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Analyzing Producer Preferences for Counter-Cyclical Government Payments

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A dynamic-stochastic model is developed to evaluate preferences among alternative countercyclical payment programs for representative farms producing corn or soybeans in Iowa and cotton or soybeans in Mississippi. Countercyclical payment programs are found to not necessarily be preferred to fixed payment programs.

Key Words: agricultural policy, bootstrapping, countercyclical payments, nonparametric

JEL Classifications: C15, D81, Q12, Q18

The Federal Agriculture Improvement and Reform (FAIR) Act of 1996 became law at a time when farm commodity prices were at their highest level in 20 years. The decades-old system of price supports and deficiency payments was replaced with fixed production flexibility contract (PFC) payments scheduled through 2002. These decoupled PFC payments were designed to decline over the six-year life of the FAIR Act as a prelude to lower government payment levels. Within two years, however, the high prices—which most observers believe were a key to the passage of the FAIR Act—fell sharply, eventually plunging to levels not anticipated by many advocates of the FAIR Act. Congress responded to the decline in prices by approving five ad hoc emergency assistance packages between October 1998 and August 2001, each providing billions of dollars in supplemental aid to farmers.

Although the FAIR Act retained a substantial countercyclical component in the form of the marketing loan program, which provides producers with loan deficiency payments (LDPs) when market prices fall below loan rates, the FAIR Act's detractors contended that a countercyclical alternative to PFC payments would be more desirable. These critics viewed the inability of the fixed PFC payments to respond to changes in the farm economy as one of the foremost weaknesses of the FAIR Act.

One proposed countercyclical alternative would base outlays on a measure of shortfalls in aggregate gross revenue per acre. In their report to the president and Congress, the Commission on 21st Century Production Agriculture endorsed this concept but did not make recommendations regarding specific program details. Prior to that, Rep. Charles Stenholm (D-Texas), the ranking minority member of the House Agriculture Committee, introduced legislation in Congress that would have created a countercyclical payment program based on aggregate gross revenue per acre. Known as Supplemental Income Payments for Producers (SIPP), this program would have provided producers with payments when the per

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acre national gross revenue of an eligible crop was less than 95% of its previous five-year average (U.S. Congress). SIPP defined national gross revenue as the product of the total U.S. production for a commodity and the higher of its season average price or loan rate. The total per acre payment to producers for a particular commodity would be equal to the positive difference between 95% of the previous five-year moving average of national gross revenue per acre and the current crop year's national gross revenue per acre.

SIPP was intended to provide producers with program payments during periods of low market revenue. Although SIPP failed to win approval in Congress, a countercyclical payment program based on price shortfalls was adopted in the Farm Security and Rural Investment Act of 2002. Advocates of SIPP and other subsequent countercyclical proposals implicitly assume that producers prefer payments based on revenue variability to the fixed PFC payments of the FAIR Act.

This paper provides an empirical evaluation of whether producers have a preference for payments from a SIPP-type program relative to PFC payments. Our approach involves a nonparametric bootstrapping model that simulates market-based net farm revenue for representative farms in Iowa and Mississippi over a five-year program period, 2000–2004. PFC payments, LDPs, and possible SIPP-type payments are added to market net revenue to determine ending wealth and producer welfare.

Prior studies modeling government payments have largely ignored price-yield correlations and/or implicitly assumed risk neutrality on the part of producers (Stinson, Coggins, and Ramezani; Tirupattur, Hauser, and Boyle). Yet Glauber and Miranda assert that the varying results across numerous studies regarding the effects of price stabilization programs on farm-level revenue variability are due to the omission of production risk and/or correlation between yield and price. Because systemic factors often cause crop losses to be widespread, many farm-level yields tend to be positively correlated with aggregate yields and thereby negatively correlated with price. This correlation creates a "natural hedge" that can provide a producer with more stable revenues, as low (high) yields will be offset by high (low) prices. Similarly, Lence and Hayes found that in areas with a significant natural hedge, pre-FAIR deficiency payments did not necessarily stabilize farm income. Often when farms experienced significant production losses, they also received lower deficiency payments due to higher market prices. Likewise, farms received higher deficiency payments in years when market revenues were already high due to unusually high production.

Price-yield correlations are incorporated into the analysis reported here and provide a basis for examining regional differences in policy preferences. Furthermore, producers in this study are assumed to be risk averse. The assumption of risk aversion is consistent with producers' behavior reflected in the widespread purchase and use of instruments such as unsubsidized crop-hail insurance, forward contracting, and futures and options.

The remainder of this paper consists of three sections. In the next section, we outline our dynamic-stochastic simulation model. We then present the results of this model for a representative Iowa farm producing corn or soybeans and a representative Mississippi farm producing cotton or soybeans. The results indicate that whether a producer benefits more from the PFC payment program or a SIPP-type payment program depends on location, what crop is produced, the level at which fixed payments or countercyclical payment triggers are set, and whether the current marketing loan program remains in place. We state our conclusions in a final section of the paper, emphasizing the impact of price-yield correlations on our results.

