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Determinants of the Strength of Strategic Adjustments in Farm Capital Structure

Cesar L. Escalante and Peter J. Barry

This study employs correlation relationships to measure the strength of trade-offs between business and financial risks as a representation of the strategic capital adjustment process. Under different business risk measures based on varying lengths of historical farm income data, results suggest that farmers tend to adopt a myopic perspective when contemplating risk-balancing plans. Cross-sectional regression results for two–time period models covering the decade of the 1980s and 1990s yielded important implications. The liquidity-constrained environment of the 1980s emphasizes the combination of risk-balancing plans, specialization, and market revenue–enhancing strategies. In the 1990s, risk balancing becomes compatible with risk-reducing crop diversification and insurance protection plans.

Key Words: business risk, correlation coefficient measure of risk balancing, expected utility mean variance model, financial risk, risk management strategy, stochastic interest rates, strategic capital adjustment

JEL Classifications: D21, D81, G11, Q12, Q14

Recent financial structure analysis has found that farms can adjust their leverage positions to longer term targets, while following a pecking order approach in responding to shorter term deviations from the longer term targets (Barry, Bierlen, and Sotomayor). The pecking order reflects the lower transaction and agency costs of internal relative to external sources of funds, whereas the target concept includes the effects of risk, risk and time attitudes, financial costs of capital, and longer term profitability. The longer term target approach is consistent with earlier financial structure studies employing risk attitude, life cycle, and farm typology frameworks (Ahrendsen, Collender, and Dixon; Ellinger and Barry; Jensen and Langemeier), as well as with risk-balancing or equilibrium analysis approaches (Barry and Robison; Gabriel and Baker; Moss, Shonkwiler, and Ford).

Most prior studies have focused on factors affecting the level of the farmer's leverage or on its rate of adjustment, rather than considering the strategic adjustment process. Strategic adjustments, originally called risk balancing by Gabriel and Baker, reflect a farmer's potential use of changes in financial structure to offset or mitigate the effects of changes in business risk. This strategic adjustment process was developed using farm-level equilibrium analysis techniques that expressed additive and multiplicative relationships between business and financial risks (Barry; Gabriel and Baker). Subsequent work that addressed the consistency of risk-balancing behavior with a farmer's expected utility-maximizing choice of optimal leverage levels (Barry, Baker, and Sanint; Collins) provided empirical evidence on the relationships between expected

Cesar L. Escalante is assistant professor, Department of Agricultural and Applied Economics, University of Georgia, Athens, GA. Peter J. Barry is professor, Department of Agricultural and Consumer Economics, University of Illinois, Urbana-Champaign, IL. The authors wish to thank two anonymous reviewers of the *Journal* for their useful comments and insights.

utility maximization and leverage (Ahrendsen, Collender, and Dixon; Jensen and Langemeier) and demonstrated the possibility of increases in financial risk to offset reductions in business risk resulting from changes in agricultural or tax policy (Featherstone et al.; Moss, Ford, and Boggess).

This study empirically measures the extent and strength of the strategic adjustment process by utilizing a longitudinal farm data set from Illinois. One of the study's unique features is an empirical approach that employs correlation relationships to measure the tradeoff between business and financial risks, as a representation of the strategic adjustment process. Moreover, this study identifies and tests the importance of demographic factors and business growth strategies that influence the strength and extent of the strategic adjustment process. Considering the farmers' preferences for combined strategies in responding to risk as revealed in a 1996 USDA survey (Harwood et al.), the potential influences of other risk management strategies on more significant financial structure adjustments are also considered in this study.

Conceptual Framework

Under an equilibrium analysis approach, Gabriel and Baker decompose risk into the following additive relationship between business and financial risk.

$$(1)\qquad TR = \frac{\sigma}{NOBIT - i} = \frac{\sigma}{NOBIT}\frac{NOBIT}{NOBIT - i} = \frac{\sigma}{NOBIT} + \frac{\sigma i}{NOBIT(NOBIT - i)},$$

where TR is the total amount of risk, $NOBIT$ is the net operating income without debt financing, σ is the $NOBIT$ standard deviation, and i is interest payments. The resulting right-hand equation consists of a business risk measure (first term) and a financial risk measure (second term).

