

The Potential Influence of Risk Management Programs on Cropping Decisions

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Subsidies for crop insurance are set as a percent of premium. Since premium rates are a direct function of relative risk, this subsidy mechanism provides higher transfers as risk increase. This is true for farmers who are neighbors, as well as for farmers who farm in different regions. Consider two farmers who face different premium rates. For the lower risk farmer, the rate is \$10 per \$100 of liability. The higher risk farmer would be charged \$20 per \$100 of liability without subsidies. Given a 50 percent subsidy, the first farmer can expect a \$5 per \$100 of liability transfer over time. The higher risk farmer expects \$10 per \$100 of liability. The incentives for the farmer receiving higher subsidies to gain access to that subsidy are stronger than those of the lower risk farmer. One way to gain access is by increasing plantings. Thus, the hypothesis to be tested is that crop insurance subsidies and participation encourage farmers to plant more crops that are eligible for those subsidies.

The primary objective of this research is to test if crop insurance subsidies have encouraged increased acreage allocations in the risky agricultural regions of the U.S. Primarily due to data limitations, an ordinary least squares (OLS) model is used in this study to explain changes in cropping patterns across the U.S. for the 1978-1982 and 1988-1992 time periods. Thus, this study represents initial research that assesses the potential influence of risk management programs on cropland use. The major limitation of the study is that a more fully specified model is not developed. There are potential simultaneity problems as the decision to extend planting could be motivated by other factors and once the acres are planted, one is more prone to insure a higher percentage of the new acres in high risk regions than in low risk regions. Wu has done the only farm level study of this issue to date that test the causality using as set of simultaneous equations. He finds that the crop insurance decision encourages additional plantings in Nebraska. Therefore, despite the limitation of this study, the Wu Study gives some indication that the causality is as is hypothesized and tested in this paper.

The results support the hypothesis that risk management programs are influencing land-use patterns in the U.S. More directly, the estimate is that for every 10 percentage point increase in participation in crop insurance there is an additional 5.9 million acres planted to the top six crops in the U.S. The current participation in buyup crop insurance

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is roughly 50 percent. Therefore, if the results of this study suggest that there may be an additional 30 million acres of crops in the U.S. because of the crop insurance program. While this number seems high, this study is also limited in that it uses aggregate data to estimate the model. *Decisions made at the margin should be modeled with farm-level data.* This is the major limitation of this study and most other work on planting response.

In addition to the aggregate data problem, the data used in this study are for a period prior to major crop insurance reforms of 1994 and 2000. The current program provides higher subsidies and greater coverage. Subsidies have moved from 30% of premium to 59% of premium for 70% coverage. Coverage is also available for 85% coverage. Additionally, CAT insurance policies have replaced much of what was being done as ad hoc disaster aid in the late 1980s and early 1990s. Under CAT policies, farmers selecting 50 percent coverage levels, at 55 percent price levels, pay only administrative costs.

Literature

Agricultural land-use patterns in the U.S. have changed dramatically in the last century. While most agree that technological advances, urban expansion, and the opening of international markets have been major driving forces behind the changing face of the agricultural landscape, many fail to recognize that agricultural policies that subsidize price and yield risk may be equally important. There has been speculation that government agricultural support programs, specifically risk management programs, have played a significant role in changing land-use patterns in the U.S. (Griffin, Skees).

Concern has risen that the subsidies on risk management programs have not just provided financial assistance to farmers in need, but have indirectly led to a misallocation of our natural resources (Griffin; Hoffman, Campbell, and Cook). The design of both the federal crop insurance and disaster assistance programs provides a higher level of transfer payments to relatively high-risk production areas.

Ricardo developed the concept of the 'extensive margin' to describe land with lower productivity than primary land (Tietenberg). The extensive margin refers to the acreage that is on the edge of production or acreage that would be brought into production next with minor changes in prices or relative cost. Many times land at the extensive margin is also used to describe land with greater yield variability. For the purposes of this study the extensive margin is the boundary between field crop and pasture production. As such it can be argued that extensive margin applies both to regions as well as to many individual farms. If the risk management programs are creating incentives to plant more at the extensive margin, they are resulting in inefficiencies and, to the extent that the extensive margin is more erodible, potential environmental problems. Griffin raised questions about how much the risk management programs offset the objectives of the Conservation Reserve Program (CRP). In short, his study suggested that for every acre taken out of production by CRP, another acre was being added because of the U.S. risk management programs.

Until the mid 1990s, the influence of disaster assistance transfers or crop insurance subsidies on resource allocation had largely been ignored. Miller and Walter (1977) first noted the likelihood that disaster assistance programs would encourage production in marginal areas. Later Hoffman, Campbell, and Cook (1994) alluded to the fact that crop insurance and disaster assistance programs provide farmers with incentives to continue to farm on fragile or ecologically valuable lands. However, neither study formally tested their hypothesis.

Griffin (1996) was the first to test the impact of disaster assistance and crop insurance programs on planted acres and, indirectly, on soil erosion at the extensive margin. Griffin used panel data on irrigation practice, Conservation Reserve Program (CRP) enrollment, disaster assistance payments, transfers from crop insurance and disaster programs, participation in the crop insurance program, and deficiency payments to predict changes in cropping intensity for two points in time in the Great Plains. The results of his study revealed a clear relationship between crop insurance and disaster assistance transfers and changes in cropping intensity in the Great Plains.

Following Griffin's study, Goodwin and Smith (1996) measured the effects of the Federal Crop Insurance Program on soil erosion and input (i.e., fertilizer and other chemicals) use in the Midwest. Goodwin and Smith's analysis suggests that crop insurance program participation has increased rapidly in areas more susceptible to erosion.

Wu (1999) investigated the effect of crop insurance on cropping patterns and chemical use. Using area study data for the central Nebraska basin, Wu estimated a farmer's crop insurance and acreage decisions using a simultaneous equation system. His results showed a shift from hay and pasture to corn production when corn crop insurance is provided. He provided formal tests to determine if the causality relationship was that crop insurance motivates more planting. These tests suggest that this is the correct causality. Wu also demonstrated that the shift in crop mix might lead to an increase in soil erosion and chemical input at the extensive margin.

