Farm Income Variability and Off-Farm Diversification in Canadian Agriculture

Simon Jetté-Nantel
Department of Agricultural Economics
University of Kentucky
Lexington, KY
Email: simon.jette-nantel@uky.edu

David Freshwater
Department of Agricultural Economics
University of Kentucky
Lexington, KY

Martin Beaulieu
Division of Agriculture
Statistics Canada
Ottawa, Ontario, Canada

Ani Katchova
Department of Agricultural Economics
University of Kentucky
Lexington, KY

Selected Paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting, Orlando, FL, February 6-9, 2010

Farm Income Variability and Off-Farm Diversification in Canadian Agriculture

Abstract

For a majority of farm families and operators in OECD countries, off-farm or non-farm occupations have become a significant source of income and a major determinant of their well being. This study investigates the use of off-farm employment as a risk management tool by farm operators. A two-part model is developed to estimate the impact of farm income risk on the decision to participate in the off-farm labour market and the level of off-farm employment income. Longitudinal farm level data for about 30,000 Canadian farms from 2001 to 2006 are used for this study. The variability of farm market revenue is found to positively affect the likelihood of off-farm work and the level of off-farm employment income, in particular for operators of larger commercial farms. The apparent ability of a significant number of operators of large farms to increase their resilience and coping capacity through off-farm employment income suggest the presence of substantial interactions between off-farm income and farm income stabilization policies. Consequently, the focus of agricultural policies on risk management and income stabilization reinforces the linkages between rural and agricultural policies. In particular, it appears that policies designed to facilitate access to off-farm work or to enhance off-farm opportunities, such as rural development programs, could contribute to achieve some objectives underlying agricultural income stabilization programs. These results reinforce the need for coherent rural and agricultural policies, and raises questions about the desirable balance between placed based rural policies and sector specific agricultural policies.

Introduction

Off-farm income[1] has become a major determinant of their well being for many farm families and operators across the OECD countries. In Canada, between 2002 and 2006 the share of farm operator's income originating from off-farm sources grew from 55% to 61.8% (Statistics Canada, 2006). Similar trends have also been observed in the U.S. (Mishra and Holthausen, 2002; Mishra and Goodwin, 1997) and Europe (OECD, 2006; Benjamin and Kimhi, 2006; Hennessy and Rehman, 2008).

The increasing importance of off-farm income in defining the welfare of farm households has significant implications for agricultural public policies. Gardner (1992, 2005) argued that off-farm income has been a factor in bringing farm household income to a comparable level with non-farm household, and contributed to the attenuation of sector-wide farm income problem. Lesser concerns with income levels lead to a refocus of the policy rationale on farm income variability. But, by reducing the variability of total income, off-farm income may also have important implications under this new policy rationale.

While off-farm income does not reduce farm income risk per se, using it to diversify a portfolio of income can improve the resilience and coping capacity of farm families and operators in facing farm income risk. And, if farm operators and families are able to diversify their resources in non-farm sectors, it appears sensible for them to take decisions based on a portfolio of income sources including farm and off-farm sources, rather than focusing only on farm income. Then, farm production decisions and household welfare are conditioned on the level and variability of total income, and not on farm income alone. In this case, the incidence of off-farm income is likely to affect public policy rationale and interact with policy tools in defining farm household welfare and production incentives.

The need, efficiency and impact of risk management policy is linked to the availability of private risk management mechanisms (OECD, 2009). It is well known that a policy meant to stabilize farm income is likely to interact with, and possibly crowd-out, private risk management mechanisms. In the longer term, this would possibly lessen the ability of the farm community to face market uncertainty autonomously. Hence, the extent to which framers' portfolio of income extends outside of the farm sector, and the risk mitigation capacity of off-farm income are likely to have an effect on the ability of agricultural policies to influence either framers' welfare or their production decisions.

But the interactions between off-farm income and agricultural farm income stabilisation policies depend in part on policy objectives as well as the characteristics of the farm families and operators to which off-farm diversification is accessible. To the extent that agricultural income stabilisation policies focus on commercial agriculture[2], which in most cases is dominated by larger farms,

[1] The term off-farm income is used here to designate the earned income (salaries, wages and self-employment), investment off the farm (including pension and social transfers), as well as income from non-farming activities which may take place on the farm holding of the operator or the family.

[2] Commercial agriculture is used here to design the farm population which are business

the linkages between off-farm income and these policies will depend more heavily on the accessibility of off-farm work to operators and families from larger farms. Conventional wisdom would suggest that larger farms face important farm labour constraints which would prevent operators from taking full advantage of off-farm opportunities. However, these operators may benefit from on-farm hired labour to gain flexibility and diversify their own labour off the farm. They may also have easier access to capital, enabling them to develop non-farm enterprises. The ability of operators of larger farms to manage risk through off-farm diversification is investigated in this study.

Properties of off-farm income as a risk management tool may also have implications for rural policies. In many OECD countries, the diminishing role of the primary agricultural sector in rural economies has raised concerns "about the effectiveness of agricultural policy as the predominant component of public policy for rural regions" (OECD, 2006, p.44), fueling the interest for integrated and place based rural development policies. In this context, the capacity of off-farm income in addressing farm income risk issues, which are central to agricultural policies in most OECD countries, would increase the interactions between rural development policies and agricultural policies, pointing towards additional benefits of rural policies for the agricultural sector.

Against this backdrop, this paper investigates the empirical evidence of off-farm portfolio diversification by farmers. As such, the paper objective is to contribute to the knowledge and understanding of recent structural changes in the primary agricultural sector, and their potential implications for both rural and agricultural policies. To achieve this goal a theoretical framework is used to derive implication of off-farm portfolio diversification by farmers. Information from that theoretical framework is then used to specify a two-part econometric model which estimates the impact of farm income risk on the decision to work off-farm and the level of off-farm income on Canadian farm-level data. The model first estimates the impact of farm income risk measures on the decision to work off-farm and in a second step the impact in the level of off-farm income is estimated. The study also provides information about the farm operators which appear to be better able to take advantage of off-farm employment income to manage farm income risk. Particular attention is given to differences across farm sizes and types. The following sections provide a literature review, a presentation of the theoretical framework, followed by a description of the empirical model and variables, and a review of results and potential implications.

Literature Review

Determinants of off-farm income

The extensive literature on off-farm labour supply and off-farm income provides many insights on farmers and farms that are more likely to have a positive off-farm income. This literature reports on the relationship between the characteristics of farms (e.g. type, size, business organization) and farmers (e.g. age,

oriented and for which farming income represents a significant share of their total income.

education, family size) and off-farm labour allocation. In terms of farmers' characteristics, the literature suggests that age has an inverted U-shape relationship with the likelihood of off-farm work; higher education increases the likelihood of working off-farm; and farming experience reduces the likelihood of off-farm work (Furtan, Van Kooten, and Thompson, 1985; Mishra and Goodwin, 1997; Howard and Swidinsky, 2000; Alasia *et al.*, 2007; El-Osta, Mishra, and Morehart, 2008).

Regarding farm characteristics, dairy farmers and to a lesser extent hog and vegetable farmers are identified as being less likely to work off the farm, while the reverse is true for grain and wheat farmers (Howard and Swidinsky ,2000; Alasia *et al.*,2007). Most studies also report that farm size, as would be expected, has a negative impact on the likelihood of off-farm work. This result appears to be invariant to the proxy used to measure farm size (e.g. gross sales, capital, acreage) (Mishra and Goodwin, 1997; Mishra and Holthausen, 2002; Howard and Swidinsky, 2000; Alasia *et al.*, 2007; El-Osta, Mishra, and Morehart, 2008).

The impact of farm location and regional characteristics has also been investigated in recent studies. Results are, however, not as robust and are sometimes unexpected. Intuition would suggest that population density is positively linked with a more dynamic labour market, thus increasing the likelihood of off-farm work. However, Howard and Swidinsky (2000) and Alasia *et al.* (2007) provide evidence that population density is negatively related to the likelihood of off-farm work. Similarly, distance to town or metropolitan areas has been found to be insignificant or to affect positively the likelihood of off-farm work, which is somewhat counterintuitive (Mishra and Goodwin, 1997; Alasia *et al.*, 2007; El-Osta, Mishra, and Morehart, 2008). But, Howard and Swidinsky (2000) found population density to increase the number of hours worked outside the farm.

Government program payments are reported to decrease the likelihood of off-farm work (Mishra and Goodwin, 1997; Howard and Swidinsky, 2000). To the extent that most payments are countercyclical and meant to stabilize farm income, the negative relationship with off-farm income may suggest that off-farm income is used as a substitute for program payments in an effort to manage farm income risk. This substitution effect would indicate the presence of perverse incentives or moral hazards linked to subsidized farm income stabilization programs.

Farm income risk and off-farm labour supply

While many authors refer to farm income risk as a key motivator leading farmers to work off-farm, the literature providing empirical assessment of the relationship between farm-income risk and off-farm labour allocation is limited. Data availability is likely the key factor explaining the limited number of empirical studies. In order to study farm income risk, farm level longitudinal data are more suitable; however, such data sets remain scarce. In fact, given the paucity of farm level data most studies had to rely on aggregated data, despite the limitations imposed by aggregation biases in risk measures (OECD, 2009). Mishra

and Goodwin (1997) is the only study found which uses farm-level data. Moreover, their study is based on a small sample which reduces the confidence with which these results can be generalized to the entire farm population.

Kyle (1993) was among the first to study the impact of farm income risk on off-farm income. Using state-level data from 1960 to 1986 and a standard linear regression, the study found that the share of off-farm income as a proportion of total income increased with the relative variability of net farm income. These early results were supported by the work of Mishra and Holthausen (2002). This later study used county-level data and a logit model to estimate the impact of farm and farmer characteristics such as age, farm size, off-farm wage, and income variability on the likelihood of off-farm work. Results suggest that variability in farm and off-farm income have a significant and positive impact on off-farm labour allocation decisions.