Model

The model employed here builds on an earlier model developed by Coble et al. to simulate revenue for purposes of rating a multicrop revenue insurance contract. Stochastic variables are simulated using nonparametric bootstrapping procedures. Although the nonparametric approach is less efficient if the underlying data distributions are known, it avoids making distributional assumptions that could lead to biased and inconsistent estimates when distributions are unknown. Coble et al. conclude that the nonparametric approach is more robust than alternative approaches since it is capable of addressing a variety of empirical data. In particular, a nonparametric approach is useful in combining multiple random variables, as for a farm facing numerous sources of risk.

Representative Farms

Two farms are simulated in the analysis—a representative Iowa farm and a representative Mississippi farm. Both farms are assumed to produce 1,000 acres from one of two crops and to have an equivalent base for PFC payments if corn or cotton is grown. The Iowa farm, in Cass County in the southwestern part of the state, produces corn or soybeans. The Mississippi farm, located in Sunflower County in the delta region of the state, produces cotton or soybeans.

The Economic Research Service (ERS) estimated in 1995 that approximately 50% of corn-belt crop land and 40% of Mississippi delta cropland was rented. To allow for comparisons across farms, we assume that for both representative farms, half the acreage under production is owned and half is cash rented.

Simulated Market Revenue

We assume farm-level yield variability is determined by two location-specific random components: county yield and farm deviations from the county yield. Farm-level market revenue variability is also dependent on the random component of market prices, which is dependent on variability in national yields. Under LDPs and countercyclical payment programs, national yields and market prices may also affect government payment levels.

To estimate the random components of national and county yields, data from 1974 through 1999 from the National Agricultural Statistics Service (NASS) of the U.S. Department of Agriculture (USDA) were used to fit a linear trend regression

$$(1) \qquad Y_{it} = \alpha_{i0} + \alpha_{i1}t + \varepsilon_{it}^{Y},$$

where t is year, i is crop, and Y_{it} is national ($Y_{it} \equiv N_{it}$) or county yield ($Y_{it} \equiv C_{it}^{j}$) for a specific location j. For each national or county regression, a matrix of residuals with t rows and i columns, ε^{Y}, is captured with the residuals expressed as a percentage of the predicted value. The residuals are used to bootstrap around the predicted yield, $\hat{Y}_{it}$. In each iteration of the model, the simulated yields, $\tilde{Y}_{it}$, are calculated as

$$(2) \qquad \tilde{Y}_{it} = \hat{Y}_{it}(1 + \varepsilon_{t}^{Y}) \quad \forall i,\ t, \quad Y = N,\ C^{j}.$$

Residuals are expressed in percentage terms to correct for any potential heteroskedasticity that may be present in the raw yield data. To account for common events affecting yields, the residuals for each crop are drawn for the same year by randomly selecting the kth row from the matrix of residuals.

Farm yield deviations from county yield are the second location-specific random component of farm-level yield. Farm yield data for the relevant crops and counties were obtained from the Risk Management Agency (RMA) of the USDA in the form of actual production history (APH) yields from 1989 to 1997. APH records have no more than 10 years of farm yield data, and a lower limit of six years of yield data was imposed for this study. Farm yield is assumed conditioned on county yield for all years where both farm and county yield data are available:

$$(3) \qquad f_{it} = C_{it}^{j} + \varepsilon_{it}^{f},$$

where f_{it} is the farm yield of crop i in year t. The matrix of residuals ε^{f} remains in absolute terms since there is no *a priori* reason to expect heteroskedasticity. Inherent correlations between farm yield deviations across crops are maintained in the model because the environmental factors that affect the yield of one crop on a particular farm may also affect the yield of the other crops on the same farm. Simulated farm yields, conditioned on the simulated county yield, are

$$(4) \qquad \tilde{f}_{it} = \tilde{C}_{it}^{j} + \varepsilon_{it}^{f} \quad \forall i,\ t.$$

Crop prices, the third random component of farm-level market revenue, are determined on a national basis. Futures prices (the average closing price on the harvest contract during the month prior to expiration) are used to approximate the market price that a producer would receive at harvest.

Price determination in the simulation proceeds as follows.[1] First, the prior year's harvest price becomes the predicted value for the current year's futures price at planting:

$$(5)\qquad P_{it}^{0} = P_{i,t-1}^{1} + \varepsilon_{it}^{P^0},$$

where P_{it}^{0} is the futures price at planting for crop i in year t and $P_{i,t-1}^{1}$ is the futures price of crop i at harvest in $t - 1$. Futures prices at planting are calculated as the average closing price of the harvest contract during the month of April. The harvest contracts for corn and cotton are based on the month of December, while the harvest contract for soybeans is based on November. The matrix of residuals ε^{P^0} consists of t rows and i columns with the residuals expressed in percentage terms. By bootstrapping from ε^{P^0}, the futures price at planting in year t is simulated as a random walk around the simulated harvest futures price in $t - 1$:

$$(6)\qquad \tilde{P}_{it}^{0} = \tilde{P}_{i,t-1}^{1}(1 + \varepsilon_{it}^{P^0}) \quad \forall i, t.$$

These residuals are also drawn together so that each crop has residuals drawn from the same time period.

