An Examination of the Adoption of Conservation Practices on Owned and Rented Farmland in Ontario and Manitoba

by

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ABSTRACT

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Approximately 40% of farmland is rented in Canada (Statistics Canada, 2011). It is therefore necessary to understand the influence farmland ownership has on the adoption of conservation practice by a farmer. Previous research on this issue however has yielded conflicting results. This conflict in literature can be potentially explained by the differences in the present value of expected returns across conservation practices. The adoption of cover crops, for example, involves a tradeoff between costs which occur in the short term and increases in the productivity of the land which occur in the longer term. On the other hand, the adoption of conservation tillage could be profitable in the short-term once the farmer has acquired the machinery. This study uses a unique dataset to examine the decision to adopt a conservation practice for the same farmer on owned and rented land. A Linear Probability Model with fixed effects was used to analyze the dataset. Tenure status was not found to be a statistically significant factor for the adoption of conservation tillage. However, the adoption of cover crops was found to be significantly higher on owned land. The results from this study suggest that the influence of tenure status can vary depending on the present value of expected returns associated with the conservation practice.
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Chapter 1. Introduction

The average rate of soil erosion in the U.S. and Canada has been steadily decreasing for the last two decades (McConkey et al., 2011; USDA, 2007). Despite this reduction, the level of soil loss has far exceeded the rate of natural soil formation (Pimentel and Burgess, 2013). Soil erosion is also a more severe problem in the developing world and as a result, approximately 75 billion tons of soil is estimated to be lost from the world’s agricultural system each year (Eswaran et al., 2001). Pimentel and Burgess (2013) argue that the loss of cropland due to soil erosion poses a critical threat to food production. The serious nature of the consequences of soil erosion has resulted in a rich history of economic research on the farmer’s decision to adopt management practices that reduce the rate of soil erosion. This literature has identified a variety of factors that significantly influence the adoption of these conservation practices. For instance, Ervin and Ervin (1982) found that the educational attainment of the farmer and the erosion potential of the land to be significant factors in the use of conservation practices. Soule (2001) argues that the financial resources of a farming operation can also act as a binding constraint on the farmer’s decision to adopt certain agricultural management practices. Prokopy et al. (2008) provides a review of the literature and identifies the factors that significantly influence the adoption of agricultural conservation practices. A summary of this literature review is presented in Table 26 in Appendix A.

Previous research on the influence of farmland ownership on the adoption of conservation practices has so far yielded conflicting results. Some studies find that owner-operators are more likely to adopt conservation practices than renter-operators (Belknap and Saupe, 1988; Lynne et al., 1988). This finding is consistent with the idea that owner-operators have a longer planning horizon than tenants and are therefore more likely to invest in
conservation practices that generate benefits in the long-term. However, another set of studies (Lee and Stewart, 1983; Rahm and Huffman, 1984; Norris and Batie, 1987;) find no differences between owner-operators and tenants, with respect to the adoption of conservation practices such as conservation tillage.

The conflict in literature might be due to the ambiguity in defining the appropriate measure for the adoption of conservation practices. For instance, Lynn et al. (1988) use the number of conservation practices adopted by farmers as a proxy for their conservation effort while Norris and Batie (1987) use total expenditures on conservation practices. Other studies (Lee and Stewart, 1983; Rahm and Huffman, 1984) use a dichotomous choice model to examine the adoption of a specific conservation practice. Soule et al. (2000) argue against using an aggregate of conservation practices since the role of tenure might vary with the rate by which conservation practices become profitable. For instance, tenure status might influence the adoption of site-specific conservation practices such as cover crops, which increase costs in the short-term while only generating benefits in the long-term. On the other hand, the role of tenure status might be less important in the adoption of non-site specific conservation practices such as conservation tillage that potentially reduce production costs in the short-term. The influence of tenure status on the adoption of conservation practice may depend on the timing of the return of the conservation practice.

The approach to defining the tenure status of a farmer also varies considerably across the literature. Tenure is frequently measured as a ratio of total rented cropland to total cropland acreage operated by the farmer (Rahm and Huffman, 1984; Norris and Batie, 1987; Belknap and Saupe, 1988). However, dummy variables are also used to indicate the tenure status of a farmer (Lee and Stewart, 1983; Lynn et al., 1988; Soule et al., 2000). The lack of a consistent approach
to model the adoption of conservation practices and defining the tenure status of the farmer has reduced the comparability of these studies, resulting in an uncertain understanding of the role of tenure status on the adoption of conservation practices.

The literature has also largely treated farmers who rent land as a homogenous group with similar incentives. However, Allen and Lueck (1992) argue that farmers have a lower incentive to exploit the land under a share-contract as opposed to a cash-contract. Soule et al. (2000) seem to support this argument by finding that farmers with a cash-contract are less likely to adopt conservation tillage than farmers with a share-contract or owner-operators. Also, the literature has implicitly assumed that all farmers who rent land operate with the same level of tenure security. However, farmers who rent land may have differing levels of tenure security, which would influence their decision to adopt conservation practices. For instance, a farmer who expects to rent a given parcel of land for the next twenty years faces drastically different incentives to adopt a conservation practice, as opposed to one who does not expect to farm the land next year. Previous research has ignored the differences in tenure security between renter-operators due to constraints in the availability of data. However, this heterogeneity must be taken into account in order to fully understand the influence of tenure status on the adoption of conservation practices.

The role of landlords in the adoption of conservation practices on rented farmland has largely been ignored in empirical literature. Approximately half the land in the U.S is owned and rented out by non-farmers, individuals who do not farm any land of their own [Kirwan, 2009]. The non-farmer landlords might face different incentives than a landlord with a farming background to maintain the productivity of the farmland. For instance, non-farmer landlords might be less likely to require the adoption of conservation practices due to high monitoring or
enforcement costs. Also, structural conservation practices such as grassed waterways and terraces require significant landowner participation. Given the significant proportion of non-farmer landlords in the agricultural markets, the role of landlords in the adoption of conservation practices is therefore also of considerable interest.

The percentage of farmland under tenancy in Canada has been steadily increasing as illustrated in Figure 1. The steady growth of the agricultural rental market combined with the conflicting results in previous research therefore requires a closer examination of the role of tenure status on the adoption of conservation practices. This study aims to enrich the debate that exists in the literature by focusing on influence of tenure status on the adoption of a machinery-related conservation practice (conservation tillage) and a site-specific conservation (cover crops).

1.1. Objectives

The purpose of this study is to evaluate the effect of tenure status on the adoption of conservation management practices in Ontario and Manitoba. More specifically, the adoption of conservation tillage and cover crops is examined.

The goal of this study is pursued through the following specific objectives

i. To develop a conceptual framework to explain the relationship between tenure security and the adoption of conservation management practices by reviewing literature.

ii. To provide an overview of the agricultural rental market in Ontario and Manitoba by collecting primary data via a survey instrument

iii. To derive an empirical model that characterizes the relationship between the adoption of the conservation practices and the various farm and operator characteristics by consulting previous applied research on this subject

iv. To test the model by using primary data collected from farmers in Ontario and Manitoba
To provide the policy implications of this research by interpreting and discussing the results generated by the empirical model.

**Figure 1: Percentage of farmland acres rented in Canada from 1976-2011 by census year**


1.2. Thesis Organization

The remainder of this thesis is organized as follows. Chapter 2 provides a brief description of the conservation tillage and cover crops, which are the focus of this study. This chapter details some of the costs and benefits associated with each practice and provides a general overview of how these practices are typically used by farmers in Canada.

In Chapter 3, the theory to explain the adoption of conservation practices and the role of tenure status is developed. This conceptual framework is then used to generate two testable
hypotheses regarding the influence of tenure status on the adoption of cover crops and conservation tillage.

The survey instrument used to gather data for this study is described in Chapter 4. In addition, this chapter provides a descriptive view of the agricultural rental market in Southern Ontario and Manitoba by summarizing the data collected via the survey instrument.

An empirical model is developed in Chapter 5 to test the hypotheses developed earlier in the thesis. This chapter provides a discussion as to why a Linear Probability Model with fixed effects was considered to be an effective tool to analyze the data. In addition, the empirical model for the adoption of conservation tillage and cover crops is specified.

Chapter 6 presents the regression results from the Linear Probability Model. This chapter provides results from both the fixed and random effects model for comparison. A discussion is presented on the statistically significant factors that influence the adoption of conservation tillage and cover crops.

The final chapter provides a summary of the thesis and discusses some of the policy implications of this research. In addition, the limitations of this study and future areas of research are identified in this chapter.
Chapter 2. Overview of Soil Conservation Practices

This study examines the influence of tenure status on the adoption of two particular types of conservation practices: conservation tillage and cover crops. This chapter provides a description of the two practices and the costs and benefits associated with their adoption.

2.1. Cover Crops

Cover crops can generally be broken down into two broad categories: Summer cover crops and winter cover crops. These crops are typically planted following the harvest of a cash crop to prevent the land from being fallow and thus reduce the exposure of soil to eroding agents such as wind and water (Creamer and Baldwin, 2000). In Ontario, summer cover crops would thus complement a winter cash crop while the winter cover crop complements a summer cash crop. The most common types of cover crops planted in Ontario are listed in Table 27 in Appendix A.

The adoption of cover crops is frequently promoted as a practice that can maintain the soil quality and productivity of the farm by reducing soil erosion (Snapp et al., 2005). Red Clover is grown as a winter cover crop and is typically underseeded with winter wheat. As a legume, it can also fix nitrogen, which might be beneficial if the farmer chooses to plant corn the following season. Oats on the other hand do not survive over the winter and are thus usually planted in the summer but can also be used as green feed. In addition to providing protection from erosion, cover crops can also build organic matter, which raises the productivity of the farm by increasing the yield potential in the long-term. The benefits of establishing a cover crop are highest on sandy soils, since they are most likely to erode due to wind or surface runoff.

Leguminous cover crops are significantly more expensive to plant than grasses because of their biological traits and the amount of seed required to establish a healthy stand (Labarta et al., 2002). The establishment of cover crop also imposes an opportunity cost on farmers since
they have to give up a season of growing a more profitable summer cash crop. In Ontario for instance, farmers can choose to plant corn or soybeans in the summer, which have similar growing seasons (May – September). However, the growing season of a winter cover crop (September – July) prevents the farmer from planting the more profitable cash crop in the summer. In Ontario, farmers could underseed red clover with winter wheat, thus providing a higher return than if they chose to plant the red clover on its own. However, the return on winter wheat is still lower when compared to the return from corn or soybeans as illustrated in Tables 28 and 29 in Appendix A. The percentage of land devoted to grow winter wheat in Ontario is therefore significantly lower than that for corn and soybeans (Figure 2). The use of a summer cover crop similarly signals the farmer’s decision to forego the more profitable summer cash crop. The adoption of cover crops therefore requires a sacrifice in short-term profitability for longer-term gains in the form of higher land productivity.

2.2. Conservation Tillage

Tillage refers to the process of preparing the field prior to planting a crop. Tillage systems can be classified into three broad categories: Intensive or conventional tillage, Minimum Tillage and No-Till. For the purposes of this study, the term conservation tillage refers to the Minimum Tillage and No-Till systems.

In Canada, the field is typically plowed with a moldboard plow in the fall under the Intensive/Conventional Tillage system. This is followed by cultivation with a chisel plow or disks in the spring prior to seeding. This type of tillage involves the inversion of the entire soil structure, which acts as an effective control on the growth of weeds. In addition, the cultivation in the spring helps to dry out the soil, which is required for successful seeding and germination.
However, the crop residue is plowed under the soil in this tillage system, which increases the risk of erosion.

**Figure 2: Estimated Acreage of Corn, Soybeans and Winter Wheat in Ontario from 2008-2012**

Source: OMAFRA. 2013

Under the minimum tillage system, the crop residue is not plowed under in the fall. In the spring, the field is either cultivated with a chisel plow, disks or coulters that only loosens the soils but does not invert it. Zone-tillage, ridge-till and strip-till systems are common examples of a minimum tillage system in which only a small portion of the soil is disturbed prior to planting. Under this tillage system, a significant amount of crop residue is left on the surface that reduces the risk of erosion and can also help build organic matter. However, since the soil is not inverted, weeds are not controlled under this tillage system and might therefore impose higher herbicide costs.
As the name implies, under the No-Till system, the land is not prepared prior to seeding. No-Till planting therefore leaves the most amount of crop residue on the surface of the three systems and subsequently the highest amount of protection from soil erosion. This system however requires modifications to the planting equipment that can enable it to cut through the crop residue to plant the seeds at the appropriate depth. A rolling coulter is mounted on the planting equipment to loosen the soil and a disk opener is then used to create a furrow in which the seed is planted. Once again, this system might impose higher herbicide costs since weeds are not controlled via soil inversion.

As mentioned above, conservation tillage systems reduce the risk of erosion by preserving a significant amount of crop residue on surface. In addition, the conservation tillage systems can also reduce yearly production costs via reductions in labour and fuel costs since the land is not tilled as extensively. However, herbicide costs are higher under conservation tillage systems, which could potentially offset the savings from fuel and labour costs (Weersink et al., 1992). On the other hand, Zentner et al. (2002) have shown that conservation tillage systems reduce production costs for certain soil conditions and crops. Fine texture soils for instance have a lower infiltration capacity, which makes them less suited for conservation tillage since the soil might be too wet for proper seeding. Similarly, corn is also less suited to conservation tillage than soybeans since corn residue is much heavier and therefore more difficult to plant in.

However, the adoption of minimum tillage and No-Till systems has steadily increased in Canada as illustrated in Figure 3.

Summary

As discussed above, the equipment requirements vary for the different type of tillage systems. A farmer would therefore incur additional overhead costs to purchase and maintain equipment for
two different types of tillage systems. The costs of production are also potentially lower under conservation tillage systems as shown in Tables 28 and 29 in Appendix A. Also, the return under a conservation tillage system is higher in the short-term if the reduction in yield is offset by reduction in fuel, labour and machinery costs. On the other hand, the decision to plant cover crops poses costs in the short-terms while the benefits can only be realized in the future time periods in the form of increased land productivity. The influence of tenure status on the adoption of conservation tillage and cover crops might differ due to the inherent difference in the timing of benefits from the two practices. This line of reasoning is developed further in the next chapter.

**Figure 3: Percentage of total land prepared for seeding via Minimum Tillage and No-Till from 1991-2011**

Chapter 3. Economic Theory of the Adoption of Conservation Practices

The economic model of soil erosion developed by McConnell (1983) and adapted by Soule et al. (2001) is used to generate hypotheses regarding the effect of tenure status on the adoption of conservation tillage and cover crops. In this simple two-period model, a farmer is assumed to grow a single crop on the field via a production practice $i$ that maximizes the present value (PV) of current net returns along with the future value of the land.

$$\max_i PV_i = \pi_i + \frac{\gamma V_i}{(1 + r)} \quad [1]$$

where $\pi_i$ represents the current net returns under practice $i$. $V_i$ represents the future value of the land under practice $i$ and $r$ is the discount rate. $V_i$ is a function of expected future net returns and therefore increases as soil erosion is reduced in the current time period. The model therefore implicitly assumes that the land will not be converted to non-agricultural purposes in the future time period. $\gamma$ is a measure of the farmer’s subjective belief of their ability to operate on the land beyond the current time period. If a farmer has complete tenure security and expects to farm the land in the next time period, then $\gamma = 1$. On the other hand, $\gamma < 1$ for farmers who do not have complete tenure security and are therefore uncertain of their ability to farm the land beyond the current time period. As tenure security decreases, the farmer’s incentive to consider the future value of the land is therefore also reduced. For the sake of simplicity, the farmer’s decision to adopt cover crops and conservation tillage will be examined separately.

3.1. Adoption of Cover Crops

The farmer’s decision to adopt cover crops is represented by $i=a$ and the decision to not plant cover crops is represented by $i=b$. The farmer would therefore choose the production practice $i$
that maximizes the present value of current net returns along with the future value of the land. The current net returns under the two different production practices can therefore be stated as:

\[ \pi_a = p y_a - c_1 z_a - c_2 x_a \quad [2] \]

\[ \pi_b = p y_b - c_1 z_b \quad [3] \]

where \( p y_i \) represents the revenue from the cash crop grown on the field. \( z \) and \( x \) represent productive inputs and conservation inputs respectively. Inputs such as fertilizer, seeds and labour that are required to grow the cash crop are considered to be productive inputs. On the other hand, inputs required to establish the cover crop are considered to be conservation inputs. The cost of productive inputs and conservation inputs are represented by \( c_1 \) and \( c_2 \) respectively. The cost of productive inputs is expected to be equal under both practices \((c_1 z_a = c_1 z_b)\). The decision to adopt cover crop however reduces net current returns since it increases production costs in the current time period via the use of conservation inputs \((x_a)\).

\[ \pi_a < \pi_b \quad [4] \]

However, cover crops are expected to reduce soil erosion beyond the first period. The reduction in soil erosion increases the future value of the land and therefore:

\[ \frac{V_a}{(1 + r)} > \frac{V_b}{(1 + r)} \quad [5] \]

The decision to plant cover crops therefore requires a tradeoff between the reduction in current net returns and an increase in the future value of the land. This model implicitly assumes that the farmer is fully aware of the impact of cover crops in both time periods. The farmer is expected to adopt cover crops when \([6]\) holds true.

\[ \frac{V_a}{(1 + r)} - \frac{V_b}{(1 + r)} > \pi_b - \pi_a \quad [6] \]
In order to examine the influence of tenure status on the adoption of conservation practice, the decision to adopt the cover crops as illustrated in [6] can now be restated as:

$$\gamma\left(\frac{V_a}{1+r} - \frac{V_b}{1+r}\right) > \pi_b - \pi_a$$  \hspace{1cm} [7]

Consider a farmer who operates on both owned and rented land. This farmer is expected to have a lower level of tenure security on the land that he/she rents than on the land that he/she owns ($\gamma_{\text{Rented}} < \gamma_{\text{Owned}}$). This farmer is therefore more likely to plant cover crops on their own field than on the rented field. The hypothesis generated from [7] can also be stated as:

**H1:** All else equal, farmers are less likely to plant cover crops on the land that they rent than on the land that they own.