The role of off-farm income in reducing total farm household income variability was also studied by Mishra and Sandretto (2002). They examined the evolution of aggregate U.S. farm income and farm income variability between 1967 and 1999. Aggregated data at the national level were used to perform an analysis based on the variance, covariance of income components over time, including farm income, and off-farm income. The authors concluded that off-farm income has played an important role in reducing total income variability.

In terms of farm-level study, Mishra and Goodwin (1997) investigated the determinants of off-farm income for 300 Kansas farms. Farmers and their spouses were asked to report 10 years of on- and off-farm income (1981-1991) as well as various demographics (e.g. education, experience, distance to town, and family size) and farm characteristics (e.g. size based on acreage, leverage, program payments). Given that farms without off-farm income represented a significant share of the sample, a tobit model was used to address data censoring issues. Results indicate that higher farm income variability increases the likelihood of having off-farm income. To our knowledge, their study is the only one estimating the impact of farm income risk on off-farm work based on farm-level data.

The tobit model used by Mishra and Goodwin (1997) implicitly assumes that farm income variability has the same impact on deciding whether or not to work off-farm and choosing the amount of off-farm labour. This assumption may not be appropriate. In fact, in their study of off-farm labour supply Howard and Swidinsky (2000) rejected the tobit specification in favour of a more general two-part model. They also found that diverse explanatory variables such as age, spouse's income, and population density can have inverse effects on off-farm labour market participation and the number of hours supplied.

This study takes advantage of a farm-level longitudinal taxation data set developed by Statistics Canada and investigates the impact of farm income risk as an explanatory factor for off-farm labour allocation. The farm-level data also allows us to explore the robustness of this relationship across farm typologies and size, which has not been explored by previous studies. While farm income risk may be of greater significance for operators of larger farms as it tends to represent a higher proportion of their total income, these operators also face

greater labour constraints which may prevent them from taking advantage of off-farm opportunities. This question is addressed in this study by comparing the results for five different farm typologies including hobby/pension farms and commercial farms of different size. A two-part model is developed to address data censoring issues and to assess the impact of farm income risk on both the decision to participate in the off-farm labour market and the quantity of labour supplied.

Theoretical Framework

In this section a model of farm labour allocation decision under uncertainty based on standard expected utility theory is used to investigate the implications of making decision based on a portfolio of income sources instead of focusing solely on farm income. Following Mishra and Goodwin (1997) and Mishra and Holthausen (2002), farmers are assumed to have a utility function U which depends on income (π) and leisure time (l) from which we can derive the optimal labour allocation decision under uncertainty.

$$U(\pi, l)$$

The income function is defined as:

$$\begin{gathered}
\pi = F(H, X_o, X_f, \epsilon_f) + G(\bar{F}, \epsilon_g) + I + OFI(L, R, X_o) \\
F(H, X_o, X_f, \epsilon_f) = \bar{F}(H, X_o, X_f)(1 + \epsilon_f) \\
G(\bar{F}, \epsilon_g) = g\bar{F}(H, X_o, X_f)(1 + \epsilon_g) \\
\begin{bmatrix} \epsilon_f \\ \epsilon_g \end{bmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_f^2 & \rho\sigma_f\sigma_g \\ \rho\sigma_f\sigma_g & \sigma_g^2 \end{bmatrix} \right)
\end{gathered}$$

Where F is farm income, which is defined by the labour allocated to farm enterprises (H), and vectors of farm characteristics (X_f) and operator's characteristics (X_o). Farm income is assumed to be stochastic and depends on the error term which reflects factors outside of the farm operator's control. G is government payments and is a constant share g of expected farm income $\bar{F}$ and varies with the error term ϵ_g. The two error terms are assumed to follow a bivariate normal distribution with correlation factor ρ defining the stochastic relationship between F and G. Given the predominance of income stabilization stabilizing policies, one would expect the correlation coefficient ρ to be negative.

Off-farm income includes investment income I, and off-farm employment income (OFI) which depends on off-farm labour supply (L), a vector of operator's characteristics (X_o) and a vector of regional socio-economic factors (R) affecting the regional labour market. In general, one would expect off-farm employment income to be substantially more stable and predictable then farm income. Consequently, it is modeled as being deterministic.

Assuming a constant absolute risk aversion (CARA) utility function, the problem can be reformulated as a mean-variance optimization problem with risk aversion factor α. [3]

$$\max_{H,L} \ \pi^e(H, X_o, X_f, L, R) - \frac{\alpha}{2} V(\pi(H, X_o, X_f, L, R, \epsilon_f, \epsilon_g)) \tag{1}$$

Where the expected income is defined as:

$$\pi^e(H, X_o, X_f, L, R) = (1+g)\bar{F}(H, X_o, X_f) + I + OFI(L, R, X_o)$$

And the variance is:

$$\begin{aligned} V(\pi) &= V(F) + V(G(\bar{F})) + 2Cov(F, G) \\ &= \bar{F}^2\sigma_f^2 + \bar{F}^2 g^2 \sigma_g^2 + 2\rho\bar{F}^2 g\sigma_f\sigma_g \end{aligned}$$

Given a fixed allocation of time to leisure such that the total hours spent on-farm, H, and the amount of time spent working off-farm, L, add up to a fixed constant T (i.e. $H = T - L$), we can optimize with respect to farm labour (H) and get the following first order condition:

$$FOC \Rightarrow \bar{F}_H(1+g) - \bar{F}_H\alpha\left(\bar{F}\sigma_f^2 + \bar{F}g^2\sigma_g^2 + 2\bar{F}g\rho\sigma_f\sigma_g\right) = OFI_L$$

This condition simply states that the certainty equivalent marginal return to farm labour should equal the deterministic off-farm labour return.

And the second order condition is:

$$SOC = \bar{F}_{HH}\left((1+g) - \alpha\bar{F}\left(\sigma_f^2 + g^2\sigma_g^2 + 2g\rho\sigma_f\sigma_g\right)\right)$$
$$-\bar{F}_H^2\alpha\left(\sigma_f^2 + g^2\sigma_g^2 + 2g\rho\sigma_f\sigma_g\right) + OFI_{LL} < 0$$

From there one can differentiate the first order condition to obtain the implied relationship between different parameters and the decision variables. Given the interest in farm income variability impacts on off-farm diversification, the FOC is totally differentiated with respect to farm income variability and farm labour to get:

$$\frac{dH}{d\sigma_f^2} = -\frac{dL}{d\rho} = \alpha\bar{F}_H\left(\frac{\bar{F}\sigma_f + \rho\bar{F}g\sigma_g}{\sigma_f SOC}\right) \ \begin{matrix} \leq \\ > \end{matrix} \ 0 \tag{2}$$

This expression is ambiguous and would be positive given the expected negative correlation ρ between farm income and government payments. However, for the relationship between farm labour and farm income variability to be positive it would require the standard deviation of farm income ($\bar{F}\sigma_f$) to be smaller than the standard deviation of government payments times the correlation coefficient

[3] This is a standard result stemming from the particular characteristics of the CARA utility function and the normality of disturbance terms.

$(\rho g \bar{F} \sigma_f)$. Our data suggest that the average correlation coefficient is between -.17 and -.33 (see table 3), and while policy risk has been acknowledged as a significant source of risk in some cases, its dominance over farm market income risk is not believed to be a widespread situation within the farm population. Hence, in general one would expect farm income variability to have a negative relationship with farm labour and given a binding labour constraint it would also imply a positive relationship with off-farm labour supply.

A second variable of interest to the relationship between farm income risk and off-farm diversification is the correlation coefficient ρ . Differentiating the FOC suggest a negative relationship between farm labour and correlation between farm income and government payments. This simply states that the income stabilizing effect of government payments stimulates investment of resources in farm activities.

$$\frac{dH}{d\rho} = -\frac{dL}{d\rho} = \alpha \bar{F}_H \left(\frac{\bar{F} g \sigma_g \sigma_f}{SOC} \right) < 0 \tag{3}$$

Empirical Model

To test some of the implications derived from the theoretical framework presented in the previous section, an empirical model of off-farm employment income is specified. Specifically, off-farm income is defined as a function of the different factors affecting the labour allocation decision. Following previous literature, the regressors include farm and farm operator characteristics, government payments, and regional socio-economic indicators. The account for farm income risk, farm income variability and correlation between farm income and government payments are also included.

The empirical model is estimated using a two-part model which relaxes some constraints implicit in a tobit model used in previous literature. The two-part model allows one to first estimate the impact of farm income risk on the choice of working off the farm, and then to estimate the impact of farm income risk on the magnitude of the off-farm employment income among the population of operator that work off the farm.

$$OFI = f\left(\mathbf{x} = \left\{\sigma_f^2, \rho, g, X_o, X_f, R\right\}\right)$$

Step One: Selection regression

The first step of the two-part model is a probit model relating farm characteristics as well as regional economic and demographic indicators to the choice of working off the farm or not. The model estimates the impact of explanatory variables on the probability to participate in off-farm employment.

To specify the probit model a latent variable z* is defined and can be thought of as representing the net benefit from off-farm work evaluated at L=0.

$$z^* = -FOC\,|_{L=0} = \left[OFI_L - \bar{F}_H(1+g) + \bar{F}_H\alpha\left(\bar{F}\sigma_f^2 + \bar{F}g^2\sigma_g^2 + 2\bar{F}g\rho\sigma_f\sigma_g\right)\right]_{L=0}$$

This unobserved variable is assumed to relate linearly to a set of explanatory variables x and an error term u.

$$z_i^* = \mathbf{x}_i^{'}\gamma + u_i$$

Given that off-farm employment benefits are high enough to induce off-farm work, a positive off-farm employment income will be observed such that:

$$z = \begin{cases} 1 & \text{if } z^* > 0 \\ 0 & \text{if } z^* \leq 0 \end{cases}$$

$$P(z_i^* > 0|\mathbf{x}) = P(z_i = 1|\mathbf{x}) = P(u < \mathbf{x}'\gamma|\mathbf{x}) = \Phi(\mathbf{x}_i'\gamma)$$

Assuming that the error term u follows a normal distribution, Φ is the cumulative normal distribution function.