The price at harvest is assumed to be a function of the futures price at planting conditioned on the ratio of simulated national yield to predicted national yield (Coble et al.). This price relationship is expressed by the equation

$$(7)\qquad \frac{P_{it}^{1}}{P_{it}^{0}} = \gamma_{i0} + \gamma_{i1}\left(\frac{\tilde{N}_{it}}{\hat{N}_{it}}\right) + \varepsilon_{it}^{P},$$

where the residuals are captured in the t by i matrix ε_{it}^{P}. The predicted harvest price, conditioned on $\tilde{P}_{it}^{0}$ and the ratio of simulated national yield to predicted national yield, is

$$(8)\qquad \tilde{P}_{it}^{1} = \tilde{P}_{it}^{0}\left[\gamma_{i0} + \gamma_{i1}\left(\frac{\tilde{N}_{it}}{\hat{N}_{it}}\right)\right].$$

Bootstrapping from ε_{it}^{P} around the predicted value of the harvest price generates the simulated harvest price:

$$(9)\qquad \tilde{P}_{it}^{1} = \tilde{P}_{it}^{0}\left[\gamma_{i0} + \gamma_{i1}\left(\frac{\tilde{N}_{it}}{\hat{N}_{it}}\right)\right] + \varepsilon_{it}^{P} \quad \forall i, t.$$

Again, the residuals for each crop are drawn together.

The total simulated net market revenue for a representative farm is found by summing the simulated net market revenue for each crop using Equations (4) and (9):

$$(10)\qquad M\tilde{k}t_{t}^{f} = \sum_{i} A_{i}[\tilde{P}_{it}^{1}\tilde{f}_{it} - \lambda(v_{i}^{f} + egp_{i}^{f}) - (1 - \lambda)v_{i}^{f}],$$

where A_i is total acres of crop i, v_i^f is the per acre nonstochastic production costs of crop i on farm f, egp_i^f is the per acre expected government payment for crop i on farm f, and λ is the percentage of total acreage that is rented (assumed to be 50%). Total simulated net market revenue is calculated assuming that the landlord captures any expected government payment on rented acres in the form of higher cash rent.

State-level cash rental rates were obtained from the National Agricultural Statistics Service. These rental rates were adjusted to remove the influence of federal farm program payments as estimated by Barnard et al. Per acre fixed and variable production costs (other than land costs) for each crop are based on enterprise budgets obtained from the extension

[1] The model utilizes a single price-generating process across all policy regimes. That is, we assume no changes to price distributions as a result of changes in policy regimes. This assumption is consistent with the findings of Lence and Hayes. However, to test the sensitivity to our results to this assumption, we also investigated a case with increased price variability. Increasing price variability by a factor of 20% decreased certainty equivalents and increased government payments, as expected, but did not change relative preferences for SIPP versus PFC payments.

service in each state (Duffy and Smith; Mississippi State University). The sum of the annual adjusted rental rate and nonland fixed and variable costs equals the per acre nonstochastic production costs ν_i^f used in Equation (10). The adjusted cash rental rate is an explicit cost on rented acreage and an opportunity cost on owned acreage.

Revenue Scenarios

Four basic revenue scenarios are modeled for each farm: 1) simple market revenue only with no government program payments of any kind; 2) a FAIR Act program consisting of the sum of market revenue, LDPs, and annual PFC payments for corn and cotton; 3) a national SIPP program consisting of the sum of market revenue, LDPs, and a supplemental income payment determined by national gross revenue relative to a specified historical base for each crop; and 4) a county-level SIPP program that includes the same components as the national SIPP program except national gross revenue is replaced by county gross revenue, as proposed by Hart and Babcock. The simulations are conducted over the period 2000–2004. Beginning the analysis in 2000 allows initialization of the simulation models using actual prices and regional yields rather than estimates of these variables. Because LDPs under the FAIR Act provide some countercyclical protection that complements the countercyclical payments of potential SIPP-type programs, we also consider scenarios in which the marketing loan program is eliminated, while PFC and SIPP payments are retained.

Data on PFC payment rates were obtained from the Economic Research Service (ERS) of the USDA (Nelson and Schertz). The PFC payments received by a representative farm are nonstochastic throughout the five-year period being simulated. They are determined by the equation

$$(11) \quad PFC_i = \sum_i .85(C^j_{i,1995} B_{i,1995} G_i),$$

where PFC_i is the PFC payment for crop i, $C^j_{i,1995}$ is the average county program yield for crop i in 1995, $B_{i,1995}$ is the farm's base acreage for crop i, and G_i is the per unit PFC payment rate for crop i. The average county program yield is used to estimate the farm program yield since a representative farm is being modeled. Average county program yields were obtained for Cass County, Iowa, from the county extension office and for Sunflower County, Mississippi, from the Farm Service Agency (FSA) field office. Following the provisions of the 1996 FAIR Act, annual PFC payments are limited to \$40,000 per farm entity.[2]

Simulated payments are calculated for both the highest and the lowest PFC payment rates authorized under the FAIR Act. That is, we use the highest (lowest) PFC rate available for a crop over the six-year life of the FAIR Act for each of the five program years being simulated. These legislated values provide one set of bounds on the range of PFC payments that might be provided in future farm bills, although with the emergency assistance Congress has provided since 1998, a higher range of PFC payments would also be reasonable to consider.