In an unpublished study, Young et al. (1999) looked at the extent of market distortion directly attributable to federal crop insurance subsidies. The study measured the market distortion by using acreage and production shifts. A national policy simulation model, POLYSYS-ERS, was used on crop insurance subsidies that were converted to commodity-specific price wedges. A price wedge was defined to be the per bushel subsidies for crop insurance were added to expected commodity prices. This simulation model was used to capture the intra- and inter-regional acreage shifts and cross-commodity price effects. The results of their study suggest that these subsidies actually generated only small shifts in aggregate plantings on a national level. Yet, at the regional level there has been a shift in planted acres towards the Plains states, away from the Far West and Southeast. Young et al. notes, "An additional important result is that price feedback and cross-price effects tend to dampen the own-price effect suggesting that acreage shifts are substantially smaller than results which ignore feedback and cross-commodity price effects." Nonetheless, their study is also limited because the level of

aggregation was at the state level. As discussed earlier, many of the production effects from crop insurance subsidies come from farm level incentives. In addition, they do not investigate the current levels of subsidy. Current subsidies are greater than for the period investigated.

Conceptual Issues and Methodology

U.S. federal crop insurance and disaster assistance programs were designed to provide financial assistance to farmers in the wake of a natural disaster. The disaster assistance program provides a direct payment to farmers who suffer from catastrophic crop loss (Goodwin and Smith). The Federal Crop Insurance Program (FCIP) provides federally subsidized insurance against crop losses resulting from a natural disaster. Specifically, the focus of the FCIP is to reduce yield risk, hence income variability. With the FCIP, farmers make a decision to purchase or not. In contrast, *ex post* disaster assistance is free insurance where all producers receive indemnity payments as a pure transfer. In the case of crop insurance, farmers can develop their plans with a strong likelihood that the product will work as they think it will. In the case of ad hoc disaster aid, farmers cannot count on how much might come or whether any payment will come when there is a crop failure. Thus, one would expect that crop insurance transfers have more influence in planting decisions than ad hoc disaster payments.

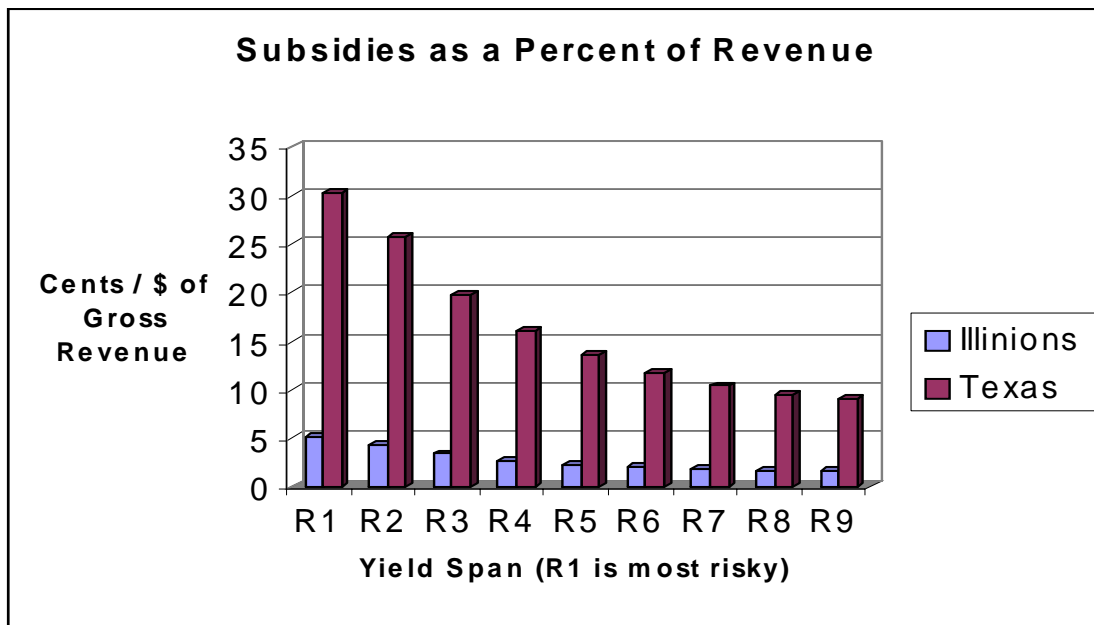
Disaster assistance programs nearly always pay based on some percent of average yield. Crop insurance pays in this same fashion. Subsidies for crop insurance are based on a percent of the premium. For example, in recent years farmers selecting 65% coverage levels received premium subsidies of 41.7%. Premium subsidies are now set at 59% for coverage up to 70%. Again, this mechanism favors high risk farmers. To illustrate this point, corn premium rates were used with the new subsidies of 59% for 70% coverage. Consider two farmers in the same county. One has an APH yield of 100 bushels and the other has a yield of 50. The 100 bushel farmer faces a 10 percent rate for his yield; his neighbor faces a 20% rate. Value insured will be 70% of the APH yield x the price. Price cancels out in these equations; therefore, a price of \$1 is used. Thus, the first farmer will insure \$70 and the second will insure \$35. The premium is $.1 \times \$70 = \7 and $.2 \times \$35 = \7 . While the subsidy is the same for both farmers, as a percent of revenue, the first farmer gets a transfer that is 4.13% and the second gets double that amount or 8.26%.

These calculations are performed in table 1 to illustrate the differences one can get within a county. Values range from 14% of total receipts to 3%. Such differences are large and occur within the same county. The values in the last column of table 1 illustrate the national values for percent of farmers who fall into the different yield spans. Clearly, only a few farmers are likely to obtain the highest values. However, keep in mind that decisions are made at the margin and every county has marginal land. For that matter, most farms have marginal land as well.

Table 1: Subsidies as a Percent of Revenue for a Sample Kansas Corn County

	APH	Rate 70	Liability	Premium	Subsidy	Sub % of Rev	Est. of Business
R1	45	34%	\$ 32	11	\$ 6	14%	1%
R2	61	28%	\$ 43	12	\$ 7	12%	3%
R3	76	21%	\$ 53	11	\$ 6	9%	7%
R4	91	16%	\$ 64	10	\$ 6	7%	15%
R5	107	13%	\$ 75	10	\$ 6	5%	28%
R6	123	11%	\$ 86	9	\$ 5	4%	26%
R7	138	9%	\$ 97	9	\$ 5	4%	12%
R8	153	8%	\$ 107	9	\$ 5	3%	4%
R9	177	8%	\$ 124	9	\$ 6	3%	3%

The figure below gives the average values for two different states to further illustrate the differences. In Texas, the average highest risk category can expect to get 30% of his/her revenue from crop insurance subsidies. This is if everything is perfect in the RMA rates for the insurance products. When actuarial problems are taken into account, the percentages can be even greater. If an individual farmer can get 30% of his/her revenue from crop insurance subsidies, one should expect these subsidies to influence planting decisions.



