**Farm Support Payments and Risk Balancing:**
**Implications for Financial Riskiness of Canadian Farms**♣

Florentina Nicoleta Uzea[a*], Kenneth Poon[b*], David Sparling[c], and Alfons Weersink[d]

[a]*Post-Doctoral Research Associate, Ivey Business School, Western University, nuzea@ivey.ca*
[b]*Research Associate, Department of Food, Agricultural and Resource Economics, University of Guelph, poonk@uoguelph.ca*
[c]*Professor, Ivey Business School, Western University, dsparling@ivey.ca*
[d]*Professor, Department of Food, Agricultural and Resource Economics, University of Guelph, aweersin@uoguelph.ca*

*Senior authorship is shared by the first two authors.

***Selected Paper prepared for presentation at the Agricultural and Applied Economics Association's 2013 AAEA & CAES Joint Annual Meeting, Washington, DC, August 4-6, 2013.***



♣The paper has been submitted for the Canadian Journal of Agricultural Economics 2014 Special Issue on *The Past, Present and Future of Government Regulation of Agriculture and Food: Is There a New Economics of Food?*

ABSTRACT

The risk balancing literature suggests that business risk management (BRM) programs may, through risk balancing (offsetting adjustments between business risk and financial risk), lead farmers to take on more financial risk than they would take otherwise, which, in turn, increases the risk of equity loss. Business risk management continues to be the central objective of Canadian agricultural policy, and this was re-enforced with the recent introduction of the Growing Forward II policy framework. However, it is not known whether Canadian BRM programs designed to offset business risk lead to increased financial risk and possibly higher levels of overall risk for individual farm operations. This paper aims to empirically examine the impact of Canadian BRM programs on the financial riskiness of farms using a longitudinal farm data set from Ontario. Results show that: 1) the lag of payment of Canadian Agricultural Income Stabilization/AgriStability diminishes the effectiveness of BRM programs in reducing business risk; 2) a relatively small share of farms exhibit risk balancing behaviour, and 3) BRM payments have no impact on the likelihood of risk balancing. Taken together, these findings suggest that the impact of BRM programs on the financial riskiness of farms is limited.

*Key words*: Risk Balancing; Business Risk; Financial Risk; Farm-Level Data; Correlation Analysis; Binary Dependent Panel Models.

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## INTRODUCTION

Business risk management (BRM) continues to be the central objective of Canadian agricultural policy, and this was re-enforced with the recent introduction of the Growing Forward II policy framework (AAFC 2012; Seguin 2012). Risk management is expected to play a fundamental role in the financial health of farm operations and the overall sector given the degree of variability in price and production. Farm income, while higher on average than before the commodity price boom that began in 2006, is also significantly more volatile (see Figure 1). Given the tight worldwide stock to use ratios for many of the major agricultural crops, shocks in supply or demand drivers can have dramatic impacts on commodity prices, which in turn affect the incomes of farms in both grain and meat producing sectors. For example, the drought in the U.S. Midwest led to record high nominal prices for corn in the summer of 2012. The drought, in addition to its impact on price, also highlighted the growing concern that climate change may increase the variability in production. The potential growing volatility in farm income associated with variations in price and production suggest a growing importance for government programs that assist farmers in coping with these gyrations in order to strengthen the viability of the farming sector.

Insert Figure 1 about here.

While government programs may produce the desired effect of reducing risk, they may also generate responses in farmers' risk management strategies that can crowd out or offset the effects of the government provided financial aid. For instance, Turvey (2012) finds that the

Canadian Agricultural Income Support Program (CAIS) and its successor, AgriStability and AgriInvest, create incentives for farmers to specialize in riskier crops that generate higher returns – that is, the risk reducing effect of these programs allows farmers to take on more risk in their crop diversification strategies. Kimura and Antón (2011) find that CAIS/AgriStability also reduces farmers' incentives to use crop insurance, as it already provides coverage for the same layers of income risk. Studies from other countries show that the reduction in risk associated with government payments may weaken farmers' incentives to hedge price through forward contracting (e.g., Antón and Kimura 2009; Coble et al 2000) and may induce risk-averse producers to use higher levels of risk-increasing inputs (e.g., Serra et al 2005; Hennessy 1998).

Another avenue through which government programs may influence farmers' risk management behaviour and increase (rather than reduce) farm risk is through risk balancing. The risk balancing hypothesis contends that exogenous shocks that affect a farm's level of business risk may induce the farm to make offsetting adjustments in its financial leverage position, leading to increased (or decreased) financial risk in response to a fall (or rise) in business risk (Gabriel and Baker 1980; Collins 1985). Using this framework, Featherstone et al (1988) and, more recently, Cheng and Gloy (2008), showed theoretically that farm policies designed to reduce business risk can, through risk balancing, lead to increased financial leverage and probability of farm financial failure. This so-called paradox of risk balancing has been used as a theoretical argument about the futility of risk-reducing agricultural policies (Skees 1999). It is not known whether Canadian BRM programs designed to offset business risk lead to increased financial risk and possibly higher levels of overall risk for individual farm operations.

This paper aims to empirically measure the effectiveness of Canadian BRM programs in reducing business risk, the extent of risk balancing behaviour, and the impact of BRM payments on risk balancing decisions by utilizing a longitudinal farm data set from Ontario. If BRM programs do reduce business risk and farmers do balance business and financial risk, BRM programs can be argued to crowd out farmers' financial risk management strategies and make farms financially riskier. The paper begins with a conceptual framework presenting the risk balancing hypothesis and how farmers may manage risk by trading business with financial risk. The next sections describe the empirical model and data used to examine the effectiveness of BRM programs, the extent of risk balancing behaviour, and the impact of BRM payments on risk balancing decisions. The section following features a discussion of the empirical results. Finally, the paper concludes with a discussion of the key findings and future work.

## CONCEPTUAL FRAMEWORK

The sources of total risk facing a business are universally equated to the sum of business (operating) risk and financial risk (e.g., Collins 1985; Robison and Barry 1987; Featherstone et al 1988; Harwood et al 1999). Business risk is defined as the inherent variability in the operating performance of the firm, independent of the way the firm chooses to finance its operations. Its level is influenced by external factors, such as price variability for outputs and inputs, uncertain availability and quality of inputs, and yield variability, as well as by internal factors, such as investment decisions and management skills. Financial risk is defined as the added variability of net returns to the owners of equity that results from the use of debt.

In order to maintain a maximum tolerable level of total risk as given by the decision-maker's level of risk aversion, the risk balancing hypothesis says any exogenous shocks that affect a firm's level of business risk could induce the firm to make offsetting adjustments in its financial leverage position. That is, any increase in business risk could be offset by a decrease in leverage. Conversely, upward adjustments in optimal leverage levels could be warranted whenever the level of business risk decreases.

Two approaches have been used to derive the risk balancing hypothesis. One approach is represented by the seminal work of Gabriel and Baker (1980). The authors developed a conceptual framework that linked production, investment, and financing decisions via a risk constraint. In their model, the decision maker maximizes net returns subject to the constraint that total risk does not exceed the maximum tolerable level. Total risk is decomposed into the following additive relationship between business and financial risk:

$$TR = \frac{\sigma}{(\bar{c}x - I)} = \frac{\sigma}{\bar{c}x}\frac{\bar{c}x}{(\bar{c}x - I)} = \frac{\sigma}{\bar{c}x} + \frac{\sigma I}{\bar{c}x(\bar{c}x - I)} \quad (1)$$

where $TR$ is the total amount of risk, $\bar{c}x$ is the expected net operating income without debt financing, $\sigma$ is the standard deviation of net operating income without debt financing, and $I$ is fixed interest payments. Business risk, which is the first term in the right-hand side of equation (1), is defined in terms of the variability of net operating income. Business risk increases with the variance in income and decreases with expected income. Financial risk, the second term in the right-hand side of equation (1), is equal to the degree of business risk inherent in the firm $\sigma/(\bar{c}x)$ and the relation $I/(\bar{c}x - I)$ which is determined by the financing decision. That is, financial risk is defined to be the added variability of net operating income of the owner's equity that results from the financial obligation associated with debt financing. Increases in interest payments thus increase financial risk.

The total risk ($TR$) is assumed to be constrained to a maximum tolerable level set at $\beta$:

$$\frac{\sigma}{\bar{c}x} + \frac{\sigma I}{\bar{c}x(\bar{c}x - I)} \leq \beta \quad (2)$$

If there is an exogenously induced decline in business risk (e.g., a change in agricultural policy that reduces σ or raises $\bar{c}x$), financial risk will also subsequently fall due to its own business risk component. As a result, total risk declines leaving slack in the risk constraint defined in equation (2). This would allow debt use and, consequently, financial risk, to increase. Alternatively, the firm may choose to undertake riskier and more profitable production or investment activities, increasing business risk.

The other approach to representing the risk balancing hypothesis is through a structural model of the overall debt-equity decision by farm operators (e.g., Collins 1985; Featherstone et al 1988). This model assumes that the decision-maker chooses the degree of financial leverage that maximizes the expected utility of the rate of return on equity, given his level of risk aversion. Total risk (*TR*) is defined as the variability of the return on equity, with return on equity (*ROE*) assumed to be a function of the debt to equity ratio ($\delta$), rate of return on assets (*ROA*) and fixed interest rate of debt ($i$) – i.e., $ROE = ROA(1+\delta) - i\delta$. That is, total risk is given by:

$$TR = \sigma_{ROE}^2 = \sigma_{ROA}^2 (1+\delta)^2 \quad (3)$$

where $\sigma_{ROE}^2$ is the variance of the return on equity (total risk), $\sigma_{ROA}^2$ is the variance of the return on assets (business risk), and $\delta$ is the degree of financial leverage (financial risk). Collins (1985) shows that the optimal debt to equity ratio resulting from the utility maximization problem is inversely related to business risk, which is consistent with the tradeoff derived by Gabriel and Baker (1980). However, Collins (1985) and Featherstone et al (1988) also show that agricultural policies that increase income, as well as reducing risk, will increase the optimal leverage ratio.

