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The Distribution of Farm Program Benefits:
An Alternative Strategy

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Among criticisms of existing agricultural support programs, the issue of equity in the distribution of benefits occupies a central position. The distributional impacts across farm size under an income insurance program are analyzed and compared to current outcomes. Insurance may equalize benefit distribution and facilitate subsidy of certain farm sizes.

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Among the criticisms of existing agricultural support programs, the issue of equity in the distribution of benefits occupies a central position. Critics frequently point out that benefits from these programs appear to accrue to large farms, while the small or medium size farms, those alleged to be most in need of assistance, receive relatively smaller benefits. In this case, benefits are usually taken to be direct income, or deficiency, payments, made as a result of the supply control programs.

Statistics on the distribution of these government payments do bear out the charges of critics. In recent years, the bulk of all deficiency payments went to the largest farms, which comprise a relatively small percentage of the total number of farms in the country. The issue of whether or not this pattern of distribution is equitable is, of course, rather more subjective. If the aim of supply control programs is to reduce production and so raise market prices to all farmers, then inducing the largest producers to participate, by means of cash payments, would seem an efficacious means of shifting the aggregate supply curve inwards. However, supply controls have not been particularly effective in this regard, largely due to the problem of slippage in administering acreage reduction. Consequently, the current perception of farm programs as inequitable is exacerbated by their ineffectiveness in reducing supply and in improving the farm sector's net income postition.

Current debate surrounding the development of the 1985 food and agricultural legislation has repeatedly touched on this issue of equity. Popular sentiment seems to support the idea that the "family" farm is in jeopardy and that government programs do little or nothing in its defense. Moreover, the "family" farm is identified with small, and more usually, medium sized farms, where the definition of small versus medium versus large changes with geographical location and commodity mix. Proposals for altering the distribution of benefits have included reduction of the maximum $50,000 per farm limit on deficiency payments, preferential credit treatment for selected farms, and negative income tax schemes targeted at "family" farms.

Another policy instrument alternative which has been considered in the somewhat different context of a new support scheme is income insurance. Insurance would differ from current support programs in at least two important respects. First, the standard of support would be related to income or revenue and not to prices received alone. Second, the absolute level of support would be more closely tied to the economic performance characteristics of individual farms, in contrast to existing loan rate and target formulae which set a national level meant to apply to large and small farms alike. These distinctions have implications for the distribution of benefits by farm size, first, because the level and stability of income may vary with farm size, and second, because the structure of an insurance scheme may allow preferential treatment of farms of a particular size without altering the economic incentives faced by all farms. These implications are explored in this analysis, which does not purport to advocate any particular distribution of farm program benefits as the most equitable but simply presents an alternative to that which currently exists.

The analysis begins with a brief description of the concept of income insurance for commodity producers. Then, data on Illinois farms are used to examine historical distributions of revenue from soybean production and to calculate insurance premiums across farm size groups. These results are then considered for their distributional implications.

Income insurance for commodity producers

Reductions in incomes of commodity producers result from production losses, low prices, or both. Current agricultural support programs provide protection against declines in yield (through crop insurance) and price (through the loan rate and deficiency payments) without explicit coordination to meet an income goal. In contrast, under an income insurance program, producers would receive compensation if income fell below a stipulated insured level, whether the shortfall were caused by low prices, low yields, or both. Income insurance thus directly addresses the issue of farm income maintenance and stabilization (see Offutt and Lins for further discussion of income insurance).

In return for protection against catastrophic shortfalls in income, a producer would be expected to pay at least part of an insurance premium.

The size of the premium required would depend on the distribution of his or her income over time. The characteristics of this distribution instrumental in determining the probability of loss or shortfall below any particular level are the mean level of income and the variance of income around that mean level. When the distribution of income is normal, these two parameters completely specify the distribution, and this information may then be used in the calculation of the monetary premium required for a particular level of protection (see Ray). The definition of income in this analysis is taken to be gross farm production revenue, which represents the receipts from the production and sale of a specific commodity (thus excluding the proceeds from custom work, land rentals, etc.). So, income insurance is something of a misnomer, and the term revenue insurance will be used instead.

Guarantee levels for such revenue insurance could be set with respect to a percentage of historical average revenue. In the absence of price supports, insurance would stabilize revenue around market determined levels and would not provide revenue enhancement if that meant insuring a return above market-determined levels. If historical revenue experience for each individual farmer were used to set premiums (as under the Individual Yield Coverage provision of multiple peril crop insurance), then the absolute level of guarantee would depend only on that farmer's experience. This standard contrasts with the current system under which support prices are determined by USDA on a national level and applied to all farms. The determination of benefits from a revenue insurance program as reflected in the size of premiums and the level of coverage will depend not only on the level of mean gross production revenue but also on its variability for a particular farm. To the extent that this relative variability differs by farm size, the distribution of benefits from revenue insurance may differ from that of current farm support programs.