The risk-balancing hypothesis is best understood when Equation (1) for TR is analyzed in terms of a bound β, which could represent the target maximum amount of total risk that a firm can tolerate given the decision-maker's level of risk aversion (Gabriel and Baker).

$$(2)\qquad \frac{\sigma}{NOBIT} + \frac{\sigma i}{NOBIT(NOBIT - i)} \le \beta.$$

The effects of exogenous shocks that disrupt this total risk constraint can be mitigated through strategic capital structure adjustments designed to make offsetting adjustments in financial risk in order to restore equilibrium conditions. The farmer actually could consider at least three alternative remedies to restore the magnitude of total risk to its original level β: business risk-reducing actions, risk-offsetting capital structure adjustments (risk-balancing strategy), or a combination of both.

The relative strength of (or the farmer's tendency to resort to) a risk-balancing response vis-à-vis other alternative strategies could be influenced by certain attributes of farm businesses. These linkages can be more elaborately demonstrated by first defining the optimal asset portfolio under an expected utility mean variance (EUMV) framework that considers the influence of the magnitude of risk and the decision-maker's risk attitude on farm leverage decisions. Freund developed a version of the EUMV model that has been used to determine optimal farm debt. Subsequent extensions of this approach addressed various issues in agricultural finance and policy such as price supports (Featherstone et al.), capital gains deductions (Moss, Ford, and Boggess), depreciation, and investment tax credits (Ahrendsen, Collender, and Dixon).

Under the assumption that borrowing costs are stochastic, the optimal leverage solution is (Parcell, Featherstone, and Barton)[1]

$$(3)\qquad \delta^* = \frac{r_a - i - \rho\sigma_a(\sigma_a - \lambda_{ai}\sigma_i)}{r_a - i + \rho\sigma_i(\sigma_i - \lambda_{ai}\sigma_a)},$$

where δ^* is the debt-to-asset ratio, r_a is the mean rate of return on assets, i is the mean

[1] Barry, Baker, and Sanint also assumed stochastic interest rates in their optimal debt model involving absolute measures of debt, assets, and equity. Earlier versions of the optimal leverage model have assumed deterministic borrowing costs (Barry; Collins).

stochastic interest rate, σ_a is the standard deviation of r_a, σ_i is the standard deviation of i, ρ is the risk aversion parameter, and λ_{ai} is the correlation between r_a and i.

The total derivative of Equation (3) is calculated as

$$(4)\quad d\delta = \frac{\rho(\sigma_i^2 - 2\sigma_i\sigma_a\lambda_{ai} + \sigma_a^2)}{D^2}dr_a - \frac{\rho(\sigma_a^2 + \sigma_i^2)}{D^2}di + \frac{\rho[2\sigma_a - \lambda_{ai}\sigma_i(\sigma_i^2 - 2\sigma_i\sigma_a\lambda_{ai} + \sigma_a^2)]}{D^2}d\sigma_a + \frac{\rho(\sigma_a\lambda_{ai}D - 2\sigma_i N)}{D^2}d\sigma_i = 0,$$

where N and D correspond to the numerator and denominator of Equation (3), respectively.

In order to maintain optimality/equilibrium (i.e., $d\delta = 0$), the following condition must hold (which was derived by rearranging terms in Equation (4) and multiplying each term by the reciprocal of dr_a)

$$(5)\quad \frac{d\sigma_a}{dr_a} = [(\sigma_a^2 + \sigma_i^2)di - (\sigma_a\lambda_{ai}D - 2\sigma_i N)d\sigma_i - (\sigma_i^2 - 2\sigma_i\sigma_a\lambda_{ai} + \sigma_a^2)D^2] \div \{[2\sigma_a - \lambda_{ai}\sigma_i(\sigma_i^2 - 2\sigma_i\sigma_a\lambda_{ai} + \sigma_a^2)]dr_a\}.$$

Equation (5) is an expanded, detailed approach in understanding the risk constraint defined in Equation (2). The left-hand side of Equation (5) captures the overall change in business risk (or the coefficient of variation of r_a), whereas the right-hand side (RHS) enumerates alternative actions in countering any modification in the farm's business risk position.

