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FARM-LEVEL EVIDENCE ON THE RISK BALANCING HYPOTHESIS FROM ILLINOIS GRAIN FARMS

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FARM-LEVEL EVIDENCE ON THE RISK BALANCING HYPOTHESIS FROM ILLINOIS GRAIN FARMS

The risk-balancing hypothesis contends that a farmer may opt to make offsetting adjustments in the farm's capital structure in response to modifications of business risk conditions (Gabriel and Baker; Barry; Barry and Robison). The hypothesis has strong analytic value and has been shown to be a useful analytical tool especially in policy issues. For instance, Featherstone, *et al.* have constructed a theoretical model based on the risk-balancing hypothesis to demonstrate the failure of the government's risk-reducing and income-augmenting policies in increasing the farmers' overall welfare conditions. Their framework illustrates how reductions in business risk could induce farmers to make optimal leverage adjustments that ultimately affect the farm's cumulative probability of earning very low rates of return on equity. Robison and Barry and Barry and Robison also illustrate the balancing concept in the context of firm-level equilibrium analysis under risk.

The concept's strong theoretical merits are, however, eclipsed by its lack of strong empirical support using farm-level data to reinforce Gabriel and Baker's preliminary findings based on aggregated U.S. farming data. This study will provide the necessary econometric test of the hypothesis using a longitudinal farm data set from Illinois grain farms. Moreover, this study will identify demographic and financial characteristics that can be attributed to farmers who subscribe to the risk-balancing strategy. Proxy measures of certain risk management strategies will also be included in the analysis to determine their compatibility with the risk-balancing strategy.

Conceptual Framework

The risk-balancing hypothesis establishes a link between business, financial and total risks. Exogenous shocks that affect a firm's level of business risk are believed to induce the firm to make offsetting adjustments in its financial leverage position.¹ The hypothesis suggests a risk management strategy that requires abstinence from incurring additional financial obligations whenever business risks are too high. Conversely, upward adjustments in optimal leverage levels may be warranted whenever the level of business risk decreases. The underlying motivation for this balancing behavior is the restoration of equilibrium or optimal conditions that have been disrupted by external shocks affecting the firm's business risk condition.

The hypothesis can be derived using an equilibrium analysis approach that examines how imbalance due to external shocks that disrupt an existing optimal organization of assets and liabilities can be restored to equilibrium conditions through risk balancing.² The approach of Gabriel and Baker, based on the additive relationship between business and financial risk, illustrates absolute changes in total risk due to debt financing. Barry's approach, on the other hand, derives a multiplicative relationship between business and financial risk and explains the effect of incremental debt financing in terms of percentage increases in total risk. These approaches are equivalent and differ only in measurement concepts.

The Additive Relationship

This additive approach utilizes information from the firm's income and cash flow statements. Business risk (BR) is defined in terms of the relative variability of either net operating income or net cash flows (Gabriel and Baker).

$$(1) \quad BR = \frac{\mathbf{S}_1}{\bar{c}x}$$

Financial risk (FR) is given by the following expression (Gabriel and Baker):

$$(2) \quad FR = \frac{\mathbf{S}_2}{\bar{c}x - I} - \frac{\mathbf{S}_1}{\bar{c}x}$$

where σ_1 and σ_2 are the standard deviations of net cash flows without and with (prior to debt servicing) debt financing, respectively; $\bar{c}x$ is expected net cash flows or net operating income without debt financing; and I is fixed debt servicing payments.³

Gabriel and Baker simplify their model by assuming the absence of a scale effect due to leverage. This assumption simplifies (2) into the following form since leverage-induced changes in the variability of net cash flows have been ruled out (hence $\sigma_1 = \sigma_2$):

$$(3) \quad FR = \frac{\mathbf{S}_1}{\bar{c}x} \frac{I}{\bar{c}x - I}$$

The above expression suggests that FR is actually dependent on the level of BR, which shows up in (3) as a partial determinant of the level of FR. These two types of risk form an additive relationship to determine total risk (TR) as shown in the following derivation (Gabriel and Baker):

$$(4) \quad TR = \frac{\mathbf{S}_1}{\bar{c}x - I} = \frac{\mathbf{S}_1}{\bar{c}x} \frac{\bar{c}x}{\bar{c}x - I} = \frac{\mathbf{S}_1}{\bar{c}x} + \frac{\mathbf{S}_1 I}{\bar{c}x(\bar{c}x - I)}$$