Regional differences in relative risk and the impact of subsidy differential among regions are only part of the story. The rules for establishing yield guarantees in the crop insurance program are tied to farmers and farms, not to parcels of land within the farm. Therefore, it is possible to add a marginal parcel of land to an existing crop insurance policy that has been established using good cropland. This type of behavior, coined 'moral hazard' in microeconomics, will increase the unintended subsidy through excess losses and favor converting marginal land on individual farms. Adding land that has lower yields than those that are proven on existing land can be profitable. The new land may likely have been converted from pasture to cropland to gain access to these subsidies. This was a significant problem in the most recent crop year (2000). RMA has significantly tightened the rules for adding new land.

Farmers have a number of choices to consider when making the decision about what to grow on a particular parcel of land. For simplicity, consider only two choices: 1) crops; or 2) pasture and grassland. The returns from pasture and grassland are the imputed value of these inputs into a livestock enterprise. In a world of risk and uncertainty, the decision will be based on relative profitability, relative risk, and the risk aversion of the decision-maker. Market forces and government programs determine relative profitability and relative risk. In the simplest terms, the portfolio choice between crops and pasture will be determined by the following:

- 1) expected price and risk for crops versus livestock ;
- 2) expected output and risk for crops versus livestock;
- 3) expected cost of production for crops versus livestock;
- 4) expected returns and risk from gov't programs for crops versus livestock.

For this study, data for livestock returns were not available. Further, cost of production data for crops were not available. Government programs are not common for livestock, though some emergency feed assistance programs have been in place. Deficiency payment data were also not available for the analysis period or at the Crop Reporting District level. Therefore, the model focuses on expected total revenue from growing crops over the study time period (the late 70s vs the late 80s) and the transfers from crop insurance and disaster payments.

Ideally, one would like to model the cropping decisions through time and across space to determine how government subsidies may have influenced where crops are grown. Year-to-year variations are difficult to capture in many models. Given the data and other practical constraints, this study develops a model that attempts to capture changes across geographical space for two distinct periods. The two time periods chosen are the '78 period (1978-82) and the '88 period (1988-92). Using a five-year period smoothes out some of the noise that cannot be modeled with this change model. The two five-year periods reflect very different regimes in the agricultural and policy environment. Crop insurance subsidies were introduced in 1981 and were still small by 1982. The '78 period was the transition period from a market driven agricultural

economy to one of more support from government. The '88 period was one of major disaster payments and large support from government.

Estimating the effects of government programs on land use, such as disaster assistance and federal crop insurance, requires a tremendous amount of data. The data used in the study are drawn from: the National Agriculture Statistical Survey (NASS), Federal Crop Insurance Corporation (FCIC), and the Economic Research Service (ERS). The data set created for this project is at the Crop Reporting District (CRD) level in the U.S., from 1974 through 1994. The information on crop insurance premiums, transfers, and liability payments were obtained from the FCIC county summary of business data. Information on disaster assistance was obtained from the ERS, and the information on acres planted and revenue was obtained from the NASS.

The focus of this study is on explaining the shifts among the CRDs for six major crops in the U.S. as measured by acres. The crops include corn, wheat, soybeans, grain sorghum, barley, and cotton. These six crops comprise nearly 90 percent of the crop acres in the US. The critical decision in the aggregate is how much potential cropland is put into these six crops versus land that is used primarily as pasture.

The Dependent Variable

Regional shifts in the cropland base, or specifically cropland use, have occurred for decades; these changes were more pronounced in the early to mid 1980s. This was also the period in which crop insurance subsidies were being established. Figure 1 shows the trend in cropland use as a percent of the total U.S. acres for the top four regions. The total acreage planted to the six crops and the associated government idled land tied to the six crops are used to measure cropland use. It is clear that the Central and Northern Plains states have gained in share since the mid 1980s. The North Central region has maintained a relatively fixed share and the Southeast has lost share.

The dependent variable, DACRE, is created to capture the shift in cropland use among the CRDs for the two time periods. Cropland use is measured as a percentage of the maximum potential cropland acres (MAXAC) for each time period. MAXACRE is the largest number of total acres devoted to the six crops and idled cropland, including CRP, over the period 1974 through 1994. MAXAC is calculated for each CRD. The sum of the maximum values represents the estimate of the total available land for crops in the study area. This total is roughly 330 million acres.

$$DCROP = CROP'88 - CROP'78$$

Where

$$CROP'88 = \text{Planted Acres}'88) / \text{MAXACRE} - (64.2\%)$$

$$CROP'78 = \text{Planted Acres}'78) / \text{MAXACRE} - (80.7\%)$$

In the final model, 285 CRDs are used. This set of CRDs comprises well over 95 percent of the U.S. acreage for these six crops. Figure 3 includes data for only those CRDs remaining in the model. This figure also illustrates the shifts that have occurred among regions in the US between the late 1970s and the late 1980s.

Table 1 gives yet another clear picture of the differences by region for the two time periods. In this table, all land planted to the six crops and all government idled land are added by region for the two time periods. The Southeast had a 17% reduction between these two periods, while the Central and Northern Plains gained 20%. The Southern Plains also gained 11% during the same time period. Again Figure 3 shows significant changes in cropping patterns by CRD. The shift to the Plains states is very clear.

Explanatory Variables

As with any model of this magnitude, compromises must be made. Two classes of independent variables are created: 1) the market and 2) the government. Market incentives include cost of production, technology, price, and other market-based influences that affect a farmer’s production decisions. Government incentives are those programs that influence farmer’s production practices, such as disaster assistance programs, crop insurance, deficiency payments, and tax policies.