The condition defined in Equation (5) demonstrates important linkages between risk balancing and other possible risk-reducing plans that affect the magnitude of dr_a, $d\sigma_a$, or both (such as growth and other risk management strategies). For example, when the farm business experiences overall growth, achieved whenever $dr_a > di$ (Barry; Collins; Escalante and Barry 2002), the need for risk balancing is explained through relatively smaller $d\sigma_i$ (if growth also results in larger $d\sigma_a$) to satisfy the equilibrium condition. Moreover, when the farm is able to effectively minimize $d\sigma_a$, supplementary risk-balancing actions might become necessary to maintain equilibrium if the multiplier of the RHS returns component (dr_a) is >1. A farmer's risk attitude (ρ) also helps determine the multiplier of $d\sigma_i$, as well as the residual term in the RHS numerator of Equation (5).

Given these linkages, the relative strength of the risk-balancing strategy (through business decisions that affect di and $d\sigma_i$) could differ among farms because of heterogeneity of farm conditions. Certain demographic and financial factors, such as farm size, operating efficiency levels, tenure position and risk attitudes, could influence the effectiveness of the capital structure adjustment process. The risk–return trade-offs under certain risk management plans could either increase or reduce the need for offsetting capital structure adjustments. The individual relevance of these financial and structural factors will be discussed in a later section that describes this study's econometric framework.

Risk-Balancing Measurement and Empirical Implications

A longitudinal farm-level data set is compiled from farms that are enrolled in the Illinois Farm Business Farm Management (FBFM) system. This sampling of farms is limited to grain farms only.[2] A subset of 80 farms that consistently maintained certified usable income statements over a 17-year period from 1982 to 1998 was used in this study.[3] This period includes the financial stress and recovery times of the 1980s, as well as major revisions of U.S. agricultural policy in the 1990s, thus providing a time period encom-

[2] The Illinois FBFM defines grain farms as those whose value of feed fed to all livestock enterprises is less than 40% of crop returns.

[3] One hundred eleven farms passed the criterion of continuous certification over the 17-year period. Farms that had incomplete observations for any of the variables used in the analysis for the entire period were excluded from the data set.

passing dynamic changes for analyzing capital structure decisions of farms.

Adjustments in capital structure decisions by farmers are determined in this study over a 5-year time horizon as they respond to the changing business risk conditions of the farm businesses. The 5-year horizon used in this analysis is partly based on the finite adjustment duration of about 5–9 years for financial ratios, including leverage ratios, with longer term components estimated by Peles and Schneller for 635 COMPUSTAT firms.

The magnitude of business risk (*BR*) is calculated as the coefficient of variation (CV) of the farm's net operating income (*NOBIT*). Five *BR* measures are considered in this study to explore a wider range of risk perceptions by the farm decision-makers: CVs calculated from 2, 3, 5, 7, and 9 years of historical *NOBIT* data.

Financial risk (*FR*) is represented by an estimate of the balancing component of Gabriel and Baker's financial risk equation defined as the ratio of interest payments (i) to net farm income after debt servicing; that is, $i/(NOBIT - i)$.[4]

The Correlation Measure of Risk Balancing

This study introduces a more straightforward proxy measure for the farmer's risk-balancing behavior by calculating a correlation coefficient measure for every five pairs of historical business and financial risk levels. The correlation coefficients measure the extent and the strength of the strategic adjustments made by the farmers in their capital structures in response to modifications in their business risk conditions in every period. A negative correlation will indicate that a farmer has made offsetting adjustments in a leverage position in response to changes in the 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. Larger absolute values of these negative correlations indicate greater degrees of strategic adjustments or risk-balancing behavior. On the other hand, a positive correlation indicates the minimal use or absence of the risk-balancing strategy. Correlation values close to 1 indicate a farmer's preference to make parallel, not offsetting, adjustments in capital structure as business risk increases.

