EFFECTS OF ALTERNATIVE FARM PROGRAMS AND LEVELS OF PRICE VARIABILITY ON TEXAS COTTON FARMS

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Abstract

This study examines the effects of alternative government farm programs and hypothetical price variability levels on two Texas cotton farms which were simulated stochastically over a 10-year period. Results indicate that a combination of high price variability and participation in government programs stimulates growth and wealth accumulation.

Key words: farm programs, price variability, simulation, cotton.

Policy analysts have frequently used simulation models to test the possible outcomes of alternative farm programs. The Wharton agricultural model (Chen), the COMGEM model (Penson et al.), and the POLISIM model (Ray and Richardson) can all be used to test the effects of hypothetical farm programs on price, total production, and use of a variety of agricultural commodities. Other simulation models have been developed that represent individual farms. These models are used to evaluate the effects of farm programs on the financial situations of "typical" producers. Models of this variety include the FLIPSIM V model developed by Richardson and Nixon and the FLIPRIP model developed by Skees. Simulation is often preferable to other techniques because it can be used to assess complex interactions involving random processes that can not be solved mathematically.

Because prices, yields, and demand for agricultural commodities can not be accurately forecasted, some analysts prefer to incorporate some of the *randomness* of nature and the marketplace into the simulation model. Generally, the parameters of probability distributions for the variables considered to be stochastic in nature are estimated and included in the model. Pseudo-random numbers are drawn and used with the estimated probability density functions (pdfs) to develop random values for the variables considered to be stochastic in nature. When the model is iterated many times, the range of possible outcomes for a specific situation can be estimated and compared with the possible outcomes of alternative situations.

In most cases, a covariance matrix for the stochastic variables is estimated from time-series data and is used to represent the joint pdf. The estimated covariance matrix is sensitive to both the data used and any detrending procedures applied. Also, use of time-series data implies that the covariance matrix is assumed to be constant over the time period specified by the data, which may not be the case. Price variability can be affected, among other things, by: (a) the farm program, (b) changes in market structure such as increased participation in the international market, and (c) institutions such as the Chicago Board of Trade. Because the assumed probability distribution may have a strong influence on simulation outcomes, it would be useful to test the sensitivity of the simulation results to changes in the covariance matrix.

The objective of this study is to examine the effects of participation in selected farm programs on the growth and survival of two different size cotton farms in the Texas High Plains under alternative levels of price variability. Although the study will not provide an exhaustive analysis of the sensitivity of

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farm policy simulation results to the assumed pdf of crop prices, it should provide a general indication of the importance of the assumptions concerning these pdfs. It is hypothesized that farm growth and survival differ not only when different levels of farm program participation are assumed but also under different levels of price variability. If this is the case, policy makers should be concerned with the effects of farm policy on price variability and policy analysts should use a range of price variability levels rather than relying solely on historical pdfs.

BACKGROUND

Since its initiation in 1938, the Commodity Credit Corporation (CCC) loan program has been one of the fundamental institutions of United States farm policy for cotton. This program provides a support price (loan rate), or guaranteed minimum price, to cotton farmers who participate in the farm program. If the market price is below the loan rate, the government provides a nonrecourse loan to producers. If the farmer does not redeem the loan within 9 months, the stocks are turned over to the government. Government owned stocks are released when the market price is above a designated "release price," which is usually some function of the loan rate, such as 140 percent.

During the 1960's, the loan rate for cotton was frequently high relative to world market prices and, thus, government stocks accumulated. The target price (deficiency payment) program was designed to provide income support to producers without interfering with the market price. The target price is set by legislation and traditionally has been tied loosely to the cost of production. Participating producers receive a deficiency payment equal to the difference between the target price and the higher of loan rate or season average market price. Total deficiency payments to any one producer are limited to $50,000.

