THE EFFECT OF ENTREPRENURIAL ORIENTATION ON CROP PORTFOLIO CHOICE: RESULTS FROM A STUDENT SIMULATION

Sub-Theme – Entrepreneurship

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ENTREPRENURIAL ORIENTATION AND MANAGING RISK

Abstract

The paper explores how crop choices within a farm simulation game are influenced by the entrepreneurial orientation (EO) of participants. To do so, we employs a survey on demographics and management style to estimate the riskiness of crop choices as well as the entrepreneurial posture of participants. The purpose is to verify if the level of EO, constructed from the dimensions identified in the literature, helps predict the student's inclination towards crop diversification as it relates to portfolio risk. The results reveal that participants with a high level of EO selected higher-risk crop portfolios, a result consistent with other empirical studies on entrepreneurship. The study is a step toward developing an analytical basis for future empirical study in farming risk mitigation.

Keywords: *Entrepreneurial Orientation, Portfolio Choice, Managing Risk*

Introduction

Farmers that are able to adopt good risk mitigation strategies are more likely to survive. Crop diversification and crop yield insurance are the traditional risk mitigation strategies that farmers normally use to minimize risk impacts resulting from price and yield variation (a few examples are: Kahan 2013; Nguyen *et al.* 2007; Ojo *et al.* 2014). In addition, the level of entrepreneurial orientation (EO) of farmers influences their risk mitigation strategies. The concept of EO refers to the decision-making processes, managerial philosophies, salient beliefs and behaviours that are entrepreneurial in nature (Lumpkin and Dess 1996; Wiklund and Shepherd 2003; Covin *et al.* 2006; Ferreira *et al.* 2015). Thus, the success of any farm business hinges on the alignment of the complex salient beliefs and decisions of the manager (Kolvereid and Isaksen 2006).

Previous studies on risk mitigation in farming indicate that decision-making plays an important role in enhancing farm income (Kahan 2013; Hanson *et al.* 2004;

Schillo 2011; Chenuos and Maru 2015). Generally, while risk-averse farm managers endeavor to mitigate risk by choosing low-risk crops and high-risk crops with crop insurance, whereas unconventional or risk-loving farm managers usually rely on high-risk crops with potential for higher gross revenue, making "one size fits all approach" of farming risk mitigation arguably impracticable and even unrealistic (Heifner *et al.* 1999:2-8). The unique nature of farming activities *ipso facto* makes mitigation of risk impacts far more complicated amid a swirl of price and yield vagaries.

Regardless of the nature of the farm business, risks affect the achievement of its goals with various contingencies which are inherently unpredictable (e.g. Kimura *et al.* 2010; Hanson *et al.* 2007; Passioura 2006; Koesling *et al.* 2004; Miller *et al.* 2004:4; Sadras *et al.* 2003; Sadras 2002). In the farm business, risks can emerge from different sources, for example, financial risk, marketing risk (including price risk), operational risk, institutional change risk, crop yield risk, technological risk, and so on (Heifner *et al.* 1999). The decision on the type of risk mitigation strategies to adopt is the most difficult of all (Kahan 2013). To make matters more complex, entrepreneurial farmers may see risk taking as a means to improve performance outcomes, which would influence their decisions and the types of risk mitigation strategies they employ. For example, Rauch *et al.* 2009; Dodd and Wang 2011; Freiling and Lütke 2014; and Chenuos and Maru 2015 discuss how the level of EO affects the decision-making processes.

