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Modeling Correlated and Disaggregated Crop Revenue Distributions: Implications under Mixed Policy and Program Initiatives

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Jim A. Jansen, Matthew C. Stockton, and Bradley D. Lubben,

This work outlines the quantitative procedures and results of the policy effects for alternative designs of federal revenue-based farm income safety net programs on eight individual representative farms across the state of Nebraska. Measures include financial impacts of the farm crop revenue-based safety net with a state revenue trigger versus potential alternative programs involving guarantees at the district, county, and farm levels. The methodology correlates national yield and prices with state, district, county, and farm-level yields. Results indicate that decreasing the aggregation of the revenue guarantee increases expected farm-level payments and program costs for the revenue-based safety net.

Objectives

This study defines and applies the quantitative procedures behind modeling eight representative grain and/or oilseed farms across Nebraska to evaluate expected farm level payouts associated with changes in the Average Crop Revenue Election (ACRE) program from a state guarantee to potential program alternatives involving guarantees at the district, county, or farm level. The stochastic components modeled in the simulation include price and yield expectations, variability, and correlations, including prices at the national level and yields at the national, state, district, county, and farm-level. Results of the simulation provide insight on the economic consequences of alternative revenue safety net designs for Nebraska that are also relevant to other crops or regions of the country during the 2012 Farm Bill debate.

Background

The ACRE program provides a revenue-based safety net and was authorized as part of the Food, Conservation, and Energy Act of 2008 (USDA Farm Service Agency, 2009). Previous legislation enacting the Direct and Counter-Cyclical Program (DCP) provided income support to producers based on price (USDA Farm Service Agency, 2008). Qualifying producers may either participate in the DCP or ACRE. Opting for ACRE allows the producer to still receive 80% of the Direct Payments (DPs), but the irrevocable decision eliminates participation in the Counter-Cyclical Payment Program (USDA Farm Service Agency, 2009).

States such as Nebraska have a diverse topography and a wide variety of production and climatic factors. Moderate to severe drought in western Nebraska may only have slight effects in the east. Rainfall is expected to increase 2 inches per 25 miles going from west to east. Previous findings by Dismukes, et al. (2011) show switching from the current state ACRE trigger to a

district or county guarantee may allow for increased correlation with the risks faced by an individual producer and potential farm-level payments. Previous research relevant to Nebraska by Lubben, Jansen, and Stockton (2011) support this finding.

Debates surrounding the work of the Joint Select Committee on National Deficit Reduction created a rich source of farm program proposals to evaluate potential farm-level program payments. The current design of ACRE with a state revenue trigger serves as the base against which to compare alternative program designs. At the next lower geographic level, the Aggregate Risk and Revenue Management (ARRM) proposal relied on a district guarantee, whereas the Systemic Risk Reduction Program (SRRP) proposal presented a county trigger. At the farm level, the Agricultural Risk Coverage (ARC) proposal correlated protection against farm-level crop revenue losses by using a producer-level guarantee (Shields and Schnepf, 2011). The current ACRE program, along with ARRM, SRRP, and ARC create a set of hypothetical alternatives to investigate potential farm program payments and implications on national program costs.

Simulation and forecast modeling relevant to farm income and policy analysis has historically focused on either a sector-level analysis or representative-farm comparison. This type of research serves as the basis for identifying a modeling and analysis procedure relevant to farm-level decisions in Nebraska. Building upon previous simulation modeling incorporates strengths of previous techniques. Grasping the scope and variability leads to analysis relevant to the diversity of cropping patterns across the state.

At a sector level the Food and Agricultural Policy Research Institute (FAPRI) (2011) provides annual agricultural baseline projections and policy analysis. Estimates provided by the FAPRI model are aggregated or averaged, however, and may not reflect the outcomes relevant

for farm-level decision making. Projected values do provide insight for national policy debates and overall performance of major sectors composing the agricultural industry. In another sectoral analysis, Coble and Dismukes (2008) outlined potential average payouts of integrating government programs and crop insurance across eligible acres in the United States. Dismukes, Arriola, and Coble (2010) further evaluated potential ACRE payouts across the United States and identified average variability rates of yields pertinent to the program's revenue triggers. Their results also reaffirmed the importance of correlation between farm and state-level yields related to the likelihood of potential ACRE payouts.

Projections from the FAPRI model serve as parameters for farm-level modeling taking place at the Agriculture and Food Policy Center (AFPC) at Texas A&M University. The models used by AFPC evaluate different risk alternatives for approximately 98 representative crop, livestock, and dairy farms strategically located across the United States to forecast the financial health of these operations under alternative policies and production scenarios. Nebraska's contribution to the AFPC project are two representative grain farms located in the south central portion of the state measuring 2,400 and 4,300 acres in size (Richardson, et al., 2011). These models while generally representative lack the detail for wide application across the state.

Woodard, Sherrick, and Schnitkey (2009) expand upon previous crop insurance studies by integrating a multi-crop framework with data from the Illinois Farm Business Farm Management (FBFM) record keeping system in the simulation analysis of crop insurance. Drawing upon the FBFM and Kansas Farm Management Association (KFMA) yield series, Zulauf, Schnitkey, and Langemeier (2010) modeled a more extensive evaluation by incorporating the interactions between ACRE, Supplemental Revenue Assistance Payments (SURE) program, and Revenue Protection (RP) crop insurance. These studies highlight the

impact correlations have between producer level yields and larger aggregated distributions, single-crop versus multi-crop models, and geographical and climatic patterns of yield productivity and variability have on the performance of various risk management tools.

With the diversity in size, numbers, and location throughout Nebraska, previous studies and research have not developed the specific methodology and procedure necessary for evaluating alternative federal revenue-based farm income safety net programs. Previous models do however serve as a guide in developing a more specific model. A theme common amongst previous studies and many forecasting methods is to use information from the past such as variability to predict possible future yield and price distributions. It is always important to consider the relationships among the variables to be included in a simulation. Accounting for the interactions among various crop yields and prices requires that correlations are included at each aggregation level throughout the simulation process.

