage for Nebraska increases from 8 to 29 percent relative to Iowa, associated with a 10- and 5-percent return to land, respectively. This 21-percent difference results in Nebraska becoming a very marginal corn-producing area in the presence of lower interest rates. This is because Nebraska's comparative advantage is largely associated with inexpensive land relative to that of other areas. A lower rate of return to land effectively discounts the source of comparative advantage in corn production in this area.

Soybeans

In soybean production, very large enterprises of about 800 acres have a l-percent cost advantage over 300-acre," medium-size enterprises (table 8-2). The change in relative production

Figure 8-1.— Firm Enterprise Data System Production Areas



SOURCE: US. Department of Agriculture,

Table 8=2.—Summary of the Measures of Internal Economies of Size in Selected Corn, Soybean, and Wheat Producing Areas, 1983

Commodity, State, and area	Economies of size	Structural elasticity (°/0)	Enterprise size (acres)		Enterprise cost ($/unit)	
			Medium	Very large	Medium	Very large
Corn:						
IL 300	Very large	– 7	246	1,113	$119	$100
IN 101	Very large	–22	271	903	105	100
1A 201	Very large	–22	170	576	105	100
NE 400[b]	Very large	–12	266	1,715	113	100
Overall	Increasing	–15	234	1,003	111	100
Soybeans:						
IL *300*	None	–44	270	684	102	100
1A 201	Very large	–14	210	707	108	100
MS 100	None	45	795	1,262	99	100
OH 101	None	8	244	897	86	100
Overall	Constant	–179	302	790	101	100
Wheat						
KS 1OO	Very large	- 8	774	3,909	118	100
MT 200	Very large	–12	421	577	110	100
ND 200	None	–38	338	1,283	103	100
WA 400	None	6	753	2,388	85	100
Overall	Constant	–36	647	2,661	103	100

[a]The percentage change in enterprise size in acres feral-percent change introduction costs relative to the medium and very large enterprise size range,
[b]Irrigated.

SOURCE: Office of Technology Assessment.

Table 8-3.–Summary of the Measures of Interregional Comparative Advantage Among Selected Corn, Soybean, and Wheat Producing Areas, 1983

Commodity, State, and area	Economies of size	Comparative advantage A[a] (%)	Comparative advantage B[b] (%)	Enterprise size (acres)
Corn:				
IL 300	Very large	114	116	663
IN 101 . . .	Very large	110	114	586
1A 201 .,	Very large	100	100	335
NE 400[c] ...	Very large	108	129	1,095
Total	Increasing	109	113	610
Soybeans:				
IL 300	None	103	102	464
1A 201	Very large	100	100	362
MS 100	None	124	138	1,126
OH 101, . . .	None	105	109	570
Total	Constant	105	106	521
Wheat:				
KS 100. ..,	Very large	100	100	2,152
MT 200 .,	Very large	103	112	1,352
ND 200 . . .	None	109	133	893
WA 400	None	100	104	1,613
Total . . .	Constant	102	109	1,647

[a]Assumes a 10-percent rate of return on 1982 land values.
[b]Assumes a 5-percent rate of return on 1982 land values.
[c]Irrigated.
SOURCE: Off Ice of Technology Assessment.

and resource concentration is positive for very large enterprises and is increasing at a rate of about 13 percent per year. The structural elasticity is – 179, indicating that a 179-percent increase in (or nearly tripling from 300 to 500 acres) an average soybean enterprise acreage results in a l-percent decrease in production cost. There is evidence to argue for the existence of constant internal economies of size in soybean production across the selected producing areas.

In general, internal size economies do not exist (except for Iowa) among the selected soybean areas because soybean yields are only from 1 to 6 percent higher on very large enterprises relative to medium-size enterprises. Very large enterprises have higher expenditures on fertilizer, herbicides, and insecticides in proportion to yield. And very large enterprises use relatively more efficient machines and tractors, particularly in land preparation, relative to medium-size enterprises.

Iowa also has a comparative advantage in soybean production among the selected producing areas (table 8-3), regardless of whether the return to land is assumed to be 5 or 10 percent of its 1982 value. This area has the smallest average soybean enterprise size, the lowest level of resource concentration, and one of the lowest percentages of change in resource concentration of the selected producing areas. The trends in relative yield and land prices indicate that the comparative advantage of Iowa in soybean production will decrease in the future, particularly in relation to Illinois. Iowa is unique among the soybean areas studied in that it has substantial internal economies of size, particularly for custom harvesting of very large enterprises, that can be exploited. The data suggest that soybean producers in Iowa are not operating at the least cost of production. The quality of the initial resource endowment in Iowa provides producers with the ability to remain highly competitive in soybean production without having to exploit size economies fully.

In Mississippi the comparative disadvantage in soybean production increases from 24 to 38 percent relative to Iowa, associated with a 10- and 5-percent return to land, respectively. This 14-percent difference results in Mississippi becoming an even more marginal soybean-producing area as interest rates decrease. This is because Mississippi's "comparative advantage" is associated with less expensive land. A lower rate of return to land effectively discounts the source of comparative advantage in soybean production in this area.

Wheat

In wheat production, very large enterprises of about 2,600 acres have a 3-percent cost advantage over 640-acre, medium-size enterprises. The change in relative production and resource concentration is positive for very large enterprises and increases at a rate of about 5 percent per year. The structural elasticity is – 36, which indicates that each 36-percent increase in an average wheat enterprise acreage (between the 640- and 2,600-acre range) results in a l-percent decrease in production cost. There is evidence , to argue for the existence of constant internal economies of size in wheat production across the selected producing areas overall.

In general, the absence of internal size economies in wheat production is the result of statistical averaging. Only North Dakota exhibits constant returns to scale in wheat production. Kansas and Montana both have increasing returns to scale, while Washington has a decreasing return to scale. In Kansas, economies associated with custom harvesting are an important source of size economies for very large wheat enterprises. In Montana, size economies for very large wheat enterprises are the result of the combination of slightly higher yield and the economies associated with custom harvesting. In North Dakota, the lack of internal economies of size for very large wheat enterprises is the result of slightly higher yields offset by higher harvesting costs relative to those of medium-size enterprises. In Washington, size economies do not exist for very large wheat enterprises relative to that of medium enterprises because of the substantial diseconomies related to yield and the slightly higher capital ownership and harvesting costs.

Kansas has a comparative advantage in wheat production among the selected areas, maintaining this advantage regardless of whether the return to land is assumed to be 5 or 10 percent of its 1982 value. This area has the largest average enterprise size, the lowest resource concentration, and one of the lowest percentages of change in resource concentration of the selected wheat-producing areas studied. The trends in relative wheat yield and land prices indicate that the comparative advantage of this area may decrease slightly in the future. Kansas has substantial size economies that can be exploited. The data suggest that wheat producers in Kansas are not operating at the least cost of production. The quality of the initial resource endowment in Kansas provides producers with the ability to remain highly competitive without having to exploit size economies fully.

In North Dakota the comparative disadvantage in wheat production increases from 9 to 35 percent relative to Kansas, associated with a 10- and 5-percent return to land, respectively. This 24-percent difference results in North Dakota becoming a marginal wheat-producing area as interest rates decrease. This is because North Dakota's comparative advantage is associated with less expensive land. A lower rate of return effective y discounts the source of comparative advantage in wheat production in this area.

Rice

In rice production, very large enterprises of about 2,400 acres have a 4-percent cost disadvantage over 600-acre, medium-size enterprises (table 8-4). The change in relative production and resource concentration is positive for very large enterprises and increases at a rate of 1 percent per year. The structural elasticity is 27, indicating that each 27-percent decrease in the average acreage for a rice enterprise (between 600 and 2,400 acres) results in a l-percent decrease in production cost. There is evidence to argue for the existence of decreasing internal economies of size in rice production across the selected producing areas.