Most troublesome is that deficiency payment data could not be obtained for the two time periods. Since the model is largely explaining the differences in cropping patterns across space, this may not be a serious limitation. One can argue that deficiency payments largely influence farmers in different regions in a similar fashion to a price effect. Thus, it may not be a serious problem not to include this potentially important variable. Nonetheless, Barnett and Skees do demonstrate that program yields that are used to make deficiency payments are based on harvested acre yields rather than planted acre yields. This likely favors high risk regions as well since there will be a larger difference between planted and harvested acre yields.

Another potentially important missing variable is cost of production. Again, most farmers will face similar prices for many inputs. Since the model captures trends in yields, the differentials across space in how technologies influence trends in yields are accounted for in this model. This trend in yields is likely the most important cost of production measure for explaining regional production shifts.

The model that is used in this study follows:

DACRE = f (Regional dummy; 0 = South / 1 = Rest of U.S.	REGION
	Change in crop insurance participation	DPART
	Change in net crop insurance subsidies per \$ of revenue	DCIPAY
	Change in program base acres	DBASE
	Rate of disaster payments per \$ of revenue for ‘88 period	DISPAY
	Change in insurance premium rates paid by farmers	DRATE
	Change in some limited other crops planted	DOTHER
	Change in revenue for portfolio of 6 crops	DREV
	Change in idled acres as percent of MAXAC	DIDLE
	Base percent of acres planted to 6 crops as percent of MAXAC	A78)

Again, all changes are the differences in the variables between the two time periods, the average of 1988 to 1992 minus the average of 1978 to 1982. All variables are also converted to be percentages.

DPART – Change in crop insurance participation

As the rate of participation in crop insurance increases, one might expect that there would be more opportunity on each individual farm to add additional crop acres by converting some marginal land to crop acres. There are two possible ways to measure participation: 1) insured acres as a percentage of total crop acres or; 2) value of the crop insured (liability) as a percentage of the total expected value of the crops. Each of these is used in turn by fitting two separate models. Since there were no significant differences in these models, only results for the participation measured with acres is used.

$$PAR'78 = (\text{Acres Insured}'78 / \text{Acres Planted}'78)$$

$$PAR'88 = (\text{Acres Insured}'88 / \text{Acres Planted}'88)$$

$$DPARAC = PAR'88 - PAR'78 \text{ (expected sign is positive)}$$

The participation level averaged 22.2 % for these six crops in the '88 period and 7.8% for these six crops in the '78 period. The average difference is 14%, with a range of -5% to 55%.

Participation by taking the value of the crop insured over the expected total revenue is calculated:

$$PARL'78 = (\text{Liability}'78 / \text{Total Revenue}'78)$$

$$PARL'88 = (\text{Liability}'88 / \text{Total Revenue}'88)$$

$$DPARL = PARL'88 - PARL'78 \text{ (expected sign is positive)}$$

The participation level using liability averaged 14.0% for these six crops in the '88 period and 5.2% for these six crops in the '78 period. The average difference is 8.9%, with a range of -8% to 51%.

DCIPAY - Change in net crop insurance subsidies per \$ of total revenue

As discussed previously, crop insurance subsidies tend to favor the high-risk regions and create incentives for farmers to convert more pasture to cropland as these subsidies increase. It is fairly straightforward to calculate the net dollars transferred for each crop. The FCIC summary of business data set is used. The sum of all farmer premiums paid for crop insurance is subtracted from indemnities paid to farmers for the five-year period. Dividing by the sum of the total value of the crop that is insured during the five-year period (the insurance liability) normalizes these total transfer values.

$$FARM'78 = (\text{Indemnity Payments}'78 - \text{Farmer Premiums}'78) / \text{Liability}'78$$

$$FARM'88 = (\text{Indemnity Payments}'88 - \text{Farmer Premiums}'88) / \text{Liability}'88$$

The independent variable is simply the difference between these two rates:

$$\text{DCIPAY} = \text{FARM}'88 - \text{FARM}'78 \text{ (expected sign is positive)}$$

There is significant variability in these variables as well. One expects the '88 period transfer to be greater as there was more subsidy in that period. The average net transfer in crop insurance for the '88 period is 8.3 cents for every dollar of insurance liability versus 6.3 cents for the '78 period. While the average for the differences (the DCIPAY variable) is 2.0 cents, the range of these differences goes from -49 cents to +29 cents.

DISPAY – Rate of disaster payments per \$ of revenue for the '88 period

Just as crop insurance transfers are expected to influence production decisions, when farmers grow to expect disaster payments, these payments may also influence production decisions. Unfortunately, disaster assistance data were not available at the county or CRD level for the '78 period. Nonetheless, the levels of total disaster payments during this period were small relative to the '88 period. Only the rate of disaster payments per expected total revenue is used for the '88 period. Unlike the crop insurance transfers, everyone is eligible for the disaster payments. For this reason, the sum of all disaster payments for the six crops over the five-year period is divided by the total expected revenue for the same period.

$$\text{PAYDIS} = \text{Disaster Payments}'88 / \text{Total Revenue}'88 \text{ (expected sign is positive)}$$

This variable averages 2.55 cents per dollar of revenue. The range of the variable is from zero to 16.7 cents.

DBASE – Change in base acres for commodity program crops

Since many of the six crops were eligible for commodity program payments, it was important to incorporate for the limits that the government set on how many acres could be planted to some of these crops. For this reason, the control variable that captures the change in the base acres was developed. Base acres are important for five of the six crops: corn, wheat, cotton, grain sorghum, and barley. They were not in effect for soybeans. The percentage difference in the average base acres between the two time periods is used:

$$\text{B78} = \text{Base acres}'78 / \text{MAXAC}$$

$$\text{B88} = \text{Base acres}'88 / \text{MAXAC}$$

$$\text{DBASE} = \text{B88} - \text{B78} \text{ (expected sign is positive)}$$

DRATE – Change in insurance premium rates paid by farmers

Crop insurance experience has not been the same in every region of the country. For example, significant contract design problems created opportunities for fraud and abuse for Southern soybeans during the early 1980s (Skees et al.). Other regions had similar underwriting problems. One way used to fix these problems was to simply increase the premium rates. If insurance decisions do influence production decisions, then areas where underwriting problems were addressed by raising rates should have been disadvantaged relative to areas where rates remained relatively constant. The base or total

premium, before subsidy, is used to calculate the average premium rate during each of the five periods:

$$\text{RATE}'78 = \text{Total Premium}'78 / \text{Liability}'78$$

$$\text{RATE}'88 = \text{Total Premium}'88 / \text{Liability}'88$$

$$\text{DRATE} = \text{RATE}'88 - \text{RATE}'78 \text{ (expected sign is negative)}$$

The average rate in the '78 period is just over 8.0% versus 9.1% for the '88 period. The difference between the two periods averages just over 1%, and the range in the difference is from -9% to +12.3%.