Soybean revenue insurance for Illinois farms

In order to determine whether the benefits from revenue insurance would be distributed any differently than those from current programs, an idea of the magnitude of premiums across farm size is required. As is the case with multiple peril crop insurance, premiums would be calculated on a per acre basis as a means of standardization with respect to acreage planted.

The distribution of farm soybean revenue over time was chosen as the basis for the analysis because of the absence of an effective loan rate or subsidized storage in the market, which should tend to truncate the lower tail of the revenue distribution. However, it is recognized that the loan rate for corn, since corn is a substitute in production for soybeans in many areas, does also provide a floor under soybean prices although at a much lower level than might otherwise result. The data on soybean revenue are derived from Illinois Farm Business Farm Management Association records. Data were available on 170 farms over five years (1978 through 1982). Revenue from soybean production was determined on an annual basis as the receipts from the sale of soybeans, which could also include some sold from storage. These revenue data may also include some receipts from custom work, but there was insufficient information with which to purge this component from the data.

The historical revenue data were grouped by farm size, measured as the number of acres planted to soybeans in any particular year. The farm size groups were defined at 80 acre intervals which allowed for some variation in planted acreage from one year to the next to minimize the chance that, over time, a farm might move from one size group to the next. The group of the smallest size farms (containing 45 percent of all the farms in the sample) devoted between 140 and 220 acres to soybeans. The medium size group (37 percent of the sample) had 220 to 300 acres in soybeans, and the large size group (18 percent of the sample) between 300 and 380 acres. Thus, each farm size class contained five annual observations on soybean revenue for each farm in that size class. Recognizing that even an 80 acre interval might mask inter-farm variation, each 80 acre size class was further subdivided into four 20 acre intervals. Then, the annual revenue observations were standardized by dividing by the average number of acres planted to soybeans in that interval. The mean and standard deviation of revenue per acre for each size interval within a class were determined from these distributions. Then, revenue per acre for each 80 acre size class was obtained as an average weighted by the number of observations in each of the four 20 acre intervals.

If per acre premiums were calculated using a distribution including all farms regardless of size, the possibility of differences in mean levels and variability of revenue per acre by size group is not allowed. However, the relevant question in assessing the distribution of benefits from insurance is whether the relative variation around mean revenue levels is substantially different from one class of farm size to the next. Since the size of the premium will depend on the mean and variance of the underlying revenue distribution, these differences will directly affect the distribution of benefits from insurance.

Examination of the average soybean revenue per acre by farm size class does reveal such differences, as shown in Table 1. While the average revenue per acre increases by only about two percent from the small to large size class, its standard deviation decreases by approximately 14 percent. This phenomenon is reflected in the decrease in the coefficient of variation as farm size increases. For the purposes of revenue insurance, the underlying determinants of this pattern are of lesser importance. Premiums are based on the revenue distribution, without regard to the relative contributions of yield and price variation. In this context, it matters not whether large farms experience less revenue instability because their yields are more stable or because their marketing skills are better than those on smaller farms. A structural explanation of this phenomenon would certainly be useful in improving farm management practices, but is not attempted here.

Soybean revenue per acre for each size group interval was determined to be approximately normally distributed by application of a Chi-square goodness of fit test. Knowing that the normal distribution can be completely specified by the mean and standard deviation, these two parameters may be used in determining the insurance premium required for each farm size group at a given level of revenue coverage. The method used to calculate monetary premiums, given below, is that described by Botts and Boles in an application to normally-distributed yield data. This formula is still in general use as the basis for calculation of multiple peril crop insurance premiums.

$$P = \alpha(C - Y) + d\sigma$$

Here, P is the premium per acre (in dollars), α is the proportion of total acres with revenue less than the coverage level (C), Y is the average per acre revenue, d is the height of the normal curve at the ordinate C, and σ is the standard deviation of revenue per acre. Explained intuitively, this formula represents the expected value of the size of the loss (the difference between the revenue per acre which actually occurs and the guaranteed coverage level), which is the size of the indemnity the insuring agency would have to make in the event of a loss. (For a derivation from first principles, see Botts and Boles.) Thus, the amount so found is a pure premium rate which does not include any "loading" for administrative costs or profit.

In this context, the comparison of premium levels abstracts from other actuarial considerations which would arise in practice. In particular, the questions of independence of losses across farms or of adverse selection or moral hazard are not addressed. While acknowledging the significance of these issues, this analysis examines the distributional characteristics of a revenue insurance scheme which could impinge on its probability of adoption. For a discussion of the important issues associated with the implementation of an insurance program see the report of the Farm Income Protection Insurance Task force.

