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Farm Income Variability and Off-Farm Diversification in Canadian Agriculture

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..	not available for a specific reference period
…	not applicable
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0^s	value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
^{p}	preliminary
^{r}	revised
x	suppressed to meet the confidentiality requirements of the *Statistics Act*
A	excellent
B	very good
C	good
D	acceptable
^{E}	use with caution
F	too unreliable to be published

Farm Income Variability and Off-Farm Diversification in Canadian Agriculture

Simon Jetté-Nantel,
David Freshwater,
Martin Beaulieu,
Ani Katchova

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 by the operator as a tool to reduce the variability of the total income of the farm operator. 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 operator level data for about 31,305 Canadian farm operators from 2001 to 2006 are used for this study. The variability of farm gross 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 large commercial farms. The ability of a significant number of operators of larger farms to increase their coping capacity through off-farm employment income suggests 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 reinforce the argument for place-based policy that augments the opportunities for all residents in a locality, not just those in a specific sector.

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 total income originating from off-farm sources for operators of unincorporated farms (with gross farm revenue of $10,000 and greater) grew from 55% to 62% (Statistics Canada, 2009). 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 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 households, and contributed to the diminishing the sector-wide risks associated with farm income. 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 coping capacity of farm families and operators in facing farm income risk. 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. Farm production decisions and household welfare are then conditioned on the level

1. The term off-farm income designates the earned income (wages, salaries and net off-farm self-employment income), investment income, pension income, social transfers and RRSP income.

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 are 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 farmers' 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 farmers' welfare or their production decisions.

The interactions between off-farm income and agricultural farm income stabilization 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 stabilization policies focus on commercial agriculture[2], which by definition allocated a relatively high share of program payments to larger farms, 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), fuelling the interest for integrated and place-based rural development policies. In this context, the capacity of off-farm income to address 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, potentially creating additional benefits of rural policies for individuals and families in the agricultural sector.

This paper investigates the empirical evidence of off-farm portfolio diversification by farmers. The objective is to contribute to the knowledge and understanding of recent structural changes in farm income and off-farm income in the agricultural sector, and their potential implications for both rural and agricultural policies. To achieve this goal a theoretical framework is used to derive the implication of off-farm portfolio diversification for farmers. Information from that theoretical framework is then used to specify a two-part econometric model which first estimates the impact of farm income risk on the decision to work off-farm and then the level of off-farm income. The study also provides information about the farms and farm operator characteristics 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 operators of farm of all 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.

2. Commercial agriculture is used here to designate the farm population for which farming income represents a significant share of their total income.

Literature Review

Determinants of off-farm income

The extensive literature on off-farm labour supply and off-farm income provides many insights on farmers that are more likely to have 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, education, family size) and off-farm labour allocation. In terms of farmers' characteristics, the literature suggests that age would have an inverted U-shape relationship with the likelihood of off-farm work; higher education would increase the likelihood of working off-farm; and farming experience would reduce 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 would be identified as being less likely to work off the farm, while the reverse would be true for grain and oilseed farmers (Howard and Swidinsky ,2000; Alasia *et al.*,2007). Most studies also report that farm size, as would be expected, would have a negative impact on the likelihood of off-farm work by the operator. This result appears to be similar regardless of the indicator used to measure farm size (e.g. gross sales, farm 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 would have 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 counter-intuitive (Mishra and Goodwin, 1997; Alasia *et al.*, 2007; El-Osta, Mishra, and Morehart, 2008). Howard and Swidinsky (2000) found population density would increase the number of hours worked off the farm.

Government program payments would 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.

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 was higher in American states with higher 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 higher variability in farm income would be associated with higher off-farm income.

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 to 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 would increase the likelihood of having off-farm income. To our knowledge, their study is the only one estimating the relationship between farm income risk and off-farm work based on operator-level data.

The Tobit model used by Mishra and Goodwin (1997) implicitly assumes that farm income variability would have 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 could have inverse effects on the operator's off-farm labour market participation and the number of hours supplied by the operator.

This study takes advantage of a farm operator-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 by farm operator. The data set 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 operators of hobby/pension farms and operators of commercial farms of different sizes. A two-part model is developed to address data censoring issues and to assess the relationship between farm income risk and 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 a labour allocation 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 the optimal labour allocation decision under uncertainty can be derived.

$$U = U(\pi, l)$$

The utility function (*U*) is defined as a function of income (π) and leisure time (*l*).