DOTHER – Change in some limited other crops

Some of the other crop data (other than the 6 crops) was available. These data were used to develop a proportional value and the change in other crop acres available.

$$\text{O78} = \text{Other crop acres}'78 / \text{MAXAC}$$

$$\text{O88} = \text{Other crop acres}'88 / \text{MAXAC}$$

$$\text{DOTHER} = \text{D88} - \text{D78} \quad \text{(expected sign is negative)}$$

DREV – Change in expected revenue from the mix of six crops

The market forces are captured by calculating the expected total revenue for the mix of the six crops in each CRD. First an expected price is estimated using state price and national price data for the period 1974 to 1994. To account for major shifts in demand that may have created additional incentives to grow specific crops in a particular region, a state basis trend is estimated. For example, it is likely that as the livestock industry moved into some of the Plains states during this period, the relative state price for feed grains moved up relative to national prices. The basis is simply developed as the ratio of state prices to national prices of a crop. A simple linear trend line is fit to this series of ratios. State prices are estimated for a given year as the trend basis ratio times the national price for that year. A distributed lag structure, that weights the most recent year's information the heaviest, is imposed on the state price estimates. Therefore, the price used for any particular CRD in a given year is calculated as follows:

$$\text{Exp.Price}_t = .7 * (\text{Basis Trend}_{t-1} * \text{Nat. Price}_{t-1}) + .3 * (\text{Basis Trend}_{t-2} * \text{Nat. Price}_{t-2})$$

Expected prices are estimated for all six crops. National prices were used when state prices were missing. Expected yields are also estimated for all six crops using linear splines (Skees, Black, and Barnett). The trend yields for planted acres are used when that data is available. Otherwise, harvested acre trend yields are used. Given an expected price and an expected yield, the total revenue for the mix of the six crops in each CRD is easily calculated by using the planted acres of each crop in the CRD. Again, in the few cases where planted acres were missing, harvested acres were used.

$$\text{Total Revenue}_t = \text{Expected Price}_t * \text{Expected Yield}_t * \text{Acres Planted}_t$$

The sum of the six crops gives the total revenue from the mix of the six crops. Revenue per acre is calculated by dividing the total revenue by the sum of all acres planted to the six crops.

$$\text{REV}'88 = (\text{Total Revenue}'88 / \text{Planted Acres}'88)$$

$$\text{REV}'78 = (\text{Total Revenue}'78 / \text{Planted Acres}'78)$$

Since all variables in this model are either rates of change or percentages, the percentage change in revenue per acre between the two time periods is used as the independent variable:

$$\text{DREV} = (\text{REV}'88 - \text{REV}'78) / \text{REV}'88 \text{ (expected sign is positive)}$$

As one would expect, there is considerable variation in these numbers across space. For example, when cotton is the dominant crop the per acre revenues are quite high (exceeding \$600). By contrast, when wheat dominates the crop mix, the per acre revenues are less than \$40 per acre for some CRDs. The average in the '88 period is \$170 versus \$153 in the '78 period. There is a variation in the percentage difference in these values between the two time periods; from -17% to over 120%.

DIDLE – Change in proportion of MAXAC that are idled by gov't programs

Major differences occurred in the land that was idled by government programs in the '78 period versus the '88 period. Some limited set aside programs in the early period account for about 7.6 million acres. By contracts, set aside acres in the '88 period averaged 29 million acres. CRP acres were even greater at 31 million. These values were also measured as the proportion to the MAXAC possible to normalize them between the two times periods and across CRDs. As idled acres increase, one can expected a decline in the plantings to the six crops.

$$I78 = \text{Set aside}'78 / \text{MAXAC}$$

$$I88 = (\text{Set aside}'88 + \text{CRP}'88) / \text{MAXAC}$$

$$\text{DIDLE} = I88 - I78 \text{ (Expected sign is negative)}$$

A78 – Base proportion of planted acres in the initial period

Since there is a limit to how many acres can be added, it is logical that the initial position should influence how much change can occur. The variable is simply:

$$A78 = \text{Acres planted to 6 crops in}'78 / \text{MAXAC} \text{ (Expected sign is negative)}$$

The Models and Results

A simple OLS model is developed to explain the change in cropping intensity among the CRDS from one time period to the next. The model variables are generally of the expected sign and highly significant. The exception is the disaster payment variable that is negative rather than positive. Change in revenue is also of the wrong sign. Both are also significant. As for disaster payments, there was a major drought in the Midwest during the period. This spread the disaster payment out and could explain the results. It

may also be possible that disaster payment do not influence production decisions because people are unable to count on these payments and therefore do not include them in their production decisions.

All variables are in percentage values. Therefore, responses are considered by using percentage point changes in the explanatory variables. These changes will change the proportion of cropland that is planted in the six crops as a percent of the MAXAC. Since the planted acres in the '78 period was 267 million, a one percentage point change in planted acres is equal to 2.67 million. Thus, if the coefficient is .5 on an explanatory variable, the corresponding change in acres planted would be one half of 2.67 million.

As expected, the change in participation in crop insurance is positive and highly significant. This coefficient is .22. This value times the 2.67 million, suggest that for every 1 percent point participation in crop insurance there is a response of 586,000 acres among the six crops. Therefore, as we surpass 50 percent participation rates in crop insurance, this result suggest that planted acres to the six crops is roughly 30 million greater than it would be without crop insurance. This is roughly 10% more acres that may be planted because of crop insurance participation. The crop insurance transfer variable is also positive and highly significant.