### 3.2. Adoption of Conservation Tillage

The farmer’s decision to adopt conservation tillage is represented by $i=c$ and the decision to till the land via conventional tillage is represented by $i=t$. The farmer therefore chooses the tillage system $i$ that maximizes the present value of current net returns along with the future value of the land. The current net returns under the two different tillage systems can be stated as:

$$\pi_c = py_c - c_1 z_c - c_2 x_c$$  \hspace{1cm} [8]

$$\pi_t = py_t - c_1 z_t$$  \hspace{1cm} [9]

In this case, the conservation input $x_c$ refers to the purchase or modifications of equipment that are required for the adoption of conservation tillage. Unlike the previous case, the levels of productive inputs used are not equal in the two production practices. Conservation tillage reduces the use of productive inputs such as fuel and labour ($c_1 z_c < c_1 z_t$). The effect of the adoption of conservation tillage on current net returns is therefore ambiguous since there is an increase in the use of the conservation inputs but a decrease in the use of productive inputs. However, the cost
of machinery is typically much higher than the cost of fuel and labour so it is reasonable to expect the following:

\[ \pi_c < \pi_t \] \[ \text{[10]} \]

The use of a conservation tillage system is also expected to reduce soil erosion therefore increasing the future value of the land

\[ \frac{V_c}{(1+r)} > \frac{V_t}{(1+r)} \] \[ \text{[11]} \]

A farmer is therefore expected to adopt conservation tillage by satisfying the following condition

\[ \frac{V_c}{(1+r)} - \frac{V_t}{(1+r)} > \pi_t - \pi_c \] \[ \text{[12]} \]

In order to examine the influence of tenure status, the decision to adopt conservation tillage can therefore be restated as:

\[ \gamma \left( \frac{V_c}{(1+r)} - \frac{V_t}{(1+r)} \right) > \pi_t - \pi_c \] \[ \text{[13]} \]

Consider a farmer who operates on both owned and rented land. Suppose this farmer adopts conservation tillage on his/her own land by satisfying equation [13]. This implies that the farmer purchases or modifies the equipment for conservation tillage. Once these costs are accounted for, the adoption of conservation tillage on rented land is more profitable than conventional tillage due to the reduction in the use of productive inputs.

\[ \pi_{cr} > \pi_{tr} \] \[ \text{[14]} \]

Equation [14] implies that a farmer would adopt conservation tillage on rented land even though they might not benefit from the higher future value of the land. This results in the following hypothesis:
H2: All else equal, farmers are just as likely to adopt conservation tillage on rented land as they would on their own land.

Summary

A simple two-period model is used to generate hypotheses regarding the influence of tenure status on the adoption of conservation tillage and cover crops. Farmers operating on rented land are shown to place a lower weight on the future value of the land due to tenure insecurity. The adoption of cover crops is hypothesized to be less likely on rented land than on owned land since it reduces net current returns. On the other hand, tenure status is not expected to influence the adoption of conservation tillage since net current returns are expected to be higher under minimum tillage and No-till systems once the farmer has acquired the machinery. The next chapter provides an overview of the data that was collected to test these hypotheses.
Chapter 4. Survey Instrument and Descriptive Statistics

In order to test the hypotheses generated in the previous chapter, a survey instrument was developed to collect data from farmers in Ontario and Manitoba. This chapter provides an overview of the survey instrument. In addition, the data collected from the survey is summarized in order to provide a descriptive view of the agricultural rental market in Ontario and Manitoba.

4.1. Survey Instrument

A survey instrument (presented in Appendix B) was used to gather information from a random sample of farmers in Southwestern Ontario and Manitoba from April 8 – April 22, 2013. Figures 4.1 and 4.2 highlight the study region under consideration. A total of 1778 farmers were contacted from a database of 35,023 farmers, which was compiled by Ipsos Agriculture and Animal Health, a division of Ipsos-Reid. This database was compiled by collecting farmers’ phone numbers at trade shows over several years. The database might therefore be skewed towards farmers with larger operations who frequently attend trade shows to seek out new equipment. Of these farmers, 847 agreed to participate in the survey and 810 completed the entire survey yielding an effective response rate of 45.5%.

The survey instrument was pretested with two farmers in Southern Ontario and one farmer in Manitoba in February 2013. The farmers were contacted via the phone and had agreed to provide input on the design of the survey. The pre-test was conducted to determine if the questions in the survey were appropriate and easy to understand. The pretest was also used to establish the time it would take to complete the survey and if the length of the survey needed to be altered. After the pretest was completed, several questions were reworded for clarification and the order of the questions was also changed to reduce the time needed to complete the survey. On average the survey took 20 minutes to complete and was divided into three main sections.
Section 1 of the survey acts as a screen for the respondents. In this section, respondents are first asked to indicate their age and the location of their home farm. If the respondents are under eighteen years old or live outside the study region, they fail to qualify for the study and no further information is collected from them. If the respondents do qualify for the study, they are asked to provide some information regarding the size and structure of their farming operation. The respondents are then asked if they rented land in the previous year. If the respondent farmed rented land in the previous year, they proceed to Section 2 of the survey while those who farmed only on the land they owned skip to Section 3.

In Section 2 of the survey, the respondents are only asked to provide information on the largest property that they had rented in the previous year. The questions in this section are designed to gather information about the rental contract and the relationship between the tenant and the landlord. In addition, the respondent is also asked about the use of a crop rotation, cover crops, manure application, and use of variable-rate input applicators on the rented property. Information on site-specific factors such as the productivity, soil texture and topography of the property is also collected.

The respondents then proceed to Section 3 of the survey and are asked to provide information on the largest property that they owned in the previous year. The respondents are asked about the use of the same management practices and site-specific factors as in Section 2. The design of the survey instrument therefore allows us to compare the same farmer’s decision to adopt specific management practices on their rented and owned property. In addition, respondents are also asked to provide their opinion on whether farmers in general took better care of the land they owned than the land that they rented.
The survey was rolled out to an initial sample of 40 farmers from April 4-April 6. The preliminary data was then examined for irregularities and to make sure the respondents and the interviewers understood the questions.

Figure 4.1: Map of Ontario Census Regions and Divisions. Study region is highlighted

[Map of Ontario Census Regions and Divisions]
Figure 4.2: Map of Manitoba Census Regions and Divisions. Study region is highlighted.
When farmers were asked about what crop was grown on the field during a given year, a significant number of respondent provided multiple answers. A question was inserted into the survey to confirm that the respondent did in fact grow multiple crops on the same parcel of land. The survey was then rolled out to collect data from the larger random sample of farmers, which is summarized below.

4.2. Data Summary

The data gathered from the survey is organized into four parts. Section 4.2.1 highlights the differences between farmers who rent land and those who do not. The characteristics of the rental contracts used in Southwestern Ontario and Manitoba are summarized in Section 4.2.2. This section also provides a glimpse into the different types of agricultural landlords and offers a more detailed breakdown of the cash rental rates in Southwestern Ontario and Manitoba. Section 4.3.3 provides an overview of the rate of adoption of agricultural management practices on rented and owned properties in both provinces. Finally, section 4.3.4 summarizes the judgment of the respondents on whether farmers took better care of the land they owned than the land that they rented.

4.2.1. Renters vs. Non-Renters

As indicated in the previous section, data was gathered from 810 respondents in April 2013. Of these, 403 respondents were located in Southwestern Ontario while the remaining 407 were from Manitoba. The percentage of farmers who rented land ranged from 51.36% in Southwestern Ontario to 58.97% in Manitoba.

The mean age of the sample was found to be 59.16 years in Southwestern Ontario and 56.99 years in Manitoba as shown in Tables 1a and 1b respectively. A t-test was used to compare the difference in the mean age of the farmers who rented land and those who only operated on
their own land. In Southern Ontario, farmers who rented land were found to be significantly younger \( (t = 4.27) \) than those who only operated on their own land by an average of 4.68 years.

The trend also holds true in Manitoba where farmers who rented land were found to be significantly younger \( (t = 5.34) \) by an average of 5.39 years.

<table>
<thead>
<tr>
<th>Table 1a: Mean Age of Surveyed Farmers in Southwestern Ontario</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined</td>
</tr>
<tr>
<td>Do Not Rent</td>
</tr>
<tr>
<td>Rent</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 1b: Mean Age of Surveyed Farmers in Manitoba</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined</td>
</tr>
<tr>
<td>Do Not Rent</td>
</tr>
<tr>
<td>Rent</td>
</tr>
</tbody>
</table>

The mean size of the surveyed farming operation was found to be 429.99 acres in Southwestern Ontario and 1766.77 acres in Manitoba as presented in Tables 2a and 2b respectively. The 2011 Agricultural Census (Statistics Canada, 2011) reported an average farm size of 244 acres in Ontario and 1,135 acres in Manitoba. The comparison to the census data indicates that the sample used in this study is skewed towards larger operations. It should be noted that the survey instrument was designed to gather data from all farming operations, regardless of their size.

However, as mentioned in the previous section, the universe of farmers contacted for the survey is inherently skewed towards larger operations thus leading to a larger mean size. Renters are also shown to have a significantly larger operation than non-renters in Southwestern Ontario \( (t = -9.55) \) by an average of approximately 417 acres and in Manitoba \( (t = -5.96) \) by an average of approximately 1016 acres.
As gross farm sales increase, the likelihood of a farmer renting land generally increases in both provinces as indicated in Tables 3a and 3b. For instance, only 20 - 21% of farmers with sales less than $50,000 rent land in Southwestern Ontario and Manitoba.

### Table 2a: Mean Size of Surveyed Farming Operations in Southwestern Ontario

<table>
<thead>
<tr>
<th></th>
<th>Mean Acres</th>
<th>Std. dev.</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined</td>
<td>429.99</td>
<td>484.71</td>
<td>5</td>
<td>3500</td>
</tr>
<tr>
<td>Do Not Rent</td>
<td>215.03</td>
<td>211.70</td>
<td>5</td>
<td>1400</td>
</tr>
<tr>
<td>Rent</td>
<td>632.50</td>
<td>574.62</td>
<td>34</td>
<td>3500</td>
</tr>
</tbody>
</table>

### Table 2b: Mean Size of Surveyed Farming Operations in Manitoba

<table>
<thead>
<tr>
<th></th>
<th>Mean Acres</th>
<th>Std. dev.</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined</td>
<td>1766.77</td>
<td>1759.95</td>
<td>3</td>
<td>12000</td>
</tr>
<tr>
<td>Do Not Rent</td>
<td>1166.21</td>
<td>1425.40</td>
<td>3</td>
<td>10000</td>
</tr>
<tr>
<td>Rent</td>
<td>2182.15</td>
<td>1849.95</td>
<td>30</td>
<td>12000</td>
</tr>
</tbody>
</table>

### Table 3a: Gross Sales of Surveyed Farmers in Southwestern Ontario

<table>
<thead>
<tr>
<th>Sales</th>
<th>Number of Non-Renters (Column A)</th>
<th>Number of Renters (Column B)</th>
<th>Proportion of Farmers Who Rent Land (Column B) / (Column A+ Column B)</th>
<th>Std. Deviation of Rental Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than $50,000</td>
<td>60</td>
<td>15</td>
<td>0.2000</td>
<td>0.4027</td>
</tr>
<tr>
<td>$50,000 to $100,000</td>
<td>37</td>
<td>17</td>
<td>0.3148</td>
<td>0.4688</td>
</tr>
<tr>
<td>$100,000 to $250,000</td>
<td>54</td>
<td>45</td>
<td>0.4545</td>
<td>0.5005</td>
</tr>
<tr>
<td>$250,000 to $500,000</td>
<td>27</td>
<td>58</td>
<td>0.6824</td>
<td>0.4683</td>
</tr>
<tr>
<td>$500,000 to 1 million</td>
<td>8</td>
<td>36</td>
<td>0.8182</td>
<td>0.3902</td>
</tr>
<tr>
<td>1 million to 2 million</td>
<td>2</td>
<td>26</td>
<td>0.9285</td>
<td>0.2623</td>
</tr>
<tr>
<td>Greater than 2 million</td>
<td>3</td>
<td>7</td>
<td>0.7000</td>
<td>0.4830</td>
</tr>
</tbody>
</table>
On the other hand, between 70 – 88% of farming operations with sales greater than $2 million rent land in Southwestern Ontario and Manitoba. As mentioned before, farming operations that rent land are found to be significantly larger, which could explain the corresponding increase in sales illustrated in Tables 3a and 3b.

### Table 3b: Gross Sales of Surveyed Farmers in Manitoba

<table>
<thead>
<tr>
<th>Sales</th>
<th>Number of Non-Renters (Column A)</th>
<th>Number of Renters (Column B)</th>
<th>Proportion of Farmers Who Rent Land (Column B) / (Column A + Column B)</th>
<th>Std. Deviation of Rental Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than $50,000</td>
<td>46</td>
<td>12</td>
<td>0.2069</td>
<td>0.4086</td>
</tr>
<tr>
<td>$50,000 to $100,000</td>
<td>32</td>
<td>12</td>
<td>0.2727</td>
<td>0.4505</td>
</tr>
<tr>
<td>$100,000 to $250,000</td>
<td>35</td>
<td>45</td>
<td>0.5625</td>
<td>0.4992</td>
</tr>
<tr>
<td>$250,000 to $500,000</td>
<td>17</td>
<td>58</td>
<td>0.7733</td>
<td>0.4215</td>
</tr>
<tr>
<td>$500,000 to 1 million</td>
<td>15</td>
<td>57</td>
<td>0.7917</td>
<td>0.4090</td>
</tr>
<tr>
<td>1 million to 2 million</td>
<td>11</td>
<td>32</td>
<td>0.7442</td>
<td>0.4415</td>
</tr>
<tr>
<td>Greater than 2 million</td>
<td>2</td>
<td>15</td>
<td>0.8824</td>
<td>0.3321</td>
</tr>
</tbody>
</table>

In Tables 4a and 4b, significant differences are found in the business structure of farm operations that rent land and those that do not. In both provinces, farming operations that rent land are more likely to be incorporated than those that operate only on owned land.

### Table 4a: Business Structure of Surveyed Farmers in Southwestern Ontario

<table>
<thead>
<tr>
<th></th>
<th>Sole Proprietorship (%)</th>
<th>Partnership (%)</th>
<th>Corporation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined</td>
<td>47.51</td>
<td>27.86</td>
<td>24.63</td>
</tr>
<tr>
<td>Do Not Rent</td>
<td>56.92</td>
<td>28.72</td>
<td>14.36</td>
</tr>
<tr>
<td>Rent</td>
<td>38.65</td>
<td>27.05</td>
<td>34.30</td>
</tr>
</tbody>
</table>
Table 4b: Business Structure of Surveyed Farmers in Manitoba

<table>
<thead>
<tr>
<th></th>
<th>Sole Proprietorship (%)</th>
<th>Partnership (%)</th>
<th>Corporation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined</td>
<td>46.55</td>
<td>22.41</td>
<td>31.03</td>
</tr>
<tr>
<td>Do Not Rent</td>
<td>56.63</td>
<td>20.48</td>
<td>22.89</td>
</tr>
<tr>
<td>Rent</td>
<td>39.58</td>
<td>23.75</td>
<td>36.67</td>
</tr>
</tbody>
</table>

4.2.2. Rental Contract Characteristics

This section provides an overview of the agricultural rental market in Southern Ontario and Manitoba. Although farmers might rent multiple properties from different landlords, they were only asked to provide details about the largest property that they rented.

The farmers in our study rented their largest property for an average of 13.27 and 11.61 years in Southern Ontario and Manitoba respectively as illustrated in Tables 5a and 5b.

Table 5a: Rental Contract Characteristics in Southwestern Ontario

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
<th>Obs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acres of Largest Property</td>
<td>94.30</td>
<td>80.94</td>
<td>4</td>
<td>700</td>
<td>207</td>
</tr>
<tr>
<td>Years Renting Property</td>
<td>13.27</td>
<td>9.51</td>
<td>1</td>
<td>42</td>
<td>207</td>
</tr>
<tr>
<td>Expected Future Length of Tenure</td>
<td>8.64</td>
<td>6.55</td>
<td>0</td>
<td>30</td>
<td>160</td>
</tr>
<tr>
<td>Cash Rental Rate ($/Acre)</td>
<td>122.69</td>
<td>87.11</td>
<td>0</td>
<td>600</td>
<td>128</td>
</tr>
<tr>
<td>Crop-Share Split (% to Landlord)</td>
<td>40.89</td>
<td>22.06</td>
<td>0</td>
<td>100</td>
<td>35</td>
</tr>
</tbody>
</table>

Table 5b: Rental Contract Characteristics in Manitoba

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
<th>Obs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acres of Largest Property</td>
<td>337.59</td>
<td>310.41</td>
<td>15</td>
<td>3000</td>
<td>236</td>
</tr>
<tr>
<td>Years Renting Property</td>
<td>11.61</td>
<td>9.52</td>
<td>1</td>
<td>53</td>
<td>239</td>
</tr>
<tr>
<td>Expected Future Length of Tenure</td>
<td>7.76</td>
<td>6.53</td>
<td>0</td>
<td>30</td>
<td>201</td>
</tr>
<tr>
<td>Cash Rental Rate</td>
<td>47.20</td>
<td>23.66</td>
<td>2</td>
<td>150</td>
<td>164</td>
</tr>
<tr>
<td>Crop-Share Split (% to Landlord)</td>
<td>26.05</td>
<td>7.48</td>
<td>12</td>
<td>40</td>
<td>19</td>
</tr>
</tbody>
</table>
In addition, on average farmers expect to rent that same property for an additional 8.64 and 7.76 years in Southern Ontario and Manitoba respectively.

The majority of the rental contracts in Southwestern Ontario and Manitoba are cash contracts. Crop and cost-share contracts make up only 18.45% of the rental contracts in Southwestern Ontario and 8.94% of the rental contracts in Manitoba. Also, the majority of the rental contracts are agreed to orally in both provinces. However, it is interesting to note that written contracts are more prevalent in Manitoba (46.67%) than in Southwestern Ontario (26.21%). Tables 6a and 6b provide breakdowns of mean cash and share rental rates by county in Southwestern Ontario and by region in Manitoba. Counties with highly productive land like Peel and Chatham were generally found to have higher rental rates.

