Title: “AJAE Appendix for Ownership Restrictions and Farmland Values: Evidence from the 2003 *Saskatchewan Farm Security Act* Amendment”
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Note: The material contained herein is supplementary to the article named in the title and published in the American Journal of Agricultural Economics (AJAE)

A: Historical Background

Prior to the Saskatchewan Farm Security Act (SFSA) amendment in 2002, individuals, businesses, and various stakeholder groups held different views of the intent of the original 1974 statute. Some suggested the intended purpose of the statute was to provide Saskatchewan farmers with an advantage in buying land and to retain young farmers in the province. Others suggested that the intent of the statute was to recognize that farmland is a provincial asset and to ensure it is owned by provincial residents. Testimony from academic economists provided to the 2002 Standing Committee on Agriculture Report on Farm Land Ownership suggests that a primary motive for implementation of the 1974 statute was to reduce competition for land and to allow Saskatchewan farmers to capture gains associated with the increasing farmland prices that were prevailing at the time (SCA 2002). Saskatchewan real farmland values had declined from 1968 through 1972. The subsequent commodity boom reversed this trend and led to rapid increases in real farmland values that would continue until 1983 (Weisensel, Schoney, and van Kooten 1988).

In 2002, those in support of maintaining farmland ownership restrictions focussed on the need to assist Saskatchewan farmers, rather than expose them to increased competition from outside investment capital. Those advocating looser landownership restrictions suggested that opening up to Canadian investment would allow investment capital to enter the province and would bring Saskatchewan back in line with its neighboring provinces of Alberta and Manitoba (SCA 2002).

By 2015, the issue of farmland ownership in Saskatchewan emerged once again due to the perceived influx of outside investment capital into the province. Of particular importance, the government had allowed the Canada Pension Plan Investment Board (CCPIB) to purchase 115,000 acres of land from the farmland investment fund Assiniboia Farmland Limited Partnership (AFLP) in 2013 (Nelson 2015). This sale was controversial. One opposition party accused the Provincial government and the Farm Land Security Board (the provincial agency responsible for enforcing the SFSA) of favouring the AFLP, which has close personal ties with senior members of the governing party (Pratt 2015).

In response to renewed interest in the issue of farmland ownership, the Saskatchewan government initiated a consultation in 2015. As a part of the consultation, the government conducted a survey of more than 3,000 individuals, groups, and businesses. The results and summary of the survey, as well as written submissions from organized stakeholders are publicly available through the Government of Saskatchewan website.[1] Roughly 95% of survey respondents were Saskatchewan residents, and 65% of the respondents were farmers or retired farmers. Almost half of the sample expected to purchase farmland in the next five years, while more than 80% of the sample did not expect to sell land in the next five years. The sample is therefore heavily skewed towards individuals that could be considered "net buyers" of farmland. Deaton, Hoehn, and Norris (2007) show that net buyers of farmland tend to favour land regulation that reduces land values. Results of the survey should be interpreted with this in mind.

The results from the 2015 survey shed light on several issues of concern to respondents. Two appear to be most important: 1) the influence of relaxed ownership restrictions on farmland values and 2) on the tradition of farmer ownership of Saskatchewan farmland. More than 60% of survey respondents indicated that it was very important to "ensure farmland remains affordable for Saskatchewan farmers who wish to purchase land" and to "maintain the tradition of farmland ownership in Saskatchewan." Similarly, more than 55% of survey respondents strongly disagreed with the statement that "the agricultural industry in Saskatchewan would benefit from a greater

[1] Results of the Saskatchewan Farmland Ownership Consultation are available at:
http://www.saskatchewan.ca/government/public-consultations/past-consultations/farmland-ownership-consultation

share of investment in land purchases coming from outside the province." Finally, 70% of respondents expect that relaxing ownership restrictions further would increase land values.