The form of the relationship between business risk and financial risk can be derived by taking the standard deviation and differentiating equation (3) resulting in $\frac{\partial \sigma_{ROE}}{\partial \sigma_{ROA}} = (1+\delta)$ and $\frac{\partial \sigma_{ROE}}{\partial \delta} = \sigma_{ROA}$. That is, an increase in business risk increases total risk by (1+δ) and an increase in financial leverage increases total risk by $\sigma_{ROA}$, everything else held constant. In standard deviation form, financial risk is a linear multiple of business risk. Under this framework, the following relationship between business and financial risk is derived:

$$\frac{\partial \delta^*}{\partial \sigma_{ROA}^2} = -\frac{\lambda}{[\mathrm{E(ROA)} - \mathrm{i}]} \quad (4)$$

where λ is the risk aversion parameter and E(*ROA*) is the expected rate of return on assets. In equilibrium, the sign of equation (4) is negative, which supports the risk balancing hypothesis – a decline in business risk would produce an increase in desired financial risk, everything else held constant.

The concepts of business risk, financial risk, and risk balancing have also been applied in a portfolio theory framework to evaluate the possible responses in financial structure to changes in a firm's operating environment (e.g., Barry and Robison 1987). In portfolio theory, financial activities are considered through the introduction of a risk-free asset that can be combined with portfolios of risky assets. Positive and negative holdings of the risk-free asset represent borrowing and lending, respectively, at the risk-free interest rate.[1] Business risk arises from the variability of returns to the investor's risky assets and is independent of the financial structure of the investor's portfolio. Financial risk arises from the composition and terms of the financial claims on the assets (e.g., borrowing or leasing is a form of financial leveraging and adds to the investor's financial risk). Again, business and financial risks combine to determine total risk.

In equilibrium, the investor chooses the portfolio of risky assets that, in combination with the risk-free asset, yields the highest possible return per unit of risk. Risk balancing comes into play when any change in the expected return and standard deviation of risky assets, as well as the

[1] The impacts of risky financing activities have also been considered (e.g., Fama 1976; Elton et al 2009).

risk-free cost of borrowing, makes the original portfolio non-optimal and portfolio adjustments (offsetting responses in business risk and financial risk) are needed to restore equilibrium.

In summary, the risk balancing hypothesis assumes an inverse relationship between business and financial risk. This relationship forms the basis for the empirical analysis that follows. But before proceeding with the analysis, it is worth emphasizing that the risk balancing hypothesis may not always hold. As Gabriel and Baker (1980) acknowledge, upward adjustments in debt use are only one way in which a firm could respond to an exogenously induced decline in business risk. The other strategies could be to undertake production activities, investment activities, or a combination of the two that bring business risk back to the original level. In a similar vein, a firm could respond to an exogenously induced rise in business risk with a strictly financial decision – refinancing some of the existing debt with either a debt with longer maturity or with equity capital. Alternatively, a reorganization of production activities towards less risky, lower return activities could take place, lowering business risk.

Also, Collins (1985) shows that a decline in business risk may well cause farm owners to reduce financial leverage if accompanied by an increase in interest rate and/or a decrease in the expected rate of return to assets from operations and capital gains. In a similar vein, a rise in business risk may lead rational decision makers to increase financial leverage if accompanied by a fall in interest rate and/or an increase in the expected rate of return to assets.

## EMPIRICAL MODEL

The paper uses a three-stage approach to examine the impact of business risk management (BRM) programs on farmers' financial risk management strategies. The first stage consists of assessing the effectiveness of BRM programs in altering business risk across sectors and time.

The second stage examines the extent of risk balancing behavior by comparing business risk (BR) and financial risk (FR) for individual operations. The third stage estimates the determinants of the likelihood of risk balancing with a focus on the impact of BRM payments.

**Effectiveness of BRM Programs**

The risk balancing literature suggests that BRM programs may, through risk balancing, lead farmers to take on more FR than they would take otherwise, which, in turn, increases the risk of equity loss. However, two conditions are necessary for this result to hold: 1) BRM payments are effective at reducing BR, and 2) farmers exhibit risk balancing behaviour (taking on more FR when BR decreases as a result of BRM payments is just one strategy a farmer can use to respond; alternatively, the farmer could undertake activities that increase BR, such as plant riskier crops or use more risk-increasing inputs).

In order to see whether BRM payments reduce BR, we compare the distributions of BR and its components (i.e., standard deviation and average income) with and without program payments. Unlike other BRM payments, which are received in the same year they are triggered, CAIS/AgriStability payments are received the following year. Thus, we consider two measures of BR with program payments – one in which CAIS/AgriStability payments are accounted for in the year they are triggered and the other when these payments are shifted to the year in which they are received (we assume there are farmers in both groups – i.e., farmers that, when assessing BR, take into account CAIS/AgriStability payments in year triggered (we call them 'analytical' decision makers) and farmers that consider CAIS/AgriStability payments in year received (we call them 'practical' decision makers). BRM programs are considered to be effective to the extent that they reduce standard deviation and average of BR, by decreasing volatility of income and/or by increasing average income.

**Extent of Risk Balancing**

In order to measure the extent of risk balancing behaviour, we use two approaches. For each approach, we consider both measures of BR – with CAIS/AgriStability payments in year triggered and with CAIS/AgriStability payments shifted to year received.

First, we look at the number of observations where a change in BR of previous year leads to an opposite change in the current period's FR. We consider a one-year lag of BR to account for the fact that farm financial structure decisions made in the current year could be based on the previous year's BR level (the implicit assumption here is that historical experiences of business fluctuations are used as basis for forming expectations of future BR trends). This approach measures the extent of risk balancing by year.

The other approach is to look at how individual decision-makers respond to changes in BR over a period of time. To do this, we derive correlation coefficient measures of risk balancing for each farm in the dataset over the entire study period.[2] Pearson's correlations are calculated over parings between a one-year lagged BR and the current period's FR. Since risk balancing involves an inverse relationship between BR and FR, the extent of risk balancing is given by the share of farms with negative and statistically significant correlation coefficients.

[2] Escalante and Barry (2003) also used the correlation coefficient between BR and FR as a proxy measure for the farmer's risk balancing behaviour. The other approach used to test for risk balancing is represented by risk programming models (e.g., Escalante and Barry 2001; Cheng and Gloy 2008).

**Impact of BRM Payments on the Likelihood of Risk Balancing**

Because the amount of BRM payments a farm receives is different for farms in different sectors and size categories, we also examine the impact of program payments on the probability of risk balancing by estimating logit and probit panel models such as:

$$Pr\ (Y_{it}=1 \mid X_{it}, u_i) = G(\beta X_{it} + u_i) \qquad (5)$$

with

$$Y_{it} = \beta X_{it} + u_i + e_{it} \qquad (6)$$

where

$Y_{it}$ = binary dependent variable which takes the value of 1 when FR moves in opposite direction of BR in previous period (risk balancing behaviour) and 0 otherwise;

$X_{it}$ = vector of covariates including BRM payments, enterprise diversification, operating profit margin, operating expense ratio, interest expenses, and farm size;

$u_i$ = individual-specific error component (assumed to not vary over time);

$e_{it}$ = idiosyncratic error component (unique to each individual-year observation);

$G(\cdot)$ = standard normal cumulative distribution function (for the probit model) and logistic cumulative distribution function (for the logit model).

We do not make any assumption about $G(\cdot)$ and estimate both probit and logit models. Also, we estimate both fixed effects (logit) and random effects (probit and logit) models. The fixed effects model allows for correlation between the unobservable individual-specific component $u_i$ and the observed explanatory variables $X_{it}$. However, because the fixed effects estimator relies only on the time-series variation in Y (and Xs) within a given farm, farms that exhibit no variation in the risk-balancing dependent variable are dropped from the estimation sample – hence, information is lost. The random effects model allows us to retain the full sample. However, it makes the potentially restrictive assumption that $u_i$ and $X_{it}$ are uncorrelated. Why would we expect correlation between the unobservable individual-specific characteristics and one or more regressors? If we let $u_i$ stand for farmer's attitude towards risk, then $u_i$ is very likely to be correlated with both diversification and interest expenses, for attitude towards risk often determines the degree of diversification (diversify more if risk averse) and the degree of indebtedness (take on less debt if risk averse).

# DATA

## Data Source

The analysis uses data from the Ontario Farm Income Database (OFID), which is a longitudinal farm-level dataset compiled from farms that participated in CAIS/AgriStability every year from 2003 to 2010 (data on other BRM payments are also available for these farms). Two subsets – i.e., of field crops and beef farms, based on share of revenues in six out of the eight years – are drawn from this dataset and analyzed separately to account for the different business environments the two sectors experienced over the 2003-2010 period – i.e., deteriorating for beef and favourable for crops. These sectors also represent the two largest groups in the OFID data – there are 3,689 field crops and 1,759 beef farms in the panel of 9,028 farms used for analysis (that is, 41% and 19% of the total, respectively).

## Variable Definition

*Risk measures*

Gabriel and Baker's approach to defining BR and FR is used due to the lack of balance sheet information. We initially measure BR as the coefficient of variation[3] (i.e., standard deviation divided by the mean) of the farm's net operating income over a 4-year[4] period and FR as the ratio of interest expense to net farm income. However, we find that 86% of beef and 68% of field crops farms alternate profits with losses[5] – hence, the BR measure is vulnerable to the "mean effect" whereby we could take the variation of profits more than the variation of losses just because profits tend to be larger than the absolute value of losses. In order to ensure the results are not determined by this "mean effect," we calculate BR as the coefficient of variation of the farm's operating revenues to operating expense ratio (in what follows, we call this ratio revenue margin) – that is, we proxy the variation in net operating income (i.e., operating revenue minus operating expenses) with the variation in the operating revenues to operating expense ratio. To be consistent, we also replace net operating income with the revenue margin in the FR measure. The summary statistics for these BR and FR measures are reported in Table 1 together with those for the explanatory variables below.

Insert Table 1 about here.

[3] We choose the coefficient of variation (over the standard deviation) to account for changes in the mean of a farm's net income over time (net income increased over the study period for field crops farms and decreased for beef farms). This allows us to compare between the different levels of BR a farm experienced in different years.

[4] We also did the analysis with the coefficient of variation calculated from 3 years of data to account for the fact that farmers may make decisions based on more recent experiences of income volatility. The results were similar to the 4-year BR measure ones.

[5] Only 6% of beef and 30% of field crops farms experience profits in all years, while 8% of beef and 2% of field crops farms experience losses in all years.

