2012

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Applied Economic Perspectives and Policy Advance Access published January 6, 2012
Applied Economic Perspectives and Policy (2012) volume 00, number 00, pp. 1–20.
doi:10.1093/aepp/ppr043

Submitted Article

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Submitted 12 August 2010; accepted 28 November 2011.

Abstract *Canadian dairy farmers purchase a marketing quota through the Provincial Marketing Boards to sell milk in Canada. That quota captures rents created by regulations and is subject to policy risk. We define policy risk as the farmers' expectation that quota rents will decline or disappear over time. We calculate the effect of perceived policy risk to determine whether the Uruguay Round Agreement affected the amount of protection given to farmers. Calculated policy risk ranged from 14-29%. Policy risk increased in the years leading up to the Uruguay Round Agreement, but decreased after the WTO was established and remains at a historic low.*

Key words: Canadian supply management system, dairy policy, policy risk.

JEL codes: Q130, Q180.

Introduction

In any protected industry, specific investments are subject to the risk that the government may change its governing regulations, which in turn would affect profitability. Nowhere is this policy risk more salient than in the Canadian dairy industry, where farmers have millions of dollars invested in the right to market milk, and where the value of this right only exists as long as the government continues to block the import of dairy products. The unprecedented inclusion of agriculture in the Uruguay Round of the General Agreement on Tariffs and Trade (GATT) was seen as the potential death knell for Canadian supply management of dairy, poultry and eggs, and resulted in 40,000 farmers marching in protest on Parliament Hill, the seat of the Canadian government. While the World Trade Organization (WTO) did force a number of changes in Canadian dairy policy, the exact effect of these changes remains unknown. In this article, we use a measure of a policy risk premium to determine whether the WTO truly affected the amount of protection provided to the Canadian dairy industry.

Profit in the Canadian dairy industry depends on a variety of regulation, including domestic production quotas, support prices and trade controls. In the Canadian dairy system, farmers must purchase (or inherit) a production quota, which acts as a license to sell milk. These quotas are traded on provincial exchanges, and their price reflects not only the current rent associated with milk production, but expected future profits as well. As such, the value of these quotas is intrinsically tied to the perception of the future of the supply management system (Barichello 1996 and 2000). This system also makes dairy producers increasingly vulnerable to future trade actions (Richard 1996; Richards and Jeffrey 1997).

Arguably the greatest challenge to the Canadian system of dairy, poultry and egg supply management came with the establishment of the WTO on January 1, 1995, which resulted in changes to milk price support and the form of import controls. Shortly thereafter, New Zealand and the United States challenged Canada's trade rules on dairy products at the WTO, resulting in further changes in Canadian dairy regulations. Over the past two decades, however, quota prices have continued to rise, raising the question of whether protection for the Canadian dairy industry had actually changed. In this article, we determine how several policy instruments affect the perceived protection extended to farmers.

Policy risk premiums are a timely topic given the potential expansion of property right assignment via tradable pollution permits to cover greenhouse gas emissions. Like the Canadian dairy system itself, if producers are required to own scarce permits, these permits may become a substantial financial asset whose value is subject to changes in carbon policy. For Canadian dairy farmers, quotas have become their largest single financial investment. This substantial financial stake increases the farmers' incentive to lobby to retain the existing level of protection, thereby perpetuating the system. Trade agreements not only threaten future profits for farmers but also create uncertainty regarding what they often view as their retirement savings. Unlike other forms of price risk, this policy risk is difficult to hedge. Recent discussion, which recognizes the substantial challenge of making such changes equitable, has proposed options for dissolving the system (Barichello, Cranfield and Meilke 2009).

Following Newell, Papps and Sanchirico (2007), we use a simple net present value model of asset pricing applied to the Canadian dairy quota to extract a measure of policy risk (Barichello 1996 and 2000). Quota value is a function of expected future annual return, interest rate and appreciation rate, and a policy risk variable that captures uncertainty regarding future quota value. Unlike Newell, Papps and Sanchirico (2007), we observe both the price of the quota and its implicit rental rate, which allows us to explicitly solve for policy risk. This measure of policy risk gives us a direct, if imperfect, measure of the perceived protection extended to farmers from government programs. We then estimate the effects of policy changes in the dairy supply management system on policy risk to determine how these programs affect farmers' perception of risk. While several authors have introduced the notion that quota-holding producers bear substantial policy risk (Veeman 1982 and 1987, Sumner and Wilson 2005), only a few studies incorporate policy risk into their models (Grainger and Costello 2010, Wilson and Sumner 2004, Lermer and Stanbury 1985, Alston 1992). To our knowledge, the present article is one of the first to use data on the value of policy-generated assets and their imputed rental rates. We find that policy risk premium is substantial in the Canadian dairy industry. Second, as anticipated, we find evidence that policy risk did increase leading up to the introduction of the WTO, but that it decreased after the WTO was finalized. However, we see no sign that Canadian dairy producers feel threatened by the Doha round of WTO talks.

Related Literature

Policy risk in agricultural production has been modeled in different ways. Just and Rausser (2002) conclude that policy risk affects behavior. Some studies mention the risk component in the expected quota value (Veeman 1982 and 1987, Sumner and Wilson 2005), while others explicitly incorporate risk into their model (Grainger and Costello 2010, Newell, Papps and Sanchirico 2007, Wossink and Gardebroek 2006, Wilson and Sumner 2004, Alston 1992, Lermer and Stanbury 1985). Veeman (1982 and 1987) argues in her theoretical work that the risk associated with the supply management programs can be captured as higher discount rates, shorter time horizons or more conservative estimates of anticipated net benefits used by producers. While supply controls can help stabilize prices and thus reduce market risks, the supply controls introduce a second, new risk: the risk associated with future changes in the programs, or the termination of the program (Alston 1992). In one of the few empirical estimates of policy risk, Grainger and Costello (2010) find that property rights security, measured through the uncertainty about the future of the programs governing individual transferable quotas for fisheries, has a significant effect on asset values in fisheries. Policy risk has also been associated with the high rate of return received by California dairy producers and is positively correlated with the rate of return to dairy quota (Sumner and Wilson 2005; Wilson and Sumner 2004).

