Do farmers treat rented land differently than the land they own? A fixed effects model of farmer's decision to adopt conservation practices on owned and rented land

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1. Introduction

Are farmers better stewards of the land they own than the land they rent from others? This is a longstanding question in agricultural economics and one that is still relevant—the percentage of farmland under tenancy in Canada has been steadily rising for the last two decades and tenants now operate approximately 40% of Canadian farmland (Statistics Canada, 2011). Previous research investigating this question has yielded conflicting results. Belknap and Saupe (1988) and Lynne et al. (1988) find that owner-operators are more likely to adopt conservation practices than renters. Several other studies find no differences in use of conservation practices between owner-operators and tenants (Lee and Stewart 1983; Rahm and Huffman 1984; Norris and Batie 1987).[1] Soule et al. (2000) argue that the role of tenure might vary with the rate of return on conservation practices. For instance, tenure might influence the adoption of site-specific conservation practices such as cover crops, which increase costs in the short-term and may generate benefits only in the long-term. On the other hand, the role of tenure might be less important for the adoption of non-site specific conservation practices such as conservation tillage that potentially reduce costs in the short-term.

In this paper, we examine the role of tenure on the use of two conservation practices: conservation tillage and cover crops. Whereas the prior literature examines the role of tenure using farm-level data for each farmer, we collect and analyze plot-level data for a sample of farmers that operate on their own land and on rented land. This allows us to identify the impact of tenure on use of conservation practices based off of variation within farmers. The prior literature also implicitly assumes that tenure security is equal on all rented land. That is, a plot of

[1] 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.

land that the farmer expects to rent for the next fifteen years has the same tenure security as a plot of land that the farmer expects to rent only for the next five years. We relax this assumption and examine the extent to which variation in the expected length of the rental relationship influences the use of conservation practices.

We find that the influence of tenure status varies with the type of conservation practice. Farmers are less likely to plant cover crops on the land that they rent compared to the land that they own. Our results also suggest that tenure status has no influence on the use of conservation tillage. These results are consistent with the fact that cover crops require site-specific investments that tend to pay off only in the long-term, whereas the use of conservation tillage is not site-specific and a farmer can expect to realize cost savings in the short-term. We also find that variation in tenure security matters for the use of cover crops. Farmers are less likely to plant cover crops on land that they only expect to rent for five years or less compared to land that they own. On the other hand, farmers who expect to rent for more than five years are found to treat rented land no differently than the land they own. Overall, our results suggest that tenure security does play a role in the use of conservation practices. As expected, it is most important in short-term rental arrangements for a site-specific practice such as the use of cover crops.

The remainder of the paper is organized as follows. Section 2 provides a conceptual framework that seeks to explain the influence of tenure on the use of different types of conservation practices. This is followed in section 3 by a discussion of the empirical model. The data used in this study is described and summarized in section 4. The results are presented in section 5 and section 6 provides concluding remarks.

2. Conceptual Framework

Following McConnell (1983) and Soule et al. (2001) we use a two period model to emphasize the effect of tenure security on the decision to adopt conservation practices. In this model, a farmer grows a single crop via production practice *i*. The farmer seeks to maximize the present value of net benefits, π_i, which is comprised of two components: (1) V_{i0}, the net returns to using practice *i* in the initial period and (2) V_{i1} the net returns to practice *i* in the future period:

$$\max_i \pi_i = V_{i0} + \gamma \frac{V_{i1}}{(1+r)} \qquad [1]$$

where $1+r$ is a discount factor used to assess the present value of future returns and γ captures tenure security. If a farmer has complete tenure security then $\gamma = 1$; γ is between one and zero for farmers who do not have complete tenure security. When assessing alternative production practices, lower tenure security diminishes incentives to adopt production practices that sacrifice returns in the initial period for greater returns in the future period.

The importance of tenure security and the tradeoff between future and present returns can be clarified further by example. Assume a farmer is choosing between a conventional production practice ($i=c$) and a 'green' or conservation production practice ($i=g$). If the green production practice diminishes initial returns but increases returns in the future period, a farmer chooses the green production practice, *g,* when the tradeoff is characterized as:

$$\gamma\left[\frac{V_{g1}}{(1+r)} - \frac{V_{c1}}{(1+r)}\right] \geq V_{c0} - V_{g0}. \qquad [2]$$

Equation 2 identifies a key relationship between γ and the expected net benefit of choosing a conservation practice, g, over a conventional practice. If conservation practices are expected to

reduce profits in the initial period, i.e., $V_{c0} - V_{g0} > 0$, then lower levels of γ require higher net-returns in the second period to justify adoption.