The equation for calculating national- or county-level SIPP payments in a given year is

$$(12) \quad SIPP_{it} = \sum_i \max\left\{0, \left[RT^*\left(\frac{1}{5}\sum_{i=-5}^{-1} \max[LR_i, P^{\dagger}_{it}]Y_{it}\right) - \max[LR_i, \tilde{P}^{\dagger}_{it}]\tilde{Y}_{it}\right]\right\}A_i,$$

where $SIPP_{it}$ is the SIPP payment for crop i in year t, RT is the gross revenue trigger percentage, and all other variables are as previously defined.[3] After simulating the first year of the five-year program period, simulated

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[2] For simplicity, the representative farm is assumed to constitute one farm entity under USDA regulations.

[3] As noted earlier, the proposed SIPP legislation would calculate gross revenue for a commodity based on the higher of the season average price or the loan rate. But USDA statistics on season average price reflect prices during the marketing season—not the growing season. Since season average prices cannot be calculated until approximately nine months after harvest, we substitute harvest-time market price for season average price when calculating SIPP payments.

prices and yields feed back into the calculation of the moving average of past revenue per acre. Two values for RT are considered: 95%, as originally proposed by Rep. Stenholm, and a lower level of 90%.

Equation (12) determines national or county gross revenue per acre by taking the higher of harvest price and the loan rate and multiplying it by the corresponding per acre yield. It then computes the difference between 90% or 95% of the five-year average of national (county) gross revenue per acre and the national (county) gross revenue per acre in year t. If the amount in brackets is positive, it is multiplied by the representative farm's total acreage of crop i to determine the producer's total SIPP payment for the crop. No annual payment limits for SIPP were specified in the legislation that was introduced. However, to facilitate comparison, annual simulated SIPP payments, like PFC payments, are initially limited to $40,000 annually.

Finally, LDPs for each crop i are calculated as

$$(13)\quad LDP_{it} = \max[0, (LR_i - \tilde{P}^{l}_{it})\tilde{f}_{it}A_i],$$

where LR_i is the loan rate for crop i. Thus, an LDP is equal to the product of simulated farm yield per acre and the total number of acres multiplied by the difference between the loan rate and the simulated market price at harvest, or zero, whichever is larger. LDPs are limited to $75,000 annually for each farm entity.

Certainty Equivalents of Ending Wealth

The welfare of producers under the four scenarios is measured by certainty equivalents based on the constant absolute risk aversion (CARA) utility function:

$$(14)\quad U = 1 - \exp(-cW),$$

where c is the coefficient of absolute risk aversion and $c > 0$.[4] Each representative farm in this study is assumed to have an initial wealth of $1,000,000. We assume producers are slightly risk averse, reflected in the value $c = 0.000001$. The certainty equivalent for Equation (14) is

$$(15)\quad CE_c = \frac{\ln(1 - U)}{-c},$$

where CE_c is the certainty equivalent associated with c.

Once the net market revenue and government payments have been simulated for the first year, this amount is added to the initial wealth to calculate the first year's ending wealth. The ending wealth in the first year becomes the initial wealth for the next year, and the process is applied to each of the five years in the simulation. The five-year time frame is simulated through 50,000 iterations. Expected government payments in Equation (10) are calculated within the model as a mean across years and iterations for the particular government program being simulated.

Because we use a dynamic model, the calculation of expected utilities incorporates time preference. Following the recommendation of Hardaker, Huirne, and Anderson, the utilities from individual period ending wealths are discounted using a constant time preference factor, r, here assumed equal to 0.05:

$$(16)\quad PV[U(W_{tj})] = \frac{U(W_{tj})}{(1 + r)^t},$$

where $U(W_{tj})$ refers to the utility of ending wealth for year t and iteration j.

Producers are assumed to establish program preferences based on the certainty equivalent of the expected present value of the utility of ending wealth over the five-year program period. Once the utilities of wealth in each year have been discounted, certainty equivalents can be calculated for each revenue scenario for each representative farm:

$$(17)\quad CE_{sc} = \frac{\ln\{1 - \overline{PV[U(W)]}\}}{-c},$$

where $\overline{PV[U(W)]}$ is the expected present value

[4] One reason for using a CARA utility function is that certainty equivalents can be calculated even when extensive resampling results in negative ending wealths in some cases.

Table 1. Implicit Correlation Between Farm-Level Yields and Other Stochastic Variables

	Correlation with County Yield	Correlation with National Yield	Correlation with Harvest Price
Sunflower County, Mississippi			
Cotton	0.78	0.40	−0.01
Soybeans	0.73	0.41	−0.20
Cass County, Iowa			
Corn	0.86	0.71	−0.41
Soybeans	0.69	0.48	−0.24

of the utility of ending wealth calculated as the mean (across iterations and years) of the discounted utilities of wealth. The subscript *sc* designates a particular revenue scenario for a particular representative farm.

The certainty equivalent represents the amount of money a producer would accept to avoid the risk present in a particular revenue scenario. The revenue scenarios that include government payments would be expected to have higher certainty equivalents than simple market revenue with no government payments because the government payments increase income and/or mitigate some of a producer's risk.