By owning the quota, Canadian dairy farmers bear the regulatory risk (Lermer and Stanbury 1985). Barichello (1996) specifies a model to calculate the expected quota value as a function of expected returns from the quota, its interest rate, future returns growth and the probability that rents from the supply management system will end, defined as policy risk. Barichello (2000) calculates a decline in policy risk since just prior to the mid-1990s, suggesting that while farmers believed major policy changes might flow from the WTO, the realization of the agreement was not as threatening as its earlier perception. We build upon this work to estimate systematically how policy risk changed with the introduction of the WTO and subsequent changes to the supply management system.

We see multiple contributions of this article. Unlike previous literature, we are able to disentangle the direct effects of policy risk from the collective policy instruments on profitability. That is, we can provide an estimate of the value of stable property rights defined with the quota. We also empirically estimate how policy risk has changed as a function of recent policy changes induced by the WTO.

Estimating Policy Risk

To calculate policy risk one needs to start with a model of quota values. Quota values are observed because in virtually all Canadian provinces, incremental units of quota are traded on provincial exchanges based on bids and offers from prospective buyers and sellers. We follow a long tradition in the analysis of asset prices by assuming quota prices are equal to the expected net present value of the quota or the annual net benefits of producing milk, plus any other flow benefits (or costs) of quota ownership. Our model draws upon the capital asset pricing model (CAPM) but introduces the notion of policy or default risk as originally presented in Eaton and Gersovitz (1981).

The expected returns, *R*, from a marginal unit of quota (e.g. the milk price less marginal costs) are discounted by an interest rate *r*, which should include the appropriate premium for non-diversifiable systematic risk. This premium is the familiar beta value estimated in CAPM models. Non-diversifiable systematic risk refers to the variance in returns to the quota, such as from changes in the milk price or production costs, that is correlated with the returns from all other economic activities or investments, and therefore cannot be offset by diversification.[1]

The discounting process can also include any expectations of growth in future returns or capital gains (the rate of which is denoted by *g*), again following textbook treatments of pricing capital assets under conditions of open competition for the asset. Assuming the quota is a long term investment like other dairy farm assets (i.e. assuming it has an infinite time horizon), the equation for the price of quota is $P_Q = R/(r\text{-}g)$.

To introduce policy risk, we define it as the probability that the returns from the quota will fall to zero (or, more realistically, that they will be reduced) by a change in the policy regime that underpins those returns. This risk is manifest in a possible fall in the expected value of the asset rather than an increase in the variance of its future returns, which is the risk normally incorporated via a risk premium in the discount rate. It is this characterization of the policy risk facing quota holders that appears to be most descriptively accurate in quota markets. This characterization is also analogous to what Eaton and Gersovitz term the default risk faced by commercial banks lending to foreign governments that may repudiate their loans or default on their repayment, as Argentina did in 2001.

In our model we denote this risk with λ, which is defined as the probability that the quota rents from supply management will end. When introducing this factor, the price of the quota becomes an expected value. The previous discounted rents are now weighted by $(1\text{-}\lambda)$ and the prospective permanent loss of rents is weighted by its probability, λ. Incorporating

[1] *While we do not measure the correlation between returns from a quota and expected market risk directly, we note that for farmland, estimates of the imputed investment risk premium using a CAPM model are very low, ranging from 0.03 to 0.32 in U.S. studies. This implies that variability in returns to farmland are not highly correlated with returns to other assets (Noland 2010; Barry 1980; Irwin, Forster and Sherrick 1988). If returns to holding a quota are similar to those for other specific agricultural assets such as farmland, their price should not be affected by portfolio risk, and a simple net present value model is appropriate. Second, despite concerns that quota markets may have been subject to market speculation in recent years, work by Cairns, Meilke and Bennett (2010) argue that quota prices are largely driven by economic fundamentals. Further, given that quota ownership is restricted to dairy farmers, including penalties for non-delivery, we believe that an asset pricing model that focuses on the productive value of a quota is appropriate.*

policy risk in this manner has the attractive feature that initially in year 1, the probability that the quota regime will stay intact is relatively high (1-λ), but this probability decreases each year in a geometric decay. The expression for the quota price simplifies to equation (1):

$$P_Q = \frac{R(1-\lambda)}{r+\lambda-g} \tag{1}$$

where P is the price of the quota, R is the rental price or annual return, r is the real interest rate, g is the rate of quota value appreciation, and λ is the policy risk. This equation can be re-arranged to measure the policy risk, as shown in equation (2):

$$\lambda = \frac{R+P_Q(g-r)}{P_Q+R} \tag{2}$$

It is this equation that will provide us with the measure of policy risk, discussed below.

Factors That Affect Perceived Risk

Farmers' perceived policy risk is a function of the stability of the policy mechanisms that underpin the supply management system. Marketing quotas, support prices and trade controls comprise the main elements of protection in the supply management system. In the following section, we outline the various components of the supply management system and discuss how recent policy changes may have affected perceived risk.