In general, the presence of internal diseconomies of size among the selected rice-producing areas is a result of the following: Rice yields are from about O to 10 percent lower on very large enterprises than that of medium-size enterprises. Rice yield diseconomies are related to the ability to maintain a uniform distribution of flood irrigation water on the field. The uniform distribution of water is affected by the extent to which the fields have been leveled and the water levels maintained. The data indicate that the extent of leveling is approximately 100 percent across enterprise size among the rice-producing areas. Therefore, yield diseconomies necessarily relate to the timeliness of water, fertilizer, herbicide, insecticide, and fungicide application. Rice producers on medium enterprises are better able to manage these applications than those on very large enterprises. Finally, in Texas there are diseconomies associated with purchased canal water used for irrigation.

California has a comparative advantage in rice production among the selected rice-producing areas (table 8-5), maintaining this advantage regardless of whether the return to land is assumed to be 5 or 10 percent of its 1982 value. California has the largest average rice enterprise

Table 8-4.—Summary of the Measures of Internal Economies of Size in Selected Rice and Cotton Producing Areas, 1979 and 1982

Commodity, State, and area	Economies of size	Structural elasticity (°/0)	Enterprise size (acres)		Enterprise cost ($/unit)	
			Medium	Very large	Medium	Very large
Rice:						
CA *400*[b]	None	40	850	3,575	$97	$100
TX 1001[b]	None	33	691	2,068	97	100
DLT 100 & 300[b]	None	14	509	1,904	92	100
AR 200[b]	None	30	377	1,619	96	100
Overall	Decreasing	27	625	2,397	96	100
Cotton:						
AL 600	VL	–14	568	1,842	108	100
CA 500[b]	None	64	614	2,833	98	100
MS 100	None	Infinite	754	2,868	100	100
TX 200[b]	None	118	436	1,707	99	100
TX 200	VL	– 9	972	5,920	117	100
Overall	Constant	–77	653	3,040	102	100

[a]The percentage change in enterprise size in acres for a 1-percent change in production costs relative to the medium and very large enterprise size range.
[b]Irrigated.

SOURCE: Office of Technology Assessment.

Table 8-5.-Summary of the Measures of Interregional Comparative Advantage Among Selected Rice and Cotton Producing Areas, 1979 and 1982

Commodity, State, and area	Economies of size	Comparative advantage A[a] (%)	Comparative advantage B[b] (%)	Enterprise size (acres)
Wee:				
GA 400C	None	100	100	1,071
TX 1001[c]	None	124	134	802
DLT 100 & 300[c]	None	114	120	694
AR 200C	None	108	114	45
Total	Decreasing	100	115	776
Cotton:				
AL 600	VL	123	125	1,225
CA 500C	None	109	107	2,088
MS 100	None	100	101	1,787
TX 200[c]	None	101	103	1,224
TX 200	VL	104	100	3,283
Total	Constant	106	105	2,020

[a]Assumes a 10-percent rate of return on 1982 land values (1978 values for rice)
[b]Assumes a 5-percent rate of return on 1982 land values (1978 values for rice).
[c]Irrigated.

SOURCE: Office of Technology Assessment

size and the second highest level of production or resource concentration, after Mississippi, of the selected rice-producing areas. Production and resources are becoming less concentrated in California, at a rate of — 2 percent per year. The trends in relative yield and land prices indicate that comparative advantage in this area will remain unchanged. Internal size economies have been fully exploited in this area. The data suggest that the minimum average cost point in rice production is reached at the medium enterprise size. The data also suggest that the support price for rice is such that the average revenue curve is substantially above the minimum point on the average cost curve. In this case firms can achieve a higher profit by extending output beyond the minimum point, even though they experience higher average total costs than smaller firms operating at a low point on the average cost curve.

In Texas the comparative disadvantage in rice production increases from 24 to 34 percent relative to that of California, associated with a 10- to 5-percent return to land, respectively. This lo-percent difference results in Texas becoming an even more marginal rice-producing area as interest rates decrease, because Texas' comparative advantage is associated with less expensive land. A lower rate of return effectively discounts the source of comparative advantage in rice production in this area.

Cotton

In cotton production very large enterprises of about 3,000 acres have a 2-percent cost advantage over 650-acre, medium-size enterprises. The change in relative production and resource concentration is positive and increases at a rate of 10 percent per year for very large cotton enterprises. The structural elasticity is –77, which

indicates that each 77-percent increase in the average acreage for a cotton enterprise (between 650 and 3,000 acres) results in a l-percent decrease in production cost. There is evidence to argue for the existence of constant internal economies of size in cotton production across the selected producing areas.

In general, the absence of internal size economies in cotton production is the result again of statistical averaging. Only three of the five selected cotton-producing areas have constant returns to scale. These areas include California, Mississippi, and Texas (irrigated). On the other hand, Alabama and Texas (dryland) both have increasing returns to scale in cotton production. Size economies exist for Alabama's very large cotton enterprises because these enterprises incur lower machinery and tractor-related expenses for a given field operation and still manage to obtain a slightly higher yield. In California, size diseconomies are primarily related to the diseconomies of purchased irrigation water for cotton production. In Mississippi the lack of size economies in cotton production for very large enterprises relates to similar preharvest and ownership costs without significantly higher yields. In Texas (irrigation), the lack of size economies relates to the combination of size diseconomies in harvesting and cultivation, along with slightly higher yields enjoyed by the medium enterprise in this area. In Texas (dryland), size economies for very large enterprises relate to the substantial preharvest and ownership cost advantage associated with lower machinery and tractor expenses for a given field operation without substantial loss in yield.

In terms of comparative advantage, there is a three-way tie for comparative advantage in the production of cotton among the selected areas. These three areas are Mississippi and Texas (both irrigated and dryland). These three areas maintain their comparative advantage (within 2 to 3 percentage points), regardless of whether returns to land are assumed to be 5 or 10 percent of its 1982 value. These three areas have the lowest resource concentration and an average enterprise size of between l, zoo to 3,300 acres. The percentage of change in resource concentration in these areas ranges from 2 to 20 percent per year. The trend in relative yield and land prices indicates that Mississippi will have a comparative advantage over Texas in cotton production. On the other hand, Mississippi loses comparative advantage in cotton production to Texas as interest rates decrease. Even though land prices are higher in Mississippi, a lower rate of return on land works to the advantage of Texas because land there is a larger percentage of total cost. Also, in Texas more of the cotton is planted in strip rows to conserve soil moisture, and fewer herbicides or insecticides are used than is the case in Mississippi. The data also suggest that cotton producers in Texas (dryland) are not operating at the least cost of production. The quality of the initial resource endowment in Texas (dryland) provides producers with the ability to remain competitive without having to exploit size economies fully. As a result, Mississippi and Texas have nearly equal comparative advantages in cotton production.

In Alabama the comparative disadvantage in cotton production increases from 23 to 25 percent relative to that of Mississippi and Texas, associated with a 10- and 5-percent return to land, respectively. A decrease in the interest rate does not substantially alter the marginal position of Alabama in cotton production. The comparative disadvantage in cotton production in Alabama is due to low relative yields, combined with high fertilizer, lime, insecticide, and harvesting costs. Aside from more fully exploiting size economies, Alabama has few options for increasing its comparative advantage in cotton production in the future.

Summary and Conclusions

The data suggest the following conclusion regarding internal economies of size for the selected commodities (table 8-6): The evidence for increasing returns to scale for corn and decreasing returns to scale for rice, given the configurations for the enterprises for these commodities in 1983 and 1979, respectively, are the strongest. Each of the selected corn areas has substantial internal economies as enterprise size increases from medium to very large. On the

Table 8-6.—Economies of Size and Structural Elasticities for Selected Commodities and Areas

Commodity	Size economies	Structural elasticity	Internal economies of size		
			Increasing	Constant	Decreasing
Corn	Increasing	–15	IL, IN, 1A, **NE**		
Wheat	Constant	–26	KS, MT	ND	WA
Cotton	Constant	–77	AL, TX	CA[a], MS, TX[a]	
Soybeans	Constant	– 179	1A	IL, MS	OH
Rice	Decreasing	27			CA[a], TX[a], DLT[a], AR[a]

[a]Irrigated.