The income function is defined as:

$$\pi = F(H, X_o, X_f, \varepsilon_f) + G(\bar{F}, \varepsilon_g) + I + OFEI(L, R, X_o)$$

$$F(H, X_o, X_f, \varepsilon_f) = \bar{F}(H, X_o, X_f)(1 + \varepsilon_f)$$

$$G(\bar{F}, \varepsilon_g) = g\bar{F}(H, X_o, X_f)(1 + \varepsilon_g)$$

$$\begin{bmatrix} \varepsilon_f \\ \varepsilon_g \end{bmatrix} : N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_f^2 & \rho\sigma_f\sigma_g \\ \rho\sigma_f\sigma_g & \sigma_g^2 \end{bmatrix} \right)$$

Total income is defined as the sum of farm income (F) which depends on farm labour (H), operator's characteristics (X_o) and farm characteristics (X_f); government program payments (G) which are a function of expected farm income ($\bar{F}$); investment income (I) and off-farm employment income (OFEI) which depends on off-farm labour (L), regional socio-economic characteristics (R), and operator characteristics (X_o).

Farm income (*F*) is defined by the labour allocated to farm enterprises (*H*), and vectors of farm characteristics (X_f) and operator characteristics (X_o). Farm income is assumed to be stochastic with an error term (ε_f) which reflects factors outside of the farm operator's control. Government program payments (*G*) is a constant share *(g)* of expected farm income $(\bar{F})$ 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 importance of farm income stabilization policies, one would expect the correlation coefficient *(ρ)* to be negative.

For this study, off-farm income includes investment income (*I*) [3] and off-farm employment income (*OFI*). OFI depends on off-farm labour supply (*L*), a vector of operator 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 than 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.[4]

$$\max_{H,L} \pi^e(H, X_o, X_f, L, R) - \frac{\alpha}{2} V\left(\pi(H, X_o, X_f, L, R, \varepsilon_f, \varepsilon_g)\right)$$

3. In the empirical analysis that follows, investment income also includes pension and social transfers such as employment insurance.
4. This is a standard result stemming from the particular characteristics of the CARA utility function and the normality of disturbance terms.

Where the expected income is defined as:

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

And the variance is:

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

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 is the first order condition (FOC) obtained from maximizing utility *U* with respect to farm labour (*H*). This expression states that, in equilibrium, the certainty equivalent of marginal return to farm labour equals the off-farm wage (OFI).

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 (SOC) is:

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

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:

$$\frac{dH}{d\sigma_f^2} = -\frac{dL}{d\sigma_f^2} = \alpha\bar{F}_H\left(\frac{\bar{F}\sigma_f + \rho\bar{F}g\sigma_g}{\sigma_f SOC}\right) \gtrless 0$$

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 $(\rho\bar{F}g\sigma_g)$. Our data suggest that the average correlation coefficient is between -0.17 and -0.33 (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. Assuming a binding labour constraint it would also imply a positive relationship with off-farm labour supply. Relaxing this assumption would weaken the link between farm income risk and off-farm labour as leisure time may be traded for farm labour. But this would not change the expected sign.

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 the 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.

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

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. Farm income risk, farm income variability and correlation between farm income and government payments are also included.

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

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.

Step One: Hurdle or participation model
The first step of the two-part model is a probit model relating operator and 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 represents the net benefit from off-farm work evaluated at L=0.

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

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:

$$z = \begin{cases} 1 \;\; if \; z* > \mathbf{0} \\ 0 \; if \; z* \leq \mathbf{0} \end{cases}$$

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

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

And the log-likelihood function is

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

Step Two: Level model
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.

$$ln(OFEI_i) = \mathbf{x_i'}\beta + \varepsilon_i, \qquad E(\varepsilon_i|\mathbf{x_i}) = 0, \qquad \forall\, \mathbf{i} : \mathbf{z} = \mathbf{1}$$

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.

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:

$$\frac{OFEI^{\theta} - \mathbf{1}}{\theta} = \mathbf{x}'\beta + \varepsilon, \qquad \varepsilon \sim N(0, \sigma^2)$$

An estimate of θ close to 0 would support the use of the log-linear structural form, while $\theta = 1$ would support the use of an ordinary least square model without transformation of the dependent variable.

Variables selection and data description

This study uses longitudinal farm operator data developed by Statistics Canada of income tax data from individuals reporting gross farm income and corporate entities that are classified as farms.[5] The database contains farm operator longitudinal data for more than 38,000 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 gross market revenue 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 geographic location of each farm (i.e. census division and census subdivision of farm headquarters). This spatial reference allows us to complement the data set with additional socioeconomic information on the milieu of the geographic area where the operator resides using data 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 gross market revenue. The other category of non-commercial farms is the hobby/pension category which included farm operators with less than $50,000 in farm gross market revenue and more than $50,000 in total off-farm income. Operators of commercial farms were divided into three groups according to the size of their farming operation. The small and medium category included farm operators reporting an average of $100,000 or less in farm gross market revenue. The large category included farm operators reporting between $100,000 and $500,000 in farm market revenue while the very large category included farm operators reporting more than $500,000 in farm market revenue.

