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THE INFLUENCE OF MARKET RETURNS AND GOVERNMENT PAYMENTS ON CANADIAN FARMLAND VALUES

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Abstract

This study estimates the impact of changes in market returns and government payments on farmland values across Canada using data from 1959 to 2009. A recursive simultaneous equation model is estimated to account for the counter-cyclical relationship between market returns and government payments. The results indicate that farmland values are more responsive to changes in market returns than in government payments, but both are important drivers of land values. The elasticity of land values with respect to government payments is lower than has been observed in the United States. In addition, the partial decoupling of government payments has not reduced their impact on farmland values.

Key Words: Farmland Values; Government Payments; Market Returns

JEL Classifications: Q15, Q18

Introduction

Farmland values across Canada have increased substantially over the past 50 years, both in nominal and in real terms. Land values have increased despite the fact that nominal per-acre net farm income excluding government payments has been decreasing and, in many cases in recent years, has been negative (Statistics Canada). Conversely, government payments provided through farm support programs have been increasing and are often considered one of the primary factors behind growing land values (Roberts, Kirwan, and Hopkins, 2003; Shaik, Helmers, and Atwood, 2005; Weersink et al., 1999). Our objective is to explore the forces behind increasing farmland values in Canada, focusing in particular on how market returns and government payments have contributed to these values.

Canadian farm programs have been designed to provide income support to protect farmers from the inherent production and market risks they face. The primary objective of such programs is to provide payments that compensate farmers for lost income. However, these payments may also be capitalized into the value of assets such as land, which forces asset prices higher. If producers are using government payments to justify higher prices for land, this implies that these programs are camouflaging market signals and that their objectives are not being fully met.[1] The increasing land values could, in turn, generate greater demand for government payments to compensate producers for the lower incomes exacerbated by higher debt loads.

In the United States, Shaik, Helmers, and Atwood (2005) found that the elasticity of farmland values with respect to government payments has varied, ranging from 0.30-0.40 during the 1960s and dropping to about 0.15-0.20 in the 1990s. This decline coincided with a shift in the nature of government programs from “coupled” programs to at least partially “decoupled” programs. Farm support programs are considered to be coupled if their benefits are directly related to production. For example, a price support program that compensates farmers for low commodity prices will influence their production decisions if the size of the payment is based on their current output. Conversely, if the payments are based on historical production, their influence on current production decisions is less direct, in which case programs are considered to be at least partially decoupled. Some program payments increase total farm revenue but do not increase per-unit net returns of specific production alternatives, and thus do not offer incentives to increase production of one commodity over another. However, these payments may keep resources in agriculture that would otherwise leave the sector (Burfisher and Hopkins, 2003). This shift to partially decoupled programs occurred partly in response to WTO negotiations, which stipulated that government payments in either the Blue Box or Green Box would not be subject to constraints/disciplines under the Uruguay Round Agreement on Agriculture (WTO, 1994).[2]

[1] This is based on the assumption that maintaining the wealth of farmers through constant or higher farmland values is not an objective of government programs.

[2] The Blue Box and Green Box programs are defined in Article 6, section 5(a) (*Domestic Support Commitments*) and Annex 2 (*Domestic Support: The Basis for Exemption from the Reduction Commitments*) of the Agreement on Agriculture (WTO, 1994). Under the draft text tabled by Chairman Falconer, as part of the multilateral Doha Development Agenda negotiations, government payments in the blue box would be subject to international disciplines (WTO, 2008).

A similar shift has also occurred in Canada, where current programs are partially decoupled. This shift began with programs such as the Net Income Stabilization Account (NISA), which was introduced in 1991. Risk management programs introduced under ensuing policy frameworks in 2003 (Agricultural Policy Framework) and in 2008 (Growing Forward) focus on income support rather than price support and on whole farm coverage rather than commodity specific coverage. As a consequence, these programs are no longer coupled to production decisions for specific commodities; however, they are not fully decoupled since compensation is still based on current output or revenue. This shift away from fully coupled programs may affect the impact that program payments have on output and farmland values (Bakhshi and Kerr, 2009).

In order to take such shifts in policy into consideration and to more accurately estimate the impact of government payments on farmland values across Canada, the sample period for this study, 1959-2009, is divided into three general policy regimes: 1) 1959-1974, when government payments were largely coupled to output but minimal; 2) 1975-1990, when government payments were generally commodity specific and rising rapidly; and 3) 1991-2009, when government payments were generally non-commodity specific and hence partially decoupled.[3]

In addition to market returns and government payments, another factor that may play a role in determining land values is the influence of population growth. With a constantly increasing population in major urban areas, the growth of cities continues to encroach on agricultural land. Land that is sold for development commands a large premium, and as cities expand the surrounding agricultural land may be purchased speculatively at prices that far exceed expected returns from agricultural production. To account for this influence, we incorporate population factors into the estimation framework, as did Barnard et al. (1997) and Goodwin, Mishra, and Ortalo-Magne (2003).