And the loglikelihood function is

$$L(\gamma)^* = \sum_{i=1}^{N} z_i ln\left(\Phi(\mathbf{x}_i'\gamma)\right) + (1-z_i) ln\left(1-\Phi(\mathbf{x}_i'\gamma)\right)$$

Step Two: Outcome regression

The second step of the model is a least square regression relating farm characteristics and location as well as regional economic and demographic indicators to the log of off-farm income.

$$ln(OFI) = \mathbf{x}'\beta + \epsilon, \quad E(\epsilon|\mathbf{x}) = 0$$

The set of regressors do not have to be the same in the two steps of the model, but given the lack of a priori theoretical reasons to reject a regressor from the second or first step, all regressors are kept for both steps. However, the model allows coefficient estimates to vary between step one and two of the model.

It is important to note that in contrast to other sample selection models such as Heckman models, the two-part model does not allow to obtain unbiased estimates on the effect of regressors on the level of off-farm income for the entire population. The estimates from the two-part model are restricted to the actual population of farm operators which reported off-farm income. However, two-part models are more robust than Heckman models as they do not require distributional assumptions. The absence of exclusion restrictions, as is the case for the current study, also contributes in making the two-part model more robust than the Heckman model. Most importantly, although they cannot be extended to the entire farm population, the estimates from the two-part model

allow us to gain important insights regarding the behavior of farmers actually engaged in off farm work.

Finally, the log-linear structural form is selected based on the skewness of off-farm income distribution. To confirm that choice, Box-Cox regressions are performed. The Box-Cox regressions are specified as follows:

$$\frac{OFI^{\theta}-1}{\theta} = \mathbf{x}'\beta + \epsilon, \quad \epsilon \sim N(0,\sigma^2)$$

An estimate of θ close to 0 would support the use of the log-linear structural form, while $\hat{\theta}$ would support the use of an ordinary least square model without transformation of the dependent variable.

Variables selection and data description

This study uses a longitudinal farm operator data developed by Statistics Canada using income tax data from individuals reporting positive gross farm income and corporate entities that are classified as farms.[4] The database contains farm operator longitudinal data for more than 30,000 farm operators in Canada for the years 2001 to 2006, and was designed to be representative of the 2001 Canadian farm operator population. In this study only farm operators reporting an average of $10,000 or more in farm market revenues are considered, leaving 31,305 farm operators in the sample. The data set provides detailed information on all sources of off-farm income as well as farm revenues and expenses. Information about farm production type (e.g. dairy, grain, beef), is also provided in the data set as well as the location of each farm (i.e. census division and subdivision of farm headquarters). This spatial reference allows us to complement the data set with additional socioeconomic information from the Census of Population that takes place every five years.

To investigate potential differences across farm size and type, the sample of operators of unincorporated farms was divided along five different farm typologies (see Table 1). The non-commercial farms were divided into two groups; a low-income category included farm operators with less than $25,000 in total income and less than $50,000 in farm market revenues. The other category of non-commercial farms is the hobby/pension category which included farm operators with less than $50,000 in farm market revenues and more than $50,000 in total off-farm income. Commercial farms were divided into three groups according to their size. The small and medium category included farm operators reporting an average of $100,000 or less in farm market revenues. The large category included farm operators reporting between $100,000 and $500,000 in farm market revenues while the very large category included farm operators reporting more than $500,000 in farm market revenues.

Table 1 Farm Typology for Operators of Unincorporated Farms

[4] The details on data sources and sampling methodology are provided in Statistics Canada (2008).

Table 1 Typology for Unincorporated Farms

Non-commercial	
Hobby/Pension	Includes all farms which earned less than $50,000 in average annual farm market revenues, and more than $50,000 in annual total off-farm income, while maintaining an average total operator income[1] above $25,000.
Low-Income	Includes farms which earned less than $25,000 in total income annualy, and generated less than $50,000 in annual farm market revenues.
Commercial [2]	
Small	Farms with average farm market revenues of less than $100,000/yr
Large	Farms with average farm market revenues between $100,000/yr and $500,000/yr
Very large	Farms with average farm market revenues of more than $500,000/yr

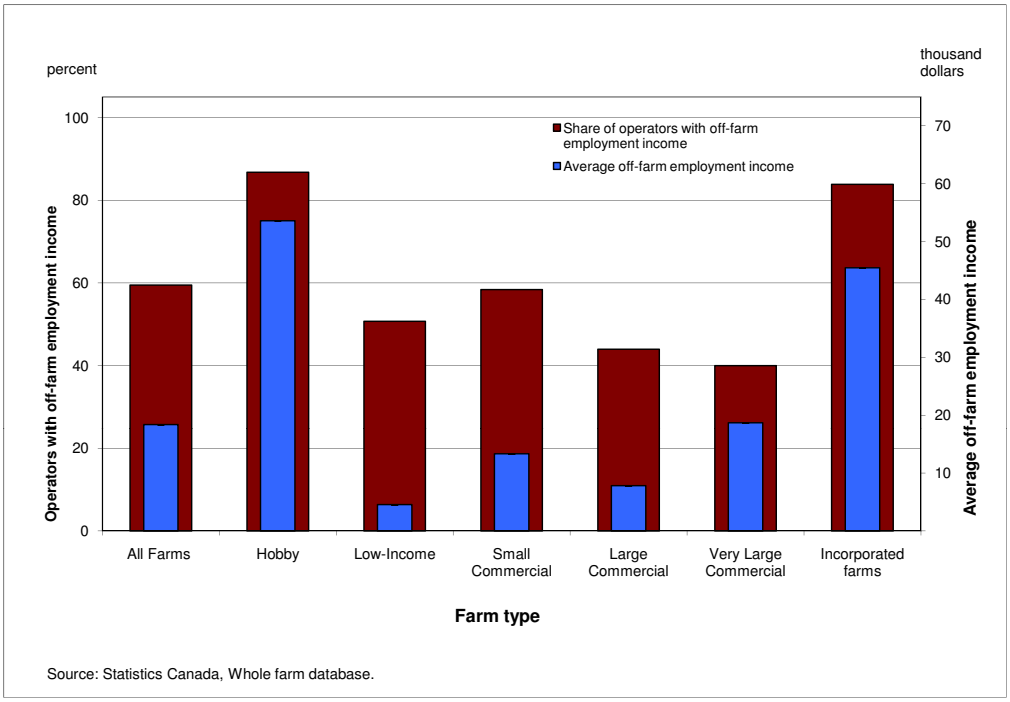
1- Total operator income includes off-farm income from all sources and net farm income including government payments.
2- Farms are classified as commercial only if they are excluded from non-commercial categories.
Note: All criteria are evaluated based on the 2001 to 2006 averages.

Off-farm income in Canada between 2001 and 2006

The dependent variables used in the empirical model are defined based on the farm operator off-farm employment income averaged over the period 2001 to 2006 (see Table 2). Off-farm employment income refers to income from wages and salaries, and self-employment, and excludes investment or pension income. This distinction allows us to focus on the ability of farm operator to diversify their labour allocation towards non-farm activities. This distinction is important to allows us to delineate the potential interactions between rural and agricultural stabilization policies. While off-farm investment can also contribute to income stabilization, its linkage with local economic conditions and policies are much weaker as one can easily invest in stocks or assets just about anywhere in the world. However, opportunities to allocate labour to non-farm activities are likely to be linked more tightly to local or regional economic conditions.

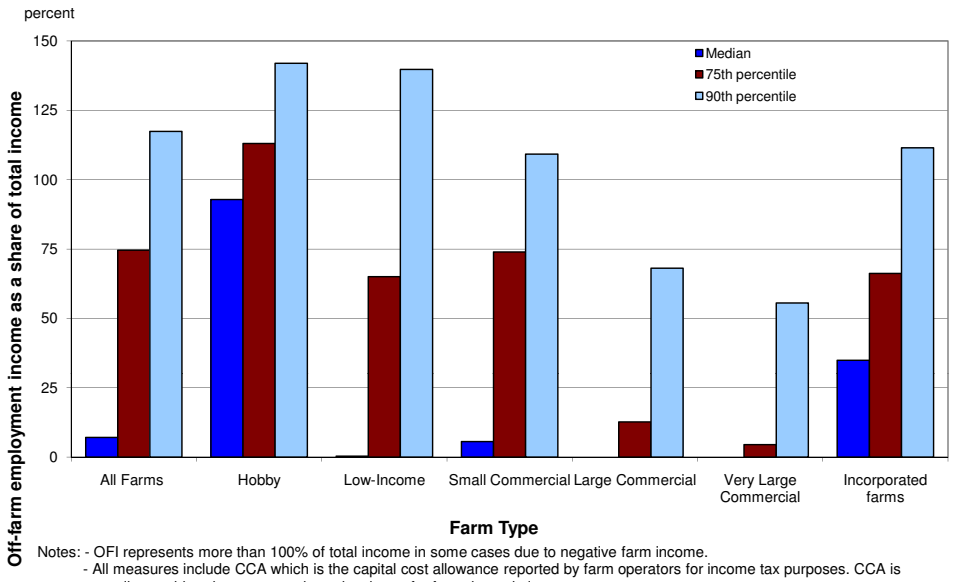
The first step of the empirical model, the probit model, uses a binary variable which takes a value of one if average operator off-farm employment income is positive and zero otherwise. The data in Figure 1 show that almost 60% of farm operators earned off-farm employment income in the form of wages or self employment during the 2001 to 2006 period. Looking at operators of unincorporated farms, the data show that operating a smaller unincorporated farm increases the likelihood that the operator earns off-farm income compared to larger ones, likely reflecting farm labour constraints. But the percentage of operators with off-farm employment remains above 40% among operators of the largest farms, suggesting that off-farm income is important for farms of all sizes. This statistic is employment revenues is also very high among operators of incorporated farms, reaching 80%. Since incorporated farms tend to be larger, it is rather unexpected that these farms show a very high reliance on off-farm income sources. This could, however, be explained by the unique ability of operators of incorporated farms to transfer part of the farm income in the form of salaries paid to themselves (which is included as off-farm income for tax purposes and

Figure 1: Farm operators' off-farm employment income, Canada, 2001 to 2006



Source: Statistics Canada, Whole farm database.