Data

The geographical differences of Nebraska cause production systems and cropping patterns to differ across the state. Traditionally, western regions have semi-arid conditions and lighter soil profiles, whereas eastern areas incorporate greater precipitation and heavier soil layers. These features influence cropping patterns and expected trend yields seen throughout the state. Irrigation remains a strong feature throughout many operations because of available water sources. Irrigated crops have higher expected yield projections and less variability than dryland grain and oilseed plants. Throughout the following analysis grains not receiving additional moisture from irrigation and solely relying on precipitation for water will be referenced as dryland crops.

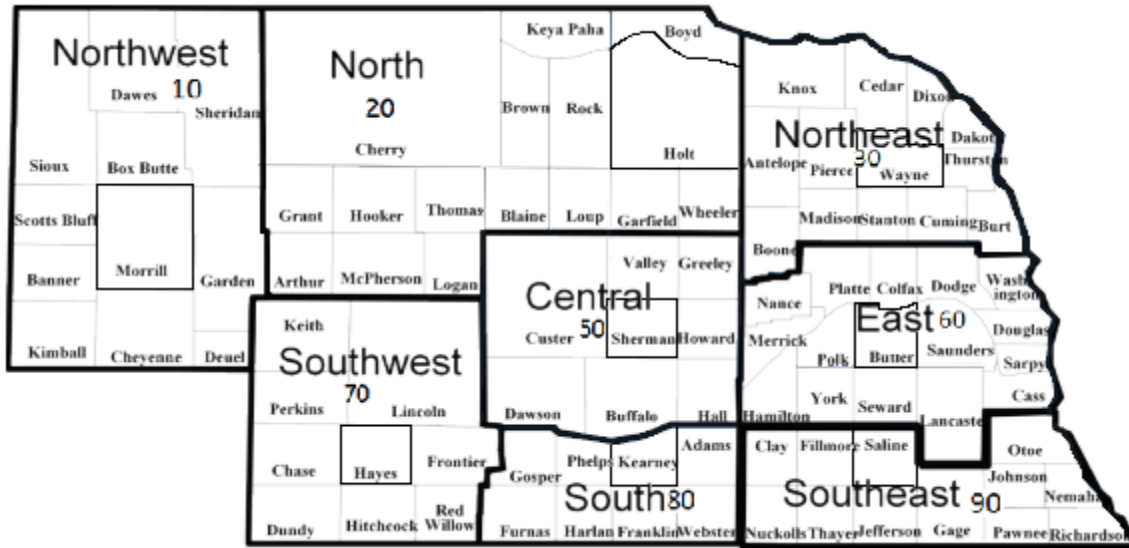


Figure 1. Nebraska NASS Agricultural Statistical Districts and Representative County Simulation Sites

The NASS-Agricultural Statistical Districts (ASDs) subdivide Nebraska’s 93 counties into eight regions. Figure 1 displays the eight NASS-ASDs for Nebraska. Districts are named as well as number numbered according to NASS definitions. Each set of district counties share similar production characteristics and yield expectations. Also in Figure 1, one county per district has been outlined as a representative county within the district. The districts and their representative counties include: Northwest 10 – Morrill, North 20 – Holt, Northeast 30 – Wayne, Central 50 - Sherman, East 60 – Butler, Southwest 70 – Hayes, South 80 – Kearney, and Southeast 90 – Saline. These counties represent the typical attributes of the district productivity and cropping patterns. Specifying district and counties showing representative attributes of Nebraska crop production allows for parameter estimation of crop yields from historical NASS records.

Price parameter specification limits the complexity of modeling while capturing the appropriate relationships. The difference between the planting-time average and harvest-time average futures prices are used as a proxy to simulate price variability. Daily futures price series

from commodity trades are maintained by the Commodity Research Bureau (CRB) (Commodity Research Bureau, 2011). Based upon these records an annual deviation from the spring planting-time price and the harvest-time price were determined to serve as the stochastic price elements. The simulated harvest time futures price provides the basis from which other price parameters are derived.

Historical Marketing Year Average (MYA) prices reported by NASS allowed for generating a 10-year average fixed basis between harvest-time futures prices and MYA prices (USDA National Agricultural Statistics Service, 2011). MYA prices recorded by NASS relevant to the model include one each at the national and state level. Government programs that rely on a national MYA price utilize the simulated futures price plus the national MYA basis, whereas the farm level revenue calculations use the harvest-time futures plus the state MYA basis to determine a cash price. The variability of historical price data provides estimates for basis. Also, historical futures price data provides deviations between average planting-time to harvest-time futures prices.

Crop acres and yields necessary for evaluating effects alternative farm income safety nets include national, state, district, county, and the representative farm level. Also, at the farm level crop acreage and mix reflecting the average characteristics of a farm operating in each NASS-ASD are required. To derive these characteristics, a variety of data sets comprises the necessary elements to project crop mix or yields, variability, and farm size. Historical variations from expectations serve as the basis for determining deviations from trend yields.

NASS maintains annual yield and harvested acreage data for the national, state, districts, and county level (USDA National Agricultural Statistical Service 2011). In some regions or counties, data may be limited due to confidentiality issues. Using available county-level acreage

and yield values, the irrigation and dryland cropping practices for all major crops in Nebraska can be aggregated to the district level. Patterns observable from these values show distinct cropping patterns across major regions of Nebraska. Wheat production remains concentrated in the western part of the state, whereas soybean acreages are concentrated in the eastern area. Irrigation is a major factor throughout the state.