At the individual farm level, the loan rate and the target price program affects the dispersion of price and income respectively by truncating the lower tails of the distributions, leading to higher means and smaller variances. As the dispersion of the distribution increases, more of the lower tail is truncated by the farm programs. The effects of truncation are therefore increased as price and income variability increase. Although both the specific provisions of government programs and the national level of participation influence the distribution of market price (Gardner; Lin et al.; Meyers and Ryan; Salathe et al.), these aggregate effects are beyond the scope of this study. It is assumed that price variability caused by changes in the farm program over the period of the data are captured in the historical covariance matrix.

Although the CCC program involves both a support price and a release price, their relative positions with respect to the market price have been such that, in spite of generally favorable market conditions throughout the late 1970's, the release price for cotton has not been triggered since 1974. It should also be remembered that the release price is not a legislated price ceiling. When market price exceeds the release price, government owned stocks, if available, are released from storage. If insufficient stocks are owned by the government to satisfy demand at the release price, market price will remain above the release price. In no year from 1972 to 1981 were government owned stocks greater than 500 bales. For these reasons, the effect of the loan program should be to increase the mean of the farm-level price distribution.

Because of the nature of the CCC and target price programs, it is hypothesized that increased price variability will result in higher average incomes for farm program participants. With increased price variability, the probability of receiving very high prices increases. Athough the probability of very low market prices also increases, the loan and target price program protects producers from the downside risk. Because the probability of some very "good" years increases, it is likely that the combination of high price variability and participation in the farm program would stimulate expansion as sufficient cash would be available in some years to finance downpayments on machinery and land. It is uncertain, *a priori*, if the probability of bankruptcy will increase as price variability increases. This will depend, to a large degree, on the level of protection offered by participation in the farm program.

METHODOLOGY

Two different cotton farms in the Texas Southern High Plains were simulated assuming three farm program participation possibilities and five different price variability assumptions. A whole-farm simulation model, FLIPSIM V[1], was used to evaluate the impacts

[1]FLIPSIM is documented in Richardson and Nixon.

of selected farm programs and different probability distributions for cotton and cottonseed prices on farm growth and survival. FLIPSIM V was used for the analyses because it is capable of simulating different size crop farms under alternative farm programs and price probability distributions.

Possible crop enterprises on the farm were dryland and irrigated cotton lint and cottonseed. The base probability distributions of crop prices and yields were developed using historical data (1971-1982) for these variables in the study area. Prices and yields for all crop enterprises of the typical farms were assumed to have a multivariate normal distribution. Annual harvested acre yields for a representative farm were obtained from the local Agricultural Stabilization and Conservation Service (ASCS) office. Because these yields are not available in any publication, they are reported in Table 1. Annual cotton lint prices for the period were obtained by randomly drawing one price from the daily January prices reported for the Lubbock cash cotton market for each of the years 1971 to 1982 (USDA).[2] A similar approach was used to obtain cottonseed prices for this time period. (Average annual prices and county average yields were not used because averaging would result in a downward bias in the estimate of the variability faced by individual producers.) The prices used in the study are also reported in Table 1. The base covariance matrix was developed from deviations about the means. No statistically significant trend was found in yields during this period so no detrending procedure was applied. Although this was generally an inflationary period, the prices were not deflated because it was believed that producers often perceive variability in nominal, not real, terms and the prices were not moving in a consistently upwards direction. Because the objective of this study is to test the sensitivity of farm growth and survival to different levels of price variability, little would be gained by deflating prices.

Four hypothetical probability distributions for prices and yields were developed from the base covariance matrix. Standard deviations of prices in the base covariance matrix were scaled up and down over the range of plus or minus 60 percent, but the same set of means was used for all five of the pdfs.