The factors described above are taken into consideration in this study in estimating the contribution of various determinants to farmland values in Canada. Considerable attention has focused on the determinants of farmland values in the U.S. (Barnard et al., 1997; Goodwin, Mishra, and Ortalo-Magne, 2003; Roberts, Kirwan, and Hopkins, 2003; Shaik, Helmers, and Atwood, 2005) but this is much less the case in Canada (Clark, Klein, and Thompson, 1993; Weersink et al., 1999). Further, whereas previous Canadian studies have focused on specific provinces, we present the first comprehensive study of farmland values across Canada.

While there are similarities in agricultural production practices between Canada and the U.S. and their agricultural industries are intertwined and co-dependent to some degree, the influence of government and the associated policy regimes have differed considerably in these two countries. Hence, in addition to estimating the impacts of various determinants on farmland values across Canada, we also determine whether such policy differences affect the elasticity of farmland values with respect to government payments in Canada relative to that of the U.S., as estimated by previous studies.

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[3] There are, of course, exceptions to this general characterization of farm programs during these time periods; however, we believe this is an appropriate representation of the nature of federal farm support programs in Canada.

The empirical analysis is conducted using a recursive simultaneous equation model, similar to the approach of Shaik, Helmers, and Atwood (2005), which permits a comparison of the impact of government payments on farmland values between the two countries as well as other factors such as market returns. A further contribution of our analysis is to see if the shift to partially decoupled farm support programs in Canada has influenced the capitalization of government payments into farmland values.

How agricultural policy affects farmland values and how the benefits of farm support programs are distributed have important policy implications. When farmland prices increase as a result of the capitalization of government payments, production costs increase, and the benefits are transferred from the producer to the landowner. Kuchler and Tegene (1993) suggest that because the supply of agricultural land is relatively fixed, program payments accrue only to the landowner. One important feature of modern farming is the increasing "disconnect" between agricultural production and land ownership.[4] Consequently, even though payments are often made directly to the producer, the landowner will often reap the benefits of the program through higher land rents. In this case, producers can benefit from government payments only if they are also farmland owners. However, if the rate of capitalization of government payments into land values is decreasing, this would imply that more of the benefits remain with producers instead of being passed on to landowners.

The next section provides a brief overview of the determination of asset prices using net present values. An empirical framework for estimating the effects of various determinants on farmland values across Canada is presented in the third section. The fourth section discusses the data used in the empirical analysis, while the results of this analysis are presented in the fifth section. The final section offers conclusions and suggestions for further research.

Conceptual Framework

The general approach to pricing assets such as farmland has been through the present value model, which involves the determination of the net present value (NPV) of the asset. The NPV is calculated by estimating the future stream of cash returns resulting from ownership of the asset and discounting this cash flow based on the level of uncertainty inherent in the expected returns. This can be specified by the following equation:

$$V_t = \sum_{j=0}^{\infty} \frac{E_t R_{t+j}}{\left(1 + r_{t+j}\right)} \quad (1)$$

where V_t is the value of the asset, R_t is the real return from the asset based on expectations in period t (E_t), and r_t is the real discount rate, which may vary over time. This equation can be simplified by assuming a constant discount rate (r) and constant expected returns $\left(\overline{R}\right)$, so that:

[4] In the United States, 43.7% of land operated by farms is rented (Burfisher and Hopkins, 2003). In Canada, the percentage of land rented is 37.4% (Statistics Canada, 2001).

(2) $$V_t = \frac{\overline{R}}{r}$$

This model has formed the basis for many studies of asset values, including farmland values. For example, Weersink et al. (1999) derived the following model based on equation (1):

(3) $$L_t = \sum_{j=1}^{\infty} b^j E_t R_{t+j}$$

where L_t is the value of land, R_t is the rent from land at time t, E_t is the expectations operator, and b is the discount rate, such that $b^j = 1/(1+r_{t+j})$. To account for returns from both production (P) and from government payments (G), Weersink et al. (1999) expanded the model to:

(4) $$L_t = \sum_{j=1}^{\infty} (b_1^{\,j} E_t P_{t+j} + b_2^j E_t G_{t+j})$$

where b_1 and b_2 are the time-varying discount rates of P and G, respectively. The value of land is thus calculated as the present value of the expected future returns, discounted according to the risk of income from each source. The discount rates from each source are allowed to differ to reflect varying levels of uncertainty associated with the different sources of future returns. The discount rate for each source of income may also vary over time. However, if the discount rate for each source of income is assumed to be constant over time, then equation (4) can be simplified to:

(5) $$L_t = \beta_1 E_t P_{t+1} + \beta_2 E_t G_{t+1}$$

where β_1 and β_2 are the respective constant discount rates for expected cash flows from production and government payments. This equation constitutes the general form for models that have been used for agricultural asset value determination.