*Explanatory variables*

BRM payments (*brmpay*) include payments from CAIS/AgriStability, AgriInvest, and a number of ad-hoc programs (see Appendix 1 for a list of the main farm support programs triggered over the study period). Data on Crop Insurance payments were not available for this analysis. BRM payments, along with all other monetary values, were adjusted to real 2003 dollars using the consumer price index. Enterprise diversification (*enterprdiv*) represents revenue allocations among various operations (e.g., field crops, beef, dairy, swine, etc.) and is calculated based on the concept of a Herfindahl index[6], with lower index values indicating greater levels of diversification. We include this variable to examine compatibility between diversification and risk balancing as risk management strategies. Operating profit margin (*opprofmrgn*), calculated by dividing the farm's net operating income (before interest and taxes) by total operating revenue, is used as a measure of profitability. Operating expense ratio (*opexpratio*), calculated as total operating expense divided by total operating revenue, is used as a measure of operating efficiency. Interest expense (*interestexp*) is a proxy measure for the amount of debt a farm has. Size category dummies are defined in terms of total sales. Farms are sorted into five size classes as follows: class 1 (*size1*) includes farms with less than $10,000 in sales, class 2 (*size2*) includes farms with sales of $10,000 to $99,999, class 3 (*size3*) includes farms with sales of $100,000 to $249,999, class 4 (*size4*) includes farms with sales of $250,000 to $499,999, and class 5 (*size5*) includes farms with more than $500,000 in sales.

[6] Herfindahl index, H = $\sum_{i=1}^{n}(share_i^2)$.

## RESULTS

### Effectiveness of BRM Programs

Figure 2 (panels *a* to *h*) illustrates the standard deviation and average across farms for BR with and without program payments, as well as the average across farms for the two components of BR – standard deviation and average of revenue margin. The results for each sector are presented by year and size category.

Insert Figure 2 about here.

For beef farms, BRM payments (both with CAIS/AgriStability in year triggered and in year received) increase average revenue margins for all size categories; however, the larger the farm, the smaller the impact. Also, the results show that BRM payments reduce variability of revenue margin only when CAIS/AgriStability payments are accounted for in year triggered. When CAIS/AgriStability payments are shifted to year received, BRM payments increase the variability of revenue margin. This is a logical result since low income is the trigger for BRM payments and the program objective is to compensate for low income years.

The net result is that BRM payments reduce average BR only for the smallest farms – farms selling less than $10,000 per year. For the other size classes, BRM payments reduce average BR only when CAIS/AgriStability payments are accounted for in the year triggered. When CAIS/AgriStability payments are shifted to year received, BRM payments have no impact or tend to increase average BR. Also, BRM payments (both with CAIS/AgriStability in year triggered and in year received) reduce variability of BR for following size classes: up to $10,000, $10,000 to $99,999, and $250,000 to $499,999. For farms with sales of $100,000-249,999 and $500,000 and over, BRM payments with CAIS/AgriStability in year triggered have almost no impact on variability of BR, while BRM payments with CAIS/AgriStability in year received increase variability, as expected.

For field crops farms, BRM payments (both with CAIS/AgriStability in year triggered and in year received) increase average revenue margin for all size categories, though to different extents. However, they also increase variability of revenue margin. The net result is that BRM payments reduce average BR only when CAIS/AgriStability payments are accounted for in year triggered. When shifted to year received, CAIS/AgriStability payments increase average BR. The impact of BRM payments (both with CAIS/AgriStability in year triggered and in year received) on standard deviation of BR is minimal.

Taken together, these results suggest that the lag of payment of CAIS/AgriStability reduces the effectiveness of BRM programs for both beef and field crops sectors. Thus, the impact of BRM payments on risk balancing decisions and the financial riskiness of farms depends on the type of decision-maker – i.e., 'analytical' (considers BRM payments with CAIS/AgriStability in year triggered) versus 'practical' (looks at BRM payments with CAIS/AgriStability in year received).

**Extent of Risk Balancing**

Despite the difference in the business environment they experienced over the study period, beef and field crops farms exhibit fairly similar behaviour. Table 2 presents the number of farms where a change in BR of previous year leads to an opposite change in the current period's FR, by sector.[7] The share of risk-balancing farms in a given year varies between 38.8% and 43.6% for beef and between 43.2% and 45.3% for field crops.

Insert Table 2 about here.

[7] For instance, a change in BR from 2006 to 2007 leads to an opposite change in FR from 2007 to 2008.

These shares are similar to the shares of farms that exhibit negative BR-FR correlations[8] – i.e., around 41% for beef and 46% for field crops (Table 3). However, the correlation coefficient is statistically significant for only about 6% of beef as well as field crops farms.[9] That is, only a small share of farms are risk balancers when we look at risk balancing over the entire period.

Insert Table 3 about here.

**Impact of Program Payments on the Likelihood of Risk Balancing**

Tables 4 to 7 summarize the results from the fixed effects (logit) and random effects (probit and logit) models for beef and field crops, for the cases when CAIS/AgriStability payments are accounted for in the year triggered and in the year received. Both the fixed effects and random effects models have explanatory power for the field crops sector and the Hausman test suggests that there is no systematic difference between the fixed effects logit coefficients and the random effects logit coefficients. In contrast, the fixed effects model for the beef sector has little (when CAIS/AgriStability payments are shifted to year received) or no explanatory power (when CAIS/AgriStability payments are accounted for in the year triggered). Moreover, the Hausman test suggests that we cannot reject the null hypothesis that the unobserved individual-specific characteristics are uncorrelated with the observed explanatory variables. As a result, the random effects logit model is preferable to the fixed effects model (the coefficients are consistent and efficient).

Insert Tables 4-7 about here.

[8] Correlation coefficient is calculated over four BR-FR pairs with the first pair being BR in 2006 and FR in 2007.
[9] The small number of BR-FR pairs means correlation values have to be very large to be significant – i.e., $|rho| \geq 0.9$.

The results show that BRM payments do not affect the likelihood of risk balancing behaviour for either field crops or beef farms (the impact of program payments on the incidence of risk balancing is negative for beef and positive for field crops; however, it is not statistically significant for any of the sectors). Interest expenses (which proxy a farm's degree of leverage) are positively associated with risk balancing in the beef sector and negatively associated in the field crops sector. Profitability decreases the likelihood of risk balancing for both sectors, while operating efficiency increases the probability of risk balancing for field crops (the impact of operating efficiency, though also positive, is not statistically significant for beef farms). The more diversified a farm is, the less likely it is to trade off BR with FR in both beef and field crops sectors. Finally, larger beef and field crops operations tend to be significantly more likely to risk balance.[10]

## CONCLUDING DISCUSSION

The risk balancing literature suggests that BRM programs may, through risk balancing (offsetting adjustments between business risk and financial risk), lead farmers to take on more financial risk than they would take otherwise, which, in turn, increases the risk of equity loss. The objective of this paper was to empirically examine the impact of Canadian BRM programs on the financial riskiness of farms using a longitudinal farm data set from Ontario.

A key finding from this analysis is that the lag of payment of CAIS/AgriStability diminishes the effectiveness of BRM programs in reducing BR for both beef and field crops farms. Also, we find that a relatively small share of farms exhibit risk balancing behaviour –

[10] Note that the size dummies are not significant in the fixed effects model for field crops, while they are in the random effects models. This suggests that there is not enough variation in size within individual farms (remember that the fixed effects estimator relies only on the time-series variation in the explanatory variables within a given farm).

farms that would respond to a decrease in BR as a result of BRM payments by taking on more debt (than they would take otherwise). Finally, regression results show that BRM payments have no impact on the likelihood of risk balancing. Taken together, these findings suggest that the impact of BRM programs on the financial riskiness of farms is limited.

However, these results must be interpreted with caution for at least two reasons. First, the analysis lacks the balance sheet information needed to account for the impact of expected capital gains (e.g., land value appreciation) on the decision to take on more debt. Second, it lacks data on Crop Insurance payments, which are significant for the field crops sector. Despite these limitations, this study provides motivation for future work on the potential crowding out effect that BRM programs can have on farmers' financial risk management strategies. Future work could extend present analysis to incorporate balance sheet information, as well as Crop Insurance data.

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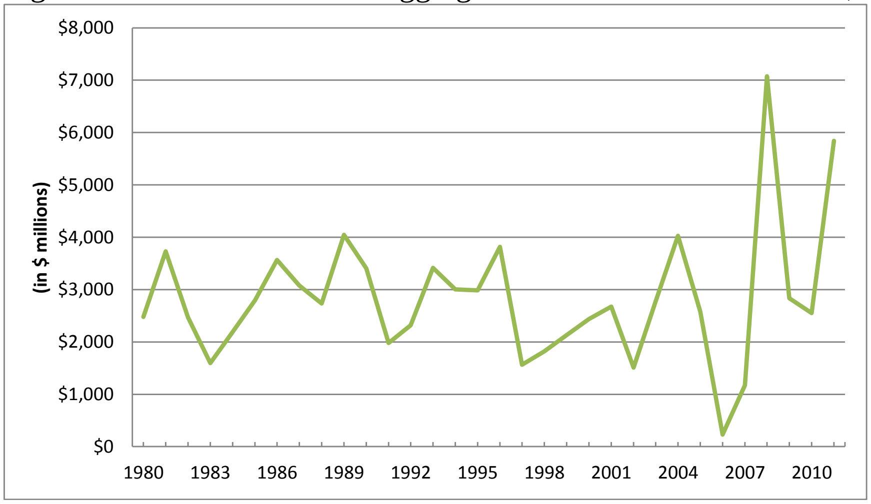
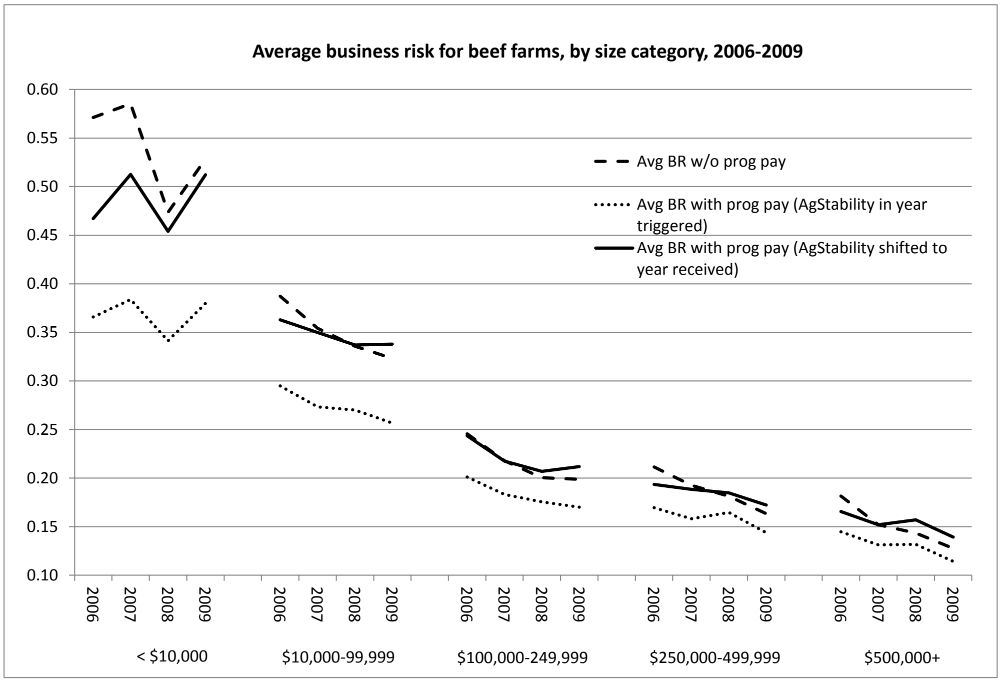
Figure 1. Net farm income – Aggregate across all Canadian farms, 1980-2011