SOURCE: Of fice of Technology Assessment.

other hand, each of the selected rice areas has internal diseconomies as enterprise size increases from medium to very large.

The strongest case for constant returns to scale can be made for cotton. Three of the five selected cotton-producing areas have constant size economies, given the configuration of cotton enterprises in 1982. Only Alabama and Texas (dryland) have increasing economies of size. Alabama is a marginal cotton-producing area, however, as indicated by the data on comparative advantage.

Texas (dryland) is one of the most competitive cotton-producing areas studied. The average enterprise size in Texas is the largest of the selected areas, while the percentage change in resource concentration between 1978 and 1982 was the lowest. This seems to indicate that producers of dryland cotton in Texas are willing to forego the potential gain associated with expanding enterprise size to avoid the additional exposure to risk and uncertainty. The capital investment in land and machinery required as cotton enterprises in this area expand from 1,000 to 6,000 acres substantially increases indebtedness, which threatens survivability of the firm. In particular, the uncertainty associated with cotton yields in this area of Texas make indebtedness unattractive.

The arguments for constant returns to scale in the cases of wheat and soybeans are somewhat more ambiguous. Selected areas having increasing, constant, and decreasing returns to scale are present for both of these commodities. In the case of wheat, Kansas has substantial size economies as enterprises increase from 800 to 4,000 acres. This area has the largest average wheat enterprise size of the selected areas and the lowest change in resource concentration between 1978 and 1982. This seems to indicate that producers of wheat in Kansas are willing to forego the potential gains in order to avoid additional exposure to risk and uncertainty associated with expanding enterprise size. A similar case can be made for wheat production in Montana. In the case of soybeans, enterprises in Iowa have size economies as they increase from 200 to 700 acres: This area has the lowest average enterprise size and the lowest percentage of change in resource concentration between 1978 and 1982 of the selected soybean areas.

Therefore, size economies for corn and size diseconomies for rice are constant and broadly based results. Constant size economies for soybeans, wheat, and cotton exist in general, but important exceptions exist for increasing (and decreasing) economies of scale in each of these commodities. Two of the important exceptions of increasing returns are Texas dryland cotton and Kansas wheat. The data suggest in both of these areas for their respective commodities that producers are willing to forego increasing return to scale to avoid additional risk and uncertainty associated with expanding enterprise size, which potentially could also threaten the survival of the firm.

It should be noted that the analysis focused on technical efficiencies in determining economies of size. Pecuniary economies (e.g., discounts on input supplies or services purchased in volume) that are important for very large enterprises were not taken into account. If they had been considered, pecuniary economies would have provided more economies of size for the very large operations. For wheat, soy-

beans, and cotton this could have changed the above overall analysis from constant to increasing economies of size.

This information strongly suggests that resource concentration for most American field crops will probably continue for some time. Powerful forces at work in the farm economy will lead to fewer and larger farms.

ECONOMIC IMPACTS OF EMERGING TECHNOLOGIES AND SELECTED POLICIES FOR VARIOUS SIZE CROP FARMS

The analysis of size economies did not take into account various policies and their impacts on resource concentration. This section will present the findings of just such an analysis of four selected regions in the United States that represent significant agricultural production in the commodities considered in farm policy: corn, cotton, soybeans, rice, and wheat. Within each production region, representative moderate, large, and very large commercial farms were identified and analyzed.[2] It was assumed for the analysis that the technology development and adoption conditions in existence would be those of the most likely environment, outlined in chapter 2.

Two techniques were used to analyze the effects of selected policy provisions and technology on farms within each region. Information was obtained on resource characteristics, acreage devoted to specific crops, and historic projected yields of crops eligible for farm program provisions. These data were used to develop resource characteristics of the three different farm sizes. Then a simulation model was used to analyze the economic viability and growth potential of each representative farm for selected policy and technology advance scenarios (appendix E contains a detailed discussion of the model).

The following presents the representative farms and major findings for the production areas analyzed. Obviously, more areas could have been analyzed, but neither time nor the resources allocated to this study would permit their inclusion. It is expected that the results will apply in broad principle to the major production region of which each area is a part. It is important to remember that the results of this analysis are mainly illustrative. Thus the relative results for the several farm sizes and for the several alternative policy and technology scenarios are probably more important than any specific numbers generated by the analysis.

Crop Farms Analyzed

Corn-Soybean Farms in the Corn Bolt

The North Central Region of the United States produces approximately 50 percent of the U.S. total production of corn and soybeans. Representative farms for this region are three farms from the corn-soybean cash grain area of east central Illinois and three farms from the irrigated row crop area of south central Nebraskans

The representative farm situations developed and used in this analysis were constructed from two basic data sources: 1) national cost-of-production surveys by USDA in 1978 and 1983, and 2) farm record data collected and analyzed by the Universities of Illinois and Nebraska. The size of the representative farms and the acreages of owned and rented cropland were developed from the size distributions in the USDA cost-of-production surveys. The very large farms approximate the largest 10 percent of farms in the surveys; the large farms, the 70th to 90th percentiles; and the moderate farms, the 40th to 70th percentiles.

[2]Small and part-time farms were not included because these farm operators in general depend on off-farm employment for their primary source of income.

[3]These representative farms were developed and analyzed in the OTA paper "Economic Impacts of Selected Farm Policies, Income Tax Provisions, and Production Technology on the Economic Viability of Corn-Soybean Farms in East Central Illinois and Irrigated Row Crop Farms in South Central Nebraska, " prepared by W.B. Sundquist, 1985.

Financial status, as measured by net worth, debt load (both intermediate-term and long-term), and leverage ratio, differs dramatically from farmer to farmer. Data from the most recent USDA Agricultural Finance Survey were used to depict the beginning financial characteristics for the six representative farms (tables 8-7 and 8-8).

All of the representative farms are well-mechanized production units ranging from 640 to 2,085 acres of cropland, and all farms include a combination of owned and rented land. Of the six representative farms, only the very large units in each area employ full-time workers. The other farms operate with a combination of family and part-time workers. The Illinois farms have all of their cropland devoted to cash crop production of corn and soybeans. The Nebraska farms are cash crop operations that combine both gravity and sprinkler technologies to irrigate corn and a small acreage of soybeans. In addition, these farms produce a substantial acreage of grain sorghum under a nonirrigated (dryland) regime. Production on this dryland acreage tends to be somewhat riskier than that for the irrigated component of the farming operations, but irrigated farming still has some year-to-year yield variability, owing to weather. Although a number of these irrigated corn farms also produce some wheat and/or corn silage, those enterprises have not been included in the analysis.

The crop mix for the Nebraska farms is identical for all three farm sizes: irrigated corn (58.3 percent of cropland acres), irrigated soybeans (6 percent), dryland sorghum (35.7 percent). On the Illinois farms, the proportion of corn to soybeans varies only slightly for the three representative farms, with corn planted on 52 to 55 percent of the cropland acreage and soybeans on the balance.

For the Illinois farms, all cropland has the same per-acre value, whereas the price of cropland on the Nebraska farms reflects the differentials for four categories of land: 1) gravity ir-

Table 8-7.—Financial Characteristics of Three Representative Corn-Soybean Farms in East Central Illinois

Characteristics	Farm size (acres)		
	Moderate	Large	Very large
Cropland acres	640	982	1,630
Acres owned	260	429	458
Acres leased	380	553	1,172
Value of owned real estate ($1,000 [b])	900.5	1,480.6	1,538.4
Value of machinery ($1,000)	92.2	104.8	129.0
Long-term debt ($1,000)	126.1	557.4	579.4
Intermediate-term debt ($1,000)	55.3	62.9	83.8
Initial net worth ($l,000[c])	855.4	1,027.6	1,106.4
Leverage ratio (fraction)	0.21	0.61	0.60
Long-term debt/asset ratio (fraction)	0.14	0.38	0.38
Intermediate-term debt/asset ratio (fraction)	0.60	0.60	0.65
Equity ratio (fraction)	0.82	0.62	0.63
Off-farm income ($1,000)	8.2	7.4	7,6
Minimum family living expenses ($1,000)	18.0	20.0	24.0
Maximum family living expenses ($1,000)	36.0	40.0	48.0
Marginal propensity to consume (fraction)	0.20	0.20	0.20

[a] A family size of four persons was assumed for the purposes of estimating family labor supply and determining appropriate income tax rates.
[b] Includes land and building.
[c] May include assets other than land, buildings, and machinery.