### Table 6a: County Mean Cash and Share Rental Rates in Southwestern Ontario

<table>
<thead>
<tr>
<th>County</th>
<th>Cash Contract (Number)</th>
<th>Cash Rental Rate ($/acre) (Std. dev.)</th>
<th>Share-Contract (Number)</th>
<th>Crop Share % (% to Landlord) (Std. dev.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brant</td>
<td>5</td>
<td>86.25 (44.98)</td>
<td>1</td>
<td>90 (-)</td>
</tr>
<tr>
<td>Bruce</td>
<td>9</td>
<td>86.67 (25.23)</td>
<td>1</td>
<td>75 (-)</td>
</tr>
<tr>
<td>Chatham</td>
<td>10</td>
<td>265.83 (183.20)</td>
<td>5</td>
<td>36.20 (9.36)</td>
</tr>
<tr>
<td>Dufferin</td>
<td>3</td>
<td>64 (48.08)</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Elgin</td>
<td>9</td>
<td>164.29 (37.79)</td>
<td>3</td>
<td>29.33 (4.04)</td>
</tr>
<tr>
<td>Essex</td>
<td>10</td>
<td>143.14 (86.41)</td>
<td>4</td>
<td>40.75 (6.99)</td>
</tr>
<tr>
<td>Grey</td>
<td>10</td>
<td>47.14 (32.90)</td>
<td>4</td>
<td>55 (63.63)</td>
</tr>
<tr>
<td>Haldimand</td>
<td>10</td>
<td>80 (58.43)</td>
<td>1</td>
<td>35 (-)</td>
</tr>
<tr>
<td>Halton</td>
<td>4</td>
<td>56.25 (20.97)</td>
<td>0</td>
<td>---</td>
</tr>
<tr>
<td>Hamilton</td>
<td>2</td>
<td>20 (-)</td>
<td>0</td>
<td>---</td>
</tr>
<tr>
<td>Huron</td>
<td>16</td>
<td>167.27 (91.69)</td>
<td>0</td>
<td>---</td>
</tr>
<tr>
<td>Lambton</td>
<td>12</td>
<td>148.33 (67.63)</td>
<td>6</td>
<td>40.5 (11.67)</td>
</tr>
<tr>
<td>Middlesex</td>
<td>10</td>
<td>177.25 (57.93)</td>
<td>5</td>
<td>31.20 (1.64)</td>
</tr>
<tr>
<td>Niagara</td>
<td>5</td>
<td>42 (18.23)</td>
<td>0</td>
<td>---</td>
</tr>
<tr>
<td>Oxford</td>
<td>10</td>
<td>169.37 (58.21)</td>
<td>4</td>
<td>30 (-)</td>
</tr>
<tr>
<td>Peel</td>
<td>3</td>
<td>40 (35)</td>
<td>0</td>
<td>---</td>
</tr>
<tr>
<td>Perth</td>
<td>9</td>
<td>191.42 (46.43)</td>
<td>1</td>
<td>50 (-)</td>
</tr>
<tr>
<td>Simcoe</td>
<td>11</td>
<td>61.67 (29.79)</td>
<td>0</td>
<td>---</td>
</tr>
<tr>
<td>Waterloo</td>
<td>4</td>
<td>91.25 (30.65)</td>
<td>3</td>
<td>60 (40)</td>
</tr>
<tr>
<td>Wellington</td>
<td>12</td>
<td>77.88 (67.37)</td>
<td>1</td>
<td>---</td>
</tr>
</tbody>
</table>
Table 6b: Regional Mean Cash and Share Rental Rates in Manitoba

<table>
<thead>
<tr>
<th>Region</th>
<th>Cash Contract (Number)</th>
<th>Cash Rental Rate ($/acre) (Std. dev.)</th>
<th>Share-Contract (Number)</th>
<th>Crop Share % (% to Landlord) (Std. dev.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Plains</td>
<td>26</td>
<td>44.52 (23.30)</td>
<td>1</td>
<td>12(-)</td>
</tr>
<tr>
<td>Eastman</td>
<td>10</td>
<td>57.56 (26.43)</td>
<td>1</td>
<td>15 (-)</td>
</tr>
<tr>
<td>Interlake</td>
<td>10</td>
<td>35.31 (15.38)</td>
<td>1</td>
<td>33 (-)</td>
</tr>
<tr>
<td>Parkland</td>
<td>24</td>
<td>45.20 (16.34)</td>
<td>4</td>
<td>32 (6.27)</td>
</tr>
<tr>
<td>Pembina</td>
<td>45</td>
<td>65.55 (32.19)</td>
<td>4</td>
<td>23.6 (5.68)</td>
</tr>
<tr>
<td>Westman</td>
<td>67</td>
<td>39.30 (15.76)</td>
<td>6</td>
<td>26 (5.86)</td>
</tr>
<tr>
<td>Winnipeg</td>
<td>1</td>
<td>---</td>
<td>0</td>
<td>---</td>
</tr>
</tbody>
</table>

Tables 7a and 7b provide a breakdown of the different types of agricultural landlords in Southwestern Ontario and Manitoba and the rent that they charge. Non-farmer investors play a large role in the agricultural rental market in both provinces. Approximately 40.58% and 29.17% of the landlords can be classified as non-farmer investors in Southwestern Ontario and Manitoba, respectively. Non-farmer investors are therefore the most common type of landlord in Southwestern Ontario while retired farmers take that title in Manitoba with 35.83%. The results in tables 7a and 7b also indicate that active farmers supply a considerable portion of farmland in the agricultural rental market. Active farmers also charge the highest mean cash rental rate of $166.88/acre among all landlord types in Southwestern Ontario. On the other hand, retired farmers charge the highest rental rate of $49.98/acre in Manitoba. This data should be treated with caution because rental rates are a function of many factors, including the productivity and use of land. Our findings regarding landlord type may be the result of correlation between these other factors and landlord type. Our future research will attempt to control for all factors and isolate the influence of landlord type on rental rates.
Table 7a: Mean Cash Rental Rate by Landlord Type in Southwestern Ontario

<table>
<thead>
<tr>
<th>Landlord Type</th>
<th>Share of Rental Properties (%)</th>
<th>Mean Cash Rent ($/acre)</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
<th>Obs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Farmer</td>
<td>13.52</td>
<td>166.88</td>
<td>146.81</td>
<td>40</td>
<td>600</td>
<td>16</td>
</tr>
<tr>
<td>Widow (er)</td>
<td>10.63</td>
<td>109.44</td>
<td>62.02</td>
<td>0</td>
<td>200</td>
<td>9</td>
</tr>
<tr>
<td>Retired Farmer</td>
<td>18.84</td>
<td>156.74</td>
<td>65.99</td>
<td>3</td>
<td>250</td>
<td>19</td>
</tr>
<tr>
<td>Non-Farmer Investor</td>
<td>40.58</td>
<td>109.79</td>
<td>72.64</td>
<td>0</td>
<td>300</td>
<td>60</td>
</tr>
<tr>
<td>Investment Company</td>
<td>1.45</td>
<td>150</td>
<td>141.42</td>
<td>50</td>
<td>250</td>
<td>2</td>
</tr>
<tr>
<td>Government</td>
<td>1.45</td>
<td>35</td>
<td>25.98</td>
<td>20</td>
<td>65</td>
<td>3</td>
</tr>
<tr>
<td>Other</td>
<td>13.52</td>
<td>109.42</td>
<td>77.01</td>
<td>20</td>
<td>250</td>
<td>19</td>
</tr>
</tbody>
</table>

Table 7b: Mean Cash Rental Rate by Landlord Type in Manitoba

<table>
<thead>
<tr>
<th>Landlord Type</th>
<th>Share of Rental Properties (%)</th>
<th>Mean Cash Rent ($/acre)</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
<th>Obs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Farmer</td>
<td>14.58</td>
<td>47.63</td>
<td>25.90</td>
<td>12</td>
<td>116</td>
<td>24</td>
</tr>
<tr>
<td>Widow (er)</td>
<td>11.25</td>
<td>44.63</td>
<td>19.61</td>
<td>8</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>Retired Farmer</td>
<td>35.83</td>
<td>49.98</td>
<td>24.75</td>
<td>10</td>
<td>150</td>
<td>62</td>
</tr>
<tr>
<td>Non-Farmer Investor</td>
<td>29.17</td>
<td>45.23</td>
<td>23.73</td>
<td>2</td>
<td>150</td>
<td>48</td>
</tr>
<tr>
<td>Investment Company</td>
<td>0.42</td>
<td>20</td>
<td>-</td>
<td>20</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Government</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>8.75</td>
<td>46.11</td>
<td>19.81</td>
<td>20</td>
<td>75</td>
<td>9</td>
</tr>
</tbody>
</table>
Tenants were also asked how well informed their landlords are regarding rental rates. Not surprisingly, active farmers and retired farmers were considered to be the most well informed group of landlords as shown in Table 8. The government was thought to be the least informed about rental rates followed by non-farmer investors and widow(er)s.

<table>
<thead>
<tr>
<th>Landlord Type</th>
<th>Very Well Informed (%)</th>
<th>Well Informed (%)</th>
<th>Somewhat Informed (%)</th>
<th>Poorly Informed (%)</th>
<th>Do not know rental rates at all (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Farmer</td>
<td>53.97</td>
<td>34.92</td>
<td>11.11</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Widow (er)</td>
<td>41.67</td>
<td>29.17</td>
<td>25.00</td>
<td>0</td>
<td>4.17</td>
</tr>
<tr>
<td>Retired Farmer</td>
<td>49.60</td>
<td>39.20</td>
<td>11.20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Non-Farmer Investor</td>
<td>39.87</td>
<td>28.10</td>
<td>22.88</td>
<td>5.23</td>
<td>3.92</td>
</tr>
<tr>
<td>Investment Company</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Government</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>66.67</td>
<td>33.33</td>
</tr>
<tr>
<td>Other</td>
<td>33.33</td>
<td>35.42</td>
<td>27.08</td>
<td>4.17</td>
<td>0</td>
</tr>
</tbody>
</table>

Tables 9a and 9b present mean cash rental rates based on the relationship between landlords and tenants. In Southwestern Ontario, tenants who had no relationship with the landlord faced the lowest mean rental rates of $103.70/acre. On the other hand, tenants who were friends with their landlord received the lowest mean rental rate in Manitoba. Once again, the caveat of rental rates being a function of land productivity and use rather than the relationship between landlords and tenants applies here.
Table 9a: Influence of Social Capital on Mean Cash Rental Rates in Ontario

<table>
<thead>
<tr>
<th>Social Capital</th>
<th>Mean Cash Rent ($/acre)</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
<th>Obs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family</td>
<td>130.94</td>
<td>75.46</td>
<td>35</td>
<td>250</td>
<td>16</td>
</tr>
<tr>
<td>Acquaintance</td>
<td>127.50</td>
<td>105.06</td>
<td>30</td>
<td>600</td>
<td>40</td>
</tr>
<tr>
<td>Friend</td>
<td>130.44</td>
<td>83.59</td>
<td>0</td>
<td>385</td>
<td>39</td>
</tr>
<tr>
<td>No Relation</td>
<td>103.70</td>
<td>72.05</td>
<td>0</td>
<td>250</td>
<td>33</td>
</tr>
</tbody>
</table>

Table 9b: Influence of Social Capital on Mean Cash Rental Rates in Manitoba

<table>
<thead>
<tr>
<th>Social Capital</th>
<th>Mean Cash Rent ($/acre)</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
<th>Obs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family</td>
<td>46.08</td>
<td>24.24</td>
<td>20</td>
<td>150</td>
<td>36</td>
</tr>
<tr>
<td>Acquaintance</td>
<td>48.18</td>
<td>22.09</td>
<td>10</td>
<td>95</td>
<td>40</td>
</tr>
<tr>
<td>Friend</td>
<td>43.97</td>
<td>18.82</td>
<td>5</td>
<td>90</td>
<td>53</td>
</tr>
<tr>
<td>No Relation</td>
<td>52.11</td>
<td>30.57</td>
<td>2</td>
<td>150</td>
<td>35</td>
</tr>
</tbody>
</table>

4.2.3. Agricultural Management Practices

In the survey, respondents were asked to provide details on their tillage practices, the use of cover crops, manure applications, and use of a variable rate input applicator on their largest rental property. The respondents were then asked the same questions about the management practices on the largest property that they owned. This section provides an overview of the management practices adopted on rental and owned properties.

In Table 10a, the adoption rates for Minimum tillage/No-till, Variable rate input applicators, cover crops and manure applications are presented for both rented and owned properties in Southwestern Ontario. There is a considerable difference in the application of manure between rental and owned properties, while there seems to be little difference in the adoption of the other management practices. A similar trend holds in Manitoba as shown in
Table 10b. However, since the use of cover crops is limited in Manitoba, respondents were instead asked about the use of chaff spreaders, straw choppers or heavy harrows for crop residue management.

### Table 10a: Adoption rates of management practices in Ontario

<table>
<thead>
<tr>
<th>Management Practice</th>
<th>Rented Property</th>
<th>Observations</th>
<th>Own Property</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum/No-Till</td>
<td>66.18%</td>
<td>204</td>
<td>60.98%</td>
<td>387</td>
</tr>
<tr>
<td>Cover Crop</td>
<td>18.84%</td>
<td>207</td>
<td>26.41%</td>
<td>390</td>
</tr>
<tr>
<td>Precision Agriculture</td>
<td>17.73%</td>
<td>203</td>
<td>15.01%</td>
<td>373</td>
</tr>
<tr>
<td>Manure Application</td>
<td>31.40%</td>
<td>207</td>
<td>53.57%</td>
<td>392</td>
</tr>
<tr>
<td>Surface or Tile Drainage</td>
<td>60.39%</td>
<td>207</td>
<td>84.69%</td>
<td>392</td>
</tr>
</tbody>
</table>

Approximately 82.5% of the respondents indicated that they used one of these implements on their rental property, while 76.65% of the respondents used one of the implements on their own property. It should be noted that the use of these management practices are potentially dependent on...
on site and crop-specific factors. Tables 10a and 10b do not control for these factors and should therefore be treated with caution.

Respondents were asked whether their landlord had any stipulations regarding specific management practices in their rental contracts. As illustrated in Table 11, very few rental contracts come with specific stipulations. This might be due to the oral and informal nature of the rental agreements. Stipulations regarding tillage were found to be the most common with 8.76% of the respondents indicating that they had specific instructions from their landlord regarding the type of tillage practice they could use.

<table>
<thead>
<tr>
<th>Type of Stipulation</th>
<th>Rental Contracts with Stipulation</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tillage Practices</td>
<td>8.76%</td>
<td>445</td>
</tr>
<tr>
<td>Crop Selection</td>
<td>5.61%</td>
<td>446</td>
</tr>
<tr>
<td>Surface or Tile Drainage</td>
<td>6.95%</td>
<td>446</td>
</tr>
<tr>
<td>Fertilizer or Manure Application</td>
<td>5.16%</td>
<td>446</td>
</tr>
<tr>
<td>Herbicide Application</td>
<td>5.38%</td>
<td>446</td>
</tr>
</tbody>
</table>

Cost-share programs in Ontario (Canada-Ontario and Farm Stewardship program) and Manitoba (Environmental Farm Action Program & Manitoba Sustainable Agricultural Practices Program) offered funding for a variety of management practices. However, only a small percentage of surveyed farmers applied for and received funding for the management practices listed in Table 12.
Table 12: Applications to Cost-Share Programs in Ontario and Manitoba

<table>
<thead>
<tr>
<th>Management Practice</th>
<th>Number of Applications (%)</th>
<th>Number of Funded Projects (%)</th>
<th>Total Number of Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cover Crops</td>
<td>5 (1.28%)</td>
<td>2 (0.51%)</td>
<td>391</td>
</tr>
<tr>
<td>Residue Management</td>
<td>59 (14.97%)</td>
<td>13 (3.30%)</td>
<td>394</td>
</tr>
<tr>
<td>Conservation Tillage</td>
<td>68 (8.71%)</td>
<td>28 (3.59%)</td>
<td>781</td>
</tr>
<tr>
<td>Precision Agriculture</td>
<td>42 (5.35%)</td>
<td>21 (2.68%)</td>
<td>785</td>
</tr>
</tbody>
</table>

4.2.4. Farmer Perception

The respondents in the survey were asked if they think farmers take better care of the land they own than the land that they rent. As illustrated in Figure 5, 53% of the sample or 431 respondents agree with proposition that farmers take better care of their own land than the land that they rent.

**Figure 5: Response to whether farmers took better care of their own land than the land that they rented**

Of these 431 farmers, 78% agree with the notion that farmers use more fertilizer or manure on the land they own than the land that they rent. Also, 63% of this sample agreed that farmers use a more complex crop rotation on their own land than the land that they rent. It should be noted
that in Figure 3, 39.51% or 320 farmers disagree with the stated proposition. In order to understand why farmers might treat the land that they rent with the same care as the land that they own, respondents were asked to rate the reasons shown in Figure 6 as very important, moderately important or not important. Of the 320 farmers in this sample, 73% of them rated securing the rental contract for the next year as being a very important reason as to why a farmer would treat the land that they rent with the same care as the land that they own. A smaller majority of farmers also rated maintaining their reputation in the community, taking better care of the environment and meeting the conditions of the rental contract as very important reasons why farmers do not differentiate in their management practices between their owned and rented properties.

**Figure 6: Reasons why farmers treat the land that they rent with the same care as the land that they own**

<table>
<thead>
<tr>
<th>Reason</th>
<th>Very Important</th>
<th>Moderately Important</th>
<th>Not Important</th>
<th>Don’t Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reputation</td>
<td>70%</td>
<td>20%</td>
<td>10%</td>
<td>0%</td>
</tr>
<tr>
<td>Secure Contract</td>
<td>75%</td>
<td>15%</td>
<td>10%</td>
<td>0%</td>
</tr>
<tr>
<td>Environmental Stewardship</td>
<td>65%</td>
<td>25%</td>
<td>10%</td>
<td>0%</td>
</tr>
<tr>
<td>Contract Stipulation</td>
<td>60%</td>
<td>20%</td>
<td>20%</td>
<td>0%</td>
</tr>
</tbody>
</table>

**Summary**

This chapter provided a description of the survey instrument that was used to collect data from a random sample of farmers in Ontario and Manitoba. In addition, the data is summarized to provide a broad overview of the agricultural rental market in the two provinces.
In summary, farmers who rent land were found to have larger operations in terms of size and sales and are significantly younger. In both provinces, farming operations that rent land are more likely to be incorporated than those that operate only on owned land. Farmers were found to rent a given property for an average of approximately 12-13 years in Manitoba and Southwestern Ontario. There is considerable variation in the length of rental arrangement in both provinces. Rental rates were also found to vary considerably by the location of the property.