The risk-balancing hypothesis is best understood when the above expression for TR is analyzed in terms of a bound β for maximum total risk that a firm can tolerate (Gabriel and Baker):

$$(5) \quad \frac{\mathbf{s}_1}{\bar{c}x} + \frac{\mathbf{s}_1 I}{\bar{c}x(\bar{c}x - I)} \leq \mathbf{b}.$$

Any exogenous shock affecting the level of BR would disrupt the total risk constraint and thus requires some strategy for restoring conditions that satisfy the above inequality. A slack in the risk constraint results when some exogenous force brings down the BR level. The FR component is also partly reduced (due to its own BR component) and the firm may choose to undertake riskier and more profitable production, investment or financing (or a combination of these) activities to take advantage of the slack in the constraint. These strategies could ultimately raise the levels of BR and FR until the above constraint is satisfied once again.

Conversely, adjustments in the firm's financial structure could also be used (as a stand-alone strategy or in combination with risk reducing production and/or investment strategies) to counter the effect of exogenous shocks that raise the firm's BR level.

The Multiplicative Relationship

This approach utilizes concepts of portfolio theory that form the basis of constructing a capital market line (CML). Combinations of a risk-free asset and a dominant portfolio of risky assets define a set of possible risk-efficient portfolios from which an optimal capital structure can be determined. Holdings of the risk-free asset indicate the firm's financial leverage profile where positive holdings correspond to lending activities and negative holdings indicate borrowing from external sources.

In a borrowing scenario, the expected return to an investor's wealth is given by the weighted returns on the risk-free asset and the portfolio of risky assets (Barry, Barry and Robison):

$$(6) \quad \bar{r}_e = \bar{r}_a P_a - iP_i.$$

Translated into balance sheet terms, the subscript "a" corresponds to risky assets which is equivalent to a firm's total assets (A), "i" stands for the risk-free asset represented by total debt (D) and "e" is the investor's equity capital. The weights on the returns P_a and P_i are the ratios A/E and D/E which are consistent with the balance sheet identity, A-D=E.

Since asset i is risk-free with zero variance, the variance of the rate of return on equity is given by (Barry, Barry and Robison):

$$(7) \quad \mathbf{s}_e^2 = \mathbf{s}_a^2 P_a^2.$$

Using this framework, an expression for the total risk (TR) of an investor's portfolio can be formulated through a measure of the coefficient of variation of the rate of return on the investor's wealth or equity capital (Barry, Barry and Robison):

$$(8) \quad TR = \frac{\mathbf{s}_e}{\bar{r}_e} = \frac{\mathbf{s}_a P_a}{\bar{r}_a P_a - iP_i}.$$

TR can be easily decomposed into its components by considering that (similar to Gabriel and Baker) business risk (BR) can be measured as the coefficient of variation of the rate of return on risky assets:

$$(9) \quad BR = \frac{\mathbf{s}_a}{\bar{r}_a}.$$

Dividing TR by BR will yield an expression for financial risk (FR):

$$(10) \quad FR = \frac{\bar{r}_a P_a}{\bar{r}_a P_a - iP_i}$$

which can be interpreted as the rate of return on risky assets relative to the rate of return on equity capital – a flow measure of leverage.

The multiplicative relationship between BR and FR in determining TR can be verified by multiplying the above FR and BR expressions (Barry, Barry and Robison):

$$(11) \quad TR = \left(\frac{\mathbf{S}_a}{\bar{r}_a} \right) \left(\frac{\bar{r}_a P_a}{\bar{r}_a P_a - iP_i} \right) = \frac{\mathbf{S}_a P_a}{\bar{r}_a P_a - iP_i} = \frac{\mathbf{S}_e}{\bar{r}_e}$$

which is equivalent to the expression in (8).