TABLE 1. PRICES AND YIELDS FOR TYPICAL COTTON FARMS IN THE TEXAS SOUTHERN HIGH PLAINS USED IN THE STUDY

Year	Yield		Cotton price	Cottonseed price
	Irrigated	Dryland		
	----------lb./acre----------		cents/lb.	$/ton
1971	474	297	32.05	54.0
1972	415	377	24.58	51.5
1973	591	650	56.04	97.0
1974	341	0	27.87	125.0
1975	212	337	48.67	88.0
1976	553	187	58.60	99.0
1977	552	380	42.00	64.0
1978	471	419	53.40	122.0
1979	369	91	59.43	112.0
1980	215	152	68.04	119.0
1981	667	347	44.65	80.0
1982	0	0	49.21	85.0

For example, in the –60 percent matrix (price variability level I), the base covariance between cotton lint and cottonseed price was multiplied by .16 (.40 X .40) because both standard deviations were scaled down by 0.40. The base covariance between cotton lint price and dryland cotton yield was multiplied by .4 because only the standard deviation for price was altered. Five different price variability levels were used in this study. Price variability level I involved a 60 percent reduction in the standard deviation for prices and level II represented a 40 percent reduction in these standard deviations. Price variability level III was the historical base. Price variability levels IV and V involved increases in the standard deviation for the price variables of 40 percent and 60 percent, respectively.

ALTERNATIVE POLICIES TESTED

The alternative farm program scenarios analyzed include: (a) full participation in the 1981 provisions of the 1981 Farm Bill including the target price (70.9 cents/pound), loan rate (52.5 cents/pound), and all-risk crop insurance (BASIC); (b) participation in the loan program and crop-insurance (NOTAR); and (c) participation in crop insurance only (NOSUPP).

A supply control mechanism, such as set-aside, was not included in the analyses for two reasons. First, no supply control provision was in effect during the 1981 crop year. More importantly, inclusion of a supply control measure would make the results of the three policy options difficult to compare. A supply control program links participation in the price and income protection provisions

[2]It was assumed all cotton lint would be sold in January since most cotton in the study area (88 percent) is ginned by mid-January (Bailey).

of the farm program to a reduction in acreage for the program commodities, but acreage reduction is generally not required for participation in crop-insurance. In the NOSUPP trial, therefore, overall cotton production would be higher than in the other trials because there would be no requirement to reduce acreage. Higher production would exacerbate the effects of changes in price variability on income variability, making the NOSUPP scenario difficult to compare with the others.

TYPICAL FARMS

Two typical cotton farm situations in the Texas Southern High Plains were developed from producer survey data obtained by Smith. The two farms selected for the present study represent a part-time family farm in the region (511 acres) and a full-time commercial farm in the region (1,088 acres). The survey data describe the typical characteristics of 511 and 1,088 acre farms in the region including volume of cotton produced, production practices, machinery complements, financial position, input purchases, marketing experience, and family living expenses.

The typical farms include recognition of economies experienced by different size farms. The typical farm specifications reflect the differences in input costs associated with size, the cost advantages associated with typical levels of vertical integration, and the marketing price advantages associated with each size category. Smith found that the larger farms generally realized higher prices due to their ability to market cotton in large lots and that large-scale producers had more economic incentive to invest time in marketing cotton. Larger farms also had lower cash production costs because of the ability to take advantage of volume discounts. In addition, larger farms are able to use machinery more efficiently, leading to lower per acre machinery costs.

Differences in financial characteristics, off-farm income, and living expenses associated with the different farm sizes were also recognized in the typical farm specifications. Table 2 provides a summary of selected demographic and financial characteristics for the two typical farms used in the simulation model. It should be noted that the leverage ratio is nearly twice as large for the 1,088-acre farm as for the 511-acre farm. The relatively high debt load on the larger farm would be expected to increase the farm's vulnerability to bankruptcy.

Assumptions about the farms in Table 2 are held constant across all policy and price variability options simulated. Further information about the farms used in this analysis can be found in Smith.

SIMULATION MODEL

FLIPSIM V is a firm level, recursive, Monte Carlo simulation model which simulates annual production, farm policy, marketing, farm management, and income tax aspects of a farm. The different size farms in this study were simulated over a 10-year planning horizon which was replicated 50[3] times for each farm-size/farm-program/price-variability combination.