SOURCE: Office of Technology Assessment.

Table 8-8.—Financiai Characteristics of Three Representative irrigated Corn Farms in South Central Nebraska'

Characteristics	Farm size (acres)		
	Moderate	Large	Very large
Cropland acres	672	920	2,085
Acres owned	302	530	1,042
Acres leased	370	390	1,043
Value of owned real estate ($l,000 [b])	477.7	838.4	1,648.3
Value of machinery ($1,000)	102.7	112.1	183.9
Long-term debt ($1,000)	123.2	102.0	291.1
Intermediate-term debt ($1,000)	40.1	53.7	98.0
Initial net worth ($l,000[c])	448,3	839.0	1,463.1
Leverage ratio (fraction)	0.39	0.20	0.27
Long-term debt/asset ratio (fraction)	0.26	0.12	0.18
Intermediate-term debt/asset ratio (fraction)	0.39	0.48	0.53
Equity ratio (fraction)	0.72	0.84	0.79
Off-farm income ($1,000)	8.2	8.2	9.7
Minimum family living expenses ($1,000)	18.0	18.0	24.0
Maximum family living expenses ($1,000)	36.0	36.0	48.0
Marginal propensity to consume (fraction)	0.20	0.20	0.20

[a] A family size of four persons was assumed for the purposes of estimating family labor supply and determining appropriate income tax rates,
[b] Include land and building.
cMay include assets other than land, buildings, and machinery.

SOURCE: Office of Technology Assessment.

rigated, 2) sprinkler irrigated, 3) dryland with irrigation potential, and 4) dryland without irrigation potential. Each of the three Nebraska farms, however, has the same proportions of gravity irrigation, sprinkler irrigation, and dryland acres.

Wheat Farms in the Southern Plains

Approximately 65 percent of U.S. wheat production is produced in the Great Plains. For the analysis of representative wheat farms, farms were selected from the Southern Plains region. They are representative of wheat farms in western Kansas, eastern Colorado, and the Oklahoma and Texas Panhandle.[4]

The three farms selected for the analysis are a typical moderate farm in the region (1,280 acres), a large farm (1,900 acres), and a very large farm (3,200 acres). The initial financial characteristics for the three representative farms are summarized in table 8-9. The proportion of cropland owned by each farm was obtained from the most recent Agricultural Finance Survey, summarized for wheat farmers in western Kansas, eastern Colorado, the Oklahoma Panhandle, and the Northern High Plains of Texas.

Average long- and intermediate-term debt-to-asset ratios from the Agricultural Finance Survey were used to estimate initial values for long- and intermediate-term debts. All three wheat farms had about the same beginning equity levels (75 percent) (table 8-9). Minimum family living expenses were based on values obtained from a Texas A&M survey that asked for the minimum annual cash expenditure for family living. The Agricultural Finance Survey was used to obtain values of off-farm income for the three representative farm operators.

A typical cropping pattern in the Southern Plains is to irrigate 50 percent of all cropland and to raise wheat on one-half of this irrigated land. Grain sorghum is typically raised on the other half of the irrigated cropland. Wheat is generally also raised on the portion of the cropland that is not irrigated. This cropping pattern was assumed for all three farms.

Table 8-9.—Financiai Characteristics of Three Representative Wheat Farms in the Southern Plains

Characteristics	Farm size (acres)		
	Moderate	Large	Very large
Cropland acres	1,280	1,920	3,200
Acres owned	640	840	1,400
Acres leased	640	1,080	1,800
Acres of pastureland owned	120	220	360
Value of owned cropland ($1,000)	296.0	388.5	647.5
Value of owned pastureland	29.4	53.9	88.2
Value of machinery ($1,000)	241.9	352.2	477.2
Value of off-farm investments ($1,000)	37.3	49.0	53.5
Beginning cash reserve ($1 ,000)	10.0	12.0	20.0
Long-term debt ($1,000)	60.2	86.3	143.5
Intermediate-term debt ($1,000)	83.2	126.5	171.3
Initial net worth ($1 ,000)	470.3	642.3	970.7
Equity ratio (fraction)	0.77	0.75	0,75
Leverage ratio (fraction)	0.31	0.33	0,33
Long-term debt/asset ratio (fraction)	0.19	0.20	0.20
Intermediate-term debt/asset ratio (fraction)	0.34	0.36	0.36
Off-farm income ($1,000)	12.4	9.8	9.0
Minimum family living expenses ($1,000)	18.0	20.0	23.0
Maximum family living expenses ($1,000)	40.0	50.0	50.0
Marginal propensity to consume (fraction)	0.25	0.25	0.25

SOURCE: Office of Technology Assessment

Numerous crop share arrangements prevail in the region for leased land. However, these arrangements generally involve the producer paying the landlord about 25 percent of the crop and the landlord paying none of the production and harvesting costs. This crop share arrangement was assumed for all leased cropland.

General Crop Farms in the Delta Region of Mississippi

The Mississippi Delta is an excellent region for analysis of general crop farms.[5] Farms in this area can produce a variety of crops not possible in other parts of the United States. The rep-

[4] These representative farms were developed and analyzed in the OTA paper "Economic Impacts of Selected Policies and Technology on the Economic Viability of Three Representative Wheat Farms in the High Plains, " prepared by James W. Richardson, 1985.

[5] These representative farms were developed and analyzed in the OTA paper "Economic Effects of Selected Policies and Technology on the Economic Viability of General Crops Farms in the Delta Region of Mississippi," prepared by B.R. Eddleman, 1985.

resentative farms in this region produce cotton, rice, soybeans, and wheat (or other small grains).

The three representative farms developed for this study are a moderate farm (1,443 acres), a large farm (3,119 acres), and a very large farm (6,184 acres). Table 8-10 provides a summary of the financial and resource characteristics for the three representative farms. The long-term and intermediate-term debt-to-asset ratios for the 1,443-acre farm and the 3,119-acre farm were obtained from the Agricultural Finance Survey and adjusted to reflect the equity levels as reported from a 1983 mail survey of farms in the delta. These debt ratios are the average for part-owner general crops farms in the Mississippi Delta region that had debt on real estate in 1979. Financial ratios for the largest farm were developed by extending the ratios on a per-acre basis for a 3,457-acre farm, as reported in the most recent Agricultural Finance Survey, and were adjusted by the equity levels reported for the largest farm-size group.

Table 8-10.—Financial Characteristics of Three Representative General Crops Farms in the Delta of Mississippi

Characteristics	Farm size (acres)		
	Moderate	Large	Very large
Cropland acres	1,443	3,119	6,184
Acres owned	533	1,419	3,064
Acres leased	910	1,700	3,120
Acreage of principal crops in 1983:			
Cotton	395	1,088	2,250
Rice	305	574	871
Soybeans	640	1,190	2,539
Wheat (or other small grains)	82	247	180
Value of owned cropland ($1,000)	799.5	2,128.5	4,596
Value of farm machinery ($1,000)	378.9	786.7	1,209.8
Value of off-farm investments ($1,000)	129.1	210.3	358.7
Beginning cash reserve ($1 ,000)	31.9	71.1	141.6
Long-term debt (1,000),	331.4	840.8	1,640.8
Intermediate-term debt ($1,000).	243.8	413.0	574.7
Net worth ($1,000)	748.6	1,921.5	4,047.5
Total equity to assets (fraction)	0.56	0.60	0.64
Long-term debt/asset ratio (fraction)	0.41	0.40	*0.36*
Intermediate-term debt/asset ratio (fraction)	0.64	0.52	0.48
Off-farm income ($1 ,000)	18.3	18.2	36.0
Minimum family living expense ($1,000)	18.0	24.0	30.0
Maximum family living expense ($1,000)	27.0	36.0	45.0
Marginal propensity to consume (fraction)	0.25	0.25	0.25

SOURCE: Office of Technology Assessment.