The risk-balancing hypothesis can be illustrated graphically using the CML in Figure 1 (Barry and Robison). Point C is the initial (equilibrium) optimal portfolio of risky and risk-free assets given the investor's risk preference. Whenever a parameter value changes, this portfolio becomes non-optimal, thus, requiring adjustments to restore optimal conditions. An adjustment may take the form of a tradeoff between BR and FR. For example, an increase in σ_a rotates the CML downward around the risk-free rate i in the vertical axis and introduces a riskier market portfolio M' (Barry and Robison). This causes an aggregate increase in TR. Given the investor's risk preference restricting the maximum allowable total risk at its original level (in the same notion that a maximum tolerable risk level β was specified in the additive approach), the possible strategies for attaining this goal include any or a combination of the following: reductions in financial leverage (risk balancing), borrowing cost and business risk.

Econometric Design

A longitudinal farm-level data set is compiled to test the risk-balancing hypothesis using farms that are enrolled in the Illinois Farm Business Farm Management (FBFM) system. This sampling of farms is limited to grain farms only.⁴ The grain farms are further downsized to a subset of 80 farms that consistently maintained certified usable income statements over a seventeen-year period, from 1982 to 1998.⁵

This study will employ two econometric approaches to test the risk-balancing hypothesis. The first phase of the analysis involves a cross-sectional regression utilizing 80 farm observations (one mean value for each variable for each farm). This procedure, however, could open up the same aggregation issue that was raised relative to the results obtained by Gabriel and Baker. Although the extent of aggregation here is arguably lesser, this approach disregards effects of inter-year variations in the values of the variables that could influence risk-balancing decisions. Nonetheless, this approach is retained in this study since it could give an indication of the overall incidence of the farmers' risk-balancing practices over a longer portion of the entire sample period.

The second phase, a time series-cross sectional analysis, will utilize moving five-year average measures for all the variables. This approach increases the number of observations, solves the aggregation issue, and considers systematic relationships between variables based on intra- and inter-year variations in their values.

This study adopts a straightforward measure of risk balancing as the dependent variable of the estimating equations. A correlation coefficient is calculated from a time series data on business risk and financial risk measures for each farm in the data set.

The magnitude of a farm's business risk is calculated as a moving three-year coefficient of variation of its net operating income (Gabriel and Baker). Financial risk is represented by an estimate of the balancing component of its equation, the second component of (1.2), i.e. $\frac{I}{\bar{c}x - I}$ (Gabriel and Baker).

Considering that the previous, and not the current, period's business risk condition, may influence a farm's financial structure decision, the correlation coefficient measure is calculated based on pairings between a one-year lagged measure of business risk and the current period's financial risk level.

The derivation of the risk balancing measures under the two econometric approaches is illustrated using the time-series data in Table 1 corresponding to a sample farm. Under the cross-sectional approach, the correlation coefficient measure is based on fourteen (14) pairs of the risk measures starting from the first pair in 1985. This pair includes a financial risk measure (FR) that corresponds to the interest to asset returns ratio (INTRAT) of the farm in 1985 and a business risk measure (BR) that corresponds to the CV of net operating farm income (NOBIT) calculated as of 1984. This CV of NOBIT is derived from its mean and standard deviation based on the observations from the immediate past three years, from 1982 to 1984. A correlation coefficient is calculated on all chronological pairs of these risk measures that sum up to fourteen (14) until the end of the time series in 1998. The fourteen-year correlation measure for this farm is -0.2845 implying that increases in business risk on average were followed by decreases in financial risk, and vice versa.

On the other hand, the time series-cross sectional approach adopts a moving five-year correlation coefficient measure of risk balancing. Hence, there are ten (10) risk

balancing measures for this farm starting from the first correlation coefficient of -0.0246 calculated in 1989 based on the last five pairs of the risk measures. (See column COR-5 in Table 1)

A negative correlation calculated from the pairings of risk measures will indicate that the farm has made offsetting adjustments in its leverage position in response to changes in its business risk condition. This means that upward trends in the magnitude of business risk are associated with downward trends in the farm's financial risk position, thus confirming the incidence of risk balancing. On the other hand, a positive correlation indicates the absence of the risk-balancing strategy.

The analysis also utilizes regression procedures to determine factors that may be significantly related to risk balancing. The explanatory variables will include the following structural and financial characteristics of farms to explore their possible linkages with risk balancing.