In the FLIPSIM V model, the analyst may select one of three options for determining the crop-mix. In this study, the farm's crop-

TABLE 2. DEMOGRAPHIC AND FINANCIAL CHARACTERISTICS OF TWO TYPICAL FARMS BY SIZE IN THE TEXAS SOUTHERN HIGH PLAINS, 1983

Characteristic	Units	Farm size	
		511 acres	1,088 acres
Age of operator	years	51.	41
Acres owned	acres	261	381
Acres leased	acres	250	707
Value of owned land	$1,000	163.6	229.8
Value of equipment	$1,000	77.8	169.4
Long-term debt	$1,000	36.9	63.1
Intermediate-term debt	$1,000	37.6	116.8
Net worth	$1,000	166.9	219.3
Long-term debt to assets	pct.	23	27
Intermediate-term debt to assets	pct.	48	69
Debt-to-equity ratio	pct.	44	82
Off farm income[a]	$1,000	21.0	16.0
Minimum family living withdrawal	$1,000	15.2	15.2

[a]Off-farm income includes only income from services or salaries. Source: Smith.

[3]Trials performed by Perry et al. indicate that little additional information is gained by iterating the model a greater number of times.

mix of irrigated and dryland cotton was predetermined based on the proportion of the farm that had historically been irrigated. The constant crop-mix option was selected because it is the simplest. The analysis was also run using the linear programming option; however, little change was noted.

The analysis was done using nominal dollars to reflect actual costs of capital and the anticipated investment potentials for farmers. Base production and harvesting costs obtained from the producer surveys were increased at 5 percent annually over the planning horizon to account for inflation.[4] The model simulates cash production costs by multiplying the inflation adjusted per acre input costs by planted acreages for the respective crops. Labor costs are calculated as the sum of full-time labor charges plus the cost of part-time labor. Harvesting costs are the product of the inflation-adjusted per unit harvesting cost, yield,[5] and harvested acreage.

Average annual crop prices were inflated 4 percent per year. Inflation of prices received at a slightly lower rate than costs reflects a trend that has been observed over the period that the joint pdf of prices and yields was developed. This assumption is consistent with Tweeten's estimate that farmers are able to pass on only about 72 percent of increased production costs. This assumption may not be valid for the future; however, results for the simulation trials are all affected in the same manner so comparisons of the alternative policy participation options remain valid.

The model amortizes all outstanding loans as simple interest mortgages. (Annual interest rates for existing land, machinery, and operating loans were, respectively, 8.5, 13, and 15 percent.) The market value of farm machinery and cropland is updated, assuming the value of land increases 5 percent per year and the nominal value of used equipment decreases 1 percent per year. The upward adjustment of land values to keep pace with inflation may not reflect the current situation in the study area, but is consistent with the longrun trend over the data period. As with the assumptions regarding inflation, results for all simulation trials are affected in the same manner so comparisons of the alternative policy participation options are not invalidated by this assumption.

Equipment purchased prior to 1981 is depreciated using a 5 to 7 year life and the double declining balance method. Equipment purchased after 1980 is cost recovered assuming a 5-year life and accelerated cost recovery rules. Equipment which passes its economic life (7 to 10 years) is replaced by trading it for a new replacement. The cost of replacement equipment is assumed to increase 5 percent per year (the inflation rate) from its base price. First year expensing and maximum investment tax credit are calculated for new equipment.

Cash receipts for each crop are the product of random yield, harvested acres, fraction of crop marketed, and random price, less the landlord's share of each crop. When the market price is less than the effective loan rate for a crop, the operator's share of the cotton crop is placed in the CCC loan rather than being sold if the operator is assumed to participate in the program. Stocks are redeemed from the CCC loan if the market price in the following year exceeds the net loan rate. Deficiency payments are paid when the average price is less than the target price. The deficiency payment is a function of the payment rate, farm program yield, harvested (or base) acreage, and national allocation factor (0.90).