Another independent variable that appears to have a large influence on cropland use is the change in crop insurance premium rates (DRATE). In this case, a one unit increase in the DRATE ratio (total premium/liability—the premium rate difference between the two time periods) would result in a 1.66 decrease in cropland use (a reduction of about 4.4 million acres). Still, care should be taken in interpreting the parameter estimates. The largest change in rates occurred in the Southeast. The southern states had tremendous actuarial problems during the 1980s. The solution has been to raise rates. Some of the crop acres may have switched to trees in the Southeast and this is not reflected in the dependent variable. The dummy variable for regions captures some of this. Nonetheless, the result suggests that rate increases may have placed the South at a competitive disadvantage relative to the rest of the U.S.

As expected, the change in commodity base acres (DBASE) also influences cropland use. As farmers built base, they were able to slightly increase their cropland use. While significant in both models, the parameter estimates are relatively low; suggesting that the variable really has little impact on aggregate use of cropland acres.

Finally, one might ask how robust the model is when the time periods are changed. A number of different time periods were constructed for several pairs of different time period models. The three variables that maintain significant are: 1) change in crop insurance rates; 2) change in crop insurance transfers; and 3) change in crop insurance participation.

Conclusion

The importance of this research lies in two areas. The first is resource allocation. If different regions receive different incentives from government transfers to put acres into production, then production will be technically inefficient. The second is the

consistency in agricultural public policy. By encouraging production, risk management programs are offsetting supply control benefits of the programs like the CRP.

This research has significant implications for agricultural policy. The Disaster Assistance Program was eliminated with the 1994 crop insurance reform. The subsidy on crop insurance was increased so that coverage is free (minus a \$60 administration fee) for 50% coverage level and 55% price. Thus, the current crop insurance program contains the catastrophic element of the disaster program. However, there is an important difference. With the CAT insurance there is a contract that provides certainty of a payment. With *ad hoc* disaster aid this was not the case. The models presented here suggest that the disaster aid did not influence production decisions while the crop insurance did. The results do support the original hypothesis that U.S. crop insurance programs have created incentives for farmers to plant more acres, in particular in regions that are most risky.

Of the most concern, is the degree to which crop insurance participation appears to influence cropland use patterns. This not only has had potentially large influences on where crops are grown, but has also likely had a large influence in the aggregate cropland use. If the results here are accurate, additional crop acreage for the crops studied may be more than 10 percent greater because of crop insurance participation and subsidies. More research is needed to examine this important issue.

While this research identifies an important issue in the way the subsidies are structured for crop insurance, the issue can be addressed. Rather than base subsidies on the percentage of premium charged to farmers, a flat subsidy per acre could be used. Even more useful would be to target a per unit of production subsidy. For example, if it were determined that 3 cents a bushel is the proper subsidy for a bushel of corn, it would be possible to devise rules to make this happen. This would be more efficient than the current subsidy rules. Such rules would no longer favor high-risk regions and farmers.

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Figure 1: Regional Share of Six Crops + All Government Idled Cropland for the Six Crops; Corn, Soybeans, Wheat, G. Sorghum, Cotton, and Barley.

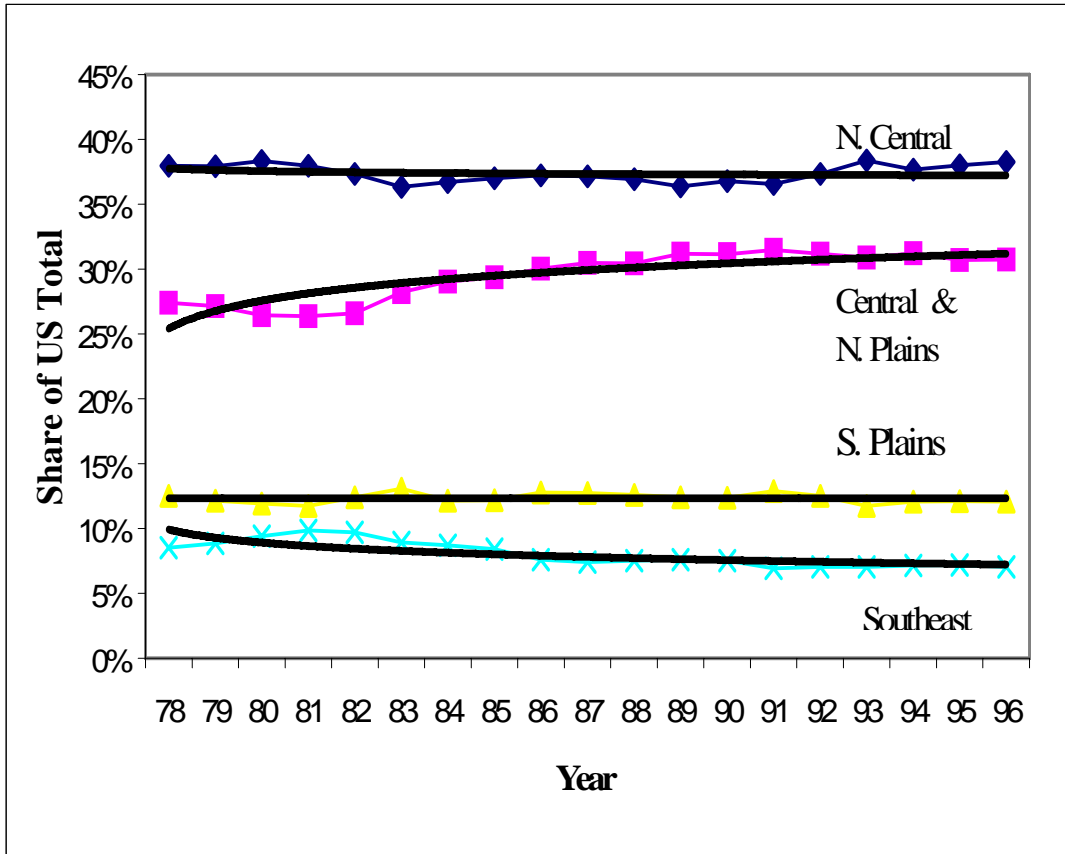


Table 1: Differences in the Average Annual Acres Devoted to the Top Six Crops and All Government Idled Land for the Two Time Periods

	1978-82	1988-92	% Change
Southeast	25,547,581	21,828,392	-17%
Delta	11,410,626	9,939,920	-15%
S. Plains	33,477,6'88	37,469,303	11%
Far West	19,806,816	19,829,121	0%
Central & N. Plains	73,830,000	92,759,183	20%
North Central	104,429,978	109,751,917	5%
N. East	7,052,993	6,779,705	-4%
U.S. Total	275,555,681	298,357,540	8%