Our survey results indicate that non-farmer investors own a large portion of the agricultural land in the rental market in both provinces. Non-farmer investors charge a lower average rental rate than retired and active farmers in both Manitoba and Southwestern Ontario. Fixed cash contracts are the dominant form of rental contract in both Manitoba and Southwestern Ontario. While a large majority of the contracts in Southwestern Ontario tend to be oral contracts, there is a more even split in Manitoba where approximately 47% of the contracts are written.

Only a small percentage of rental contracts contain stipulations regarding specific management practices. Also, approximately 53% of the farmers agree with the proposition that some farmers take better care of the land they own than the comparable land that they rent. Of these farmers, a clear majority agrees that farmers would use more fertilizer or manure and a more complex crop rotation on the land they own than the comparable land that they rent.
Chapter 5. Empirical Model of the Adoption of Conservation Practice

The purpose of this chapter is to develop an empirical model to test the hypothesis generated in Chapter 3. As described in Chapter 4, the adoption decision of the same farmer is observed on both owned and rented properties, which creates a panel-structured dataset. This chapter provides a discussion on the Linear Probability Model (LPM) with fixed effects, which is used to analyze the given dataset. An empirical model that explains the adoption of the various conservation practices will also be specified in this chapter.

5.1 Linear Probability Model

The purpose of this study is to examine the influence of tenure status on the adoption of conservation practices. The adoption of conservation tillage or cover crops is therefore the dependent variable in the empirical model but can only take on a value of 0 (non-adoption) or 1 (adoption). The site-specific characteristics such as tenure status are considered to be the independent variables, which attempt to explain the adoption decision of the farmer. The LPM assumes that there is a linear relationship between the independent and dependent variables. The expected value of adoption can therefore be stated as:

\[ E[y] = x_j \beta_j \]  \hspace{1cm} [15]

where \( y \) represents the dependent variable or more specifically, the adoption of a particular conservation practice; \( x_j \) is a vector of independent variables and \( \beta_j \) is a vector of coefficients that are estimated by the model. However, since the adoption of conservation practice can only take on values of 0 and 1; [15] can be restated as:

\[ P(y = 1 | x) = x_j \beta_j + \epsilon \]

In this model, \( \beta_j \) is estimated via Ordinary Least Squares (OLS) and can be interpreted as the marginal effect of the explanatory variable \( x_j \) on the probability of the adoption of the given management practices. More specifically, \( \beta_j \) measures the change in the probability of the
adoption of conservation tillage, a complex crop rotation or cover crops given a one-unit increase in \( x_j \). However, using a linear model for a binary response can lead to problematic issues, which are discussed below.

5.1.1. Heteroskedasticity

In a linear regression model, errors are assumed to be homoscedastic, which implies:

\[
E[\varepsilon^2 | x] = \sigma^2 \tag{16}
\]

Since the dependent variable can only take on values of 0 and 1, a linear function does not produce error terms with equal variance and therefore heteroskedasticity is present in the model. The presence of heteroskedasticity does not lead to biased estimators, however robust standard errors and t statistics should be used for valid hypothesis testing since the estimated variance and covariance matrix will be biased.

5.1.2. Negative Probabilities

Using a LPM can result in estimates of \( y \) that are negative or greater than 1. Since \( \hat{y} \) is an estimated conditional probability, a \( \hat{y} \) less than 0 indicates a negative probability, which is problematic. However, Wooldridge (2012, 563) suggests that the LPM produces consistent estimates despite occasionally predicting probabilities outside the unit interval, provided the explanatory variables do not consistently take on extreme values and have a reasonable standard deviation.

5.2. Index Function Models

In order to overcome the difficulties associated with the LPM, index models were developed to restrict the dependence of the response probability on independent variables. Following Wooldridge (2012, 565-567), \( y^* \) is a latent variable model which is defined as

\[
y^* = x\beta + \varepsilon \tag{17}
\]
where, \( y=1 \) when \( y^*>0 \)

\( y=0 \) when \( y^*<0 \)

Since the purpose of this study is to examine the adoption of tenure status, the primary interest is in determining \( P(y=1) \). Given [4], this can be restated as

\[
P(y = 1 \mid x) = P(y^* > 0 \mid x) \quad [18]
\]

The distribution of the error term \( \varepsilon \) is assumed to be symmetric about 0 and \( G \) is a cumulative distribution function of \( \varepsilon \). This implies that

\[
P(y^* > 0 \mid x) = G(x \beta) \quad [19]
\]

\[
P(y = 1 \mid x) = G(x \beta) = p(x) \quad [20]
\]

where \( p(x) \) is a function of \( x \) through the index \( x\beta=\beta_0+x_2\beta_2+\ldots+x_k\beta_k \). The function \( G(.) \) therefore maps the index into the response probability and only takes on values \( 0<G(z)<1 \) for all \( z \in \mathbb{R} \).

If \( G \) takes on a standard normal cumulative distribution, it is considered to be a Probit Model. On the other hand, if \( G \) takes on a standard logistic distribution, it is considered to be a Logit Model.

For instance, since the Probit follows a standard normal distribution, it can be represented as:

\[
P(y = 1 \mid x) = \int_{-\infty}^{\infty} \frac{1}{\sqrt{2\pi} \sigma^2} e^{-\frac{(y-x\beta)^2}{2\sigma^2}} dx \quad [21]
\]

The likelihood function of this model can be stated as

\[
L(\beta) = \prod_{i=1}^{N} [G(x_i \beta)]^{y_i} [1 - G(x_i \beta)]^{1-y_i} \quad [22]
\]

Maximum Likelihood Estimation (MLE) is then used to derive the coefficients. However, the coefficients of an index function model are not interpreted in the same way as those from a LPM.
since the estimated \( \beta \) are for \( y^* \). The marginal effect (\( \beta^* \)) of the explanatory variable on the probability of the adoption of a conservation practice however can be computed by deriving:

\[
\frac{\partial P(y = 1 | x)}{\partial x} = G(x' \beta) \beta^* \quad [23]
\]

5.3. Omitted Variable Problem

Previous studies that have modeled the adoption of conservation practices as a binary choice have primarily relied on the index function models that have been discussed above. The estimates produced via a linear or an index function model however can be biased if it suffers from an omitted variable problem. Following Wooldridge (20012, 281-282), a distinction can be drawn between observable explanatory variables (\( x_1, x_2 \ldots x_k \)) and any omitted variables which can be grouped into a single variable c. Assuming a linear model and the adoption of a management practice represented by \( y \) and the error term \( \varepsilon \), the regression function can be stated as:

\[
y = \beta_0 + x\beta + c + \varepsilon \quad [24]
\]

If \( \text{Cov}(x,c) \neq 0 \), \( \beta \) will be biased and inconsistent since the error term will be correlated with an explanatory variable. The marginal effect of an explanatory variable will either be overstated or understated depending on the level of correlation with the omitted variable.

The omitted variable problem might arise due to the difficulty in quantifying qualitative variables. For instance, the adoption of conservation tillage and cover crops might be influenced by a farmer’s experience with these practices. However, it is difficult to accurately measure a farmer’s experience in specific management practices. Similarly, a farmer’s attitude towards the environment is also difficult to quantify but might be an important factor in the decision to adopt a conservation practice. One solution to the omitted variables problem is using a proxy variable
that is strongly correlated with the unobservable variable. The use of these proxy variables is problematic however because they are imperfect measures of the unobserved variable since they may not be as strongly correlated as assumed. The panel structure of the dataset in this study however provides a solution to this omitted variable problem

5.4. Unobserved Effects Model

The adoption decision of the same farmer is observed on two different locations: on an owned property and a rented property. The adoption decision can be categorized as $y_p$ and the observed explanatory variables can be classified as $x_p$ where $p = 1$ for owned property and 2 for rented property. The unobserved variables $(c)$ can includes a measure of a farmer’s experience or attitude toward the environment. All the farmers in this dataset rent land in the same county/municipality in which they own property. The regional and climatic effect on the decision to adopt a management practice can therefore also be considered as a variable with a constant partial effect. Equation 26 can therefore be restated as:

$$y_p = \beta_0 + x_p \beta + c + \epsilon_p$$  \hspace{1cm} [25]

5.4.1 Fixed Effects vs. Random Effects

The unobserved effects model can be broadly divided into two types; fixed effects models and random effects models. In a fixed effects model, the unobserved variables are typically treated as variables that need to be estimated. On the other hand, the random effects model treats the unobserved effects as random variables. Wooldridge (2012, 285-286) makes a case for a clearer distinction between the two types of models. If the correlation between the explanatory variables and the unobserved effects is thought to be zero ($\text{Cov}(x_p, c) = 0$), the random effects model is a more efficient estimator. However, the estimates are biased in a random effects model if there is correlation between any of the explanatory variables and the unobserved effects due to the
omitted variable problem that was discussed above. The fixed effects model on the other hand makes no assumption about the dependence of the explanatory variables on the unobserved effects. Therefore, the fixed effects model would produce biased estimates even if the unobserved variables were correlated with the explanatory variables (Cov(x,c) ≠ 0 ). However, the fixed effects model requires the estimation of a parameter for each unit as opposed to the random effects model where only the mean of the unit effects is estimated. As a result, the estimates produced by the fixed effects model produces estimates with a higher level of variance since they are much more sensitive to the outliers in the dataset. In addition the fixed effects model cannot estimate the marginal effect of an explanatory variable when there is no variation within the sample. The choice between a fixed effects model and a random effects model therefore hinges on the tradeoff between variance and bias if the correlation between the explanatory and unobserved variables is unknown.

5.4.2 Hausman Test

The Hausman test statistic (H) is distributed chi-square with degrees of freedom equal to the number of regressors in the model and is a measure of the difference in estimates from the fixed effects and random effects model. It can be stated as:

\[ H = (\hat{\beta}_{RE} - \hat{\beta}_{FE})'[Var(\hat{\beta}_{FE}) - Var(\hat{\beta}_{RE})]^{-1}(\hat{\beta}_{RE} - \hat{\beta}_{FE}) \]  \[ 26 \]

If the unobserved effects are uncorrelated with the explanatory variables, the estimates produced by the random effects model should be similar to those produced by the fixed effects model. Therefore, a p<0.05 is usually taken as evidence that the estimates produced by the two models are statistically significantly different and therefore a fixed effects model is chosen to avoid biased estimates. The failure to reject the null hypothesis however doesn’t necessarily guarantee
unbiased estimates from the random effects model; it only implies that the test lacks sufficient statistical power to detect any difference in the estimates between the two models.

In Stata 12.0, the Hausman test cannot be computed with robust standard errors. However, since the random effects imposes a condition of zero correlation between the explanatory variable and unobservable effects. A test that checks for overidentifying restrictions therefore can also serve as an effective test between random and fixed effects model. Wooldridge (2012, 290-291) describes this test, in which the random effects model is estimated with the original explanatory variables transformed into deviations-from mean-form. In Stata 12.0, this test is conducted via the \textit{xtoverid} command, which reports a large-sample chi-squared test statistic and is also referred to as the Sargan-Hansen test statistic. The Sargan-Hansen test statistic is numerically equal to the Hausman test statistic under homoscedasticity but can also be reported for robust standard errors. Therefore, the Sargan-Hansen test statistic is used to determine the appropriateness of the random effects model in this study.

5.5. Model Specification

A binary response model with fixed effects is therefore a more effective tool to analyze the influence of tenure status on the adoption of conservation practices than a regular binary response model since it solves the omitted variables problem. A Logit or a Probit model are preferred since they avoid some of the problems associated with LPM. A Logit model with fixed effects for instance estimates the following conditional maximum likelihood function.

$$L(\beta) = (w_i \log G[(x_{i2} - x_{i1})\beta] + (1 - w_i) \log \{1 - G[(x_{i2} - x_{i1})\beta]\})$$  \[27\]

where $w_i=1$ if a farmer decides to adopt a conservation practice on their own property and not on the rented property. On the other hand, $w_i=0$ if a farmer decides to adopt a conservation practice on their rented property but not on their own property.
However, due to the nature of its estimation strategy, this model cannot use samples if there is no variation in the adoption decision of the farmer between the rented and owned property. The sample size that can be used by this model is therefore severely restricted. The LPM on the other hand estimates $\beta$ via OLS

$$\bar{y}_i = \frac{1}{n_i} \sum_p y_{ip} \quad y_{ip}^* = y_{ip} - \bar{y}_i \quad [28]$$

$$\bar{x}_i = \frac{1}{n_i} \sum_p x_{ip} \quad x_{ip}^* = x_{ip} - \bar{x}_i \quad [29]$$

where $y_{ip}^*$ is regressed onto $x_{ip}^*$. This estimation strategy allows the model to keep samples where there is no variation in the dependent variable within each unit. The results from the LPM fixed effects model will be presented in the next chapter, while the results from the logit fixed effects model are presented in Appendix C.

5.5.1 Conservation Tillage

In order to measure the adoption of conservation tillage, farmers were asked to identify the type of tillage system that was used on their rented and owned properties in 2012. Farmers were considered to adopt a conservation tillage system if they had a minimum tillage or a No-till system. The adoption of the conservation practices might depend on crop-choice and site-specific factors as discussed in Chapter 2. For instance, hay or other forage crops do not require the seedbed to be extensively prepared and hence conservation tillage might be the preferred option. The most dominant crops in both provinces are also included to control for crop choice. The probability of soil loss is higher in fields that have a hilly topography and the adoption of conservation tillage is therefore expected to be higher in these farms. Fields with fine soil texture or poorly drained soils are less suited to the use of conservation tillage since wet soils delay
planting and significantly reduce yields. On the other hand, fields that are located near wetlands might be more likely to adopt conservation tillage since the consequences of soil erosion may be more severe. As the size of the field increases, the likelihood of conservation tillage is expected to increase due to the greater potential for cost-savings. The model can therefore be stated as:

$$P(y_{ip} = 1 \mid x) = T_{ip}\beta_1 + S_{ip}\beta_2 + C_{ip}\beta_3 + \alpha_i + \epsilon_{ip}$$  \[30\]

where $p=1$ for own property and 2 for rented property. The independent variable $y_{ip} = 1$ indicates adoption of conservation tillage while $y_{ip} = 0$ indicates non-adoption. The tenure status ($T_{ip}$), site-specific variables ($S_{ip}$) such as soil texture, topography, drainage, and Crop-Choice ($C_{ip}$) variables are presented along with their hypothesized signs in Table 13. The unobserved effects and the error term are represented by $\alpha_i$ and $\epsilon_{ip}$ respectively.

**Table 13: Hypothesized signs of variables that explain the adoption of conservation tillage**

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Description</th>
<th>Expected Sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own</td>
<td>Field is owned</td>
<td>+</td>
</tr>
<tr>
<td>Fine</td>
<td>Soil Texture is fine</td>
<td>-</td>
</tr>
<tr>
<td>Hilly</td>
<td>Field has hilly topography</td>
<td>+</td>
</tr>
<tr>
<td>Drainage</td>
<td>Field has been drained</td>
<td>-</td>
</tr>
<tr>
<td>Plot Size</td>
<td>Size of the field</td>
<td>+</td>
</tr>
<tr>
<td>Wetland</td>
<td>Wetland located within or adjacent to the field</td>
<td>+</td>
</tr>
<tr>
<td>Corn12</td>
<td>Field was used to grow corn in 2012</td>
<td>+/-</td>
</tr>
<tr>
<td>Soy12</td>
<td>Field was used to grow soy in 2012</td>
<td>+/-</td>
</tr>
<tr>
<td>Canola12</td>
<td>Field was used to grow canola in 2012</td>
<td>+/-</td>
</tr>
<tr>
<td>Spring Wheat12</td>
<td>Field was used to grow spring wheat in 2012</td>
<td>+/-</td>
</tr>
<tr>
<td>Winter Wheat12</td>
<td>Field was used to grow winter wheat in 2012</td>
<td>+/-</td>
</tr>
<tr>
<td>Forage12</td>
<td>Field was used to grow forage crops in 2012</td>
<td>+</td>
</tr>
</tbody>
</table>

5.5.2 Cover Crops

The adoption of cover crops was measured by asking farmers in Ontario if they planted cover crops on their rented and owned properties in 2012. The decision to plant a cover crop in any
given year can be influenced by the crops grown on the land. For instance, farmers might be more likely to plant a leguminous cover crop to replace the nitrogen consumed by corn in the previous year. Similarly, farmers might be less likely to plant a leguminous cover crop if soybeans were planted the same year since it is already a legume. As discussed in chapter 2, the benefits of a cover crop are highest on sandy soils since they are most likely to erode. Fields with irrigation systems are also more likely to plant cover crops since there is no competition between crops. Since some cover crops like oats and rye can be used as feed, the distance from the home farm where the livestock are typically housed might also influence the adoption of certain cover crops. The model can therefore be stated as:

\[ P(y_{ip} = 1 | x) = T_i \beta_1 + S_i \beta_2 + C_i \beta_3 + \alpha_i + \epsilon_{ip} \]  

where \( p = 1 \) for own property and 2 for rented property. The independent variable \( y_{ip} = 1 \) indicates adoption of a cover crop while \( y_{ip} = 0 \) indicates non-adoption. The tenure status (\( T_i \)), site-specific variables (\( S_i \)) such as soil texture and Crop-Choice (\( C_i \)) variables are presented along with their hypothesized signs in Table 14. The unobserved effects and the error term are represented by \( \alpha_i \) and \( \epsilon_{ip} \) respectively.