Results

Table 1 presents correlations between the yield for each representative farm and the respective county yield, national yield, and harvest price. Farm-level yields are more highly correlated with county yields than national yields for each crop in both locations. Iowa corn yields are negatively correlated with harvest prices. Soybean yields in both locations are less negatively correlated with harvest prices (in absolute value terms) than Iowa corn. Mississippi cotton yields are essentially independent of harvest prices. The farm-level yield for corn in Iowa is more highly correlated with the county and national yield than is the farm-level yield of cotton in Mississippi. This relationship indicates that corn yield risk in Cass County, Iowa, is more systemic than cotton yield risk in Sunflower County, Mississippi. This, combined with the differences in price-yield correlations, implies that, all other things being equal, farm-level revenue risk for the representative farm growing cotton in Mississippi should be greater than that of the representative farm growing corn in Iowa. This conclusion follows the relationship between aggregate and disaggregate revenues suggested by Glauber and Miranda.

Certainty Equivalents under FAIR and SIPP

Table 2 presents certainty equivalents for the mean present value of the expected utility of ending wealth derived from market revenue and the marginal contributions to these certainty equivalents from LDPs, PFC payments, and national-level SIPP payments. Producers are better off under any government program than facing the market alone—without these payments, certainty equivalents fall sharply from initial wealth. The welfare of the representative Mississippi cotton producer is generally improved more from government payments than is the welfare of the representative Iowa corn producer. The LDPs for soybeans benefit the representative Iowa farm somewhat more than the Mississippi farm, which is mostly due to the higher expected yield for Iowa soybeans relative to Mississippi soybeans. Relative to market revenue only, LDPs for cotton increase the certainty equivalent for the Mississippi farm by 10.0%. The analogous comparison for corn shows an increase in the certainty equivalent for the Iowa farm of 5.2%. LDPs raise certainty equivalents for soybeans by 3.5% and 4.9% in Mississippi and Iowa, respectively.

PFC payments for cotton made at the lowest annual payment rate under the FAIR Act

Table 2. Certainty Equivalents of Mean Present Value of Expected Utility of Ending Wealth over a Five-Year Program Period with the SIPP Five-Year Revenue Moving Average Initialized Using Historical Data for 1995–1999

	Sunflower County, Mississippi		Cass County, Iowa	
	Cotton ($)	Soybeans ($)	Corn ($)	Soybeans ($)
Net Market Revenue with No Government Payments	611,688	768,728	717,389	776,652
Marginal Effect of LDPs	60,998	26,579	37,323	38,190
Marginal Effect of PFC Payments with LDPs in Place (Lowest Annual Payment Rate Under FAIR)	38,114	0	23,943	0
Marginal Effect of PFC Payments with LDPs in Place (Highest Annual Payment Rate Under FAIR)	44,608	0	40,309	0
Marginal Effect of SIPP Payments Triggered at the National Level with LDPs in Place (90% Trigger)	12,816	5,968	8,951	5,605
Marginal Effect of SIPP Payments Triggered at the National Level with LDPs in Place (95% Trigger)	17,356	11,951	15,016	11,951

Notes: LDPs are limited to $75,000 annually. PFC and SIPP payments are limited to $40,000 annually.

increase the certainty equivalent for the Mississippi farm by 6.2% at the margin when added to the increase from LDPs. PFC payments for corn at the lowest rate marginally increase the certainty equivalent for the Iowa farm by 3.3%. Corresponding increases to certainty equivalents from PFC payments at the highest rate are 7.3% for cotton and 5.6% for corn. National-level SIPP payments received in addition to LDPs increase the certainty equivalent for cotton by 2.1% and 2.8% at the 90% and 95% trigger levels, respectively. Increases to the certainty equivalent for corn from national-level SIPP payments are 1.3% and 2.1% at the respective triggers. For both Mississippi and Iowa soybeans, certainty equivalents increased 0.7% for SIPP with a 90% trigger and 1.5% for SIPP with a 95% trigger. Except for the highest PFC payments for corn, the marginal effects of PFC and SIPP payments in all cases are smaller than the effects of LDPs.

As we assume the crop produced is the same crop as that of the historical base, producers on both farms prefer PFC payments to SIPP payments if cotton or corn is grown with LDPs in place.[5] If only soybeans are produced, SIPP is preferred because soybeans do not receive PFC payments.

Risk Aversion

To test for the impacts of risk aversion on policy preferences, the coefficient of absolute risk aversion was varied between zero (risk neutrality) and 0.000003 (moderate to high risk aversion). As would be expected, increasing the coefficient of absolute risk aversion reduced certainty equivalents for all policy alternatives. Higher levels of risk aversion made countercyclical payments such as LDPs and SIPP *relatively* more attractive when compared to PFC payments. However, given the assumed parameters on PFC and SIPP payments, higher levels of risk aversion did not change the absolute preference for PFC payments over SIPP payments.

[5] This study does not model the ad hoc emergency assistance payments made by Congress in the latter years of the FAIR Act, which if included would increase the value of the program to producers.