Figure 2: Off-farm employment income as a share of operator's total income, Canada, 2001 to 2006



Notes: - OFI represents more than 100% of total income in some cases due to negative farm income.
- All measures include CCA which is the capital cost allowance reported by farm operators for income tax purposes. CCA is usually considered as an upper bound estimate for farm depreciation costs.

Source: Statistics Canada, Whole farm database.

could contribute to inflate off-farm income statistics for this category of farm)[5]. Note that this limitation of the data does not apply to unincorporated farms and, for this reason, operators of incorporated and unincorporated farms are treated separately in the study.

Average off-farm employment income is used as the dependent variable in the second part of the econometric model. Figure 1 shows that, operators earned on average $18,371 per year in off-farm wages and self employment income. Once again hobby/pension farmers rely most heavily on off-farm income showing an average $53,611 per year. Figure 1 also shows that operators of very large commercial farms earned $18,679 per year in off-farm employment income on average, which is higher than for their smaller counterparts. This would further supports the idea that off-farm work has become a significant source of income even for operators of the larger farms.

Figure 2 provides a more detailed picture of the distribution of off-farm employment income among each farm typology by showing the relative importance of these sources. First, statistics for median farms indicate that off-farm employment income represented 7.1% of total income of farm operators. It also represented 74.6% of total income for one farm operator out of four (75th percentile). For many unincorporated non-commercial and small commercial farmers, the share of total income coming from off-farm wages and self employment is larger than 100%, reflecting the fact that many of them face negative net farm income. Among operators of larger unincorporated farms, off-farm employment income represented 4.5% or more of total income for at least 25% of these operators (75^{th} percentile), and it is the primary source (55.5%) of income for at least one operator out of ten (90th percentile). Overall, the data indicate that off-farm work is of economic importance formost farm types and sizes.

Explanatory variables

Summary statistics for all explanatory variables are presented in Table 2. Farm income risk is the key explanatory variable in this study. The longitudinal aspect of the data set allows us to define different measures of farm income risk. The coefficient of variation (CV) was chosen as a proxy for farm income risk, because a normalized measure of variability allows for comparison across farm size. A natural candidate would have been to use the coefficient of variation of farm income. However, since the sample contains a large number of observations with negative average farm income, it is not possible to use CV as a measure of farm income risk for the entire sample. Instead the coefficient of variation of farm market revenues is used. It is expected that most of the income fluctuation will be due to changes in revenues and, therefore, this measure should provide a good proxy for farm income risk. The sample statistics show that farm market revenue is quite volatile with a CV between 26% and 43%. This measure of risk decreased with farm size and was lower for operators of incorporated farms. This suggests that larger and incorporated farms may have greater incentives to manage farm revenue risk and/or may be in a better position to take advantage

[5]It is not currently possible to easily identify if the source of the operator salaries and wages is from his/her incorporated farm or from another enterprises.

of some risk management tools to stabilize farm market revenues.

Program payments and their stabilization effect are also expected to affect farm income risk and the decision to work off-farm. Data on program payments include provincial program payments, disaster assistance payments, crop insurance revenues, and payments from the Canadian Agricultural Income Stabilisation program. The correlation between program payments and farm income is obtained for the 2001 to 2006 period. As expected, program payments are negatively correlated with net farm income. The negative relationship is more pronounced for larger commercial farms, signaling a higher stabilization effect of program payments for these operators.

To measure the relative importance of program payments for each farm operator, the mean program payments received over the 2001-2006 period expressed as a percentage of total farm revenues was used. This relative measure allows for easier comparisons across farm size. The sample suggests that Canadian farm operators received on average slightly more than 15% of their revenues from program payments. Operators of very large unincorporated farms were relying the least on program payments, in relative terms, as it accounted on average for 9.2% of the farm revenues. However, these operators also received the highest average program payments in absolute value ($74,280).

Net operating income is also expected to influence off-farm income. Large differences exist in net operating farm income across farm sizes and types. Operators of incorporated farms averaged $42,620 in net operating farm income compared to $72,260 in average loss for very large unincorporated farms. Farm size was measured by the average farm market revenues over the period 2001 to 2006. Size variation (measured by CV) within farm typology was especially pronounced for the larger unincorporated farms and incorporated farms.

Another key variable affecting the farm labour constraint was the farm production type, based on the main farm enterprise. The binary variables included in the model are determined by the contribution of different enterprises to farm revenues. To be classified in any given farm type, the enterprise must account for at least 50% of the farm market revenues. The most frequent farm types in the sample were grain and oilseeds, and beef, accounting for 36.3%, and 29.9% respectively. Among other types, dairy accounted for 11% of farm operators, other crops for 6.7%, and each of the other production types represented 5% or less of the sample.

The last farm characteristic introduced in the model was the regional farmland value. This variable was included as a proxy for farm productivity which, according to the theoretical framework, may affect the value of farm labour and in the decision to work off-farm. To the extent that land values reflect land rent, it should provide an indicator of farm productivity which in turn may provide information on farm labour productivity. Farmland value was defined for each census division using data from farmland transactions between 1996 and 2006 obtained from the Farm Credit Canada (FCC).

Operator characteristics

Table 2 Summary Statistics - Explanatory Variables, Canada (average 2001 to 2006)

		Unincorporated farms					
	All Farms	Hobby	Low-Income	Small	Large	Very Large	Incorporated farms
Farm Income Risk							
CV[1] of farm market revenues(log)	3.55	3.75	3.77	3.62	3.26	3.34	3.27
	(0.72)	(0.6)	(0.64)	(0.69)	(0.71)	(0.77)	(0.81)
Correlation (NFI, Gov't payments)	-0.24	-0.17	-0.19	-0.24	-0.33	-0.31	-0.21
	(0.48)	(0.45)	(0.47)	(0.48)	(0.48)	(0.49)	(0.47)
Farm Characteristics							
Farm size($1,000)	155.85	23.58	24.33	51.64	186.18	1033.92	711.73
	(1 101.0)	(11.02)	(11.05)	(26.14)	(83.3)	(1 569.4)	(3 170.7)
NOFI ($1,000)	7.23	-4.64	-2.24	3.47	14.05	-72.26	42.62
	(107.13)	(12.25)	(10.99)	(16.42)	(38.71)	(614.87)	(245.59)
Program payments	15.41	14.40	17.39	17.22	12.78	9.15	12.85
	(17.85)	(18.55)	(22.43)	(18.28)	(11.67)	(12.44)	(14.74)
Farmland value($1,000/ac)	1.70	1.93	1.55	1.58	1.59	2.13	2.25
	(2.27)	(2.52)	(2.11)	(2.09)	(2.07)	(2.53)	(2.95)
Production type				percent			
Grain and Oilseed	36.33	36.96	29.61	41.96	38.34	15.09	29.82
Potato	0.67	0.30	0.29	0.47	0.67	3.19	2.11
Other Vegetable	1.23	0.05	1.46	1.07	1.03	1.80	2.30
Fruit and Nut	2.27	3.05	2.23	2.58	1.16	0.61	2.83
Greenhouse/Nursery	1.69	1.00	0.98	1.38	1.28	2.56	5.34
Other Crop	6.66	8.74	9.06	6.72	3.32	2.68	6.44
Beef	29.88	37.38	41.85	30.08	22.05	42.46	13.12
Dairy	10.90	0.69	4.43	9.08	21.14	8.76	19.50
Hog	3.19	0.58	1.73	2.19	4.94	11.98	7.38
Poultry	2.17	0.77	0.88	0.55	3.77	6.27	7.53
Other Animal	5.01	10.46	7.48	3.90	2.29	4.62	3.64
Operator Characteristics							
Age (2001)	50.24	49.84	52.25	51.62	46.59	47.18	49.65
	(13.35)	(13.68)	(14.48)	(14.02)	(11.54)	(10.93)	(10.41)
Pension/Inv. income ($1,000)	22.23	54.23	9.69	16.09	17.32	34.70	41.74
	(78.66)	(117.63)	(10.01)	(31.57)	(73.09)	(195.67)	(151.45)
Socioeocnomic Characteristics							
Pop. density(2001) (pers./km^2)	174.86	238.36	157.02	177.63	150.35	161.48	185.47
	(311.59)	(428.55)	(278.44)	(303.22)	(247.91)	(292.48)	(358.09)
Employment rate (2001) (percent)	63.48	64.64	62.52	63.49	63.61	64.37	63.84
	(10.58)	(9.95)	(13.7)	(10.75)	(10.66)	(9.44)	(9.45)
Statistical Area Classification (SAC)				percent			
Census Metropolitan Area	14.19	22.32	12.87	13.01	12.04	12.90	16.60
Census Agglomeration	11.32	16.78	9.29	10.96	9.76	15.02	13.53
Strong MIZ	13.48	11.95	12.71	12.98	14.76	15.91	15.39
Moderate MIZ	25.79	18.53	27.78	25.47	28.29	27.48	25.23
Weak MIZ	22.87	20.45	24.67	24.45	21.86	20.40	19.12
No MIZ	9.26	7.10	9.33	10.19	10.65	5.56	6.11
Unidentified SAC	3.08	2.88	3.34	2.95	2.64	2.74	4.02
Number of observations	31305	1063	2700	5983	9042	1461	11056
Sum of weights	218781	23776	46092	75885	46085	2302	24640

Note: Standard deviations are provided in parentheses.

1- CV= coefficient of variation

Source: Statistics Canada, Whole farm database

Individual operator characteristics have been found to be key determinants of off-farm labour supply in the previous literature. In this study, the age of the operator as of 2001 was included. Alasia *et al.* (2007) reported evidence of a non-linear relationship between off-farm labour supply and age. Following their findings, a quadratic term was included in the model. Pension and investment income was also provided for each farm operator. This included off-farm income other than salaries, business income, self-employment income or professional income. Taxable capital gains were included in pension and investment income. To the extent that these sources of income provide alternative diversification opportunities they are expected to affect off-farm income decisions.