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Description</th>
<th>Expected Sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own</td>
<td>Field is owned</td>
<td>+</td>
</tr>
<tr>
<td>Coarse</td>
<td>Coarse Soil Texture</td>
<td>+</td>
</tr>
<tr>
<td>Distance</td>
<td>Distance from home farm</td>
<td>-</td>
</tr>
<tr>
<td>Irrigated</td>
<td>Field has been irrigated</td>
<td>+</td>
</tr>
<tr>
<td>Corn12</td>
<td>Field was used to grow corn in 2012</td>
<td>+/-</td>
</tr>
<tr>
<td>Soy12</td>
<td>Field was used to grow soy in 2012</td>
<td>+/-</td>
</tr>
<tr>
<td>Winter Wheat12</td>
<td>Field was used to grow spring wheat in 2012</td>
<td>+</td>
</tr>
</tbody>
</table>
5.5.3 Winter Wheat

Since the measure of adoption of cover crop was only taken in a single year, it might exclude some farmers who could have planted a cover crop in previous years. Unfortunately, the dataset described in Chapter 4 does not contain information on the adoption of cover crops in previous years. However, there is data available on the cash crops that were grown by the farmers in the last three years. If the adoption of cover crops is heavily influenced by a particular cash crop, the role of tenure status on the adoption of a cover crops can then be examined more completely by its influence on the adoption of these crops. For instance, red clover is typically underseeded with winter wheat. Therefore, the decision to plant red clover might be significantly dependent on the decision to plant winter wheat. Also, as discussed in Chapter 2, the decision to plant winter wheat alone could signal the adoption of a conservation practice since it generates a lower return in the short-term but provides long-term benefits in the form of added organic matter. Following the conceptual framework in Chapter 3, this would suggest that all else equal, farmers are less likely to plant winter wheat on rented land as they would on their own land. For the purposes of this study, the farmers were considered to adopt winter wheat if they were observed planting it at least once in a three-year period (2010-2012). Once again crop and site-specific factors are included in the regression model to isolate the influence of tenure status on the adoption of a complex crop rotation. The soil texture of the field is controlled by including fine and medium textured soils and omitting coarse textured soils in the model. The coefficients on the soil variables should therefore be interpreted relative to the omitted variables. The presence of an irrigation system might be beneficial to planting winter wheat since they do not have to compete for water with other crops such as red clover. Corn and Soybeans are included in the model to control for the other crop choices the farmers make. For instance, farmers who grow
soybeans are more likely to incorporate wheat in their rotation than farmers who grow corn. Once again, the distance variable is included to account for the livestock the farmer may have which could influence the decision to plant winter wheat. The model can therefore be stated as:

\[ P(y_{ip} = 1 | x) = T_{ip}\beta_1 + S_{ip}\beta_2 + C_{ip}\beta_3 + \alpha_i + \epsilon_{ip} \quad [32] \]

where \( p=1 \) for own property and 2 for rented property. The independent variable \( y_{ip} = 1 \) indicates the farmer planted winter wheat at least once between 2010 – 2012 while \( y_{ip} = 0 \) indicates non-adoption. The tenure status (\( T_{ip} \)), site-specific variables (\( S_{ip} \)) such as soil texture, irrigation and Crop-Choice (\( C_{ip} \)) variables are presented along with their hypothesized signs in Table 15. The unobserved effects and the error term are represented by \( \alpha_i \) and \( \epsilon_{ip} \) respectively.

**Table 15: Hypothesized signs of variables that explain the adoption of winter wheat**

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Description</th>
<th>Expected Sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own</td>
<td>Field is owned</td>
<td>+</td>
</tr>
<tr>
<td>Fine</td>
<td>Soil Texture is coarse</td>
<td>+/-</td>
</tr>
<tr>
<td>Medium</td>
<td>Soil Texture is medium</td>
<td>+/-</td>
</tr>
<tr>
<td>Irrigation</td>
<td>Field is irrigated</td>
<td>+</td>
</tr>
<tr>
<td>Distance</td>
<td>Distance from Home farm</td>
<td>-</td>
</tr>
<tr>
<td>Corn</td>
<td>Field was used to grow corn</td>
<td>-</td>
</tr>
<tr>
<td>Soy</td>
<td>Field was used to grow soybeans</td>
<td>+</td>
</tr>
</tbody>
</table>

**Summary**

The fixed effects model with panel data provides a solution to the omitted variables problem. Since the adoption of conservation practices can be influenced by several unobservable variables, the fixed effects model is an effective tool to analyze the influence of tenure on the adoption decision. The Linear Probability Model is used for analysis since the dependent variable can only take on binary values. Although the index function models such as Logit or Probit avoid some of the concerns of the Linear Probability model, the effect of tenure status on
farmers who exhibit no variation in their adoption decision on rented and owned can not be estimated in a fixed effects Logit or Probit model. The results from the Logit fixed effects model are however provided in Appendix C. Empirical models are specified for the adoption of conservation tillage, cover crop and winter wheat by accounting for site-specific characteristics such as soil texture and topography along with the crops that were grown on the specific field. The next chapter provides the regression results from these Linear Probability Models.
6. Results

This chapter will present results from the empirical models presented in Chapter 5. First, results from a chi-square test will be presented to determine the statistical relationship between the adoption of a conservation practice and tenure status. This will be followed by results from the LPM with fixed effects and random effects. This chapter will also provide a discussion of the main findings of this thesis by highlighting the results from the LPM models. Finally, the LPM models will be tested for heteroskedasticity in order to determine the validity of the use of standard errors for hypothesis testing. The results from a Hausman test will also be provided in order to determine the difference between the estimates from the random effects and fixed effects models.

6.1. Conservation Tillage

A chi-square test is used to test the null hypothesis that the farmer’s decision to adopt conservation tillage and the tenure status of the farmer are independently distributed. There were 425 observations of farmers who operated both on rented and owned properties in Southwestern Ontario and Manitoba. Therefore, there were a total of 850 observations on the decision to adopt conservation tillage. The results from the chi-square test are presented in Table 16 and fail to reject the null hypothesis of statistical independence between the adoption of conservation tillage and tenure status.

The results from the LPM with fixed effects and random effects are presented in Table 17. As discussed in the previous chapter, the LPM by its design suffers from heteroskedasticity and therefore robust standard errors are used for hypothesis testing.
Table 16: Chi-square test between the adoption of conservation tillage and tenure status

<table>
<thead>
<tr>
<th>Conservation Tillage</th>
<th>Rented Property</th>
<th>Owned Property</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did Not Adopt</td>
<td>145</td>
<td>153</td>
<td>298</td>
</tr>
<tr>
<td>Adopted</td>
<td>280</td>
<td>272</td>
<td>552</td>
</tr>
<tr>
<td>Total</td>
<td>425</td>
<td>425</td>
<td>850</td>
</tr>
</tbody>
</table>

Pearson chi² = 0.3307  DF=1  Pr = 0.565

The Sargan-Hansen statistic (p=0.4125) fails to reject the null hypothesis that the coefficients from the random effects model are consistent. However, as discussed in the previous chapter, this does not imply that the coefficients reported in Table 2 are completely free from bias. The explanatory variables were also tested for multicollinearity, which can cause the variances of the estimates to become too large for a valid hypothesis test. All of the explanatory variables were correlated below the 0.8 threshold that is commonly used to test for collinearity. The Joint Hypothesis test statistic (p=0.0025) rejects the null hypothesis that coefficients are jointly equal to zero.

Tenure status is not a statistically significant factor that explains the adoption of conservation tillage. This confirms the hypothesis H1 generated in Chapter 3 which stated that all else equal, farmers would be just as likely to adopt conservation tillage on their rented land as they would on their own land. Site-specific factors such as soil-texture and crop-choice on the other hand were found to be statistically significant factors at the 95% confidence level on the probability of the adoption of conservation tillage. For instance, the probability of the adoption of conservation tillage is found to be 9.54% lower on fields with a heavy soil texture. The size of the field is also found to have a statistically significant, albeit marginal effect on the adoption of conservation tillage. As the size of the field increases by 100 acres, the probability of the adoption of conservation tillage is only increased by 0.43%.
<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Fixed Effects Model</th>
<th>Random Effects Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Own</td>
<td>-0.00883 (-0.43)</td>
<td>-0.0101 (-0.51)</td>
</tr>
<tr>
<td>Fine</td>
<td>-0.0954* (-2.16)</td>
<td>-0.0479 (-1.41)</td>
</tr>
<tr>
<td>Hilly</td>
<td>0.115 (1.75)</td>
<td>0.0670 (1.16)</td>
</tr>
<tr>
<td>Plot_Size</td>
<td>0.0000425* (1.99)</td>
<td>0.0000553* (2.57)</td>
</tr>
<tr>
<td>Drainage</td>
<td>-0.0472 (-1.24)</td>
<td>-0.0533 (-1.74)</td>
</tr>
<tr>
<td>Wetland</td>
<td>-0.00354 (-0.11)</td>
<td>0.0220 (0.77)</td>
</tr>
<tr>
<td>Distance</td>
<td>0.000257 (0.91)</td>
<td>0.000212 (0.60)</td>
</tr>
<tr>
<td>Corn12</td>
<td>-0.138** (-3.09)</td>
<td>-0.120*** (-3.29)</td>
</tr>
<tr>
<td>Soy12</td>
<td>0.0573 (1.79)</td>
<td>0.0685* (2.41)</td>
</tr>
<tr>
<td>Winter_Wheat12</td>
<td>0.0357 (0.88)</td>
<td>0.0423 (1.15)</td>
</tr>
<tr>
<td>Canola12</td>
<td>0.0603 (1.43)</td>
<td>0.0502 (1.45)</td>
</tr>
<tr>
<td>Spring_Wheat12</td>
<td>0.0166 (0.47)</td>
<td>0.00758 (0.25)</td>
</tr>
<tr>
<td>Forage12</td>
<td>0.0900* (2.08)</td>
<td>0.0438 (1.24)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.700*** (13.59)</td>
<td>0.666*** (14.01)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model Statistics</th>
<th>Fixed Effects Model</th>
<th>Random Effects Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>836</td>
<td>836</td>
</tr>
<tr>
<td>Within R²</td>
<td>0.0833</td>
<td>0.0794</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Joint Hypothesis Test</th>
<th>Fixed Effects Model</th>
<th>Random Effects Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-Statistic/ Wald chi²</td>
<td>2.51</td>
<td>38.95</td>
</tr>
<tr>
<td>Prob&gt;F/ Prob&gt;chi²</td>
<td>0.0025</td>
<td>0.0002</td>
</tr>
</tbody>
</table>

* t statistics in parentheses
* p < 0.05,  ** p < 0.01,  *** p < 0.001
Fields that were used to grow corn in 2012 were found to be 13.8% less likely to be tilled via a minimum tillage or No-Till system. The other crops did not have a statistically significant influence on the adoption of conservation tillage. The results from the random effects model lead to similar conclusions. In the random effects model however, soil texture was not found to be statistically significant and fields that were used to grow soybeans in 2012 were found to be more 6.85% more likely to be tilled via conservation tillage.

6.2. Cover Crops

A chi-square test is used to test the null hypothesis that the farmer’s decision to adopt cover crops and the tenure status of the farmer are independently distributed. Data was collected only for farmers in Ontario, which restricts the universe of farmers who both rented and owned land to 198 observations. Therefore, there were a total of 396 observations on the decision to adopt cover crops. The results from the chi-square test are presented in Table 18 and reject the null hypothesis of statistical independence between the adoption of cover crops and tenure status at the 95% confidence level.

The Sargan-Hansen statistic (p=0.0000) rejects the null hypothesis that the coefficients from the random effects model are consistent. The results from the random effects model are presented in Table 19 but should treated with caution as they could be biased. All of the explanatory variables were correlated below the 0.8 threshold that is commonly used to test for collinearity. The Joint Hypothesis test statistic (p=0.001) rejects the null hypothesis that coefficients are jointly equal to zero.

Tenure status is found to be a statistically significant factor at the 99% confidence level on the probability of the adoption of cover crop. The results from Table 19 indicate that the probability of cover crops being planted in 2012 was 9.58% higher on owned fields than on
rented fields. This result confirms the hypothesis $H2$ generated in Chapter 3 which stated that all else equal, farmers would be less likely to adopt conservation tillage on their rented land as they would on their own land.

Table 18: Chi-square test between the adoption of cover crops and tenure status

<table>
<thead>
<tr>
<th>Cover Crops</th>
<th>Rented Property</th>
<th>Owned Property</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did Not Adopt</td>
<td>168</td>
<td>147</td>
<td>315</td>
</tr>
<tr>
<td>Adopted</td>
<td>30</td>
<td>51</td>
<td>81</td>
</tr>
<tr>
<td>Total</td>
<td>198</td>
<td>198</td>
<td>396</td>
</tr>
</tbody>
</table>

Pearson chi$^2 = 6.8444$      DF=1                Pr = 0.009

Table 19: LPM Results for the model specified to explain the adoption of cover crops

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Fixed Effects Model</th>
<th>Random Effects Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Variable: Cover Crops =1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Own</td>
<td>0.0958*** (3.12)</td>
<td>0.0823** (2.65)</td>
</tr>
<tr>
<td>Coarse</td>
<td>-0.0401 (-0.56)</td>
<td>0.0399 (0.86)</td>
</tr>
<tr>
<td>Irrigated</td>
<td>0.242 (1.19)</td>
<td>0.313* (2.06)</td>
</tr>
<tr>
<td>Distance</td>
<td>-0.000522 (-1.81)</td>
<td>-0.000751* (-2.26)</td>
</tr>
<tr>
<td>Corn12</td>
<td>-0.0577 (-1.17)</td>
<td>0.00558 (0.15)</td>
</tr>
<tr>
<td>Soy12</td>
<td>-0.105* (-2.19)</td>
<td>-0.0469 (-1.25)</td>
</tr>
<tr>
<td>Winter_Wheat12</td>
<td>0.258*** (4.02)</td>
<td>0.331*** (5.81)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.188*** (3.52)</td>
<td>0.0889* (2.11)</td>
</tr>
</tbody>
</table>

Model Statistics

| N      | 391    |
| Within $R^2$ | 0.1943 | 0.1777 |

Joint Hypothesis Test

| F-Statistic/ Wald chi$^2$ | 4.79 | 55.97 |
| Prob>F/ Prob>chi$^2$      | 0.001 | 0.0000 |

$t$ statistics in parentheses

*p < 0.05,  ** p < 0.01,  *** p < 0.001
The probability of the adoption of cover crops seems to be heavily influenced by the cash crop being grown. Fields that were used to grow soybeans in 2012 were found to be 10.5% less likely to adopt cover crops. On the other hand, fields that were used to grow winter wheat in 2012 were 25.8% more likely to plant cover crops. The significant influence of winter wheat however raises a serious concern. Farmers who rent land to grow corn and soybeans on rented land may not have access to the land over the winter due to the terms of their rental contract and might be therefore less likely to plant a cover crop. On the other hand, farmers who rent land to grow winter wheat have access to the land over the winter, which could explain the higher probability of the adoption of both summer and winter cover crops. As discussed in Chapter 2, red clover is often underseeded with winter wheat and acts as a cover crop after the winter wheat is harvested. It is therefore useful to examine the influence of tenure status on the adoption of winter wheat. The decision to plant a cover crop on rented property can therefore be implicitly signaled by the decision to rent land to plant winter wheat. The influence of tenure status on the decision to plant winter wheat is therefore examined below.

6.3. Winter Wheat

In order to examine the influence of tenure status on the decision to plant winter wheat, the farmer’s rotation should be taken into consideration. For instance, a farmer with a corn/soy/winter wheat rotation could have planted winter wheat in 2010 but not 2012. The crop rotation of a farmer can therefore be accounted for by observing a farmer’s decision to plant winter wheat over a three-year period (2010-2012). In this study, a farmer is therefore considered to plant winter wheat if they were observed to plant it at least once in the three-year timeframe. This universe of farmers who both operated on the same owned and rented parcel of land for at least three years is restricted to 183 farmers in Ontario in this dataset. Therefore, there were a
total of 366 observations on the decision to adopt cover crops. A chi-square test is used to test the null hypothesis that the farmer’s decision to plant winter wheat and the tenure status of the farmer are independently distributed. The results from the chi-square test are presented in Table 20 and reject the null hypothesis of statistical independence between the decision to plant winter wheat and tenure status at the 90% confidence level.

<table>
<thead>
<tr>
<th>Winter Wheat</th>
<th>Rented Property</th>
<th>Owned Property</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did Not Adopt</td>
<td>102</td>
<td>85</td>
<td>187</td>
</tr>
<tr>
<td>Adopted</td>
<td>81</td>
<td>98</td>
<td>179</td>
</tr>
<tr>
<td>Total</td>
<td>183</td>
<td>183</td>
<td>366</td>
</tr>
</tbody>
</table>

Pearson $\chi^2 = 3.1600$  DF=1  Pr = 0.075

The Sargan-Hansen statistic (p=0.0000) rejects the null hypothesis that the coefficients from the random effects model are consistent. The results from the random effects model are presented in Table 21 but should treated with caution as they could be biased. All of the explanatory variables were correlated below the 0.8 threshold that is commonly used to test for collinearity. The Joint Hypothesis test statistic (p=0.0481) rejects the null hypothesis that coefficients are jointly equal to zero at the 90% confidence level.

Tenure status is found to be a statistically significant factor at the 95% confidence level on the probability of the decision to plant winter wheat. The results from Table 21 indicate that the probability of winter wheat being planted over a three-year period was 8.73% higher on owned fields than on rented fields. This suggests that farmers are less likely to rent land to plant winter wheat and are therefore less likely to plant cover crops. As shown in Tables 2 and 3 in Appendix A, the return from planting winter wheat is significantly lower than that from planting corn or soybeans. However, growing winter wheat might add back organic matter to the soil,
which can increase yields in the future time periods. The decision to plant winter wheat can therefore also be seen via the same lens as that for cover crops, where the farmer is required to reduce short-term profits in order to realize benefits in the long-term. It is not surprising then that farmers are more likely to plant winter wheat on their own property than on rented property.