- Farm size

Measured in tillable acres, size is expected to be negatively related to the correlation coefficient measure of risk balancing, the model's dependent variable. In order to sustain the benefits of economies of scale and improved production efficiencies, larger farms are expected to prudently utilize their credit reserves capacity in order to balance business and financial risk levels. Size is considered an important factor influencing a farm's choice of strategies for coping with risk (Harwood, *et al.*). Moreover, Purdy, Langemeier and Featherstone present evidence of a significant positive size effect on a farm's mean financial performance, although their framework could not establish a significant effect on

the variability of farm income. Barry, Escalante and Bard, however, find that a significant negative size effect on income variability exists when both intra- and inter-year variations are considered in the estimating procedure.

- Management Expertise (AGE)

The farmer's age shall be used as proxy for management expertise that is expected to vary negatively with the dependent variable. Older, more experienced farm managers/operators are expected to be more adept at devising strategies that balance risks confronting the farm enterprise.

- Financial efficiency

The farm's operating expense ratio (OPRAT), calculated by dividing the farm's total operating expense (excluding interest and depreciation) by gross revenues, will be used as a measure of financial efficiency. The logical expectation is for this variable to vary positively with the dependent variable. Lower values of this ratio, indicating higher levels of financial efficiency, are expected to be associated with higher incidence of the risk-balancing behavior. A highly efficient farm that is able to keep operating expenses at low levels develops a cushion against high financing costs that may protect its realized net farm income levels from plunging below satisfactory levels. Increased business risk exerts more pressure on operating expenses to rise. A highly efficient farm, in order to protect its bottom-line figure, would most likely reduce financing costs to stabilize its net income position.

It can also be argued, however, that a negative financial efficiency effect is plausible under more positive behavioral expectations on farmers that are

relatively more financially distressed. Less efficient farms plagued by dominant production costs relative to farm revenues are more vulnerable to further increases in business risk and thus, might be more inclined to adjust their financial risk positions.

- Tenure

The farm's tenure ratio, calculated as the ratio of owned acres to total farm acres, is expected to vary positively with the risk balancing measure. This means that farms that own a greater percentage of the total farmland area will be less inclined to resort to risk balancing. This argument is based on the low debt carrying capacity of farmland. Scott provides evidence suggesting that leasing of farmland actually improves a farmer's access to credit. Results from another study (Ellinger and Barry) indicate that higher leasing ratios are associated with higher accounting rates of return and debt-to-asset ratios.

Proxy measures of certain risk management strategies will also be included as additional regressors. Results of a survey conducted by the USDA (Harwood, *et al.*) indicate that farmers in general combine strategies in countering increasing income risk. Hence, most of the strategies included in this analysis are expected to be compatible with risk balancing

- Marketing Price Index

A proxy measure to represent the aggregate, collective effect of a farm's marketing practices is the ratio of average annual crop prices received by the farmer to the average annual crop prices received by all farms participating under

the FBFM system. This measure is based on price data on the three major crops produced by Illinois grain farms: corn, soybeans and wheat.

Barry and Baker justify that certain marketing strategies provide the firm with greater liquidity and thus, greater certainty of loan repayment that coincide with lenders' preferences. The results of another study conducted by Turvey and Baker indicate that hedging practices of farmers actually encourage higher debt levels because the former reduces overall business risk after offsetting some of the increased financial risk created by the latter.

- Insurance

This strategy will be represented by the amount of insurance premium, inclusive of crop, liability and other types of insurance, spent on every acre tilled by the farm operator. As the risk-balancing strategy discourages higher levels of debt in highly risky conditions, this strategy provides farmers with an additional source of liquidity in times of adversities. The expected coefficient sign for this variable is positive, as higher insurance premium per acre could be associated with larger values of the risk balancing measure. Payoffs from insurance programs usually serve as buffer against fluctuating incomes due to adverse conditions, thus has a stabilizing effect on farm revenues. This effect therefore reduces the need for the farm to regulate the level of financial risk.

- Diversification Strategies

Measures of the farm's diversification strategies are developed based on the concept of a Herfindahl index (H) of industry concentration:

$$H = \sum_{i=1}^n (share_i)^2.$$

Under this approach, a fully specialized farm takes on an index value of 1 while smaller index values indicate more diversified business portfolios. In this analysis, two measures of diversification are considered. One is a measure of crop diversification that considers the revenue contributions of each of the three crops produced: corn, soybeans and wheat. A second measure is added to capture the farm's enterprise diversification strategy. This measure considers the revenue shares of the crop enterprises as a whole and the farm's livestock operations.