Table 1 Farm typology for operators of unincorporated farms

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

1. Total operator income includes off-farm income from all sources and net farm income including program payments.
2. Small and medium 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 a focus on the ability of the farm operator to diversify their labour allocation towards non-farm activities. This 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 closely 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 over the 2001 to 2006 period and zero otherwise. Figure 1 shows that almost 60% of farm operator off-farm employment income was in the form of wages or

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

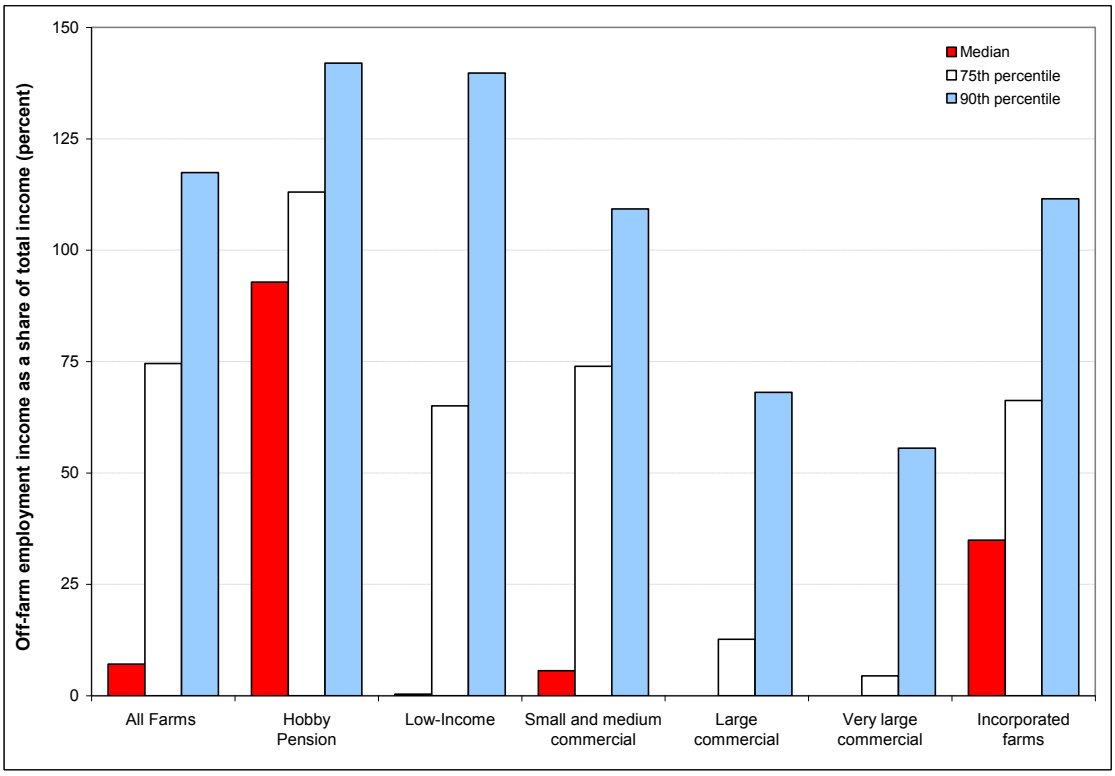
self employment during the 2001 to 2006 period. For operators of unincorporated farms, the data show that operating a smaller unincorporated farm increases the likelihood that the operator earns off-farm income compared to those operating larger farms. But the percentage of operators with off-farm employment remains above 40% among operators of the largest farms, suggesting that some operators can combine off-farm work with the operation of a larger farm.

Off farm employment revenues is also high among operators of incorporated farms, at approximately 80%. This estimate could be biased 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 thus contributes to inflate off-farm income statistics for this category of farm.[6]

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 support the idea that off-farm work has become a significant source of income even for operators of the larger farms.