Annual yield data series observed from the NASS data base including the nation, state, districts, and counties serve as the foundation for stochastic simulation values. Trend yields are calculated at the national, state, and district level leaving the deviations from trend as a measure of crop variability attributes in a specific area. County yields were regressed directly off of simulated district yields according to crop and practice. Also, to estimate farm level yields an implied volatility procedure utilizing RMA crop insurance quotes allowed for the expansion of county yields to the farm level to express idiosyncratic risk elements. Yields selected for simulation were chosen based upon the percentage of overall crops comprising harvested cropland acres for a particular area. Reducing the overall number of crops modeled limits the complexity of correlations and relationships requiring consideration.

Farm-level revenue modeling requires crop yields and acreages representative of operations in a given district or county. To gain a broader perspective on the size and scale of Nebraska farm operations, the 2007 Census of Agriculture conducted by NASS provides cropland acres and total number of operators sorted according to gross farm income ranges (USDA National Agricultural Statistics Service, 2009). Operations in Nebraska with gross farm income above \$100,000 per year account for the greatest percentage of overall commodity production. Therefore, using acres and farm number from these operations provides a set of representative farms that reflect typical commodity production in Nebraska. Based upon

operations in the 2007 Census of Agriculture meeting the income parameters, the total cropland acres and producers at the district level were aggregated from the county data. Dividing these two figures provides the average number of cropland acres per representative site in each district.

From the aggregated harvested acres data at the county level previously identified, these values were weighted at the district level to determine the percent of each major crop and practices for the respective region. These values were multiplied by the average number of cropland acres for each representative farm to create the acreage distributions in Table 1. The farms in each column are named according to the geographic regions in which these farms represent. Crops are excluded from a representative farm if they are not a significant part of the districts crop mix.

Table 1. Representative Farm Sites with Cropland Acres, Expected Yields, and Actual Production History

	District 10	District 20	District 30	District 50	District 60	District 70	District 80	District 90
Cropland Acres	Farm	Farm	Farm	Farm	Farm	Farm	Farm	Farm
Corn Irrigated	372.9	891.0	230.1	794.7	318.9	702.6	558.6	280.4
Corn Dryland	-	157.2	380.2	126.8	273.4	282.6	171.5	377.7
Soybeans Irrigated	-	329.1	147.7	206.0	173.7	96.9	303.7	173.8
Soybeans Dryland	-	-	303.9	-	259.8	-	-	377.5
Winter Wheat	874.4	-	-	-	-	522.3	167.0	-
Total	1247.3	1377.3	1062.0	1127.5	1025.8	1604.3	1200.8	1209.3
Expected Yields								
2011 (bu./acre)								
Corn Irrigated	166.0	188.1	205.7	194.9	190.5	193.4	204.6	195.8
Corn Dryland	-	76.5	155.5	94.0	129.9	71.1	112.5	111.3
Soybeans Irrigated	-	58.0	56.0	60.0	60.0	58.6	63.0	58.7
Soybeans Dryland	-	-	47.5	-	42.7	-	-	39.3
Winter Wheat	42.0	-	-	-	-	41.0	48.1	-
Actual Production History								
2001-2010 (bu./acre)								
Corn Irrigated	156.9	175.0	185.4	181.8	183.2	183.0	193.0	186.2
Corn Dryland	-	71.5	131.9	81.4	123.4	68.4	89.2	111.5
Soybeans Irrigated	-	51.6	53.3	55.9	56.6	55.6	59.0	56.6
Soybeans Dryland	-	-	42.1	-	42.1	-	-	38.7
Winter Wheat	35.4	-	-	-	-	43.0	46.7	-

Also, Table 1 displays expected farm level trend yields in 2011 and (actual production history) APH yields based upon the 2001-2010 time period. Using the county level yields and adding in a stochastic, idiosyncratic risk element creates the farm level yields. Implied yield

volatility from crop insurance premiums was used to generate the stochastic element necessary to derive yield variability representative to those crops being modeled at the farm level. Also, crops modeled at the district and county level were appropriately correlated with those represented at the farm level. District and county yields are modeled only for those crops and practices that are included at the representative farm level.

Other acreage and yield parameters relevant to the farm level for analysis of risk management tools relate to the government program alternatives. The alternative farm income safety nets require base acre and yield parameters. For this analysis, total base acres are assumed to equal total cropland acre for each of the representative farms. The Olympic average yield for a particular farm equals the average of the APH yields over the past five years with high and low values being dropped from the tabulations. Planted acres for the alternative program arrangement reflect those crops actually being raised for the current production year. Also, program yields reflect those of historical record available from a weighted data set maintained by USDA FSA (USDA Farm Service Agency, 2006).

Methods

At the base of the modeling procedure, a moving linear trend was fitted to the yield data to determine deviations from projections. Price deviations were calculated as the deviation from the average change in futures prices from planting-time to harvest time. The raw deviations were non-stationary were detrended to account for biases resulting from trend due to technological and productivity gains over time. Finally a multi-step procedure was used to determine the directionality of correlations between yield and price parameters to allow for their full expression between simulation variables.

As the level of yield aggregation decreases, the absolute deviations from trend increase due to the effects of averaging over a smaller land area. These historical deviations serve as the source of variability in the simulation model. Stochastic deviations are assumed to have normalized distributions based upon preliminary analysis failing to reject this assumption. Yield deviations were calculated for all crops and practices and evaluated at the national, state, and district levels, whereas the county and farm level yields were simulated directly from higher-level yields. Table 2 shows the 42 calculated yield deviations along with the corresponding regions, cropping practice, and value.