Since lower H values are associated with diversification, a positive relationship between these variables and the risk balancing measure would indicate the latter strategy's compatibility with enterprise or crop specialization. Negative relationships suggest a good combination of diversification and risk balancing strategies.

Regional differentiation of production and marketing profiles can play an important factor in determining the compatibility between these diversification strategies and risk balancing. For instance, a study on a sampling of Kansas farms (Purdy, Langemeier and Featherstone) relates a farm's financial performance to the specialization of production activities. The results indicate increased mean financial performance for farms that specialize in swine, dairy or crop production and decreased variability in financial performance among crop farms that diversify into livestock production (beef, swine, or dairy).

Farm-Level Evidence

A descriptive summary of the fourteen-year mean values of the variables is presented in Table 2. The 80 farms have been classified into four (4) classes based on their fourteen-year risk balancing (correlation coefficient) measures. Farms whose historical business and financial risk levels produce negative correlation coefficients are classified under one of the two upper classes while the lower two classes consist of farms with positive risk balancing measures. Based on the summary, a total of 47 farms belong to the upper two classes of risk balancing farms while the rest (33 farms) did not balance risks on the average over the entire sample period. This means that close to 60% of the farmers in the sample balanced risks on the average over the seventeen-year period.

There are no clear trends in the mean values of most of the explanatory variables reported in Table 2 across all four classes of the risk balancing measure. Only the mean values for insurance expense, age and enterprise diversification index display consistent trends in values as the risk balancing class increases.

Additional evidence is provided by a panel data set compiled from the same set of farms using the moving five-year average approach. Table 3 presents the annual distribution of farms across the four classes of risk balancing measures during the period 1989 to 1998. The farms were categorized this time according to their moving five-year correlation coefficient measures. As can be gleaned from that summary, in nine (9) out of ten (10) years, the proportion of risk balancers has been above 50%. The proportions were especially high in 1992 and 1998 at 69% and 76%, respectively. These results provide more solid empirical evidence to the hypothesis by confirming earlier findings in the cross-sectional analysis with much more disaggregated farm-level data.

Time Series-Cross Sectional (TSCS) Analysis⁶

This analysis is based on the moving five-year correlation coefficients for the dependent variable (risk-balancing measure) and moving five-year mean values for the explanatory variables. The moving average concept is essential to the development of a measure for the dependent variable, which involves the concept of business risk that can be captured by a measure of the coefficient of variation of net operating farm income. In this analysis, the “moving-average” concept is applied to all variables in both the right-hand and the left-hand sides of the estimating equation.

Diagnostic tests conducted on the panel data detect the presence of autocorrelated disturbances, although heteroscedasticity is not a problem. Thus, the Parks method of TSCS regression is used for this analysis. This method is ideal for data sets with such abnormalities since it performs a corrective procedure by initially assuming a first-order autoregressive error structure with contemporaneous correlation between cross-sections. Then, it estimates a covariance matrix by a two-stage procedure leading to the estimation of the regression parameters using the Generalized Least Squares (GLS) method (SAS Manual).

Table 4 presents a summary of the regression coefficient estimates and their corresponding p values obtained under the Parks-TSCS method. The model’s F statistic indicates that the model’s explanatory power is highly significant. Its R^2 is relatively high at 90.99%. Except for size and insurance, all variables are highly significant regressors.

The signs of the significant coefficient estimates for the structural variables coincide with their expected relationships to the risk balancing measure. This means that in general risk-balancing grain farms tend to be managed by older farmers that own relatively less land. Also, farms that experience greater financial distress as reflected by low levels of financial efficiency tend to be more vulnerable to increases in business risk and thus are more inclined to balance risks.

Three of the four risk management strategies considered in this analysis are significantly related to the risk-balancing strategy. The enterprise diversification variable is positively signed, thus suggesting that farms that balance risks usually diversify into crop and livestock production. In contrast, the negative coefficient of the crop diversification variable indicates compatibility between risk balancing and crop specialization.