Marketing Quotas

At the core of the Canadian supply management system there are marketing quotas that limit the supply of milk, which generates high and stable prices. Only farmers that hold a quota permit can receive these high prices, and only for milk produced within the quota. The Canadian Milk Supply Management Committee sets a national quota of industrial milk based on expected sales at prevailing wholesale prices, and this quota is allocated to the provinces depending on historical market shares (Romain 2001).[2] Individual milk producers can then buy or sell their quota within the province at market-determined prices at monthly auction sales overseen by provincial boards or agencies (Canadian Dairy Industry Profile 2002).

The quota exchange market for industrial milk was established in the early 1980s, and took several years to mature (Barichello 2000).[3] We observe that the discount rate for a quota was especially high in 1982 and 1983, when data for some of the provinces first became available. This is presumably because quota valuations were still tentative and learning was taking place. We take the maturity of each provincial market into account

[2] *British Columbia is the one exception, and after protests to the federal government, saw an increase in its allocation in 1988/1989.*

[3] *Industrial milk quota exchanges started in 1980 for Ontario and Quebec, 1982 for Alberta, 1994 for Saskatchewan, and 1996 for British Columbia. Fluid milk quota exchanges began much earlier, varying by province. Ontario started in approximately 1967 and British Columbia started in 1956.*

when estimating policy risk by including an "infant market" variable as a binary variable for the first two years of the quota market.

Support prices

Support prices constitute the prices at which the Canadian Dairy Commission (CDC) buys or sells butter and skim milk powder. As part of the support price, the federal government previously paid a direct subsidy to the farmers for deliveries of industrial milk and cream to meet domestic demand (Task Force on National Dairy Policy 1990). This subsidy was reduced in 1993 and 1995, and then phased-out between February 1998 and February 2002 because of the 1995 WTO commitments. To compensate producers for the loss of the direct subsidy[4], the government raised the skim milk powder support price (Barichello 2000). While the loss of the industrial milk subsidy may have increased the risk that industrial processors would reduce their consumption of milk, thereby reducing the value of the rents provided by supply management, the increased skim milk powder support price may have mitigated against any perceived increase in risk.

Trade controls

Trade controls constitute the final element of the supply management system, and are the most vulnerable to trade agreements. Before the 1995 WTO Agreement, Canada used import quotas to maintain the supply management system. The WTO trade agreement was perceived as a threat to Canada's continued supply management system and the value of dairy quota due to limits placed on import protection, as well as restrictions on the use of export subsidies. Thus, one might expect policy risk to reach a high level leading up to the WTO agreement. The final agreement allowed countries to continue import protection through the use of Tariff Rate Quotas (TRQs), which mandate a fraction of domestic consumption to be imported at low tariff levels, but allows countries to impose high tariffs on any imports over that amount. Canada set prohibitive tariffs on imports in excess of the quota ranging from 155-299% (Barichello, Cranfield, and Meilke 2009).

Before the WTO agreement, Canada used differential export prices and input subsidies to help domestic processors compete on the international market. These programs were altered in response to the WTO, though they retained differential export pricing. This modified program was then successfully challenged by New Zealand and the United States, who claimed that it violated the WTO agreement. Details on these export programs are provided in the Supplementary data.

The loss of these special export provisions may increase the perceived policy risk, as they make processors more sensitive to the domestic price of industrial milk, giving them an incentive to lobby against higher prices paid to dairy farmers and to substitute away from expensive domestic inputs to less expensive, alternative imported ingredients (Nogueira and Baylis 2006). Not only do these changes directly affect processors, they also influence the profitability of dairy farmers and potentially place more pressure on the preservation of the supply management system.

[4]*CDC Annual Report 2001-2002. Available at: http://www.cdc.ca/.*

Farmers may be particularly concerned about the political power of processors given the high degree of consolidation in the last decade. Farmers are concerned that the larger, more powerful processors can exert market power, particularly in the face of losing various subsidies that allowed them to benefit from the supply management system.[5] Thus, the more powerful processors could lobby against the high prices paid to farmers, increasing the level of risk perceived by farmers.

In advance of the WTO's establishment in January 1995, the general perception among farmers and observers was that the WTO would reduce the protection extended to Canadian dairy farmers as soon as Canada complied with its provisions. In response to the WTO, however, new programs were introduced to protect dairy farmers while conforming to the agreement. Industry observers noted that quota prices remained high during this period, indicating faith in the continued supply management system. Did farmers perceive a loss in protection due to these trade-induced changes? To answer this question, we estimate how these policy changes affect the out measure of policy risk.

Empirical Model and Data

Our data cover the large dairy producing provinces of Ontario, Quebec, Saskatchewan, Alberta and British Columbia from 1980 to 2006.[6] We could not obtain data for Manitoba and a number of the Atlantic Provinces, which do not produce much industrial milk. Some Atlantic provinces also had price caps on the quota over this time period, which would have complicated our analysis. We rely on industrial milk quota exchange data for the above provinces, where the quota is bought and sold as a stock (no rentals). One unit of quota allows a farmer to market one hectolitre of milk each (dairy) year, as long as s/he holds the quota. In any given dairy year, a farmer has the choice of purchasing a quota that has already been "used" for that year, and is hence only available for next year and all future years, or s/he can buy an "unused" quota that can be used to market milk in the current year (as well as all future years). The value of an unused quota corresponds to the value of P_Q in equations (1) and (2). A measure of the annual use value of a quota, R, is more difficult to obtain because of the ban on quota rental. Here, we make use of the fact that the difference between the value of an unused and used quota represents the effective rental rate of a quota, and thus serves as a good measure of R. Other factors may push this value up or down in the short run, so we would expect it to be measured with some error. But because both the used and unused quota values capture any long-run changes in profitability, the net value of unused versus used only captures inter-annual changes in profit, while the discounted future stream of expected profits should be netted out.[7]