Alternatively, higher levels of tenure security, γ, increase the magnitude of the net-benefits associated with conservation practices that increase returns in the future period. For this reason, we expect increased tenure security to increase the likelihood of adoption of conservation practices that tradeoff short run returns for longer run gains.

3. Empirical model

We are primarily interested in the impact of tenure security on the use of conservation practices. We use plot-level data documenting conservation practice use on both owned and rented land for the same farmer. The probability that farmer *i* uses conservation practice *g* on plot *j* is written as:

$$\Pr(g_{ij} = 1) = \alpha X_{ij} + \beta T_{ij} + \delta_i + \varepsilon_{ij} \qquad [3]$$

where α and β are vectors of unknown parameters to be estimated; X_{ij} denotes observed plot-level characteristics including physical features of the land and cropping history; T_{ij} denotes plot-level tenure status; δ_i denotes farmer-specific characteristics; and ε_{ij} captures idiosyncratic shocks. Since we observe farmers choices on both the land they own and land they rent, we can eliminate δ_i through the inclusion of farmer fixed effects. The parameters of equation (3) are estimated using a fixed effects linear probability model.

We begin by examining the overall impact of tenure on the use of two conservation practices: cover crops and conservation tillage. In this case, T_{ij} takes on a value of one if the farmer is renting the plot and takes on a value of zero if the farmer owns the plot. Next, we examine possible heterogeneity in the impact of tenure security on use of conservation practices.

Each of the rented plots is classified according to the renters' expectation about the length of the rental relationship. A short-term rental arrangement is one where the renter expects to rent the land for an additional five (or fewer) years. A long-term rental arrangement is one where the renter anticipates renting the land for more than five years into the future. In this case, we enter two dummy variables for tenure security. The first is a short-term rental arrangement indicator, which takes on a value of one if the farmer is renting the plot and expects to rent the plot for five or less additional years and is equal to zero otherwise. The second is a long-term, rental arrangement indicator that takes on a value of one if the plot is rented and the renter expects to rent for five or more additional years.

4. Data

We use data from a survey of farmers in Southern Ontario and Manitoba, carried out over a two week period in April 2013. Our survey questionnaire was conducted through Ipsos Agriculture and Animal Health, a division of Ipsos-Reid. The sample of 1,778 farmers is drawn from a database of 35,023 farmers compiled and maintained by Ipsos. Of the 1,778 farmers contacted, approximately 46% (810) of the respondents completed the entire survey. Of these, 403 respondents are from Southern Ontario and the remaining 407 are from Manitoba. Approximately 51% of farmers in in Southern Ontario and 59% of farmers in Manitoba farm rented land. Our analysis is restricted to the 425 farmers who operate on both rented and owned land in the two provinces.

For each farmer, the survey collected information on the largest plot of land that the farmer owned and the largest plot of land that the farmer rented.[2] The survey collected detailed plot-specific characteristics for land that the farmer owns and land that the farmer rented in. For rented land, the survey documented expected length of tenure and the type of landlord that owns the rented land. Table 1 presents summary statistics for the variables used in this analysis.

Conservation practices

In this paper, we focus on two conservation practices: conservation tillage and cover crops. We ask farmers if they used conventional tillage, minimum tillage, or no-till in 2012. A farmer is defined as using conservation tillage if minimum tillage or no-till is used. Among farmers that farm both owned land and land rented in, we find that approximately 66% of farmers use conservation tillage on land that they rent in and 64% of farmers use conservation tillage on land that they own.

We also investigate the role of tenure on use of cover crops in Ontario.[3] We ask farmers if they planted a cover crop on land they rented in and owned in 2012. Cover crops include crops planted in the fall post-harvest, excluding winter wheat. In Ontario, a cover crop such as red clover is often underseeded with winter wheat. For farmers that farm both land they own and land they rent in, we find that approximately 15% of farmers plant cover crops on land that they rent in and 26% of farmers plant cover crops on land that they own.

[2] We restricted attention to the largest plots of owned and rented land in order to keep the length time it took to complete the survey to under 20 minutes. Focussing on one owned and one rented plot allowed us to collect very detailed information on each plot.