Empirical Model

A recursive simultaneous equation model is utilized in this study, following Shaik, Helmers, and Atwood (2005)[5], to estimate the impacts of various factors on farmland values across Canada. This approach begins with the traditional capitalization model, where farmland values are a function of market returns and government payments. In addition, population variables, real interest rate, risk associated with returns, and dummy variables representing different provinces are included in the model, which is specified as:

[5] Shaik, Helmers, and Atwood (2005) specify farmland value as a function of expected crop returns, expected farm program payments, real interest rate, expected variability associated with returns, urban expansion, and non-farm employment; while government payments are specified as a function of crop returns, risk, farm size, herfindahl index (to show crop diversification), and farm bill dummy variables.

(6) $$FV_{it} = \alpha_0 + \alpha_1 \sum_{t-1}^{t-5} MR_{it}/5 + \alpha_2 GP_{it} + \alpha_3 Pop_{it} + \alpha_4 PopGr_{it} + \alpha_5 Rate_t + \alpha_6 Risk_{it} + \alpha_7 T + \sum_i \beta_i Prov_i + \varepsilon_t ,$$

i=1,…,8; t=1,…,51

where FV_{it} is real farmland value per acre in province i (British Columbia (BC), Alberta (AB), Saskatchewan (SK), Manitoba (MB), Ontario (ON), Quebec (QU), Prince Edward Island (PEI), Nova Scotia (NS), New Brunswick (NB)) in year t; MR_{it} represents market returns per acre, for which expectations for year t are specified as a five year moving average of market returns across years t-1 through t-5;[6] GP_{it} is government payments per acre; Pop_{it} is the population density (people per arable acre); $PopGr_{it}$ is the population annual growth rate; $Rate_t$ is the real interest rate, which is constant across all provinces; $Risk_{it}$ is the expected variability of returns; T represents a linear time trend (1959=1); and $Prov_i$ represents provincial dummy variables, with Ontario being the base province.

Market returns have been accounted for in various ways in previous studies, such as net farm returns (Goodwin, Mishra, and Ortalo-Magne, 2003), crop returns (Shaik, Helmers, and Atwood, 2005), farm sales (Gardner, 2002), and both farm sales and costs (Roberts, Kirwan, and Hopkins, 2003). Due in part to the variation evident across the literature and in part to uncertainty regarding the appropriateness of various measures for market returns in Canada, we explore several alternative approaches to the specification of expected market returns. These include net farm income, net crop returns, and a third specification in which net crop returns are separated into crop receipts and crop expenses. Empirically, this third specification is found to be the most suitable for accounting for the impacts of market returns on farmland values.

Market returns and government payments are each anticipated to have a positive relationship with farmland values. However, there may be identification issues that arise due to the counter-cyclical relationship that often exists between market returns and government payments (Shaik, Helmers, and Atwood, 2005). Government payments tend to be higher in years when market returns decline, as greater payments are triggered from support programs to compensate for decreased production, prices or net returns. In addition, estimating equation (6) independently may not be appropriate since farmland values and government payments may be simultaneously determined. This issue can be addressed by specifying a second equation that accounts for the inverse relationship between government payments and market returns:

(7) $$\ln(GP_{it}) = \sigma_0 + \sigma_1 MR_{it} + \sigma_2 Risk + \sigma_3 T + \sum_i \lambda_i Prov_i + \sum_j \rho_j PR_j + \mu_t ,$$

i=1,…,8; t=1,…,51; j=1,3

where government payments are estimated as a function of market returns, risk, time, provincial dummy variables, and time period dummy variables (PR_j) for the three policy regimes (PR1: 1959-1974; PR2: 1975-1990; PR3: 1991-2009), with PR2 being the base regime.

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[6] These moving averages are used to proxy producers' expectations of market returns. This approach also reduces the wide fluctuations that occur in these data series.

To address the endogeneity of the government payments variable, an instrumental variable approach is used through an iterative estimation of equations (6) and (7). Equation (7) is estimated initially, from which predicted values for government payments are used as an instrument for government payments in equation (6).[7] This approach permits a more accurate determination of: 1) whether government payments have significantly influenced farmland values in Canada; and 2) the relative magnitudes of the impacts of market returns and government payments on farmland values.

This approach follows that of Shaik, Helmers, and Atwood (2005), who estimate a model similar to equations (6) and (7), where market returns are specified as crop returns. Our initial specification of market returns in equations (6) and (7) is adjusted net farm income. Next, we estimate a model in which market returns are specified as net crop returns. This specification, which is based on that of Roberts, Kirwan, and Hopkins (2003) and of Shaik, Helmers, and Atwood (2005)[8], takes into account the returns from the primary use of farmland – i.e., crop production.[9] A subsequent specification involves separating net crop returns into crop receipts and crop expenses to account for the expected opposite effects of receipts and expenses on both land values and government payments.[10] Crop receipts are anticipated to have a positive effect on land values and a negative effect on government payments, while the opposite effects are anticipated for crop expenses.

