Ownership Restrictions and Farmland Values: Evidence from the 2003 *Saskatchewan Farm Security Act* Amendment

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ABSTRACT

An underlying issue in discussions of farmland ownership restrictions is their impact on farmland values and on land acquisition costs for local farmers. In this article, I examine the farmland value consequences of relaxing a particularly stringent farmland ownership restriction in the Canadian province of Saskatchewan. *The Saskatchewan Farm Security Act* was introduced in 1974 and prohibited non-Saskatchewan residents and corporations from owning Saskatchewan farmland. In 2003, the Act was amended to allow Canadian residents and Canadian corporations to acquire farmland, bringing Saskatchewan in line with neighboring provinces and states that restrict foreign ownership but are open to domestic ownership. I estimate the impact of the 2003 amendment on Saskatchewan farmland values using 1995 through 2010 parcel-level farmland transactions in Saskatchewan and its neighboring province of Manitoba. The impact of the 2003 amendment is assessed in a series of econometric models that use differential trends in farmland prices in the two provinces before and after the amendment. I find that the 2003 amendment led to a 1.9 to 3.1% per year increase in Saskatchewan farmland values.

Keywords: Institutional investors; farmland ownership; farmland values; agricultural policy

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Concerns about absentee farmland ownership in the US and Canada date back to the early days of European settlement of the region (Gates 1945). In the 1970s and 1980s, several US states and Canadian provinces—together accounting for a majority of the two countries farmland—introduced formal legislation restricting farmland ownership.[1] Supporters of ownership restrictions view them as a means to prevent "outsiders" from bidding up land values beyond the reach of local family farms, and to mitigate fears about absentee control of food production and farmland stewardship. Others suggest that increased capital investment in farmland facilitates agricultural expansion and improves productivity to the benefit of the sector.

Farmland ownership has recently emerged as a contentious issue internationally, due in part to increased interest from outside investors seeking to capture recent high returns on investment in agricultural land (Deininger and Byerlee 2012; Creswell 2013; Economist 2015). Investment in large-scale farming dominates concerns about farmland ownership in several developing and transitional regions with the greatest potential to expand or to intensify crop acreage (Byerlee and Deininger 2013). Several Eastern European EU member states restrict farmland ownership by foreign residents primarily out of a concern that foreign residents—including western Europeans—will bid up farmland prices (Swinnen, Van Herck, and Vranken 2016). Concerns about outside farmland investment are not limited to developing and transitional countries; public debate in Australia about increased large-scale investment in farmland led to the creation in 2015 of a public foreign ownership register as well as tightened reviews of land purchases by foreigners (Sippel, Larder, and Lawrence 2017).

[1] By the beginning of the 1980's, 30 US states had farmland ownership restrictions that restricted foreign ownership (Schian 1984). In Canada, all three of the Canadian Prairie Provinces had farmland ownership restrictions by the mid-1980's (Heminthavong and Lavoie 2015).

Recent concerns about farmland ownership have also arisen in several of the US states and Canadian provinces that passed the most stringent farmland ownership restrictions in the 1970s and 1980s. For instance, in response to the purchase of Smithfield Foods Inc. by Shuanghui International Holdings, Missouri amended its farmland ownership restrictions in 2013 to allow up to one percent foreign ownership of farmland (Baertlein and Huffstutter 2013). In 2016, North Dakota voters overturned a 2015 state law that relaxed restrictions on corporate ownership of farmland (Bosman 2016). The North Dakota referendum was followed by a US federal court lawsuit challenging the prohibition on corporate farming (Olson 2016). There have been several attempts to relax farmland ownership restrictions in Wisconsin (Schultz 2014), and in 2017 Iowa upheld its farmland ownership restrictions with an objective of protecting "small, independent family farmers" (Lucht 2017). The Canadian province of Saskatchewan recently revisited farmland ownership restrictions due to concerns about investment from large-scale out-of-Province investors (Pratt 2015).

An underlying issue in all discussions of farmland ownership restrictions is their impact on farmland values and on land acquisition costs for local farmers (GAO 1978; Rausser and Schmitz 1980; Laband 1984; Ferguson, Furtan, and Carlberg 2006; Byerlee and Deininger 2013; Doering 2015). In this article, I examine the farmland value consequences of relaxing a particularly stringent farmland ownership restriction in the Canadian province of Saskatchewan. *The Saskatchewan Farm Ownership Act*—subsequently renamed *The Saskatchewan Farm Security Act* (SFSA)—was introduced in 1974 and prohibited non-Saskatchewan residents and corporations from owning Saskatchewan farmland. In 2003, the SFSA was amended to allow Canadian residents and Canadian corporations to acquire farmland for agricultural purposes, bringing

Saskatchewan in line with neighboring provinces and states that restrict foreign ownership but are open to domestic ownership.

Recent media reports have conveyed a general sense that increased outside investment due to the 2003 SFSA amendment contributed to increases in Saskatchewan farmland values (Pratt 2015; Tait 2015). Anecdotally, two important sources of outside investment capital emerged after the 2003 amendment: 1) recent immigrants with the means to raise financing from abroad (Waldie 2012) and 2) institutional investors such as the farmland investment funds that emerged in Saskatchewan starting in 2006 following the SFSA amendment (Blackwell 2008). Going beyond anecdotal evidence, a detailed study of Saskatchewan farmland ownership presents evidence of a substantial increase in ownership by institutional and other large investors from outside of the province (Desmarais et al. 2017). In the 53 rural municipalities with the highest concentrations of outside investor ownership, Desmarais et al. (2017) estimate that outside investors might have accounted for 14 to 22% of arms-length transactions between 2003 and 2014. Since farmland is thinly traded and the supply of farmland is price inelastic, a small increase in the demand for farmland can have substantial impacts on farmland values (Rausser and Schmitz 1980). The analysis in this article provides estimates of the impact of these new sources of outside investment capital on Saskatchewan farmland prices.

Two streams of literature examine the capitalization of agricultural and land use policies into farmland values. The first literature is concerned with identifying the impact of farm programs on farmland values and rental rates. Wu and Lin (2010) examine the impact of US Conservation Reserve Program subsidies and find that they increase farmland values by between 2 and 14%. Towe and Tra (2013) examine the impact of the US 2005 Renewable Fuel Standard; they find that the net capitalization effect of the standard is a 15 to 28% increase in farmland values. A large

literature examines the impact of decoupled farm subsidies on rental rates. These studies are motivated by the fact that government programs transfer significant resources to the agricultural sector, with the stated intent of improving the welfare of farmers. The extent to which farmers really do benefit from government support depends on the link between farmland ownership and capitalization of program benefits. Kirwan and Roberts (2016) provide a detailed review of this large literature and, consistent with recent results from the literature, they present new evidence based on field-level data that a substantial share of the subsidy dollar is captured by farmers rather than landlords.

A second literature examines several policy tools governments use to intervene in rural land markets—including zoning, differential assessments, and farmland preservation easements—in the interest of sustaining working farmland. These tools affect land use and as a consequence influence the types and numbers of buyers willing to bid within the affected land market. This has consequences for the value of affected properties; for example, recent research suggests that the property value impact of down-zoning is a function of distance from metropolitan areas and resource versus non-resource use of parcels (Deaton and Vyn 2010; Liu and Lynch 2011; Eagle et al. 2015; Deaton and Vyn 2015). An objective of these policies is to maintain farmland supply, which in some cases can reduce farmland values. In this article, I examine the property value impacts of a land tenure policy that explicitly reduces competition for farmland, with the objective of making farmland more affordable for local farmers who are in a position to buy land. This is accomplished, of course, at the expense of landowners wishing to sell.

Despite their widespread use, little prior research has examined the impact of ownership restrictions on farmland values. Carlberg (2002) uses a 1950 to 1999 time series of average farmland values in Saskatchewan and Alberta and finds that the SFSA had no impact on

Saskatchewan farmland prices. Carlberg and Furtan (2003) use similar data for Manitoba, Saskatchewan, and Alberta and, as in Carlberg (2002), find that the SFSA does not impact Saskatchewan farmland values. Based on 47 annual observations of Saskatchewan farmland prices from 1953-2001, Ferguson, Furtan, and Carlberg (2006) find that the SFSA reduced farmland prices by an average of $6 to $48 per acre over the 1974 to 2001 period.[2] Gabruch and Micheels (2017) follow up on Ferguson, Furtan, and Carlberg (2006) with 1953-2014 Saskatchewan data and estimate that the SFSA restriction on out-of-Province buyers reduced the growth rate of farmland prices by 4.5% per year.

The SFSA amendment provides a unique opportunity to study the impact of ownership restrictions for a couple of reasons. First, it is one of the few policy changes to occur after the widespread introduction of farmland ownership restrictions in the U.S. and Canada more than three decades ago. This allows me to take advantage of recently available sales-level transaction datasets in Saskatchewan and Manitoba. Second, North American farmland ownership restrictions typically apply to *foreign* investment, but permit *domestic* investment. Foreign investment in farmland increases farmland values and, as pointed out by Rausser and Schmitz (1980), increased investment in jurisdictions without ownership restrictions will tend to increase farmland values in jurisdictions with ownership restrictions. For example, Manitoba restricts foreign farmland investment, whereas Ontario does not. Increased foreign capital flows into Ontario will increase farmland values in that province. To the extent that Manitoba farmland is a substitute for Ontario farmland, Manitoba farmland values will increase as well. The SFSA, in contrast, restricted outside investment *from all sources*, effectively insulating Saskatchewan land values from the effects of

[2] Ferguson, Furtan, and Carlberg (2006) present results in 1992 US dollars. I convert their estimates to 1992 Canadian dollars using the 1992 CAD/US exchange rate of 0.828136. The Canadian CPI adjustment of 117.89 is used to convert 1992 dollars to the 2002 Canadian dollars used throughout this article.

investment capital flows into neighboring provinces and states. The SFSA amendment therefore provides a clean setting to examine the farmland value impact of opening a jurisdiction to new outside investment.

The analysis in this article improves upon the earlier SFSA studies in several respects. First, all of the prior studies employ time series approaches utilizing average annual province-level farmland prices derived from survey responses. Survey responses are potentially subject to bias if respondents incorporate the expected impact of policy into estimates of the value of their land. In this article, I use actual sales transaction data combined with a detailed set of property characteristics. Second, Ferguson, Furtan, and Carlberg (2006) construct a time-varying measure of the stringency of the SFSA based on annual variation in acreage restrictions relative to annual variation in average farm size. This implies the impact of the SFSA is identified off of time series variation in their measure of the stringency of the SFSA, which is primarily driven by variation in average Saskatchewan farm size. My analysis, by contrast, identifies the impact of relaxing the SFSA due to the discrete legislative amendment that took effect January 1, 2003.