[3] Cover crops have not been widely adopted in Manitoba due to a combination of climatic conditions and lack of awareness among agricultural producers.

Tenure security

We ask farmers how long they expect to rent the land they are currently renting. We therefore capture the subjective expectation of tenure security. Our results suggest that, on average, farmers expect to continue to rent for approximately eight more years. Figure 1presents the distribution of expected rental lengths. Note that respondents to the survey tended to report in five year increments, such that there are a large number of farmers that expect to rent their land for an additional five, ten, and fifteen years.

Plot characteristics

We collect information pertaining to soil texture, topography, use of surface or tile drainage, the use of irrigation, detailed information on past cropping history on all fields within each plot of land, and the size of the plot. Plot characteristics are included in the models top control for physical characteristics of the land that may influence use of conservation practices.

We include several controls for the physical characteristics of plots. Soil texture is thought to be an important determinant of the benefits of conservation tillage. Conservation tillage conserves soil moisture and is most beneficial on well drained sandy land. Clay land may have excess moisture problems and farmers are therefore less likely to use conservation tillage on clay land. Cover crops, on the other hand, increase water use and are therefore less likely on well drained sandy land. Topography is included as a control for the potential for soil and water erosion, which is thought to be higher on hilly land. Both conservation tillage and cover crops increase the length of time organic matter is on the field, thus reducing soil and water erosion. We therefore expect that farmers are more likely to use these practices on hilly land.

We also include information of investments in field infrastructure that influence the productivity of the land. In the survey we ask farmers whether or not the land has been improved for agricultural purposes through surface or tile drainage. In some cases land that has been drained, particularly by tile drainage, is land that is inherently poorly drained and we would expect farmers are less likely to use conservation tillage and more likely to use cover crops on this land. The survey also collected information on which p0lots of land are irrigated. Due to increased water demand associated with cover crops, we expect that cover crops are more likely on land that is irrigated.

Cropping history can influence the use of both conservation tillage and cover crops. We include a set of dummy variables for several of the main crops planted in each province indicating whether or not the crop was planted on the plot in 2012**.** In Ontario, legume cover crops such as red clover are more likely to be planted to fix nitrogen following a corn crop and less likely to be planted following soybeans which fix their own nitrogen. On the other hand, the adoption of conservation tillage might be less likely after harvesting crops that generate thick residue. Finally, plot size is included as a control for the variation in size between owned and rented properties.

5. Results

We begin with the overall impact of land tenure on the use of conservation tillage and cover crops. These results are reported in Table 2. This is followed by an investigation of the role of the expected length of tenure on the use of conservation practices, presented in Table 3.

Overall impact of tenure

Our results suggest that tenure status does not influence the use of conservation tillage.

This is consistent with the fact that conservation tillage is not site-specific and in many cases generates short-term cost savings. Farmers are therefore just as likely to adopt conservation tillage on their rented land as they are on land they own. We also find that several site-specific characteristics influence the use of conservation tillage. Farmers are more likely to use conservation tillage on fields with coarse soils, consistent with the fact that coarse soils are more likely to suffer moisture deficits and conservation tillage conserves moisture. Farmers on hilly land are more likely to adopt conservation tillage, possibly due to concerns about soil and water erosion. Conservation tillage is more likely on larger plots of land. We find that farmers are less likely to use conservation tillage on land that is currently planted to corn, possibly due to the thick residue associated with this crop. Finally, land planted in soybeans in 2012 is more likely to be in conservation tillage.

Tenure status influences the use of cover crops. Our results suggest that farmers are 8.3% less likely to plant cover crops on land they rent compared to land they own. The use of cover crops is a site-specific conservation practice that likely generates net benefits only in the long-term. It appears as though farmers are more reluctant to plant cover crops in cases where they may not be in a position to realize the long-term benefits. Aside from tenure status, the use of cover crops seems to be influenced by the crop being grown. Fields that were used to grow soybeans in 2012 are 10.4% less likely to be planted to cover crops. On the other hand, fields that were used to grow winter wheat in 2012 are 27.2% more likely to plant cover crops, which is consistent with the fact that cover crops are often underseeded with winter wheat.[4]

[4] Farmers who 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 may therefore be 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. To address this possible concern, we examine the influence of tenure status on the decision to plant winter wheat, which is a less profitable crop than corn and soybeans but builds soil organic matter in the long-term. We restrict our attention to farmers who had access to the same rented plot for at least three years. We find that farmers are less likely to plant winter wheat on rented land than on their own land, consistent with our results in the cover crop equation.