The correlation measures are calculated over pairings between a 1-year lagged *BR* measure and the current period's *FR* level. This approach recognizes that, barring any major drastic changes in the farm business environment (such as drought) as the production year progresses, farm financial structure decisions made in the current year could be influenced by the decision-maker's expectations of future business risk trends. This analysis assumes that historical experiences of business fluctuations are used as basis for forming these expectations. Hence, capital structure decisions made since the start of every production year could be based on the previous year's *BR* level. In practice, the farmer's expectations could be updated periodically because modifications in the risk environment are actually experienced at certain occasions during the production year. However, available farm-level data are reported on an annual basis and could not capture such intrayear adjustments in business conditions.

The derivation of the risk-balancing measures is illustrated with the time series data in Table 1 corresponding to a particular farm drawn out from the sample. Using a 3-year *BR* measure, 14 pairs of the risk measures could be obtained from the sample period 1982–1998.[5] The first pair of risk measures in 1985 includes an *FR* measure for the farm in 1985 and a *BR* measure that corresponds to the CV of *NOBIT* calculated as of 1984. This CV of *NOBIT* is derived from its mean and standard deviation calculated from the observations from the immediate past 3 years (1982–1984). A correlation coefficient is calculated on all

[4] Gabriel and Baker's net operating method was used in this analysis, so the parameter i represents interest payments.

[5] The number of pairs of risk measures under the other versions of business risk are 15, 12, 10, and 8 for the 2-, 5-, 7-, and 9-year measures, respectively.

Table 1. Calculation of Risk-Balancing Measures for a Sample Illinois Grain Farm

Year	*INTRAT* (*FR*)[1]	*NOBIT*[2]	*MN-NOBIT*[3]	*STDEV-NOBIT*[4]	*BR* at $T - 1$[5]	*FR* at *T*[6]	*COR*-5[7]	*COR*-14[8]
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

[1] Interest expense divided by net income after interest payments (financial risk).
[2] Net income before interest and taxes.
[3] Mean *NOBIT*, calculated for the last 3 years.
[4] Standard deviation of *NOBIT* (last 3 years).
[5] Business risk level of previous year, calculated as *NOBIT*'s coefficient of variation.
[6] Financial risk level of current year.
[7] Correlation between last five annual pairs of business and financial risk levels.
[8] Correlation between 14 annual pairs of business and financial risk levels.

contemporaneous, chronological pairs of these risk measures that add up to 14 until the end of the time series in 1998. The 14-year correlation measure for this particular farm observation is −0.2845, implying that increases in business risk on average were associated with decreases in financial risk.

Historical Proportions of Risk-Balancing Farms

Table 2 presents an annual tally of mean risk-balancing measures for risk- and nonrisk-balancing farms, as well as the proportions of risk-balancing farms to total farm observations under the five different *BR* measures. In general, the number of significantly dominant proportions of risk-balancing farms decreases as the length of *BR* evaluation period increases. This suggests that farmers in general do not tend to look much further into more historically remote business experiences. Rather, a farmer's propensity to adopt the risk-balancing strategy is greater when such decisions are based on more recent experiences of income volatility.

Specifically, the 2-year *BR* measure yielded the highest number of risk-balancing farm proportions significantly greater than .50. The 3-year *BR* measure produced five significant proportions, with one significant result for the 5-year *BR* measure. The two longer *BR* measures did not produce any significantly dominant proportions for the risk-balancing farms.