The mix of acreages planted in each crop changed by farm size. In general, the acreage planted in cotton and soybeans increased relative to the acreage planted in rice and wheat as farm size increased. The moderate farm planted 73 percent of tillable cropland in cotton and soybeans, while the large and the very large farms planted 89 and 82 percent, respectively, of tillable cropland in cotton and soybeans. In the analysis, as the farm was allowed to grow in size to the next largest farm size, the proportion of cropland planted in each crop was changed to reflect these differences in crop mix.

Cotton Farms in the Texas Southern High Plains

Cotton is an important commodity in the United States, and over one-half of the cotton produced can be found in the Southern High Plains of Texas. The three farms selected for analysis are a typical moderate farm in the region (1,088 acres), a large farm (3,383 acres), and a very large farm (5,570 acres).[6] These size farms accounted for 31 percent of the farms and 62 percent of the cotton lint produced in the Texas Southern High Plains.

Table 8-11 provides a summary of the demographic and financial characteristics for the three representative cotton farms used in the present study. The long- and intermediate-term debt-to-asset ratios for the moderate farm were obtained from the Agricultural Finance Survey. These debt ratios are the average for part-owner cotton farmers in the Texas High Plains who had debt on real estate in 1979. Financial ratios reported by Smith (1982) for the two larger farms were used because the Agricultural Finance Survey did not provide information for farms in these categories.

A special survey of farmers identified average annual off-farm income and minimum fam-

[6] These representative farms were developed and analyzed in the OTA paper "Economic Impacts of Selected Policies and Technology on the Economic Viability of Three Representative Cotton Farms in the Texas Southern High Plains," prepared by James W. Richardson, 1985.

Table 8-11.—Financial Characteristics of Three Representative Cotton Farms in the Texas Southern High Plains

Characteristics	Farm size (acres)		
	Moderate	Large	Very large
Cropland acres	1,088	3,383	5,570
Acres owned	381	1,048	3,453
Acres leased	707	2,335	2,117
Value of owned real estate ($1 ,000)	222.4	611.7	2,015.4
Value of machinery ($1 ,000)	144.5	420.8	713.9
Value of off-farm investments ($1 ,000)	59.0	110.0	213.7
Beginning cash reserve ($1 ,000)	16.7	52.0	85.5
Long-term debt ($1 ,000)	61,1	120.9	4887
Intermediate-term debt ($1 ,000)	98.3	203.6	475,4
Initial net worth ($1,000)	275.0	854.8	2,032.3
Leverage ratio (fraction)	0.62	0.72	0.67
Long-term debt/asset ratio (fraction)	0.61	0.40	049
Intermediate-term debt/asset ratio (fraction)	0.27	0.20	0.24
Equity ratio (fraction)	0.68	0.48	0.67
Off-farm income ($1 ,000)	16.0	0.0	0 0
Minimum family living expenses ($1,000)	15.2	29.1	38.0
Maximum family living expenses ($1 ,000)	50.0	50.0	600
Marginal propensity to consume (fraction)	0.25	0.25	025

SOURCE Office of Technology Assessment

ily living expenses by farm size (Smith, 1982). Maximum annual family living expenses were assumed to be $50,000 to $60,000, depending on farm size. The model assumes the family will use 25 cents of every additional dollar of disposable income, over and above the minimum requirement, for family living. In no instance, however, will family living expenses exceed the maximum indicated in table 8-11.

Cotton production costs for the three farms were estimated based on Smith's (1982) study. The two larger farms had a 13 percent lower total cost of production, per pound of cotton lint, than the moderate-size farm. The mix of irrigated and nonirrigated cotton changed across farm size. The moderate farm irrigated 32 percent of its available cotton acreage, while the two larger farms irrigated only 23 percent. In the simulation analysis, as the moderate farm grew in size, its proportion of irrigated cropland was decreased to 23 percent.

Farm Policy, Tax Policy, and Technology Scenarios

The three representative farms for each production region were analyzed for the period 1983-92 under alternative policy scenarios.[7] Six farm policy scenarios (including a continuation of the 1981 farm bill), an income tax provision scenario, two financial stress scenarios, a technology option, and anew entrant scenario were analyzed for each farm. All assumptions and policy values associated with each scenario were held constant across farm sizes to allow direct comparison of their impacts on different size farms. Appendix E contains a summary of the analysis for each farm size by region.

Current Policy

The current policy scenario involves continuing through 1992 the current income tax provisions and the price supports, income support, and supply control programs of the 1981 farm bill. In addition, it was assumed that annual mean crop yields for the three representative farms in each of the four production regions will increase as new technologies are introduced and adopted by farmers in the most likely technology environment. For this policy scenario it was assumed that the following farm policies were in effect:

- The Commodity Credit Corporation (CCC) loan program is available to producers for corn, cotton, rice, sorghum, soybeans, and wheat.
- A 3-year, indirect, farmer-owned reserve (FOR) is available for feed grains and wheat.[8]
- An acreage diversion/set-aside program is in effect for 1983 to 1985, using the actual acreage reduction levels and diversion payment rates specified for these years.

[7]The current version of the Firm Level Income Tax and Farm Policy Simulator (FLIPSIM V), developed by James W. Richardson and Clair J. Nixon, was used to simulate the three representative farms in each region.

[8]The 1977 farm bill established FOR as a 3-year extension of the CCC loan after grain had been in the regular loan for 9 months. Stocks remain in the farm operator's control until the Secretary of Agriculture authorizes release.

- A target price-deficiency payment program is available for corn, cotton, rice, sorghum, and wheat in all years.
- The $50,000-payment limitation for deficiency and diversion payments is in effect and is effective on the farm as specified.
- Farms of all sizes are eligible to participate in these farm program-provisions.

Values for loan rates, target prices, diversion rates, and diversion payment rates for 1983 and 1984 are set at their actual values, expressed in 1982 dollars. Values for these variables for 1985 are set at their respective levels announced on or before September 14, 1984, by Secretary of Agriculture Block. Loan rates and target prices for 1985 are held constant through 1992. No acreage reduction program is assumed to be in effect after 1985.

It was assumed that the following options for depreciating machinery and calculating income taxes are used for the current policy scenario:

- Machinery, livestock, and buildings placed in use prior to *1981* are depreciated using the double declining balance method.
- Machinery, livestock, and buildings placed in use after *1980* are depreciated using the accelerated cost recovery method.
- The operator elects to claim first-year expensing for all depreciable items placed into use after *1980*.
- The operator elects to take maximum investment tax credit (ITC) and thus reduces the basis for all depreciable assets placed into service after *1980*.
- The operator adjusts crop sales across tax years to reduce current-year taxes.
- The operator may use either the regular income tax computation or income averaging to calculate Federal income tax liabilities.
- There is no maximum interest deduction for calculating taxable income.
- The actual self-employment tax rates and maximum income levels subject to this tax for *1983* and *1984* are used. Announced values for these variables in *1985-86* are used, and the *1986* values are held constant through *1992*.
- The operator elects to trade in old machinery on new replacements at the end of each item's economic life.

Results Expected

Since this policy includes price supports, income supports, and supply control programs to maintain and stabilize prices and farm income at a reasonable level and reduce the price and income risks, it is anticipated that all farms under this program will have a higher probability of remaining solvent over the lo-year planning horizon, will have higher net farm incomes, and will have stronger financial positions.