Socio-economic characteristics

The socio-economic environment is expected to affect the off-farm opportunity cost of labour. Several variables were used to define the socio-economic environment, including population density, employment rate and the statistical area classification (SAC). The population density was defined for each census consolidated subdivision and has an average of 175 persons per square kilometre. The employment rate variable was defined for each census subdivision and reflected the percentage of the labour force aged 15 years old and over which was employed. The average employment rate was 63.5%[6] . It is expected that a higher population density and a higher employment rate would indicate a more dynamic labour market, greater off-farm opportunities and higher wages in the off-farm sector.

The other socio-economic variables were based on the SAC which reflects the urban influence on the local labour market. The first two classes of the SAC are the census metropolitan areas (CMA) and the census agglomerations (CA) both of which indicate urban areas, with the CMAs usually containing more densely populated urban core than the CAs. The four other classes, the Metropolitan Influenced Zones (MIZ), are based on the percentage of workers within the census sub-division which commute to urban areas (a CMA or a CA)[7]. A majority of farm operators within the sample are located in rural areas with less than 30% of their workers commuting to urban regions. However, the data suggest that a particularly large concentration of operators of hobby/pension farms was found in urban regions. This distribution of hobby/pension farm operators may be explained by the greater opportunities for off-farm work. For about 3% of the observations the SAC variables could not be obtained. To avoid losing these

[6]The total labour force, as defined by Statistics Canada, includes all members of the population 15 years of age and over, excluding institutional resident (i.e. person living in an institution, such as a hospital or a jail. This measure contrast with standard US measure of the labour force which only accounts for people employed or actively looking for a job.

[7]The four MIZ classes are defined as follows:

- Strong MIZ: at least 30% of the municipality's resident employed labour force commute to work in any CMA or CA
- Moderate MIZ: at least 5%, but less than 30% of the municipality's resident employed labour force commute to work in any CMA or CA.
- Weak MIZ: more than 0%, but less than 5% of the municipality's resident employed labour force commute to work in any CMA or CA
- No MIZ: fewer than 40 or none of the municipality's resident employed labour force commute to work in any CMA or CA.

Table 3 Regional distribution of farms - Canada, 2001

	All Farms	Unincorporated farms					Incorporated farms
		Hobby	Low-Income	Small	Large	Very Large	
Region				percent			
Atlantic Provinces	2.52	2.20	2.94	1.86	2.54	5.77	3.72
Quebec	13.67	5.70	12.55	12.55	14.65	14.22	25.05
Ontario	22.90	26.81	22.97	22.16	22.51	24.98	21.78
Manitoba	9.26	5.20	11.38	8.50	11.98	9.54	6.42
Saskatchewan	23.12	21.12	23.20	26.22	23.52	10.23	15.79
Alberta	23.38	31.34	21.22	24.11	21.70	29.99	19.99
British Columbia	5.15	7.63	5.74	4.59	3.10	5.25	7.24
Canada	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Statistics Canada, Whole farm database

observations a value of zero was imputed for the SAC variables and a dummy variable was included to account for these missing observations.

Finally, the sample distribution across Canadian regions is also reported in Table 3. A majority of operators in the data set were located in western provinces, i.e. Manitoba, Saskatchewan, and Alberta.

Results

The first two models that were estimated include all incorporated and unincorporated farms within the sample. Model 2 differs from model 1 by adding interaction terms for each region and for incorporated farms. This allows one to test the different impact of farm income risk variables across regions and between incorporated and unincorporated farms. The estimated marginal effects from the probit model as well as the regression coefficients from the log-linear model are presented in Table 4. The Box-Cox test results are also reported and the estimates of 0.21 support the use of a log-linear functional form for the second step of the two-part model.

Farm characteristics

As would be expected, farm size was inversely related with the level of earned off-farm income. However, operating a larger farm was found not to affect the likelihood of off-farm work. Moreover, the impact on the level of off-farm employment income was very small; an increase of $100,000 in average farm market revenue would reduce the expected off-farm employment income by 1%. This suggests that as farm size increases, operators manage to overcome farm labour constraints by using hired labour on the farm.

To obtain a better understanding of the use of off-farm employment income across farm typologies and farm size the model was estimated on subgroups of

Table 4 Results - Including all farms, Canada (2001 to 2006)

	Model 1			Model 2		
	Probit		Log-linear	Probit		Log-linea
	Coefficient	Marginal Effect	Coefficient	Coefficient	Marginal Effect	Coefficier
Farm Income Risk						
CV of farm market rev. (log)	0.136	0.052 ***	0.049	0.184	0.071 ***	0.171
	(0.018)	(0.007)	(0.032)	(0.041)	(0.016)	(0.078)
Correl. (NFI, Gov't payments)	0.129	0.050 ***	0.033	0.017	0.007	-0.128
	(0.029)	(0.011)	(0.052)	(0.074)	(0.029)	(0.141)
Farm Characteristics						
Farm size ($1,000)	0.0000	0.0000	0.0001 ***	0.0000	0.0000	0.0001
	(0.0000)	(0.0000)	(0.00004)	(0.0000)	(0.00001)	(0.00004)
NOFI ($1,000)	-0.0002	-0.0001 ***	0.0000	-0.0002	-0.0003 ***	0.0000
	(0.00008)	(0.00003)	(0.0002)	(0.00008)	(0.00013)	(0.00017)
Program payments	-0.0016	-0.0006 **	-0.0045 ***	-0.0016	-0.0008 **	-0.0045
	(0.0008)	(0.0003)	(0.0014)	(0.0008)	(0.0003)	(0.0014)
Farmland value($1,000/ac)	0.0059	0.0000	0.0346 ***	0.0059	0.0000	0.0346
	(0.0061)	(0.0000)	(0.0099)	(0.0061)	(0.0000)	(0.0099)
Production type						
Grain and Oilseed (base)						
Potato	0.265	0.098 *	0.047	0.083	0.032	-0.386
	(0.147)	(0.051)	(0.289)	(0.175)	(0.065)	(0.29)
Other Vegetable	-0.379	-0.150 ***	-0.423 **	-0.477	-0.188 ***	-0.661
	(0.09)	(0.036)	(0.184)	(0.097)	(0.038)	(0.179)
Fruit and Nut	0.097	0.037	-0.148	0.062	0.024	-0.176
	(0.118)	(0.044)	(0.201)	(0.126)	(0.048)	(0.207)
Greenhouse/Nursery	-0.145	-0.057	0.078	-0.333	-0.131 ***	-0.326
	(0.095)	(0.038)	(0.153)	(0.10)	(0.04)	(0.151)
Other Crop	0.023	0.009	0.043	-0.007	-0.003	-0.005
	(0.056)	(0.021)	(0.101)	(0.059)	(0.023)	(0.104)
Beef	-0.031	-0.012	0.061	-0.016	-0.006	0.094
	(0.034)	(0.013)	(0.058)	(0.036)	(0.014)	(0.062)
Dairy	-0.631	-0.248 ***	-0.885 ***	-0.768	-0.299 ***	-1.293
	(0.041)	(0.015)	(0.081)	(0.049)	(0.018)	(0.09)
Hog	-0.213	-0.084 ***	-0.380 ***	-0.376	-0.148 ***	-0.702
	(0.056)	(0.022)	(0.108)	(0.063)	(0.025)	(0.112)
Poultry	0.044	0.017	0.064	-0.203	-0.080 **	-0.435
	(0.086)	(0.033)	(0.117)	(0.102)	(0.041)	(0.115)
Other Animal	-0.004	-0.001	0.193	-0.019	-0.007	0.148
	(0.076)	(0.029)	(0.12)	(0.079)	(0.031)	(0.123)
Operator Characteristics						
Age (2001)	0.074	0.029 ***	0.157 ***	0.069	0.026 ***	0.147
	(0.007)	(0.003)	(0.014)	(0.007)	(0.003)	(0.014)
Age squared	-0.0011	-0.0004 ***	-0.0020 ***	-0.0011	-0.0004 ***	-0.0020
	(0.0001)	(0.00)	(0.0002)	(0.0001)	(0.00)	(0.0002)
Pension/Inv. income ($1,000)	0.0034	0.0013 ***	0.0024 ***	0.0027	0.0010 ***	0.0019
	(0.0005)	(0.0002)	(0.0004)	(0.0004)	(0.0002)	(0.0003)

Note: Standard deviations are provided in parentheses.