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

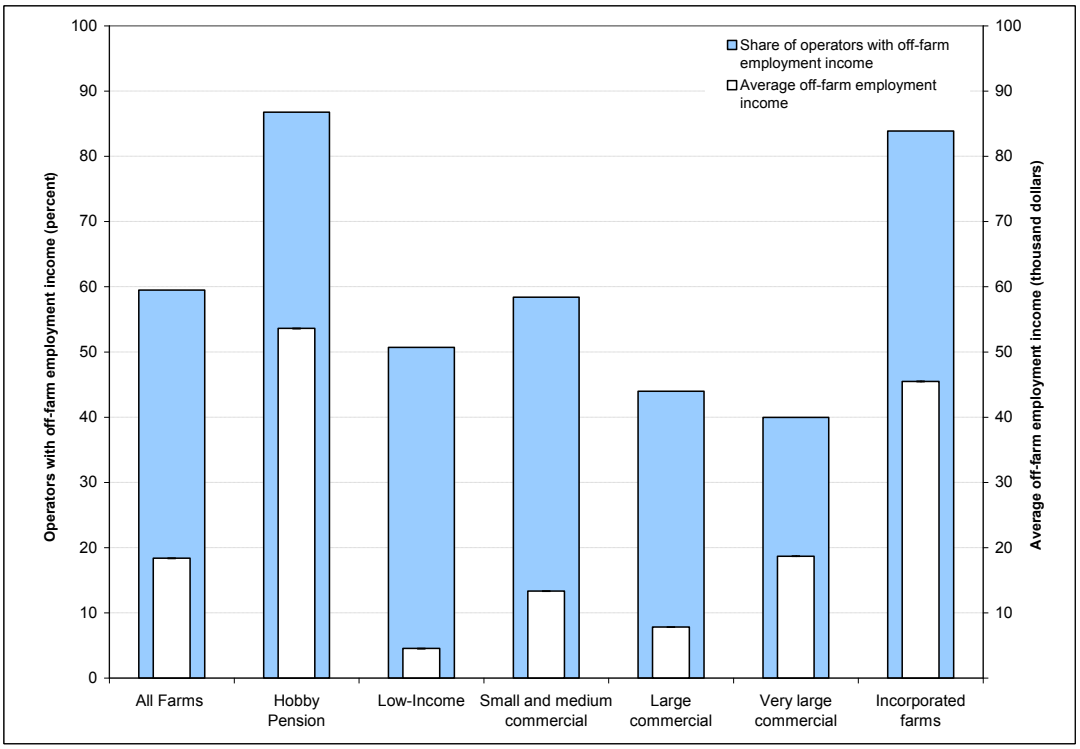


Notes:
Off-farm income represents more than 100% of total income in some cases due to negative farm income.
All measures include Capital cost allowance (CCA) which is the capital cost allowance reported by farm operators for income tax purposes. CCA is usually considered as an upper bound estimate for farm depreciation costs.
Source: Statistics Canada, Farm operator longitudinal database.

6. 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 enterprise or off-farm employment.

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 and medium commercial farmers, the share of total income coming from off-farm wages and non-farm self-employment is larger than 100%, because the net farm income is negative. 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 (75th 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 for operators of most farm types and sizes.

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



Source: Statistics Canada, Farm operator longitudinal database.

Explanatory variables

Summary statistics for all explanatory variables are presented in Table A1 in Appendix. 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 CV of farm income. However, since the sample contains a large number of observations with negative average net farm income, it is not possible to use CV as a measure of farm income risk for the entire sample. Instead the CV of farm gross market revenue 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 net farm income risk. The sample statistics show that farm gross market revenue is quite volatile with a CV between 26.0% and 43.6%. This measure of risk decreased with farm size and was lower for incorporated farms. This suggests that operators or larger and incorporated farms may have adopted measures to manage farm revenue risk and they may be in a better position to take advantage of some risk management tools to stabilize farm gross market revenue.

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 Stabilization

Program. The correlation between program payments and farm income is studied for the 2001 to 2006 period. As expected, program payments are negatively correlated with net farm income. The negative relationship is more pronounced for large commercial farms, signalling 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 to 2006 period expressed as a percentage of total farm gross revenue was used. This relative measure allows for easier comparisons across farm size. The results suggest that Canadian farm operators received program payouts equivalent to 15.4% of total farm gross revenue. Operators of very large unincorporated farms relied the least on program payments, in relative terms, as it accounted on average for 9.2% of the total farm gross revenue. However, these operators also received the highest program payments, averaging $74,280.