Table 2. National, State, and District Yield Variable Deviations

Variable	Region	Crop Practice¹		Value	Variability
crnfutprdv	United States	corn	futures	prices	deviation
soyfutprdv	United States	soybeans	futures	prices	deviation
hrwwhtfutprdv	United States	hard red	futures	price	deviation
		winter			
uscrintotylddv	United States	corn	total	yield	deviation
ussoytotylddv	United States	soybean	total	yield	deviation
uswhttotylddv	United States	wheat	total	yield	deviation
necrnirrylddv	Nebraska	corn	irrigated	yield	deviation
necrndrylddv	Nebraska	corn	total	yield	deviation
nesoyirrylddv	Nebraska	soybean	irrigated	yield	deviation
nesoydrylddv	Nebraska	soybean	dry	yield	deviation
newhttotylddv	Nebraska	wheat	total	yield	deviation
D10crnirrylddv	District 10	corn	irrigated	yield	deviation
D20crnirrylddv	District 20	corn	irrigated	yield	deviation
D30crnirrylddv	District 30	corn	irrigated	yield	deviation
D50crnirrylddv	District 50	corn	irrigated	yield	deviation
D60crnirrylddv	District 60	corn	irrigated	yield	deviation
D70crnirrylddv	District 70	corn	irrigated	yield	deviation
D80crnirrylddv	District 80	corn	irrigated	yield	deviation
D90crnirrylddv	District 90	corn	irrigated	yield	deviation
D20crndrylddv	District 20	corn	dry	yield	deviation
D30crndrylddv	District 30	corn	dry	yield	deviation
D50crndrylddv	District 50	corn	dry	yield	deviation
D60crndrylddv	District 60	corn	dry	yield	deviation
D70crndrylddv	District 70	corn	dry	yield	deviation
D80crndrylddv	District 80	corn	dry	yield	deviation
D90crndrylddv	District 90	corn	dry	yield	deviation
D20soyirrylddv	District 20	soybean	irrigated	yield	deviation
D30soyirrylddv	District 30	soybean	irrigated	yield	deviation
D50soyirrylddv	District 50	soybean	irrigated	yield	deviation
D60soyirrylddv	District 60	soybean	irrigated	yield	deviation
D70soyirrylddv	District 70	soybean	irrigated	yield	deviation
D80soyirrylddv	District 80	soybean	irrigated	yield	deviation
D90soyirrylddv	District 90	soybean	irrigated	yield	deviation
D30soydrylddv	District 30	soybean	dry	yield	deviation
D60soydrylddv	District 60	soybean	dry	yield	deviation
D90soydrylddv	District 90	soybean	dry	yield	deviation
D10whttotylddv	District 10	wheat	total	yield	deviation
D70whttotylddv	District 70	wheat	total	yield	deviation
D80whttotylddv	District 80	wheat	total	yield	deviation

¹ Total cropping practices include all irrigated and dryland production and acreage for a particular region.

For every yield deviation, an Ordinary Least Squares (OLS) moving trend regression was fitted to the previous 30 years of data. For example, the 1990 deviation for irrigated corn in District 30 represents the derivation from the linear trend fitted to the actual data between 1960 and 1989. The following year's calculation, 1991, bases the deviation off the OLS refitted to 1961 to 1990. This process is repeated so that annual readjustments of the linear trend are yielded by dropping the oldest and adding the most recent observation allowing for structural changes, such as increases in productivity. Deviations for price represent the difference between the planting-time and harvest-time monthly future averages to determine expected fall harvest price.

To account for trend changes occurring in corn, soybeans, and wheat yield deviations due to technological and productivity advancements, an OLS regression was used to detrend deviations of actual production from the linear projections. For consistency all deviations from the linear projections were detrended for each level of yield aggregation and price. With a relatively small sample size for deviations from the linear projections, the OLS proved to be the most effective method. Price deviations received the same moving OLS technique applied to yield deviations to remain consistent in the modeling procedure. Once the raw deviations from the linear trend projection were detrended, the following correlation procedure was utilized to allow for relationships to carry through at every price and yield level.

Prior research done by Lubben and Jansen analyzed correlation relationships involving MYA prices along with national, state, district, and county crop yields in Nebraska. These values show yields and prices at various levels have statistically significant relationships (2010). Depending upon the proposed government programs under evaluation the alternative may perform differently depending upon the strength of yield and price correlations to the critical

program value. Correlations must be maintained between the 96 stochastic yield and price variables. Every draw of the simulation needs to relay the correlative effects of yields and price elements on other variables. To achieve this goal, an approach involving a base correlation matrix coupled with sorted Directed Acyclic Graphs (DAGs) allows for observation of the respected relationships.

At the base of the model, a correlation matrix simultaneous draws the relationships between 12 national and state time adjusted yield parameters along with the respected prices to create the base values. Increasing the number of relationships beyond the 12 base parameters causes singularity and non-convergence of the correlation matrix. Relationships between lower aggregation levels such as district, county, and farm level yields still need observance to ensure correlative features. A multistep procedure involving TETRAD IV, yield regressions, and crop insurance yield calibrations allowed for the interactions to carry through at the lower aggregation levels.

At the core of state averages, district level yields by cropping practices create the weighted values. The various relationships involving the state and district time adjusted yield deviations were decomposed using TETRAD IV software to determine the causal nature of the variables to each other. First the deviations were sorted according to cropping practices involving irrigation and rain fed production. Limitations in TETRAD IV do not allow for all 42 state and district yield variables listed in Table 2 to be analyze all in the same DAG pattern. Correlations between state and district variables show the strongest relationships involving those by cropping practices. Sorting irrigated and rain fed time adjusted deviations does not acknowledge a mutual exclusive property between the production methods, but a higher level of relationship relevance and stability.

After sorting and uploading the variables to TETRAD IV, a DAG search produced in Figure 2 for the irrigated variables and Figure 3 for the dry land counter parts outline the causal relationships. Arrows or edges connecting the variable sets show the directionality of patterns. Output images were sorted according to the base state variables leading lower aggregation level time adjusted district deviations. Based upon this assumption, district to state arrow directionalities were reversed to reflect the larger state groups leading lower level collections.

A line connecting two variables in a DAG, but not possessing an arrow to infer causality in flow indicates an undirected edge. These outlines had the assumption made that the state or higher level district variables directed the unspecified edge in the respected relationship. Also, one arrow or series of edges cannot represent a circular reference between one variable and a lower level time adjusted deviation. Undirected edges and arrows in Figure 2 and Figure 3 use Fischer's z-test statistics to determine the DAG relationships which have statistical significance. Any relationship failing to be statistically different from zero was not displayed on the resulting image.