**Table 21: LPM Results for the model specified to explain the adoption of winter wheat**

<table>
<thead>
<tr>
<th></th>
<th>Fixed Effects Model</th>
<th>Random Effects Model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variable: Winter Wheat = 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Explanatory Variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Own</td>
<td>0.0873* (2.12)</td>
<td>0.106** (2.65)</td>
</tr>
<tr>
<td>Fine</td>
<td>-0.149 (-1.39)</td>
<td>0.00370 (0.05)</td>
</tr>
<tr>
<td>Medium</td>
<td>0.0234 (0.17)</td>
<td>-0.0242 (-0.31)</td>
</tr>
<tr>
<td>Irrigated</td>
<td>-0.0172 (-0.23)</td>
<td>-0.0314 (-0.32)</td>
</tr>
<tr>
<td>Distance</td>
<td>-0.000182 (-0.44)</td>
<td>0.0000745 (0.18)</td>
</tr>
<tr>
<td>Corn</td>
<td>-0.0791 (-0.72)</td>
<td>-0.0528 (-0.77)</td>
</tr>
<tr>
<td>Soy</td>
<td>0.317* (2.40)</td>
<td>0.464*** (6.84)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.341** (2.65)</td>
<td>0.114 (1.62)</td>
</tr>
<tr>
<td><strong>Model Statistics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>362</td>
<td>362</td>
</tr>
<tr>
<td>Within R²</td>
<td>0.0888</td>
<td>0.0622</td>
</tr>
<tr>
<td><strong>Joint Hypothesis Test</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-Statistic/ Wald chi²</td>
<td>2.08</td>
<td>68.45</td>
</tr>
<tr>
<td>Prob&gt;F/ Prob&gt;χ²</td>
<td>0.0481</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

*t statistics in parentheses

*p < 0.05, **p < 0.01, ***p < 0.001

6.4. Tenure Security

As discussed before, not all renter-operators expect to rent a given parcel of land for the same period of time. The heterogeneity in the planning horizon can therefore also influence the adoption of conservation practices. In order to test this line of reasoning, the adoption of cover
crops was examined only among farmers who expected to the rent a given parcel of land for more than 5 years. The universe of farmers who operate on both owned and rented land and expect to do so for at least 5 more years is restricted to 128 farmers in Ontario in this dataset, resulting in a total of 256 observations. Since these farmers expect to operate on both the owned and rented parcel of land for a considerable amount of time, the decision to plant cover crops is not expected to depend on tenure status. The results from the chi-square test are presented in Table 22 and reject the null hypothesis of statistical independence between the adoption of cover crops and tenure status at the 95% confidence level.

**Table 22: Chi-square test between the adoption of cover crops and tenure status of the farmers who expect to operate on the same parcel of land for at least 5 years**

<table>
<thead>
<tr>
<th>Cover Crops</th>
<th>Rented Property</th>
<th>Owned Property</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did Not Adopt</td>
<td>107</td>
<td>93</td>
<td>200</td>
</tr>
<tr>
<td>Adopted</td>
<td>21</td>
<td>35</td>
<td>56</td>
</tr>
<tr>
<td>Total</td>
<td>128</td>
<td>128</td>
<td>256</td>
</tr>
</tbody>
</table>

Pearson chi\(^2\) = 4.4800      DF=1       Pr = 0.034

The Sargan-Hansen statistic (p=0.0001) rejects the null hypothesis that the coefficients from the random effects model are consistent. The results from the random effects model are presented in Table 22 but should treated with caution as they could be biased. All of the explanatory variables were correlated below the 0.8 threshold that is commonly used to test for collinearity. The Joint Hypothesis test statistic (p=0.005) rejects the null hypothesis that coefficients are jointly equal to zero.

Tenure status surprisingly remains a statistically significant factor in the adoption of cover crops at the 95% confidence level in the fixed effects model and at the 90% confidence level in the random effects model. Using this subset of the sample, the probability of cover crops being planted on own property was found to be 7.49% higher than that on rented property. This
potentially suggests that farmers who expect to rent the same parcel of land for at least 5 may still not necessarily have secure tenure. One of the limitations of this dataset is the lack of information on the actual length of the rental contract. For instance, a farmer with a one year rental contract who still expects to rent the same parcel of land for at least 5 years may not plant cover crops because of the uncertainty associated with the rental contract.

Table 23: LPM Results for the model specified to explain the adoption of cover crops for farmers who expect to rent the land for at least 5 years

<table>
<thead>
<tr>
<th></th>
<th>Fixed Effects Model</th>
<th>Random Effects Model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variable:</strong></td>
<td>Cover Crops=1</td>
<td>Cover Crops=1</td>
</tr>
<tr>
<td><strong>Explanatory Variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Own</td>
<td>0.0749*</td>
<td>0.0669</td>
</tr>
<tr>
<td></td>
<td>(2.02)</td>
<td>(1.76)</td>
</tr>
<tr>
<td>Coarse</td>
<td>-0.132</td>
<td>-0.00898</td>
</tr>
<tr>
<td></td>
<td>(-1.43)</td>
<td>(-0.15)</td>
</tr>
<tr>
<td>Irrigated</td>
<td>0.112</td>
<td>0.108</td>
</tr>
<tr>
<td></td>
<td>(0.42)</td>
<td>(0.56)</td>
</tr>
<tr>
<td>Distance</td>
<td>-0.000300</td>
<td>-0.000453</td>
</tr>
<tr>
<td></td>
<td>(-1.66)</td>
<td>(-1.76)</td>
</tr>
<tr>
<td>Corn12</td>
<td>-0.0314</td>
<td>0.0402</td>
</tr>
<tr>
<td></td>
<td>(-0.49)</td>
<td>(0.83)</td>
</tr>
<tr>
<td>Soy12</td>
<td>-0.0559</td>
<td>0.00223</td>
</tr>
<tr>
<td></td>
<td>(-0.93)</td>
<td>(0.05)</td>
</tr>
<tr>
<td>Winter_Wheat12</td>
<td>0.355***</td>
<td>0.404***</td>
</tr>
<tr>
<td></td>
<td>(4.52)</td>
<td>(5.81)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.163*</td>
<td>0.0558</td>
</tr>
<tr>
<td></td>
<td>(2.27)</td>
<td>(1.03)</td>
</tr>
<tr>
<td><strong>Model Statistics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>253</td>
<td>253</td>
</tr>
<tr>
<td>Within R²</td>
<td>0.2523</td>
<td>0.2340</td>
</tr>
<tr>
<td><strong>Joint Hypothesis Test</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-Statistic/ Wald chi²</td>
<td>4.07</td>
<td>46.02</td>
</tr>
<tr>
<td>Prob&gt;F/ Prob&gt;chi²</td>
<td>0.0005</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

* t statistics in parentheses
  * p < 0.05, ** p < 0.01, *** p < 0.001

6.5. Livestock

As discussed in Chapter 2, cover crops can sometimes be used for feeding livestock. Although, the regression models have included distance from the home farm as an explanatory variable to
account for this factor, it might not completely capture the influence of livestock. However, by only considering farmers who operate on both owned and rented land and also do not have any livestock, the influence of tenure status on the adoption of cover crops can be tested more rigorously. The universe of farmers without livestock who operate on owned and rented property in Ontario is restricted to 77 farmers in Ontario in this dataset, leading to a total of 154 observations.

The results from the chi-square test are presented in Table 23 and reject the null hypothesis of statistical independence between the adoption of cover crops and tenure status at the 90% confidence level.

Table 24: Chi-square test between the adoption of cover crops and tenure status of the farmers who do not own any livestock

<table>
<thead>
<tr>
<th>Cover Crops</th>
<th>Rented Property</th>
<th>Owned Property</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did Not Adopt</td>
<td>65</td>
<td>56</td>
<td>121</td>
</tr>
<tr>
<td>Adopted</td>
<td>12</td>
<td>21</td>
<td>33</td>
</tr>
<tr>
<td>Total</td>
<td>77</td>
<td>77</td>
<td>154</td>
</tr>
</tbody>
</table>

Pearson chi² = 3.1240 DF=1 Pr = 0.077

The Sargan-Hansen statistic (p=0.0000) rejects the null hypothesis that the coefficients from the random effects model are consistent. The results from the random effects model are presented in Table 23 but should treated with caution as they could be biased. All of the explanatory variables were correlated below the 0.8 threshold that is commonly used to test for collinearity. The Joint Hypothesis test statistic (p=0.0131) rejects the null hypothesis that coefficients are jointly equal to zero at the 95% confidence interval.

Once again, tenure status is found to be a significant factor in the adoption of cover crops. In the fixed effects model, the probability of cover crops being planted on owned property is
9.37% higher than that on rented property. Therefore, the adoption of cover crops is not purely a function of owning livestock.

Table 25: LPM Results for the model specified to explain the adoption of cover crops for farmers who do not own any livestock

<table>
<thead>
<tr>
<th></th>
<th>Fixed Effects Model</th>
<th>Random Effects Model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variable:</strong></td>
<td>Cover Crops = 1</td>
<td></td>
</tr>
<tr>
<td><strong>Explanatory Variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Own</td>
<td>0.0937* (2.25)</td>
<td>0.0795 (1.88)</td>
</tr>
<tr>
<td>Coarse</td>
<td>0.103 (0.71)</td>
<td>0.0944 (1.04)</td>
</tr>
<tr>
<td>Irrigated</td>
<td>0.132 (0.56)</td>
<td>0.283 (1.70)</td>
</tr>
<tr>
<td>Distance</td>
<td>-0.00115 (-1.53)</td>
<td>-0.00129* (-2.09)</td>
</tr>
<tr>
<td>Corn12</td>
<td>0.00373 (0.05)</td>
<td>0.0750 (1.24)</td>
</tr>
<tr>
<td>Soy12</td>
<td>-0.111 (-1.67)</td>
<td>-0.0175 (-0.29)</td>
</tr>
<tr>
<td>Winter_Wheat12</td>
<td>0.319*** (3.54)</td>
<td>0.371*** (4.55)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.117 (1.21)</td>
<td>0.00914 (0.12)</td>
</tr>
<tr>
<td><strong>Model Statistics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Within R²</td>
<td>0.3744</td>
<td>0.3464</td>
</tr>
<tr>
<td><strong>Joint Hypothesis Test</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F-Statistic/ Wald chi²</td>
<td>2.76</td>
<td>37.56</td>
</tr>
<tr>
<td>Prob&gt;F/ Prob&gt;chi²</td>
<td>0.0131</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

* t statistics in parentheses
  * p < 0.05, ** p < 0.01, *** p < 0.001

**Summary**

This chapter presented the regression results from the models specified in Chapter 5. The regression models provide some insight into the other site-specific characteristics that can influence the adoption of conservation practices. For instance, fields with clayey soil texture were found to be less likely to be tilled via conservation tillage systems. Tenure Status was not found to be a statistically significant factor in the adoption of conservation tillage, while the
probability of cover crops and winter wheat being planted was higher on owned land. The hypotheses developed in Chapter 2 are confirmed by these results as farmers are more likely to plant cover crops on their own land but are just as likely to use conservation tillage on rented land as they would on their own land. The next chapter discusses the implications of these results.
Chapter 7. Summary and Policy Implications for Cost-Share Programs

This chapter provides a summary of the thesis and discusses some of the implications of the results presented in the previous chapter. In addition, a discussion will be provided on some of the limitations of this study and the steps needed to improve the quality of the analysis. The chapter concludes with a few suggestions on potential areas of research in issues related to this study that can be pursued in the future.

7.1. Summary

The goal of this thesis is to examine the influence of tenure status on the adoption of conservation practices. This study draws a distinction between conservation practices that are site-specific such as cover crops and those that require equipment modifications to reduce input use such as conservation tillage. All else equal, tenure status was not hypothesized to play a significant role in the adoption of conservation tillage since the farmers reap the benefits of reduced input costs once they adopt the new technology on their own property. However, farmers were hypothesized to be less likely to adopt cover crops on rented property as they would on their own property since the benefits associated with cover crops are only realized in the long-term. In order to test these hypotheses, a survey instrument was developed to collect data from farmers in Ontario and Manitoba in April 2013. The dataset contained information regarding the adoption of conservation practices by the same farmer on owned and rented property. Since the same farmer is observed making the adoption decision on both owned and rented properties, the unique dataset has a panel structure. The unobservable variables such as the farmer’s attitude towards environment or experience in the use of cover crops can therefore be controlled by the use of a fixed effects model for a more rigorous analysis. The results from the regression model confirm the hypotheses that were generated in Chapter 3. Tenure status was
not found to be a statistically significant factor in the adoption of conservation tillage while the probability of cover crops being planted on owned land was significantly higher than that on rented land. In order to confirm that farmers did have access to the land over the winter-when cover crops are typically planted- the adoption of winter wheat was examined over a three-year period. The farmers considered for this analysis had rented the same parcel of land for the last three years and were still significantly less likely to plant winter wheat on rented property than on their own property. The results therefore suggest that tenure status does influence the adoption of site-specific conservation practices such as cover crops but is not a significant factor in the adoption of machinery related practices such as conservation tillage.

7.2. Policy Implications

The federal government in partnership with the provincial government has designed voluntary cost-share programs (Environmental Farm Action Program, Manitoba Sustainable Agricultural Practices Program, Canada-Ontario Farm Stewardship Program) to encourage producers to adopt management practices that preserve the productivity of Canadian farmland. However, these cost-share programs have limited funds to allocate to producers to increase their adoption of soil-conservation management practices. The economic problem therefore is to maximize the adoption of soil-conservation management practices given the financial constraints.

Currently, these cost-share programs allocate funds to producers and do not specifically target farms that are operated by tenants. The results from this research indicates that a concentrated effort should be made to incentivize the adoption of site-specific conservation practices such as cover crops on rented property. Alternatively, the cost-share programs could target the landowners directly to increase the adoption of these conservation practices. For instance, this study highlights the significant number of non-farmer landlords in the agricultural
rental market in both provinces. In order to effectively increase the adoption of conservation practices, the cost-share programs should therefore work with landlords to conserve the productivity of the significant fraction of farmland that is being operated by tenants. On the other hand, funds need not be targeted specifically to landowners for machinery related conservation practices that reduce input costs like conservation tillage.

7.3. Limitations

The main limitation of this study is the lack of complete understanding of the terms of the rental contract. Although, farmers were asked how long they expected to rent the same parcel of land, data was not collected on the actual length of the lease. Farmers with longer leases might be more likely to adopt site-specific conservation practices since they have secure tenure and are therefore in a position to realize the benefits from the adoption of conservation practices such as cover crops.

The role of landlords in the adoption of conservation practices has also been ignored in this study. Landlords could influence the adoption of conservation practices by including stipulations in the rental contract. This is especially important given the significant number of non-farmer landlords in both provinces. This study implicitly assumes that the tenant is completely free to make the decision on adopting conservation tillage and cover crops, which may or may not be true.

Finally, the use of the Linear Probability Model could also be described as a limitation of this study since it is only an approximation of the true functional form. The Linear Probability Model was chosen because of the lack of variation in the dependent variable for a significant portion of the sample.
7.4. Future Research

The influence of tenure status on the adoption of conservation practices has been shown to vary depending on the characteristics of the particular management practice. The relationship between landlords and tenants might also influence the adoption of conservation practices. For instance, farmers might be more likely to adopt conservation practices such as cover crops on land that they rent from family members than on land that they rent from others.

The design of this study can also be used to examine the influence of other site-specific management practices such as grassed waterways and buffer strips. However, the adoption of these structural management practices probably requires a significant amount of participation from the landowner. As discussed above, the role of the landowner and the terms of the rental contract in the adoption of conservation practices have been largely ignored by the literature and is likely a fruitful source for future research. For instance, the influence of rental rate on the adoption of conservation practices has not been examined. Landlords might offer tenants a lower rental rate to compensate for the adoption of a conservation practice that reduces returns in the short-term. The adoption of specific practices might also depend on the type of landlord. For instance, active and retired farmers who rent out land might be more involved in management decisions. Given the extent of non-farmer ownership of rented farmland, the influence of landlords on the adoption of conservation practices is a particularly relevant research question.

Finally, Soule et al. (2000) provide evidence that share-contracts are more conducive to the adoption of certain conservation practices than cash-contracts. This hypothesis can be tested in the Canadian context for a different set of conservation practices.
References


Appendix A: Conservation Practices

Table 26: The number of studies that found explanatory variables to have a statistically positively significant, negatively significant or insignificant influence on the adoption of soil conservation practices at the 95% confidence interval. Adapted from Prokopy et al., 2008

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Significant (+)</th>
<th>Significant (-)</th>
<th>Insignificant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acres</td>
<td>12</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Age</td>
<td>4</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Income</td>
<td>8</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Information</td>
<td>2</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>Labour</td>
<td>6</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>Network</td>
<td>9</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Awareness</td>
<td>5</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Tenure</td>
<td>4</td>
<td>4</td>
<td>13</td>
</tr>
</tbody>
</table>

Table 27: Common summer and winter cover crops grown in Ontario

<table>
<thead>
<tr>
<th>Cover Crop</th>
<th>Establishment</th>
<th>Family</th>
<th>Season</th>
<th>Feed</th>
</tr>
</thead>
</table>
| Red Clover     | Can be underseeded in cereal crop  
Can be interseeded in standing crop | Legume | Survives over winter | No           |
| Alfalfa        | Can be underseeded in cereal crop  
Can be interseeded in standing crop | Legume | Perennial variety can survive over winter | Yes           |
| Oats           | Not seeded with other crops | Grass   | Does not survive winter | Yes           |
| Rye            | Can be interseeded in standing crop | Grass   | Survives over winter | Yes           |
Table 28: A sample cost of production budget for corn, soybeans and winter wheat under conventional tillage. Prices and yields are calculated using the average of last four years. Adapted from Field Crops Budget, Publication 60, OMAF. 2013

<table>
<thead>
<tr>
<th>Conventional Tillage</th>
<th>Grain Corn</th>
<th>Soybeans</th>
<th>Winter Wheat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sample Costs/Acre ($)</td>
<td>Sample Costs/Acre ($)</td>
<td>Sample Costs/Acre ($)</td>
</tr>
<tr>
<td>Seed</td>
<td>108.65</td>
<td>51.30</td>
<td>51.90</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>127.95</td>
<td>28.45</td>
<td>86.45</td>
</tr>
<tr>
<td>Herbicide</td>
<td>13.15</td>
<td>36.90</td>
<td>23.00</td>
</tr>
</tbody>
</table>

**Input Costs**

**Tractor & Machinery Expenses**

<table>
<thead>
<tr>
<th></th>
<th>Fuel</th>
<th>Maintenance</th>
<th>Other (Labour, Storage, Trucking, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>28.30</td>
<td>15.85</td>
<td>202.5</td>
</tr>
<tr>
<td></td>
<td>19.75</td>
<td>15.90</td>
<td>81.15</td>
</tr>
<tr>
<td></td>
<td>19.75</td>
<td>15.55</td>
<td>87.6</td>
</tr>
</tbody>
</table>