The 7- and 9-year measurement approaches also yielded some pairings of insignificantly different mean risk-balancing measures for the two classes of farms. In contrast, the three shorter *BR* measures yielded significantly different means for the two farm groups.

Econometric Design and Results

This study's econometric design differs significantly from previous studies using farm-level

Table 2. Risk Balancers versus Nonrisk-Balancers[1] under Various Business Risk (*BR*) Measurement Methods, Illinois Farms, 1989–1998

Business Risk Measure	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
A. Class of risk balancers, mean risk-balancing measure (correlation coefficient[2])										
2-Year *BR*	−0.347*	−0.413*	−0.355*	−0.392*	−0.353*	−0.449*	−0.420*	−0.372*	−0.344*	−0.373*
3-Year *BR*	−0.383*	−0.442*	−0.361*	−0.367*	−0.313*	−0.323*	−0.396*	−0.358*	−0.293*	−0.385*
5-Year *BR*			−0.490*	−0.542*	−0.430*	−0.446*	−0.367*	−0.328*	−0.377*	−0.373*
7-Year *BR*					−0.360*	−0.427*	−0.317	−0.427	−0.317	−0.333*
9-Year *BR*							−0.404	−0.378	−0.348*	−0.382*
B. Class of nonrisk-balancers, mean risk-balancing measure (correlation coefficient)										
2-Year *BR*	0.408	0.460	0.354	0.362	0.443	0.301	0.408	0.306	0.398	0.277
3-Year *BR*	0.478	0.515	0.423	0.426	0.486	0.399	0.474	0.358	0.353	0.297
5-Year *BR*			0.490	0.479	0.569	0.471	0.534	0.454	0.428	0.394
7-Year *BR*					0.482	0.607	0.669	0.624	0.620	0.681
9-Year *BR*							0.485	0.447	0.504	0.392
C. Percentage of risk balancers to total farms[3]										
2-Year *BR*	55.00	62.50*	70.00*	68.75*	70.00*	80.00*	72.50*	72.50*	81.25*	73.75*
3-Year *BR*	61.25*	60.00*	62.50*	68.75*	55.00	55.00	48.75	53.75	57.50	76.25*
5-Year *BR*			57.50	55.00	63.75*	57.50	52.50	48.75	46.25	43.75
7-Year *BR*					50.00	31.25	23.75	26.25	28.75	28.75
9-Year *BR*							41.25	38.75	47.50	47.50

[1] Farm observations yielding negative correlation between historical values of business and financial risk measures are classified as risk-balancing farms, whereas nonrisk-balancing farms experienced either zero or positive correlation results.

[2] An asterisk denotes significant mean difference for classes of risk- and nonrisk-balancing farms at the 95% confidence level.

[3] An asterisk denotes significance at the 95% confidence level for rejection of the null hypothesis that the proportion of risk balancers to total farms ≤ .50.

data to test the risk-balancing hypothesis. This analysis utilizes a more straightforward risk-balancing measure, the correlation coefficient between business and financial risks, as the dependent variable instead of asset (Ahrendsen, Collender, and Dixon) or leverage (Jensen and Langemeier) measures. Thus, this study's framework extends beyond the verification of the strategic adjustment construct by identifying linkages between the strength and extent of such adjustments and their potential determinants among a set of farm attributes and financial factors.

The entire time period, 1982–1998, is divided into two episodes to compare capital structure adjustment decisions during two contrasting periods. The first period captures the financial stress conditions of the 1980s. An individual farm's risk-balancing measure was calculated over the 5-year period 1987–1991, but its business risk measure was based mostly on farm conditions in the 1980s starting in 1982, especially for the longer *BR* measures. On the other hand, the second period, 1994–1998, covers the relatively more stable financial conditions of the 1990s before income risk started to accelerate in the latter part of the decade.

Ordinary least squares (OLS) regression techniques are employed to the two cross-sectional models covering two different time periods. Each model has undergone five iterations to determine the sensitivity of regression estimates to the five different *BR* measures.