Finally, Ferguson, Furtan, and Carlberg (2006) and Gabruch and Micheels (2017) restrict their analysis to annual time series observations of Saskatchewan farmland prices. This approach relies on a comparison of farmland values over time within Saskatchewan; estimates are biased if other unobserved trends are influencing Saskatchewan farmland values. In this article, I estimate the impact of the 2003 SFSA amendment on Saskatchewan farmland values using 1995 through 2010 parcel-level farmland transactions in Saskatchewan and its neighboring province of Manitoba, which serves as a control. The impact of the SFSA amendment is assessed in a series of econometric models that use differential trends in farmland prices in the two provinces before and after the amendment. Important property characteristics including soil productivity, land cover,

parcel size, and location, as well as time-varying measures of farm cash receipts and recent changes in population and oil and gas sector employment are included as controls.

I find that Saskatchewan farmland prices were loosing ground to Manitoba prices prior to the SFSA amendment. The SFSA amendment brought Saskatchewan farmland ownership legislation back in line with Manitoba legislation and, after a period of adjustment, put Saskatchewan prices on the same path as those in Manitoba. Interestingly, I find that the SFSA amendment had little immediate effect on Saskatchewan farmland values. This is consistent with evidence suggesting that outside investment only began to enter Saskatchewan in a significant way beginning in 2006 (Magnan and Sunley 2017). From 2006 onwards, Saskatchewan farmland values have increased at the same rate as prices in Manitoba. Overall, the results suggest that the 2003 SFSA amendment led to a 1.9 to 3.1% per year increase in Saskatchewan farmland values. Calculated at the average per acre value of Saskatchewan farmland over the 1995-2002 period, this implies that prices increased by $38 to $62 per acre, or between $6,080 and $9,920 per quarter section (expressed in 2002 Canadian dollars). This estimate captures the combined impact of the SFSA amendment on Saskatchewan farmland values as well as the potential impact of the amendment on Manitoba prices due to, for instance, diversion of investment capital from Manitoba to Saskatchewan after the amendment. Several robustness checks indicate that the baseline results are robust to alternative specifications.

The remainder of the article proceeds as follows. In the following section I present a historical background of Saskatchewan farmland ownership restrictions including a discussion of the perceptions and motivations behind the original SFSA, which are updated over time. The empirical model and collection of data are presented in section three. Section four presents results and

discussion, including several robustness checks and investigation of potential heterogeneous effects of the SFSA amendment. Concluding remarks are presented in the final section.

Historical Background

The 1973 Saskatchewan Final Report of the Special Committee on the Ownership of Agricultural Lands suggests that the farmland ownership restrictions introduced in Saskatchewan were motivated by a desire to ease the transfer of farmland from one generation of Saskatchewan farm families to the next. Concerns about increasing farm size and rural depopulation were also expressed (Legislative Assembly of Saskatchewan 1973). It is interesting to note that the recommendation of the Special Committee was to limit farmland ownership to Canadian citizens, but this recommendation was not followed. Instead, *The Saskatchewan Farm Ownership Act* passed in 1974 restricted farmland ownership to Saskatchewan residents.[3]

The Saskatchewan Farm Ownership Act dealt with four classes of landowners: 1) resident persons defined as individuals that resided in Saskatchewan for 183 days or more in any given year, 2) agricultural corporations which are controlled by farmers who are resident persons, 3) non-residents, and 4) non-agricultural corporations (Finley 1981).[4] In 1988, *The Saskatchewan Farm Ownership Act* was consolidated with several other Acts under the SFSA. At this time,

[3] Passage of the 1974 statute occurred under Saskatchewan's New Democratic Party (NDP), which at that time was also taking steps to "nationalize" Saskatchewan's potash and oil industries under provincially owned Crown Corporations (Emery and Kneebone 2008). The statute is therefore consistent with other provincial government efforts to promote and maintain Saskatchewan-based ownership of natural resources in the province.

[4] Finley (1981) provides an interesting discussion of farmland ownership restrictions in Saskatchewan up to the 1980 amendment of *The Saskatchewan Farm Ownership Act*. In 1974, non-agricultural corporations were allowed to own up to $15,000 (assessed value, excluding buildings) of Saskatchewan farmland. Non-residents were allowed to own 160 acres. At that time the Act defined a resident person as an individual who lived with 20 miles of the Saskatchewan border, which implied that Manitoba, Alberta, and US residents living close to Saskatchewan could purchase unlimited amounts of Saskatchewan farmland. Several changes occurred between 1974 and 1980, such that an acreage restriction (rather than assessed value) was imposed on non-agricultural corporations and the definition of a resident changed to included only individuals living within Saskatchewan's borders.

acreage restrictions on non-Saskatchewan Canadian residents (non-residents under the SFSA) and Saskatchewan non-agricultural corporations increased to 320 acres, while the acreage restrictions on non-Canadian residents and non-agricultural corporations outside of Saskatchewan were maintained at 10 acres.

The most substantial changes to the SFSA were debated in 2002 and came into effect in January 2003. The 2003 SFSA amendment changed the definition of a resident person to include individuals who are Canadian citizens or who reside in Canada for 183 days or more in any year. The amendment removed all farmland ownership restrictions on Canadian residents and 100-percent Canadian owned entities. Non-Canadian residents and non-100-percent Canadian owned entities continue to be limited to 10 acres. This change brought Saskatchewan legislation in line with similar legislation in Alberta and Manitoba.[5]

The 2003 SFSA amendment did not have an instantaneous impact on the Saskatchewan farmland market. It took some time for farmland investment funds to start operations and to begin to raise capital from investors. Desmarais et al. (2017) state that media reports suggest investment activity began in 2007. Magnan and Sunley (2017) use Saskatchewan Farmland Security Board data to conduct a detailed assessment of the extent of investor activity since the SFSA amendment. They show that outside investment into the province did not start until 2005 when investors comprised just over 1% of arms-length transactions in the province. They find that investor activity doubled to account for approximately 2% of annual transactions in 2006 and then increased to account for approximately 4% of arms-length transactions from 2007 through 2010. According to

[5] In Alberta, the *Foreign Ownership of Land Regulations* came into effect in 1979 and limits foreign citizens and foreign controlled corporations to 20 acres of farmland (Government of Alberta 1979). In Manitoba, *The Farm Lands Ownership Act* came into force in 1984 and restricts Manitoba farmland ownership to Canadian residents and corporations. Non-Canadian individuals or corporations must apply to the Manitoba Farm Industry Board for an exemption to obtain an interest in more than 40 acres of farmland (Government of Manitoba 1984).

Magnan and Sunley (2017), the cumulative amount of investor-held acreage continued to increase at least at an annual rate of 4% through to 2014.

The issue of Saskatchewan farmland ownership restrictions re-emerged in 2015 due to several high profile land purchases by pension funds and other large intuitional investors. The prospect of continued future purchases by institutional investors or by private individuals with foreign backing led to a lengthy farmland ownership consultation undertaken by the Government of Saskatchewan in 2015. Once again, renewed calls for tightening farmland ownership restrictions came at a time of increasing farmland values; Farm Credit Canada estimates that Saskatchewan farmland prices increased by 19% from 2013 to 2014 (Nelson 2015). A more detailed history of the evolution of farmland ownership restrictions in Saskatchewan, including a discussion of the responses to the 2015 farmland ownership consultation are provided in the Supplementary Appendix.

Empirical Approach

I am interested in examining the impact of the SFSA amendment on Saskatchewan farmland values. The basic empirical strategy is to test for a break from pre-existing differences in the level or trend of Saskatchewan farmland values relative to farmland values in a comparison province or region. Identification of the impact of the SFSA is therefore based on the assumption that pre-existing differences in the level or trend of farmland prices would have persisted in the absence of the SFSA amendment.

The study region encompasses the southeastern portion of Saskatchewan and the southwestern portion of the neighboring province of Manitoba. Figure 1 outlines the study region with the rural municipalities included in the sample outlined. The use of these two regions restricts the sample to spatially contiguous land parcels that are more likely to share similar physical

characteristics.[6] The two provinces are also exposed to similar political and market forces. Saskatchewan and Manitoba have similar provincial tax regimes and both were governed by provincial left-of-centre NDP governments in the periods before and after the 2003 SFSA amendment. Agricultural production has historically been the dominant land use in the region, although production from the Bakken oil play in the southeastern corner of Saskatchewan and the southwestern corner of Manitoba increased substantially after adoption of horizontal drilling in the region in 2006 (Hislop 2013).

I take two approaches to identify the impact of the SFSA amendment on farmland values. The first approach estimates the parameters of a flexible specification that allows the difference in parcel-level farmland value trends between Saskatchewan and Manitoba to change annually. This specification is flexible in the sense that it does not restrict breaks to correspond with implementation of the SFSA amendment, but rather allows the data to indicate when changes in the temporal pattern occur (see Finkelstein 2007 for a similar application). The second approach uses a deviation from trend analysis that controls for pre-existing differences in trends in the two regions and tests for a deviation from trend coinciding with the SFSA amendment in 2003.

Flexible differences in trends analysis

I start with a basic flexible specification that allows me to: 1) trace out the temporal pattern of pre-existing differences in farmland values in Saskatchewan relative to Manitoba; 2) conduct a series of pre-amendment falsification tests to establish whether or not there is a break in the pre-existing

[6] The northern extent of the Manitoba study region is adjacent to Riding Mountain National Park, which is the transition point from the Aspen Parkland ecoregion to the Mid-boreal Upland ecoregion. The eastern extent of the Manitoba study region coincides with the transition from the Aspen Parkland ecoregion to the Lake Manitoba Plain ecoregion. The Manitoba study region is therefore almost entirely within the Aspen Parkland ecoregion while the Saskatchewan study region contains sales within the Aspen Parkland, Moist Mixed Grassland, and Mixed Grassland ecoregions (Ecological Stratification Working Group 1996).

differences in trends prior to the SFSA amendment; and 3) estimate the impact of the SFSA amendment on Saskatchewan farmland values. The estimating equation is:

$$(1) \quad \ln(p_{igt}) = \alpha_g \mathbf{1}(\mathrm{RM}_g) + \beta_t \mathbf{1}(\mathrm{Year}_t) + \sum_{t=1995}^{t=2010} \gamma_t \, \mathbf{1}(\mathrm{SK}) \cdot \mathbf{1}(\mathrm{Year}_t) + \varepsilon_{igt}$$

where i indexes individual sales parcels, g indexes the rural municipality in which the sale parcel is located, and t indexes the year the sale occurred. The dependent variable is the log price per acre p_{igt} for each sale parcel, which is deflated by the Canadian Consumer Price Index and expressed in 2002 dollars; $\mathbf{1}(\mathrm{RM}_g)$ are rural municipality fixed effects that control for fixed differences in farmland values across municipalities due to differences in climate, proximity to local amenities and urban centres, municipal investment in local infrastructure such as roads and community services, and municipal tax rates; $\mathbf{1}(\mathrm{Year}_t)$ are year fixed effects that control for time-varying factors that are common across the study region, including macroeconomic factors such as interest rates and exchange rates; and ε_{igt} is the error term.