[5]*Schmitz and Schmitz (1994) find no evidence in their theoretical study to support the claim that supply management has reduced processor and retailer market power.*

[6]*Our time series for Ontario runs from August 1980 to July 1997; Saskatchewan from August 1994 to December 2000; British Columbia from May 1996 to February 2006; Alberta from November 1982 to July 2000; and Quebec from January 1980 to June 1996. The data we use are limited by the time when the Milk Marketing Boards reported prices for used and unused quotas.*

[7]*Estimations of quota values regressed on this measure of rental values also confirm that is a reliable reflection of R (Ramirez 2006).*

Our dependent variable, policy risk, is measured by equation (2), where the expected quota value (P_Q) and the annual return are measured as described above. The real interest rate (r) was obtained from the Bank of Canada website.[8]

We have to make some assumptions about the farmers' expected rate of quota appreciation (g). To test the effect of our assumptions, we calculate the appreciation rate, g, in two alternative ways. First, we calculate the appreciation rate of used quota for the past five years, assuming producers use past appreciation as their best predictor of the future appreciation rate.[9] Second, we calculate the appreciation rate of used quota for the full time period, assuming producers use the average appreciation as their best predictor of the future appreciation rate. Farmers are likely to give attention to long-run changes in asset value since they hold their quota for an average of 14 years, and using the average over the timeframe is one manner of capturing such a long-term view. Information regarding quota prices is recorded by the provincial milk marketing boards and agencies. These data were obtained through CDC, Agriculture and Agri-Food Canada, and the corresponding provincial milk marketing boards and agencies (updated from Baylis and Furtan 2003). Quota prices were deflated using the monthly Consumer Price Index for fresh milk (2002 = 100), obtained from Statistics Canada.[10]

We perform several robustness tests. Given that many of our variables can only proxy for farmers' expectations, one may be concerned that the imputed policy risk is measured with substantial error. To test whether spurious temporal variation in our policy risk variable drives our results, we calculate a three month rolling average of the policy risk variable, and use it as an alternative to the monthly policy risk variable. Second, as noted above, we recognise that our measure of the appreciation rate may be flawed. One concern with using the average of appreciation over the entire period may be that we use current and future values of quota to predict expected appreciation early in our time series. To address this concern, we also estimate the model using an appreciation rate generated from past quota values. Third, quota markets are generally perceived as being 'thin', which may add spurious variation to our measures of R and quota value. To take this potential error into account, we use two different schemes to place more weight on those observations from quota markets that have less monthly variation and more farmer participation. We first weight the data by the inverse of the standard deviation of the difference between the price of unused and used quota by province, and second, we weight the data by the average number of dairy farms in the province to capture the 'robustness' of the quota market. Further, to address the concern that those provinces with a larger number of dairy farms, and therefore more robust quota markets, may affect the results, we include the number of farms by province in the regression. Fourth, one might be concerned that those provinces with shorter time-series may bias our

[8] *Bank of Canada website: http://www.bankofcanada.ca.*

[9] *The appreciation rate (g) is calculated as the ratio of price of used quota in time t-5 relative to time t, raised to the 1/5, minus one, where t represents years, $g = (\text{used quota price}_{t-5}/\text{used quota price}_t)^{1/5} - 1$. This formula assumes that appreciation occurs over a five-year time horizon. We adjusted the formula to consider that in the second year, farmers only had one year of observations to base the appreciation rate on, two years in the third, etc.*

[10] *Statistics Canada website: http://www.statcan.gc.ca/*

Table 1. Summary statistics of policy risk variables: mean (standard deviation)

Variable	Before WTO	After WTO
Risk premium	19.79	15.81
	(14.97)	(11.27)
Appreciation Rate (5-year average)	0.06	0.10
	(0.15)	(0.09)
Return	9.10	7.08
	(4.46)	(4.14)
Unused Quota Price	28.11	44.78
	(11.77)	(19.56)
Used Quota Price	19.81	38.33
	(8.96)	(17.65)
Interest Rate	0.11	0.06
	(0.04)	(0.01)

results. Thus, we estimate the two models without Saskatchewan, and then without British Columbia to test whether these short time-series affect our results. Last, we use the change in the price of an unused quota as our dependent variable to test whether we see a similar effect with this less precise measure of policy risk. We discuss the results of these robustness tests in the results section.

Summary statistics of the variables used to calculate policy risk are presented in table 1. We see that while farmers do discount the current price of quota substantially to take policy risk into account, this policy risk appears to decrease after the WTO, on average. Both used and unused quota prices increase substantially, while the return from quota decreases. We see some evidence that farmers do not perceive the WTO as a threat to profitability within the Canadian dairy industry. To provide a clearer picture of these changes before and after the WTO was established, in figure 1 we graph the value of a used quota over time in panel (a). We observe a clear structural change after 1995, the year the WTO was introduced. To highlight this structural change, in panel (b) we graph the predicted values of a used quota following a quadratic trend. The structural change is even more evident. In panel (c), we graph the number of information articles over time.[11] For this variable, we observe a clear increase in the number of articles by month around the time of WTO establishment, which is highlighted by the quadratic prediction of information as a function of time depicted in panel (d).