* significant at the 10% level; ** significant at the 5% level;*** significant at the 1% level

For the probit model the significance level is based on resulst for the coefficient estimates

Table 4 Results - Including all farms, Canada (2001 to 2006) cont'd

	Model 1			Model 2		
	Probit		Log-linear	Probit		Log-linea
	Coefficient	Marginal Effect	Coefficient	Coefficient	Marginal Effect	Coefficier
Socioeocnomic Characteristics						
Pop. density (100 pers./km^2)	0.009	0.004 *	0.031 ***	0.012	0.005 ***	0.032
	(0.005)	(0.002)	(0.009)	(0.005)	(0.002)	(0.009)
Employment rate (percent)	0.003	0.001 **	0.005 **	0.003	0.001 **	0.003
	(0.001)	(0.00)	(0.002)	(0.001)	(0.001)	(0.002)
Statistical Area Classification						
CMA	0.132	0.050 ***	0.012	0.162	0.061 ***	0.059
	(0.056)	(0.021)	(0.105)	(0.058)	(0.021)	(0.103)
CA	0.130	0.049 ***	0.109	0.121	0.046 **	0.056
	(0.054)	(0.02)	(0.096)	(0.056)	(0.021)	(0.097)
Strong MIZ (base)						
Moderate MIZ	0.056	0.021	-0.134 *	0.080	0.031 *	-0.105
	(0.044)	(0.017)	(0.077)	(0.046)	(0.017)	(0.077)
Weak MIZ	0.005	0.002	-0.076	0.041	0.016	-0.057
	(0.046)	(0.018)	(0.079)	(0.05)	(0.019)	(0.082)
No MIZ	-0.019	-0.007	-0.377 ***	0.028	0.011	-0.300
	(0.057)	(0.022)	(0.10)	(0.061)	(0.023)	(0.103)
Unidentified SAC	0.071	0.027	0.176	0.088	0.033	0.252
	(0.073)	(0.028)	(0.114)	(0.079)	(0.029)	(0.114)
Regions						
Atlantic				-0.33	-0.13 *	0.09
				(0.19)	(0.08)	(0.35)
Quebec				-0.23	-0.09	-0.68
				(0.16)	(0.06)	(0.29)
Ontario (base)						
Manitoba				-0.50	-0.20 ***	-1.15
				(0.21)	(0.08)	(0.37)
Saskatchewan				-0.25	-0.10	-1.15
				(0.23)	(0.09)	(0.41)
Alberta				-0.60	-0.23 ***	-0.52
				(0.22)	(0.09)	(0.39)
British Columbia				0.36	0.13	0.68
				(0.27)	(0.09)	(0.35)
Interaction terms						
Regions / CV farm revenues						
Atlantic				0.07	0.03	-0.03
				(0.06)	(0.02)	(0.10)
Quebec				0.02	0.01	0.08
				(0.05)	(0.02)	(0.08)
Ontario(base)						
Manitoba				0.08	0.03	0.22
				(0.06)	(0.02)	(0.10)
Saskatchewan				0.04	0.02	0.25
				(0.06)	(0.02)	(0.11)
Alberta				0.13	0.05 **	0.13
				(0.06)	(0.02)	(0.10)
British Columbia				-0.08	-0.03	-0.17
				(0.08)	(0.03)	(0.10)

Note: Standard deviations are provided in parentheses.

* significant at the 10% level; ** significant at the 5% level;*** significant at the 1% level

For the probit model the significance level is based on resulst for the coefficient estimates

Table 4 Results - Including all farms, Canada (2001 to 2006) cont'd

	Model 1			Model 2		
	Probit		Log-linear	Probit		Log-linea
	Coefficient	Marginal Effect	Coefficient	Coefficient	Marginal Effect	Coefficier
Interaction terms cont'd						
Regions/Corr.(NFI;Gov't pmts)						
Atlantic				0.08	0.03	0.22
				(0.12)	(0.05)	(0.18)
Quebec				0.01	0.01	-0.12
				(0.09)	(0.03)	(0.16)
Ontario(base)						
Manitoba				0.08	0.03	0.24
				(0.09)	(0.04)	(0.17)
Saskatchewan				0.21	0.08 **	0.23
				(0.10)	(0.04)	(0.17)
Alberta				0.18	0.07 *	0.23
				(0.09)	(0.04)	(0.17)
British Columbia				0.02	0.01	0.08
				(0.11)	(0.04)	(0.19)
Incorporated farms				2.64	0.51 ***	3.49
				(0.12)	(0.01)	(0.16)
Inc. farms/CV farm revenues				-0.49	-0.19 ***	-0.59
				(0.03)	(0.01)	(0.04)
Inc. farms/Corr.(NFI;Gov't pmts)				0.00	0.00	0.12
				(0.05)	(0.02)	(0.07)
Intercept	-1.10 ***		6.05 ***	-1.03 ***		6.14
	(0.21)		(0.38)	(0.25)		(0.45)
Number of observations	31304		19302	31304		19302
Adjusted R^2			0.107			0.182
Theta (Box-Cox test)			0.216			0.214
Loglikelihood	-18164			-17370		
Pseudo-R^2	0.140			0.178		

Note: Standard deviations are provided in parentheses.

* significant at the 10% level; ** significant at the 5% level;*** significant at the 1% level

For the probit model the significance level is based on resulst for the coefficient estimates

unincorporated farms. The estimated marginal effects from the probit models by farm typology as well as the regression coefficients from the log-linear part of the model by farm typology are presented in Table 5.

These regressions provide interesting results regarding farm size. For all but operators of very large unincorporated farms, farm size is inversely related with off-farm work. Unlike in the general models, farm size reduces not only the level of operators' off-farm employment income but also the likelihood of off-farm work. However, this effect appears to be decreasing in magnitude as farms get larger. An increase of $10,000 in average farm market revenue would reduce the likelihood of small commercial farm operators to have off-farm employment income by 5%. But the same increase in farm size would have literally no effect for operators of large and very large farms. A similar effect is estimated between farm size and the level of earned off-farm income. For small commercial farm operators, an additional $10,000 in average farm market revenue decreased off-farm employment income by about 2%. However, for operators of very large farms, size did not affect the expected level of earned off-farm income. Hence, farm size was a key determinant of off-farm work mainly among operators of smaller farms. Beyond a certain farm size, this effect became negligible.

The estimate for farmland value, was insignificant for the probit model. Results from model 1 and 2 (Table 4) indicate that for operators located in a region where farmland value was higher by $1000 per acre, the level of off-farm employment income increases by 3%. Supporting these results, a higher net farm operating income had a negative although minimal impact on the likelihood of off-farm work.

Finally, a farm's dominant enterprise is also found to influence operator's off-farm work decisions (Table 4 and 5). Operators of grain farms were more likely than other farm types to work off the farm. And, among operators that have off-farm work, grain farmers are expected to have a higher off-farm employment income than most of the other farmers. The lower labour requirement of grain farms compared to other farming enterprises can explain these results. In line with previous literature, dairy as well as vegetable, and hog farm operators were found to be among the least likely to have off-farm work.

Socioeconomic environment

Socioeconomic factors also appear to affect the farm operator's decision to work off the farm and their level of earned off-farm income. As expected, population density of the region had a positive impact on the likelihood of off-farm work and the level of earned off-farm income. An increase of Increasing population density by 100 persons per square kilometre would increase the likelihood of off-farm work increased by only about 0.1%, and would raise the expected level of off-farm employment income by 3% (Table 4). The employment rate, like population density, also had a small positive impact on off-farm work.

Further information on socioeconomic characteristics was provided by the access to urban labour markets, as defined by the statistical area classification (SAC).

These variables had a strong effect on the decision to work off-farm and the level of earned off-farm income. In general, having a greater access to urban employment opportunities increased the likelihood of off-farm work (Table 4). Farm operators within the limits of urban regions (i.e. in CMAs or CAs) were 5% more likely to work off the farm compared to those in strong metropolitan influenced zones (MIZ). In addition, operators in areas more isolated from urban labour markets (i.e. in moderate, weak, and no MIZs), the average level of off-farm employment income was lower by 13% to 37% compared to those in strong MIZ. This is most likely explained by higher wages in urban labour markets and a more diversified set of opportunities which may allow operators to make a more productive use of their human capital. The probit results contrasted with those of Alasia *et al.* (2007) who found a positive relationship between distance to urban center and the likelihood of off-farm work.

Results of the regressions by type of unincorporated farms provide more details on the relationship between off-farm work and access to urban labour markets (Table 5). First, operators located in more remote regions were expected to have a lower off-farm income. Also in line with general results discussed above, operators of small commercial farms located in urban regions were more likely to have off-farm work compared to other operators of small commercial farms. But this relationship was reversed in the case of operators of very large farms. The likelihood of observing off-farm income went up by 14% for operators of very large commercial farms located in the regions which are most disconnected from urban labour markets (i.e. No MIZ).

Operator characteristics

The marginal effect of the age variables on the likelihood of off-farm work had signs and magnitudes which were robust across farm typologies. Results conform to the findings of previous studies (Table 4 and 5). Age had a positive impact on both the likelihood of off-farm work and the level of earned off-farm income. But this relation was reversed after a certain age. Alternative sources of income such as pension and investment income may be complements to off-farm employment income as it shows a positive relationship with the likelihood of off-farm work and off-farm employment income level. A $1000 increase in pension or investment income would increase the expected off-farm income level by only 0.2% .

Farm income risk

With respect to farm income risk, the results in Table 4 show that the variability of farm market revenue and the stabilization effect of program payments had a significant impact on the likelihood of off-farm work and also would increase the expected level of earned off-farm income. First, if the correlation between farm income and program payments increased by about 0.5 than farm operators were 2.5% more likely to have off-farm work. The estimates also indicate that a change in the variability of farm market revenue corresponding to the sample standard deviation (i.e. 0.72) increased the likelihood of off-farm work by about

Table 5. Results - Unincorporated farms by farm type, Canada (2001 to 2006)