Differential trends in farmland prices are estimated by the set of parameters on the interaction between the year fixed effects, $\mathbf{1}(\mathrm{Year}_t)$, and the dummy indicator for the province of Saskatchewan, $\mathbf{1}(\mathrm{SK})$, which is equal to one if the sale occurs in Saskatchewan and zero if the sale occurs in Manitoba. The reference year is 2002. The parameters on the interaction term, γ_t, trace out the temporal pattern of trends in Saskatchewan farmland prices relative to trends in Manitoba farmland prices:

$$(2) \quad \gamma_t = E\left[\ln(p_{igt})|\mathrm{SK}=1; \mathrm{Year}=t\right] - E\left[\ln(p_{igt})|\mathrm{SK}=1; \mathrm{Year}=2002\right] - \left\{E\left[\ln(p_{igt})|\mathrm{SK}=0; \mathrm{Year}=t\right] - E\left[\ln(p_{igt})|\mathrm{SK}=0; \mathrm{Year}=2002\right]\right\}.$$

In words, the γ_t provide estimates of the change in Saskatchewan farmland prices from year t to 2002 relative to the change in Manitoba farmland prices over the same time frame.

The coefficients on the γ_t trace out the temporal pattern of differences in farmland values in Saskatchewan relative to Manitoba. Breaks in the differences in farmland value trends can be formally evaluated using a test statistic assessing the difference in the changes in the γ_t. I construct a test statistic that assesses the average annual change in γ_t over a n-year period relative to the average annual change in γ_t over a $(\text{Year}_b - 1995)$-year period:

$$(3) \quad \Delta(n\text{-years}) = \frac{(\gamma_{b+n} - \gamma_b)}{n} - \frac{(\gamma_b - \gamma_{1995})}{\text{Year}_b - 1995}.$$

where the b subscript denotes the base year for the calculation. For instance, when assessing the impact of the SFSA amendment, the base year is set to 2002. The differences in the pre-amendment period $(\gamma_{2002} - \gamma_{1995})$ and the post-amendment period $(\gamma_{2002+n} - \gamma_{2002})$ are averaged over the number of years in each period in order to provide an estimate of the differences in the average annual *percentage rates of change* across the two periods.[7]

Control variables

A large literature examines the temporal determinants of farmland values. Notable among these studies, Just and Miranowski (1993) develop a structural model of farmland price changes and present evidence that three major factors explain the 1970s farmland price boom: 1) inflation, 2) the opportunity cost of capital, and 3) returns to farming. The year fixed effects included in equation (1) control for macroeconomic variables such as inflation and the opportunity cost of capital, but do not control for regional variation in farming returns over time. Further, the

[7] The coefficient estimates on the dummy variable interactions between $\mathbf{1}(\text{SK})$ and $\mathbf{1}(\text{Year}_t)$ are transformed according to Kennedy (1981): $\hat{g}_t = 100\left(\exp\left\{\hat{\gamma}_t - \frac{1}{2}\hat{V}(\hat{\gamma}_t)\right\} - 1\right)$. Following van Garderen and Shah (2002), the standard errors are estimated as: $\tilde{V}(\hat{g}_t) = 100^2 \exp\{2\hat{\gamma}_t\}\left[\exp\left\{-\hat{V}(\hat{\gamma}_t)\right\} - \exp\left\{-2\hat{V}(\hat{\gamma}_t)\right\}\right]$. The test statistics described in equation (3) impose linear restrictions on the full set of interaction terms. I estimate standard errors based on the linear restriction and the variance-covariance matrix adjusted according to van Garderen and Shah (2002).

specification in equation (1) does not control for recent changes in regional population, nor changes in oil and gas employment. Since each of these variables are potentially important determinants of the relative level and trends of farmland values in the two provinces, the specification proposed in equation (1) likely suffers from omitted variables bias.

The following estimating equation modifies equation (1) to control for physical characteristics of sales parcels and time-varying covariates:

$$(4) \quad \ln(p_{igt}) = \alpha_g \mathbf{1}(\mathrm{RM}_g) + \beta_t \mathbf{1}(\mathrm{Year}_t) + \sum_{t=1995}^{t=2010} \gamma_t \, \mathbf{1}(\mathrm{SK}) \cdot \mathbf{1}(\mathrm{Year}_t) + X_i \vartheta + Z_{gt} \mu + \varepsilon_{igt}$$

where X_i is a set of time-invariant physical characteristics of sales parcels including soil productivity, pre-SFSA amendment land use, and the number of acres in the sale parcel; Z_{gt} includes region-level five year lagged averages of annual per acre farm cash receipts (including crop receipts, livestock receipts, and government payments), recent population changes, and recent oil and gas sector employment changes, where g denotes the region; and ε_{igt} is the error term.

Deviation from trend analysis

An advantage of the flexible specifications in equations (1) and (4) is that they do not restrict the break from trend to coincide with the SFSA amendment. Finkelstein (2007) notes two potential shortcomings of the flexible specifications. First, the test statistic as proposed in equation (3) relies on a point-to-point comparison utilizing only three estimates, whereas a parametric approach can make more efficient use of all available data. Second, relying on a point-to-point comparison may generate misleading results if the point chosen for comparison does not line up with neighboring points. The following specification estimates the impact of the SFSA based on deviations from pre-existing trends. The deviation from trend estimating equation is:

$$(5) \quad \ln(p_{igt}) = \alpha_m \mathbf{1}(\mathrm{RM}_m) + \beta_t \mathbf{1}(\mathrm{Year}_t) + \delta_{SK} \mathbf{1}(\mathrm{SK}) \cdot t_t + \theta_{SK} \mathbf{1}(\mathrm{SK}) \cdot (t - 2002)_t$$

$$+X_i\vartheta + Z_{gt}\mu + \varepsilon_{igt}$$

where t_t is a linear time trend interacted with the Saskatchewan dummy variable $\mathbf{1}(\text{SK})$; and $(t-2002)_t$ is a deviation from trend term (equal to zero for all $t < 2003$) interacted with the Saskatchewan dummy variable $\mathbf{1}(\text{SK})$. The two coefficients on the linear time trend interaction, $\delta_{SK=1}$ and $\delta_{SK=0}$, identify separate pre-existing trends in Saskatchewan and Manitoba farmland prices. Differences in pre-existing trends can be assessed by evaluating the difference between the two coefficients: $\delta_{SK=1} - \delta_{SK=0}$. The deviation from trend interaction term allows for changes in trend in the post-SFSA amendment period. The coefficients on the deviation from trend interaction term, $\theta_{SK=1}$ and $\theta_{SK=0}$, identify post-amendment deviation in trends of farmland values in Saskatchewan and Manitoba. The difference between the two coefficients, $\theta_{SK=1} - \theta_{SK=0}$, identifies the impact of the SFSA amendment on Saskatchewan farmland values. Finally, the post-amendment difference in trends is the difference between the Saskatchewan and Manitoba post-amendment farmland value trends: $(\delta_{SK=1} + \theta_{SK=1}) - (\delta_{SK=0} + \theta_{SK=0})$.

An advantage of this approach is that it estimates separate time paths of farmland prices in Manitoba and Saskatchewan. Therefore, this not only identifies a deviation in the temporal trend in Saskatchewan farmland prices, but also allows the trend in Manitoba farmland prices to adjust in the post-amendment period. A drawback of this approach, relative to the flexible specification in equation (4), is that it forces the response to the SFSA amendment to begin in 2003. This restriction is relaxed in robustness checks by 1) allowing for a one-time discrete shift in the level of the differences in farmland values in the two provinces and 2) allowing the deviation from trend to occur at different points in time in the post-amendment period.

It is important to note that, at the margin, the SFSA amendment might have diverted investment capital from Manitoba to Saskatchewan. This will reduce the level or trend in Manitoba

farmland prices in the post-amendment period. I expect this potential effect, if present, is relatively small due to the large number of potential farmland investment opportunities available to outside capital. Unfortunately, there is no direct approach to assess the importance of this potential effect using the data available for this study. The impact of the SFSA amendment estimated in this article should therefore be interpreted as the combined effect of the increase in Saskatchewan farmland values and the potential decrease in Manitoba farmland values.

I cluster standard errors at the rural municipality level in all specifications. This allows for general patterns of heteroscedasticity and for arbitrary correlation in the error terms within each municipality, therefore accounting for contemporaneous error correlation within municipality as well as serial correlation within municipalities over time (Bertrand, Duflo, and Mullainathan 2004; Cameron and Miller 2015). There are a couple of additional potential threats to reliable construction of clustered standard errors in this application. First, the rural municipality clusters are unbalanced: there are 186 rural municipalities in the full sample, which vary in size from the smallest rural municipality with 25 observations to the largest municipality with 331 observations. Unbalanced clusters reduce the effective number of clusters when there is substantial cluster heterogeneity (Carter, Schnepel, and Steigerwald, forthcoming). A small effective number of clusters tends to generate small standard errors and overstates the precision of estimated treatment effects (Cameron and Miller 2015). Results in Carter, Schnepel, and Steigerwald (forthcoming) suggest the effective number of rural municipality clusters in this application is sufficient.[8]

[8] If all 21,220 observations were balanced across 186 municipalities, then each would contain approximately 114 observations. The ratio of the municipality with the largest number of observations (331) to the 'balanced' number of observations (114) is 2.9:1. Carter, Schnepel, and Steigerwald (2016) show, based on 2500 observations and 100 clusters, that the effective number of clusters for a 2.9:1 ratio is between approximately 60% and 90% of the total number of clusters. This suggests that, at a minimum, there are 112 effective clusters in the full data set, which is sufficiently large to construct clustered standard errors. Morrison and Lin Lawell (2017) conduct a similar exercise.

Second, clustering at the municipality level assumes independent errors across municipalities and this may not hold in practice. For instance, some agricultural policy is set provincially and we might expect there to be correlation in errors across municipalities within the same province. Alternatively, municipalities in close proximity to one another may have spatially correlated errors, once again violating the assumption that errors are independent across municipalities. One solution is to cluster at a more aggregate level such as census division, census agricultural region, or province. In this application, however, the effective number of clusters available at these more aggregate levels is small and will not be sufficient to construct clustered standard errors without a small cluster adjustment (Carter, Schnepel, and Steigerwald forthcoming). As a robustness check, I present several alterative sets of results in the Supplementary Appendix allowing for standard errors clustered at the census division, census agricultural region, and province.