**Operating Costs**

|                      | 496.40     | 233.45     | 284.25       |

**Revenue**

<table>
<thead>
<tr>
<th></th>
<th>Yield (bu/acre)</th>
<th>Price (bu/acre)</th>
<th>Revenue/Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>153.5</td>
<td>5.5</td>
<td>844.25</td>
</tr>
<tr>
<td></td>
<td>44.2</td>
<td>11.96</td>
<td>528.63</td>
</tr>
<tr>
<td></td>
<td>77.3</td>
<td>5.6</td>
<td>432.88</td>
</tr>
</tbody>
</table>

**Return**

|                      | Return/Acre     | 306.47         | 295.18       | 148.63       |

**Overhead Costs**

<table>
<thead>
<tr>
<th></th>
<th>Depreciation</th>
<th>Interest</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>28.45</td>
<td>13.05</td>
<td>29.05</td>
</tr>
<tr>
<td></td>
<td>29.65</td>
<td>15.25</td>
<td>29.05</td>
</tr>
<tr>
<td></td>
<td>14.45</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 29: A sample cost of production budget for corn, soybeans and winter wheat under No-Till. Prices and yields are calculated using the average of last four years. Adapted from Field Crops Budget, Publication 60, OMAF. 2013

<table>
<thead>
<tr>
<th>No-Till</th>
<th>Grain Corn</th>
<th>Soybeans</th>
<th>Winter Wheat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sample Costs/Acre ($)</td>
<td>Sample Costs/Acre ($)</td>
<td>Sample Costs/Acre ($)</td>
</tr>
<tr>
<td>Input Costs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed</td>
<td>108.65</td>
<td>51.30</td>
<td>51.90</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>127.95</td>
<td>28.45</td>
<td>86.45</td>
</tr>
<tr>
<td>Herbicide</td>
<td>20.05</td>
<td>43.80</td>
<td>23.00</td>
</tr>
<tr>
<td><strong>Tractor &amp; Machinery Expenses</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel</td>
<td>13.45</td>
<td>10.40</td>
<td>9.30</td>
</tr>
<tr>
<td>Maintenance</td>
<td>10.45</td>
<td>11.90</td>
<td>12.45</td>
</tr>
<tr>
<td>Other (Labour, Storage, Trucking, etc.)</td>
<td>205.05</td>
<td>84.40</td>
<td>79.90</td>
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<tr>
<td><strong>Operating Costs</strong></td>
<td>485.60</td>
<td>230.25</td>
<td>263.00</td>
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<tr>
<td><strong>Revenue</strong></td>
<td></td>
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<tr>
<td>Yield (bu/acre)</td>
<td>153.5</td>
<td>44.2</td>
<td>77.3</td>
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<tr>
<td>Price(bu/acre)</td>
<td>5.5</td>
<td>11.96</td>
<td>5.6</td>
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<tr>
<td>Revenue/Acre</td>
<td>844.25</td>
<td>528.63</td>
<td>432.88</td>
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<tr>
<td><strong>Return</strong></td>
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<tr>
<td>Return/Acre</td>
<td><strong>358.65</strong></td>
<td><strong>298.38</strong></td>
<td><strong>169.88</strong></td>
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<td><strong>Overhead Costs</strong></td>
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<tr>
<td>Depreciation</td>
<td>18.85</td>
<td>29.65</td>
<td>29.05</td>
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<tr>
<td>Interest</td>
<td>8.40</td>
<td>15.25</td>
<td>14.45</td>
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Appendix B: Survey Instrument

Ontario and Manitoba Farmland Ownership Survey

Instructions:

- Text enclosed in [square brackets] are instructions for the surveyor, while those in [italics] indicate that a statement is to be said, upon conditions in the brackets, for example in the introduction “Good [morning/afternoon/evening]”, the words statement in the square brackets depends on the time of day.

Text with no formatting is spoken, or for potential answers for the respondent.

Introduction:

“Good [morning/afternoon/evening], my name is [first, last] from Ipsos Agriculture and Animal Health. I am calling on behalf of researchers at the [IF ONTARIO INSERT “University of Guelph and the Ontario Agricultural College” IF MANITOBA INSERT “University of Manitoba”]. We are collecting data on agricultural management practices and land rental patterns, in the hopes of gaining a better understanding of farmland ownership and rental market in [IF ONTARIO INSERT “Ontario” IF MANITOBA INSERT “Manitoba”]. We are interested in your opinions and insights to help us better understand the issue. This study is being funded by the LEARN Network.

If you agree to participate in this survey your responses to these questions will not be released and will be protected to the full extent possible under Canadian and U.S. laws. Your responses will only be recorded on a computer program and will not be taped. We will record your name and address separately from your responses. Any results published by researchers at the [IF ONTARIO INSERT “University of Guelph” IF MANITOBA INSERT “University of Manitoba”] will be reported in a general way. [IF ONTARIO INSERT “For example, they might write something like, “The rental rates in Dufferin County ranged from 50 to 200 dollars an acre.””]

Please note that you are free to withdraw from the survey at any time and have the right to refuse to answer any question without any consequence. If you withdraw from the survey all of the information that you provided up to that point will not be used and will be deleted. If you qualify, the survey will take approximately 15 to 20 minutes to complete and will include a compensation of $20 for your time. If you like, a summary of the completed research results can be made available to you.

[IF ONTARIO INSERT “This survey has been cleared by the University of Guelph Research Ethics Board under the research ethics board number 13FE031. If you would like more information on the survey or the results you can contact Professor Brady Deaton or Professor Alfons Weersink at the University of Guelph.” IF MANITOBA INSERT “This survey has been
cleared by the University of Manitoba Research Ethics Board. You can contact the University of Manitoba Research Ethics Board at 204-474-7122. When you call please inform them you are calling about the Land Rental Survey and provide the following Protocol #J2013:033. If you would like more information on the survey or the results you can contact Professor Chad Lawley at the University of Manitoba or Professor Brady Deaton at the University of Guelph. ”

Would you like the contact information for [IF ONTARIO INSERT “the Research Ethics Board or”] the Professors?”

[IF NO, SKIP TO A. IF YES, PLEASE PROVIDE FOLLOWING INFORMATION]

[IF ONTARIO INSERT “You can contact Brady Deaton by email at bdeaton@uoguelph.ca or by phone at 519-824-4120 extension 52765. You can also contact Alfons Weersink by email at aweersin@uoguelph.ca or by phone at 519-824-4120 extension 52766. When you call please inform him you are calling about the Land Rental Survey. You can contact the University of Guelph Research Ethics Board at 519-824-4120 extension 56606 or by email at reb@uoguelph.ca. When you call please inform them you are calling about the Land Rental Survey and provide the following REB# 13FE031 ”]

[IF MANITOBA INSERT “You can contact Brady Deaton by email at bdeaton@uoguelph.ca or by phone at 519-824-4120 extension 52765. You can contact Chad Lawley by email at chad_lawley@umanitoba.ca or by phone at 204-474-9397. When you call please inform him you are calling about the Land Rental Survey.”]

A.) Are you willing to participate in the survey regarding land rental in [IF ONTARIO INSERT “Ontario’ IF MANITOBA INSERT “Manitoba”]? 

[ If Yes] – “Thank you very much”
[If No] – “Thank you, have a great day!”

Section I - Qualification:

First, we are going to ask you a few general questions about you and your farm operation.

1. So to begin, can you please tell me what year you were born in? 
   [RANGE = 1900 TO 2013] 
   [IF 1995 OR GREATER THANK AND TERMINATE: Thank you but for this survey we need to speak with agricultural producers that are at least 18 years of age. Hopefully we can conduct another study with you in the future. Thank you for your time.]

2. In what [IF ONTARIO INSERT “county is your home farm located in” IF MANITOBA INSERT “municipality is your home yard located”]? (DO NOT READ LIST)
[ONTARIO LIST]
  Brant*
  Bruce*
  Chatham-Kent*
  Dufferin*
  Elgin*
  Essex*
  Grey*
  Haldimand-Norfolk*
  Halton*
  Hamilton-Wentworth*
  Huron*
  Lambton*
  Middlesex*
  Niagara*
  Oxford*
  Peel*
  Perth*
  Simcoe*
  Waterloo*
  Wellington*
  Algoma
  Cochrane
  Durham
  Haliburton
  Hastings
  Frontenac
  Greater Sudbury / Grand Sudbury
  Kawartha Lakes
  Kenora
  Lanark
  Leeds and Grenville
  Lennox and Addington
  Manitoulin
  Muskoka
  Nipissing
  Northumberland
  Ottawa
  Parry Sound
Peterborough
Prescott and Russell
Prince Edward
Rainy River
Renfrew
Stormont, Dundas and Glengarry
Sudbury
Thunder Bay
Timiskaming
York
Other [ANCHOR AT BOTTOM]

[MANITOBA LIST]

<table>
<thead>
<tr>
<th>Albert*</th>
<th>Grandview*</th>
<th>North Cypress*</th>
<th>South Norfolk*</th>
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<tr>
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<td>Headingly*</td>
<td>Park (South)*</td>
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<td>Pembina*</td>
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<td>Brenda*</td>
<td>Killarney - Turtle Mountain*</td>
<td>Pipestone*</td>
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<td>La Broquerie*</td>
<td>Portage la Prairie*</td>
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<td>Cameron*</td>
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<td>Langford*</td>
<td>Ritchot*</td>
<td>Swan River*</td>
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<td>Daly*</td>
<td>Lorne*</td>
<td>Rockwood*</td>
<td>Valley River 63A*</td>
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<td>Dauphin*</td>
<td>Louise*</td>
<td>Roland*</td>
<td>Victoria*</td>
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<td>Rosedale*</td>
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<td>Franklin*</td>
<td>Morton*</td>
<td>Shoal Lake*</td>
<td>Woodlands*</td>
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<tr>
<td>Gilbert Plains*</td>
<td>Mountain (North)*</td>
<td>Sifton*</td>
<td>Woodworth*</td>
</tr>
<tr>
<td>Glenella*</td>
<td>Mountain (South)*</td>
<td>Silver Creek*</td>
<td>Other [ANCHOR AT BOTTOM]</td>
</tr>
</tbody>
</table>
3. How many acres of land did your operation farm in 2012, including all rented, leased, or crop-shared lands?

[RANGE = 1 to 20000]

4. What types of livestock do you have on your farm this year? (DO NOT READ LIST, ACCEPT ALL RESPONSES)
   - Dairy Cattle
   - Beef Cattle
   - Sheep
   - Poultry
   - Hogs
   - Other (Specify)
   - None

5. We are now going to ask about the business structure of your farm operation. Is your farm operation a… (READ LIST)
   - Sole proprietorship
   - Partnership
   - Corporation

6. We are now going to ask about your total farm sales in 2012, please ask me to stop when I get to the right category. Would you say your 2012 gross farm sales were…(READ LIST)
   - Less than $50,000
   - $50,000 to $100,000
   - $100,000 to $250,000
   - $250,000 to $500,000
   - $500,000 to 1 million
   - 1 million to 2 million
Greater than 2 million

7. Did you actively try to find new farmland to rent in 2013? *(Please select one response)*
   Yes
   No

8. Did your farm operation rent any land from other landowners in 2012? This includes cash rental, share-cropping, and cost-shared lands. *(Please select one response)*
   Yes
   No
   [IF YES CONTINUE TO Q.9, OTHERWISE SKIP TO SECTION 3]

9. How many acres in total did you rent from other landowners in 2012, including cash rental, crop-sharing and cost sharing?
   [RANGE = 1 TO RESPONSE FROM Q.3]

10. And for the [INSERT ACRES FROM Q.9] acres rented from other landowners in 2012, how many different landlords did you have?
    [RANGE = 1 TO 99]

**Section 2 – Detailed Information on Properties Rented**
In the following questions we are hoping to gain a better understanding of the land you rent and the landowner who you rent from. We are also hoping to better understand your relationship with the landlord that you rent from. For any questions in this section which you are uncomfortable answering please indicate that and we will go to the next question.

11. How many farmable acres was the largest property that you rented in 2012?
    [RANGE = 1 TO RESPONSE FROM Q.9]
    [“For the next set of questions, we will only be dealing with this property.”]

12. How long have you been renting this land from this landlord?
    [RANGE = 1 TO 99] Years

13. How long do you expect to rent this land from this landlord?
    [RANGE = 0 TO 99] Years
14. Thinking of the landlord of this property, is this person a member of your immediate or extended family? (*Please select one response.*)

Yes
No

[IF YES IN Q.14 SKIP TO Q.16, OTHERWISE CONTINUE]

15. Would you categorize this landlord to be an acquaintance, a friend, or none of the above? (*Please select one response.*)

An acquaintance
A friend
None of the above

16. We would like to better understand the characteristics of landowners in [IF ONTARIO INSERT “Ontario”, IF MANITOBA INSERT “Manitoba”]. For this reason we are going to ask you a series of questions about the landowner. Please answer yes, no, or I don’t know to each of the following questions.

   a) Would you describe the landlord as an active farmer? (*Please select one response*)
      Yes
      No
      Don’t Know
      [IF Yes, Skip to G]

   b) Would you describe the landlord as the spouse of a deceased farmer? (*Please select one response*)
      Yes
      No
      Don’t Know
      [IF Yes, Skip to G]

   c) Would you describe the landlord as a retired farmer? (*Please select one response*)
      Yes
      No
      Don’t Know
      [IF Yes, Skip to G]
d) Would you characterize the landlord as a Non-Farmer who is primarily holding the land as an investment opportunity? *(Please select one response)*
   - Yes
   - No
   - Don’t Know
   [IF Yes, Skip to G]

e) Is the landlord a company or corporation who purchased farmland as a form of investment? *(Please select one response)*
   - Yes
   - No
   - Don’t Know
   [IF Yes, Skip to Q.17]

f) Does the government (Federal/provincial/municipal) own this land? *(Please select one response)*
   - Yes
   - No
   - Don’t Know
   [IF Yes, Skip to Q.18]

g) Does the landlord use the land as a place of residence? *(Please select one response)*
   - Yes
   - No
   - Don’t Know
   [IF Yes, Skip to Q.18]

17. Is this landlord based in [IF ONTARIO INSERT “Canada” IF MANITOBA INSERT “Manitoba”]? *(Please select one response)*
   - Yes
   - No

18. How well informed do you believe that this landlord is regarding the rental rates in your area? Do you believe they are: *(READ LIST)*
   - Very well informed
   - Well informed
   - Somewhat informed
   - Poorly informed
   - Do not know rental rates at all
19. Thinking about this property, what crops did you grow on this land in 2012? (DO NOT READ LIST)

**Grain and Oilseed:**
- Seed Corn
- Silage Corn
- Grain Corn
- Sweet Corn
- Winter Wheat
- Spring wheat
- Canola
- Spring Cereals
- Soybeans
- Flax

**Pulse and Speciality Crops:**
- Buckwheat
- Canary Seed
- Dry Beans
- Edible Beans
- Dry Peas
- Faba Beans
- Lentils
- Mustard

**Forage:**
- Hay
- Pasture
- Alfalfa
- Forage Seeds

**Other:**
- Potatoes
- Vegetables
- Fruit Trees
- Other (Specify)
- None

20. Did you rent this property in 2011? (Please select one response)
   - Yes
   - No
20 B. Thinking about this property, what crops were grown on this land in 2011? *(DO NOT READ LIST) (INTERVIEWER NOTE: WE ARE INTERESTED IN THIS ANSWER REGARDLESS OF WHETHER THEY RENTED THIS PROPERTY OR NOT IN 2011)*

[USE LIST OF CROPS FROM Q19]

21. Did you rent this property in 2010? *(Please select one response)*
   
   Yes
   
   No

21B. Thinking about this property, what crops were grown on this land in 2010? *(DO NOT READ LIST) (INTERVIEWER NOTE: WE ARE INTERESTED IN THIS ANSWER REGARDLESS OF WHETHER THEY RENTED THIS PROPERTY OR NOT IN 2011)*

[USE LIST OF CROPS FROM Q19]

[IF MORE THAN 1 CROP MENTIONED IN ANY OF Q19, Q20B, Q21B CONTINUE OTHERWISE SKIP TO Q22]

Q21c. I noticed that you planted more than one crop on this property in at least one of the past three years. Can you please tell me what the crop rotation or rotations were for this property over the past three years? What we mean by that is for example was the rotation [IF ONTARIO INSERT "corn/soy/corn or it could be for half the property it was corn/soy/corn while the other half was winter wheat/corn/soy" IF MANITOBA INSERT "spring wheat/canola/barley or it could be for half of the property it was wheat/canola/barley while the other half was canola/wheat/soybean"] (INTERVIEWER NOTE: PLEASE CAPTURE EACH OF THE ROTATIONS THAT THE RESPONDENT PROVIDES.)