We estimate two primary models. First, we consider the explicit effect of uncertainty leading up to the WTO, the WTO itself, and the U.S. and New Zealand court case on farmers' perceived risk. We control for the first two years of a province's quota exchange (infant market variable), cycles during the dairy year and provincial fixed effects:

$$\begin{aligned} policy\ risk_{it} &= \beta_0 + \beta_1 WTO\ variable_t + \beta_2 Information_t \\ &+ \beta_3 Markating_{it} + \beta_4 FE_i + \mu_{it} \end{aligned} \tag{3}$$

[11]*Information is the number of press articles in Lexis Nexis related to Canada, dairy, and GATT or WTO by month.*

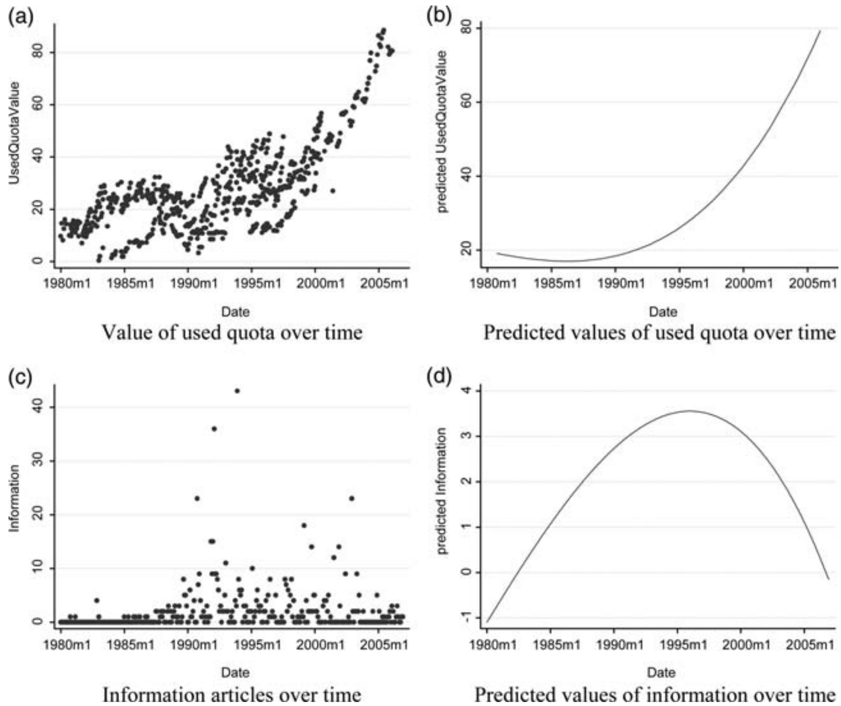

Figure 1. Graphic representation of pre- and post- WTO changes of key variables

where subscript i refers to the province (Alberta, British Columbia, Ontario, or Quebec) and t to the month.[12] We include three WTO variables: WTO_t, $pre\text{-}WTO\ time\ trend_t$, and $WTO\ time\ trend_t$. The Information variables are: $log\ Information\ pre\text{-}WTO_t$, $log\ Information\ US\_New\ Zealand_t$, and $log\ Information\ Doha_t$. Finally, the Marketing variables are: $Infant\ Market_{it}$, $Beginning\ Dairy\ Year_t$, and $End\ Dairy\ Year_t$. For more details on the variables used, refer to table 2.

The WTO variable is a dummy variable starting in January 1995. To capture the perceived threat to the supply management system from trade negotiations, we include the number of general press articles in Lexis Nexis related to Canada, dairy, and GATT or WTO by month. We interact this information variable with the three years leading up to the WTO (January 1992 to December 1993), the two years during the United States and New Zealand WTO case against Canadian dairy policy (January 1997 to December 1998), and the years of the Doha Round negotiations in our dataset (January 1999 to December 2006). We capture the cyclical nature of the dairy year using two dummy variables, one for the first three months at the beginning of the year, and one for the last three months at the end of the year. We include two monthly time trends, the first of which represents all the months in our dataset leading to the formation of the WTO. The other one represents all the months in our dataset after the formation of the WTO. Last, we include the provincial fixed effects.

We would expect that news stories leading up to the WTO's establishment, during the United States and New Zealand dispute, and during the Doha Round negotiations would all increase perceived policy risk, and

[12] *Saskatchewan is included in the constant.*

Table 2. Variable description

Variable	Description
Policy Risk	Probability perceived by farmers that the quota rents from the supply management system will end.
WTO 1995 to 2006	Binary variable equal 1 from 1995 to 2006, zero otherwise.
log Information pre-WTO	Log of number of press articles in Lexis Nexis related to Canada, dairy, and GATT or WTO by month from January 1992 to December 1993.
log Information US_NewZealand	Log of number of press articles in Lexis Nexis related to Canada, dairy, and GATT or WTO by month from January 1997 to December 1998.
log Information Doha	Log of number of press articles in Lexis Nexis related to Canada, dairy, and GATT or WTO by month from January 1999 to December 2006.
Infant Market	Binary variable equal 1 from August 1980 to July 1982 for Ontario; from August 1994 to July 1996 for Saskatchewan;from May 1996 to April 1998 for British Columbia; from November 1982 to October 1984 for Alberta; and from January 1980 to December 1981 for Quebec; zero otherwise.
Beginning dairy year	Seasonality variable equal to 1 for August, September and October, zero otherwise.
End dairy year	Seasonality variable equal to 1 for April, May and June, zero otherwise.
pre-WTO time trend	Trend variable to represent the months leading to the formation of the WTO, where January 1980 equals 1, February 1980 equals 2, . . . , December 1994 equals 180, and zero otherwise.
WTO time trend	Trend variable to represent the months after the formation of the WTO, where January 1995 equals 1, February 1995 equals 2, . . . , December 2006 equals 144, and zero otherwise.
Ontario	Binary variable equal to 1 for Ontario, zero otherwise.
BC	Binary variable equal to 1 for British Columbia, zero otherwise.
Alberta	Binary variable equal to 1 for Alberta, zero otherwise.
Quebec	Binary variable equal to 1 for Quebec, zero otherwise.
Change % Milk price subsidized	The variable measures the change in the percentage of the milk price subsidized by the federal government.
Change Rebate	60% of the difference between Canadian and U.S. milk price from August 1990 to July 1993, 85% from August 1993 to July 1995, and zero otherwise.
Change Class 5e	U.S. milk price from October 1996 to July 2000, and zero otherwise.