Figure 2 displays the appropriate relationships between the 17 irrigated time adjusted yield deviations. Depending upon the strength of these interactions, causality of the direct edges relays the movement. Also, interdependent relationships show variables do not hold mutual exclusive properties by crop type, but simulation distributions must take these interactions into consideration when modeling the system to examine yield variability on crop revenue across different regions. Assumptions made about correlations between yield parameters are affirmed by DAG analysis.

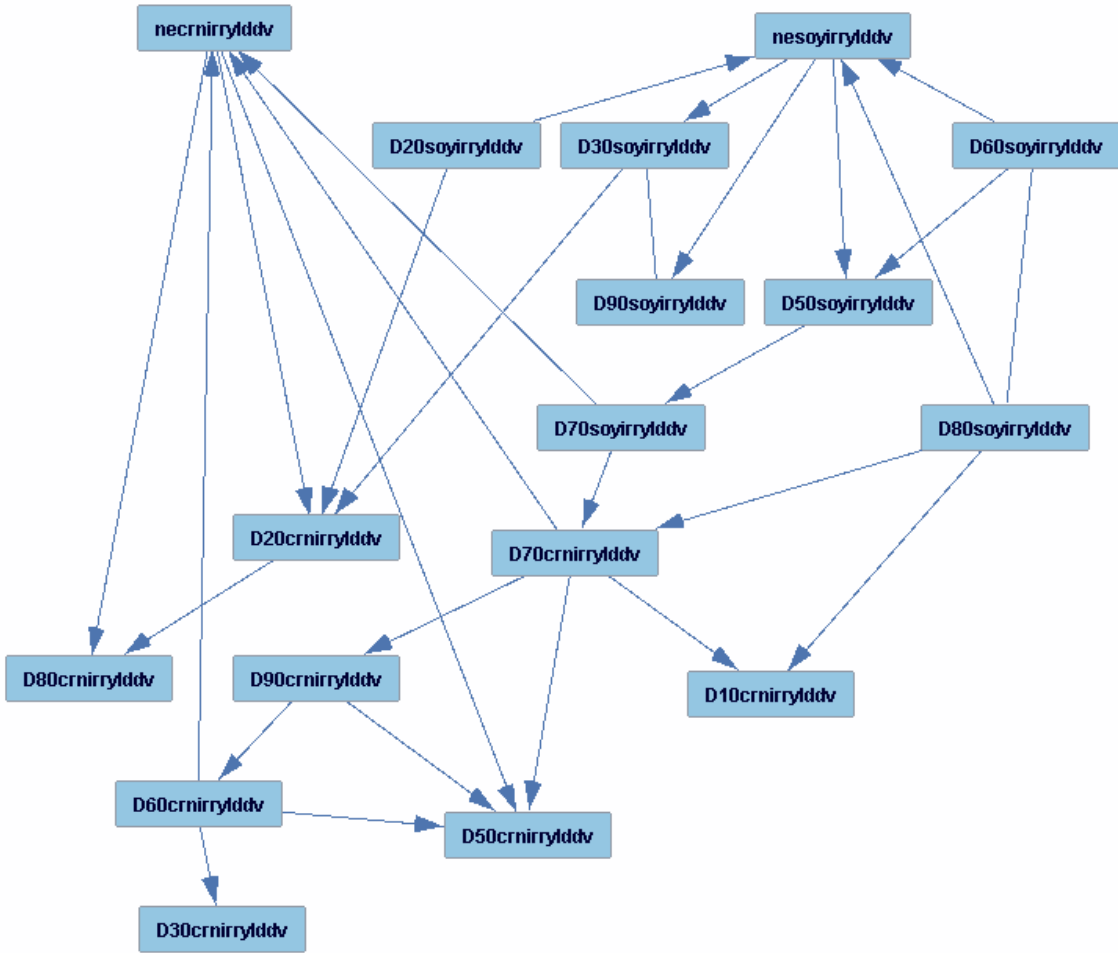


Figure 2. Irrigated State and District Yield Deviation Directed Acyclic Graph

Observations made about Figure 2 carry through for the 16 dry land time adjusted yield deviations in Figure 3. Due to the limitations in cropping practices involving rain fed production, fewer regions have modeling for dryland soybeans verses the irrigation counterpart. Based upon the DAG diagram created from this procedure, district time adjusted yield deviations were regressed on the leading state or district variables according to the relationships documented. These relationships between nodes allows for the identification of independent variables with regards to a particular dependent variable.