Net farm operating income is also expected to influence off-farm income. Large differences exist in net farm operating income across farm sizes and types. Operators of incorporated farms averaged $42,620 in net farm operating income compared to an average loss of $72,260 for very large unincorporated farms. Farm size was measured by the average farm gross market revenue over the period 2001 to 2006. Farm size variation (measured by farm gross market revenue 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 more than 50% of the farm market revenues. The most frequent farm types in the sample were grain and oilseeds (36.3%) and beef (29.9%). Dairy accounted for 10.9% of other farm types, other crops for 6.7%, and each of the other 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 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 Farm Credit Canada (FCC).

Operator characteristics

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. Taxable capital gains were also 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.

Table 2 Summary statistics, Canada, 2001 to 2006

	All Farms	Unincorporated farms					Incorporated farms
		Hobby Pension	Low-Income	Small and medium commercial	Large commercial	Very large commercial	
Farm income risk							
CV of farm market revenues (log)	3.55	3.75	3.77	3.62	3.26	3.34	3.27
CV of farm market revenues (percent)	34.7	42.3	43.6	37.4	26.0	28.2	26.4
Correlation (net farm income, program payments)	-0.24	-0.17	-0.19	-0.24	-0.33	-0.31	-0.21
Farm characteristics							
Farm size($1,000)	155.85	23.58	24.33	51.64	186.18	1,033.92	711.73
Net operating farm income ($1,000)	7.23	-4.64	-2.24	3.47	14.05	-72.26	42.62
Program payments (percent)	15.4	14.4	17.4	17.2	12.8	9.2	12.9
Farmland value($1,000 per acre)	1.70	1.93	1.55	1.58	1.59	2.13	2.25
Production type				percent			
Grain and oilseed	36.3	37.0	29.6	42.0	38.3	15.1	29.8
Potato	0.7	0.3	0.3	0.5	0.7	3.2	2.1
Other vegetable	1.2	0.1	1.5	1.1	1.0	1.8	2.3
Fruit and nut	2.3	3.1	2.2	2.6	1.2	0.6	2.8
Greenhouse/Nursery	1.7	1.0	1.0	1.4	1.3	2.6	5.3
Other crop	6.7	8.7	9.1	6.7	3.3	2.7	6.4
Beef	29.9	37.4	41.9	30.1	22.0	42.5	13.1
Dairy	10.9	0.7	4.4	9.1	21.1	8.8	19.5
Hog	3.2	0.6	1.7	2.2	4.9	12.0	7.4
Poultry	2.2	0.8	0.9	0.6	3.8	6.3	7.5
Other livestock	5.0	10.5	7.5	3.9	2.3	4.6	3.6
Operator characteristics							
Age (2001)	50.2	49.8	52.3	51.6	46.6	47.2	49.6
Pension and investment income ($1,000)	22.23	54.23	9.69	16.09	17.32	34.70	41.74
Number of observations	31,305	1,063	2,700	5,983	9,042	1,461	11,056
Sum of weights	218,781	23,776	46,092	75,885	46,085	2,302	24,640
Population density (2001) (persons/km^2)	174.9	238.4	157.0	177.6	150.4	161.5	185.5
Employment rate (2001) (percent)	63.5	64.6	62.5	63.5	63.6	64.4	63.8
Statistical Area Classification (SAC)				percent			
Census Metropolitan Area	14.2	22.3	12.9	13.0	12.0	12.9	16.6
Census Agglomeration	11.3	16.8	9.3	11.0	9.8	15.0	13.5
Strong Metropolitan Influenced Zones (MIZ)	13.5	11.9	12.7	13.0	14.8	15.9	15.4
Moderate MIZ	25.8	18.5	27.8	25.5	28.3	27.5	25.2
Weak MIZ	22.9	20.4	24.7	24.4	21.9	20.4	19.1
No MIZ	9.3	7.1	9.3	10.2	10.7	5.6	6.1
Unidentified SAC	3.1	2.9	3.3	2.9	2.6	2.7	4.0

Source: Statistics Canada, Farm operator longitudinal database.

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 174.9 persons per square kilometre. The employment rate variable was defined for each census subdivision and reflected the percentage of the labour force 15 years of age and over which was employed. The average employment rate was 63.5%[7]. 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 containing a 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)[8]. 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 observations a value of zero was imputed for the SAC variables and a dummy variable was included to account for these missing observations.

The sample distribution across Canadian regions is reported in Table 3. A majority of operators in the data set were located in the Prairie Provinces.