Data

This study uses provincial data, derived from Statistics Canada's CANSIM database, from 1959 to 2009 for farmland values, the various specifications of market returns, government payments, population density, population growth rate, and interest rate. These variables, with the exception of the population growth rate and the interest rate, are converted to a per-acre basis. Where applicable, variables are adjusted for inflation using the GDP deflator for Canada (1997=100). In calculating adjusted net farm income, government payments are removed from net farm income (CANSIM Table #002-0009) to avoid double-counting this revenue. Net farm income is further adjusted by removing land rental expenses, as these expenses are not relevant when considering land ownership, and by removing depreciation expenses to eliminate the effects of imputed costs. Net crop returns are derived based on farm cash receipts (CANSIM Table #002-0001) for crops and on farm operating expenses (CANSIM Table #002-0005) related specifically to crop production, which include seed, fertilizer, pesticide, irrigation, crop insurance, custom work, and machinery expenses (e.g., fuel; repairs). Provincial population figures are divided by the amount of arable land to determine population density. The interest rate is the chartered bank prime business lending rate, as reported by Statistics Canada, which is adjusted based on the GDP deflator. The risk variable that corresponds to each specification of market returns is calculated

[7] A log-linear functional form is used for equation (7) to avoid generating negative predicted values. The resulting predicted values are subsequently converted back to a linear form prior to estimation of equation (6).
[8] Both of these studies use gross crop sales rather than net crop returns, although Roberts, Kirwan, and Hopkins (2003) also account for costs.
[9] Other studies, such as Barnard et al. (1997), account for factors of production related to crop production rather than market returns.
[10] Accordingly, the term MR_{it} in equations (6) and (7) is divided into two variables: crop revenue (CR_{it}) and crop expenses (CE_{it}).

as the standard deviation of market returns (adjusted net farm income or net crop returns, depending on model specification) in the five years prior to year *t*.

Table 1 provides descriptive statistics for per-acre farmland values, adjusted net farm income, net crop returns, and government payments (in constant 1997 dollars) for the nine Canadian provinces included in the analysis over the time period 1959-2009. Average real farmland values in Canada are highest in Ontario ($2,139.53/acre), followed by British Columbia ($1,470.03/acre), and are lowest in Saskatchewan ($337.06/acre). Ontario also has the highest average adjusted net farm income ($108.85/acre) among the provinces, while Prince Edward Island has the highest net crop returns ($76.48/acre). Government payments are substantially higher in Quebec ($45.24/acre) than in all other provinces, where average payments range from $7.74/acre in Saskatchewan to $23.86/acre in Prince Edward Island. Trends over time in the average values across Canada for each of these variables are displayed in figure 1, which shows that real adjusted net farm income trends slightly downward over the study period while real net crop returns trend slightly upward. The impacts of these varying trends on the results of the respective models are examined in the following section.

Results and Discussion

The estimation of equations (6) and (7) using conventional econometric techniques are valid only if the underlying time series do not contain unit roots, i.e., they are stationary (denoted as I(0)). In the presence of unit roots, conventional econometric techniques can produce spurious estimates as the error terms are correlated. In many cases, even though the time series are non-stationary in their level form, they are stationary in first difference form. In this context, the time series is integrated of order one, denoted as I(1).

Unit root tests are conducted for each of the data series, by province, using the Augmented Dickey-Fuller test. This involves regressing the first differences of each data series on the lagged dependent variable, a one year lagged level variable, and a time trend variable, as in:

$$\Delta Y_t = \lambda_0 + \lambda_1 \Delta Y_{t-1} + \lambda_2 Y_{t-1} + \lambda_3 t + \varepsilon_t \,, \tag{8}$$

where Y is the value of the series of interest and ΔY_t is Y_t-Y_{t-1}. A statistically significant coefficient for the lagged level variable (λ_2) confirms the non-existence of unit roots, i.e., the series is stationary. The results of the Augmented Dickey-Fuller tests, provided in table 2, indicate that the existence of unit roots in approximately one-half of the series could not be rejected. However, a clear pattern is not observed among different series and different provinces, while further tests on stationarity indicate that the first differences of almost all of the series do not contain unit roots. This suggests that the likelihood of generating spurious parameter estimates is low.