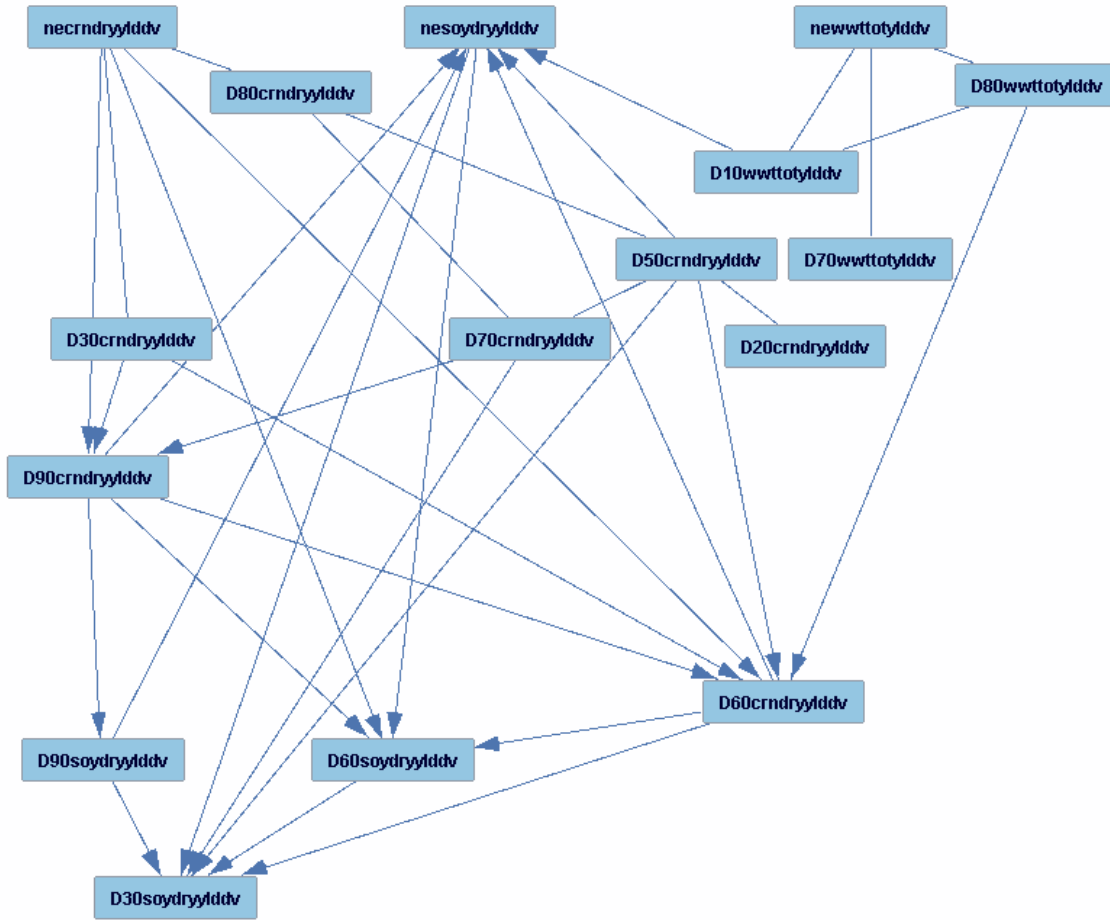


Figure 3. Dryland State and District Yield Deviation Directed Acyclic Graph

As the linkage between district and county yields remain high due to a strong correlation measurement, direct relationships between these variables was drawn without a DAG search. By using this assumption the direct relationships by crop and production practice between district and country variables serve as basis of regressing lower yield aggregation off the higher broader distribution. This method is a reverse of the actual aggregation process where farm, county, district, state yields aggregate to become the national yield. By using this approach correlations can be properly identified and used, assuring a feasible simulation. Historical county yields by crop and practice serve as the dependent variable in the regression off the independent higher level district yields. County simulation variables were not adjusted for the trend resulting from

the time progression because independent district yields already account for this element in the model.

To derive yields representative of expectations and variability for the model farms, a stochastic component was added to the simulated county level yields in which a particular site lies. Miranda’s (1991) implied volatility procedure utilizing crop insurance premiums allow for county level variability to be adjusted to those at the farm level. An assumption made under the calibration method assumes crop insurance premiums properly assess premium rates as actuarially fair rate. Also, the expected county and farm level yield for a particular crop and practice must be the same. Through this process the average variability expressed by farms operating in a particular county were obtained. By modeling the distributions through the procedure described statistically significant correlation relationships carry through with each random draw generated.

Table 3. Alternative Farm Program Simulation Scenarios

Alternative	Guarantee Geography	Guarantee Level	Payment Cap	Payment Acres
No Program	-	-	-	-
ACRE: State	State	90%	25% of Guar.	85%
ARRM: District	District	90%	15% of Guar.	85%
SRRP: County	County	70%	100% of Guar.	85%
ARC: Farm	Farm	87%	12% of Oly. Avg. Rev.	60%

Table 3 displays the alternative farm program scenarios modeled in this study. Each alternative has a guarantee geography, guarantee level, payment cap, and payment acres correlating with the parameters with the current or proposed farm program. As the base, the model simulated crop revenue without the effects of any government program. Next, the four farm program alternatives with the geographical revenue guarantees including: ACRE: State, ARRM: District, SRRP: County, and ARC: Farm serve as the four scenarios to analyze potential

farm program payments, aggregate costs, and the effects of farm programs with crop revenue. As a note, DPs are not included in the analysis of any of the farm program alternatives.

Results

The simulation of yields and prices modeled on farm program alternatives in Table 3 provides an analysis of potential revenue safety net designs, payments, and aggregate program costs. Shifting the revenue safety net trigger from the state level under the current ACRE program to a smaller geography generally increases the risk protection provided by the program, increasing the frequency of the safety net triggering and also the expected payments. Table 4 show the expected payments for 2011 range from just \$28 to \$277 per farm over the 8 representative farms, but increase to \$2,900 to \$7,628 per farm under the ARC proposal.

Table 4. Average Farm Program Payment by Acre per Representative Farm

Representative Farm	ACRE: State	ARRM: District	SRRP: County	ARC: Farm
District 10 Farm	\$32	\$178	\$133	\$5,403
District 20 Farm	51	4,089	691	3,714
District 30 Farm	243	1,690	0	2,900
District 50 Farm	28	3,761	3,227	4,341
District 60 Farm	217	2,278	690	3,767
District 70 Farm	112	2,495	4,186	7,628
District 80 Farm	37	3,677	1,500	3,274
District 90 Farm	277	2,870	2,375	4,261

These are still small payments per acre as shown in Table 5 due primarily to the high initial price expectations in 2011 relative to the revenue safety net guarantee levels. But, the expected payments and the program costs clearly increase with the closer proximity of the safety net trigger to the farm level. (Table A.1 in the appendix provides statistical details of the simulation results beyond the average payments shown in Table 4.)