The following factors, representing certain components of the optimality condition in Equation (5), were considered as potential determinants of the strength of risk balancing.

Structural Factors

Two structural factors representing a farmer's risk attitude and the size of a farm are considered in this analysis.

Risk attitude. The farmer's age is used as proxy for level of risk aversion, which is expected to vary negatively with the dependent variable. The link between a farm operator's age and risk attitude has been well established by empirical studies, which suggest that older farmers tend to exhibit greater risk aversion (Lins, Gabriel, and Sonka; Patrick, Whitaker, and Blake). In the equilibrium condition in Equation (5), risk attitudes could influence the strength of changes in σ_i and the residual term of the RHS numerator. Thus, in this study, older farm operators would be expected to balance risks to a greater degree.

Farm size. Measured in tillable acres, size could be negatively related to the correlation coefficient measure of risk balancing. In order to sustain the benefits of economies of scale and improved production efficiencies, larger farms might be inclined to prudently utilize their credit reserve capacity in order to balance business and financial risk levels. Moreover, larger farms in general could enjoy easier access to credit and avail of more favorable loan terms (including interest rates) than smaller farms owing to their longer track record of credit dealings with lenders. These benefits could provide these farms with greater flexibility to make such necessary adjustments involving $d\sigma_i$ and di as specified in Equation (5).

Growth Strategies

Growth-enhancing strategies enter the optimality condition of Equation (5) through changes in the mean rate of return (dr_a). The need for risk-balancing remedies depends on whether growth is accompanied by high volatility of farm returns ($d\sigma_a$) or not.

Two proxy measures of capital and operations management strategies are considered in this analysis. Unfortunately, the dearth of farms that maintain certified usable family living records in the FBFM system prevents this study from including the growth effect of nonfarm variables, such as nonfarm income and reductions in family living withdrawals.

Tenure. The farm 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 farmers that own a greater percentage of the total farmland area will be less inclined to resort to risk balancing.[6] Low tenure ratios are gener-

[6] Debt and leasing are treated separately in this study. Hence, the financial risk measure involves loan interest payments only.

ally associated with higher accounting rates of return (Ellinger and Barry) and business growth (Escalante and Barry 2002). Moreover, the expected positive tenure effect is justified by the low debt carrying capacity of farmland. Scott provides evidence suggesting that leasing of farmland actually improves a farmer's access to credit.

Operating efficiency. The farm's operating expense ratio (*OPRAT*), calculated by dividing the farm's total operating expense (excluding interest and depreciation) by gross revenues, is used as a measure of operating efficiency. Under increasing farm risk conditions, lower ratios associated with higher operating efficiency and business growth potential (Escalante and Barry 2002) could create the need for risk-balancing decisions to offset the effects of income swings that could diminish business growth and efficiency. It is, however, possible that for some farms, greater operating efficiency could add to the farm's risk-bearing capacity and, thus, could mute the adjustment process.

Risk Management Strategies

The expected relationships between proxy measures of certain risk management strategies and the risk-balancing measure will depend on the net influence of changes in $\bar{r}_a$ and σ_a^2 that determine the overall change in CV of $\bar{r}_a$. Consistent with principles of risk efficiency, the effective minimization of σ_a^2 generally entails trade-offs in terms of reductions in $\bar{r}_a$. The extent of these trade-offs, in addition to other factors such as risk attitudes (Escalante and Barry 2001), determines the relevance of the risk-balancing strategy. From the optimality condition in Equation (5), overall net increments in the CV of $\bar{r}_a$ (i.e., risk effect becoming more dominant than the returns effect) will require, among several options, certain strategic actions that minimize the negative effect of $d\sigma_i$ to help produce a larger collective value for the parameters that comprise the RHS numerator of Equation (5). The inclusion of longer term measures of business risk in this analysis will allow the determination of the risk-reducing effects of the strategies considered, whose short-run effects could not be immediately discerned.