Entrepreneurial Orientation (EO)

In spite of the abundant research on EO, little work has been done modeling how an EO would influence simulated crop choices among farm businesses nor are there uniform measures for mitigating risk impacts (a few examples are Covin *et al*. 2006; Lumpkin and Dess 1997). This is partly due to the uniqueness of agriculture, which is the basic reason behind the various risk modelling techniques developed by many economists over the years (a few examples are: Kahan *et al.* 2013:29-86; Nguyen *et al.* 2007; Bryla *et al.* 2004; Miller *et al.* 2004:7-20; Sadras *et al*. 2003; and Heifner *et al.* 1999). Whatever risks farmers are facing in their daily activities, finding ways of mitigating their impacts have been problematic for centuries. Many authors have endeavored to devise several risk mitigation techniques for farm businesses based on the business and political environment, geographical location, amount of invested capital, farm size, type of crops and land quality (Miller *et al.* 2004; Glauber *et al.* 2002; Heifner *et al.* 1999). The present paper attempts to simulate the risk mitigation strategies that farmers use as it relates to self-reported levels of EO. The entrepreneurial proclivity of a farmer could determine their inclination to use

crop diversification and/or crop insurance to lessen risk impacts resulting from their decisions and choices.

EO involves a firm's inclination to innovate, become more proactive in their decision-making, take risks by trying new ideas in an uncertain environment, and aggressively pursue their goals and eager to seek new opportunities (Rauch *et al.* 2009; Wang 2008; Kropp *et al.* 2008). EO is therefore an integral component of the determinants of risk and farm performance (Covin and Slevin 1991; Schillo 2011). For instance, Schillo (2011) confirms that several publications as well as a meta-analysis often lead to the conclusion that a higher EO is generally associated with risk loving attitudes and increased performance. Miller (1983) originally proposed the term, EO and Covin and Slevin (1989) further developed the concept of EO.

Miller (1983) suggests that EO consists of three main dimensions: risk taking, pro-activeness, and innovativeness (e.g., Covin and Slevin 1991; Miller 1983; Miller 2007; Miller and Friesen 1978; Venkatraman 1989). Lumpkin and Dess (1996) add two more components (dimensions) to EO: autonomy and competitive aggressiveness. Any risk mitigation strategy adopted by farmers reflects their entrepreneurial philosophy on risk-taking, pro-activeness, innovativeness, autonomy and competitive aggressiveness. In other words, the type of mitigation strategies that farmers choose to rely on highly depends on their level of EO. Moreno and Casillas (2008) propose that the greater the firm EO, the greater will be the degree of launching of new products-technologies. Kreiser and Davis (2010) consider risk-taking, pro-activeness and innovativeness as unique sub-dimensions of EO. Kreiser and Davis (2010) further argue that more entrepreneurial oriented firms would exhibit a higher propensity of each sub-dimension of EO. The foregoing findings suggest that truly entrepreneurial oriented firms have a high proclivity for risk taking, and thus risk mitigation strategies depend on the farmers' philosophy of effective management.

SaskSim Farm Business Simulator

SaskSim is a spreadsheet based farm business management simulator, which allows student participants to manage a hypothetical farm business and to make decisions on crop choices, buying or renting additional land, and whether to take crop yield insurance over five cropping periods (crop years) (Brown, 2015). The participants can choose to grow any or all the six crops available. The number of crops a participant can grow depends on the total costs of production and their total cash balance at the beginning of the farming season in order to cover cash operating costs before harvest. At the end of each period,

information on each participants' crop choices, crop insurance, funds available, net cash flow, crop revenue and costs of production become available. The lower the costs of production of a crop, the more of that crop a participant can grow and vice versa. Participants can rent or buy additional land as long as they have the funds available. Table 1 displays the list of the crops participants can select to plant and the coefficient of variation of their yield and price.

Table 1: Crop Choices and Coefficients of Variation (CV) of Prices and Yields

Crops	*CV of Yield*	*CV of Price*
Spring Wheat	0.302	0.254
Malt Barley	0.435	0.256
Red Lentils	0.654	0.600
Chickpeas	0.833	0.692
Flax	0.480	0.388
Canola	0.278	0.253

Source: SaskSim Manual (Brown 2015)
CV: Estimation based on the means and the standard deviations of the prices and yields in the SaskSim manual.