Table 5. Expected Farm Program Payments by acre per Representative Farm

Representative Farm	ACRE: State	ARRM: District	SRRP: County	ARC: Farm
District 10 Farm	\$0.03	\$0.14	\$0.11	\$4.33
District 20 Farm	0.04	2.97	0.50	2.70
District 30 Farm	0.23	1.59	0.00	2.73
District 50 Farm	0.02	3.34	2.86	3.85
District 60 Farm	0.21	2.22	0.67	3.67
District 70 Farm	0.07	1.56	2.61	4.75
District 80 Farm	0.03	3.06	1.25	2.73
District 90 Farm	0.23	2.37	1.96	3.52

Table 5 also illustrates the differences in expected payments per acre across a state such as Nebraska with a range of productivity and climatic factors. Shifting the revenue safety net trigger from the state level to a more-local level may greatly increase the relevance and the risk protection provided by the program. The largest payments per acre under the ARC farm-level guarantee are in districts 10 and 70, the northwestern and southwestern parts of Nebraska respectively. These regions of the state are more semi-arid growing regions susceptible to moisture stress that experience greater yield variability. As a result, revenue safety net payments that trigger at the farm level under ARC pay more on these farms than any of the program alternatives at higher levels of aggregation.

While adjusting the geography of the revenue safety net trigger may increase the risk management protection provided by the program, none of the alternatives are expected to make farm program payments of the magnitude of the current DP program which has paid Nebraska producers more than \$300 million in recent years. Thus, it appears the revenue safety net alternatives all represent a possible shift to a more relevant, but much smaller farm program for producers.

Further analysis of farm program payments together with crop revenue (statistical details in Table A.2 in the appendix) reinforces the smaller role for farm programs. While farm program payments are estimated from \$28 to \$7,628 across the 8 representative farms under the various

program alternatives, crop revenue alone (in the no program alternative) is estimated at \$601,805 to \$1,363,132 across the 8 representative farms. Farm program payments do correlate with reduced crop revenue as designed, particularly with the farm-level ARC proposal, but even then, the reduction in the coefficient of variation is generally less than 1 percentage point. The result is that revenue safety net programs may contribute to a farm's risk management plan, but given the price and revenue expectations going into the 2011 growing season, there is substantially more risks that cannot protect the producer by the use of any known farm program. These risks fall directly to the producer to manage.

Conclusion

Policy discussions related to the 2012 Farm Bill introduced a variety potential federal revenue-based farm income safety net programs. The model developed here provides the framework to simulate expected farm level payouts associated with current policy alternatives. At the base of the simulations is a correlated national and state yield and price deviation matrix. This matrix provides the core of the models and guides the directionality of the yields and prices for a particular outcome. Once simulated the district yields are ordered by a Direct Acyclical Graph (DAG) search to properly regress them to each other their related state deviations. Counties selected as representing typical attributes of a district are regressed on corresponding district yield variables according to commodity type and cropping practice from which representative farms were simulated using a stochastic component representing farm level expectations implied by crop insurance premium rates for the 2011 production year.

Changing the revenue safety net guarantee from the current state-level ACRE guarantee to a more-local guarantee will increase the expected risk protection and program payments for producers. But, given current price and revenue expectations for crop producers in Nebraska,

estimated revenue program payments across all proposed program alternatives will not be of the magnitude of current DPs. As a result, the potential program changes will likely continue the recent transition in programs toward an increased emphasis on risk management and producer decision-making.

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Appendix

Table A.1. Representative Farm Simulation Summary Statistics for Farm Program Payment Alternatives

District 10 Farm Program Payment Alternatives					
Variable	ACRE: State	ARRM: District	SRRP: County	ARC: Farm	
Mean	32.08	178.41	133.09	5,402.54	
StDev	526.90	1,695.69	1,699.80	7,905.89	
CV	1,642.30	950.47	1,277.17	146.34	
Min	0.00	0.00	0.00	0.00	
Max	10,299.21	20,009.83	27,229.71	32,808.84	

District 20 Farm Program Payment Alternatives					
Variable	ACRE: State	ARRM: District	SRRP: County	ARC: Farm	
Mean	50.66	4,089.46	690.57	3,713.81	
StDev	667.73	7,810.79	3,866.79	9,807.43	
CV	1,317.94	191.00	559.94	264.08	
Min	0.00	0.00	0.00	0.00	
Max	12,833.45	24,582.27	36,054.03	51,362.12	

District 30 Farm Program Payment Alternatives					
Variable	ACRE: State	ARRM: District	SRRP: County	ARC: Farm	
Mean	242.62	1,690.15	0.00	2,900.18	
StDev	2,711.15	3,717.69	0.00	5,867.81	
CV	1,117.43	219.96	0.00	202.33	
Min	0.00	0.00	0.00	0.00	
Max	51,546.06	10,015.89	0.00	33,881.87	

District 50 Farm Program Payment Alternatives					
Variable	ACRE: State	ARRM: District	SRRP: County	ARC: Farm	
Mean	28.00	3,761.10	3,227.13	4,341.02	
StDev	340.50	6,223.21	10,233.26	9,588.59	
CV	1,216.13	165.46	317.10	220.88	
Min	0.00	0.00	0.00	0.00	
Max	6,419.21	19,239.52	78,413.50	57,200.50	

District 60 Farm Program Payment Alternatives					
Variable	ACRE: State	ARRM: District	SRRP: County	ARC: Farm	
Mean	216.74	2,278.21	689.59	3,766.67	
StDev	2,127.79	5,070.30	7,122.62	6,533.96	
CV	981.75	222.56	1,032.88	173.47	
Min	0.00	0.00	0.00	0.00	
Max	36,095.49	28,643.97	103,326.82	37,731.58	

District 70 Farm Program Payment Alternatives					
Variable	ACRE: State	ARRM: District	SRRP: County	ARC: Farm	
Mean	112.39	2,495.35	4,186.28	7,627.78	
StDev	1,183.03	3,554.43	16,469.85	11,280.41	
CV	1,052.64	142.44	393.42	147.89	
Min	0.00	0.00	0.00	0.00	
Max	21,543.95	13,699.90	136,219.19	57,802.30	