Table 3 Regional distribution of farm operators, Canada, 2001

		Unincorporated farms					
	All Farms	Hobby Pension	Low-Income	Small and medium commercial	Large commercial	Very large commercial	Incorporated farms
Region				percent			
Atlantic Provinces	2.5	2.2	2.9	1.9	2.5	5.8	3.7
Quebec	13.7	5.7	12.5	12.6	14.6	14.2	25.1
Ontario	22.9	26.8	23.0	22.2	22.5	25.0	21.8
Manitoba	9.3	5.2	11.4	8.5	12.0	9.5	6.4
Saskatchewan	23.1	21.1	23.2	26.2	23.5	10.2	15.8
Alberta	23.4	31.3	21.2	24.1	21.7	30.0	20.0
British Columbia	5.2	7.6	5.7	4.6	3.1	5.3	7.2
Canada	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Statistics Canada, Farm operator longitudinal database.

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

8. The four MIZ classes are defined as follows:

1- Strong MIZ: at least 30% of the municipality's resident employed labour force commute to work in any CMA or CA.

2- 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.

3- 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 .

4- No MIZ: fewer than 40 or none of the municipality's resident employed labour force commute to work in any CMA or CA.

Results

The first two models that were estimated include all operators of 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 to the level of off-farm employment 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 sub-groups of 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. In contrast to the general models, increasing 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 operators of small and medium commercial farms to have off-farm employment income by 5%. But the same increase in farm size has literally no effect for operators of large and very large farms. A similar effect is estimated between farm size and the level of off-farm employment income. For operators of small and medium commercial farms, an additional $10,000 in average farm market revenue decreases off-farm employment income by about 2%. However, for operators of very large farms, size did not affect the expected level of off-farm employment 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.

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

Table 4 Model Results - All farm operators, Canada, 2001 to 2006

	Model 1			Model 2		
	Probit		Log-linear	Probit		Log-linear
	Coefficient	Marginal Effect	Coefficient	Coefficient	Marginal Effect	Coefficient
Farm Income Risk						
CV of farm market revenues (log)	0.136	0.052 ***	0.049	0.184	0.071 ***	0.171 **
Correlation (net farm income, program payments)	0.129	0.050 ***	0.033	0.017	0.007	-0.128
Farm Characteristics						
Farm size	0.0000	0.0000	0.0001 ***	0.0000	0.0000	0.0001 ***
Net operating farm income	-0.0002	-0.0001 ***	0.0000	-0.0002	-0.0003 ***	0.0000
Program payments	-0.0016	-0.0006 **	-0.0045 ***	-0.0016	-0.0008 **	-0.0045 ***
Farmland value	0.0059	0.0000	0.0346 ***	0.0059	0.0000	0.0346 ***
Production type						
Grain and Oilseed (reference)						
Potato	0.265	0.098 *	0.047	0.083	0.032	-0.386
Other Vegetable	-0.379	-0.150 ***	-0.423 **	-0.477	-0.188 ***	-0.661 ***
Fruit and Nut	0.097	0.037	-0.148	0.062	0.024	-0.176
Greenhouse/Nursery	-0.145	-0.057	0.078	-0.333	-0.131 ***	-0.326 **
Other crop	0.023	0.009	0.043	-0.007	-0.003	-0.005
Beef	-0.031	-0.012	0.061	-0.016	-0.006	0.094
Dairy	-0.631	-0.248 ***	-0.885 ***	-0.768	-0.299 ***	-1.293 ***
Hog	-0.213	-0.084 ***	-0.380 ***	-0.376	-0.148 ***	-0.702 ***
Poultry	0.044	0.017	0.064	-0.203	-0.080 **	-0.435 ***
Other livestock	-0.004	-0.001	0.193	-0.019	-0.007	0.148
Operator Characteristics						
Age (2001)	0.074	0.029 ***	0.157 ***	0.069	0.026 ***	0.147 ***
Age squared	-0.0011	-0.0004 ***	-0.0020 ***	-0.0011	-0.0004 ***	-0.0020 ***
Pension and investment income	0.0034	0.0013 ***	0.0024 ***	0.0027	0.0010 ***	0.0019 ***
Socioeocnomic Characteristics						
Population density (2001)	0.009	0.004 *	0.031 ***	0.012	0.005 ***	0.032 ***
Employment rate	0.003	0.001 **	0.005 **	0.003	0.001 **	0.003
Statistical Area Classification						
CMA	0.132	0.050 ***	0.012	0.162	0.061 ***	0.059
CA	0.130	0.049 ***	0.109	0.121	0.046 **	0.056
Strong MIZ (reference)						
Moderate MIZ	0.056	0.021	-0.134 *	0.080	0.031 *	-0.105
Weak MIZ	0.005	0.002	-0.076	0.041	0.016	-0.057
No MIZ	-0.019	-0.007	-0.377 ***	0.028	0.011	-0.300 ***
Unidentified SAC	0.071	0.027	0.176	0.088	0.033	0.252 **
Regions						
Atlantic				-0.33	-0.13 *	0.09
Quebec				-0.23	-0.09	-0.68 **
Ontario (reference)						
Manitoba				-0.50	-0.20 ***	-1.15 ***
Saskatchewan				-0.25	-0.10	-1.15 ***
Alberta				-0.60	-0.23 ***	-0.52
British Columbia				0.36	0.13	0.68 *
Interaction terms						
Regions / CV farm revenues						
Atlantic				0.07	0.03	-0.03
Quebec				0.02	0.01	0.08
Ontario (reference)						
Manitoba				0.08	0.03	0.22 **
Saskatchewan				0.04	0.02	0.25 **
Alberta				0.13	0.05 **	0.13
British Columbia				-0.08	-0.03	-0.17 *
Regions/Correlation(Net farm income; program paiements)						
Atlantic				0.08	0.03	0.22
Quebec				0.01	0.01	-0.12
Ontario (reference)						
Manitoba				0.08	0.03	0.24
Saskatchewan				0.21	0.08 **	0.23
Alberta				0.18	0.07 *	0.23
British Columbia				0.02	0.01	0.08
Incorporated farms				2.64	0.51 ***	3.49 ***
CV farm revenues				-0.49	-0.19 ***	-0.59 ***
Correlation(Net farm income; program paiements)				0.00	0.00	0.12 *
Intercept	-1.10 ***		6.05 ***	-1.03 ***		6.14 ***
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		