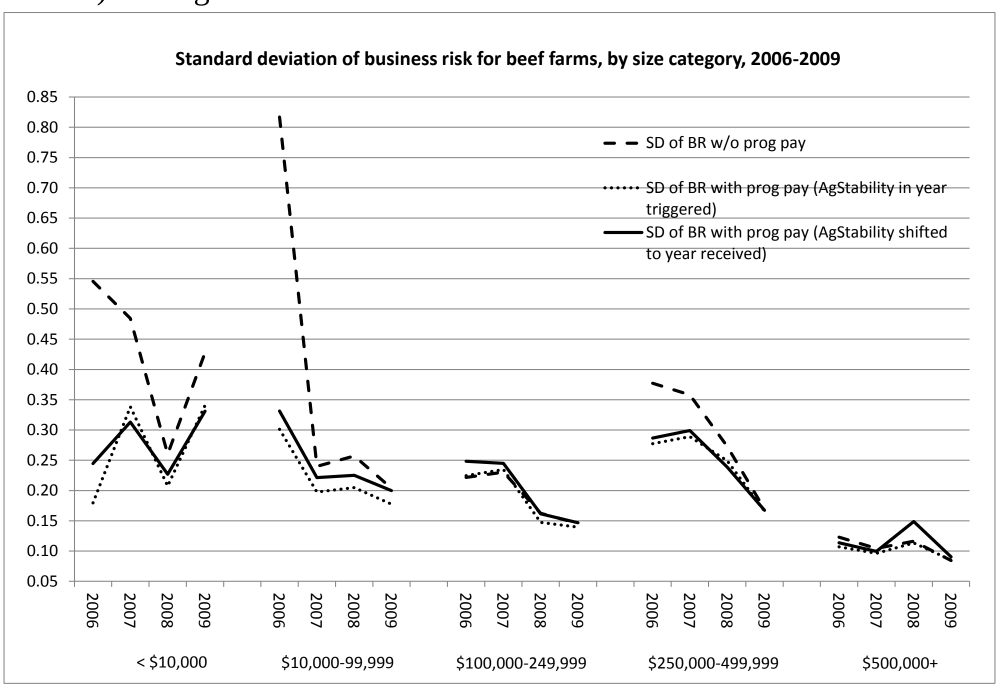



Source: Statistics Canada, CANSIM Table 002-0009: Net farm income.

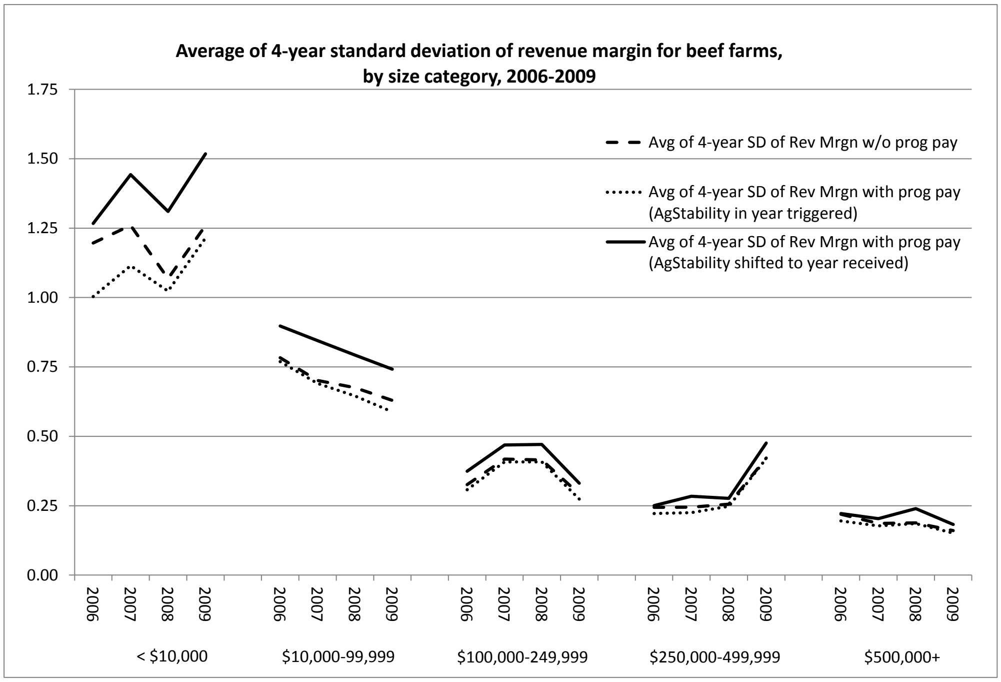
Figure 2. Impact of program payments on business risk and its components, by sector and size category, 2006-2009