District 80 Farm Program Payment Alternatives					
Variable	ACRE: State	ARRM: District	SRRP: County	ARC: Farm	
Mean	36.79	3,677.43	1,499.63	3,274.02	
StDev	461.86	7,863.34	7,474.89	5,935.06	
CV	1,255.34	213.83	498.45	181.28	
Min	0.00	0.00	0.00	0.00	
Max	8,947.65	28,475.93	66,051.95	38,890.51	

District 90 Farm Program Payment Alternatives					
Variable	ACRE: State	ARRM: District	SRRP: County	ARC: Farm	
Mean	277.06	2,869.62	2,374.52	4,261.09	
StDev	2,517.68	5,682.66	18,206.86	6,710.21	
CV	908.73	198.03	766.76	157.48	
Min	0.00	0.00	0.00	0.00	
Max	45,418.04	35,752.24	267,756.04	39,996.30	

Table A.2. Representative Farm Simulation Summary Statistics for Crop Revenue and Farm Program Payment Alternatives

District 10 Farm Crop Revenue and Farm Program Payment Alternatives					
Variable	No Program	ACRE: State	ARRM: District	SRRP: County	ARC: Farm
Mean	601,804.97	601,837.06	601,983.38	601,938.06	607,207.51
StDev	153,144.25	153,104.24	152,974.90	153,050.35	148,117.34
CV	25.45	25.44	25.41	25.43	24.39
Min	151,266.95	151,266.95	151,266.95	151,266.95	184,075.79
Max	1,079,414.20	1,079,414.20	1,079,414.20	1,079,414.20	1,079,414.20
District 20 Farm Crop Revenue and Farm Program Payment Alternatives					
Variable	No Program	ACRE: State	ARRM: District	SRRP: County	ARC: Farm
Mean	1,363,132.10	1,363,182.77	1,367,221.56	1,363,822.67	1,366,845.92
StDev	297,782.95	297,798.08	296,836.51	297,756.16	292,799.33
CV	21.85	21.85	21.71	21.83	21.42
Min	404,187.54	404,187.54	408,289.17	404,187.54	455,549.66
Max	2,075,428.05	2,075,428.05	2,075,428.05	2,075,428.05	2,075,428.05
District 30 Farm Crop Revenue and Farm Program Payment Alternatives					
Variable	No Program	ACRE: State	ARRM: District	SRRP: County	ARC: Farm
Mean	1,005,511.76	1,005,754.39	1,007,201.91	1,005,511.76	1,008,411.94
StDev	179,135.55	178,889.23	178,332.27	179,135.55	176,027.49
CV	17.82	17.79	17.71	17.82	17.46
Min	418,561.50	418,561.50	418,561.50	418,561.50	449,473.73
Max	1,581,699.86	1,581,699.86	1,581,699.86	1,581,699.86	1,581,699.86
District 50 Farm Crop Revenue and Farm Program Payment Alternatives					
Variable	No Program	ACRE: State	ARRM: District	SRRP: County	ARC: Farm
Mean	1,191,186.64	1,191,214.63	1,194,947.73	1,194,413.77	1,195,527.65
StDev	266,694.01	266,701.93	265,373.89	265,981.66	261,073.67
CV	22.39	22.39	22.21	22.27	21.84
Min	199,675.22	199,675.22	214,803.16	199,675.22	248,368.75
Max	1,811,795.24	1,811,795.24	1,811,795.24	1,811,795.24	1,811,795.24
District 60 Farm Crop Revenue and Farm Program Payment Alternatives					
Variable	No Program	ACRE: State	ARRM: District	SRRP: County	ARC: Farm
Mean	900,795.69	901,012.43	903,073.90	901,485.28	904,562.36
StDev	158,164.14	157,892.24	157,013.52	157,777.35	154,289.96
CV	17.56	17.52	17.39	17.50	17.06
Min	396,221.48	396,221.48	396,221.48	396,221.48	433,953.06
Max	1,350,447.81	1,350,447.81	1,350,447.81	1,350,447.81	1,350,447.81
District 70 Farm Crop Revenue and Farm Program Payment Alternatives					
Variable	No Program	ACRE: State	ARRM: District	SRRP: County	ARC: Farm
Mean	1,177,680.09	1,177,792.48	1,180,175.44	1,181,866.37	1,185,307.88
StDev	263,334.22	263,383.89	262,804.98	262,413.10	256,636.73
CV	22.36	22.36	22.27	22.20	21.65
Min	358,596.21	358,596.21	358,596.21	358,596.21	405,142.47
Max	1,924,921.60	1,924,921.60	1,924,921.60	1,924,921.60	1,924,921.60
District 80 Farm Crop Revenue and Farm Program Payment Alternatives					
Variable	No Program	ACRE: State	ARRM: District	SRRP: County	ARC: Farm
Mean	1,136,063.46	1,136,100.26	1,139,740.89	1,137,563.09	1,139,337.49
StDev	193,315.85	193,319.41	191,548.64	193,575.64	190,956.14
CV	17.02	17.02	16.81	17.02	16.76
Min	536,895.66	536,895.66	536,895.66	536,895.66	569,191.37
Max	1,603,007.71	1,603,007.71	1,609,260.45	1,627,527.46	1,603,007.71
District 90 Farm Crop Revenue and Farm Program Payment Alternatives					
Variable	No Program	ACRE: State	ARRM: District	SRRP: County	ARC: Farm
Mean	944,607.39	944,884.45	947,477.01	946,981.91	948,868.48
StDev	166,673.96	166,295.16	165,210.63	163,954.68	162,581.04
CV	17.64	17.60	17.44	17.31	17.13
Min	427,882.75	437,295.88	442,016.32	463,311.00	467,879.05
Max	1,533,412.69	1,533,412.69	1,533,412.69	1,533,412.69	1,533,412.69