Data

I use transaction-level sales data from Manitoba and Saskatchewan. The full study period stretches sixteen years, from 1995 through to 2010, providing eight years of pre-amendment and eight years of post-amendment sales data. The study period is restricted to sales that occurred up to and including 2010, which is the last year of sales available in the Manitoba data. The Manitoba transaction data was obtained through a data use agreement with the Manitoba Provincial Assessor. The Saskatchewan transaction data was obtained through a Comparable Land Sales data license purchased from the Saskatchewan Farm Land Security Board. Both data sets provide information on arms-length sales transactions of agricultural land. The two datasets each document the date of the sale, the quarter sections involved in each sale, and the total acreage of each quarter section. The land transaction data is used to calculate the total acres in each sale as well as the sale price

per acre. The Manitoba data also documents the sworn value of the land as well as the soil type and land cover on each quarter section included in the sale. The Saskatchewan data does not include physical characteristics of quarter sections but does record the buyer and seller involved in each transaction.

Several steps were required to clean and prepare the two transaction datasets such that they contain comparable types of sales. The data provided by the Manitoba Provincial Assessor is bare agricultural farmland that has been declared arms-length and does not involve the government as a buyer or a seller. In some cases in the Manitoba data the sworn value of the sale is greater than the actual sale price. It is reasonable to suspect that these are not arms-length transactions and so they are dropped from the data. Similarly, Saskatchewan transactions not declared arms-length, sales involving buyers and sellers with common last names or other identifiers, and sales involving the government as either a buyer or a seller are dropped from the data.

The Saskatchewan transaction data contains some sales with buildings, including residences and farm structures, whereas the Manitoba data does not. The Saskatchewan data is merged with Agriculture and Agri-Food Canada (AAFC 2015) georeferenced land use datasets that indicate the presence of buildings in the years 2000 and 2010. Sales transactions that included at least one quarter section with one or more buildings in either 2000 or 2010 are dropped from the Saskatchewan transaction dataset. A potential concern with this approach is that the geospatial land use data is derived from 30 meter resolution satellite data, which tends to underreport small landscape features such as residences and other buildings (Irwin and Bockstael 2007). The use of land use datasets from two years should reduce the number of quarter sections with buildings that are missed due to the 30 meter resolution. It is also possible that this approach will mistakenly drop sales parcels that sold prior to 2010 without a building, but that were subsequently developed.

This is likely not a serious concern in this rural study region, which has experienced population decline over the last several decades. It is important to note that the results presented in this analysis are conditional on the sales parcel not having a building.[9]

Finally, the SFSA applies to land intended for agricultural production and a couple of steps are taken to minimize the number of non-agricultural parcels within the sample. Sales of parcels with fewer than 40 acres are unlikely to be used for agricultural purposes and are dropped. Further, parcels that sold for more than $4,000 per acre are likely not destined for agricultural production in this study region and are dropped from the sample. The results are robust to inclusion of these parcels.

Sale parcel characteristics

The bare agricultural land transaction data is merged with georeferenced soil and land use datasets that document physical characteristics of sales parcels. The soils data is used to document the percentage of the sale acreage that belongs to one of seven agricultural capability classes (ACCs). Assignment to ACC categories was done by the Canadian Land Inventory (CLI) as is made publicly available by Agriculture and Agri-Food Canada (AAFC). ACCs provide an overall indication of the suitability of land parcels for agricultural production as a function of several characteristics including soil type, natural drainage, slope, and salinity. The ACC summarizes all of these characteristics into one index of soil capability. As in Lawley and Towe (2014), ACC 1 and 2 present no significant crop production limitations and are classified as high productivity

[9] Restricting the sample to bare agricultural land focusses on farmland that is most likely destined for agricultural use—consistent with application of the SFSA. It is possible, however, that the majority of outside investors purchased farmland with the intention of leasing to local farmers and were therefore more likely to target sales parcels without physical structures that require long-term maintenance. If this is the case, the demand for farmland without buildings increased more than the demand for farmland with buildings, and restricting the sample to parcels without buildings will tend to overstate the average impact of the SFSA amendment on farmland values. There is no evidence to suggest that this is a significant concern for the analysis in this article.

soils; ACC 3 and 4 have moderate to severe limitations for crop production and are classified as medium productivity soils; and ACC 5, 6, and 7 are not suited for crop production and are classified as low productivity soils. Low productivity soils is the omitted category in this analysis. Since agricultural production is the dominant form of land use in the region, I expect that sales parcels with a larger share of high and medium productivity soil will command a premium price relative to parcels with a larger share of low productivity soil.

Land use data is obtained from AAFC land cover layers derived from 30 meter resolution satellite images. The land use data is from the 2000 data layer, which utilizes imagery from 1998 through 2002 and therefore documents landscape features in the pre-amendment period. The AAFC land use data follows the Intergovernmental Panel on Climate Change (IPCC) protocols and consists of 15 different classes (AAFC 2015). These classes are collected into six categories including forests, wetland, cropland, grassland, settlement, and other land. In this study, cropland serves as the omitted category. Lawley (2014) uses a similar set of land uses in Manitoba and finds that sales parcels with a greater share of acreage in wetlands, bush/pasture, and native hay sell at a discount relative to parcels with a greater share of cropland.

Total acres in the sale is included as a control for the overall size of the sale parcel. Several previous studies find that large parcels sell at a lower per acre price than small parcels; Brorsen, Doye, and Neal (2015) present evidence that the "small parcel size premium puzzle" is derived from the fact that small parcels tend to be closer to urban areas, and are therefore more likely to be developed and less likely to be used strictly for agricultural production. The inclusion of sales parcel acreage can be viewed as an indirect control for potential future use of the parcel.

Time-varying covariates

The objective is to identify the impact of the SFSA amendment on Saskatchewan land values, using observed land transactions in Saskatchewan and Manitoba. The two provinces are similar in terms of landscape features but there can be significant variation in the market forces prevailing in the two provinces over time. Perhaps the most important factor influencing farmland values is farming returns. I include annual per acre total cash receipts and government payments to control for changes in farming returns. Similar to Goodwin, Mishra, and Ortalo-Magne (2011), I include the average of total cash receipts and government payments in the five preceding years to capture recent expectations about the returns to farming.[10]

Cash receipts and government payments are publicly available from Statistics Canada at the provincial level only.[11] Since the study area in this research uses portions of Manitoba and Saskatchewan it is necessary to construct sub-provincial estimates of farming returns. Fortunately, province-level crop and livestock cash receipts are reported by crop type and livestock species. I construct annual estimates of crop and livestock cash receipts for the sub-provincial Saskatchewan and Manitoba study regions based on their shares of total provincial acreage for each crop type and inventory for each livestock species, derived from Census of Agriculture statistics updated every five years.[12] Government payments are not broken out by crop type or livestock species so it is not possible to assign government payments at a sub-provincial level. The aggregate measure of per acre returns to farming used in the regression analysis is the sum of 1) sub-provincial crop and livestock receipts and 2) province-wide government payments.

[10] Just and Miranowski (1993) and Goodwin, Mishra, and Ortalo-Magne (2011) use net returns to farming. Statistics Canada reports net income at the provincial level. Net income is not reported by commodity and so it is not possible to construct a net return measure at the sub-provincial level. The gross return used in this paper does not account for variation in production costs over time. However, variation in production costs is small relative to variation in revenue, and production costs tend to follow a slow upward trend over time. Inclusion of year effects and province-specific time trends controls for slow increases in production costs.

[11] Statistics Canada CANSIM Table 002-0001: http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=20001

[12] Statistics Canada, Census of Agriculture, Farm data and farm operator data tables: http://www.statcan.gc.ca/pub/95-629-x/2007000/4123856-eng.htm

The development of the Bakken oil play in southeastern Saskatchewan and southwestern Manitoba since 2006 is a potentially important factor influencing local land values in that portion of the study region. The direct effect of increased oil extraction in the region is expected to be small because landowners do not directly benefit in a significant way from the oil extracted from beneath their land. In Canada, Provincial governments own most mineral rights, which are leased to private oil and gas companies.[13] Under common law, mineral rights lessees have the right to access and extract their minerals but must enter into a surface rights lease with the landowner. Provincial legislation in both Manitoba and Saskatchewan entitles surface rights owners to compensation, intended to cover costs associated with the loss and use of land, as well as any adverse impacts on use of the landowners remaining land.[14] Surface rights owners cannot deny the mineral rights lessee access to the land and therefore have little bargaining power when negotiating compensation.[15]

Although the direct effect of oil development on farmland prices may be small, oil development should increase local incomes through increased employment and spillovers into the local economy. Increased income and demand for residential development should therefore

[13] The complex history of mineral rights in the Canadian Prairie Provinces is discussed in Vigrass (2007). The homestead system granted mineral rights on land settled prior to 1887 west of the third meridian and 1890 east of the third meridian. On land settled after these years the mineral rights were reserved to the Crown (Federal government). Similarly, land purchased from the Hudson's Bay Company prior to 1908 and from the Canadian Pacific Railway prior to 1902 included mineral rights. Mineral rights owned by the Federal government were transferred to Provincial governments in a 1930 agreement. Currently in Saskatchewan, the Provincial government owns approximately 80% of mineral rights, 16.5% are on freehold land, and 3.5% are held by the Federal government (Saskatchewan Ministry of the Economy 2017). Vigrass (2007) points out that in many cases freehold rights are held separately from surface rights. This implies that the owner of the surface rights may not be the owner of the mineral rights associated with a parcel of land.

[14] Importantly, these include the adverse effects of the placement of well pads and roads that impact the efficiency of the farming operation due to the obstruction of large farm machinery during field operations, increased weed infestation, and increased soil compaction. Nuisance costs associated with proximity of well sites to residences, farm sites, and livestock operations are also considered.

[15] Wang (2016) finds no evidence that revenue from surface rights leases increase the value of farmland parcels in Alberta. This result is consistent with weak bargaining power of surface landowners relative to mineral rights owners and suggests that Alberta landowners are not earning a premium above the costs associated with oil and gas development on their land.

increase local land values. I use the five-year average percentage change in employment in the oil and gas sector at the economic region level to control for the influence of oil and gas development.[16] I also include the five-year average percentage change in population at the economic region level as a control for local changes in the demand for land. Goodwin, Mishra, and Ortalo-Magne (2011) include a similar variable and find recent population growth increases farmland values. In a series of robustness checks, I restrict the geographic extent of the sample to further account for differential exposure to the Bakken oil play and population trends.

Data trimming

Although Manitoba is the closet comparison province for Saskatchewan, examination of summary statistics for the raw data indicates significant differences between the two samples in both sales parcel characteristics and time-varying covariates. For instance, in the raw data Manitoba has a larger share of high productivity soils and a lower share of medium productivity soils relative to Saskatchewan. This is consistent with the fact that all of the study region in Manitoba lies in the black soil zone, while the study region in Saskatchewan encompasses the black, dark brown, and brown soil zones.[17] With respect to land use, Saskatchewan has a larger share of land in cropland and a smaller share of land in grassland, wetland, and trees relative to Manitoba.