Prices and yields of the six crops for each decision period are drawn randomly based on their means and standard deviations assuming a normal distribution. The variation in prices and yields are restricted to two standard deviations below and above the means. SaskSim uses a random number generator in a spreadsheet to draw prices and yields for each period. Crop yield insurance, when purchased, guarantees 70% of the mean yield and all six crops are insurable (Brown).

Data

Description of the SaskSim Participants

Table 2 displays the number of participants that took part in SaskSim for each period. A participant is removed from SaskSim if his/her total cash balance falls below zero. In all, sixty-seven students took part in the simulation game during period one and thirty-five participants were able to complete the 5 cropping periods.

Crop Portfolio Weighted Risk Index (CPWRI) and Proposed Variables

In answering the research questions, the items in EO dimensions are assumed to influence the participants' CPWRI. The CPWRI measures the level of risk associated

with participants' crop choices in any given period of farming. The CPWRI is measured in terms of the standard deviations of the expected net income per crop and their proportion in the portfolio. That is, the participant' weighted risk index of crop choices is assessed based on the standard deviation of a portfolio using the number of crops they grow and their proportion of total land used by each crop in a given period.

Table 2: **SaskSim Participants**

Item	**Class 1: BPBE 322**	**Class 2: BPBE 320**	**Class 1 & 2**
Year	No. of Students	No. of Students	Total
1	29	38	67
2	26	35	61
3	24	36[P]	60
4	11	35	46
5	9	26	35

Note:[P] A participant rejoined the simulation game, although they did not take part in the previous period.

A firm's success is increasingly seen as being quite multidimensional (Hart and Milstein 2003). In the same way, a farmer's business performance rests on their decisions on crop diversification, crop yield insurance and their level of EO. Hence, the participant's level of EO may influence their CPWRI. Likewise, crop diversification and crop yield insurance determines the CPWRI and therefore, their correlational relationship is considered.

Measuring Entrepreneurial Orientation (EO)

In determining the level of EO of firms, Covin and Slevin (1989) employ three items for each entrepreneurial dimension to measure the level of entrepreneurship of firms. The study, hence, considers innovativeness, risk-taking, competitive aggressiveness and pro-activeness as important dimensions of the concept of entrepreneurial orientation (Miller 1983; Covin and Slevin 1989; Rezaei *et al.* 2012). The research also uses the models suggested by Covin and Slevin 1989; Miller 1983 and the methods employed by Rezaei *et al.* 2012 with modifications to measure the level of EO of each participant in SaskSim.

It should be noted that while crop choices (and hence a calculation of crop portfolio weighted risk index) were made for each period, the level of entrepreneurial orientation was only measured at the beginning of the simulation.

Description and Summary of Survey on Management Style

Risk attitudes vary widely among farmers around the world. Risk mitigation strategies largely depend on the farmer's level of EO (Schillo 2011). The EO questionnaire contained several parts, including demographics and management style. Table 3 provides the demographic information of the participants in SaskSim. Preliminary testing revealed that participants' program of study has no significant effect on their crop choices. Even though the class a participant is taking has a significant effect on his/her crop choices. It can be said that the academic knowledge of farming that the participants have gained would give them more insights on farming risk mitigation. Managerial experience is a crucial part of the analyses of risk mitigation. Initial analysis shows that thirty-two students grew up on a farm where they were part of the decision-making process.

Table 3: Demographic of the EO Survey

Program of Study	Total	**Gender**	
Agribusiness	36	Male	43
Agronomy	27	Female	24
Agribusiness and Agronomy diplomas	1	**Age Range**	
Animal Science	2	18-24	59
Environmental Science	1	25-44	8
Total	67		

Table 4 provides descriptive statistics for the EO Questionnaire. Question seven considers the participant's level of experience in farming with a mean of 3.18 (on a five-point scale) with one and five being the lowest and the highest level of farm experience respectively. Questions eight and nine measure the participants' level of innovativeness and pro-activeness on a seven-point scale. Question ten to twelve assess the participants' level of competitiveness and questions thirteen and fourteen measure the participants' level of risk (risk-loving, risk neutral or risk-averse – all on a seven-point scale). Overall,

the results indicate that the majority of the participants do not have a high level of EO. Questions eight to fourteen indicate that participants EO dimensions' scores were below 6.00 (a score of 6.00 to 7.00 on a seven-point scale constitutes a high level of the item in question. Approximately 17.9% of the respondents were identified as having a high level of farm experience (Question 7 – Table 4).