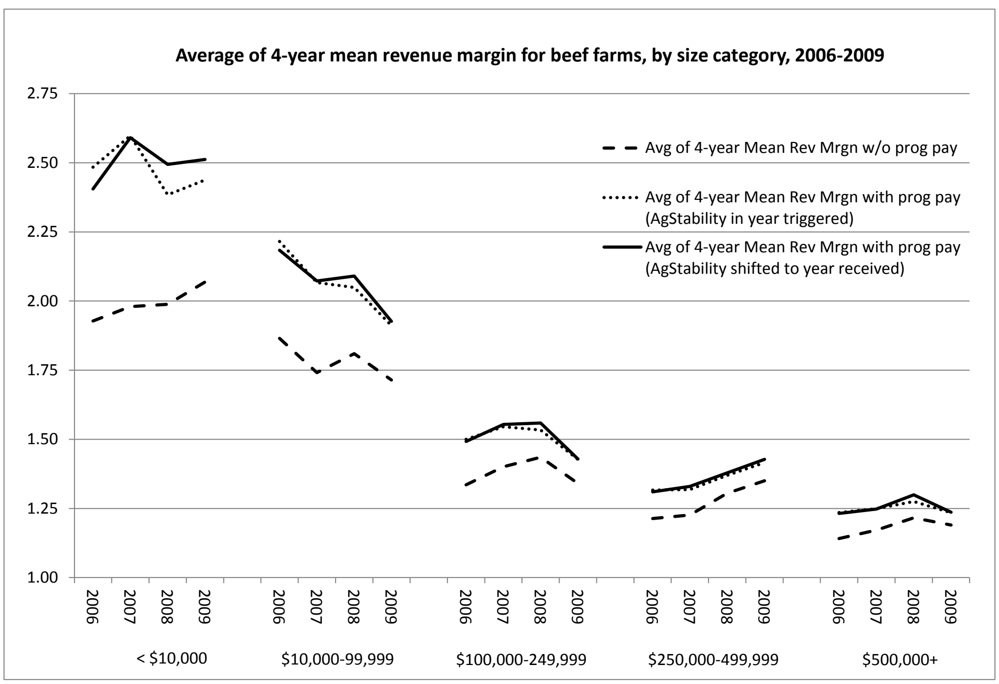

Panel a) Average across farms of individual farm business risk – Beef



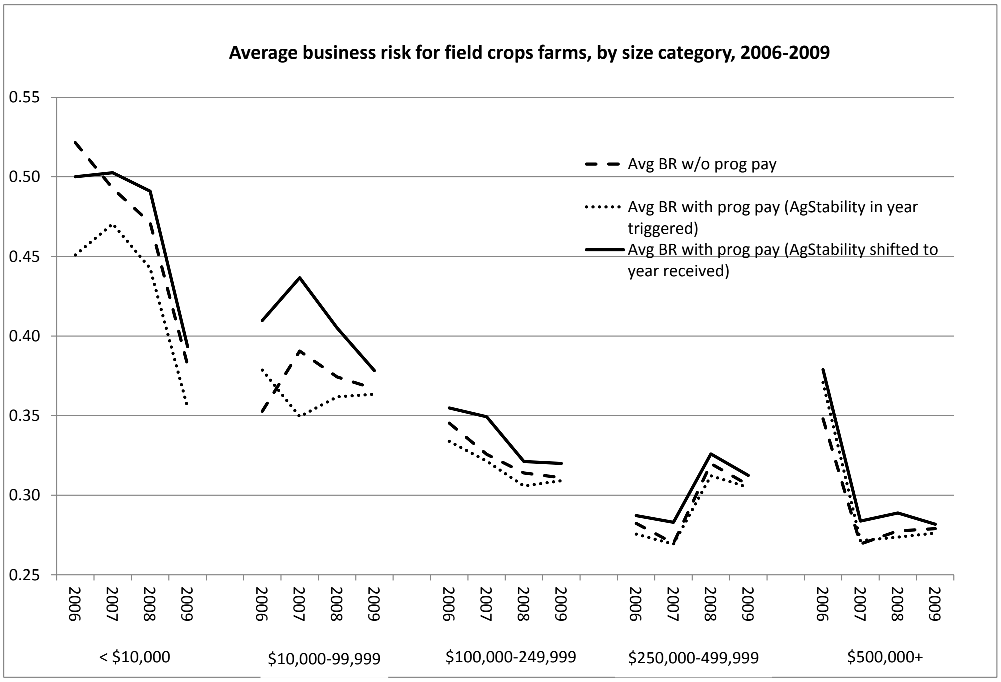

Panel b) Standard deviation of business risk – Beef



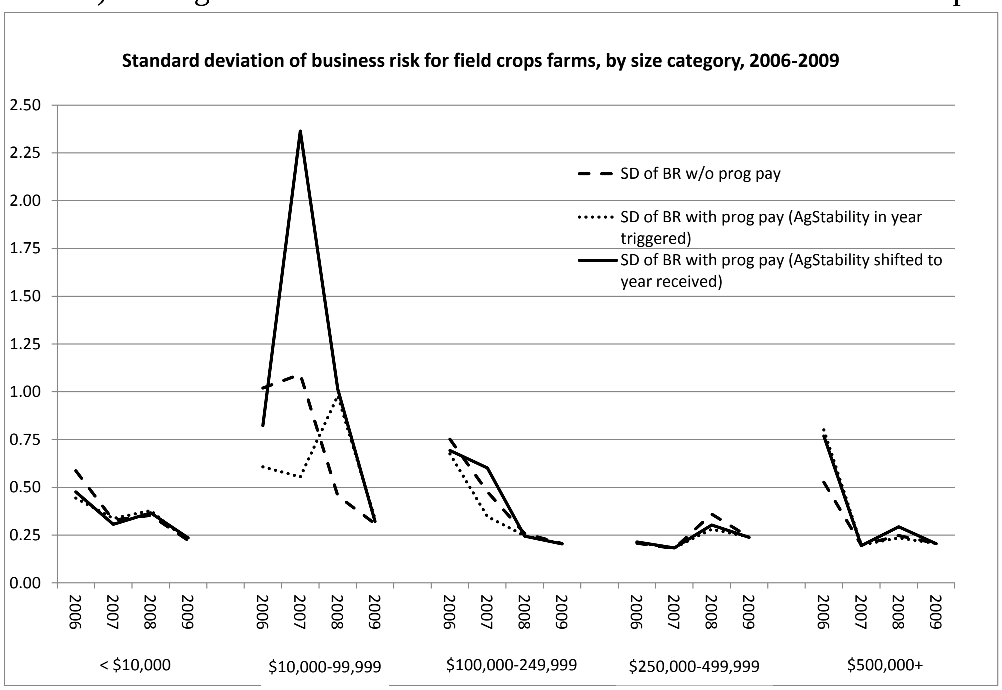

Panel c) Average across farms of individual farm 4-year standard deviation of revenue margin – Beef



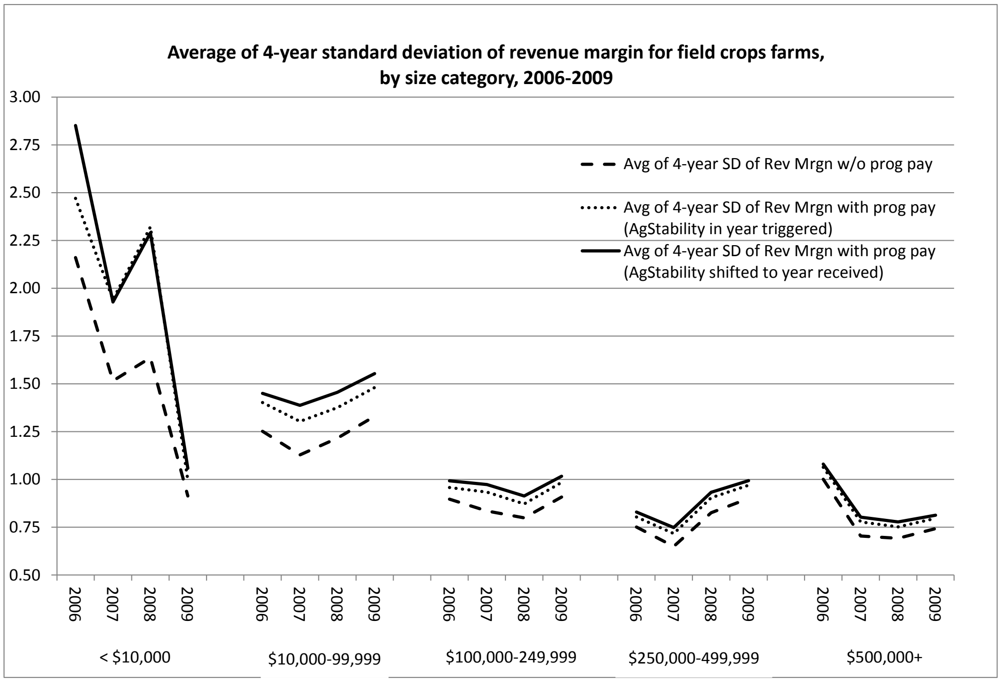

Panel d) Average across farms of individual farm 4-year mean revenue margin – Beef



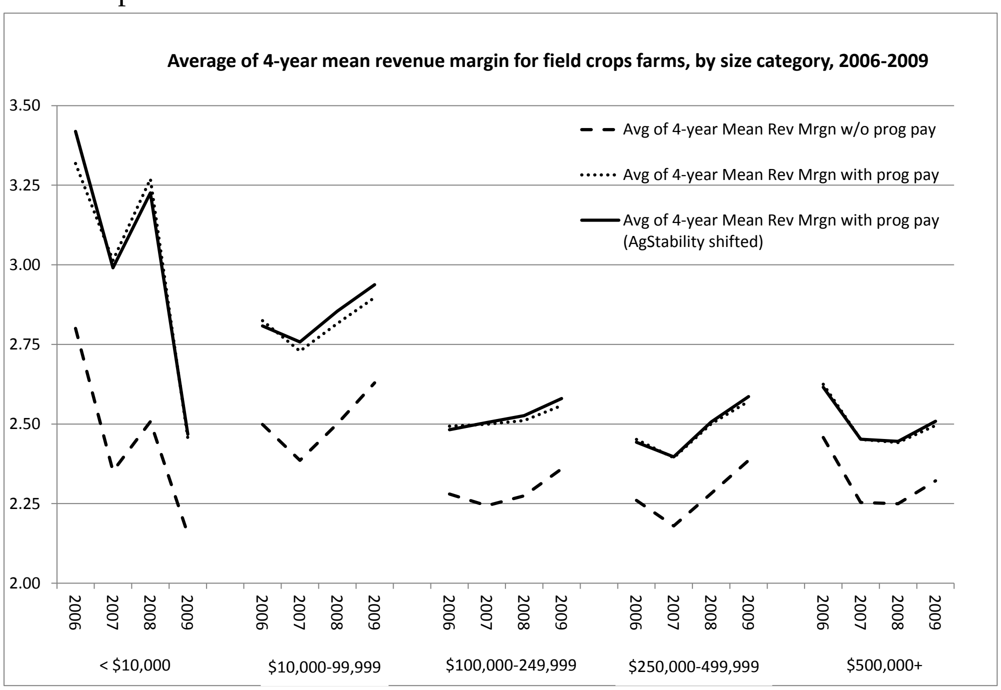

Panel e) Average across farms of individual farm business risk – Field crops




Panel f) Standard deviation of business risk – Field crops




Panel g) Average across farms of individual farm 4-year standard deviation of revenue margin – Field crops




Panel h) Average across farms of individual farm 4-year mean revenue margin – Field crops

Table 1. Summary statistics (average and standard deviation), by sector and size category, 2006-2010