The Determinants of Farmland Values

As described in the third section, the empirical approach begins with the estimation of equation (7), in order to generate predicted values of government payments. These predicted values are subsequently used as an instrument for the government payments variable (GP_{it}) in the estimation of equation (6). The results of the government payments equation are provided in table 3, while the results of the farmland values equation are provided in table 4. These tables present the results for three models that differ based on the specification of market returns, as well as for a fourth model that is introduced later in this section.[11] As described above, market returns are initially specified as adjusted net farm income (Model 1), then as net crop returns (Model 2), and finally as crop receipts and crop expenses (Model 3). All three models fit the data well, as the explanatory variables account for at least 76% of the variation in the logarithm of government payments and at least 86% of the variation in farmland values. However, the results of Model 3 are most consistent with *a priori* expectations, where the variables crop receipts and crop expenses have the expected signs, are statistically significant, and give parameter estimates that are plausible. The following discussion begins by focusing on the results of the market returns and government payments variables.

The results of the farmland values equation for Model 1 (see table 4) indicate a statistically insignificant effect of adjusted net farm income on farmland values and a significantly positive effect of government payments on farmland values. The coefficients for these variables imply that an increase in adjusted net farm income has no influence on farmland values but an increase of $1.00/acre in government payments increases farmland values by $10.02/acre. The results with respect to adjusted net farm income are not consistent with expectations but it is possible that Statistics Canada's measure of net farm income, as adjusted and used in this study, is not a good indicator of the market forces driving farmland values. This possibility is suggested by figure 1, which illustrates diverging trends between adjusted net farm income and farmland values over the study period. Conversely, net crop returns appear to have a greater correlation with changes in farmland values; as such, this measure of market returns may be more appropriate for estimating farmland values in Canada.

Hence, as an alternative to adjusted net farm income, net crop returns are used in Model 2 as a proxy for market returns. The results of the farmland values equation for Model 2 indicate a significantly positive effect of net crop returns on farmland values, which is consistent with expectations. A $1.00 increase in per-acre net crop returns causes an increase in farmland values of $11.09/acre, while the coefficient for government payments indicates an increase of $7.82/acre for each additional dollar of per-acre payments. In the government payments equations for Model 1 and Model 2, both adjusted net farm income and net crop returns are found to have the expected counter-cyclical relationship with government payments.

To further explore the impact of alternative specifications of the market returns variable on the results, net crop returns are separated into two components in Model 3: crop receipts and crop expenses. In the farmland values equation (see table 4), both crop receipts and government payments have positive impacts on farmland values while crop expenses have a negative impact, as expected. The coefficients indicate that an increase of $1.00/acre in crop receipts, crop

[11] The results of the fourth model are not included in table 3 since they are identical to those of Model 3.

expenses, and government payments would result in, respectively, an increase of $11.88/acre, a decrease of $14.58/acre, and an increase of $7.87/acre in farmland values. In the government payments equation, the results are also consistent with expectations, where an increase in crop receipts reduces government payments while an increase in crop expenses increases payments.[12] The result of a statistical test to see if crop receipts and crop expenses have the same magnitude but opposite effect on government payments is rejected, which implies that government payments are more responsive to changes in crop expenses than to changes in crop receipts.

Estimates of the elasticities for the farmland values equation across the three models are presented in table 5. The estimated elasticities of farmland values with respect to government payments are quite consistent, even with the changes in the specification of market returns, ranging from 0.13 (Models 2 and 3) to 0.17 (Model 1). Farmland values appear to be more responsive to changes in market returns (with the exception of adjusted net farm income) than to changes in government payments, as the elasticity with respect to net crop returns (Model 2) is 0.43 and the elasticities with respect to crop receipts and crop expenses (Model 3) are 1.16 and -0.86, respectively. The greater responsiveness to market returns is consistent with the findings of Shaik, Helmers, and Atwood (2005). However, this is contrary to the findings of Weersink et al. (1999), where farmland values were found to be considerably more responsive in the long run to changes in government payments. The elasticities in table 5 also indicate that farmland values are quite responsive to changes in population density.

The discussion now turns to the results of the remaining variables for both equations, focusing in particular on Model 3. Many of the coefficients in the farmland values equation are similar in sign and significance across the three models. One notable exception is risk, which is statistically insignificant in Model 1 but in Models 2 and 3 has the expected negative impact on farmland values. Positive impacts on land values are found for population density, population growth rate, and the time trend, while the interest rate has a negative impact. The coefficient for the interest rate variable in Model 3 indicates that a one percentage point increase in the real interest rate reduces farmland values by $9.37/acre. These results imply that the recent upward trend in farmland values is due not only to changes in market returns and government payments but also to factors such as increasing population and the associated growth of urban areas as well as the downward trend in the interest rate. Since our model is based on provincial data, we cannot measure the impact of population at the local level; however, with some provinces being sparsely populated and others densely populated, an important average effect of population growth and population density is captured by the model. Increasing urban population may also affect agricultural land values indirectly through increasing purchases of farmland for investment purposes by urban residents.