Marketing price index. A proxy measure to represent the collective effect of a farm's marketing practices is the ratio of average annual prices of major Illinois crops (corn, soybeans, and wheat) received by the farmer to the average annual prices received by all farms participating under the FBFM system. Attainment of farm-level prices above the average prices received by the larger group of farmers (smaller than the overall market) could indicate greater risk carrying capacity and reduces the need for offsetting adjustments in financial risk. In general, marketing strategies provide the firm with greater liquidity and, thus, greater certainty of loan repayment that coincides with lenders' preferences (Barry and Baker). Moreover, hedging practices of farmers actually encourage higher debt levels because they reduce overall business risk after offsetting some of the resulting incremental financial risk (Turvey and Baker).

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. Payoffs from insurance programs usually serve as buffers against fluctuating incomes as a result of adverse conditions, thus having a stabilizing effect on farm revenues. The longer term risk measurement approaches employed in this study will help capture the effectiveness of insurance plans as a form of risk management.

Diversification strategies. Measures of the farmer's diversification strategies are developed based on the concept of a Herfindahl index (H)

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

Under this approach, lower index values indicate greater levels of diversification. This analysis considers crop diversification (revenue contributions from three crops produced: corn, soybeans, and wheat) and enterprise diversification (revenue allocations between crop and livestock operations).

Table 3. Ordinary Least Squares Regression Results, Cross Sectional Models for Two Time Periods, Illinois Grain Farms

Variable	1987–1991 5-Year Risk Measure Parameter Estimate	SE	1994–1998 3-Year Risk Measure Parameter Estimate	SE
Intercept	6.04716***	1.39778	−1.71974	1.27214
Farm size (acres)	0.00004466	0.00016998	0.00011085	0.00011480
Age of farm operator	−0.02408***	0.00693	−0.00672	0.00538
Operating expense ratio	0.63382	0.46110	0.04902	0.43783
Insurance expense ratio	−0.00821	0.02407	−0.03461***	0.01056
Tenure ratio	0.41235	0.28170	0.64044***	0.21686
Crop diversification index	−4.70448***	1.58865	3.57157***	1.26119
Enterprise diversification index	−2.03014***	0.52812	−0.36065	0.44168
Marketing price index	−1.50827***	0.51794	0.76524	0.61361
P value, F statistic (model)	0.0021		0.0031	
Model R^2	0.2794		0.2697	

Note: Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) confidence levels.

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).

Econometric Results

Table 3 presents a summary of the regression coefficient estimates and their corresponding standard errors for the model with the most significant explanatory power in each time period.[7] The results indicate the farmers' tendency to use a longer risk evaluation period (5 years) under the stressful conditions of the 1980s. In contrast, the business risk evaluation period is shorter at 3 years during the more financially stable period of the 1990s. It can be surmised that persistent financial and business stress, such as the farmers' experience of increasing loan delinquency, bankruptcy, and declining profitability in the 1980s, are harder to dismiss and, thus, are usually considered when forming expectations about future business risk conditions using evaluation periods that extend much further into the past.

Among the structural variables, age had significant influence on risk-balancing decisions in the 1980s model. Risk attitudes are indeed expected to exert much stronger influence on farmers' decisions to prudently enforce capital structure adjustments during periods of higher income volatility, such as the farm crises years of the 1980s.

On the other hand, the tenure ratio became a significant component of the 1990s model. After the farm credit record improved and as farmland leasing became an increasingly attractive land control strategy in the early 1990s, increased access to credit under larger leased acreage significantly influenced risk-balancing decisions.