	Pension/Hobby		Low-income		Commercial farms: Small		Large		Very large	
	Probit	Log-linear	Probit	Log-linear	Probit	Log-linear	Probit	Log-linear	Probit	Log-linear
	Marg. effect	Coeff.	Marg. effect	Coeff.	Marg. effect	Coeff.	Marg. effect	Coeff.	Marg. effect	Coeff.
Farm Income Risk										
CV of farm market rev. (log)	0.009	0.042	0.023	-0.036	0.032 **	0.036	0.063 ***	0.372 ***	-0.007	0.353 ***
	(0.009)	(0.085)	(0.022)	(0.083)	(0.014)	(0.057)	(0.011)	(0.059)	(0.023)	(0.143)
Correl. (NFI, Gov't payments)	0.002	0.008	0.034	-0.294 ***	0.022	-0.127	0.023	0.238 ***	0.044	0.414 *
	(0.009)	(0.102)	(0.032)	(0.111)	(0.021)	(0.089)	(0.017)	(0.095)	(0.035)	(0.24)
Farm Characteristics										
Farm size($1,000)	0.0001	0.004	-0.006 ***	-0.022 ***	-0.005 ***	-0.019 ***	-0.0002 ***	-0.002 ***	0.000	0.000
	(0.0003)	(0.0048)	(0.0014)	(0.0049)	(0.0004)	(0.0014)	(0.0001)	(0.0005)	(0.0000)	(0.0001)
NOFI ($1,000)	-0.0005	-0.015 ***	-0.012 ***	-0.043 ***	-0.008 ***	-0.033 ***	-0.002 ***	-0.011 ***	0.000 ***	-0.001 **
	(0.0005)	(0.005)	(0.002)	(0.011)	(0.001)	(0.003)	(0.00)	(0.003)	(0.00)	(0.00)
Program payments	-0.0003	-0.010 ***	-0.003 ***	-0.014 ***	-0.005 ***	-0.016 ***	-0.004 ***	-0.030 ***	-0.007 ***	-0.033
	(0.0003)	(0.003)	(0.001)	(0.003)	(0.001)	(0.002)	(0.001)	(0.006)	(0.003)	(0.021)
Farmland value($1,000/ac)	0.0004	0.008	-0.013	-0.014	-0.002	0.004	0.000	0.061 ***	0.004	0.059
	(0.0008)	(0.020)	(0.010)	(0.028)	(0.010)	(0.017)	(0.000)	(0.020)	(0.010)	(0.041)
Production type										
Grain and Oilseed (base)										
Potato	n/a	-3.331 ***	0.412 ***	-0.426	0.078	0.431	-0.054	-0.175	-0.021	-0.451
		(1.408)	(0.155)	(0.425)	(0.147)	(0.341)	(0.046)	(0.293)	(0.089)	(0.561)
Other Vegetable	-0.494 ***	-0.250	-0.145 *	-0.462	-0.172 ***	-0.705 **	-0.106 *	-0.655 *	-0.074	0.774
	(0.209)	(0.289)	(0.077)	(0.354)	(0.071)	(0.339)	(0.058)	(0.392)	(0.133)	(1.069)
Fruit and Nut	-0.026	0.016	-0.051	-0.534	0.038	-0.190	0.047	-0.963 ***	0.071	-2.201 *
	(0.037)	(0.193)	(0.078)	(0.375)	(0.082)	(0.337)	(0.056)	(0.344)	(0.161)	(1.178)
Greenhouse/Nursery	-0.057	0.063	-0.076	-0.901 *	-0.225 ***	-0.432	-0.078	-1.064 ***	-0.308 ***	-2.080 ***
	(0.072)	(0.193)	(0.114)	(0.534)	(0.088)	(0.455)	(0.06)	(0.39)	(0.061)	(0.64)
Other Crop	0.010	-0.130	-0.083	-0.261	-0.047	-0.147	-0.108 ***	-0.368	0.039	-1.939 ***
	(0.009)	(0.166)	(0.052)	(0.222)	(0.04)	(0.129)	(0.04)	(0.273)	(0.126)	(0.594)
Beef	0.015	0.042	-0.024	0.066	-0.063 ***	-0.150 *	-0.094 ***	-0.264 **	-0.118 **	-0.758 *
	(0.011)	(0.115)	(0.037)	(0.13)	(0.023)	(0.084)	(0.021)	(0.12)	(0.054)	(0.399)
Dairy	-0.101	-0.520 **	-0.222 ***	-0.750 **	-0.273 ***	-0.935 ***	-0.180 ***	-1.329 ***	-0.149 **	-2.837 ***
	(0.146)	(0.256)	(0.05)	(0.368)	(0.031)	(0.149)	(0.023)	(0.144)	(0.066)	(0.556)
Hog	-0.204	0.238	-0.088	-0.581	-0.072	0.145	-0.043	-1.041 ***	-0.092	-2.087 ***
	(0.155)	(0.242)	(0.102)	(0.392)	(0.055)	(0.152)	(0.03)	(0.164)	(0.062)	(0.473)
Poultry	-0.032	-0.392	0.314 **	-0.663	-0.063	-0.243	0.048	0.070	-0.166 ***	-1.212 **
	(0.057)	(0.256)	(0.15)	(0.418)	(0.075)	(0.198)	(0.043)	(0.191)	(0.068)	(0.57)
Other Animal	-0.003	0.278	-0.127 **	-0.325	-0.070	-0.272 *	-0.119 ***	-1.047 ***	0.009	-0.259
	(0.016)	(0.23)	(0.065)	(0.204)	(0.052)	(0.164)	(0.048)	(0.281)	(0.112)	(0.582)

Note: Standard deviations are provided in parentheses. * significant at the 10% level; ** significant at the 5% level;*** significant at the 1% level

Table 5. Results - Unincorporated farms by farm type, Canada (2001 to 2006), cont'd

	Pension/Hobby		Low-income		Commercial farms: Small		Large		Very large	
	Probit	Log-linear	Probit	Log-linear	Probit	Log-linear	Probit	Log-linear	Probit	Log-linear
	Marg. effect	Coeff.	Marg. effect	Coeff.	Marg. effect	Coeff.	Marg. effect	Coeff.	Marg. effect	Coeff.
Operator Characteristics										
Age (2001)	-0.004	0.049 **	0.024 ***	0.078 ***	0.033 ***	0.156 ***	0.013 ***	0.068 ***	0.018 *	0.123 *
	(0.003)	(0.022)	(0.007)	(0.029)	(0.005)	(0.025)	(0.005)	(0.027)	(0.01)	(0.07)
Age square	0.000	-0.001 **	0.000 ***	-0.001 ***	-0.001 ***	-0.002 ***	0.000 ***	-0.001 ***	0.000 **	-0.001 *
	(0.0000)	(0.0003)	(0.0001)	(0.0003)	(0.0001)	(0.0003)	(0.0001)	(0.0003)	(0.0001)	(0.0007)
Pension/Inv. income ($1,000)	0.000	0.001 ***	0.004 ***	-0.001	0.001 ***	0.002 ***	0.001 ***	0.001 ***	0.000 *	0.001 ***
	(0.0000)	(0.0002)	(0.0016)	(0.0065)	(0.0004)	(0.0009)	(0.0002)	(0.0005)	(0.0001)	(0.0004)
Socioeconomic Characteristics										
Pop. density (100 pers./km^2)	0.001	0.014 **	0.003	0.011	0.002	0.027 **	0.005	0.020	0.008	0.042
	(0.001)	(0.006)	(0.005)	(0.022)	(0.003)	(0.013)	(0.003)	(0.019)	(0.006)	(0.037)
Employment rate (percent)	-0.001	0.001	0.002	0.009 **	0.003 ***	0.000	0.001	0.003	-0.001	-0.008
	(0.001)	(0.002)	(0.001)	(0.004)	(0.001)	(0.003)	(0.001)	(0.004)	(0.002)	(0.013)
Statistical Area Classification										
CMA	-0.003	0.085	0.035	-0.342	0.088 **	-0.230	0.004	0.220	0.026	-0.641
	(0.015)	(0.062)	(0.062)	(0.226)	(0.039)	(0.158)	(0.032)	(0.175)	(0.067)	(0.451)
CA	-0.008	0.036	0.090	-0.079	0.072 *	-0.073	0.030	-0.064	0.035	-0.033
	(0.017)	(0.062)	(0.063)	(0.23)	(0.038)	(0.161)	(0.032)	(0.181)	(0.058)	(0.391)
Strong MIZ (base)										
Moderate MIZ	-0.002	0.058	0.080 *	-0.037	0.045	-0.176	0.008	-0.165	-0.009	-0.242
	(0.014)	(0.065)	(0.047)	(0.163)	(0.031)	(0.119)	(0.025)	(0.148)	(0.052)	(0.374)
Weak MIZ	-0.006	0.004	0.042	0.144	0.038	-0.207 *	0.035	0.109	-0.078	-0.753 *
	(0.016)	(0.062)	(0.048)	(0.165)	(0.032)	(0.124)	(0.027)	(0.151)	(0.053)	(0.426)
No MIZ	-0.014	-0.025	0.049	-0.098	0.032	-0.457 ***	0.043	-0.180	0.142 *	-0.101
	(0.026)	(0.081)	(0.06)	(0.213)	(0.04)	(0.156)	(0.033)	(0.176)	(0.08)	(0.517)
Unidentified SAC	0.017	-0.056	-0.146 **	-0.104	0.044	-0.047	0.043	0.136	0.192 *	-0.186
	(0.014)	(0.072)	(0.074)	(0.291)	(0.052)	(0.195)	(0.046)	(0.224)	(0.115)	(0.496)
Intercept		9.552 ***		8.175 ***		7.934 ***		6.643 ***		6.314 ***
		(0.496)		(0.795)		(0.653)		(0.727)		(2.213)
Number of observations	1056	931	2700	1388	5983	3334	9042	3893	1461	567
Adjusted R^2		0.328		0.262		0.256		0.145		0.176
Theta (Box-Cox test)		0.340		0.326		0.299		0.093		0.069
Loglikelihood	-200		-1424		-2953		-5701		-914	
Pseudo-R^2	0.52		0.24		0.27		0.08		0.07	

Note: Standard deviations are provided in parentheses. * significant at the 10% level; ** significant at the 5% level;*** significant at the 1% level

3.5% and the expected level of off-farm employment income would be about 12% higher. This suggests that farm operators facing higher farm income risk were able to diversify their income sources off the farm.

In addition, a higher proportion of revenues from program payments, which tend to be countercyclical and to stabilize farm income, lead operators to have, on average, a lower likelihood of off-farm work and a lower off-farm employment income. The impact of program payments was minimal on the likelihood of off-farm work and more sizeable on the expected level of off-farm employment income. If program payments accounted for 25% of farm market revenue for an operator (compared to an average of 15%), the expected off-farm employment income would be 4.5% lower compared to the average farm operator.

Overall, the results from Model 1 (Table 5) show a statistically significant relationship between farm income risk and earned off-farm income. Consequently, some degree of labour mobility between the farm and non-farm sectors appear to exist and this mobility has been used by farm operators to diversify their income portfolio.