Provincial differences are evident in both the government payments and farmland values equations. The estimated coefficients indicate that farmland values are lower across all provinces as compared to those in Ontario. The results of the government payments equation indicate that per-acre payments are significantly higher in Quebec but significantly lower across other

[12] Since government payments in Canada are directed to all producers and not just crop producers, the case could be made that government payments should be a function of total farm cash receipts and total expenses rather than crop receipts and crop expenses. However, making this change in Model 3 does not affect the nature of the results. As such, these results are not reported in table 3.

provinces, with the exception of Prince Edward Island, relative to payments in Ontario. The nature of these differences is quite consistent across the various specifications of market returns.

It is evident from the results of the policy regime variables in the government payments equation for Model 3 that per-acre payments are significantly lower in both the first and third policy regimes (PR1 and PR3) than in the second policy regime (PR2). Real government payments increased from the first to the second regime and decreased from the second to the third regime. These changes in the level of government payments across the three policy regimes suggest that the rate of capitalization of government payments into farmland values (represented by α_2 in equation 6) may vary across policy regimes. Consequently, to explore this issue, Model 3 is modified by adding interaction terms (*PR1*Gov't Payments*; *PR3*Gov't Payments*) to the farmland values equation for the first and third policy regime dummy variables with the government payments variable (Model 4). In this way, we can see if the impact of government payments on farmland values has changed over the three policy regimes. The results (see table 4) indicate that the rate of capitalization is significantly lower for the first regime relative to the second regime,[13] and is somewhat higher in the third regime. Importantly, this implies that the shift to partially decoupled programs in the third policy regime did not reduce the rate of capitalization of payments into farmland values. This outcome differs from that of Shaik, Helmers, and Atwood (2005), where the program payment share of land values was found to decline with recent Farm Bills.

Summary and Conclusions

This study builds on previous U.S.-based studies and examines the determinants of farmland values in Canada, focusing in particular on the relative impacts of market returns and government payments. To account for the counter-cyclical relationship between these two variables, we conduct the empirical analysis using a recursive simultaneous equation model, following the approach used by Shaik, Helmers, and Atwood (2005). While we examine the results of this model under alternate specifications of market returns, including adjusted net farm income and net crop returns, we find the specification based on crop receipts and crop expenses to be the most appropriate for the estimation of the determinants of farmland values in Canada. Further, while the specification of market returns is found to affect the estimated impact of this variable on both farmland values and government payments, the use of alternate specifications of market returns had little impact on the estimated impact of government payments on farmland values.

Based on the results of Model 3, where market returns are accounted for by crop receipts and crop expenses, an additional dollar per acre of government payments increases farmland values by $7.87/acre. By comparison, Goodwin, Mishra, and Ortalo-Magne (2003) estimated an

[13] The magnitude of the coefficient (-18.33) for *PR1*Gov't Payments* relative to that of *Gov't Payments* (4.67) was initially a concern. However, the sum of these two coefficients is not found to be statistically different from zero. Hence, while the impacts of government payments in the first regime are significantly lower than the impacts in the second regime, the impacts in the first regime are not significantly different from zero. The lack of significant impacts on farmland values could be due to two factors: 1) this regime represents the first years that producers in Canada received government payments; and 2) payments were relatively low during these years.

increase in farmland values of just under $5.00/acre for each additional dollar of farm program payments. The estimated elasticity for government payments in Model 3 is 0.13, which is lower than similar estimates across previous studies. For example, Shaik, Helmers, and Atwood (2005) estimated the elasticity of farm program payments in the U.S. to be 0.30, while Barnard et al. (1997) found elasticities of government payments ranging from 0.12 to 0.69, with an average of 0.27, across various regions in the U.S. Thus, the comparison of results across these studies suggests that the proportion of farmland values attributable to government payments may be somewhat lower on average in Canada than in the U.S. The larger impact of government payments on land values in the U.S. than in Canada is not a result of greater levels of overall support in the U.S. (16.5% of gross farm receipts) than in Canada (22.4% of gross farm receipts) based on their average (1986-2010) percentage producer support estimates (OECD, 2011). However, in the U.S. nearly all direct domestic support is made to the crop sector whereas in Canada it is spread over the entire agricultural sector. In addition, there are differences between the two countries in the nature of farm support programs, which tend to be commodity-specific in the U.S. and, particularly in recent years, whole-farm based in Canada. Regardless of these differences, it is evident that in both countries farmland values are pushed upward by government payments.

This study also looks for variation in the impacts of government payments on farmland values across a set of policy regimes. This follows the approach of Shaik, Helmers, and Atwood (2005), who found that the share of land values generated by farm program payments dropped substantially between the 1970s and the 1990s. Conversely, it appears that the policy shift in Canada to more decoupled farm support programs has not resulted in lower capitalization of government payments into farmland values.

A potential limitation of this study is the use of data aggregated at the provincial level, which may smooth out variation across regions within each province. While estimation of the impacts on farmland values using county level data may be a preferred approach, data is not available at the sub-provincial level. If such data becomes available, future research could look for regional variation in the factors affecting farmland values.