Expected rental length

We examine the impact of tenure security on use of conservation practices. Once again, we find that farmers are no more or less likely to use conservation tillage on land they own versus land they rent, irrespective of the expected future length of the rental arrangement. Farmers are therefore behaving as if the net benefits of using conservation tillage are positive in the very short-run. It may also be the case that it is easier for the farmer to use a one cropping system across all land the farmer operates, independent of tenure status on individual plots.

Our results suggest that the expected length of rental arrangement matters for the use of cover crops. We find that renters who expect to rent the land for an additional five years or less are less likely to use cover crops. Conversely, long-term renters appear equally as likely to plant cover crops on rented land as they are to plant cover crops on the land that they own. This is an interesting result, which indicates that farmers in long-term rental arrangements expect to reap the long-term benefits associated with cover crops. Farmers are behaving as though the net benefits associated with cover crops are positive only after five or more years.

6. Conclusion

This study examines the impact of land tenure on the use of conservation practices. We draw a distinction between conservation practices that are site-specific, such as cover crops, and those that are not site-specific, such as conservation tillage. We use plot-level data collect for a sample of farmers in southern Ontario and Manitoba to examine use of conservation practices on land they rent versus land they own. Identification of the role of tenure is based on within-farmer variation, which allows us to control for the many possible farmer-specific characteristics

that might influence the use of conservation practices.

We find that tenure status does not influence the use of conservation tillage. However, we do find that farmers are less likely to use cover crops on land they rent compared to land they own. Further, it appears as though farmers in short-term rental relationships are less likely to use cover crops on rented land than lend they own, and farmers in long-term rental arrangements treat rented land the same as they treat land they own. Our results therefore suggest that tenure status does influence the adoption of site-specific conservation practices, such as cover crops.

Table 1: Summary Statistics			
Variable	Mean	Std. Deviation	Description
Conservation Tillage	0.65	0.48	The field was primarily tilled via conservation tillage in 2012 (1=yes, 0 = no)
Cover Crops	0.20	0.40	A cover crop was planted on the field in 2012 (1=yes, 0 = no)
Rented	0.50	0.50	Field is rented by farmer (1=yes, 0 = no)
Coarse soil	0.22	0.41	The field is characterized by a coarse soil texture (1=yes, 0 = no)
Hilly land	0.05	0.22	The field is characterized by a hilly topography. (1=yes, 0 = no)
Drained	0.58	0.49	The field has been drained by surface or tile drainage (1=yes, 0 = no)
Irrigated	0.03	0.17	The field is irrigated (1=yes, 0 = no)
Plot size (acres)	308.97	485.62	The size of the field in acres (1=yes, 0 = no)
Corn planted in 2012	0.33	0.47	Corn was planted on the field in 2012 (1=yes, 0 = no)
Soybean planted in 2012	0.35	0.48	Soybean was planted on the field in 2012 (1=yes, 0 = no)
Winter wheat planted in 2012	0.15	0.36	Winter Wheat was planted on the field in 2012 (1=yes, 0 = no)
Canola planted in 2012	0.26	0.44	Canola was planted on the field in 2012 (1=yes, 0 = no)
Spring wheat planted in 2012	0.22	0.42	Spring Wheat was planted on the field in 2012 (1=yes, 0 = no)