Comparison across regions

Model 2 (Table 4) provides additional information on the characteristics of operators who have been able to combine farm and off-farm opportunities to build a more stable income portfolio. Estimates from Model 2 provide information on the determinants of off-farm employment income for unincorporated farms in Ontario (reference group), and the difference with farm operators from other provinces. These results indicated that the use of off-farm work was more common in Ontario than in any other province. For example, farm operators from the Atlantic Provinces, Manitoba and Alberta were 13% to 23% less likely to work off the farm compared to operators in Ontario. Also, on average farmers from Quebec, Manitoba and Saskatchewan had significantly lower off-farm employment income compared to operators in Ontario.

While farmers from the Prairies tend to rely less on earned off-farm income, their use of it was more responsive to farm income risk. In Ontario, a 10% increase in farm market revenue variability would increase the expected off-farm employment income by 1.7%. In Manitoba and Saskatchewan, the same change would imply 4% increase in earned off-farm income. In addition, higher farm income risk increased the likelihood of working off-farm for operators of Alberta and Saskatchewan operators more than those of Ontario. In contrast, off-farm employment income was higher among farmers from British Columbia than those in Ontario, but the relationship with farm income risk was significantly weaker. Hence, higher responsiveness to farm income risk could be associated with lower levels of off-farm employment income.

Model 2 (Table 4) also provides a comparison between incorporated and unincorporated farms. Operators of incorporated farms were 50% more likely to work off the farm and had a much higher level of off-farm employment income. Furthermore, operators of incorporated farms had a markedly different rela-

tionship to farm income risk. These operators' off-farm work decisions were less influenced by farm income risk, and results even suggest a negative relationship. While a statistically insignificant link could be explained by the inability, or lack of incentive, of farm operators to get involved with off-farm work, a negative relationship would be much harder to justify on theoretical grounds. Once again, this result may be an artifact of the income tax data, reflecting the ability of incorporated farm operators to transfer part of the farm income in the form of a salary to the operator, and inflate off-farm employment income statistics for this type of farm business organisation.

Comparison across farm typologies and size

Estimates in Table 5 suggest that, among operators of unincorporated farms, the effect of variability in farm revenues on off-farm work decisions was most pronounced among large commercial farm operators. For operators of large and very large farms, a 10% increase in farm market revenues variability would increase their expected off-farm employment income level by about 3.5%. Given the average off-farm employment income of about $46731annually for operators of very large farms, this estimate implies that a farmer with a variability of farm market revenue of 33% would be expected to earn $1,636 more than a farmer with variability of 30%. However, estimates were insignificant for operators of non-commercial farms and small commercial holdings. The responsiveness of off-farm employment income to farm market revenue risk among operators of larger commercial farms may reflect their heightened preoccupation with farm income variability or the higher diversification benefits of off-farm income in their income portfolio.

The correlation between farm income and program payments also seems to have a greater impact on off-farm decisions among operators of larger unincorporated farms. According to the results, an increase of the correlation between farm income and program payments by 0.1 (which would reduce the stabilization effect of program payments) would increase the expected off-farm employment income by about 2.3% and 4.0% for operators of large and very large farms, respectively. Given the standard deviation of 0.5 for this variable within the data set, these estimates suggest an economically significant response to farm income risk among operators of larger unincorporated farms.

The effect on the decision to work off-farm was also significant for operators of small and large farms. However, the magnitude of the effect was relatively small. The same 10% increase in the variability of farm market revenues would only increase the likelihood of off-farm work by slightly less than 1%. Farm market revenue variability had no significant effect on the likelihood of off-farm work among operators of very large farms. The fact that estimates were not significant for operators of very large farms may reflect a high barrier to enterthe off-farm labour market for these operators, potentially attributable to farm labour constraints.

Thus, the results with respect to variability in farm market revenue, the correlation between program payments, and net farm income indicate that operators of

larger commercial farms were more likely to use off-farm employment income as a risk management tool. But given that farm risk variables were not significant with respect to the likelihood of off-farm work among operators of very large farms may indicate the presence of a relatively large barrier to entry for these operators. Nevertheless, results strongly suggest that operators of very large farms who are participating in the off-farm labour market show the ability to use off-farm opportunities to manage farm income risk.

Conclusion

Off-farm income has become a major determinant of farm operators' and farm families' well-being. The farm-level data set used in this study indicates that about 60% of Canadian farm operators have reported off-farm employment income between 2001 and 2006, with an average off-farm employment income of $18.371. In this context, this article contributes to the knowledge and understanding of this structural change in the primary agricultural sector, and its potential implications for both rural and agricultural policies.

This article provides empirical evidence supporting the idea that, in response to farm income risk, farmer's diversify their income portfolio via off-farm activities. The results of the analysis for commercial farms, which represent the central focus of agricultural policies, further support the idea that off-farm income is of relevance to farm income stabilization policies. The data indicate that among operators of the largest unincorporated farms, one operator out of ten earns more than 30% of its income from off-farm sources. Moreover, econometric results show that it is operators of the larger commercial farms that appear to employ off-farm income as a risk management in response to farm income risk. This may reflect their greater preoccupation with fluctuation in farm market revenue and income, but it also suggests that a significant number of these operators of large farms were able to work around farm labour constraints to take advantage of off-farm opportunities.

The ability of farm operators and households to increase their resilience to farm income risk by exploiting off-farm opportunities has important policy implications. Off-farm diversification must then be added to a list of existing, albeit imperfect, private risk management tools. The existence of these tools implies that farm income stabilization policies risk crowding out private initiatives.

While it should also be noted that off-farm opportunities, on their own, are unlikely to fully address farm income instability issues, the focus of agricultural policies on risk management and income stabilization reinforces the linkages between rural and agricultural policies. It appears that policies designed to facilitate access to off-farm work or to enhance off-farm opportunities, such as rural development programs, could contribute to achieve some objectives underlying agricultural income stabilization programs.

Consequently, the policy focus on risk management combined with the fact that farmers production decisions and their welfare appear to be conditioned on an income portfolio including a substantial amount of off-farm income reinforce

the need for coherent rural and agricultural policies. In particular, the analysis points towards additional benefits of rural policies for the agricultural sector, as increasing off-farm opportunities could be used by farm operators and families to manage income risk. This conclusion is in line with recent affirmation of the American Farm Bureau that by now "farm communities are less dependent on farms than farms are dependent on rural communities" (American Farm Bureau, 2008, p.viii). This raises questions about the desirable balance between placed based rural policies and sector specific agricultural policies, and on whether and how agricultural policies should account for off-farm diversification possibilities in order to minimize the crowding out of private initiatives.

Finally, many possible extensions of this study can be contemplated. First, the data used in this study pertain to the operators but it would be of interest to understand if the same effects are present at the family level, and whether the number of operators on a farm affects the results. Future research could also look at other measures of risk in order to assess the robustness of the results. All of these extensions could be helpful in understanding structural changes within the farming community and provide further information on the potential interactions between off-farm income and agricultural policies.

References

American Farm Bureau. "Making American Agriculture Productive And Profitable: Executive Summary."
Internet site: http://www.fb.org/index.php?fuseaction=issues.maapp (Accessed August 4, 2009).

Alasia, A., R.D. Bollman, A. Weersink, and J. Cranfield. Off-Farm Labour Decisions of Canadian Farm Operators in 2001: The Role of Operator, Farm, Community and Regional Determinants (1991 to 2001). Ottawa, Canada: Statistics Canada, Agriculture and Rural Working Paper Series, Catalogue no. 21-601-MIE2007085, 2007.

Benjamin, C., and A. Kimhi. "Farm work, off-farm work, and hired farm labour: estimating a discrete-choice model of French farm couples' labour decisions." *European Review of Agricultural Economics* 33(2006):149-171.

El-Osta, H.S., A.K. Mishra, and M.J. Morehart. "Off-Farm Labor Participation Decisions of Married Farm Couples and the Role of Government Payments." *Review of Agricultural Economics* 30(2008):311-332.

Furtan, W.H., G.C. Van Kooten, and S.J. Thompson. "The Estimation of Off-Farm Labor Supply Functions in Saskatchewan." *Journal of Agricultural Economics* 36(1985):211-220.

Gardner, B.L. "Changing Economic Perspectives on the Farm Problem," *Journal of Economic Literature*,Vol. XXX(March 1992), March, pp. 62-101.

Gardner, B.L. "The Little Guys Are O.K." Op-Ed article, New York Times, March 7, 2005.

Hennessy, T.C., and T. Rehman. "Assessing the Impact of the "Decoupling" Reform of the Common Agricultural Policy on Irish Farmers' Off-farm Labor Market Participation Decisions." *Journal of Agricultural Economics* 59(2008):41-56.

Howard, W., and M. Swidinsky. "Estimating the Off-farm Labour Supply in Canada." *Canadian Journal of Agricultural Economics* 48(2000):1-14.

Kyle, S.C. "The Relation Between Farm Production Risk and Off-Farm Income." *Agricultural and Resource Economics Review* 22(1993):179-188.

Mishra, A.K., and B.K. Goodwin. "Farm Income Variability and the Supply of Off-Farm Labour." *American Journal of Agricultural Economics* 79(1997):880-887.

Mishra, A.K., and D.M. Holthausen."Effect of Farm Income and Off-Farm Wage Variability on Off-Farm Labour Supply." *Agricultural and Resource Economics Review* 31(2002):187-199.

Mishra, A.K., and C.L. Sandretto. "Stability of Farm Income and the Role

of Nonfarm Income in U.S. Agriculture." *Review of Agricultural Economics* 24(2002):208-211.

OECD. Income Risk Management in Agriculture. Paris, France: Organisation for Economic Cooperation and Development, 2001.

OECD. The New Rural Paradigm: Policies and Governance. Paris, France: Organisation for Economic Cooperation and Development, 2006.

OECD. Risk Management in Agriculture - A Holistic Conceptual Framework. Paris, France: Organisation for Economic Cooperation and Development, 2009.

Statistics Canada. Statistics on Income of Farm Operators. Ottawa, Canada: Statistics Canada, Catalogue no. 21-206-X, 2009.

Statistics Canada. Whole Farm Database Reference Manual. Ottawa, Canada: Statistics Canada, Catalogue no. 21F0005G, 2008.