22. Do you expect to rent this property this year? *(Please select one response)*
   
   Yes
   
   No

[IF YES IN Q22A CONTINUE OTHERWISE SKIP TO Q23]

22B. Thinking about this property, what crops will be grown on this land this year? *(DO NOT READ LIST) (WE ARE INTERESTED IN THIS ANSWER REGARDLESS OF WHETHER THEY RENTED THIS PROPERTY OR NOT)*

[USE LIST OF CROPS FROM Q19]
23. Thinking about this property, in which [IF ONTARIO INSERT “county’, IF MANITOBA INSERT “municipality”] is it located in? *(DO NOT READ LIST)*
   [ONTARIO LIST]
   [INSERT ALL ITEMS FROM ONTARIO LIST IN Q2 THAT HAVE A “*”]
   Other (Specify)

   [MANITOBA LIST]
   [INSERT ALL ITEMS FROM MANITOBA LIST IN Q2 THAT HAVE A “*”]
   Other (Specify)

24. Thinking about this property, approximately how many kilometers is it away from your home farm?
   [RANGE = 0 TO 500]

25. How would you compare this land to other land in your area? Would you consider it to be *(READ LIST)*:
   Very poor
   Poor
   Good
   Very good
   Excellent

   [IF MANITOBA CONTINUE OTHERWISE SKIP TO Q26]
25A. Thinking about this property, what is the risk area & soil productivity rating assigned by crop insurance?
   Provide answer (Specify)
   Unsure

26. Thinking about this property, would you characterize the dominant soil texture to be:
   *(READ LIST)*
   Clay
   Clay loam
   Silty loam
   Loam
   Sandy loam
   Sandy

27. Thinking about this property, would you characterize the topography to be: *(READ LIST)*
   Flat
Gently rolling
Hilly

28. Are there any wetlands, rivers, streams or lakes within, or adjacent to, this property?
   (Please select one response)
   Yes
   No

29. Of the farmable land on this property, what percentage can you consistently crop?
   [RANGE 0 TO 100]

30. To your knowledge, has this property been improved for agricultural purposes by surface
    or tile drainage? (Please select one response)
    Yes
    No
    Don’t Know

   [IF YES CONTINUE, OTHERWISE SKIP TO Q.32]

31. Did you drain this property by surface or tile drainage (Please select one response)
    Yes
    No

32. Thinking about this property, is the land irrigated? (Please Select one response)
    Yes
    No
    Don’t Know

   [IF ONTARIO CONTINUE OTHERWISE SKIP TO Q33C]

33. Thinking about this property, did you plant a cover crop in 2012? (Please Select one
    response)
    Yes
    No

   [IF YES CONTINUE, OTHERWISE SKIP TO Q.33C]

33B. Thinking about this property, what cover crop did you plant in 2012? (Please Record
     Answer)

   [IF MANITOBA CONTINUE OTHERWISE SKIP TO Q34]

33C. Thinking about this property, in 2012 did you use a chaff spreader, straw chopper, or
      heavy harrows for crop residue management? (Please Select one response)
      Yes
No

34. Thinking about this property, in 2012 was the land primarily prepared using: *(READ LIST)*
   - No-Till
   - Minimum or Conservation Tillage
   - Conventional Tillage

35. Thinking about this property, did you apply manure in 2012? *(Please select one response)*
   - Yes
   - No

36. Thinking about this property, did you use a variable rate applicator in 2012? *(Please select one response)*
   - Yes
   - No

   [IF YES CONTINUE, OTHERWISE SKIP TO Q.38]

37. Which of the following maps were used for this property? *(READ LIST) (Check all that apply)*
   - GPS Yield Map
   - Electrical Conductivity (EC) map
   - Topography Map
   - Satellite or remote sensed image
   - None of the above

Next you will be asked about the type of rental agreement you have for this property such as cash rental, crop-share or cost-share and by that we mean:

**Cash rental** is “a rental agreement where a fixed annual payment is paid to the landlord, and the tenant owns the entire crop.”

**Crop-share** is “a rental agreement where the tenant gains exclusive use of the plot, bears all the costs of production and shares a portion of the crop with the landlord”

**Cost-share** is “a rental agreement where the tenant gives the landlord a share of the crop yield, but the landlord also pays a share of the operating expenses other than the cost of land”
38. Was the rental agreement with this landlord cash rental, crop share or cost-share? (Please select one response)

- Cash Rental
- Crop-share
- Cost-share
- Other (Specify)

[ASK Q.39 AND Q.40 FOR PROPERTY WHERE CASH RENTAL IS SELECTED IN Q.38 AND SKIP Q.41. ASK Q.41 FOR PROPERTY WHERE CROP-SHARE OR COST-SHARE IS SELECTED IN Q.38 AND SKIP Q.39 AND Q.40]

39. What was the cash rental rate you paid in dollars per cropped acre for this property in 2012?

[RANGE =0 TO 999.99]

40. Did you pay more than the required rental rate to the landlord for this property in 2012? (Please select one response)

- Yes
- No

41. What percentage of the crop did you pay the landlord in 2012?

[Range = 0 to 100]

42. Do you anticipate an increase in rental rate for this property in 2014? (Please select one response)

- Yes
- No
- Don’t Know

43. Was this rental agreement an oral or written contract? (Please select one response)

- Oral
- Written
- Other (Specify)

44. We would like to better understand the characteristics of this rental contract. Please answer Yes or No to the following questions
a) Does this contract have specific provisions regarding tillage practices? *(Please select one response)*
   Yes
   No

b) Does this contract have specific provisions regarding crop selection? *(Please select one response)*
   Yes
   No

c) Does this contract have specific provisions regarding surface or tile drainage? *(Please select one response)*
   Yes
   No

d) Does this contract have specific provisions regarding fertilizer or manure applications? *(Please select one response)*
   Yes
   No

e) Does this contract have specific provisions regarding herbicide applications? *(Please select one response)*
   Yes
   No

**Section 3: Detailed Information on Properties Owned**
In the following questions we are hoping to gain a better understanding of the land you own. For any questions in this section which you are uncomfortable answering please indicate that and we will go to the next question.

45. How many acres is the largest property you own?
   
   [RANGE = 1 TO RESPONSE IN Q.3]

   [“For the remaining questions, we will only be dealing with this property.”]

46. How long have you and/or your family owned this property?
   
   [RANGE = 0 TO 200] Years

47. Thinking about this property, what crops did you grow on this land in 2012? *(DO NOT READ LIST)*

   **Grain and Oilseed:**
   Seed Corn
Silage Corn
Grain Corn
Sweet Corn
Winter Wheat
Spring wheat
Canola
Spring Cereals
Soybeans
Flax

**Pulse and Speciality Crops:**
Buckwheat
Canary Seed
Dry Beans
Edible Beans
Dry Peas
Faba Beans
Lentils Mustard

**Forage:**
Hay
Pasture
Alfalfa
Forage Seeds

**Other:**
Potatoes
Vegetables
Fruit Trees
Other (Specify)
None

48. Did you own this property in 2011? *(Please select one response)*
   Yes
   No

48B. Thinking about this property, what crops were grown on this land in 2011? *(DO NOT READ LIST)* *(INTERVIEWER NOTE: WE ARE INTERESTED IN THIS ANSWER REGARDLESS OF WHETHER THEY OWNED THIS PROPERTY OR NOT)*

   [USE LIST OF CROPS FROM Q47]
49. Did you own this property in 2010? (Please select one response)
   Yes
   No

49B. Thinking about this property, what crops were grown on this land in 2010? (DO NOT READ LIST) (INTERVIEWER NOTE: WE ARE INTERESTED IN THIS ANSWER REGARDLESS OF WHETHER THEY OWNED THIS PROPERTY OR NOT)

   [USE LIST OF CROPS FROM Q47]

[IF MORE THAN 1 CROP MENTIONED IN ANY OF Q47, Q48B, Q49B CONTINUE OTHERWISE SKIP TO Q50]

Q49c. I noticed that you planted more than one crop on this property in at least one of the past three years. Can you please tell me what the crop rotation or rotations were for this property over the past three years? What we mean by that is for example was the rotation [IF ONTARIO INSERT "corn/soy/corn or it could be for half the property it was corn/soy/corn while the other half was winter wheat/corn/soy" IF MANITOBA INSERT "spring wheat/canola/barley or it could be for half of the property it was wheat/canola/barley while the other half was canola/wheat/soybean"] (INTERVIEWER NOTE: PLEASE CAPTURE EACH OF THE ROTATIONS THAT THE RESPONDENT PROVIDES.)

50. Do you still own this property this year? (Please select one response)
   Yes
   No

   [IF YES IN Q50 CONTINUE OTHERWISE SKIP TO Q51]

50B. Thinking about this property, what crops will be grown on this land this year (DO NOT READ LIST) (WE ARE INTERESTED IN THIS ANSWER REGARDLESS OF WHETHER THEY OWNED THIS PROPERTY OR NOT)

   [USE LIST OF CROPS FROM Q47]

51. Thinking about this property, in which [IF ONTARIO INSERT “county”, IF MANITOBA INSERT “municipality”] is it located in? (DO NOT READ LIST)
   [ONTARIO LIST]
   [INSERT ALL ITEMS FROM ONTARIO LIST IN Q2 THAT HAVE A “*”]
   Other (Specify)
52. Thinking about this property, approximately how many kilometers is it away from your home farm? (Please insert 0 if property selected is Home Farm) 
   [RANGE = 0 TO 500]

53. How would you compare this land to other land in your area? Would you consider it to be
   (READ LIST):
   Very poor
   Poor
   Good
   Very good
   Excellent

[IF MANITOBA CONTINUE OTHERWISE SKIP TO Q54]

53A. Thinking about this property, what is the risk area & soil productivity rating assigned by crop insurance?

   Provide answer (Specify)
   Unsure

54. Thinking about this property, would you characterize the dominant soil texture to be:
   (READ LIST)
   Clay
   Clay loam
   Silty loam
   Loam
   Sandy loam
   Sandy

55. Thinking about this property, would you characterize the topography to be: (READ LIST)
   Flat
   Gently rolling
   Hilly

56. Are there any rivers or streams within, or adjacent to, this property? (Please select one response)
   Yes
   No
57. Of the farmable land on this property, what percentage can you consistently crop?
   [RANGE 0 TO 100]

58. To your knowledge, has this property been improved for agricultural purposes by surface
   or tile drainage? (Please select one response)
   Yes
   No
   Don’t Know

59. Thinking about this property, is the land irrigated? (Please Select one response)
   Yes
   No
   Don’t Know

[IF ONTARIO CONTINUE, OTHERWISE SKIP TO Q60A]

60. Did you apply to the Canada-Ontario Farm Stewardship Program for funding to plant
   cover crops on this property in 2012? (Please select one response)
   Yes
   No

[IF MANITOBA CONTINUE OTHERWISE SKIP TO Q61]

Q60A. Did you apply to the Environmental Farm Action Program for funding to purchase a
chaff spreader, straw chopper, or heavy harrows for crop residue management? (Please select
one response)

   Yes
   No

[IF ONTARIO CONTINUE OTHERWISE SKIP TO Q62]

61. Thinking about this property, did you plant a cover crop in 2012? (Please Select one
response)
   Yes
   No

[IF YES IN Q.61 CONTINUE, OTHERWISE SKIP TO Q.62]

61B. Thinking about this property, what cover crop did you plant in 2012? (Please Record
Answer)

[IF YES IN Q.60 CONTINUE, OTHERWISE SKIP TO Q.62]

61C. Did you receive funds from the Canada-Ontario Farm Stewardship Program to plant
cover crops on this property in 2012? (Please Select one response)
62. Thinking about this property, in 2012 did you use a chaff spreader, straw chopper, or heavy harrows for crop residue management? (Please select one response)
   - Yes
   - No

[IF YES IN Q.60A CONTINUE, OTHERWISE SKIP TO Q.63]

62B. Did you receive funds from the Environmental Farm Action Program to purchase a chaff spreader, straw chopper, or heavy harrows? (Please Select one response)
   - Yes
   - No

63. Did you apply to the [IF ONTARIO INSERT “Canada-Ontario Farm Stewardship Program”, IF MANITOBA INSERT “Manitoba Sustainable Agricultural Practices Program”] for funding to purchase tillage equipment? (Please select one response)
   - Yes
   - No

64. Thinking about this property, in 2012 was the land primarily prepared using: (READ LIST)
   - No-Till
   - Minimum or Conservation Tillage
   - Conventional Tillage

[IF YES IN Q.63 CONTINUE, OTHERWISE SKIP TO Q.66]

65. Did you receive funds from the [IF ONTARIO INSERT “Canada-Ontario Farm Stewardship Program”, IF MANITOBA INSERT “Manitoba Sustainable Agricultural Practices Program”] to purchase tillage equipment? (Please select one response)
   - Yes
   - No

66. Thinking about this property, did you apply manure in 2012? (Please select one response)
   - Yes
   - No
67. Did you apply to the [IF ONTARIO INSERT “Canada-Ontario Farm Stewardship Program”, IF MANITOBA INSERT “Environmental Farm Action Program”] for funding to purchase variable rate application equipment? *(Please select one response)*
   Yes
   No

68. Thinking about this property, did you use a variable rate applicator in 2012? *(Please select one response)*
   Yes
   No

   [IF YES CONTINUE, OTHERWISE SKIP TO Q.70]

69. Which of the following maps were used for this property? *(READ LIST) (Check all that apply)*
   GPS Yield Map
   Electrical Conductivity (EC) map
   Topography Map
   Satellite or remote sensed image
   None of the above

   [IF YES TO Q.67 CONTINUE, OTHERWISE SKIP TO Q.71]

70. Did you receive funds from the [IF ONTARIO INSERT “Canada-Ontario Farm Stewardship Program”, IF MANITOBA INSERT “Environmental Farm Action Program”] for variable rate application equipment? *(Please select one response)*
   Yes
   No

71. All else equal, do you think some farmers take better care of the land they own than the comparable land that they rent? *(Please select one response)*
   Yes
   No
   Don’t Know

   [IF YES IN Q.71, ASK Q.72 AND Q.73 AND SKIP Q.74. IF NO IN Q.71, ASK Q.74 AND SKIP Q.72 AND Q.73. IF DON’T KNOW/REF IN Q.71, SKIP TO Q.75]

72. Do you think some farmers use more fertilizer or manure on the land they own than the comparable land that they rent? *(Please select one response)*
   Yes
No
Don’t Know

73. Do you think some farmers use a more complex crop rotation on the land they own than the comparable land that they rent? *(Please select one response)*
Yes
No
Don’t Know

74. We are now going to list some reasons why other farmers might take the same care of the land they own as the comparable land that they rent. We’d like you to indicate whether the following reason is very important, moderately important or not important.

a) To maintain reputation in the community *(Please select one response)*
   - Very Important
   - Moderately Important
   - Not Important

b) To secure rental contract for the next year *(Please select one response)*
   - Very Important
   - Moderately Important
   - Not Important

c) To take better care of the environment *(Please select one response)*
   - Very Important
   - Moderately Important
   - Not Important

d) To meet the conditions of the rental contract *(Please select one response)*
   - Very Important
   - Moderately Important
   - Not Important

75. For the following question, please ask me to stop when I get to the right category. What is the highest level of education you have completed *(READ LIST)*
   - Some high school
   - Completed high school
   - Some Post-Secondary Education
   - Completed College Diploma/University Degree
   - Graduate School

92
76. Approximately, what share of your household income came from off-farm sources in 2012? *(READ LIST)*

- 0-25%
- 26-50%
- 51-75%
- 76-100%

**Section 4: Wrap-up**

[CLOSE]

Thank you very much for participating in our survey on Land Rental in [IF ONTARIO INSERT “Ontario”, IF MANITOBA INSERT “Manitoba”]. We are very thankful for your patience and as a token of our appreciation we will be sending you a cheque if you are willing to provide us with your address, you do not have to provide this information if you do not wish. We will not release your name and address information to any other party and it will not be linked in any way to the data we have just collected from you. A summary report of this study will be made available online at www.whoownsfarmland.com.

[SCRIPT STANDARD NAME AND ADDRESS TEMPLATE WITH A CHECK BOX FOR “I do not wish to provide my name/ I will decline the incentive”]

Thank you for your participation!
### Appendix C: Logit Regression Results

**Table 30: Logit Results for the model specified to explain the adoption of conservation tillage**

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Fixed Effects</th>
<th>Random Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variable:</strong> Conservation Tillage = 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Own</strong></td>
<td>-0.0661 (-0.11)</td>
<td>-0.297 (-0.71)</td>
</tr>
<tr>
<td><strong>Fine</strong></td>
<td>-1.431 (-1.38)</td>
<td>-1.548* (-2.24)</td>
</tr>
<tr>
<td><strong>Hilly</strong></td>
<td>1.937 (0.67)</td>
<td>1.939 (1.57)</td>
</tr>
<tr>
<td><strong>Plot_Size</strong></td>
<td>0.00194 (1.33)</td>
<td>0.00220* (2.46)</td>
</tr>
<tr>
<td><strong>Drainage</strong></td>
<td>-2.755* (-2.11)</td>
<td>-1.640* (-2.23)</td>
</tr>
<tr>
<td><strong>Wetland</strong></td>
<td>0.0607 (0.08)</td>
<td>0.279 (0.48)</td>
</tr>
<tr>
<td><strong>Distance</strong></td>
<td>0.0130 (0.22)</td>
<td>0.00552 (0.35)</td>
</tr>
<tr>
<td><strong>Corn12</strong></td>
<td>-2.125* (-2.31)</td>
<td>-2.522*** (-3.41)</td>
</tr>
<tr>
<td><strong>Soy12</strong></td>
<td>2.291 (1.84)</td>
<td>1.713* (2.48)</td>
</tr>
<tr>
<td><strong>Winter_Wheat12</strong></td>
<td>0.621 (0.67)</td>
<td>0.913 (1.10)</td>
</tr>
<tr>
<td><strong>Canola_12</strong></td>
<td>2.018 (1.74)</td>
<td>1.422 (1.92)</td>
</tr>
<tr>
<td><strong>Spring_Wheat12</strong></td>
<td>-1.093 (-0.69)</td>
<td>-0.150 (-0.18)</td>
</tr>
<tr>
<td><strong>Forage12</strong></td>
<td>2.261 (1.90)</td>
<td>1.340 (1.72)</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>---</td>
<td>0.191*** (3.81)</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td>---</td>
<td>2.437 (1.95)</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>---</td>
<td>-7.212* (-2.22)</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>114</td>
<td>834</td>
</tr>
</tbody>
</table>

`t` statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Table 31: Logit Results for the model specified to explain the adoption of cover crops

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Fixed Effects Model</th>
<th>Random Effects Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Variable: Cover Crops=1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Own</td>
<td>0.330 (0.31)</td>
<td>0.487 (0.91)</td>
</tr>
<tr>
<td>Coarse</td>
<td>-0.101 (-0.06)</td>
<td>0.458 (0.66)</td>
</tr>
<tr>
<td>Irrigated</td>
<td>37.61 (0.00)</td>
<td>3.397* (2.15)</td>
</tr>
<tr>
<td>Distance</td>
<td>-0.312 (-1.33)</td>
<td>-0.316* (-2.49)</td>
</tr>
<tr>
<td>Corn12</td>
<td>-1.260 (-0.98)</td>
<td>-0.0973 (-0.16)</td>
</tr>
<tr>
<td>Soy12</td>
<td>-18.57 (-0.00)</td>
<td>-0.868 (-1.35)</td>
</tr>
<tr>
<td>Winter_Wheat12</td>
<td>23.57 (0.00)</td>
<td>4.392*** (4.60)</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td>-0.00418 (-0.12)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td>0.585 (0.82)</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td>-4.048 (-1.76)</td>
</tr>
<tr>
<td>N</td>
<td>78</td>
<td>391</td>
</tr>
</tbody>
</table>

* t statistics in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001