| Variable | Statistic | Less than $10,000 | $10,000-99,999 | $100,000-249,999 | $250,000-499,999 | $500,000 and more |
|---|---|---|---|---|---|---|
| Field Crops | | | | | | |
| 2006 | | | | | | |
| Business risk | Avg | 0.52 | 0.35 | 0.35 | 0.28 | 0.35 |
| | Std dev | 0.59 | 1.02 | 0.75 | 0.21 | 0.53 |
| Business risk with prog pay | Avg | 0.45 | 0.38 | 0.33 | 0.28 | 0.37 |
| | Std dev | 0.44 | 0.61 | 0.68 | 0.21 | 0.80 |
| Business risk with prog pay shifted | Avg | 0.50 | 0.41 | 0.35 | 0.29 | 0.38 |
| | Std dev | 0.48 | 0.82 | 0.69 | 0.21 | 0.77 |
| Financial risk* | Avg | 0.30 | 0.31 | 0.72 | 1.51 | 3.76 |
| | Std dev | 1.27 | 0.74 | 0.89 | 1.45 | 4.18 |
| Herfindahl index | Avg | 0.96 | 0.92 | 0.89 | 0.88 | 0.86 |
| | Std dev | 0.13 | 0.16 | 0.18 | 0.19 | 0.20 |
| Operating profit margin | Avg | -1.70 | -0.11 | 0.04 | 0.08 | 0.12 |
| | Std dev | 10.14 | 0.76 | 0.33 | 0.26 | 0.22 |
| Operating expense ratio | Avg | 10.17 | 1.44 | 1.22 | 1.29 | 1.37 |
| | Std dev | 53.15 | 1.45 | 0.78 | 1.48 | 1.29 |
| BRM payments, $ | Avg | $4,574 | $13,394 | $37,775 | $82,329 | $182,618 |
| | Std dev | $5,654 | $10,406 | $20,597 | $41,643 | $133,744 |
| BRM payments (CAIS/AgriStability shifted), $ | Avg | $4,809 | $15,196 | $41,396 | $86,031 | $191,478 |
| | Std dev | $5,670 | $11,991 | $23,794 | $42,287 | $128,692 |
| Interest expenses, $ | Avg | $1,943 | $5,522 | $14,079 | $28,339 | $75,478 |
| | Std dev | $4,161 | $9,386 | $15,611 | $24,043 | $76,065 |
| 2007 | | | | | | |
| Business risk | Avg | 0.49 | 0.39 | 0.33 | 0.27 | 0.27 |
| | Std dev | 0.33 | 1.09 | 0.48 | 0.18 | 0.20 |
| Business risk with prog pay | Avg | 0.47 | 0.35 | 0.32 | 0.27 | 0.27 |
| | Std dev | 0.34 | 0.55 | 0.35 | 0.18 | 0.20 |
| Business risk with prog pay shifted | Avg | 0.50 | 0.44 | 0.35 | 0.28 | 0.28 |
| | Std dev | 0.31 | 2.36 | 0.60 | 0.18 | 0.19 |
| Financial risk* | Avg | 0.55 | 0.30 | 0.76 | 1.56 | 3.55 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Std dev | 2.45 | 0.76 | 1.13 | 2.25 | 4.16 |
| Herfindahl index | Avg | 0.96 | 0.93 | 0.91 | 0.89 | 0.89 |
| | Std dev | 0.11 | 0.15 | 0.16 | 0.18 | 0.18 |
| Operating profit margin | Avg | -2.53 | -0.06 | 0.09 | 0.12 | 0.14 |
| | Std dev | 10.15 | 0.99 | 0.37 | 0.25 | 0.25 |
| Operating expense ratio | Avg | 4.59 | 1.37 | 1.18 | 1.05 | 1.18 |
| | Std dev | 11.93 | 4.62 | 1.95 | 0.48 | 1.04 |
| BRM payments, $ | Avg | $2,767 | $4,355 | $11,739 | $24,395 | $53,724 |
| | Std dev | $4,495 | $3,249 | $6,566 | $10,939 | $28,842 |
| BRM payments (CAIS/AgriStability shifted), $ | Avg | $2,465 | $5,459 | $13,955 | $27,476 | $64,075 |
| | Std dev | $4,108 | $5,354 | $9,453 | $16,623 | $55,040 |
| Interest expenses, $ | Avg | $2,367 | $4,950 | $13,645 | $29,302 | $68,091 |
| | Std dev | $5,261 | $9,341 | $16,845 | $40,279 | $72,331 |
| | | | | 2008 | | |
| Business risk | Avg | 0.47 | 0.37 | 0.31 | 0.32 | 0.28 |
| | Std dev | 0.35 | 0.46 | 0.26 | 0.36 | 0.25 |
| Business risk with prog pay | Avg | 0.44 | 0.36 | 0.31 | 0.31 | 0.27 |
| | Std dev | 0.38 | 0.98 | 0.25 | 0.28 | 0.23 |
| Business risk with prog pay shifted | Avg | 0.49 | 0.41 | 0.32 | 0.33 | 0.29 |
| | Std dev | 0.37 | 1.01 | 0.24 | 0.30 | 0.29 |
| Financial risk* | Avg | 0.61 | 0.21 | 0.52 | 1.22 | 2.95 |
| | Std dev | 1.85 | 0.57 | 0.68 | 2.03 | 3.62 |
| Herfindahl index | Avg | 0.94 | 0.94 | 0.93 | 0.93 | 0.90 |
| | Std dev | 0.16 | 0.14 | 0.14 | 0.14 | 0.16 |
| Operating profit margin | Avg | -2.34 | 0.04 | 0.18 | 0.20 | 0.19 |
| | Std dev | 12.68 | 0.75 | 0.31 | 0.27 | 0.31 |
| Operating expense ratio | Avg | 4.36 | 1.12 | 0.89 | 0.98 | 0.97 |
| | Std dev | 13.14 | 2.98 | 0.58 | 1.26 | 0.76 |
| BRM payments, $ | Avg | $259 | $1,098 | $2,715 | $5,169 | $11,564 |
| | Std dev | $446 | $1,911 | $3,739 | $7,897 | $12,477 |
| BRM payments (CAIS/AgriStability shifted), $ | Avg | $925 | $1,346 | $3,126 | $5,910 | $12,750 |
| | Std dev | $2,431 | $2,408 | $4,315 | $7,520 | $14,218 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Interest expenses, $ | Avg | $4,532 | $4,221 | $10,879 | $24,452 | $61,261 |
| | Std dev | $8,931 | $9,166 | $13,083 | $26,050 | $74,832 |
| | | | | 2009 | | |
| Business risk | Avg | 0.38 | 0.37 | 0.31 | 0.31 | 0.28 |
| | Std dev | 0.22 | 0.31 | 0.21 | 0.24 | 0.21 |
| Business risk with prog pay | Avg | 0.36 | 0.36 | 0.31 | 0.30 | 0.28 |
| | Std dev | 0.22 | 0.33 | 0.20 | 0.24 | 0.21 |
| Business risk with prog pay shifted | Avg | 0.39 | 0.38 | 0.32 | 0.31 | 0.28 |
| | Std dev | 0.23 | 0.32 | 0.20 | 0.24 | 0.20 |
| Financial risk* | Avg | 0.65 | 0.21 | 0.49 | 0.95 | 2.44 |
| | Std dev | 3.02 | 0.49 | 0.81 | 1.07 | 3.49 |
| Herfindahl index | Avg | 0.95 | 0.95 | 0.93 | 0.93 | 0.92 |
| | Std dev | 0.13 | 0.13 | 0.14 | 0.14 | 0.14 |
| Operating profit margin | Avg | -3.13 | -0.03 | 0.10 | 0.14 | 0.15 |
| | Std dev | 19.16 | 1.12 | 0.37 | 0.27 | 0.23 |
| Operating expense ratio | Avg | 4.80 | 1.20 | 1.03 | 0.98 | 1.05 |
| | Std dev | 19.17 | 3.91 | 1.80 | 1.17 | 0.97 |
| BRM payments, $ | Avg | $852 | $1,917 | $4,632 | $8,594 | $21,196 |
| | Std dev | $1,341 | $2,835 | $5,603 | $8,359 | $21,685 |
| BRM payments (CAIS/AgriStability shifted), $ | Avg | $678 | $1,388 | $3,845 | $7,650 | $19,590 |
| | Std dev | $1,171 | $1,938 | $5,811 | $6,348 | $17,916 |
| Interest expenses, $ | Avg | $2,607 | $3,771 | $9,587 | $19,675 | $49,019 |
| | Std dev | $5,103 | $7,556 | $12,864 | $21,131 | $65,706 |
| | | | | 2010 | | |
| Business risk | Avg | 0.43 | 0.37 | 0.31 | 0.32 | 0.28 |
| | Std dev | 0.26 | 0.28 | 0.21 | 0.24 | 0.19 |
| Business risk with prog pay | Avg | 0.41 | 0.36 | 0.30 | 0.31 | 0.27 |
| | Std dev | 0.27 | 0.29 | 0.21 | 0.24 | 0.19 |
| Business risk with prog pay shifted | Avg | 0.43 | 0.37 | 0.31 | 0.31 | 0.27 |
| | Std dev | 0.28 | 0.29 | 0.21 | 0.24 | 0.19 |
| Financial risk* | Avg | 0.49 | 0.16 | 0.43 | 0.97 | 2.32 |
| | Std dev | 1.77 | 0.38 | 0.57 | 1.10 | 3.41 |
| Herfindahl index | Avg | 0.93 | 0.96 | 0.94 | 0.94 | 0.92 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Std dev | 0.16 | 0.12 | 0.13 | 0.13 | 0.15 |
| Operating profit margin | Avg | -2.58 | 0.18 | 0.18 | 0.20 | 0.21 |
| | Std dev | 16.51 | 2.74 | 0.34 | 0.24 | 0.21 |
| Operating expense ratio | Avg | 5.70 | 1.08 | 0.92 | 0.88 | 0.95 |
| | Std dev | 14.71 | 5.13 | 1.14 | 0.61 | 0.74 |
| BRM payments, $ | Avg | $678 | $1,228 | $3,484 | $7,315 | $20,832 |
| | Std dev | $1,444 | $1,695 | $3,080 | $6,268 | $22,145 |
| BRM payments (CAIS/AgriStability shifted), $ | Avg | $887 | $1,769 | $4,456 | $8,333 | $21,510 |
| | Std dev | $1,340 | $2,662 | $5,265 | $8,667 | $20,788 |
| Interest expenses, $ | Avg | $3,075 | $3,388 | $9,191 | $21,202 | $50,767 |
| | Std dev | $6,589 | $6,809 | $11,468 | $22,373 | $73,569 |