The 1982 insurance rates for the Federal Crop Insurance program in the study area are used for both representative farms. It is assumed that the farm operators elect the 65 percent yield coverage level and the high price guarantee. This level of coverage is representative of the study area and is consistent with other research for the region (Lemieux et al.). Provisions to increase or decrease the annual insurance premium based on loss records are incorporated into the model.

After simulating the farm policies selected by the user, the model determines the farm operator's year-end financial position and cal-

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[4]Over the 1980-1983 period, the Consumer Price Index rose from 246.8 to 298.4 (1967=100) which is consistent with an average annual inflation rate of approximately 5 percent (U.S. Department of Commerce).

[5]Average annual yields were held constant over the planning horizon because there was no discernible trend in yields in the study region over the time horizon of the data.

culates family cash withdrawals[6] and accrued income taxes. Year-end cash flow deficits are handled as follows: (a) grant a lien on crops in storage, (b) refinance long-term equity, (c) refinance intermediate-term equity, (d) and/or sell cropland.[7] If the operator is unable to cover the deficit, the farm is declared insolvent and the model begins the next iteration. A farm may also be declared insolvent if its debt-to-equity ratio exceeds the maximum established by lenders in the local area (2.33).

Personal income taxes and social security taxes are calculated for the operator who is assumed to be married and filing a joint income tax return with four personal exemptions. The regular income tax liability is computed using two methods: income averaging (if qualified) and the standard tax tables. The model selects the tax strategy which results in the lower income tax liability.

The farm is permitted to grow each year by purchasing cropland if the operator has sufficient cash to cover the 30 percent down payment plus additional machinery necessary for the proposed larger farm. The operator is permitted to borrow against equity in land to meet up to 50 percent of the down payment. The farm operation can also grow by leasing land if the operator can meet the downpayment requirements for purchasing additional machinery needed by the proposed large size farm. If machinery is purchased due to growth, it is depreciated and the operator's income taxes are recalculated.

Probability of survival, average present value of ending net worth, and average ending farm size are the three criteria for evaluating the firm level impacts of alternative farm programs and price variability levels. The average present value of ending net worth (PVENW) is the farm operator's average ending net worth discounted to the first year of the planning horizon using a discount rate of 5 percent. The 5 percent figure was selected because 5 percent interest is generally available on passbook accounts in the area. Selection of a different discount rate would not have changed the ranking of results, only the magnitude of PVENW. The probability of survival is the number of iterations the farm remains solvent divided by the total number of iterations (50).

RESULTS

The simulation results for the 511-acre and 1,088-acre farms are presented in tables 3 and 4, respectively. For both farms under all price variability/policy participation combinations, both the average present value of ending net worth PVENW and the average ending acres operated are greater than their beginning values, but the amount of increase is different in each case.

The 511-acre farm exhibits the strongest tendency to grow in terms of both financial assets and acreage operated under a combination of high price variability and full participation in the farm program (BASIC option). For the 511-acre farm under the BASIC option, average ending acreage operated increases from 655 acres under the lowest level of price variability to 805 acres under the highest level of price variability. Similarly, the average present value of ending net worth is $283,700 under the BASIC option with low price variability and $345,800 when price variability is high. This indicates that, as hypothesized, farm program provisions interact with high price variability to create a climate favorable to farm growth.

For the 511-acre farm under the BASIC option, the probability of survival does not appear to be affected by the level of price variability but remains a constant 98 percent, indicating that when full participation in the farm program is elected, increased price variability does not result in an increased risk of insolvency for farms with these characteristics.