Figure 2
U.S. Crop Production Regions

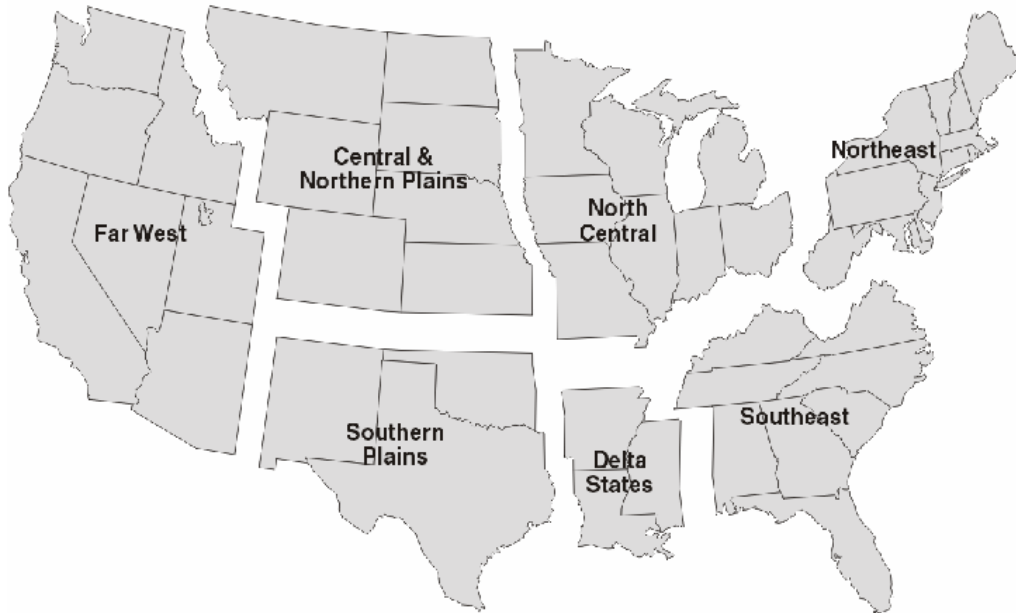


Figure 3: Gains and Losses in Crop Share for the Top Six US Crops Plus All Idled Land Between 1988-92 and 1978-82

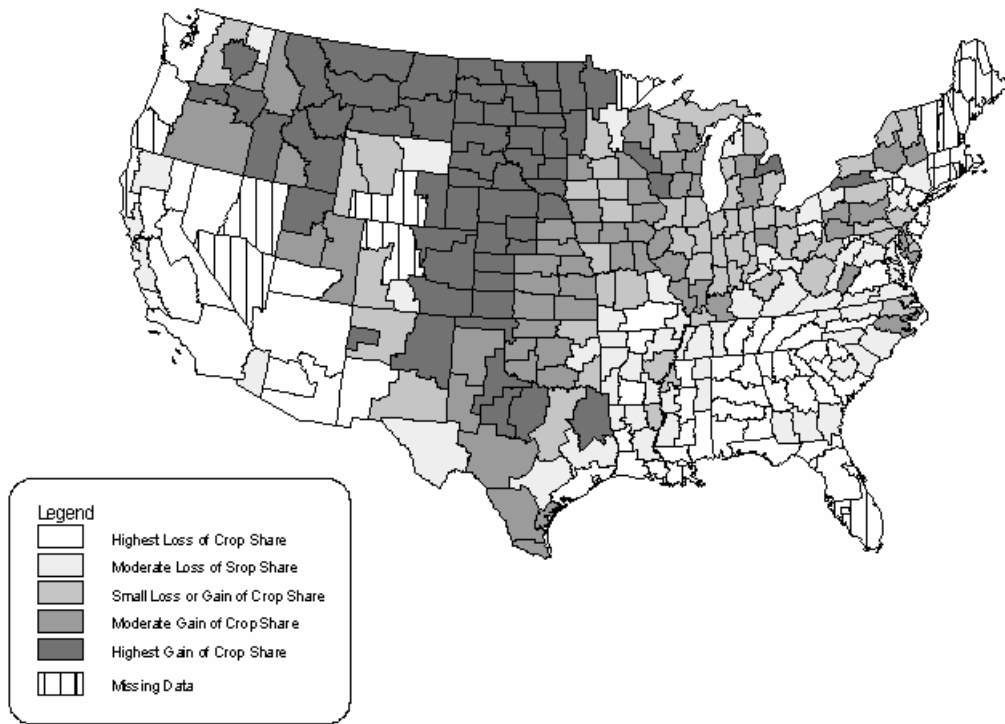


Table 4: Model Results and Variable Values

R Squared= .64 For Explaining Change in Proportion of cropland planted to 6 crops

	Parameter Estimate	Standard Error	T score	T -Test	Variance Inflation	Acreage Influence for a 1 % pt increase
INTERCEP	12.18	5.33	2.3	0.0232	0	
REGION	14.36	1.52	9.5	0.0001	1.4	
DPART	0.22	0.06	3.5	0.0006	1.7	586,543
DCIPAY	0.23	0.07	3.6	0.0004	1.3	625,741
DBASE	0.47	0.05	9.1	0.0001	1.2	1,266,659
DISPAY	-0.52	0.34	-1.5	0.1243	1.7	(1,387,751)
DRATE	-1.66	0.29	-5.8	0.0001	1.3	(4,444,119)
DOTHER	-0.59	0.19	-3.1	0.002	1.1	(1,567,114)
DREV	-0.14	0.06	-2.2	0.0273	1.2	(363,085)
DIDLE	-0.47	0.07	-6.3	0.0001	1.2	(1,254,331)
A78	-0.37	0.06	-6.4	0.0001	1.2	(989,595)

Table 5: Equations Used in SAS for Model

Max Acre = the maximum area planted in the 6 crops + set aside + CRP over the period 1969-1994. These values are summed over all 285 CRDs to get MAXAC.

In every case, 78 refers to the average values for the 5 year period 1978-1982 and 88 refers to the average values for the 5 year period 1988-1992.

Values appearing in BOLD are used in the model.