Beef

| Variable | Statistic | Less than $10,000 | $10,000-99,999 | $100,000-249,999 | $250,000-499,999 | $500,000 and more |
|---|---|---|---|---|---|---|
| 2006 | | | | | | |
| Business risk | Avg | 0.57 | 0.39 | 0.25 | 0.21 | 0.18 |
| | Std dev | 0.55 | 0.82 | 0.22 | 0.38 | 0.12 |
| Business risk with prog pay | Avg | 0.37 | 0.29 | 0.20 | 0.17 | 0.14 |
| | Std dev | 0.18 | 0.30 | 0.22 | 0.28 | 0.11 |
| Business risk with prog pay shifted | Avg | 0.47 | 0.36 | 0.24 | 0.19 | 0.17 |
| | Std dev | 0.24 | 0.33 | 0.25 | 0.29 | 0.11 |
| Financial risk* | Avg | 0.16 | 0.27 | 0.77 | 1.21 | 4.33 |
| | Std dev | 0.31 | 0.54 | 1.03 | 1.32 | 7.29 |
| Herfindahl index | Avg | 0.90 | 0.85 | 0.81 | 0.81 | 0.85 |
| | Std dev | 0.18 | 0.18 | 0.19 | 0.18 | 0.18 |
| Operating profit margin | Avg | -1.60 | -0.61 | -0.13 | -0.01 | 0.02 |
| | Std dev | 3.18 | 2.62 | 0.54 | 0.19 | 0.17 |
| Operating expense ratio | Avg | 3.21 | 1.91 | 1.31 | 1.09 | 1.21 |
| | Std dev | 3.55 | 3.05 | 0.81 | 0.20 | 1.43 |
| BRM payments, $ | Avg | $1,934 | $3,839 | $11,205 | $14,449 | $43,660 |
| | Std dev | $3,454 | $6,831 | $17,698 | $16,879 | $82,790 |
| BRM payments (CAIS/AgriStability shifted), $ | Avg | $2,177 | $4,894 | $10,826 | $15,769 | $64,845 |
| | Std dev | $3,453 | $8,298 | $19,458 | $21,261 | $147,565 |
| Interest expenses, $ | Avg | $1,550 | $3,634 | $9,158 | $15,439 | $49,834 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Std dev | $2,332 | $5,945 | $12,070 | $17,701 | $82,503 |
| | | | 2007 | | | |
| Business risk | Avg | 0.59 | 0.35 | 0.22 | 0.19 | 0.15 |
| | Std dev | 0.48 | 0.24 | 0.23 | 0.36 | 0.10 |
| Business risk with prog pay | Avg | 0.38 | 0.27 | 0.18 | 0.16 | 0.13 |
| | Std dev | 0.34 | 0.20 | 0.23 | 0.29 | 0.10 |
| Business risk with prog pay shifted | Avg | 0.51 | 0.35 | 0.22 | 0.19 | 0.15 |
| | Std dev | 0.31 | 0.22 | 0.24 | 0.30 | 0.10 |
| Financial risk* | Avg | 0.30 | 0.40 | 0.76 | 1.59 | 4.93 |
| | Std dev | 0.88 | 1.77 | 1.04 | 1.68 | 7.98 |
| Herfindahl index | Avg | 0.92 | 0.84 | 0.79 | 0.79 | 0.83 |
| | Std dev | 0.15 | 0.19 | 0.20 | 0.19 | 0.18 |
| Operating profit margin | Avg | -1.99 | -0.88 | -0.13 | -0.04 | 0.00 |
| | Std dev | 3.81 | 2.79 | 0.36 | 0.17 | 0.15 |
| Operating expense ratio | Avg | 3.72 | 2.08 | 1.45 | 1.07 | 1.06 |
| | Std dev | 4.34 | 3.89 | 4.50 | 0.20 | 0.44 |
| BRM payments, $ | Avg | $2,400 | $5,532 | $10,057 | $16,705 | $46,752 |
| | Std dev | $2,720 | $5,864 | $10,435 | $18,552 | $98,814 |
| BRM payments (CAIS/AgriStability shifted), $ | Avg | $2,649 | $4,762 | $11,270 | $15,282 | $43,379 |
| | Std dev | $3,283 | $6,495 | $14,635 | $18,441 | $79,390 |
| Interest expenses, $ | Avg | $1,977 | $4,002 | $8,906 | $18,864 | $56,078 |
| | Std dev | $3,238 | $7,081 | $11,210 | $20,718 | $87,027 |
| | | | 2008 | | | |
| Business risk | Avg | 0.47 | 0.34 | 0.20 | 0.18 | 0.14 |
| | Std dev | 0.26 | 0.26 | 0.16 | 0.27 | 0.12 |
| Business risk with prog pay | Avg | 0.34 | 0.27 | 0.18 | 0.16 | 0.13 |
| | Std dev | 0.21 | 0.20 | 0.15 | 0.25 | 0.11 |
| Business risk with prog pay shifted | Avg | 0.45 | 0.34 | 0.21 | 0.18 | 0.16 |
| | Std dev | 0.23 | 0.23 | 0.16 | 0.24 | 0.15 |
| Financial risk* | Avg | 0.25 | 0.26 | 0.63 | 1.26 | 4.44 |
| | Std dev | 1.00 | 0.55 | 1.04 | 1.48 | 7.65 |
| Herfindahl index | Avg | 0.91 | 0.82 | 0.76 | 0.78 | 0.82 |
| | Std dev | 0.18 | 0.20 | 0.20 | 0.20 | 0.19 |
| Operating profit margin | Avg | -1.42 | -0.34 | 0.02 | 0.05 | 0.07 |
| | Std dev | 2.49 | 1.18 | 0.39 | 0.18 | 0.34 |
| Operating expense ratio | Avg | 2.71 | 1.64 | 0.99 | 0.96 | 0.93 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Std dev | 3.28 | 8.54 | 0.56 | 0.39 | 0.45 |
| BRM payments, $ | Avg | $2,236 | $4,854 | $9,395 | $17,048 | $60,163 |
| | Std dev | $2,714 | $4,853 | $8,702 | $13,043 | $113,795 |
| BRM payments (CAIS/AgriStability shifted), $ | Avg | $3,266 | $7,386 | $13,943 | $23,092 | $74,145 |
| | Std dev | $3,432 | $6,681 | $11,666 | $19,818 | $131,490 |
| Interest expenses, $ | Avg | $1,678 | $3,769 | $8,051 | $16,582 | $51,793 |
| | Std dev | $3,090 | $6,635 | $10,388 | $19,613 | $84,058 |
| | | | | 2009 | | |
| Business risk | Avg | 0.53 | 0.32 | 0.20 | 0.16 | 0.13 |
| | Std dev | 0.43 | 0.20 | 0.15 | 0.17 | 0.08 |
| Business risk with prog pay | Avg | 0.38 | 0.26 | 0.17 | 0.14 | 0.11 |
| | Std dev | 0.34 | 0.18 | 0.14 | 0.17 | 0.09 |
| Business risk with prog pay shifted | Avg | 0.51 | 0.34 | 0.21 | 0.17 | 0.14 |
| | Std dev | 0.33 | 0.20 | 0.15 | 0.17 | 0.09 |
| Financial risk* | Avg | 0.19 | 0.31 | 0.59 | 0.98 | 3.80 |
| | Std dev | 0.65 | 0.86 | 0.93 | 1.16 | 6.69 |
| Herfindahl index | Avg | 0.93 | 0.82 | 0.78 | 0.77 | 0.80 |
| | Std dev | 0.15 | 0.20 | 0.20 | 0.19 | 0.19 |
| Operating profit margin | Avg | -3.02 | -0.82 | -0.11 | -0.06 | 0.00 |
| | Std dev | 9.49 | 2.01 | 0.28 | 0.17 | 0.24 |
| Operating expense ratio | Avg | 4.18 | 1.85 | 1.12 | 1.12 | 0.97 |
| | Std dev | 8.09 | 2.27 | 0.57 | 1.40 | 0.28 |
| BRM payments, $ | Avg | $1,397 | $3,479 | $8,819 | $15,071 | $47,348 |
| | Std dev | $1,932 | $5,066 | $10,697 | $18,245 | $96,100 |
| BRM payments (CAIS/AgriStability shifted), $ | Avg | $971 | $1,509 | $2,802 | $6,219 | $23,300 |
| | Std dev | $1,717 | $3,392 | $6,450 | $11,083 | $62,273 |
| Interest expenses, $ | Avg | $1,281 | $3,169 | $7,188 | $11,834 | $43,059 |
| | Std dev | $3,294 | $5,990 | $10,580 | $14,182 | $72,979 |
| | | | | 2010 | | |
| Business risk | Avg | 0.58 | 0.34 | 0.22 | 0.16 | 0.14 |
| | Std dev | 0.40 | 0.22 | 0.20 | 0.10 | 0.09 |
| Business risk with prog pay | Avg | 0.47 | 0.28 | 0.19 | 0.14 | 0.12 |
| | Std dev | 0.35 | 0.19 | 0.19 | 0.10 | 0.09 |
| Business risk with prog pay shifted | Avg | 0.57 | 0.35 | 0.23 | 0.17 | 0.15 |
| | Std dev | 0.33 | 0.21 | 0.20 | 0.11 | 0.09 |
| Financial risk* | Avg | 0.24 | 0.21 | 0.50 | 0.84 | 0.35 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Std dev | 0.87 | 0.64 | 0.74 | 0.96 | 0.60 |
| Herfindahl index | Avg | 0.89 | 0.82 | 0.78 | 0.77 | 0.80 |
| | Std dev | 0.19 | 0.20 | 0.21 | 0.20 | 0.19 |
| Operating profit margin | Avg | -3.91 | -0.39 | 0.02 | 0.10 | 0.09 |
| | Std dev | 26.93 | 5.22 | 0.45 | 0.17 | 0.14 |
| Operating expense ratio | Avg | 6.39 | 1.44 | 1.16 | 0.87 | 0.89 |
| | Std dev | 40.51 | 5.17 | 3.89 | 0.20 | 0.30 |
| BRM payments, $ | Avg | $519 | $998 | $2,732 | $3,850 | $18,280 |
| | Std dev | $1,240 | $2,133 | $4,857 | $6,308 | $44,294 |
| BRM payments (CAIS/AgriStability shifted), $ | Avg | $1,134 | $3,389 | $9,348 | $13,534 | $48,396 |
| | Std dev | $1,863 | $4,684 | $11,343 | $16,569 | $95,464 |
| Interest expenses, $ | Avg | $1,994 | $3,063 | $7,342 | $11,846 | $42,819 |
| | Std dev | $4,489 | $6,115 | $10,367 | $13,569 | $68,783 |

Note: * means that financial risk has been normalized (by dividing it by 10,000) to take values similar to business risk.

Table 2. Extent of risk balancing as defined by the number of observations where a change in business risk leads to an opposite change in financial risk, by sector and year

| | BR ’06-’07 & FR ’07-‘08 | BR ’07-’08 & FR ’08-‘09 | BR ’08-’09 & FR ’09-‘10 |
|---|---|---|---|
| **Beef** | | | |
| AgriStability in year triggered | 705 (40.1%) | 685 (38.9%) | 731 (41.6%) |
| AgriStability shifted to year received | 715 (40.6%) | 682 (38.8%) | 767 (43.6%) |
| **Field Crops** | | | |
| | BR ’06-’07 & FR ’07-‘08 | BR ’07-’08 & FR ’08-‘09 | BR ’08-’09 & FR ’09-‘10 |
| AgriStability in year triggered | 1,657 (44.9%) | 1,594 (43.2%) | 1,652 (44.8%) |
| AgriStability shifted to year received | 1,638 (44.4%) | 1,600 (43.4%) | 1,671 (45.3%) |

Note: number in parentheses indicates percentage of the total.