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Table 1. Descriptive Statistics for Farmland Values, Market Returns, and Government Payments by Province, 1959-2009 (Constant 1997 $/acre)

	PEI	NS	NB	QU	ON	MB	SK	AB	BC
Farmland Values									
Mean	1,046.47	752.15	644.21	1,035.37	2,139.53	432.22	337.06	564.52	1,470.03
Standard Deviation	507.96	317.11	301.59	535.74	837.02	118.93	114.11	249.90	663.01
Minimum	323.31	230.05	230.05	404.14	764.92	217.61	161.65	198.96	603.35
Maximum	1,803.36	1,258.59	1,187.50	2,207.81	3,724.22	683.33	636.67	1,115.63	3,236.72
Adjusted Net Farm Income									
Mean	84.13	62.82	60.46	83.07	108.85	38.17	30.12	29.25	46.68
Standard Deviation	55.07	18.20	24.02	21.37	33.42	18.00	19.17	13.94	22.89
Minimum	-75.77	6.39	13.77	34.46	42.66	0.75	-5.46	0.89	-0.07
Maximum	228.33	102.48	148.01	125.29	189.87	79.38	74.51	55.33	89.20
Net Crop Returns									
Mean	76.48	26.24	49.54	4.77	70.18	23.82	29.91	14.74	48.37
Standard Deviation	48.37	20.50	29.02	22.57	26.66	11.20	14.56	7.94	19.60
Minimum	0.07	-2.65	-2.42	-21.94	25.03	-8.07	1.10	-1.38	21.78
Maximum	177.34	63.85	118.57	57.57	118.97	51.50	68.28	35.05	91.64
Government Payments									
Mean	23.86	8.50	10.89	45.24	20.07	9.99	7.74	7.85	9.13
Standard Deviation	17.34	6.15	8.93	29.35	14.62	8.76	6.97	6.84	7.42
Minimum	0.09	0.09	0.07	0.07	0.08	0.65	0.15	0.55	0.11
Maximum	85.00	22.90	34.74	106.11	53.98	31.65	25.39	24.10	26.04

Note: PEI: Prince Edward Island; NS: Nova Scotia; NB: New Brunswick; QU: Quebec; ON: Ontario; MB: Manitoba; SK: Saskatchewan; AB: Alberta; BC: British Columbia

Table 2. Augmented Dickey Fuller Test Results

Variable	*PEI*	*NS*	*NB*	*QU*	*ON*	*MB*	*SK*	*AB*	*BC*
Farmland Values	-2.208	-2.062	-1.872	-1.607	-3.280	-2.408	-2.568	-3.238	-2.409
Adjusted Net Farm Income	-5.065	-2.622	-4.189	-3.209	-2.783	-3.567	-3.040	-3.429	-2.533
Net Crop Returns	-5.917	-1.400	-3.852	-2.046	-2.968	-3.764	-2.958	-3.459	-2.678
Crop Receipts	-6.008	-1.307	-4.065	-2.308	-2.429	-3.896	-3.223	-3.365	-2.445
Crop Expenses	-1.720	-2.413	-3.279	-2.163	-2.096	-2.655	-2.197	-2.479	-2.287
Government Payments	-5.562	-3.838	-4.288	-4.132	-3.972	-3.708	-2.513	-3.255	-2.657

Note: The figures indicate the calculated τ statistic for the coefficient in the lagged level variable in each series. The critical τ values are 3.766 at 1% level, 3.171 for 5% level and 2.870 for 10% level.

Table 3. Estimation Results for the Government Payment Equation

Variable	Model 1	Model 2	Model 3
Adjusted Net Farm Income	-0.0024 **		
	(0.0010)		
Net Crop Returns		-0.0043 ***	
		(0.0012)	
Crop Receipts			-0.0063 ***
			(0.0014)
Crop Expenses			0.0134 ***
			(0.0031)
PR1 (1959-1974)	-0.5664 ***	-0.5522 ***	-0.5597 ***
	(0.1050)	(0.1052)	(0.1042)
PR3 (1991-2009)	-0.7707 ***	-0.7870 ***	-0.7646 ***
	(0.1101)	(0.1080)	(0.1071)
Risk	0.0089 ***	0.0171 ***	0.0156 ***
	(0.0026)	(0.0050)	(0.0049)
Time	0.0561 ***	0.0616 ***	0.0523 ***
	(0.0052)	(0.0052)	(0.0059)
Prince Edward Island	-0.1708	-0.2519	-0.2779 *
	(0.1375)	(0.1646)	(0.1630)
Nova Scotia	-0.8271 ***	-0.9000 ***	-0.6373 ***
	(0.1166)	(0.1189)	(0.1429)
New Brunswick	-0.6766 ***	-0.7399 ***	-0.5165 ***
	(0.1184)	(0.1171)	(0.1349)
Quebec	0.6471 ***	0.4663 ***	0.4857 ***
	(0.1101)	(0.1323)	(0.1311)
Manitoba	-0.7597 ***	-0.8027 ***	-0.4877 ***
	(0.1284)	(0.1206)	(0.1540)
Saskatchewan	-1.0002 ***	-1.0130 ***	-0.5626 ***
	(0.1330)	(0.1174)	(0.1814)
Alberta	-0.9249 ***	-0.9940 ***	-0.5897 ***
	(0.1339)	(0.1256)	(0.1763)
British Columbia	-0.8275 ***	-0.7958 ***	-0.4216 ***
	(0.1240)	(0.1098)	(0.1587)
Constant	1.1843 ***	1.0242 ***	0.8046 ***
	(0.2421)	(0.2070)	(0.2158)
Adjusted R^2	0.7675	0.7691	0.7739
Observations	459	459	459