These results reflect the actual farming practices of Illinois grain farms especially those located in the North Central region that highly specialize in corn and soybean production. Barry, Escalante and Bard provide similar results in their study that identifies linkages between crop diversification, among other variables, and economic risk in detailed regional models that include a subset of North Central Illinois farms. In their models, enterprise diversification becomes a significant regressor when included in a general model that considers all farms in the Illinois FBFM data set, regardless of the farms' geographical location. The variable, however, loses its significance in two disaggregated regional models, including the North Central Illinois regional model. It therefore seems that for grain farms, especially in the North Central Illinois region, the

benefits of risk reduction under an enterprise diversification scheme are outweighed by gains of comparative advantage enjoyed by these highly specialized grain farms.

Finally, the marketing price index variable that captures the effects of the farm's marketing strategy is also significant and positively signed. The coefficient sign suggests that the incidence of risk balancing coincides with cases of low price indexes (i.e. the average annual crop price received by the farm is less than the average annual crop price received by all farms in the FBFM system). Although observers (such as the majority of extension economists surveyed by Brorsen and Anderson in 1997) may argue that forward contracting, as a marketing strategy, results in relatively higher average farm prices, there is empirical evidence that suggests otherwise. Townsend and Brorsen argue that the cost of forward contracting is actually not zero, thus reducing the level of the average farm price.⁷ The result obtained in this analysis, therefore, suggests that risk balancing and forward contracting may be compatible strategies.

Summary and Conclusions

The risk-balancing hypothesis, which involves the prudent and regulated use of a farm's borrowing capacity in the face of increasing business risk conditions, has been firmly established as a normative concept in agricultural finance literature. Its intuitive appeal has motivated theoretical extensions in policy and other disciplines. However, its strong analytic appeal is eroded by its lack of solid empirical support that must come from farm-level, instead of aggregated, data.

This study has provided the necessary evidence to fill in this deficiency. Verification of the validity of the risk-balancing hypothesis has been established using

econometric procedures. The econometric approach looked into trends in historical farm data to identify the frequency of risk balancing among farmers, determine the attributes of farmers that subscribe to the strategy and explore its compatibility with other risk management strategies. The results confirm that more than half of the farmers in the sample indeed balanced business and financial risks over a seventeen-year period. The dominance of risk-balancing farmers is maintained even when the farm samples were further disaggregated into ten five-year groups under the moving five-year average approach. The non-risk balancers may have lower degrees of risk aversion or they may have employed other risk management methods not evident in these data.

This class of risk-balancing farmers has also been identified as relatively older operators of farms with lower levels of financial efficiency and relatively higher proportions of leased to owned farmland. Moreover, risk balancing was found to be compatible with crop specialization, enterprise diversification and marketing (such as forward contracting) strategies.

These results provide significant implications on the viability of risk balancing as a tool for risk management. As the agricultural sector continues to confront nagging risks caused by market, production and even institutional uncertainties, the need for more effective strategic plans at the farm level becomes greater. This study provides motivation for examining the extent of risk reduction realized under a more integrated risk management approach. Given the compatibility between risk balancing and certain alternative strategies demonstrated in this study, risk balancing is expected to become an integral component in a menu of strategic plans designed to counter increasing income risk.

Footnotes

1. For simplicity, financial leverage shall be used in this study to pertain only to debt financing. The farm's leasing contracts, though legitimately considered as another form of leveraging, shall be treated separately.
2. The hypothesis can also be derived using a different approach, the expected utility-mean-variance approach in deriving the hypothesis (Barry, Baker and Sanint; Collins).
3. The parameter "T" would include interest and principal payments only if $\bar{c}x$ is defined in terms of net cash flows or interest expenses only if the net operating income method is used.
4. The Illinois FBFM defines grain farms as those whose value of feed fed to all livestock enterprises is less than 40% of crop returns.
5. Actually, there are 111 farms that passed the criterion of continuous certification over the seventeen-year period. However, farms that had incomplete observations for any of the variables used in the analysis for the entire period were excluded from the data set.
6. An estimation procedure involving ordinary least squares regression is also applied to the cross-sectional data. The results are less insightful. The entire model's explanatory power is very low (R^2 of 10.76%) and insignificant (p value of 0.3342). Only one of eight regressors, the insurance variable, is significant at the 5% confidence level.
7. The major effect of forward contracting is on $\hat{\sigma}_p$, the variability of commodity prices (Barry and Willman; Escalante). If $\hat{\sigma}_p$ declines more than the average farm price ($\hat{1}_P$)

declines, then the coefficient of variation of farm prices ($\hat{\sigma}_p/\hat{I}_P$) experiences an overall decline. This could allow the farm's level of financial risk to increase. In this sense, forward contracting and risk balancing are still compatible strategies, although in an offsetting way.