Results Obtained

- Except for Texas cotton farms, all farms in the other four regions had a 100-percent probability of remaining solvent over the lo-year period. For Texas cotton farms, the probability y of survival ranged from **92** percent for the moderate farms to 94 percent for very large farms.
- All farms in four of the five regions increased their absolute net worth by the end of the period, with very large farms increasing more than the moderate farms. The two smaller farms in Illinois experienced a loss in net worth over the period, while the largest farm experienced a 14.5-percent increase in real net worth.
- On average, all three farms were able to grow by purchasing and leasing cropland. Moderate farms grew faster than the very large farms. The moderate and large grain farms grew at approximately the same rate.
- Average annual net farm incomes for all farms substantially benefited by the presence of price and income supports in the current policy. Removal of these program provisions resulted in negative average annual net farm incomes for farms in all regions except Illinois. (Illinois net farm incomes did not fall below zero because a large portion of cropland was devoted to soybeans, which do not receive a deficiency payment.)

- Ratios of net farm income to total Government payments reveal that, across all regions, the moderate farms were more dependent on Government payments to maintain their incomes than were the very large farms.

Price Supports

The price supports program is designed to prevent prices from falling below a certain level and to stabilize prices through the CCC nonrecourse loans at established loan rates to farmers. Such loans, plus interest and storage costs, can be repaid within 9 to 12 months when the commodity is sold on the cash market. If the market is not favorable for a farmer to sell the commodity and repay his loan, CCC accepts the commodity in full payment of the loan.

CCC releases its stock to the market when prices are high and withdraws stocks from the market when prices are low. Thus the program also stabilizes prices.

Results Expected

- Since price supports stabilize prices and prevent prices from falling below the loan rate, this program should increase farm income and reduce the price risk for farmers.
- All farms should have a higher probability of survival, greater net present value,[9] and higher net farm incomes than they would have had without the program.

Results Obtained

- Price supports increased the probability of survival for all three representative farms in all regions.
- Net farm incomes for these farms also increased with the price supports program. In all regions, the larger the farm, the greater the increase in net farm income.
- With increased farm incomes and reduced price risk, all three farms in all regions experienced increases in real net worth.
- Average ending farm sizes were not significantly different because of the price support program.

Income Supports

Income supports are accomplished through deficiency payments and the target price. Deficiency payments are paid to farmers to make up the difference between a price determined to achieve a politically acceptable income level (target price) and the average market price. Deficiency payments are made on each farm's base acres and farm program yield. The farm program yield is based on each farm's yield history. Target prices were set initially to reflect an average cost of production.

Deficiency payments were initiated to raise and stabilize farmer incomes to the level of the nonfarm population while allowing farm prices to be competitive in the export market. Total annual Government payments (deficiency and diversion) were limited to $50,000.

Results Expected

- The major impact of deficiency payments should be to increase the income level of producers who participate in the farm program. Since the payments are based on the quantity of eligible production, large-scale producers benefit more than small-scale producers, up to the $50,000-payment limitation.
- Deficiency payments also reduce income risk for producers, increase their ability to obtain financing, and thus increase the probability of all farms remaining solvent.

Results Obtained

- The deficiency payment program increased the probability of survival more for moderate Texas cotton farms than for the very large Texas farm. For farms of other regions, the

[9] The concept of present value is used to help measure the profit potential of an investment decision. Simply put, a dollar today is worth more than a dollar in the future because today's dollar can be invested and can accrue interest. Thus the present value of a specified amount of money payable at a specified future date is the amount of money that one would have to invest now in order to have that future amount by that future date. In analyzing an investment over several periods, a positive present value would indicate an economically attractive decision; a negative present value would not.

probability of survival was 100 percent, with or without income supports.

- Income supports increased net farm incomes substantially for all farms, often moving net farm incomes from negative to positive.
- Income supports enhanced net farm incomes of all farms more than the price support program.
- The presence of the $50,000-payment limitation causes the income support program to benefit moderate farms relatively more than very large farms. In contrast, the price support program results in a greater advantage for large and very large farms.
- With reduced income risk and greater farm incomes under the income support program, all farms improved real wealth, and average after-tax net present value increased for all farms.
- Income supports increased the average ending farm size for all farms. Average ending farm size increased at a faster rate for moderate farms than for very large farms.
- Removal of the $50,000 limitation on deficiency payments benefited larger farms more than smaller farms. Big winners of this program were big farms in Texas and Mississippi. In Texas, for example, when the $50,000-payment limitation was removed, average annual net farm income increased $3,600, $50,000, and $104,000 for moderate, large, and very large farms, respectively.
- Increased farm income strengthened the financial positions of larger farms, increasing their ability to obtain more financing. All three representative farms, especially the very large farms, had increased net worth at the end of the lo-year period. For example, removal of the $50,000 limitation increased the ending net worth of the moderate Texas cotton farm by $37,000, of the large Texas farm by $441,000, and of the very large Texas farm by *$1,019,000.*

supply Control Policy (Acreage Reduction Program)

The objective of acreage reduction programs is to reduce the quantity produced, and thus the supply, of a given commodity. Acreage reduction consists of an acreage set-aside and/or acreage diversion that is generally voluntary. Acreage set-aside programs require participating farmers to idle a percentage of their crop base acres so that they are eligible for other program benefits. Acreage diversion programs pay producers a given amount per acre to idle a percentage of their base acres. A farmer's base acres are determined by the production history of the crop.

For this analysis the provisions of the current policy were modified by adding a 15-percent set-aside with a 5-percent diversion for corn, cotton, rice, sorghum, and wheat in 1986-92. Normal slippage[10] (30 percent for corn and 70 percent for all other crops) and program participation rates were used to estimate the resulting real increase in mean prices for these crops in 1986-92. All other provisions of the current policy were used without change.

Results Expected

- To the extent that acreage reduction programs reduce production, they reduce supply and stocks and increase prices domestically for those commodities. Higher prices will result in higher total and net incomes for all farm sizes. Farms that participate in diversion payments also benefit from the program through increased cash receipts, up to the $50,000 limit.
- Slippage in the programs reduces the programs' effectiveness, increases the farms' net present value, and increases farm size.

[10] **Slippage** is the difference between the percent of production decrease and the percent of acreage reduced. These two percentages are different because farmers tend to set aside marginal lands in Government programs or intensify the cultivation of remaining land,

- Higher incomes lead to more disposable income for debt repayment and retained earnings for accelerating farm growth.
- Farm operators' average net present value should increase.
- Faster rates of growth should be experienced by the farms because of increased cash accumulation, repayment capacity, and equity in existing land assets.

Results Obtained

- Imposing a 20-percent acreage reduction program increased the average net present value and ending net worth for all three farms in all regions except for the large farm in Illinois.
- Imposing a 20-percent acreage reduction to existing farm programs resulted in an increase of 20 to 300 percent in net farm income for almost all farms.
- Average ending farm size for all three farm sizes increased relative to the initial farm size.
- Imposing additional supply controls to existing farm programs does not substantially change the rate of growth or ending farm size of all farms. Moderate farms continued to grow faster than larger farms.
- Eliminating slippage reduced the rate of growth relative to that in the current policy for all three farm sizes.
- The less slippage in an acreage reduction program, the smaller the increase in average net present value for all three farm sizes.

No Farm Program

In the no-farm-program scenario, all farm programs outlined for the current policy were eliminated for all 10 years of the planning horizon. In this essentially free market environment, farm prices and income are very unstable because: 1) production varies, owing to weather and biological factors; and 2) demand for farm products changes. The inelastic nature of supply and demand for farm products makes farm prices particularly unstable. The variability in prices and incomes has both favorable and unfavorable aspects. From a favorable perspective, the movement in prices reflects changes in supply and demand conditions and is a signal for production regarding market needs. However, when prices become highly unstable, the signals may be misinterpreted, and mistakes may be made in production and marketing decisions. The result frequently is misallocation of resources. In addition, variability in price and income increases the risk and uncertainty to the farm business.