The approach in this study is to use Manitoba as a comparison group for Saskatchewan. In this context, it is important to ensure that the two groups are as similar as possible. I use the data trimming procedure outlined in Imbems and Rubin (2015) to balance the time-invariant observed variables across the Manitoba and Saskatchewan observations. The procedure proposed by Imbens

[16] An economic region is a group of census divisions as defined by Statistics Canada. There are four economic regions in the study region of Saskatchewan and four in the study region of Manitoba.
[17] The soil zones of western Canada are presented in Fuller (2010).

and Rubin (2015) provides a rules-based method of estimating the propensity score (based on a combination of linear and non-linear covariates constructed from the set of sales parcel characteristics) and of eliminating those observations that fall outside of a calculated range of propensity scores. This eliminates observations that have a very high likelihood of being from Saskatchewan (Manitoba), which are also sales parcels that likely have no comparable counterpart in the Manitoba (Saskatchewan) set of sales parcels. The details of the data trimming procedure and summary statistics for the full set of observations and the discarded observations are documented in the Supplementary Appendix.

After trimming, the two samples are much closer in terms of observable time-invariant physical characteristics. Table 1 presents summary statistics for the trimmed Manitoba and Saskatchewan data, broken out into the pre-amendment and post-amendment periods. In the trimmed sample, approximately 37% (36-38%) of sales parcel acreage is in high (medium) capability soil in Manitoba, compared to 38-39% (36-38%) in Saskatchewan. With respect to land use, Manitoba parcels tend to have more acreage in developed use, wetland, grassland, and trees. These differences are most substantial for trees; tree acreage in Manitoba accounts for 9-10% of total acreage, whereas tree acreage accounts for 5% of land use in the Saskatchewan portion of the study region.

The means of the time-varying covariates differ substantially across the two samples. Farming returns are higher in Manitoba, which is primarily a reflection of a larger livestock sector in Manitoba. Although farming returns are higher in Manitoba, real farming returns increased in both provinces over the course of both the pre and post-amendment periods. Manitoba and Saskatchewan both experienced annual population declines, with Manitoba experiencing population decline in the post-amendment half of the study period and Saskatchewan experiencing

population decline over both the pre and post-amendment periods. Finally, over the 2003 to 2010 period, oil and gas sector employment grew in Saskatchewan at approximately 0.05% per year, whereas it fell in Manitoba at approximately 0.24% per year, on average. I conduct several robustness checks in the results section dealing with the lack of balance of the time-varying covariates.

Results

I start with a graphical presentation of the results from the flexible specification presented in equation (1). This specification provides a simple picture of the differences in trends in Saskatchewan relative to Manitoba, much like a simple comparison of four means as is often reported in difference-in-differences studies. Figure 2 plots the γ_t estimates for each year, where each estimate is normalized such that the estimate in the reference year (2002) is equal to the mean difference between the 2002 log per acre price in Saskatchewan and the 2002 log per acre price in Manitoba. The dashed lines trace out 95% confidence intervals, following van Garderen and Shah (2002).

As displayed in figure 2, the log per acre prices in Saskatchewan and Manitoba diverged in the pre-amendment period, such that Saskatchewan farmland values lost ground relative to Manitoba. The diverging trend in the pre-amendment period does not persist into the post-amendment period. Visual inspection of figure 2 suggests that trends in Manitoba and Saskatchewan farmland values began to converge starting in 2006, after which they followed parallel paths through to 2010. In the following section, I conduct formal statistical tests and control for potentially important confounding variables.

Flexible differences in trends analysis

Table 2 presents test statistics estimated from equations (1) and (4) assessing: 1) the pre-SFSA amendment differences in farmland value trends; 2) the results from a series of falsification tests imposing fake treatments in the pre-amendment period; and 3) estimates of the impact of the SFSA amendment. The results presented in the first column of table 2 indicate that the difference between farmland values in Saskatchewan relative to Manitoba increase over the 1995 to 2002 period by approximately 4% per year. This estimate does not control for important time varying covariates such as farming returns, changes in population, and changes in oil and gas employment. After controlling for these covariates in equation (4) the estimated pre-SFSA amendment difference between farmland values in the two provinces diverges by 1.8% per year. Controlling for time-varying covariates therefore absorbs 2.2% of the divergence in farmland values observed in the pre-amendment period.

The falsification tests reported in table 2, based on estimates from equations (1) and (4), all suggest that there is no break in the pre-SFSA amendment trend. This result is consistent with the notion that the SFSA amendment should have no impact on farmland values prior to its implementation in 2003. The falsification tests suggest that the pre-amendment trend is linear. I use this result to extrapolate the pre-amendment trend into the post-amendment period. This identification strategy relies on an assumption that the underlying trend across the pre and post-amendment periods is locally linear.

Estimates of the impact of the SFSA amendment reported in table 2 are similar across the two specifications from equations (1) and (4). Differences in the two specifications emerge in the "first seven years" and "first eight years" estimates, which range from 2.9% and 3% in equation (1) to 1.8% and 2.1% in equation (4), which controls for time varying covariates. Consistent with the

graphical evidence presented in figure 2, the test statistics suggest that the SFSA amendment had an immediate impact in 2003, but that this impact went to zero in the subsequent two years. The test statistics also suggest that the SFSA amendment put the two provinces on parallel paths beginning in 2006. This dynamic response to the SFSA amendment is consistent with the gradual entry of outside farmland investors into Saskatchewan that began to increase in a substantial way starting in 2006 and 2007, as documented in Magnan and Sunley (2017) based on their inspection of Saskatchewan land titles. On average, the estimated impact of the SFSA amendment is an annual increase in Saskatchewan farmland values ranging from 2.9% in equation (1) to 2.4% in equation (4).

Deviation from trends analysis

Table 3 presents results from the baseline specification of the parametric deviation from trends analysis from equation (5). Results from the baseline deviation from trends specification are consistent with the results reported from the more flexible differences in trends analysis. After controlling for year fixed effects, parcel-specific physical characteristics, and time-varying covariates, the difference in pre-SFSA amendment trends in the two provinces is -2.9%, which suggests that Saskatchewan farmland prices were losing ground to Manitoba farmland prices prior to 2003.

In the post amendment period, the deviation from trend results suggest that Saskatchewan farmland prices increased by 3.1% per year (based on a 4.3% deviation from trend) and Manitoba farmland prices increased by 3.3% per year (based on a 1.6% deviation from trend). The post-amendment trends in the two provinces are not statistically different from one another, which suggests that farmland prices in the two provinces followed parallel trends after the farmland

ownership restrictions in Saskatchewan were brought back in line with those in Manitoba. Combining the pre-amendment difference in trends with the post-amendment difference in trends (the difference in deviation from trends presented in table 3) suggests that the SFSA amendment increased Saskatchewan farmland prices by an average of 2.6% per year over the first eight years after the SFSA amendment.

It is important to note again that this identification approach relies on an assumption that the pre-amendment difference in trends is locally linear and would have persisted in the absence of the SFSA amendment. In a typical difference-in-differences analysis the parallel trends assumption holds prior to the treatment and there is a potential shift or change in the relative trend after treatment with a new "policy." In this application the opposite occurs. Farmland prices in the two provinces are diverging prior to the treatment when farmland ownership restrictions in the two provinces are different. After amendment of the SFSA the farmland ownership restrictions in the two provinces converge and farmland values in the two provinces follow parallel trends.

Robustness: Alternative geographic specifications

I evaluate the robustness of the deviation from trends analysis with several alternative geographic specifications presented in table 4. Perhaps the most important concern with the baseline results from the entire study region is the development of the Bakken oil field in southeastern Saskatchewan and southwestern Manitoba, which coincided with the timing of the SFSA amendment. Since much of the Canadian Bakken development has occurred on the Saskatchewan side of the border it is possible that farmland price increases in Saskatchewan reflect the influence of oil and gas development rather than the influence of the SFSA amendment.

The baseline models control for development of the Bakken oil play using changes in oil and gas employment as a proxy for investment activity in the region. This may not adequately control for the potential impacts of the oil play on farmland prices. For instance, surface rights leases provide landowners with a certain flow of income for the lifetime of the well and it is possible that this has increased farmland values in the region.[18] Directly controlling for this type of an effect is difficult so as a robustness check I exclude sales parcels that occur within and in close proximity to the Bakken oil field region in Saskatchewan and Manitoba, accounting for just under 50% of the study region.[19] Column (1) from table 4 presents results from this robustness check. I find that the SFSA amendment increased Saskatchewan farmland values by an average of 2.6% per year. This result suggests that differential development of the Bakken oil play between the two provinces is not driving the baseline results reported in table 3.

A second potential issue is that the study region covers a wide geographic extent and the Saskatchewan parcels on the western side of the study region are closer to Alberta than to Manitoba. It is possible that the two study regions are different farmland markets. If unobserved region-specific factors influence farmland values in the western portion of the Saskatchewan study region then Manitoba sales may not be a suitable comparison group.[20] I investigate the potential importance of this issue through an alternative geographic specification that includes only those Saskatchewan sales parcels that are in the three Census Divisions on the Saskatchewan-Manitoba border. Column (2) of table 4 presents results for this specification, and once again demonstrate that the baseline results are robust. When the study region is restricted to parcels along the

[18] Countering this, Wang (2016) finds that surface rights leases do not increase Alberta farmland values.
[19] This includes all sales parcels south of the Assiniboine River in Saskatchewan and Manitoba, and all parcels east of Moose Jaw in Saskatchewan and west of Brandon in Manitoba. The excluded area therefore provides a wide buffer around the Bakken region, which eliminates any potential spatial spillover effects that might influence farmland values.
[20] Michaels and Smith (1990) show that failure to account for market segmentation can bias hedonic estimates of amenity values.

Saskatchewan-Manitoba border, the results suggest that the SFSA amendment increased farmland values by 3.1% per year.

Column (3) of table 4 reports the results of a specification that excludes parcels in the Bakken oil play region (as in the specification from column (1)) and excludes sales parcels that are not along the Manitoba-Saskatchewan border (as in the specification from column (2)). This reduces the full sample size by approximately two-thirds. Results estimated from this sample suggest that the SFSA amendment reduced farmland prices in Saskatchewan by 3.3% per year, once again demonstrating that the baseline results are not biased upwards by differential development of the Bakken oil play nor by inclusion of sales parcels far from the Manitoba-Saskatchewan border.