A number of risk management variables are also significantly related to the risk-balancing measure in both time period models. In

[7] Diagnostic results indicate the absence of heteroscedasticity in these models. Collinearity diagnostics produced highest condition index numbers of 2.866 and 2.856 for the 1991 and 1998 models, respectively, which were below the critical value established by Belsley to detect multicollinearity.

the 1980s model, the crop and enterprise diversification indexes had negative coefficients, thus implying the compatibility between specialization and strategic capital structure adjustments. The emphasis on specialization is most likely based on a more urgent need to increase farm revenues to improve the low liquidity positions of farms during such a period. For most of these grain farms, especially those operating in the north-central Illinois region, the benefits of risk reduction under an enterprise diversification scheme could have been outweighed by gains of comparative advantage enjoyed by these highly specialized grain farms (Barry, Escalante, and Bard).

In contrast, the 1990s model emphasized synergistic risk-reducing benefits from both crop diversification and risk-balancing strategies. Moreover, greater insurance protection against fluctuating farm incomes is attributed to higher degrees of risk balancing in the same model. Both of these variables directly result in a reduction in variability. However, their risk reduction benefits are probably overwhelmed by a larger multiplier for the returns effect in Equation (5) that mainly involves parameters that measure the relative variability of asset returns and borrowing costs. Thus, these results suggest the need to supplement these strategies with risk-balancing decisions for greater risk efficiency.

Finally, the marketing price index variable that captures the effects of the farmer's marketing strategy is negatively signed in the 1980s model, thus suggesting that higher price indexes are associated with more intensive risk balancing. Although observers (such as the majority of extension economists surveyed by Brorsen and Anderson in 1997) might argue that forward contracting, as a marketing strategy, results in relatively higher average farm prices, empirical evidence 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. Based on the latter argument, the result obtained in this analysis could indicate that farms in the 1980s that faced serious liquidity constraints could have maximized farm revenues by selling their products whenever they could, and perhaps not necessarily through forward contracts that minimize price risk in exchange for previously negotiated farm prices that were relatively lower than what most farmers were receiving on the average.

Summary and Conclusions

The concept of strategic adjustments in capital structure, originally called the risk-balancing hypothesis, presents a risk management alternative that involves the prudent and regulated use of a farmer's borrowing capacity in the face of increasing business risk conditions. A normative concept in the agricultural finance literature, the hypothesis has firm theoretical foundations in frameworks based on firm-level equilibrium analysis, expected utility mean variance analysis and partial adjustment theory of capital structure. Its intuitive appeal has motivated theoretical extensions in policy and other disciplines.

In this study we used a longitudinal farm-level data set from Illinois grain farms to provide important information on the frequency and strength of strategic capital structure adjustments by farmers. A more straightforward measure based on the correlation coefficients between several annual pairings of business and financial risk measures is used to capture the strength and extent of strategic adjustments in capital structure, or the risk-balancing behavior. This analysis considered different business risk measures that involved varying lengths of historical farm income data. Econometric procedures were also used to establish significant statistical relationships between the extent of such adjustments and several farm attributes and alternative risk management strategies.

Under different business risk measurement methods, the number of significantly dominant proportions of risk-balancing farms became smaller as the length of the business risk evaluation period increased. This result provides an important implication on the myopic perspective that farmers could adopt when contemplating risk-balancing plans.

The econometric results for two time periods representing the 1980s and the 1990s provide contrasts of factors determining the farmers' use of strategic capital structure adjustments in response to increased business risk conditions. In addition to the significant influence of risk attitudes, the liquidity-constrained environment in the 1980s emphasizes the compatibility between risk-balancing practices and the need for revenue-enhancing business plans that involve crop and enterprise specialization. These plans provide comparative trade advantages for the farms, in addition to marketing decisions that perhaps might not have necessarily been based on forward contracts. In contrast, farmers in the 1990s have been able to experience risk reduction benefits from a combination of risk-balancing plans, crop diversification, and greater crop insurance coverage. In the improved farm credit environment of the 1990s, farms have also been able to implement more flexible capital adjustments under more intensive leasing arrangements.

The results of this study provide significant implications on the viability of strategic capital structure adjustments as a risk behavioral construct and 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, strategic adjustments in long-term capital structure is an integral component in a menu of strategic plans designed to counter increasing income risk.

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