Table 3. Certainty Equivalents of Mean Present Value of Expected Utility of Ending Wealth Over a Five-Year Program Period with the SIPP Five-Year Revenue Moving Average Initialized Using Historical Data for 1995–1999

	Sunflower County, Mississippi		Cass County, Iowa	
	Cotton ($)	Soybeans ($)	Corn ($)	Soybeans ($)
Marginal Effect of Unlimited SIPP Payments Triggered at the National Level with LDPs in Place (90% Trigger)	15,412	5,968	10,885	5,649
Marginal Effect of Unlimited SIPP Payments Triggered at the National Level with LDPs in Place (95% Trigger)	24,273	12,470	18,948	12,345

Notes: LDPs are limited to $75,000 annually. PFC payments are limited to $40,000 annually. SIPP payments are unlimited.

Payment Limitations

By design, SIPP payments will vary inversely with realized gross revenue per acre. To smooth gross revenues across time, SIPP payments will be quite high in some years and quite low (possibly even zero) in other years. In Table 2, SIPP payments are limited to $40,000 per year to be consistent with PFC payment limitations. However, it might be argued that annual SIPP payments should not be limited since this constrains the countercyclical nature of the program.

The results presented in Table 3 are calculated similarly to those in the rightmost columns of Table 2, except that no limitation has been placed on annual SIPP payments. LDPs and PFC payments are still held to their 1996 FAIR Act limits. Removing the payment limitation increases the marginal effect of SIPP payments for cotton and corn. The largest increase is for cotton at the 95% trigger level. However, at the 90% and 95% trigger levels, even unlimited SIPP payments are not preferred to PFC payments. Removing the payment limitation has essentially no impact on the marginal effect of soybean SIPP payments at the 90% trigger and only a minor impact at the 95% trigger.

To facilitate a comparison of PFC and SIPP payments, we solved for SIPP trigger levels that would generate SIPP marginal certainty equivalent effects approximately equal to those generated by PFC payments. Said differently, we solved for the SIPP trigger levels that would render the representative farms indifferent between PFC and SIPP payment programs given the assumed level of risk aversion.

Table 4 presents these results for the representative Mississippi cotton farm and Iowa corn farm. When SIPP payments are limited to $40,000 annually, the representative Mississippi cotton farmer would be indifferent between PFC payments at the lowest annual payment rate under FAIR and SIPP with a trigger of 112%. The farmer would be indifferent between SIPP and PFC payments at the highest annual payment rate if the SIPP trigger were set at 125%. Without a SIPP payment limitation, the representative Mississippi cotton farm is indifferent between PFC payments at the lowest annual payment rate under FAIR and SIPP with a trigger of 100%. Similarly, without a SIPP payment limitation, the representative Mississippi cotton farm is indifferent between PFC payments at the highest annual payment rate under FAIR and SIPP with a trigger of 103%.

With a $40,000 SIPP payment limitation in place, the representative Iowa corn farm is indifferent between the low PFC payments and SIPP with a trigger of 101%. The farm is also indifferent between the high PFC payments

Table 4. SIPP Trigger Levels That Generate Marginal Certainty Equivalent Effects Approximately Equal to Those for PFC Payments When the SIPP Five-Year Revenue Moving Average Is Initialized Using Historical Data for 1995–1999

	Sunflower County, Mississippi, Cotton		Cass County, Iowa, Corn	
	SIPP Payment Limited to $40,000 Annually	Unlimited SIPP Payment	SIPP Payment Limited to $40,000 Annually	Unlimited SIPP Payment
Lowest Annual PFC Payment Rate Under FAIR	112%	100%	101%	98%
Highest Annual PFC Payment Rate Under FAIR	125%	103%	125%	105%

Notes: LDPs are limited to $75,000 annually. PFC payments are limited to $40,000 annually.

and SIPP with a trigger of 125%. When the payment limitation is removed, the farm is indifferent between the low PFC payments and SIPP with a trigger of 98%. The farm is also indifferent between the high PFC payments and SIPP with a trigger of 105%.

SIPP Without LDPs

Table 5 presents the marginal effects of national-level SIPP payments without LDPs, which can be compared to the results in Table 2. In every case, eliminating LDPs causes the marginal effects of SIPP payments to increase considerably. This suggests that the two countercyclical programs, SIPP and LDPs, are, at least to some extent, substitutes. However, given a choice between LDPs and a national-level SIPP with a 90% trigger, all the farms would prefer LDPs. If the SIPP trigger is set at 95%, all but the Mississippi soybean farm would prefer LDPs to SIPP.

The Mississippi cotton farm has the strongest preference for LDPs over SIPP. This reflects the fact that the Mississippi cotton farm has the smallest natural hedge. The lowest correlation between farm yield and national yield occurs for Mississippi cotton. Also, the yield on Mississippi cotton is essentially independent of price. This implies that there is less correlation between farm revenue and national revenue for the Mississippi cotton farm than for the Mississippi soybean farm or either crop produced on the Iowa farm.

Higher Market Prices

For the models described here, prices were initialized at the very low levels present at the end of 1999. An analysis was also conducted with market prices initially set 20% higher. Not surprisingly, higher market prices increased market revenues and decreased LDPs and SIPP payments. For this reason, higher market prices make PFC payments more attractive relative to SIPP payments.