Table 4: **Results – EO Survey Questions**

Question No.	Description	Mean	Standard Deviation	Agree
7	How would you rate your experience with farm business if you grew up on a farm or if you personally manage a farm business?	3.18	1.34	46.27%
8	*In general, we favour:* A. strong emphasis on the use of tried and true products or services for our business; B. strong emphasis on using new products and services, technological leadership, and innovations	3.72	1.03	26.87%
9	*How many new lines of products or services has your business marketed during the past three years?* A. Changes in product or service lines have been mostly of a minor nature; B. Changes in product or service lines have usually been quite dramatic.	3.16	1.03	14.71%
10	*In dealing with competitors my/our business:* A. Typically responds to actions which competitors' initiate; B. Typically adopts a very competitive attitude, not avoiding clashes with competitors	3.76	0.97	25.37%
11	A. Typically seeks to avoid clashes with competitors, preferring a live-and-let-live attitude; B. Typically adopts a very competitive attitude, not avoiding clashes with competitors	3.48	0.95	16.92%
12	*In general, we:* A. Tend to focus on low-risk investment projects (with normal and certain rates of return); B. Tend to go for high-risk investment projects (with chances for very high returns).	3.39	1.04	19.40%
13	*In general, we believe that:* A. Given the nature of the business environment, it is best to explore our options gradually via cautious, incremental behaviour; B. Given the nature of the business environment, bold, wide-ranging acts are necessary to achieve the business's objectives	3.24	0.85	10.29%
14	*When confronted with decision-making situations involving uncertainty, we:* A. Typically adopt a cautious wait and see attitude in order to minimize the probability of making costly decision; B. Typically adopt a bold, aggressive attitude in order to maximize the probability of exploiting potential opportunities.	3.40	0.87	10.29%

Methods

The methodology uses an average of the item scores on each entrepreneurial dimension as a measure of the level of EO, and "is used in most real-world cases" (Rezaei *et al.* 2012:4065). Drawing on a sample of 67 participants in an administered questionnaire in SaskSim, the measurement of the level of EO is based on participants' innovativeness and pro-activeness, competitive aggressiveness, and risk-taking. The sample size varies depending on the test, as some participants did not fully complete the EO survey on management style. Using the methodology adopted by Rezaei *et al.* 2012 with modifications, the participants' level of entrepreneurship is computed as:

$$\text{EO Score} = \frac{1}{7}[\text{IP8} + \text{IP9} + \text{CA10} + \text{CA11} + \text{RT12} + \text{RT13} + \text{RT14}] \qquad (8)$$

where
EO Score – participant's score on the EO;
IP - variable for innovativeness and pro-activeness (eight and nine represent the items/questions);
CA - variable for competitive aggressiveness (ten and eleven represent the items/questions); and
RT - variable for risk-taking (twelve, thirteen and fourteen represent the items/questions).

A high score on the EO is believed to represent a high level of entrepreneurial posture and vice versa. To determine the relationship between the dependent variables, crop portfolio weighted risk index (CPWRI), crop diversification index (CEI_{CD}) and crop yield insurance (CYI), and the independent variables, the multivariate panel regression model has been used to account for cross-sectional and time series nature of the data. Incorporating the exogenous variables (including categorical variables) defined above, $CPWRI_j$, CEI_{CDj} and CYI_j have been formulated as shown by equations (1), (2) and (3) respectively.

$$CPWRI_j^t = \tau_1 + \tau_2 EO_j + \tau_3 GUF_j + \tau_4 G_j + \tau_5 AR_j + \tau_6 C_j + \varepsilon_{jt} \qquad (1)$$

$$CEI_{CDj}^t = \tau_1 + \tau_2 EO_j + \tau_3 GUF_j + \tau_4 G_j + \tau_5 AR_j + \tau_6 C_j + \varepsilon_{jt} \qquad (2)$$

$$CYI_j^t = \tau_1 + \tau_2 EO_j + \tau_3 GUF_j + \tau_4 G_j + \tau_5 AR_j + \tau_6 C_j + \varepsilon_{jt} \qquad (3)^1$$

where

[1] The estimation used logit model on the panel data.