that farmers might see such attention as a precursor to government action. Because the WTO initiated the minimum access commitment, forcing some low-tariff imports, and established a trade dispute system where Canada's trading partners could challenge trade-distorting policies, farmers might well have assumed that it would increase the probability that the supply management system would be dismantled. The supply management system, however, appeared to weather the threat, and policy risk might have actually decreased once the agreement was in place.

In the second model, we add specific policy changes to the above specification. Because most of these changes in expectations or perceptions are difficult to measure precisely, we heavily rely on time dummies that we judge to be correlated with these expectations. Many of the specific policy changes made in response to the WTO were to eliminate programs deemed to be export subsidies, which largely affected processors, but might have affected farmer's perceptions of the robustness of the supply management system. We include the change in percentage of the industrial milk price subsidized by the government and policy periods with added protection to milk processors (like the rebate to further processors and the implementation of class 5e) to see if these processor policy changes affected farmers.[13] Specifically, we estimate the following model:

$$\begin{aligned} \textit{policy risk}_{it} &= \delta_0 + \delta_1 \textit{WTO variables}_t + \delta_2 \textit{Information}_t \\ &+ \delta_3 \textit{Marketing}_{it} + \delta_4 \textit{Policy Changes}_t + \delta_5 FE_i + \varepsilon_{it} \end{aligned} \tag{4}$$

where we include three policy changes variables: *Δ% Milk price subsidized, Δ Rebate*, and *Δ Class 5e*.

The variable Δ% Milk price subsidized is the the change in the percentage of the milk price subsidized by the federal government. The Δ Rebate variable represents the change in the rebate, which is 60% of the difference between the Canadian and U.S. milk price from August 1990 to July 1993, 85% of the difference from August 1993 to July 1995, and zero otherwise. The Δ Class 5e variable represents change in the price for milk class 5e, which takes the value of the U.S. milk price during the period that this class existed (from October 1996 to July 2000), and zero otherwise. The percentage milk price subsidized, rebate and class 5e represent protection to further-processors. We expect the change in these variables to be negatively correlated with policy risk, because negative changes and the elimination of these programs decrease the protection to processors that could lobby against the high prices paid to farmers.

Results

We estimated equations (3) and (4) with Stata (version 11.2) using a cross-sectional time-series feasible generalized least squares regression, with 510 observations when calculating g as a 5-year average, and 585 observations when calculating g as a constant for the full time period.[14] This estimation procedure allows us to correct for the heteroskedasticity and panel-specific autocorrelation of order one that was found in the data. We use a Wald Chi-square test for joint significance and we reject the hypothesis that the variables are jointly insignificant at the 1% level. We estimate equations 3 and 4 without and with the pre-WTO time trend and WTO time trend. Results for the two models are quite similar and are

[13] *For more details on the supply management system and its programs, please refer to the Supplementary data.*

[14] *For equation 4, we have 451 observations when calculating g as a 5-year average, and 520 observations when calculating g as a constant for the full time period.*

Table 3. Perceived policy risk estimation results for equation 3

	Appreciation rate: 5-year rolling average		Appreciation rate: constant	
Variable	**Base**	**with trend**	**Base**	**with trend**
WTO 1995 to 2006	−5.51**	−8.34	−5.33***	−6.51***
	(2.64)	(5.26)	(1.39)	(1.87)
pre-WTO monthly time trend		−0.04		−0.02
		(0.03)		(0.01)
WTO monthly time trend		−0.19***		−0.07***
		(0.05)		(0.02)
log Information pre-WTO	1.49**	1.55**	1.13**	1.29**
	(0.60)	(0.60)	(0.52)	(0.52)
log Information US_NewZealand	3.20**	2.39*	−0.11	−0.48
	(1.42)	(1.42)	(0.78)	(0.79)
log Information Doha	0.42	0.42	−0.17	−0.27
	(0.58)	(0.59)	(0.43)	(0.42)
Infant market	−3.28	−7.22***	3.01***	−0.07
	(2.55)	(2.59)	(0.93)	(1.15)
Beginning dairy year Aug, Sep, Oct	−3.12***	−3.09***	−2.17***	−2.14***
	(0.78)	(0.79)	(0.58)	(0.58)
End dairy year Apr, May, Jun	0.80	0.69	0.66	0.55
	(0.62)	(0.62)	(0.47)	(0.47)
Ontario	1.95	−4.16	−7.62***	−9.85***
	(8.70)	(9.44)	(2.30)	(2.41)
British Columbia	9.75	18.13**	4.66***	7.12***
	(7.54)	(9.00)	(1.71)	(1.96)
Alberta	8.81	4.21	−1.39	−3.04
	(7.81)	(8.91)	(2.19)	(2.30)
Quebec	1.09	−5.40	−6.44***	−8.86***
	(9.02)	(9.54)	(2.20)	(2.33)
Constant	14.71*	25.97***	24.57***	29.12***
	(7.84)	(10.09)	(2.17)	(2.79)
Wald Chi-squared	42.46	67.16	129.86	157.83

*Note: standard errors in parentheses, *** = 1%, ** = 5%, * = 10% significance levels, respectively.*

presented in table 3 for equation 3 and table 4 for equation 4. Elasticities and standard errors at the mean for our key variables are presented in table 5.