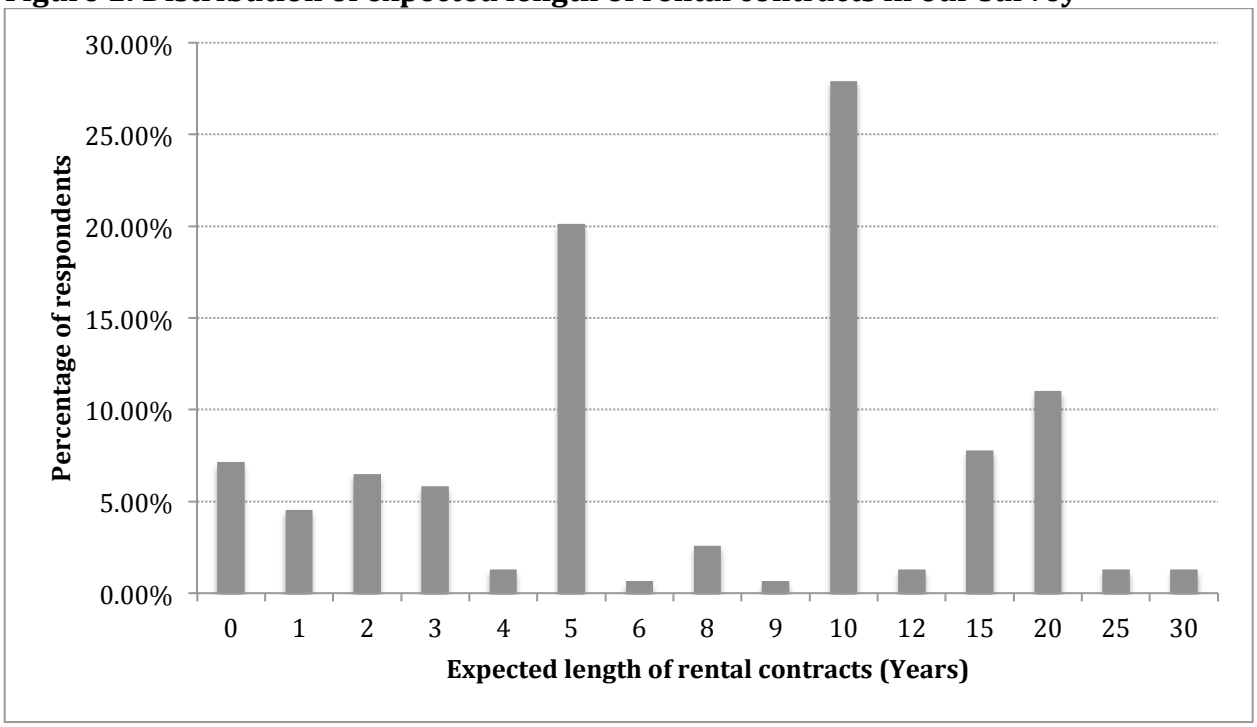
Table 2: Impact of tenure on use of conservation practices						
	Conservation tillage			Cover crop		
	Coef.		Std. Err.	Coef.		Std. Err.
Rented	0.003		0.020	-0.083	**	0.034
Coarse soil	0.120	**	0.047	-0.042		0.071
Hilly land	0.109	*	0.061	0.013		0.097
Drained	-0.026		0.039	0.067		0.070
Irrigated	-0.227		0.146	0.259		0.208
Plot size (acres)	0.000	**	0.000	0.000		0.000
Corn planted in 2012	-0.124	***	0.044	-0.050		0.050
Soybean planted in 2012	0.063	**	0.031	-0.104	**	0.049
Winter wheat planted in 2012	0.034		0.040	0.271	***	0.063
Canola planted in 2012	0.062		0.045			
Spring wheat planted in 2012	0.037		0.039			
Constant	0.611	***	0.036			
Number of observations	847			396		
R^2	0.023			0.147		

Notes: ***,**,* denotes statistical significance at 1%, 5%, and 10% respectively

Table 3: Impact of expected length of rental relationship on use of conservation practices						
	Conservation tillage			Cover crop		
	Coef.		Std. Err.	Coef.		Std. Err.
Expect to rent ≤ 5 years	-0.009		0.028	-0.116	**	0.053
Expect to rent > 5 years	0.005		0.030	-0.062		0.038
Coarse soil	0.106	**	0.052	0.054		0.069
Hilly land	0.088		0.066	0.083		0.080
Drained	-0.048		0.041	0.030		0.074
Irrigated	-0.234		0.148	0.274		0.201
Plot size (acres)	0.000		0.000	0.000		0.000
Corn planted in 2012	-0.110	**	0.044	-0.054		0.048
Soybean planted in 2012	0.061	*	0.034	-0.116	**	0.050
Winter wheat planted in 2012	0.038		0.042	0.175	**	0.071
Canola planted in 2012	0.045		0.043			
Spring wheat planted in 2012	0.038		0.035			
Constant	0.641	***	0.034			
Number of observations	771			310		
R^2	0.021			0.157		

Notes: ***,**,* denotes statistical significance at 1%, 5%, and 10% respectively

Figure 1: Distribution of expected length of rental contracts in our survey



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