$CPWRI_j^t$= crop portfolio weighted risk index for jth participant at period(t),

CEI_{CDj}^t= crop diversification index for jth participant at period(t),

CYI_j^t = crop yield insurance for jth participant at period(t),

EO_j= level of entrepreneurial orientation for jth participant,

GUF_j = previous experience for jth participant,

G_j = 1 if the gender is male, 0 if not,

AR_j = 1 if the age is within the range [18 – 24], 0 if not [25-44],

C_j = 1 if the participant is in BPBE 320, 0 if not (BPBE 322)[2].

Preliminary Results of SaskSim and EO Questionnaire

Figure 1 shows that the participants' average CPWRI decreased throughout the periods of farming. However, the average CPWRI increased slightly during period four and at the same time, the average EO score decreased. It is very clear that, most participants were planting low-risk crops after period one. It is worthwhile to note that between period three and four, the average CPWRI increased slightly and the average EO score decreased slightly. The continuous decrease in the average EO could be attributed to the fact that some participants without funds were forced out of the game or voluntarily dropped out. In the same way, a participant with a very high EO score could either go out of business, leading to a decrease in the average CPWRI. In spite of this, it is expected that a participant's level of EO should influence their crop choice decisions. The trend shows a continuous decrease of CPWRI for most participants. In comparison with period two, it can be inferred that the majority of the participants in SaskSim have a higher CPWRI during period one, possibly because they grew higher-risk crops.

[2] The participants in the BPBE 322 class program of study was agribusiness, whereas those in the BPBE 320 was a mixture of agronomy, environmental science and animal science.