Results Expected

- Average farm incomes will be less with no loans or price supports because the floor on prices received for these commodities has been removed, allowing prices to fluctuate freely.
- Net present value will be lower and more unstable than with price and income supports.
- Net worth of farms will decline because the market value of cropland will be less, since there are no benefits from the programs to be capitalized into the land.
- Farms will have less probability of survival because of increased instability in prices for crops. The impact will be more pronounced for highly leveraged farms that cannot survive without price and/or income support and for smaller farms that cannot survive with high price risk.

Results Obtained

- Removing all farm programs reduced the probability of survival for all three farm sizes in cotton and wheat regions, relative to the base policy. The probability of survival fell more for the moderate farms in these regions than for the very large farms. For example, in cotton the moderate farm's chance of remaining solvent for 10 years decreased from 92 to 42 percent. The chance for the solvency

of very large farms decreased from 94 to 78 percent.

- The probability y of having a positive after-tax net present value declined significantly for all farm sizes in all regions except for those farms in the Mississippi Delta, For example, in the Southern Plains the probability of a positive net present value for the moderate farm declined to about 10 percent. In most cases the very large farms had a higher probability of positive net present value than did the moderate farms. The probability of a positive net present value was 100 percent in the Mississippi Delta without the farm program, owing primarily to diversification of crop production and the reduced relative yield variability in the Delta compared with that of the other regions.
- Ending net worth declined for all three farm sizes in all regions. In most regions the absolute decline in net worth was greater for the large and very large farms than for the moderate farms. For example, the large and very large Texas cotton farms experienced a decline of $743,000 and $1,100,800 in net worth, respectively, from that of the current policy, while the moderate farms' net worth declined $396,800. The ending net worth of the Mississippi Delta farms declined the least of all regions because a significant portion of crop acreage was devoted to soybeans.
- In the absence of farm programs, all three farm sizes continued to grow in all regions, but at a much slower rate than under the current policy, For example, farms in the Southern Plains declined from the current policy an average of about 20 percent in ending farm size.

Target Farm Program Benefits

For the target farm program benefits scenario, all farm program and income tax provisions of the current policy were used except that large farms were not eligible to participate in farm program provisions. Farms producing more than $300,000 worth of program commodities (corn, cotton, rice, sorghum, soybeans, and rice) valued at their localized loan rate were not permitted to participate directly in the program provisions (CCC loan, FOR, target price / deficiency payments, and diversions / set-asides), Mean prices and relative variability in prices were not adjusted because it was assumed that a sufficient number of "small" farms participated in the farm program for the price support actions of the CCC loan and FOR to function normally.

Results Expected

- Findings for moderate farms will be the same as the findings for the current policy.
- Large and very large farms exempted from the programs will receive indirect benefits from other farms participating in the programs,
- Compared to the no-farm-program scenario, the following should be observed for large and very large farms:
  —Net present value will be higher and more stable.
  —Net worth of these farms will be greater.
  —Farms will have a greater probability of survival because of the increased stability in prices.
  —Farms will be larger because of increased income and large repayment capacity.

Results Obtained

- Moderate farms consistently producing less than $300,000 in program crops exhibited the same growth rates, net farm incomes, and ending financial positions as they do under the current policy,
- Farms that grew beyond or were initially larger than the $300,000 threshold level of sales experienced lower average Government payments, net farm incomes, average net present values, and net worths than under the current policy, owing to targeting program benefits.
- The larger the farm, the greater the reduction in average ending acres from the current policy for farms in the Southern Plains, Nebraska, and Illinois. Moderate grain farms in these regions experienced no real change in average ending farm size, because their level of total sales was less than $300,000.

- Growth rates for the very large farms in Texas and the Delta were similar to those experienced under the no-farm-program option. The moderate and large farms in the Delta experienced reduced rates of growth relative to that of the very large farms. A similar relationship was observed between the large and very large cotton farms in Texas. The reason for these different rates of growth is that the very large farms in these regions depend less on farm programs than smaller size farms do.

Reduced Income Tax Benefits and Current Farm Program

The Federal income tax provisions in place for the current policy were made more restrictive in the reduced income tax benefits and base farm program scenario. All farm policy provisions of the current policy were left unchanged, The more restrictive Federal income tax provisions included the following:

- Machinery, livestock, and buildings were depreciated using the straight-line cost recovery method.
- First-year expensing provisions were eliminated for all depreciable items.
- Maximum ITC provisions were eliminated.
- The maximum annual interest expense that could be used to reduce taxable income was ***$15,600.***
- The operator was required to sell obsolete machinery upon disposition rather than trading it in on new replacements, thus forcing recapture of excess depreciation deductions.

Results Expected

- Making Federal income tax policies less favorable tends to increase income tax payments by reducing tax deductions. Net cash farm income is not affected directly in the first **4** to *6* years. After that, interest income usually becomes a factor, and higher tax payments in the first 4 years reduce cash available for interest income in later years.
- The farm operator will have lower tax deductions and tax credits when machinery is replaced. The length of time machinery is kept will not likely be shortened from the current policy because machinery was replaced based on its normal economic life, not its depreciation life.
- Reducing tax deductions and tax credits will mean greater annual income tax payments, resulting in greater cash flow requirements and reduced ending cash reserves. Net present value will likely be reduced because of lower retained earnings and the slower accumulation of wealth.

Results Obtained

- Adoption of a more restrictive set of Federal income tax provisions had little impact on farm survival.
- Increasing the Federal tax burden on farmers reduced the average annual rate of growth in farm size about the same for all sizes of farms in each region. Average ending farm size was about *8* percent less than that for the current policy for large and very large farms and about 4 percent less for moderate farms.
- The more restrictive income tax provisions reduced the propensity to grow through purchasing cropland and increased the propensity to lease cropland for growth. For example, in the Mississippi Delta the growth rate in owned cropland for the moderate farm was reduced to 4 percent, and the growth rate in leased cropland increased by 49 percent,
- The changes in the tax provisions resulted in reduced annual net farm incomes for all sizes of farms in all regions. The reduction in net farm income was greater for the very large farm relative to the moderate farm because the very large farm had more depreciable items affected by changes in depreciation rules, ITC s, and capital gains treatment of sales of used machinery.

Technology Scenarios

To determine the impact of technology on structure, selected farm policy scenarios were simulated, assuming increases in mean yields

of crops only from the use of existing technologies. A comparison of these simulated results with those of the previous farm policy scenarios, which included increases in mean yields from emerging technologies, indicates the impact of new technology on structure. Three policy alternatives were analyzed under these conditions. They were the base farm policy, which continues all provisions of the 1981 farm bill, the elimination of income support provisions, and the elimination of all farm program provisions.

Results Expected

- The longer the technology is in use for each farm, the greater should be the benefit to wealth accumulation, net income, and rate of growth in acres controlled.
- The greater the increase in productivity, the greater should be the increases in wealth, net income, and rate of growth in acres controlled.

Results Obtained

- Farm policies had more effect on the final amount of acres controlled than did technology, across all sizes of farms in all regions.
- Technology had a greater impact on the final amount of acres controlled for the very large farms in all regions (except Nebraska) than for the moderate and large farms. Yield-enhancing benefits from emerging technologies increased average final farm size 1 to 2 percent in the Delta, Illinois, and Texas and 10 percent in the Southern Plains. The greatest increase in farm size occurred in the Southern Plains, because these farms are principally wheat producers. The greatest increases in yields were predicted by OTA to occur for wheat.
- Small increases in final farm size for the other regions can be explained by the relatively smaller increases in yields (based on the results of OTA workshops for corn, soybeans, cotton, and rice).
- Flows of new technology for all commodities in all regions were found to increase annual net farm incomes for each size of farm. Net farm income was increased relatively more for the very large farms than for the moderate farms, across all farm policies evaluated.