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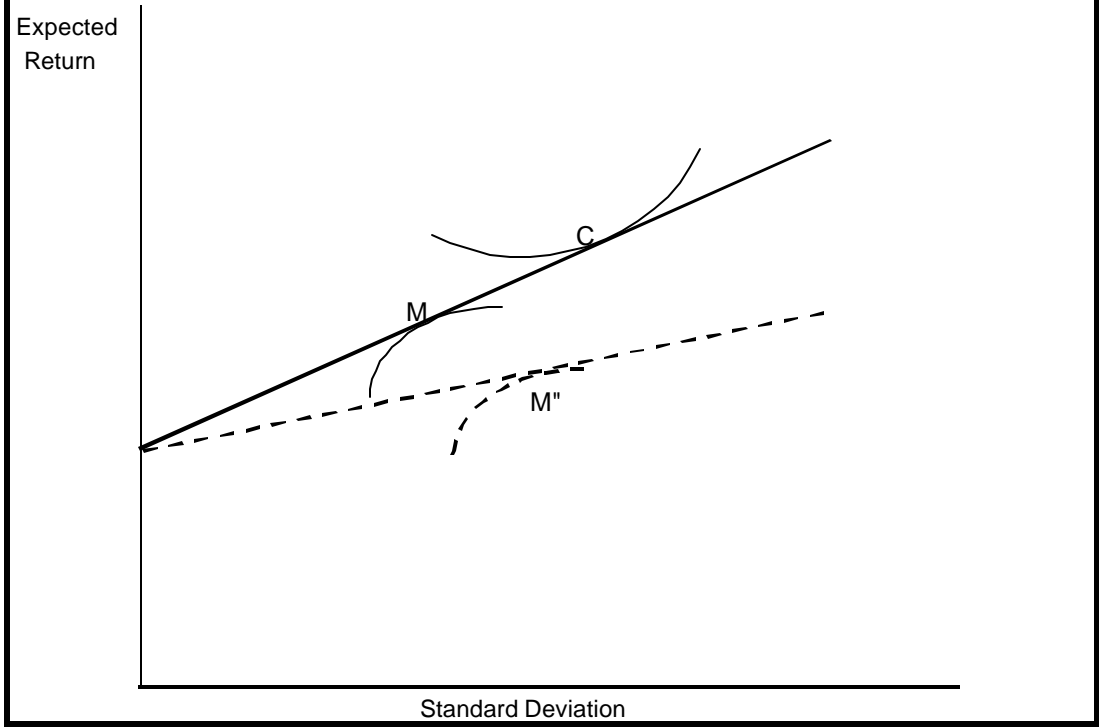
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Figure 1: Shift in Risk Efficient Set for a Change in Variance of Risky Assets (Barry and Robison)