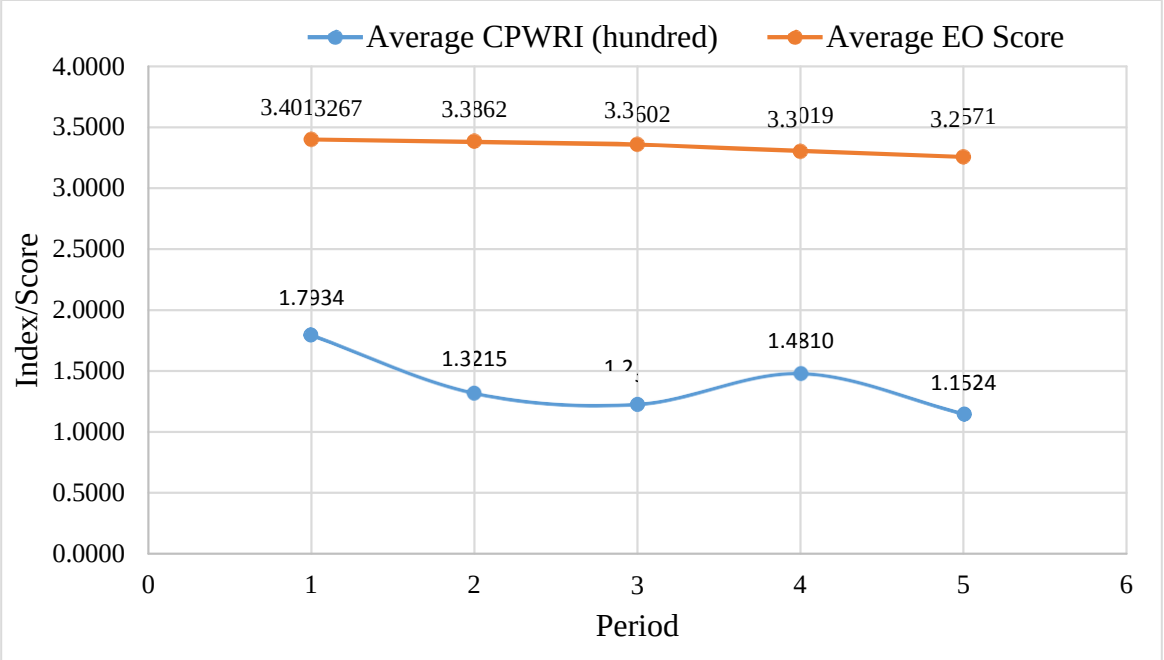

Figure 1: **Relationship between the Averages of CPWRI and EO Score**

The numbers indicate that participants were maintaining approximately the same portfolio of crops over the periods. The standard deviations of the average of CPWRI could be an indication that participants growing similar crops and or introducing few new crops into their portfolio. The standard deviation of the CPWRI of the participants' decreased from 56.81% to 48.23% of their means between period two to four. The numbers indicate that the gap in the participants' CPWRI was reducing over the periods. Participants were choosing a few new crops to plant and or maintaining their crop portfolio. Overall, in comparison with period one, the majority of the participants from period two to five inclusive grew lower-risk crops, whereas the overall averages for the EO decreased every period.

Table 5: **Results of Multivariate Panel Regression**

Independent Variables/Items	Estimated Coefficient/Values (including EO)	Estimated Coefficient/Values (including EO dimensions & LFE)
Constant	63.6699***	91.0044**
	(22.4971)	(46.0868)
Level of Entrepreneurial Orientation (EO)	16.9418***	
	(5.9641)	
Innovativeness and Proactiveness (IP)		1.1931
		(3.0944)
Competitive Aggressiveness (CA)		2.2758
		(8.1679)
Risk- Taking (RT)		8.0170**
		(5.2647)
Grew Up on Farms (GUF)	16.5847*	13.1965
	(8.9127)	(8.4706)
Level of Farm Experience (LFE)		5.9755
		(3.5981)
Gender (G)	14.7232***	13.7118***
	(4.3198)	(3.7688)
Age Range (AR)	2.2006	2.9405
	(3.9301)	(4.3077)
Class of Participant (C)	-24.0709***	-33.1382*
	(7.1986)	(17.6049)
Prob(F-statistic)	0.0010	0.0596

The estimated results of a multivariate panel regression model are presented in Table 5. The main focus of the analysis is the examination of the relationship between crop portfolio weighted risk index and the level of entrepreneurial orientation, it is of importance to note that the coefficient of independent variable EO turned out to be significant. The coefficient being positive and significant implies that risk of portfolio increases with the level of entrepreneurial orientation among our sample.

Table 6: **Results of Multivariate Panel Regression of Crop Diversification and Crop Yield Insurance**

Dependent Variables Independent Variables/Items	Estimated Coefficient/Values) *Crop Diversification* $(CE/_{CD})$	Estimated Coefficient/Values *Crop Yield Insurance (CYI)*
Constant	0.5421***	-3.6456***
	(0.0807)	(1.3298)
Level of Entrepreneurial Orientation (EO)	0.0261*	-0.1910
	(0.0192)	(0.2868)
Grew Up on Farms (GUF)	0.0469	0.5008
	(0.0508)	(1.2038)
Gender (G)	0.0017	0.8112
	(0.0142)	(0.7361)
Age Range (AR)	0.0453	0.1792
	(0.0345)	(0.5583)
Class of Participant (C)	-0.1651**	1.7729***
	(0.0637)	(0.5731)
Prob(F/LR-statistic)	0.0000	0.0001