Under the NOTAR option, the operator is assumed to participate in the loan and crop insurance program, but receives no deficiency payment. Loss of the deficiency pay-

[6]Limits on annual cash withdrawals were established at $15,000 (lower limit) and $40,000 (upper limit). Within these limits, family living expenses were based on the following consumption function:

Withdrawals = 15,200 + 0.25 (disposable income − 15,200); where disposable income is total cash farm income minus accrued federal and self employment taxes and the value of straight line depreciation for all machinery on the farm which was scheduled for replacement at the end of its economic life. The marginal propensity to consume is based on work reported by Richardson and Nixon. It is the mode of a variety of estimated marginal propensities to consume for U.S. farm families. As with other assumptions in this study, the choice of marginal propensity to consume is consistent in all trials and therefore will not affect the major conclusions of this study.

[7]Cropland which is sold to meet cash flow deficits is assumed to be leased back on a crop-share basis. This allows the farm operator to continue to use fully his/her investment in machinery.

TABLE 3. RESULTS OF SIMULATING A TYPICAL 511-ACRE TEXAS SOUTHERN HIGH PLAINS COTTON FARM FOR 10-YEARS ASSUMING FIVE ALTERNATIVE LEVELS OF PRICE VARIABILITY AND THREE FARM PROGRAM PROVISIONS.

Item	Price variability levels[a]				
	I	II	III	IV	V
Probability of survival:[b]			Pct.		
BASIC	98	98	98	98	98
NOTAR	98	100	100	98	96
NOSUPP	98	100	98	94	96
PVENW:[c]			Thou. $		
BASIC	283.7	288.7	311.4	337.7	345.8
NOTAR	263.9	264.4	278.1	297.9	304.0
NOSUPP	262.9	261.4	252.5	242.8	246.5
Average acreage operated in last solvent year:			Acres		
BASIC	655	668	725	789	805
NOTAR	597	613	626	649	655
NOSUPP	585	585	588	597	610

[a]Price variability level I represents 40 percent of the normal price variability. Similarly, level II is 60 percent of normal, level III is normal, level IV is 40 percent greater than normal, and level V is 60 percent greater.

[b]The probability of survival identified in this study is the probability that the farm will maintain its equity ratios at levels established by local financial institutions, i.e. a debt-to-equity ratio of less than 2.33.

[c]This is the average over 50 iterations of the present value of ending net worth. Initial net worth for the farm was $166,900. The ending net worth for the farm was discounted using a 5 percent after tax discount rate.

ments is hypothesized to reduce producer income, resulting in a reduced capacity for expansion. It is also hypothesized that the producer under NOTAR would be exposed to more downside risk from increases in price variability thus increasing the probability of insolvency.

Results for the 511-acre farm support the first hypothesis, but not the second. Under NOTAR, the PVENW and ending acres operated are less than under BASIC at every level of price variability. However, the same trend across price variability is present with average PVENW and acres operated increasing steadily from $263,900 and 597 acres, respectively, at the lowest level of price variability to $304,000 and 655 acres at the highest level of price variability. Under the NOTAR option, growth appears to be stimulated by high price variability, but not to as great an extent as under the BASIC option.

Under the NOTAR option, the probability of survival varies from 96 percent (price variability level V) to 100 percent (price variability levels II and III). There is no trend across price variability levels and the slight changes are explained by the random components of the model. Because the probability of survival remains high, this farm appears well protected from insolvency no matter what the level of variability in price. The characteristics of this farm, given in Table 2, explain these results. The 511-acre farm has high off-farm income and a strong initial financial position, making it relatively invulnerable to insolvency.

The final policy alternative, NOSUPP, involves participation in only the crop insurance program. Under NOSUPP, unlike BASIC or NOTAR, the farm operator's average ending financial position does not benefit from increased price variability. On the 511-acre farm, the highest PVENW occurs at the lowest level of price variability. This indicates that it is the combination of farm program supports and high price variability that stimulates growth and not just increased variability alone. For the 511-acre farm under NOTAR, average ending acreage rises only slightly as variability increases. This very slight level of increase was due to occasional "good" years providing the necessary cash flow for land expansion. However, the decrease in ending net worth as variability increases demonstrates that the stimulus for overall growth is missing without the price and income support programs.