| Table 1: Calculation of Risk Balancing Measures for a Sample Farm | | | | | | | | |
|--|-------------|--------|----------|-------------|-----------|---------|-----------|------------|
| Year | INTRAT (FR) | NOBIT | MN-NOBIT | STDEV-NOBIT | BR at T-1 | FR at T | COR-5 Yrs | COR-14 Yrs |
| 1982 | 0.1566 | 38,691 | | | | | | |
| 1983 | 0.0655 | 70,482 | | | | | | |
| 1984 | 0.1687 | 38,045 | 49,073 | 18,544 | | | | |
| 1985 | 0.0871 | 64,451 | 57,659 | 17,252 | 0.3779 | 0.0871 | | |
| 1986 | 0.1679 | 42,172 | 48,223 | 14,205 | 0.2992 | 0.1679 | | |
| 1987 | 0.0643 | 99,716 | 68,780 | 29,015 | 0.2946 | 0.0643 | | |
| 1988 | 0.1575 | 39,360 | 60,416 | 34,064 | 0.4219 | 0.1575 | | |
| 1989 | 0.1023 | 72,346 | 70,474 | 30,221 | 0.5638 | 0.1023 | -0.0246 | |
| 1990 | 0.1039 | 79,433 | 63,713 | 21,386 | 0.4288 | 0.1039 | -0.0784 | |
| 1991 | 0.3070 | 30,983 | 60,921 | 26,168 | 0.3357 | 0.3070 | -0.2506 | |
| 1992 | 0.1086 | 86,734 | 65,717 | 30,301 | 0.4295 | 0.1086 | -0.7466 | |
| 1993 | 0.1103 | 73,212 | 63,643 | 29,081 | 0.4611 | 0.1103 | -0.7514 | |
| 1994 | 0.2027 | 44,863 | 68,270 | 21,369 | 0.4569 | 0.2027 | -0.7731 | |
| 1995 | 0.1629 | 40,117 | 52,731 | 17,895 | 0.3130 | 0.1629 | -0.5132 | |
| 1996 | 0.2256 | 33,678 | 39,553 | 5,614 | 0.3394 | 0.2256 | -0.4339 | |
| 1997 | 0.1542 | 50,943 | 41,579 | 8,725 | 0.1419 | 0.1542 | -0.0054 | |
| 1998 | 0.2077 | 41,792 | 42,138 | 8,638 | 0.2098 | 0.2077 | 0.4782 | -0.2845 |

| Table 2: Fourteen-Year Cross Sectional Mean Values of Explanatory Variables According to Risk Balancing Class | | | | |
|--|------------------------|---------------|--------------|--------------|
| Variables | Risk Balancing Classes | | | |
| | -0.80 to 0.40 | -0.39 to 0.00 | 0.01 to 0.40 | 0.41 to 1.00 |
| No. of farms | 10 | 37 | 28 | 5 |
| Size (Acres) | 624 | 848 | 828 | 886 |
| OPRAT (Ratio) | 0.5777 | 0.5525 | 0.5692 | 0.5854 |
| Tenure Ratio | 0.2182 | 0.2235 | 0.2582 | 0.1767 |
| Age (Years) | 56 | 51 | 50 | 46 |
| Insur Exp/Acre (\$) | 9.07 | 7.18 | 6.50 | 5.55 |
| Crop Diver Index | 0.5104 | 0.5118 | 0.4959 | 0.5112 |
| Enterp Diver Index | 0.8815 | 0.9373 | 0.9418 | 0.9669 |
| Mktg Price Index | 0.7101 | 0.7238 | 0.7436 | 0.6964 |

**Table 3: Number of Grain Farms According to Risk Balancing Classes
Based on Moving Five Year Correl Measure of Risk Balancing**

| Year | Class 1 | Class 2 | Class 3 | Class 4 | % of Risk Balancers |
|------|---------|---------|---------|---------|---------------------|
| 1989 | 30 | 19 | 16 | 15 | 61.25 |
| 1990 | 31 | 17 | 12 | 20 | 60.00 |
| 1991 | 30 | 20 | 15 | 15 | 62.50 |
| 1992 | 31 | 24 | 13 | 12 | 68.75 |
| 1993 | 24 | 20 | 9 | 27 | 55.00 |
| 1994 | 18 | 26 | 15 | 21 | 55.00 |
| 1995 | 18 | 21 | 17 | 24 | 48.75 |
| 1996 | 23 | 20 | 18 | 19 | 53.75 |
| 1997 | 24 | 22 | 23 | 11 | 57.50 |
| 1998 | 30 | 31 | 12 | 7 | 76.25 |

| Table 4: Regression Coefficient Estimates and Significance Time Series Cross Sectional (Parks) Model | | |
|---|----------------------|------------|
| Explanatory Variable | Coefficient Estimate | Prob > /T/ |
| Intercept | -0.16267 | 0.0211 |
| Size | -0.0006 | 0.1103 |
| OPRAT | -0.06213 | 0.0006 |
| Tenure | 0.134645 | 0.0079 |
| Age | -0.00154 | 0.0573 |
| Insurance Exp./Acre | 0.000057 | 0.9185 |
| H Index – Crops | -0.21674 | 0.0001 |
| H Index – Enterprises | 0.225873 | 0.0001 |
| Mktg Price Index | 0.114103 | 0.0001 |
| R Square/Prob>F | 0.9099 | 0.0001 |