Sensitivity Analysis of SIPP

SIPP payments are triggered by shortfalls in the current year's national gross revenue compared to its moving average for the previous five years. SIPP payments are sensitive to this choice of baseline as well as the choice of trigger level. The first four columns of Table 6 contain marginal certainty equivalent effects of a SIPP program, based on either national-level or county-level revenue, assuming that LDPs are in place and that the SIPP revenue baseline is based on a moving average of revenue per acre for the five previous years, as described in Rep. Stenholm's proposed legislation. Our simulations begin with year 2000, so the SIPP revenue baseline is based on the

Table 5. Certainty Equivalents of Mean Present Value of Expected Utility of Ending Wealth over a Five-Year Program Period Assuming a SIPP Program Without a Marketing Loan Program

	Sunflower County, Mississippi		Cass County, Iowa	
	Cotton ($)	Soybeans ($)	Corn ($)	Soybeans ($)
Marginal Effect of SIPP Payments Triggered at the National Level with No LDPs in Place (90% Trigger)	34,136	25,433	26,984	26,087
Marginal Effect of SIPP Payments Triggered at the National Level with No LDPs in Place (95% Trigger)	37,279	29,440	31,784	30,302

Note: SIPP payments are limited to $40,000 annually.

years 1995–1999. Since crop revenues were relatively high in 1996, 1997, and 1998, this baseline is probably much higher than a current baseline would be. Thus, the SIPP marginal certainty equivalent effects may be overstated relative to what would be expected currently.

To test how sensitive SIPP marginal certainty equivalent effects were to the underlying SIPP revenue baseline, we conducted an analysis where the SIPP revenue baseline for year 2000 was initialized by replacing each year of the five-year revenue moving average with the expected revenue for 2000. Said differently, this analysis assumed that for each of the years 1995–1999, realized revenue per

Table 6. Marginal Effects of Alternative SIPP Scenarios on Certainty Equivalents of Mean Present Value of Expected Utility of Ending Wealth over a Five-Year Program Period Assuming LDPs Are in Place

	Sunflower County, Mississippi		Cass County, Iowa	
	Cotton ($)	Soybeans ($)	Corn ($)	Soybeans ($)
SIPP Five-Year Revenue Moving Average Initialized Using Historical Data for 1995–1999				
Triggered at National Level (90% Trigger)	12,816	5,968	8,951	5,605
Triggered at National Level (95% Trigger)	17,356	11,951	15,016	11,951
Triggered at County Level (90% Trigger)	20,935	11,335	11,120	5,909
Triggered at County Level (95% Trigger)	27,254	15,541	14,550	9,972
SIPP Five-Year Revenue Moving Average Initialized Using Expected Revenue for 2000				
Triggered at National Level (90% Trigger)	4,763	0	1,976	0
Triggered at National Level (95% Trigger)	6,131	266	3,102	0
Triggered at County Level (90% Trigger)	6,637	2,105	6,990	309
Triggered at County Level (95% Trigger)	9,361	3,466	9,269	1,409

Notes: LDPs are limited to $75,000 annually. PFC and SIPP payments are limited to $40,000 annually.

acre for each crop was exactly equal to the expected revenue per acre for 2000. In subsequent years of the simulation, simulated revenues for 2000, 2001, and so on are incorporated into the moving average revenue baseline. This analysis is presented in the last four columns of Table 6.

When the SIPP baseline is initialized using the expected revenue for 2000, the marginal effects of SIPP payments are reduced. In an extreme case, soybean national-level SIPP payments have essentially no marginal certainty equivalent effects beyond those already generated by LDPs.

Given that farm yield is more highly correlated with county yield than with national yield (Table 1), one might expect that farmers would prefer a SIPP program based on county gross revenue instead of national gross revenue. Given the same trigger levels, this preference should be reinforced by the fact that county yields are more variable than national yields—a county-level SIPP would pay out more often and in higher amounts than a national-level SIPP. When the SIPP revenue baseline is initialized using the actual historical revenue for 1995–1999, the Mississippi farm prefers a county-level SIPP to a national-level SIPP at both trigger levels, as expected. The same is true for the Iowa farm at the 90% trigger level. However, at the 95% trigger level, the Iowa farm actually prefers the national-level SIPP to the county-level SIPP.

To understand this rather surprising finding, first notice that when the SIPP baseline is initialized at the expected value for 2000, the relationship between the marginal effects of county-level SIPP and national-level SIPP is in accordance with expectations. That is, county-level SIPP is always preferred to national-level SIPP for both crops on both farms and for both trigger levels. Therefore, the SIPP baseline determines the Iowa farm's preference for national-level SIPP versus county-level SIPP at the 95% trigger. In every case, the SIPP baselines calculated using actual historical revenue for 1995–1999 are higher than the baselines calculated using 2000 expected revenue. But differences occur between national-level SIPP and county-level SIPP in the magnitudes of the 1995–1999 baselines relative to the baselines calculated using 2000 expected revenue. For the Iowa farm, when revenue baselines are being measured as the moving average of actual revenue from 1995 to 1999, the revenue baselines for national-level SIPP are proportionately higher relative to 2000 expected values than those for county-level SIPP. That is, using the 1995–1999 moving average, the revenue baselines for both national- and county-level SIPP are higher than that for the expected value for 2000, but the proportional difference in the 1995–1999 moving average and the 2000 expected revenue is higher for national-level SIPP than for county-level SIPP. In the case of the Iowa farm, this "sampling error" in the five-year moving average estimate of expected revenue favored national-level SIPP relative to county-level SIPP—and to such a degree that it outweighed the opposing effect of farm yield and county yield being more highly correlated than farm yield and national yield.[6] For Mississippi crops, the difference between the farm-county yield correlation and the farm-national yield correlation is much higher than for the Iowa crops (Table 1). Thus, county-level SIPP was always preferred to national-level SIPP.