B: Trimming procedure

The sample is trimmed following the procedure outlined in Imbens and Rubin (Chapter 16, 2015). The objective of this procedure is to arrive at a final specification of the propensity score, which includes linear terms and a set of interactions. The propensity score is used to trim the sample to a set of observations that are better balanced across the Saskatchewan and Manitoba samples. Observations with a propensity score close to one or zero are dropped from the sample. The following steps provide a systematic approach to determine the cut-off propensity scores:

1. Estimate the propensity score using a logit model of the likelihood a sales parcel is in Saskatchewan, with the full set of time-invariant sales parcel characteristics entered linearly. This provides a baseline log-likelihood for the iterative procedure that follows.
2. Estimate a second round of logit models. Each of these models includes i) the full set of time-invariant sales parcel characteristics entered in the baseline logit model from step 1 and ii) one interaction term selected from the full set of time-invariant characteristics. I run one additional logit regression for each potential squared term. A likelihood ratio test statistic is calculated at each step to assess the statistical significance of the improvement in the log likelihood. If the likelihood ratio test is less than one, then the iterative procedure is stopped. The specification generating the highest log-likelihood is retained for the next round.
3. Estimate a third round of logit models, each including i) the set of time-invariant sales parcel characteristics and the additional interaction term as retained from step 2 and ii)

one interaction term selected from the full set of time-invariant characteristics. As in step 2, I run one additional logit regression for each potential squared term and the specification generating the highest log likelihood (assuming the likelihood ratio test statistic in greater than 1) is retained for the next round.

4. Repeat step 3 until the improvement in the highest log likelihood compared to the previous round yields a t-statistic less than one.
5. Using the final specification of the propensity score, calculate a threshold value of the propensity score; observations with propensity scores below this threshold and observations with propensity scores above one minus the threshold are trimmed from the sample.

Table B1 presents parameter estimates of the propensity score. The interaction terms are included in the order they were chosen for inclusion in the propensity score. Table B2 presents summary statistics for the trimmed and the discarded observations. The discarded observations tend to have more low capability soil in both the set of observations discarded because of very low propensity scores and the set of observation discarded due to very high propensity scores. The discarded parcels with very low propensity scores (more likely to be from Manitoba) tended to have larger shares of acreage in developed use, wetland, grassland, and trees. The discarded parcels with high propensity scores (more likely to be from Saskatchewan) tended to have almost zero acreage in high capability soil and very little acreage in trees.

C: Full set of parameter estimates

The full set of parameter estimates for the baseline deviation in trends model (reported in table 3 in the article) is presented in table C1 below. As expected, parcels with a greater share of high productivity and medium productivity soil sell at a premium relative to parcels with more low productivity soil. An increase in the share of acreage in high productivity soil of 1% increases the per acre sales price by 0.6%, and a 1% increase in the share of acreage in medium productivity soil increases the sales price by 0.2%. Lawley (2014) finds that the premium on high (medium) productivity soil in Manitoba ranges from 0.43% (0.26%) in the 1998-2001 period to 0.37% (0.17%) in the 2006-2009 period. The soil capability premiums estimated in this study are therefore higher than previous estimates for Manitoba.

Land use has the expected impact on per acre sales prices. Relative to cropland, a 1% increase in the share of wetland on a parcel reduces the per acre sales price by 1%. Similarly, a 1% increase in grassland acreage reduces the sales price by 0.3% and a 1% increase in treed acreage reduces the sales price by 0.7%. These results indicate that wetland acreage results in the largest price discount, followed by trees and grassland. Although the land use categories used in the two studies are not directly comparable, this ranking is consistent with the estimates presented in Lawley (2014). I find little evidence that larger sales parcels sell at a lower per acre price relative to equivalent smaller sales parcels.

Gross returns to farming has a positive impact on per acre sales prices. Specifically, a $1 increase in the gross return to farming (averaged over the previous five years) increases the per acre sales price by between 0.3%. The results presented in table C1 also suggest that changes in population growth did not have a statistically significant impact on farmland values in the two provinces. Changes in recent employment in the oil and gas sector have a statistically significant positive impact on farmland values, although this parameter is imprecisely estimated.