Proportion of total crop acres available planted in the 6 crops.

a78=ac78/maxac*100;

a88=ac88/maxac*100;

dacre=a88-a78; Dependent Variable

region = 0 if the CRD is in the South (in Figure 1 this is the Southeast, Delta States, and the Southern Plains.

par78=acins78/ac78*100;

par88=acins88/ac88*100;

dpart=par88-par78;

drev=(rev88-rev78)/rev88*100;

o88=other88/maxac*100;

o78=other78/maxac*100;

dother=o88-o78;

b88=base88/maxac*100;

b78=base78/maxac*100;

dbase=b88-b78;

rate88=prem88/liab88*100;

rate78=prem78/liab78*100;

drate=rate88-rate78;

i88=(crp88+idle88)/maxac*100;

i78=idle78/maxac*100;

didle=i88-i78;

Disaster payment data for the 70s is not available. The values were much lower during this time. They were not zero. Nonetheless, this is the assumption that must be made. It is unlikely that this assumption causes serious problems. Therefore, dis78 is set equal to zero.

dis88=disp88/trev88*100;

dis78=0

dipay=dis88-dis78;

ci78=farm78/liab78*100;

ci88=farm88/liab88*100;

dci pay=ci88-ci78;

Table 6: Values for variables used in the model

	Average	Per88	Per78
DACRE	-16.6%	64.2%	80.7%
REGION (0=South)	63.0%		
DPART	14.5%	22.4%	7.9%
DCIPAY	2.0%	8.3%	6.3%
DBASE	0.005%	51.813%	51.818%
DISPAY	2.6%	0.026	0
DRATE	1.1%	9.2%	8.1%
DOTHER	0.1%	3.2%	3%

DREV	8.4%	170	153
DIDLE	15.3%	17.1%	1.8%
A78	80.7%		

--- Values in Millions ---

	-	
	88-92	78-82
	average	average
Acres Planted to 6	237.5	267.6
Acres Insured	76.9	28.5
Net Indemnities (\$)	358.9	58.3
Base Acres	194.5	180.4
Idled Acres	29.0	7.6
CRP Acres	31.5	
Max Acres	330.3	

SUM of some important variables

	Delta	North Central	SouthEast	SouthWest	UpperPlains	Lower 48
AC78	16,705,380	102,651,340	25,948,767	32,068,594	69,943,400	267,620,525
AC88	12,907,230	95,304,042	16,987,048	26,583,050	69,722,180	237,513,570
IDLE78	112,717	1,577,202	213,525	1,408,574	3,793,209	7,578,876
IDLE88	1,093,553	7,231,928	2,701,821	5,599,975	10,293,095	29,021,865
CRP88	1,025,595	7,033,323	2,505,273	5,280,554	12,611,716	31,472,188
ACINS78	1,386,335	8,810,941	1,938,088	1,515,643	12,891,792	28,482,943
ACINS88	2,309,705	28,565,394	1,985,429	8,193,670	33,062,870	76,900,161
OTHER78	-	1,153,003	1,899,607	424,590	1,152,700	5,694,030
OTHER88	0	1,153,819	1,626,472	455,232	1,500,502	6,339,894
BASE78	3,958,533	62,178,000	11,481,187	27,833,205	58,900,329	180,425,627
BASE88	7,116,975	64,620,085	13,140,117	28,777,184	67,240,474	194,555,807
PREM78	18,214,185	53,976,086	21,169,880	14,784,303	62,251,619	178,652,830
PREM88	30,020,624	206,894,717	24,994,227	84,871,003	182,572,072	545,008,820
LIAB78	208,779,197	1,054,499,284	238,696,049	142,874,354	829,192,237	2,649,602,558
LIAB88	220,291,934	4,288,060,219	227,493,522	759,769,080	2,435,708,918	8,227,828,337
FARM78	32,252,203	(19,737,389)	25,979,010	11,941,534	8,444,274	58,315,849
FARM88	35,535,265	45,469,395	9,619,125	124,824,767	130,743,929	358,887,972
MAXAC	18,297,013	115,329,598	29,890,828	43,970,276	97,295,111	330,557,644

MEAN VALUS FOR I MPORTANT VARIABLES

	MidSouth	MidWest	SouthEast	SouthWest	UpperPlains	Lower 48
DACRE	-30.44	-8.64	-33.84	-13.22	-0.98	-16.57
A78	87.94	86.78	84.95	68.21	70.37	80.75
A88	57.51	78.14	51.10	54.98	69.39	64.18
DIFF	-16.06	3.12	-18.00	4.65	19.59	-1.23
PER78	88.53	88.21	85.72	71.04	74.10	82.52
PER88	72.46	91.33	67.72	75.69	93.69	81.28
DPART	12.43	16.97	5.25	20.49	27.71	14.50
PAR78	7.67	6.08	6.11	4.76	17.91	7.85
PAR88	20.10	23.05	11.36	25.24	45.63	22.35
DREV	11.12	6.57	6.52	4.21	8.38	8.35
REV78	155.71	191.88	133.80	116.71	114.07	153.44
REV88	180.07	204.69	147.17	130.71	127.61	170.38
DOTHER	0.00	0.17	1.34	0.36	0.28	0.08
O78	0.00	2.12	6.74	2.23	2.50	3.10
O88	0.00	1.95	5.41	2.59	2.78	3.18
DBASE	11.64	0.58	0.49	2.28	8.31	0.01
B78	22.92	56.90	42.44	56.08	57.84	51.81
B88	34.56	57.47	42.93	58.35	66.16	51.82
DRATE	4.50	0.40	2.42	-0.14	0.03	1.08
RATE78	9.50	6.45	8.91	10.62	8.76	8.08
RATE88	13.99	6.85	11.33	10.48	8.79	9.16
DIDLE	14.37	11.76	15.84	17.88	20.57	15.33
I78	0.58	1.43	0.77	2.83	3.73	1.77
I88	14.96	13.20	16.61	20.71	24.30	17.10
DISPAY	3.16	2.23	2.04	4.18	3.80	2.56
DCIPAY	-6.03	3.19	-1.69	2.84	4.66	1.96
PAY	-2.86	5.42	0.36	7.02	8.47	4.52
CI78	22.90	0.61	8.68	11.69	2.06	6.33
CI88	16.87	3.80	6.99	14.53	6.72	8.29