Under the NOSUPP option, the probability of survival for the 511-acre farm does not appear to be affected by the level of price variability. This result is most likely caused by the initial financial strength of the farm and the high level of off-farm income. Again, minor variations in the probability of survival are caused by random elements in the model.

The 1,088-acre farm begins at a much more vulnerable financial position. The initial leverage ratio is .82 as compared to .44 for the 511-acre farm. The farm family is also assumed to have a lower level of off-farm income, $16,000 as compared to $21,000. These characteristics, representative of commercial-size farms in the area, are hypothesized to make this farm much more vulnerable to the down-side risks of increased variability. It is expected *a priori* that the probability of survival for this farm will decrease as price variability increases in the NOSUPP option and possibly in the NOTAR and BASIC options as well.

TABLE 4. RESULTS OF SIMULATING A TYPICAL 1,088-ACRE TEXAS SOUTHERN HIGH PLAINS COTTON FARM FOR 10-YEARS ASSUMING FIVE ALTERNATIVE LEVELS OF PRICE VARIABILITY AND THREE FARM PROGRAM PROVISIONS

Item	Price variability levels[a]				
	I	II	III	IV	V
Probability of survival:			Pct.		
BASIC	94	92	96	98	96
NOTAR	88	82	78	76	78
NOSUPP	88	80	74	64	58
PVENW:[c]			Thou. $		
BASIC	383.2	405.0	451.0	508.2	522.3
NOTAR	309.1	311.3	334.6	359.8	387.5
NOSUPP	304.7	295.4	275.2	248.1	245.7
Average acreage operated in last solvent year:			Acres		
BASIC	1,229	1,270	1,331	1,350	1,373
NOTAR	1,181	1,206	1,226	1,264	1,293
NOSUPP	1,174	1,184	1,203	1,210	1,232

[a]Price variability level I represents 40 percent of the normal price variability. Similarly, level II is 60 percent of normal, level III is normal, level IV is 40 percent greater than normal, and level V is 60 percent greater.
[b]The probability of survival identified in this study is the probability that the farm will maintain its equity ratios at levels established by local financial institutions, i.e. a debt-to-equity ratio of less than 2.33.
[c]This is the average over 50 iterations of the present value of ending net worth. Initial net worth for the farm was $166,900. The ending net worth for the farm was discounted using a 5 percent after tax discount rate.

Results for the 1,088-acre farm are similar to those for the 511-acre farm in terms of PVENW and ending acreage operated, but, as hypothesized, there is a difference in terms of probability of survival under the NOTAR and NOSUPP options, Table 4. Under the BASIC option for the 1,088-acre farm, PVENW increases with price variability from $383,200 at the lowest level of price variability to $522,300 at the highest level of price variability. Similarly, average ending acreage increases from 1,229 acres at price variability level I to 1,373 acres at price variability level V. On this farm, as well as on the 511-acre farm, a combination of high price variability and participation in the farm program stimulates growth.

Under the BASIC option, the probability of survival does not appear to be affected by the level of price variability. There is variation in the results, but the variation is not a consistent trend and is explained by random processes in the model. For both cotton farms tested in this study, it appears that a combination of full participation in the farm program and high price variability (level V) stimulates financial and physical expansion of the farm firm without resulting in an increased likelihood of firm failure.

For the 1,088-acre farm under the NOTAR option, PVENW and average ending acreage increase with price variability from $309,100 and 1,181 acres, respectively, at the lowest level of price variability to $387,500 and 1,293 acres at the highest level of price variability. Under this option, expansion continues to be stimulated by high price variability but not to as great an extent as under the BASIC option. Results for the probability of survival are mixed. A reduction in price variability below the historic base (level III) appears to result in an increased probability of survival, but an increase in price variability beyond the base does not appear to have an adverse effect because the CCC loan program protects producers from low prices.

In the final policy option, NOSUPP, the probability of survival for the 1,088-acre farm is affected by an increase in variability, dropping from 88 percent at the lowest level of price variability to 58 percent at the highest. This indicates that, without price and income supports from the farm program, a farm that has a moderate to high debt exposure is more vulnerable to insolvency under highly variable prices.