Table 3. Extent of risk balancing as defined by the correlation between business risk and financial risk, by sector

| | Farms with | | Farms with **significant**[i] | |
|---|---|---|---|---|
| **Beef** | | | | |
| | Negative BR-FR correlations | Positive BR-FR correlations | Negative BR-FR correlations | Positive BR-FR correlations |
| AgriStability in year triggered | 718 (40.8%) | 1,041 (59.2%) | 91 (5.2%) | 121 (6.9%) |
| AgriStability shifted to year received | 731 (41.6%) | 1,028 (58.4%) | 106 (6.0%) | 122 (6.9%) |
| **Field Crops** | | | | |
| | Farms with | | Farms with **significant**[i] | |
| | Negative BR-FR correlations | Positive BR-FR correlations | Negative BR-FR correlations | Positive BR-FR correlations |
| AgriStability in year triggered | 1,697 (46.0%) | 1,992 (54.0%) | 235 (6.4%) | 215 (5.8%) |
| AgriStability shifted to year received | 1,688 (45.8%) | 2,001 (54.2%) | 225 (6.1%) | 222 (6.0%) |

Notes: i – significance is based on a one-tailed test at the 5% level; number in parentheses indicates percentage of the total.

Table 4. Logit and probit estimates of the determinants of risk balancing behaviour in the beef sector, CAIS/ AgriStability shifted to year received

Dependent Variable: *riskbal*

| Independent Variable | Fixed Effects Logit | Random Effects Logit | Random Effects Probit |
|---|---|---|---|
| *enterprdiv* | -.740** | -.571* | -.346* |
| | (.394) | (.179) | (.109) |
| *opprofmrgn* | -.079* | -.035** | -.020* |
| | (.032) | (.018) | (.010) |
| *opexpratio* | .008 | .004 | .002 |
| | (.015) | (.008) | (.005) |
| *brmpay* | -.210 | -.169 | -.102 |
| | (.143) | (.112) | (.067) |
| *interestexp* | -.178 | .289* | .174* |
| | (.447) | (.141) | (.084) |
| *size2* | -.258 | .265** | .162** |
| | (.261) | (.158) | (.095) |
| *size3* | -.281 | .482* | .294* |
| | (.331) | (.175) | (.105) |
| *size4* | -.278 | .383* | .235* |
| | (.409) | (.188) | (.113) |
| *size5* | .146 | .465* | .284* |
| | (.493) | (.202) | (.122) |
| *constant* | - | -.323 | -.198 |
| | | (.222) | (.134) |
| Number of farms in the estimation sample | 1,096[ii] | 1,759 | 1,759 |
| Log-likelihood value | -1,194.21 | -3,505.97 | -3,505.57 |
| Likelihood ratio/Wald $chi^2$ | | | |
| - value | 19.73 | 33.54 | 34.64 |
| - p-value | 0.020 | 0.000 | 0.000 |
| Rho value | - | .187 | .219 |
| | | (.022) | (.024) |
| Likelihood ratio test of rho=0 | - | 90.85 | 91.69 |
| - $chi^2$ value | - | 0.000 | 0.000 |
| - p-value | | | |
| Hausman | | | |
| - $chi^2$ value | 15.22 | | |
| - p-value | 0.085 | | |

Notes: * denotes statistical significance at the 5% level; ** denotes statistical significance at the 10% level; ii – 663 farms (i.e., 36% of sample) dropped because of always risk-balancing or never risk-balancing.

Table 5. Logit and probit estimates of the determinants of risk balancing behaviour in the beef sector, CAIS/AgriStability in year triggered

Dependent Variable: *riskbal*

| Independent Variable | Fixed Effects Logit | Random Effects Logit | Random Effects Probit |
|---|---|---|---|
| *enterprdiv* | -.403 | -.400* | -.242* |
| | (.383) | (.173) | (.105) |
| *opprofmrgn* | -.038 | -.013 | -.008 |
| | (.025) | (.017) | (.010) |
| *opexpratio* | -.001 | .006 | .004 |
| | (.010) | (.008) | (.005) |
| *brmpay* | -.121 | -.049 | -.030 |
| | (.125) | (.105) | (.064) |
| *interestexp* | -.734 | .277* | .170* |
| | (.493) | (.135) | (.081) |
| *size2* | -.269 | .106 | .066 |
| | (.256) | (.151) | (.092) |
| *size3* | -.416 | .263 | .163 |
| | (.326) | (.168) | (.102) |
| *size4* | -.353 | .229 | .142 |
| | (.402) | (.180) | (.110) |
| *size5* | -.565 | .183 | .115 |
| | (.485) | (.195) | (.118) |
| *constant* | - | -.320 | -.199 |
| | | (.214) | (.130) |
| Number of farms in the estimation sample | 1,117[ii] | 1,759 | 1,759 |
| Log-likelihood value | -1,222.07 | -3,511.15 | -3,510.78 |
| Likelihood ratio/Wald $chi^2$ | | | |
| - value | 10.16 | 18.62 | 19.12 |
| - p-value | 0.338 | 0.029 | 0.024 |
| Rho value | - | .157 | .186 |
| | | (.022) | (.024) |
| Likelihood ratio test of | | | |
| rho=0 | - | 65.54 | 66.24 |
| - $chi^2$ value | - | 0.000 | 0.000 |
| - p-value | | | |
| Hausman | | | |
| - $chi^2$ value | 14.19 | | |
| - p-value | 0.116 | | |

Notes: * denotes statistical significance at the 5% level; ii – 642 farms (i.e., 36% of sample) dropped because of always risk-balancing or never risk-balancing.

Table 6. Logit and probit estimates of the determinants of risk balancing behaviour in the field crops sector, CAIS/AgriStability shifted to year received

| Dependent Variable: *riskbal* | | | |
|---|---|---|---|
| Independent Variable | Fixed Effects Logit | Random Effects Logit | Random Effects Probit |
| *enterprdiv* | -.487 | -.414* | -.268* |
| | (.420) | (.169) | (.104) |
| *opprofmrgn* | -.585* | -.119* | -.032* |
| | (.086) | (.036) | (.010) |
| *opexpratio* | .138* | .027* | .010* |
| | (.053) | (.009) | (.004) |
| *brmpay* | -.200 | .005 | .007 |
| | (.187) | (.157) | (.096) |
| *interestexp* | -.688* | .126 | .077 |
| | (.330) | (.091) | (.056) |
| *size2* | .014 | .115 | .059 |
| | (.313) | (.202) | (.123) |
| *size3* | .152 | .479* | .276* |
| | (.332) | (.206) | (.125) |
| *size4* | .175 | .584* | .339* |
| | (.357) | (.212) | (.129) |
| *size5* | -.093 | .495* | .283* |
| | (.400) | (.222) | (.135) |
| *constant* | - | -.223 | -.103 |
| | | (.258) | (.157) |
| Number of farms in the estimation sample | 2,444[ii] | 3,689 | 3,689 |
| Log-likelihood value | -2,631.79 | -7,486.62 | -7,489.07 |
| Likelihood ratio/Wald $chi^2$ | | | |
| - value | 106.45 | 101.98 | 104.38 |
| - p-value | 0.000 | 0.000 | 0.000 |
| Rho value | - | .127 | .156 |
| | | (.014) | (.016) |
| Likelihood ratio test of rho=0 | | | |
| - $chi^2$ value | - | 95.21 | 100.21 |
| - p-value | - | 0.000 | 0.000 |
| Hausman | | | |
| - $chi^2$ value | 79.13 | | |
| - p-value | 0.000 | | |

Notes: * denotes statistical significance at the 5% level; ii – 1,245 farms (i.e., 34% of sample) dropped because of all positive or all negative outcomes

Table 7. Logit and probit estimates of the determinants of risk balancing behaviour in the field crops sector, CAIS/AgriStability in year triggered

Dependent Variable: *riskbal*

| Independent Variable | Fixed Effects Logit | Random Effects Logit | Random Effects Probit |
|---|---|---|---|
| *enterprdiv* | -.805** | -.646* | -.407* |
| | (.425) | (.169) | (.103) |
| *opprofmrgn* | -.682* | -.095* | -.031* |
| | (.087) | (.034) | (.010) |
| *opexpratio* | .116* | .026* | .011* |
| | (.045) | (.009) | (.004) |
| *brmpay* | .015 | .242 | .145 |
| | (.185) | (.161) | (.095) |
| *interestexp* | -.548** | .114 | .069 |
| | (.328) | (.091) | (.055) |
| *size2* | .490 | .469* | .275* |
| | (.333) | (.210) | (.126) |
| *size3* | .565 | .855* | .508* |
| | (.350) | (.214) | (.128) |
| *size4* | .625** | .961* | .572* |
| | (.373) | (.220) | (.132) |
| *size5* | .261 | .768* | .455* |
| | (.413) | (.229) | (.138) |
| *constant* | - | -.375 | -.202 |
| | | (.264) | (.159) |
| Number of farms in the estimation sample | 2,445[ii] | 3,689 | 3,689 |
| Log-likelihood value | -2,624.68 | -7,470.94 | -7,472.25 |
| Likelihood ratio/Wald $chi^2$ | | | |
| - value | 122.85 | 131.83 | 136.20 |
| - p-value | 0.000 | 0.000 | 0.000 |
| Rho value | - | .124 | .151 |
| | | (.014) | (.016) |
| Likelihood ratio test of rho=0 | | | |
| - $chi^2$ value | - | 90.15 | 93.49 |
| - p-value | - | 0.000 | 0.000 |
| Hausman | | | |
| - $chi^2$ value | 96.71 | | |
| - p-value | 0.000 | | |

Notes: * denotes statistical significance at the 5% level; ** denotes statistical significance at the 10% level; ii – 1,244 farms (i.e., 34% of sample) dropped because of all positive or all negative outcomes.

Appendix 1. List of main farm support programs triggered during 2003-2010

| Program name | Paid to sector |
|---|---|
| AgriInvest | All |
| BSE Fed (Cows) | Beef |
| BSE Feeder (Calves) | Beef |
| Canadian Agricultural Income Stabilization (CAIS)/AgriStability | All |
| Cost of Production (COP) Program for Grains and Oilseeds | All |
| Farm Innovation Program | All |
| Federal Grains and Oilseeds Payment Program | Grains and Oilseeds |
| Interim Outstanding of AgriStability Payments | All |
| MRI Payout | All |
| MRI Topup | All |
| Ontario BSE Recovery Initiative (OBSERI/OBSERI P3A) | Beef |
| Ontario Cattle Hog and Horticulture Program (OCHHP) | Beef (Swine, Horticulture) |
| OCRT | All |
| Ontario Grains and Oilseeds Program (OGOP) | Grains and Oilseeds |
| Production Insurance Premium Adjustment (PIPA) | All (Crops only) |
| Risk Management Program (RMP) (Cost of Production based) | Grains and Oilseeds |