The simulation game and the survey expose the view that, farmers with a higher level of entrepreneurial orientation are more likely to grow crops with higher price risks and higher yield risks. Thus, a higher level of EO positively influences CPWRI. This further emphasized that, the participants with high-level EO scores grew mainly high-risk crops. The coefficients for the entrepreneurial dimensions except risk-taking were statistically insignificant, however, all positive as expected. The coefficient of risk-taking (RT) is significant indicating that risk-loving participants grew high-risk crops or their crop choices mostly consist of high-risk ones such as chickpeas and red lentils. The coefficients of level of farm experience and the dummy variable for whether or not participants grew up on a farm were positive, but statistically insignificant. The results presented in Table 6 show that entrepreneurial oriented participants are more likely to use crop diversification as a risk mitigation strategy. On the contrary, entrepreneurial oriented participants are less likely to use crop yield insurance as coefficient is negative, however, statistically insignificant.

Findings and Discussion

The focus of the paper is the relationship between CPWRI and the level of EO. It is import to note that the coefficient of EO turned out to be significant. Being positive and significant implies that a higher risk index is associated with a higher EO score and vice versa. The coefficients for the entrepreneurial dimensions except risk-taking were statistically insignificant, however, but all positive as expected. The coefficient of risk-taking is significant indicating that risk-loving participants grew high-risk crops or their crop choices mostly consist of high-risk ones such as chickpeas and red lentils. The coefficients of level of farm experience and the dummy variable for whether or not participants grew up on a farm were positive, but statistically insignificant.

The results, therefore, reinforce confidence in previous empirical test on EO (see: Covin and Slevin 1989; Covin *et al.* 2006; Lumpkim and Dess 1996; Coulthard 2007; Hanson *et al.* 2007; Kimura *et al.* 2010; Kreiser and Davis 2010; Deligianni *et al.* 2015). The higher the CPWRI, the higher the EO score in general. Although the trend is strong, the results do not lead to the unequivocal conclusion as to whether participants' level of EO change over time. There may be several factors that would compel the participants to change their risk attitudes and managerial philosophies. Nevertheless, these were not observed as the participants completed the EO survey only once. In spite of this, the sign of the coefficient of EO came as expected and conformed to previous empirical tests on the relationship between EO and crop choices in general.

Among the independent variables, the coefficient of gender has come out to be statistically significant, whereas the coefficient of age was not significant. The coefficient for gender suggests that CPWRI is significantly higher in the male participants than in the female participants.

The sign of the estimated coefficient of the class taken and its significance level implies that the CPWRI is higher among participants in BPBE 320 class than those in BPBE 322 class. The result is an indication that participants in the BPBE 322 grow lower-risk crops and were less likely to use crop yield insurance as a risk mitigation strategy.

The coefficient of EO score is statistically significant and positive suggesting that crop diversification increases as the level of EO increases. Therefore, higher EO participants are less likely to use crop yield insurance, however, it is statistically insignificant. This confirms that participants with high levels of EO are more profit-oriented, more innovative, proactive, risk loving and less likely to rely on crop yield

insurance. The participants with high EO scores grew higher-risk crops and were more inclined to use crop diversification rather than crop yield insurance.

Similar results applied to the relationship between CPWRI and index of crop yield insurance was negatively correlated. Thus, crop yield insurance is used as a risk mitigation strategy. The negative relationship between the CPWRI and crop yield insurance signifies that crop insurance is a simple risk mitigation strategy.

The negative correlational relationship between the EO scores and crop yield insurance means that, whilst participants with a high EO scores are less likely to rely on crop yield insurance, participants with a low EO score are more likely to rely on crop yield insurance as a risk mitigation strategy.

Implications

If SaskSim actually reflects real world conditions, farmers with high EO scores would rather mitigate risk by diversifying their crop portfolio than by purchasing crop yield insurance. This has major implications for governments that subsidize crop insurance programs. Anecdotal evidence appears to indicate the entrepreneurial farmers tend to manage significantly larger than average farms and produce a significant proportion of the agricultural output (Brown, 2014). If these large farms tend not to use crop yield insurance for risk mitigation, governments should question whether the investment in these programs is warranted.

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