Table 7 is similar to Table 4 except that the SIPP baseline has been initialized using the expected revenue for 2000 as in the last four columns of Table 6. With the lower baseline, even higher SIPP trigger levels are required to attain indifference between SIPP and PFC payments.

Conclusions

Design of government support programs remains a challenge in farm policy. This paper has presented the results of a nonparametric

[6] Some might wonder why the Iowa farm did not prefer national-level SIPP to county-level SIPP at the 90% trigger level when the revenue baseline was initialized at the actual historical revenue for 1995–1999. A 90% trigger level generates far fewer and smaller SIPP payments than a 95% trigger level. Thus, there are fewer opportunities to take advantage of the relative differences between the 1995–1999 moving average estimates of national and county expected revenue.

Table 7. SIPP Trigger Levels that Generate Marginal Certainty Equivalent Effects Approximately Equal to Those for PFC Payments When the SIPP Five-Year Revenue Moving Average is Initialized Using Expected Revenue for 2000

	Sunflower County, Mississippi, Cotton		Cass County, Iowa, Corn	
	SIPP Payment Limited to $40,000 Annually	Unlimited SIPP Payment	SIPP Payment Limited to $40,000 Annually	Unlimited SIPP Payment
Lowest Annual PFC Payment Rate Under FAIR	127%	116%	117%	114%
Highest Annual PFC Payment Rate Under FAIR	145%	119%	140%	123%

Note: LDPs are limited to $75,000 annually. PFC payments are limited to $40,000 annually.

dynamic simulation model to evaluate preferences among alternative government payment programs for representative farms producing corn and soybeans in Iowa and cotton and soybeans in Mississippi. Loan rates were parameterized at the levels legislated in the 1996 FAIR Act, and PFC payments were considered at both the highest and the lowest annual rates provided by this legislation. Proponents of countercyclical SIPP payments based on shortfalls in annual gross revenue contend these payments would be preferable to fixed PFC payments. We consider countercyclical payments based on both national-level and county-level revenue and with payment triggers of 95% of the previous five-year moving average of gross revenue (as proposed by the first SIPP program in 1999) and 90%. Our simulation model incorporates yield-price correlations often neglected in analyses of farm program effects and includes risk aversion on the part of producers. The analysis provides a basis for evaluating commodity and regional differences in preferences among policy options.

Our simulation results offer a number of useful insights about farm support policies. First, compared to initially assumed wealth, revenue without government payments leads to a sharp decline in the certainty equivalent of ending wealth for the Mississippi farm and a small decline for the Iowa farm. LDPs, as legislated in the FAIR Act, provide a substantial countercyclical support option, increasing certainty equivalents by 3.5% (for Mississippi soybeans) up to 10.0% (for cotton). PFC payments, in addition to LDPs, also contribute substantially to certainty equivalents of cotton and corn producers but less than the LDPs themselves in all but one instance. National-level SIPP payments, in conjunction with LDPs, make a smaller contribution to certainty equivalents than PFC payments for cotton and corn. From these results, one concludes that the general claim that producers would prefer countercyclical payments to PFC payments can be overstated, at least for the support and stabilization levels built into the FAIR Act and the original SIPP proposal of Rep. Stenholm.

The marginal contribution of SIPP-type payments generally increases when based on county gross revenue rather than national gross revenue. Similarly, the marginal value of countercyclical SIPP payments increases when they are considered as an alternative, rather than a supplement, to LDPs. Given a choice between LDPs and national-level SIPP, the Mississippi soybean farm prefers SIPP, while the cotton farm has a strong preference for LDPs. The Iowa farm prefers LDPs for both crops.

Our results also demonstrate that policy options can affect regions differently and that these differences are influenced by price and yield correlations and correlations between farm yield and yields measured at higher levels of aggregation. The lowest correlation between farm yield and national yield occurs for Mississippi cotton. Also, the yield on Mississippi cotton is essentially independent of price. This implies that cotton revenue on the Mississippi farm is less correlated with national revenue than soybean revenue on the Mississippi farm or revenue from either crop on the Iowa farm. This explains why, when considered as a substitute for LDPs, a national SIPP is much less desirable for Mississippi cotton than for Mississippi soybeans or Iowa corn and soybeans.

The difference between the farm yield–county yield correlation and the farm yield–national yield correlation is greater for the Mississippi farm than for the Iowa farm. For this reason, the Mississippi farm preferred a county-level SIPP to a national-level SIPP for all scenarios considered here. This was not always the case for the Iowa farm.

The dynamic-stochastic model developed here endogenizes these price-yield correlations across different levels of aggregation as well as cross-crop yield correlations and price correlations. The results of this study demonstrate the fundamental importance of incorporating these correlations when analyzing individual preferences for different farm programs and the effect of regional differences on these preferences. Farm-level analysis of agricultural policy alternatives like SIPP requires more than static models to suitably integrate these essential factors.

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