Summary and Conclusions

- Farm programs have major impacts on rates of growth in farm size, wealth, and incomes of commercial farmers.
- Most farm program benefits are capitalized into land values and net worth. Very large farms increase their net worth significantly more than moderate farms under current farm programs and account for a very large share of the program payments.
- Moderate farms depend more than very large farms on farm programs to maintain their incomes.
- Income supports provide significantly greater benefits to moderate farms than to very large farms. (In contrast, price supports provide more wealth and growth benefits to very large farms.) Targeting of income supports to moderate farms is an effective policy for prolonging those farms' survival.
- Very large farms can survive without income supports.
- Adoption of a more restrictive set of Federal income tax provisions had little impact on farm survival.
- Farm policies had more effect on the final amount of acres controlled than did technology, across all sizes of farms in all regions. However, in a relative context, technology had a greater impact on the final amount of acres controlled for the very large farm than for the moderate and large farms.
- Flow of new technology will increase annual net farm income for all sizes of farms, How-

ever, net farm income increased more for the very large farms than for the moderate farms.

Financial Stress and New Entrants Scenarios

Financial Stress Scenario

The financial position of many farmers is currently under severe stress. The situation is serious and may not improve for some time. Policymakers are considering various solutions to this problem. Two of the most discussed alternatives are interest rate subsidy and debt restructuring.

An *interest rate subsidy* is a loan at below-market interest rates. For example, if the Government's cost of money is 11 percent and the Farmers Home Administration makes loans at 5 percent, there is a 6-percent direct interest rate subsidy. To analyze the effects of such a credit policy, the financial positions of the three representative farms in each of the five regions were modified to depict highly leveraged farms. The long-term debt-to-asset ratio for each farm was increased to 55 percent, the intermediate-term debt-to-asset ratios were set equal to 60 percent, and annual interest rates on old loans were increased to their average values for 1980 to 1983.

The object of an interest rate subsidy is to reduce the cash expenses for interest costs, thus increasing total net cash farm income. The total cash requirements are reduced, thereby benefiting all farms. The total saving is greater for larger farms because of the total debt being larger on these farms.

Debt ***restructuring*** refers to the rescheduling of loan commitments. Debt maybe restructured by rewriting short- or intermediate-term debt to a long-term basis if the collateral justifies such change. The amount paid per year is then reduced. Without sufficient additional long-term collateral, debt restructuring is limited to rescheduling each class of loans—short-, intermediate-, and long-term—over a longer repayment period. Also, if the debt is on a fixed interest rate basis and interest rates have declined, the debt might be rescheduled in part to take advantage of lower interest rates and to obtain a longer repayment period.

Restructuring debt has the same type of expected effects as interest rate subsidy; however, the methods differ. Debt restructuring does not reduce the annual interest payments in the initial period unless long-term interest rates are less than intermediate-term interest rates. Annual principal payments are reduced, thus reducing cash flow needs of the farm operator.

Results Expected for Interest Rate Subsidy and Restructuring Debt

- Higher probability of survival.
- Higher land values, net worth, and average net present value.
- An increase in the equity ratio because current debts are paid and longer-term debts are reduced, allowing greater opportunity for the farm to grow in size because of the increased ability to leverage existing equity.

Results obtained From Financial Stress Scenarios

- Restructuring initial debt for highly leveraged farms failed to increase appreciably the probability of survival for each size of farm in any region except for moderate and large wheat farms in the Southern Plains.
- In all regions, the interest rate subsidy strategy substantially increased the average net farm income more than did the restructuring of farms' debts.
- Both debt restructuring and interest rate subsidy policies resulted in increased growth in farm size and real wealth (i.e., ending net worth) on the very large farms in all ***regions.*** In all regions but Texas, very large farms with high debts are not as dependent on financial bailout strategies for survival as moderate farms are.

- Both alternatives increased growth in farm size. Debt restructuring resulted in more rapid rates of growth than did interest rate subsidies.

Now Entrants Into Farming Scenario

All previous simulations of the effects from the farm commodity policy alternatives were based on representative farms operated by established farm producers. These simulations provide indications of the short-run effects of the alternative farm commodity policy provisions on economic survival and growth characteristics of established farm operations. They do not provide information on the survivability and economic viability of potentially new entrants into farming. To gain some general notions of the effects of selected farm commodity policies on newly established farming operations, the smallest farm in each region was simulated under the condition that the farm operator was a new entrant.

In this scenario the entering farm operator was allowed to have only minimum equity in owned farmland (30 percent) and farm machinery (35 percent). All farm machinery was considered to have a new machinery cost, and annual interest rates on long- and intermediate-term loans were equal to the 1980-83 averages. The operator was not allowed to have any off-farm investments. Because the farm operator was paying the full cost of all inputs (land, capital, machinery, and labor), these simulations provide an indication of long-run survivability and profitability of the representative farms. Three policy alternatives were analyzed under these conditions for the new entrant. They were the base farm policy, which continues all provisions of the 1981 farm bill, the elimination of the target price/deficiency payments provision of the program (no income support provisions), and the elimination of all farm program provisions.

Results Expected

- New entrants would be expected to face lower probabilities of survival, slower rates of real wealth accumulation, and slower rates of growth in farm size than would current operators on the representative farms in each region under existing farm legislation. Because both depreciation adjustments on machinery and annual cash requirements for debt repayment on real estate and machinery loans are based on new 1982 costs and current (1980-83) interest rates, annual net farm incomes will be lower for new entrants than for current operators, under existing policy.
- Elimination of income support provisions of the 1981 farm bill will be expected to reduce the probability of survival, rate of growth in real net worth and farm size, and annual net farm incomes of new entrants in each region. The greatest impacts would be expected for specialized crop farms producing commodities eligible for target prices and deficiency payments. Elimination of all farm program provisions would be expected to reduce further the rate of growth in real wealth and farm size. Annual net farm incomes for new entrants would be expected to be even lower, particularly on representative farms producing commodities eligible for set-asides and paid diversion provisions.

Results Obtained

- **New** entrants exhibited considerably lower probabilities of survival under the base farm policy than did current operators for all specialized crop farms. The diversified crop farms in Nebraska and the Mississippi Delta exhibited relatively high probabilities of survival for new entrants.
- New entrants experienced much lower rates of real wealth accumulation than did current operators under current policy. In two of the regions—High Plains wheat farm and Nebraska and Illinois crop farms–real net worth after 10 years was lower than initial net worth on the farms, indicating that the new entrant operator had to sell owned cropland to remain solvent. Net farm incomes were negative for all farms, with the High Plains wheat farm experiencing the largest relative decline in annual net income.

- New entrant farm operators in the High Plains wheat and Nebraska and Illinois crop regions were unable to increase farm size over the 10-year period under current farm policy, The Texas cotton farm and the Mississippi Delta crops farms experienced considerable growth, **20** and 33 percent, respectively,
- Eliminating the target price / deficiency payments provision of current legislation substantially decreased the probability of survival and ending net worth on all farms. Only the Texas cotton farms exhibited any appreciable growth in farm average (about 10 percent).
- Under the policy alternative of no farm programs, none of the farms exhibited reasonable potentials for remaining solvent over the 10 years, Farms in the Texas High Plains, Southern Plains, and Corn Belt had less than a 10-percent probability of survival, Mississippi Delta farms had only a 60-percent chance for remaining solvent over the 10 years.
- Under the current farm program only the Nebraska and Mississippi Delta crop farms had sufficient returns for new farmers to enter agriculture with a reasonable chance of remaining solvent and making a reasonable return on their investment,
- Elimination of income support, price support, and supply control provisions of current farm policy resulted in new entrant farmers in all five regions facing little chance of surviving and becoming an economically viable farming operation.
- Other sources of income, economic assistance, or wealth accumulation will be required for these new entrants to survive economically in an open market farm policy environment,

Summary and Conclusions

- Restructuring of debt for highly leveraged farms does not appreciably increase their probability of survival.
- Interest rate subsidy substantially increases average net farm income more than debt restructuring. It is, therefore, a more effective strategy for easing financial stress.
- Very large farms with high debts do not depend on these financial programs for survival as moderate farms do. Under these programs, very 1arge farms will grow significantly in farm size and real wealth.
- New entrants into agriculture will not likely survive even with current farm programs. Other sources of income, economic assistance, or wealth accumulation will be required.

CHAPTER 8 REFERENCES

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