In calculating premiums for the Illinois farm data, the guaranteed coverage level was set at 90 percent of the five year average revenue per acre for each size group. Since the coefficient of variation for all farm size groups averages about 16 percent, coverage levels below about 84 percent insure against the occurence of a relatively unlikely event. Moreover, for these farms, cash costs typically run closer to 90 percent of gross production revenue, suggesting that lower levels of coverage might be of less interest to producers. Average calculated premiums by farm size class are shown in Table 2.

Since average revenue per acre changes only modestly from one size class to the next, the 90 percent guarantee level provides about the same absolute level of coverage to all classes. However, the required premium per acre decreases by almost a third from the small to the large size class. This difference is attributable to the relatively greater variability round the mean revenue level experienced by the smaller farms. Inspection of the premium formula shows the importance of this increase in variability, as representd by σ, the standard deviation, which enters the calculation through its influence on the size of α and in the additive term, $d\ \sigma$. Essentially, the relatively large value for σ means that the lower tail of the revenue distribution for small farms is "fatter" than that for larger size classes, representing an increase in the probability and size of a loss.

Implications and conclusions

The distributional impacts across farm size of the revenue insurance program presented in this analysis imply that small and medium size farms would pay more than large farms for about the same absolute level of coverage. If equity is judged only by benefits received, then insurance might be considered to achieve a more equitable distribution of benefits than that attained under current programs. On the other hand, revenue insurance might still be thought regressive since the smaller farms must pay more in premiums to achieve the same benefit level. While this outcome is fair in an actuarial sense, societal perceptions of equity may well be based on other criteria.

In the context of revenue insurance, a solution to the apparent "bias" against smaller farms would be the subsidization of premiums. A more fundamental approach would determine the causes of the relatively greater variability in receipts on smaller farms and attempt to alter farm practices so as to impart greater stability. The decision to assist smaller farms, by whatever means, would be made in the political arena, and, as is the case now, be based on criteria not necessarily related to economic or actuarial standards of production efficiency.

Compared to current agricultural support programs, revenue insurance may have the advantage of allowing an equalization of benefits across farm size classes. Moreover, the benefit level is directly observable as the level of revenue guarantee per acre per farm. This absolute level is related to individual (or representative individual, as here) farm experience rather than to a standard supposed to be applicable across all farms. An insurance program would also allow some flexibility in a producers' selection of the level of guarantee according to individual farm cost structure and also risk aversion. Some operators might prefer a lower level of protection, where premiums would be lower as well. Such variation in preferences could be accomodated by the insurance program since the relevance of the underlying revenue distribution would not change with the level of coverage selected. (Insurable revenue would always be calculated net of any indemnity received.) The market environment faced by all farmers would change with revenue insurance to the extent that insurance allowed some producers to remain in operation following a bad market year, thus maintaining the level of aggregate supply.

Under revenue insurance, if the political decision is made to assist a certain class of farms, the subsidization may be accomplished in a direct manner that does not involve alteration of the mechanism by which benefits are determined for all farms. Societal perceptions of equity, expressed in the political arena, may inevitably lead to such preferential treatment of some farms. In that event, a support program which can accomodate subsidization of selected farms without directly affecting the position of all others may hold appeal. Abandonment of the price mechanism as a means of income transfer might, for example, obviate the concern over the effect of the loan rate on U.S. price competitiveness in export markets.

This analysis of revenue insurance has considered but one, albeit important, aspect of agricultural support policy. The desirability of revenue insurance as an alternative to current support programs would be evaluated by other criteria, such as aggregate supply assurance, in addition to its distributional implications. However, given the apparent concern over distributional aspects of support programs, it seems worthwhile to investigate alternative means of accomplishing politically expressed goals.

The conclusions of this study are necessarily dependent on the empirical context in which it was performed, that of specialized grain and soybean farms in Illinois. Further research into the characteristics of revenue insurance in other regions, for other commodities, and for different categorizations of farm size, would be required to validate the findings of this analysis.

Table 1. Soybean revenue per acre by farm size class

Class (acres in soybeans)	Average Revenue per acre (dollars)	Standard Deviation per acre (dollars)	Coefficient of variation (σ/μ)
SMALL (140 - 220)	$282.74	$50.88	0.18
MEDIUM (220 - 300)	284.04	46.65	0.16
LARGE (300 - 380)	288.77	43.63	0.15

Table 2. Soybean revenue insurance per acre by farm size class

Class (acres in soybeans)	Premium per acre (dollars)	Guarantee per acre (dollars)	Whole farm premium (dollars)
SMALL (140 - 220)	$9.23	$253.86	$1666.79
MEDIUM (220 - 300)	7.75	254.71	1973.13
LARGE (300 - 380)	6.72	259.83	2255.38

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