As was clear from the summary statistics, we see evidence of a substantial policy risk premium in the Canadian quota market. The average risk premium over the entire period, holding all policies constant, ranged from 14-29.12% depending on the estimation model. Policy and the anticipation of policy, however, did affect the size of the risk premium. Results using a 5-year average to estimate the appreciation rate (columns 1 and 2) are quite similar to calculating the appreciation rate as a constant (columns 3 and 4).

The coefficient on the WTO dummy variable is negative and significant. Specifically, we see a decrease in the risk of 5.3 to 8.3 points, or 11-26%, amounting to a decrease in the risk premium of almost one-third, after the trade agreement was implemented. Thus, we see evidence that despite the

Table 4. Perceived policy risk estimation results for equation 4

	Appreciation rate: 5-year rolling average		Appreciation rate: Constant	
Variable	**Base**	**with trend**	**Base**	**with trend**
WTO 1995 to 2006	−5.79**	−8.50	−5.33***	−5.35***
	(2.76)	(5.28)	(1.40)	(1.97)
pre-WTO monthly time trend		−0.04		−0.01
		(0.03)		(0.01)
WTO monthly time trend		−0.21***		−0.08***
		(0.05)		(0.02)
log Information pre-WTO	1.54**	1.57**	1.16**	1.23**
	(0.67)	(0.67)	(0.53)	(0.52)
log Information US_NewZealand	3.44**	2.10	-0.22	-0.63
	(1.48)	(1.49)	(0.82)	(0.84)
log Information Doha	0.28	0.30	−0.33	−0.32
	(0.63)	(0.63)	(0.45)	(0.45)
Infant market	−5.43**	−10.29**	2.29**	−1.25
	(2.67)	(2.76)	(1.05)	(1.28)
Change % Milk price subsidized	−295.69	−242.75	−4.41	40.80
	(229.63)	(230.72)	(163.21)	(160.37)
Change Rebate	−0.16	0.003	−0.49*	−0.46
	(0.48)	(0.48)	(0.29)	(0.28)
Change Class 5e	0.0004	0.004	0.001	0.0004
	(0.07)	(0.07)	(0.05)	(0.05)
Beginning dairy year Aug, Sep, Oct	−3.30***	−3.21***	−2.37***	−2.33***
	(0.88)	(0.88)	(0.61)	(0.60)
End dairy year Apr, May, Jun	0.64	0.51	0.69	0.58
	(0.68)	(0.67)	(0.49)	(0.49)
Ontario	3.24	−3.44	−7.24***	−9.58***
	(8.99)	(9.95)	(2.51)	(2.65)
British Columbia	10.45	19.26**	5.05**	7.94***
	(7.95)	(9.59)	(1.99)	(2.28)
Alberta	9.62	4.67	−1.14	−2.96
	(8.23)	(9.47)	(2.38)	(2.53)
Quebec	2.06	−5.07	−6.53***	−9.07***
	(9.51)	(10.19)	(2.44)	(2.60)
Constant	14.21*	26.51**	24.45***	28.47***
	(8.31)	(10.61)	(2.39)	(3.06)
Wald Chi-squared	40.64	68.84	120.47	145.26

*Note: standard errors in parentheses, *** = 1%, ** = 5%, * = 10% significance levels, respectively.*

potential threat posed by the WTO, farmers were more confident of the future of their quota value after the agreement than before. This would also explain why quota values increased so much over the post-1996 period, and would validate ad hoc explanations of this increase in quota values (Barichello, 2000, and Barichello, Cranfield and Meilke 2009).

We do see evidence that dairy farmers were concerned about the future of supply management during the early stages of negotiations. Newspaper articles leading up to the WTO in 1992 and 1993 did increase concern about the loss of the supply management system, increasing the policy risk premium by 0.24 points, or around 1%. This result indicates

Table 5. Perceived policy risk estimation results for equation 4 – Elasticities at the mean

	Appreciation rate: 5-year rolling average		Appreciation rate: Constant	
Variable	**base**	**with trend**	**base**	**with trend**
WTO 1995 to 2006	−0.17	−0.26	−0.11***	−0.11**
	(0.13)	(0.20)	(0.03)	(0.04)
log Information pre-WTO	0.011**	0.012**	0.008**	0.008**
	(0.0044)	(0.0047)	(0.0031)	(0.0031)
Change % Milk price subsidized	0.0040	0.0035	0.0001	−0.0005
	(0.0029)	(0.0031)	(0.0021)	(0.0021)
Change Rebate	−0.00042	−0.00001	−0.00038	−0.00037
	(0.00137)	(0.00129)	(0.00043)	(0.00042)
Change Class 5e	−0.00001	−0.00010	0.00002	0.00001
	(0.0020)	(0.0017)	(0.0008)	(0.0007)

*Note: standard errors in parentheses, *** = 1%, ** = 5%, * = 10% significance levels, respectively.*

that leading up to the WTO, Canadian dairy farmers were somewhat uncertain whether the Canadian government would negotiate special protection for their industry or succumb to pressure from other countries and Canada's agricultural export industries, such as the grains sector, to focus on eliminating trade barriers. We also observe that news articles during the U.S. and New Zealand trade challenge significantly increase policy risk by 0.25 points. During this trade dispute, farmers did not know how the WTO would rule nor how the Canadian government would respond to the ruling. As an aside, we also tried using simple time dummies for the pre-WTO, and US_ New Zealand dispute, but these dummies were not significantly different from zero, indicating it was not only the time period that raised concern, but the degree of attention these issues were receiving in the media.