Finally, column (4) of table 4 reports the results of a specification that excludes sales parcels in municipalities that are near urban centres (Brandon in Manitoba; Regina and Saskatoon in Saskatchewan). Proximity to urban areas may influence the impact of the SFSA amendment on farmland values if outside investors are primarily interested in the urban development potential of Saskatchewan farmland. Deaton and Vyn (2010) show that the property value impact of Ontario's Greenbelt legislation is highest in areas closest to the Toronto metropolitan area. As reported in table 4, I estimate that the SFSA amendment increased Saskatchewan farmland prices by 2.8% when parcels in close proximity to urban centres are excluded from the sample. This result suggests that new investors from outside the province were not systematically targeting land with the potential for urban development. This is also consistent with the fact that the SFSA applies to land that is to be used for agricultural purposes.

Robustness: Sensitivity to functional form

The estimation sample used in this analysis is the result of a trimming procedure based on pre-treatment time-invariant parcel characteristics. As is clear from table 1, the per acre farm returns, changes in regional oil and gas employment, and changes in regional population are not balanced across the treatment and control observations. Given the lack of balance of these covariates across the two provinces, it is possible that the treatment effect is sensitive to functional form misspecification. This is a particular concern regarding per acre farm returns, which are almost twice as high in Manitoba compared to Saskatchewan. Previous studies of the impact of farming returns on farmland values all enter farming returns linearly. Despite this, it is possible that the true relationship between farming returns and the log of farmland price is nonlinear and best approximated by entering farming returns as a quadratic or in log form.

Table 5 presents a set results from alternative functional form specifications of the baseline model that allow the covariates to have a nonlinear impact on the log of farmland price. Column (1) reports the results of a specification that enters farming returns in log form. The overall results are sensitive to this functional form; the pre-amendment difference in trends is -4% and the difference in deviation from trends in the two provinces is 3.1%, suggesting a larger effect of the SFSA amendment than is estimated in the baseline model. Entering farming returns as a quadratic yields estimates that are close to those in the baseline model: as presented in column (2) of table 5, the pre-amendment difference in trends is -2% and the effect of the SFSA amendment is to increase Saskatchewan farmland prices by 2.4% relative to Manitoba prices. Finally, I estimate the model including quadratic terms for all covariates, including time-invariant parcel characteristics and time-varying regional covariates. As presented in column (3), the results suggest that the SFSA amendment increased Saskatchewan farmland prices by 2.8% per year over the course of the first eight years in the post-amendment period.

Robustness: Additional controls for important agricultural sectors

The identification approach in this study relies on the assumption that the pre-amendment differences in trends would have persisted in the absence of the SFSA amendment. This assumption is violated if important covariates are omitted such that the difference in trends in the two provinces is a function of the omitted covariates. To explore this potential concern further I investigate historical Farm Credit Canada (FCC) annual farmland value reports.[21] These reports estimate annual changes in provincial farmland values and provide brief reports on the important drivers of Provincial farmland prices. The FCC reports confirm that the hog and potato sectors were important potential drivers of differences in farmland values in the two provinces.

In Manitoba, the hog sector expanded significantly between 1993 and 2002. Growth of the sector in Manitoba stalled in 2008 due to US country of origin labelling legislation, a Manitoba moratorium on hog barn construction and expansion, and Province of Manitoba regulations dealing with hog manure.[22] The Saskatchewan hog sector experienced slower growth over the pre-amendment period. Similarly, the potato sector experienced significant growth in Manitoba over the study period, which coincided with an increase in processing capacity in the province. It is possible that differential trends in expansion of the potato production and processing sectors in the two provinces has biased baseline estimates of the impact of the SFSA.

[21] Farm Credit Canada (FCC) is a federal Crown corporation that provides financing to farmers. The FCC publishes annual or semi-annual farmland value reports prepared by appraisers using a benchmark set of properties across the country. FCC annual farmland value reports beginning in 1998 are archived at http://publications.gc.ca/site/eng/9.830135/publication.html & http://publications.gc.ca/site/eng/9.830162/publication.html

[22] I thank an anonymous referee for pointing out the potential importance of the hog sector to farmland prices in Manitoba relative to Saskatchewan. The moratorium on hog barn expansion is expected to decrease farmland values. New restrictions on application of hog manure to cropland increase the demand for land for disposal of hog manure and should increase Manitoba farmland values in some regions.

The results reported in Tables 3, 4, and 5 all control for five-year rolling averages of farm returns, which includes cash receipts from crops and livestock production as well as government receipts. Farming returns control for a combination of crop/livestock prices and production volumes, and therefore fluctuates with global supply and demand conditions as well as local climate conditions. An additional approach to control for development of particular sectors is to include measures of inventory or seeded acreage. I create two province-level sector-specific indices as follows. The hog number index is based on an annual average of provincial hog inventory and the potato index is based on annual estimates of seeded acreage, both using 1995 as the base year. The indices provide a measure of the size of each sector in each of the two provinces in each year, relative to the size of the sector in each of the provinces in 1995.

Table 6 presents results from a series of regressions that include these additional controls for development of important agricultural sectors within the two provinces. As indicated in column (1), inclusion of the provincial hog number index has little effect on the baseline results as reported in table 3. The pre-amendment difference in trends is -3.4%, the post-amendment difference in trends is close to zero and statistically insignificant, and the impact of the SFSA amendment is to increase Saskatchewan farmland values increase by 2.7% per year on average. Reported in column (2), controlling for hog and potato indices reduces the estimated impact of the SFSA amendment to a 1.9% per year increase in Saskatchewan farmland values.

Robustness: Alternative specifications of the temporal trend

The flexible differences in trends results presented in table 2 suggest that there was an immediate increase in Saskatchewan farmland values relative to Manitoba values in the first year after the

2003 SFSA amendment. The results in table 2 also indicate that the SFSA amendment had no impact on Saskatchewan farmland prices in 2004 and 2005, as Saskatchewan farmland prices continued to loose ground to Manitoba prices over those two years. According to the results in table 2 the permanent effect of the SFSA amendment started in 2006 when Saskatchewan farmland prices began increasing at the same rate as Manitoba farmland prices.

In table 7, I report the results of two alternative specifications that allow for flexible temporal patterns in the estimated impact of the SFSA amendment. As reported in column (1), the first alternative allows for a discrete shift in Saskatchewan farmland values starting in 2003. The results suggest that the SFSA amendment increased Saskatchewan farmland values by 6.4% starting in 2003. The SFSA amendment further increased Saskatchewan farmland prices by 2% per year. Overall, these results suggest that the SFSA amendment increased Saskatchewan farmland values by 22.4% over the first eight years since the amendment.

As reported in column (2), I also allow for a kink in the deviation from trend to occur in 2006. Results from this specification suggest that the pre-amendment difference in trends was -4.8%. Immediately after the SFSA amendment Saskatchewan farmland prices continued to loose ground to Manitoba values at a rate of 5.5% per year for 2003 through 2005. Starting in 2006, Saskatchewan farmland prices follow the same trend as Manitoba prices, which translates into a 5.2% increase in Saskatchewan farmland values due to the SFSA amendment.

Discussion

Farmland ownership restrictions belong to a suite of policy measures governments employ to influence the supply and use of farmland, including zoning, differential assessments, and farmland

preservation easements. Perhaps most relevant to farmland ownership restrictions, rural land zoning restricts the use of land, which limits the potential pool of buyers. Prior research shows that zoning can have substantial effects on farmland prices. Deaton and Vyn (2010) examine Ontario's Greenbelt legislation, which restricted residential development around the Greater Toronto Area (GTA). They find that the Greenbelt reduced property values within 5 kilometers of the GTA by approximately 24%. Liu and Lynch (2011) examine the effect of lower density zoning on Maryland rural land prices. They find that the effect depends on the use of the parcel. Zoning has no effect on resource parcels (in agricultural or forest use) but reduces the value of non-resource parcels by 20-50%.

Whereas zoning and farmland preservation easements typically influence farmland markets in regions under significant urban development pressure, the farmland ownership restrictions examined in this article are common in production agriculture regions. Results from the baseline specification reported in table 3 suggest that the SFSA amendment increased Saskatchewan farmland prices by, on average, approximately 2.6% per year. Results reported in Tables 5 and 6 (based on the entire geographic region of the sample) suggest that the impact of the SFSA amendment ranged from 1.9% to 3.1% per year. Over the first eight years subsequent to the amendment, this implies that farmland prices increased by between 15.2% and 24.8%, with the baseline result suggesting a 20.8% increase.

Portrayal of the SFSA amendment in the popular press suggests that much of the opposition to the SFSA amendment arose out of a concern that young local farmers will have more difficulty purchasing farmland. With this in mind, it is useful to work through ballpark estimates of the capitalization effect of the SFSA through 2010. At the average 2002 Saskatchewan farmland price of approximately $252/acre, a 20.8% increase in farmland prices over the course of eight years

works out to a $52/acre increase in farmland prices up to the end of 2010. Taking into account the low and high estimates reported in Tables 5 and 6, the estimated impact ranges from $38/acre to $62/acre. Statistics Canada reports that the average farm size in Saskatchewan in the 2011 Census of Agriculture is 1,668 acres. Assuming the impact lies somewhere between $38/acre and $62/acre, the SFSA amendment increased the value of the average farm by between $63,384 and $103,416 through to 2010. This result also suggests that the SFSA amendment increased the cost of obtaining an average Saskatchewan farm by 4.5% to 7.8% of the $1,332,044 in capital (including the value of land, buildings, farm machinery, and equipment) invested in an average Saskatchewan farm in 2011.

The capitalization effects reported in this analysis are consistent with media accounts suggesting supporters of the SFSA amendment were potential farmland investors as well as those farmers nearing retirement and in a position to sell farmland. Prior to the SFSA amendment, investors viewed Saskatchewan farmland as underpriced relative to farmland in neighboring provinces and states, including Manitoba. The SFSA amendment opened Saskatchewan to outside investment and new investors bid up the price of Saskatchewan farmland. As of 2010, the distributional consequence of the SFSA amendment is a transfer of between $38 and $62 per acre from farmland buyers to farmland sellers that held farmland in 2002.

The results presented in this article suggest that Saskatchewan farmland prices were loosing ground relative to Manitoba prices due to a lack of outside investment capital prior to the SFSA amendment. After a period of adjustment in which outside investors started to enter the Saskatchewan farmland market, the impact of the SFSA amendment was to put Saskatchewan farmland prices on the same path as Manitoba prices. It is important to note that this is estimated over the first eight years of the post-amendment period and is therefore a medium-term impact of

the SFSA amendment. A perhaps surprising implication of this result is that Saskatchewan farmland prices are not increasing at a *faster* rate than those in Manitoba, to make up for lost value during the pre-amendment period. This suggests that the original SFSA, which restricted farmland ownership to Saskatchewan residents, had a permanent impact on Saskatchewan farmland values. Alternatively, it might be the case that the parallel trends in the post-SFSA amendment period is a medium-term outcome and that Saskatchewan farmland prices will begin to increase at a faster rate over the longer-term as the farmland market continues to adjust to new sources of outside investment capital. However, the SFSA was amended in 2016 to prevent pension plans and other institutional investors from owning Saskatchewan farmland (Johnstone 2015). Presumably, this latest amendment is intended to counteract both the medium-term and the potential longer-term outcomes of the 2003 SFSA amendment.