D: Standard errors

I cluster at the rural municipality level in all regressions reported in the main manuscript. Rural municipalities are the lowest level of government in Manitoba and Saskatchewan, with responsibility for municipal property taxation (including farmland) and investment in local infrastructure. Table D1 presents several robustness checks that cluster standard errors at the census division, census agricultural region, and the province level. This approach allows for arbitrary correlation in the error terms within the more aggregate clusters. For instance, clustering at the province level clusters at the source of policy variation in this analysis. A shortcoming of clustering at the province level is that there are only two provinces in the study and cluster robust variance estimates are valid only asymptotically (Cameron and Miller 2015).

I use a Student's *t*-distribution, with $G - 1$ degrees of freedom to assign p-values to the estimates (Cameron and Miller 2015). The results presented in table D1 indicate that the p-values on the primary treatment effect—the deviation from trend—falls in all cases. The estimated deviation from trends are statistically significant at least at the 5% level in the census division and the census agricultural region regressions, and at the 10% level in the province cluster regression.

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Table B1. Estimated parameters of propensity score

Variable	Coefficient
High capability soil (%)	-0.00378
	(0.00336)
Medium capability soil (%)	0.0963***
	(0.00327)
Developed share (%)	-0.318***
	(0.0472)
Wetland share (%)	0.0131
	(0.00798)
Grassland share (%)	0.0229***
	(0.00552)
Tree share (%)	-0.0728***
	(0.00525)
Total sale acres (100)	0.0635*
	(0.0258)
Medium capability soil*High capability soil	-0.00157***
	(0.0000493)
Medium capability soil*Medium capability soil	-0.000996***
	(0.0000268)
Tree share*High capability soil	0.00109***
	(0.0000632)
Tree share*Tree share	0.000599***
	(0.0000446)
High capability soil*High capability soil	0.0000890**
	(0.0000284)
Developed share*Medium capability soil	0.00355***
	(0.000555)
Wetland share*Medium capability soil	0.0000972
	(0.0000682)
Total sale acres*Wetland share	-0.00705***
	(0.00148)
Tree share*Developed share	-0.00471***
	(0.00114)
Developed share*High capability soil	0.00198***

	(0.000600)
Total sale acres*Tree share	-0.00302***
	(0.000911)
Total sale acres*Total sale acres	-0.00677**
	(0.00224)
Tree share*Grassland share	-0.000641***
	(0.000123)
Grassland share*Grassland share	-0.000330***
	(0.0000547)
Grassland share*High capability soil	-0.000475***
	(0.000109)
Grassland share*Medium capability soil	-0.000175***
	(0.0000351)
Tree share*Medium capability soil	-0.000128**
	(0.0000399)
Wetland share*High capability soil	-0.000421***
	(0.0000926)
Wetland share*Wetland share	-0.000278***
	(0.0000711)
Grassland share*Wetland share	-0.000589**
	(0.000180)
Tree share*Wetland share	-0.000346**
	(0.000122)
Developed share*Developed share	-0.00380
	(0.00230)
Constant	0.831***
	(0.125)
Observations	28608
Log likelihood	-14455.055

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B2. Summary statistics for trimmed sample and discarded observations

	Trimmed sample					Discarded	
	Manitoba		Saskatchewan			Low propensity score $ps < 0.108$	High propensity score $ps > 0.892$
	Mean	Std. Dev.	Mean	Std. Dev.		Mean	Mean
High capability soil (%)	37.08	33.77	38.18	35.14	0.032	5.92	0.84
Medium capability soil (%)	36.88	38.45	36.84	38.64	-0.001	52.37	66.00
Developed share (%)	1.00	1.53	0.88	1.00	-0.09	3.45	0.83
Wetland share (%)	5.67	9.71	4.74	7.59	-0.107	11.54	4.91
Grassland share (%)	4.44	15.98	2.91	12.96	-0.105	22.19	3.30
Tree share (%)	9.35	18.87	5.09	12.55	-0.266	45.60	1.19
Total sale acres (100)	2.32	1.57	2.28	1.44	-0.023	2.48	2.23
Observations	7411		13809			512	6876