* Significant at 10%; ** significant at 5%; *** significant at 1%.

Table 4. Estimation Results for the Farmland Values Equation

Variable	Model 1	Model 2	Model 3	Model 4
Adjusted Net Farm Income	-0.10			
	(0.90)			
Net Crop Returns		11.09 ***		
		(0.77)		
Crop Receipts			11.88 ***	11.22 ***
			(1.05)	(1.07)
Crop Expenses			-14.58 ***	-13.80 ***
			(2.39)	(2.40)
Gov't Payments	10.02 ***	7.82 ***	7.87 ***	4.67 **
	(1.69)	(1.55)	(1.79)	(2.11)
PR1*Gov't Payments				-18.33 **
				(7.73)
PR3*Gov't Payments				2.47 *
				(1.32)
Population Density	1,305.56 ***	620.54 ***	641.46 ***	655.58 ***
	(149.64)	(134.14)	(136.27)	(136.50)
Population Growth Rate	14.53	35.89 ***	35.08 ***	36.96 ***
	(8.98)	(7.43)	(7.49)	(7.52)
Interest Rate	-11.75 ***	-10.88 ***	-9.37 ***	-9.74 **
	(4.29)	(3.59)	(3.58)	(4.22)
Risk	0.46	-6.25 ***	-5.52 ***	-4.59 **
	(1.45)	(2.10)	(2.12)	(2.20)
Time	10.32 ***	8.68 ***	11.03 ***	10.01 ***
	(1.59)	(1.26)	(1.57)	(1.61)
Prince Edward Island	-539.39 ***	-719.98 ***	-730.96 ***	-738.15 ***
	(100.43)	(88.01)	(88.44)	(88.35)
Nova Scotia	-1,405.91 ***	-937.01 ***	-1,026.45 ***	-1,081.09 ***
	(71.77)	(57.29)	(64.46)	(67.29)
New Brunswick	-1,391.16 ***	-1,164.55 ***	-1,241.46 ***	-1,284.01 ***
	(72.97)	(50.63)	(56.25)	(58.38)
Quebec	-1,359.25 ***	-590.01 ***	-605.00 ***	-580.40 ***
	(63.35)	(73.67)	(76.29)	(80.64)
Manitoba	-821.51 ***	-757.36 ***	-856.34 ***	-896.50 ***
	(124.65)	(90.41)	(110.89)	(111.06)
Saskatchewan	-836.78 ***	-867.36 ***	-1,012.55 ***	-1,051.90 ***
	(134.55)	(96.00)	(132.74)	(132.65)
Alberta	-677.30 ***	-565.90 ***	-689.82 ***	-739.75 ***
	(122.51)	(87.02)	(116.17)	(116.73)
British Columbia	-354.82 ***	-259.85 ***	-383.87 ***	-416.73 ***
	(80.97)	(50.33)	(83.05)	(83.55)
Constant	730.89 ***	552.14 ***	638.38 ***	753.24 ***
	(153.66)	(82.52)	(103.84)	(110.75)
Adjusted R^2	0.8697	0.9088	0.9081	0.9094
Observations	459	459	459	459

* Significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5. Elasticities of Farmland Values with Respect to Selected Variables

Variable	Model 1	Model 2	Model 3
Adjusted Net Farm Income	-0.01		
Net Crop Returns		0.43	
Crop Receipts			1.16
Crop Expenses			-0.86
Gov't Payments	0.17	0.13	0.13
Population Density	0.54	0.26	0.27
Population Growth Rate	0.03	0.06	0.06
Interest Rate	-0.05	-0.04	-0.04
Risk	0.01	-0.07	-0.06

Note: Elasticities are evaluated at the mean of the sample. All elasticities are significant at the 5% level except for those of Adjusted Net Farm Income, Population Growth Rate, and Risk in Model 1.

Figure 1. Average Farmland Values, Adjusted Net Farm Income, Net Crop Returns, and Government Payments across Canada, 1959-2009 (1997=100)