Conclusion

Recent public reviews of farmland ownership restrictions in several US states and Saskatchewan as well as international concerns about the rise of large-scale farming backed by outside investment have all revolved around their impact on farmland values and on the competitiveness of local farmers (Deininger and Byerlee 2012; Nelson 2015; Bosman 2016). Local farmland buyers prefer tighter restrictions on the pool of buyers and will generally oppose moves to open farmland markets to outside investment. Landowners, on the other hand, might prefer looser farmland ownership restrictions that increase competition for their land, particularly if the next generation is not expected to continue farming. In Saskatchewan, the SFSA insulated a generation of Saskatchewan farmers and other landowners from outside competition for Saskatchewan farmland. The 2003 SFSA amendment allowed landowners who owned Saskatchewan farmland

in 2002 to sell into a partially liberalised market open to investment from the rest of Canada. I find that the 2003 SFSA amendment increased Saskatchewan farmland values, on average, by between 1.9 and 3.1 per cent per year. I also show that the estimated impact of the SFSA coincides with the entry of new outside investors into the province starting in 2006. The effect estimated in this article reflects the combined effect of the SFSA amendment on Saskatchewan farmland prices as well as a potential decrease in Manitoba prices due to the amendment.

By design the SFSA ensured ownership of Saskatchewan farmland by Saskatchewan residents. However, the SFSA placed no restrictions on the extent of farmland ownership by Saskatchewan non-farmer residents and is therefore only indirectly targeted to increase farmland ownership by farmers. Further, the results presented in this article are consistent with a relative shortage of investment capital in Saskatchewan prior to the 2003 amendment; as a result Saskatchewan farmland prices lost ground to Manitoba prices. When the farmland ownership restriction was relaxed, new investment capital from the rest of Canada flowed into the province. The extent to which this investment is derived from farmers versus non-farmers, and the impact of this new investment capital on the ability of local farmers to achieve economies of scale through land rental is unclear. What is clear from this research are the distributional consequences of the 2003 SFSA amendment, which transferred substantial wealth to farmland owners that held Saskatchewan farmland in 2002.

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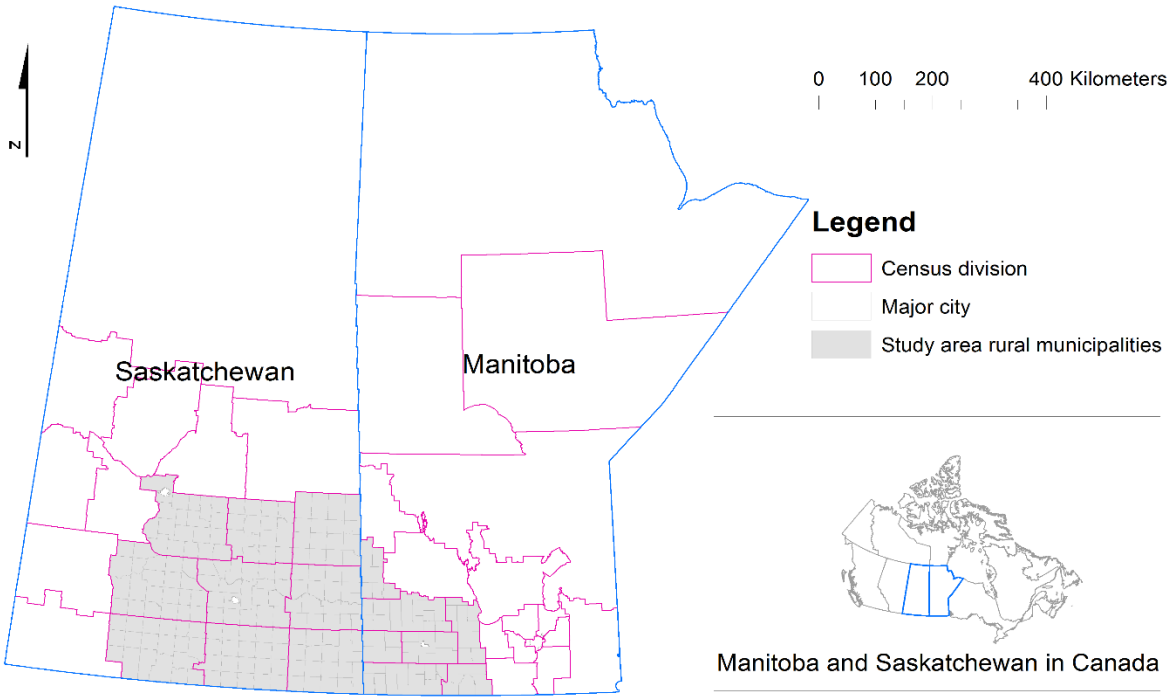

Figure 1. Study area

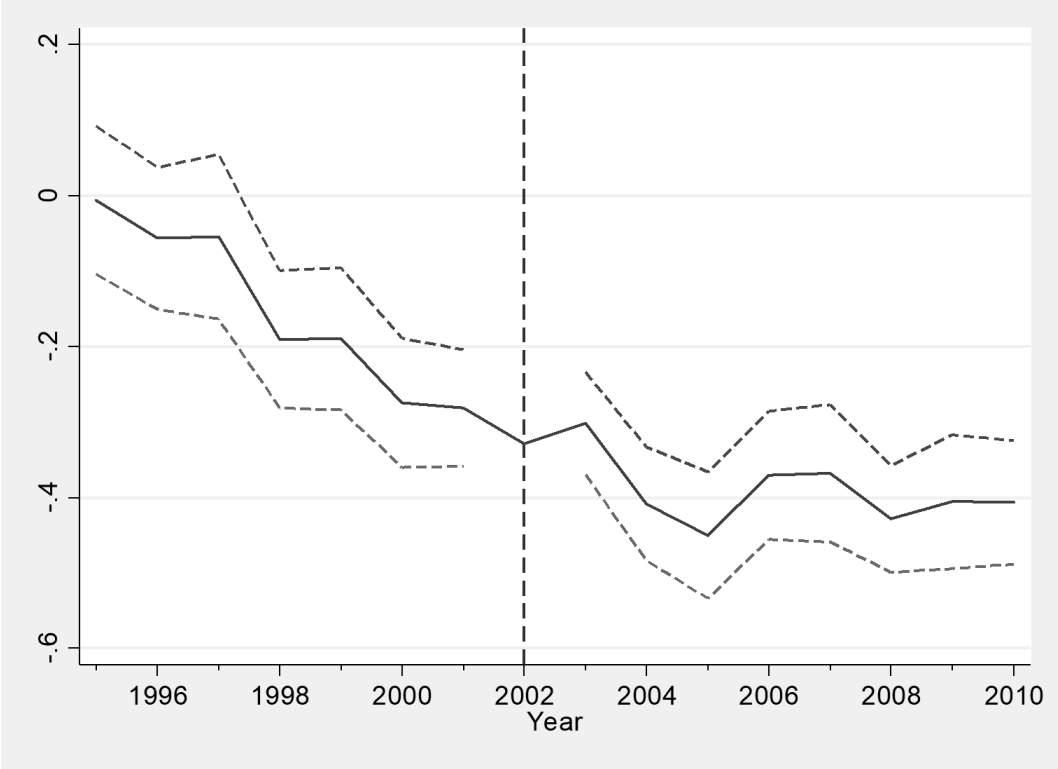

Figure 2. Farmland value trends in Saskatchewan relative to Manitoba

Notes: Figure 2 plots the γ_t coefficients from estimating the parameters of equation (1). The parameters are normalized such that the coefficient for the reference year (2002) is equal to the difference between the average log of Saskatchewan farmland values and the average log of Manitoba farmland values in 2002. The dashed lines indicate the 95% confidence interval. Coefficient estimates and confidence intervals are adjusted following Kennedy (1981) and van Garderen and Shah (2002), respectively.

Table 1. Summary Statistics for Trimmed Sample

	Manitoba				Saskatchewan			
	1995-2002		2003-2010		1995-2002		2003-2010	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Log price per acre ($2002)	5.79	0.56	6.07	0.65	5.60	0.48	5.67	0.49
High capability soil (%)	37.22	33.59	36.91	33.99	38.72	35.10	37.67	35.17
Medium capability soil (%)	36.32	38.32	37.59	38.60	35.64	38.36	37.97	38.87
Developed share (%)	0.98	1.48	1.02	1.60	0.87	1.01	0.89	0.99
Wetland share (%)	5.75	9.60	5.58	9.85	4.51	7.35	4.96	7.80
Grassland share (%)	4.35	15.73	4.54	16.30	3.24	13.81	2.60	12.08
Tree share (%)	9.01	18.54	9.77	19.27	5.01	12.45	5.17	12.65
Total sale acres (100 acres)	2.26	1.49	2.38	1.67	2.21	1.35	2.34	1.52
Farming returns ($2002)	173.33	14.85	211.89	7.36	96.89	6.32	103.06	6.20
Population change (%)	0.00	0.00	-0.01	0.01	-0.01	0.01	-0.01	0.01
Oil/gas emp. change (%)	-0.18	0.20	-0.24	0.20	0.06	0.08	0.05	0.06
Observations	4141		3270		6719		7090	

Table 2. Impact of the SFSA Amendment on Farmland Values: Flexible Difference in Trends

	Results from equation (1)			Results from equation (4)		
	Test statistic		Std. Err.	Test statistic		Std. Err.
Pre-SFSA amendment trend (2002-1995)	-0.040	***	0.005	-0.018	***	0.003
Pre-SFSA amendment falsification tests:						
False treatment in 1997 (2002-1996 vs. 1996-1995)	-0.002		0.036	0.015		0.034
False treatment in 1998 (2002-1997 vs. 1997-1995)	-0.030		0.025	0.000		0.025
False treatment in 1999 (2002-1998 vs. 1998-1995)	0.016		0.023	0.031		0.021
False treatment in 2000 (2002-1999 vs. 1999-1995)	-0.006		0.023	0.022		0.020
False treatment in 2001 (2002-2000 vs. 2000-1995)	0.018		0.027	0.034		0.023
False treatment in 2002 (2002-2001 vs. 2001-1995)	-0.008		0.041	0.053		0.040
Impact of the 2003 SFSA amendment:						
First year (2003-2002 vs. 2002-1995)	0.069	*	0.039	0.081	**	0.035
First two years (2004-2002 vs. 2002-1995)	-0.002		0.023	0.018		0.020
First three years (2005-2002 vs. 2002-1995)	-0.003		0.019	0.012		0.016
First four years (2006-2002 vs. 2002-1995)	0.030	**	0.014	0.029	**	0.013
First five years (2007-2002 vs. 2002-1995)	0.033	**	0.013	0.034	***	0.012
First six years (2008-2002 vs. 2002-1995)	0.023	***	0.010	0.021	**	0.010
First seven years (2009-2002 vs. 2002-1995)	0.029	***	0.010	0.018	*	0.010
First eight years (2010-2002 vs. 2002-1995)	0.031	***	0.009	0.021	**	0.009
Parcel-specific characteristics	No			Yes		
Time-varying covariates	No			Yes		
Observations	21220			21220		
No. of municipality clusters	186			186		
R^2 within	0.072			0.308		
R^2 between	0.086			0.424		
R^2 overall	0.026			0.339		

Notes: All specifications include year and rural municipality fixed effects. Standard errors are adjusted for 196 municipality clusters. Test statistics and standard errors are adjusted following Kennedy (1981) and van Garderen and Shah (2002), respectively.