Under NOSUPP, the 1,088-acre farm behaves similarly to the 511-acre farm in terms of PVENW and ending acres operated. High price variability alone does not appear to stimulate growth. The PVENW declines steadily with price variability from $304,700 at the lowest level of price variability to $245,700 at the highest level. Average ending acreage increases slightly as price variability increases, but the overall financial strength of the farm declines.

Previous work in the study area by Smith et al. indicated that, under historical price variability, participation in the farm program stimulates physical and financial growth. This study extends these results. Participation in the farm program results in higher PVENW and average ending acres operated regardless of the level of price variability. For example, at the historical level of price variability (level III) average ending acreage for the 1,088-acre farm is 1,331 acres under BASIC compared to 1,203 acres under NOSUPP, Table 4. Similarly, at price variability level I, average ending acreage operated for the 1,088-acre farm is 1,229 under BASIC and only 1,174 under NOSUPP. This indicates that farm program participation plays a major role in farm growth regardless of the level of market price variability.

Smith et al. hypothesized that increased price variability would result in a wider spread for ending farm size under the different policy participation scenarios. Results from this study support this hypothesis. For both farms, the greatest difference in ending farm size between the NOSUPP and BASIC trials occurs at price variability level V. Thus, results from this study indicate that farm-level policy simulations are sensitive to the assumed level of price variability.

SUMMARY AND CONCLUSIONS

The objective of this study was to assess the effects of alternative levels of price variability on farm growth and survival for a select set of farm program options. Two different cotton farms in the Texas Southern High Plains were simulated stochastically over a 10-year period, under 5 alternative levels of price variability and 3 farm policy options. The farms represented a family-size part-time operation in the study area (511 acres beginning size) and a full-time commercial-size farm in the study area (1,088 acres beginning size). Alternative levels of price variability were developed by scaling the historical standard deviations for the price variables over a range of plus or minus 60 percent and using these scaled standard deviations to develop alternative multivariate pdfs. Farm policy options included participation in the loan program, the target price program, and all-risk crop insurance (BASIC); participation in the loan and crop insurance only (NOTAR); and participation in only the crop insurance program (NOSUPP).

Results of the study indicate that increasing price variability leads to higher average ending net worth and more rapid farm growth in the presence of farm programs that protect producers from low prices and incomes. Under the BASIC and NOTAR scenarios, both farms experience increased financial and physical growth when price variability increases. For the 511-acre farm, the probability of survival is not affected by price variability when the operator does not participate in the target price program (NOTAR). On the other hand, the probability of survival for the 1,088-acre farm under NOTAR increases somewhat when price variability drops below the historical level.

Without an income and price support program, financial and physical growth is reduced for both farms at all levels of price variability. As price variability increases, present value of ending net worth decreases steadily for both farms. The probability of survival for the 511-acre farm remains high for all levels of price variability despite the absence of price and income supports. However, the probability of survival for the 1,088-acre farm decreases steadily as price variability increases. The 511-acre farm remains relatively invulnerable to insolvency due to a strong initial financial position and relatively high off-farm income, characteristics of farms of this size in the study area. By contrast, the 1,088-acre farm is characterized as having a higher debt exposure and lower off-farm income.

Results from this study have implications for the current policy environment. Programs that protect producers from downside price and income risks appear to stimulate growth, particularly when markets are volatile. For the two farms in this study, both physical and financial growth appear most stimulated by a combination of full participation in the farm program and high levels of price variability. Although the study area was limited to the Texas Southern High Plains, it is probable that the trends observed on these farms would occur generally in the United States.

Results from this study also have broader implications for policy analysts. It appears that farm-level policy simulation studies are sensitive to the assumed level of price variability. It would be advisable, therefore, for analysts to test alternative price distributions when analyzing the possible effects of farm program provisions.

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