Symbols: * significant at the 10% level; ** significant at the 5% level;*** significant at the 1% level.
Notes: For the probit model the significance level is based on results for the coefficient estimates
Source: Statistics Canada, Farm operator longitudinal database.

Socioeconomic environment

Socioeconomic factors also appear to affect the farm operator's decision to work off the farm and their level of off-farm employment income. As expected, population density of the region had a positive impact on the likelihood of off-farm work and the level of off-farm employment income. An increase of population density by 100 persons per square kilometre would increase the likelihood of off-farm work by only 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 off-farm employment 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 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 and medium commercial farms located in urban regions were more likely to have off-farm work compared to other operators of small and medium 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 with the highest distance from urban labour markets (i.e. No MIZ).

Table 5 Model Results - Farm operators of unincorporated farms by farm typology, Canada, 2001 to 2006

	Pension/Hobby		Low-income		Commercial farms					
					Small and medium		Large		Very large	
	Probit	Log-linear	Probit	Log-linear	Probit	Log-linear	Probit	Log-linear	Probit	Log-linear
	Marginal effect	Coefficient	Marginal effect	Coefficient	Marginal effect	Coefficient	Marginal effect	Coefficient	Marginal effect	Coefficient
Farm Income Risk										
CV of farm market revenues (log)	0.009	0.042	0.023	-0.036	0.032 **	0.036	0.063 ***	0.372 ***	-0.007	0.353 ***
Correlation (net farm income, program payments)	0.002	0.008	0.034	-0.294 ***	0.022	-0.127	0.023	0.238 ***	0.044	0.414 *
Farm Characteristics										
Farm size	0.0001	0.004	-0.006 ***	-0.022 ***	-0.005 ***	-0.019 ***	-0.0002 ***	-0.002 ***	0.000	0.000
Net operating farm income	-0.0005	-0.015 ***	-0.012 ***	-0.043 ***	-0.008 ***	-0.033 ***	-0.002 ***	-0.011 ***	0.000 ***	-0.001 **
Program payments	-0.0003	-0.010 ***	-0.003 ***	-0.014 ***	-0.005 ***	-0.016 ***	-0.004 ***	-0.030 ***	-0.007 ***	-0.033
Farmland value	0.0004	0.008	-0.013	-0.014	-0.002	0.004	0.000	0.061 ***	0.004	0.059
Production type										
Grain and Oilseed (reference)										
Potato	n/a	-3.331 ***	0.412 ***	-0.426	0.078	0.431	-0.054	-0.175	-0.021	-0.451
Other Vegetable	-0.494 ***	-0.250	-0.145 *	-0.462	-0.172 ***	-0.705 **	-0.106 *	-0.655 *	-0.074	0.774
Fruit and Nut	-0.026	0.016	-0.051	-0.534	0.038	-0.190	0.047	-0.963 ***	0.071	-2.201 *
Greenhouse/Nursery	-0.057	0.063	-0.076	-0.901 *	-0.225 ***	-0.432	-0.078	-1.064 ***	-0.308 ***	-2.080 ***
Other crop	0.010	-0.130	-0.083	-0.261	-0.047	-0.147	-0.108 ***	-0.368	0.039	-1.939 ***
Beef	0.015	0.042	-0.024	0.066	-0.063 ***	-0.150 *	-0.094 ***	-0.264 **	-0.118 **	-0.758 *
Dairy	-0.101	-0.520 **	-0.222 ***	-0.750 **	-0.273 ***	-0.935 ***	-0.180 ***	-1.329 ***	-0.149 **	-2.837 ***
Hog	-0.204	0.238	-0.088	-0.581	-0.072	0.145	-0.043	-1.041 ***	-0.092	-2.087 ***
Poultry	-0.032	-0.392	0.314 **	-0.663	-0.063	-0.243	0.048	0.070	-0.166 ***	-1.212 **
Other livestock	-0.003	0.278	-0.127 **	-0.325	-0.070	-0.272 *	-0.119 ***	-1.047 ***	0.009	-0.259
Operator Characteristics										
Age (2001)	-0.004	0.049 **	0.024 ***	0.078 ***	0.033 ***	0.156 ***	0.013 ***	0.068 ***	0.018 *	0.123 *
Age squared	0.000	-0.001 **	0.000 ***	-0.001 ***	-0.001 ***	-0.002 ***	0.000 ***	-0.001 ***	0.000 **	-0.001 *
Pension and investment income	0.000	0.001 ***	0.004 ***	-0.001	0.001 ***	0.002 ***	0.001 ***	0.001 ***	0.000 *	0.001 ***
Socioeocnomic Characteristics										
Population density (2001)	0.001	0.014 **	0.003	0.011	0.002	0.027 **	0.005	0.020	0.008	0.042
Employment rate	-0.001	0.001	0.002	0.009 **	0.003 ***	0.000	0.001	0.003	-0.001	-0.008
Statistical Area Classification										
CMA	-0.003	0.085	0.035	-0.342	0.088 **	-0.230	0.004	0.220	0.026	-0.641
CA	-0.008	0.036	0.090	-0.079	0.072 *	-0.073	0.030	-0.064	0.035	-0.033
Strong MIZ (reference)										
Moderate MIZ	-0.002	0.058	0.080 *	-0.037	0.045	-0.176	0.008	-0.165	-0.009	-0.242