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

Table 3. Impact of the SFSA Amendment on Farmland Values: Deviation from Trends

	Estimate	
Pre-amendment SK trend ($\delta_{SK=1}$)	-0.011	**
	(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)	
Differences:		
Pre-amendment difference in trends:	-0.029	***
$\delta_{SK=1} - \delta_{SK=0}$	(0.008)	
Post-amendment difference in trends:	-0.002	
$(\delta_{SK=1} + \theta_{SK=1}) - (\delta_{SK=0} + \theta_{SK=0})$	(0.007)	
Difference in deviation from trends:	0.026	***
$\theta_{SK=1} - \theta_{SK=0}$	(0.008)	
Parcel-specific characteristics	Yes	
Time-varying covariates	Yes	
Observations	21220	
Number of municipality clusters	186	
Minimum observations per cluster	25	
Average observations per cluster	114.1	
Maximum observations per cluster	331	
R^2 within	0.309	
R^2 between	0.168	
R^2 overall	0.062	

Notes: Specification includes year and rural municipality fixed effects, parcel-level time invariant physical characteristics, and time-varying covariates. Standard errors (in parentheses) adjusted for municipality clusters.

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

Table 4. Impact of the SFSA Amendment on Farmland Prices: Alternative Geographic Specifications

	(1) Bakken oil play region excluded		(2) Sample restricted to SK Census Divisions on SK-MB Border		(3) SK Census Divisions on Border, Bakken region excluded		(4) Near urban municipalities excluded	
	Estimate		Estimate		Estimate		Estimate	
Pre-amendment SK trend ($\delta_{SK=1}$)	-0.014	**	-0.005		-0.006		-0.015	***
	(0.007)		(0.007)		(0.009)		(0.005)	
Pre-amendment MB trend ($\delta_{SK=0}$)	0.011		0.031	**	0.015		0.009	
	(0.016)		(0.013)		(0.018)		(0.012)	
SK deviation from trend ($\theta_{SK=1}$)	0.055	***	0.041	***	0.063	***	0.047	***
	(0.010)		(0.012)		(0.013)		(0.007)	
MB deviation from trend ($\theta_{SK=0}$)	0.029	**	0.010		0.030	**	0.019	**
	(0.011)		(0.009)		(0.014)		(0.008)	
Differences:								
Pre-amendment difference in trends:	-0.025	**	-0.037	***	-0.021	*	-0.024	***
$\delta_{SK=1} - \delta_{SK=0}$	(0.011)		(0.009)		(0.012)		(0.008)	
Post-amendment difference in trends:	0.001		-0.005		0.012		0.003	
$(\delta_{SK=1} + \theta_{SK=1}) - (\delta_{SK=0} + \theta_{SK=0})$	(0.009)		(0.010)		(0.011)		(0.007)	
Difference in deviation from trends:	0.026	**	0.031	***	0.033	***	0.028	***
$\theta_{SK=1} - \theta_{SK=0}$	(0.010)		(0.011)		(0.012)		(0.008)	
Observations	11877		13144		7295		18539	
Number of municipality clusters	106		105		62		177	
Minimum observations per cluster	1		3		1		1	
Average observations per cluster	112.0		124.9		117.7		109.1	
Maximum observations per cluster	331		331		331		331	
R^2 within	0.300		0.330		0.333		0.303	
R^2 between	0.236		0.353		0.278		0.259	
R^2 overall	0.093		0.131		0.127		0.081	

Notes: All specifications include year and rural municipality fixed effects, parcel-level time invariant physical characteristics, and time-varying covariates. Standard errors (in parentheses) adjusted for municipality clusters.

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

Table 5. Impact of the SFSA Amendment on Farmland Prices: Alternative Functional Forms

	(1) Farming returns entered as log		(2) Farming returns entered as quadratic		(3) All covariates entered as quadratic	
	Estimate		Estimate		Estimate	
Pre-amendment SK trend ($\delta_{SK=1}$)	-0.011	*	-0.009		-0.010	*
	(0.006)		(0.006)		(0.006)	
Pre-amendment MB trend ($\delta_{SK=0}$)	0.029	***	0.010		0.010	
	(0.008)		(0.013)		(0.013)	
SK deviation from trend ($\theta_{SK=1}$)	0.044	***	0.041	***	0.041	***
	(0.008)		(0.008)		(0.008)	
MB deviation from trend ($\theta_{SK=0}$)	0.013	*	0.017	**	0.013	
	(0.008)		(0.008)		(0.008)	
Differences:						
Pre-amendment difference in trends:	-0.040	***	-0.020	*	-0.020	*
$\delta_{SK=1} - \delta_{SK=0}$	(0.005)		(0.011)		(0.011)	
Post-amendment difference in trends:	-0.009		0.004		0.007	
$(\delta_{SK=1} + \theta_{SK=1}) - (\delta_{SK=0} + \theta_{SK=0})$	(0.006)		(0.010)		(0.010)	
Difference in deviation from trends:	0.031	***	0.024	***	0.028	***
$\theta_{SK=1} - \theta_{SK=0}$	(0.008)		(0.008)		(0.008)	
Observations	21220		21220		21220	
Number of municipality clusters	186		186		186	
Minimum observations per cluster	25		25		25	
Average observations per cluster	114.1		114.1		114.1	
Maximum observations per cluster	331		331		331	
R^2 within	0.306		0.307		0.317	
R^2 between	0.193		0.194		0.194	
R^2 overall	0.059		0.061		0.061	

Notes: All specifications include year and rural municipality fixed effects, parcel-level time invariant physical characteristics, and time-varying covariates. Standard errors (in parentheses) adjusted for municipality clusters.

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

Table 6. Impact of the SFSA Amendment: Additional Controls for Sectoral Development

	(1) Hog number index		(2) Hog and potato indices	
	Estimate		Estimate	
Pre-amendment SK trend ($\delta_{SK=1}$)	-0.004		0.001	
	(0.017)		(0.018)	
Pre-amendment MB trend ($\delta_{SK=0}$)	0.031		0.030	
	(0.032)		(0.032)	
SK deviation from trend ($\theta_{SK=1}$)	0.034	*	0.024	
	(0.019)		(0.022)	
MB deviation from trend ($\theta_{SK=0}$)	0.007		0.005	
	(0.021)		(0.021)	
Differences:				
Pre-amendment difference in trends:	-0.034	**	-0.029	*
$\delta_{SK=1} - \delta_{SK=0}$	(0.016)		(0.015)	
Post-amendment difference in trends:	-0.007		0.010	
$(\delta_{SK=1} + \theta_{SK=1}) - (\delta_{SK=0} + \theta_{SK=0})$	(0.014)		(0.014)	
Difference in deviation from trends:	0.027	***	0.019	**
$\theta_{SK=1} - \theta_{SK=0}$	(0.008)		(0.009)	
Observations	21220		21220	
Number of municipality clusters	186		186	
Minimum observations per cluster	25		25	
Average observations per cluster	114.1		114.1	
Maximum observations per cluster	331		331	
R^2 within	0.307		0.307	
R^2 between	0.166		0.166	
R^2 overall	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 parentheses) adjusted for municipality clusters.

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

Table 7. Impact of the SFSA Amendment: Alternative Specifications of Temporal Pattern

	(1) Shift in level		(2) Kink in deviation from trend	
	Estimate		Estimate	
Pre-amendment SK trend ($\delta_{SK=1}$)	-0.018	***	0.001	
	(0.007)		(0.018)	
Pre-amendment MB trend ($\delta_{SK=0}$)	0.004		0.030	
	(0.014)		(0.032)	
SK deviation from trend ($\theta_{SK=1}$)	0.038	***		
	(0.008)			
MB deviation from trend ($\theta_{SK=0}$)	0.019	**		
	(0.008)			
SK shift in level	0.064	**		
	(0.032)			
SK deviation from trend ($\theta_{SK=1}^{2003-2005}$)			0.009	
			(0.011)	
MB deviation from trend ($\theta_{SK=0}^{2003-2005}$)			0.015	
			(0.011)	
SK deviation from trend ($\theta_{SK=1}^{2006-2010}$)			0.062	***
			(0.013)	
MB deviation from trend ($\theta_{SK=0}^{2006-2010}$)			0.010	
			(0.015)	
Differences:				
Pre-amendment difference in trends:	-0.022	**	-0.048	***
$\delta_{SK=1} - \delta_{SK=0}$	(0.009)		(0.012)	
Post-amendment difference in trends:				
$(\delta_{SK=1} + \theta_{SK=1}) - (\delta_{SK=0} + \theta_{SK=0})$	-0.003			
	(0.007)			
$\left(\delta_{SK=1} + \theta_{SK=1}^{2003-2005}\right) - \left(\delta_{SK=0} + \theta_{SK=0}^{2003-2005}\right)$			0.055	***
			(0.16)	
$\left(\delta_{SK=1} + \theta_{SK=1}^{2006-2010}\right) - \left(\delta_{SK=0} + \theta_{SK=1}^{2006-2010}\right)$			0.003	
			(0.010)	
Difference in deviation from trends:				
$\theta_{SK=1} - \theta_{SK=0}$	0.020	**		
	(0.009)			
$\theta_{SK=1}^{2003-2005} - \theta_{SK=0}^{2003-2005}$			-0.007	
			(0.011)	
$\theta_{SK=1}^{2006-2010} - \theta_{SK=0}^{2006-2010}$			0.052	***
			(0.016)	
Observations	21220		21220	
Number of municipality clusters	186		186	
Minimum observations per cluster	25		25	

Average observations per cluster	114.1	114.1
Maximum observations per cluster	331	331
R^2 within	0.307	0.307
R^2 between	0.167	0.165
R^2 overall	0.061	0.059

Notes: All specifications include year and rural municipality fixed effects, parcel-level time invariant physical characteristics, and time-varying covariates. Standard errors (in parentheses) adjusted for municipality clusters.

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