Table C1. Full set of parameter estimates from deviation from trends specification

Variable	Coefficient		Std. Err.
High capability soil (%)	0.006	***	0.000
Medium capability soil (%)	0.002	***	0.000
Developed share (%)	0.010	***	0.003
Wetland share (%)	-0.010	***	0.001
Grassland share (%)	-0.003	***	0.000
Tree share (%)	-0.007	***	0.001
Total sale acres (100 acres)	-0.001		0.002
Farm returns (CDN$2002)	0.003	**	0.002
Population change (%)	1.749		2.053
Oil/gas emp. change (%)	0.089	*	0.047
Constant	7.958		14.04
Pre-amendment SK trend ($\delta_{SK=1}$)	-0.012	**	0.005
Pre-amendment MB trend ($\delta_{SK=0}$)	0.017		0.011
SK deviation from trend ($\theta_{SK=1}$)	0.043	***	0.008
MB deviation from trend ($\theta_{SK=0}$)	0.016	**	0.008
Observations	21220		
Number of municipality clusters	186		
R^2 within	0.306		
R^2 between	0.193		
R^2 overall	0.060		

Notes: Specification includes year and rural municipality fixed effects. Standard errors (in parentheses) adjusted for municipality clusters.

*** Statistical significance at 1%; ** Statistical significance at 5%; * Statistical significance at 10%.

Table D1. Standard errors clustered at more aggregate levels

	(1) Cluster at census division level		(2) Cluster at census agricultural region level		(3) Cluster at province level	
	Estimate		Estimate		Estimate	
Pre-amendment SK trend ($\delta_{SK=1}$)	-0.011	*	-0.011	*	-0.011	
	(0.006)		(0.006)		(0.003)	
Pre-amendment MB trend ($\delta_{SK=0}$)	0.017		0.017		0.017	
	(0.012)		(0.012)		(0.005)	
SK deviation from trend ($\theta_{SK=1}$)	0.043	***	0.043	***	0.043	*
	(0.010)		(0.010)		(0.007)	
MB deviation from trend ($\theta_{SK=0}$)	0.016	*	0.016	*	0.016	
	(0.008)		(0.008)		(0.004)	
Differences:						
Pre-amendment difference in trends:	-0.029	***	-0.029	***	-0.029	**
$\delta_{SK=1} - \delta_{SK=0}$	(0.009)		(0.008)		(0.002)	
Post-amendment difference in trends:	-0.002		-0.002		-0.002	
$(\delta_{SK=1} + \theta_{SK=1}) - (\delta_{SK=0} + \theta_{SK=0})$	(0.009)		(0.009)		(0.004)	
Difference in deviation from trends:	0.026	**	0.026	**	0.026	*
$\theta_{SK=1} - \theta_{SK=0}$	(0.011)		(0.010)		(0.003)	
Observations	21220		21220		21220	
Number of clusters	16		15		2	
R^2 within	0.307		0.307		0.307	
R^2 between	0.166		0.166		0.166	
R^2 overall	0.060		0.060		0.060	

Notes: All specifications include year and rural municipality fixed effects, parcel-level time invariant physical characteristics, and time-varying covariates. Standard errors in columns (1), (2), and (3) adjusted for census division, census agricultural region, and province clusters, respectively. Statistical significance is calculated based on $G - 1$ degrees of freedom from the Student's *t*-distribution, where G is the number of clusters.

*** Statistical significance at 1%; ** Statistical significance at 5%; * Statistical significance at 10%.