Weak MIZ	-0.006	0.004	0.042	0.144	0.038	-0.207 *	0.035	0.109	-0.078	-0.753 *
No MIZ	-0.014	-0.025	0.049	-0.098	0.032	-0.457 ***	0.043	-0.180	0.142 *	-0.101
Unidentified SAC	0.017	-0.056	-0.146 **	-0.104	0.044	-0.047	0.043	0.136	0.192 *	-0.186
Intercept		9.552 ***		8.175 ***		7.934 ***		6.643 ***		6.314 ***
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	

Symbols: * significant at the 10% level; ** significant at the 5% level;*** significant at the 1% level.
Source: Statistics Canada, Farm operator longitudinal database.

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 off-farm employment 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 $1,000 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 government program payments had a significant impact on the likelihood of off-farm work and also would increase the expected level of off-farm employment 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 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 off-farm employment 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 off-farm employment 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 a 4% increase in off-farm employment income. In addition, higher farm income risk increased the likelihood of working off-farm for operators of Alberta and Saskatchewan operators more than Ontario operators. In contrast, off-farm employment income was higher among farmers from British Columbia than Ontario operators, 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 relationship 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 may result from 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

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 (table 5). 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 annual off-farm employment income of $46,731 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 and medium commercial farms. The responsiveness of off-farm employment income to farm market revenue risk among operators of large 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 medium 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 enter the 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 large 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' economic well-being. The farm-operator-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 farm income risk is related to the decision to work off the farm, farmers diversify their income portfolio with off farm activities. The ability of farm operators and households to combine risky farm enterprises and off-farm opportunities has policy implications. Off-farm diversification must then be added to a list of existing, albeit imperfect, private risk management tools. The existence of these off-farm opportunities implies that farm income stabilization policies could risk crowding out private initiatives.

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 large 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.

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 farm 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. 2007. Making American Agriculture Productive And Profitable:

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

Benjamin, C., and A. Kimhi. 2006. "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 33:149–171.

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

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

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

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

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

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

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

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

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

Mishra, A.K., and C.L. Sandretto. 2002. "Stability of Farm Income and the Role of Nonfarm Income in U.S. Agriculture." Review of Agricultural Economics 24:208–211.

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

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

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

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

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