When we included news articles leading to the new Doha round of the WTO, we found that this media attention had no effect on dairy farmers' perceived risk. Thus, we might conclude that farmers felt that their interests were sufficiently protected at the Uruguay round of the GATT, and therefore felt no (additional) threat from the subsequent round.

In our second specification (table 3, column 2 for appreciation rate as a 5-year average and column 4 for appreciation rate as a constant), we included monthly time trends both before and after the WTO to capture the dynamics surrounding the WTO agreement. We observe evidence that the risk premium decreased when the trade agreement was signed, but not before that. The primary effect appeared to be that since the WTO, the risk premium has diminished more rapidly than before the trade agreement. While the WTO decreased the risk premium in the quota market overall, this decrease came over time, as farmers observed the evolution of supply management system rule changes and the failure of external challenges to alter that system significantly.

In equation 4, we included variables to capture policy changes that largely affected Canada's processors. The coefficients on the policies and their elasticities were not significantly different from zero (tables 4 and 5).

The coefficients on the change in the percentage of milk price subsidized, the change in the rebate to further-processors and the change in class 5e milk price indicate that the removal of these policies largely do not affect risk perceptions. Thus, we see evidence that farmers may not believe their policy risk is affected by changes in the level of protection extended to processors.

One exception is that the coefficient on the change in the rebate program is negative and significant in column 3, using the appreciation rate as a constant, and without including the monthly time trends before and after the WTO. This result may imply that farmers were concerned by the potential increase in lobbying efforts by processors to access cheap milk. As the market power of processors has increased, farmers may be increasingly concerned about the divergence of processor and producer interests associated with the loss of these processor benefits from supply management.

Our results prove to be quite robust to different specifications; the full results are available in the on-line Supplementary data.[15] First, we calculate a three-month rolling average of the policy risk variable, and use it as an alternative to the monthly policy risk variable. Results from this robustness test are consistent with our previous results. Second, because one might be concerned that averaging the appreciation rate might affect our results, we estimate the model using only the lagged appreciation rate, and find no substantive difference. Third, because of the substantial differences in our provinces, and therefore our observations, we weight the data by the inverse of the standard deviation of the difference between the price of unused and used quota by province to capture the 'robustness' of the quota market. We then weight the data by the average number of dairy farms in the province. Results from these two models are quite similar to those presented above and are presented in table A1 in the on-line Supplementary data. Fourth, we estimate the two models without Saskatchewan, and then without British Columbia, given that the timeframes are shorter for these two provinces. Results do not change qualitatively from those presented above. Fifth, we include the number of farms by province. This specification increases the significance of some of our variables, but this result may be due to collinearity as the number of farms have a high variance inflation factor.

Changes in perceived policy risk should also be captured in the change in quota price. If farmers obtain new information that makes them less certain about the continuation of the supply management system, quota prices should fall. We employ the change in the price of unused quota as our dependent variable in equation 4; using the base model and then adding the two monthly trends, before and after the WTO, we added the feed index for Canada, number of farms by year by province, milk price and interest rate to capture other factors that may affect quota value but would be netted out in our measures of policy risk, λ.[16] Results from this specification are presented in table A2 in the on-line Supplementary data. In the regression on the change of price of unused quota, the WTO monthly trend, feed index, beginning of dairy year and end of dairy year are the only significant variables. We do observe an increase in the price

[15] *Results for all robustness tests are available upon request.*

[16] *We did include these variables in models using λ as our dependent variable, and the coefficients were not significantly different from zero.*

of unused quota after the WTO's establishment, which is consistent with our previous result of a decrease in policy risk after the WTO. Thus, while the change in the price of unused quota captures the change in policy risk, it also captures all changes in profitability, technology and other factors that affect quota price, resulting in noisy estimates and insignificant coefficients. Thus, we feel these results justify the use of our original, more structured and well-defined measure of policy risk to capture the relationship between risk and changes in policy.[17]

Conclusions

To test whether farmers lost any regulatory protection due to the Uruguay Round Agreement on Agriculture, we develop an explicit model for defining and measuring policy risk. By adding considerable structure to a simple earnings/price ratio, our model allows us to explain why the quota price is discounted so heavily relative to the annual flow profits from, or rental rate of, the quota. We find that our measure of policy risk is high, ranging from 15-30% over our time period. The measure declines over time, notably after the URAA is signed, but still remains at around 15% post-1995. This result is important because if we relied only on beta risk from a simple CAPM model, where estimates range from 0.03-0.3%, one could not explain why quota prices are as low as they are relative to patterns of annual profits.

We then explain how this measure of policy risk varies with changes to the Canadian supply management system; it behaves in a very plausible manner, and gives us insight about how farmers' perception of policy risk has varied with a series of factors that might be expected to alter those perceptions. In itself, this adds considerable support to our measure of policy risk.

The dummy for the URAA ("WTO"; taking a value of 1 after 1995) is negative and significantly different from zero. In the only specification where it is not quite significant at the 10% level, the monthly time trend post-1995 is significant. Moreover, the risk premium has diminished more rapidly since the URAA compared to prior to its agreement, reflecting an increasing confidence over time that the rule changes adopted internally in response to the agreement and the challenges to it would successfully maintain border protection.

Dairy farmers were concerned about the future of supply management in early negotiations (policy risk rose significantly in all specifications). Also, news about the U.S. and New Zealand trade challenges to Canada's dairy trade protection increased policy risk modestly. By contrast, news articles about the new Doha WTO round had no effect on dairy farmers' perceived risk.

Interestingly, there is a regional effect on policy risk. Provincial dummies for Ontario and Quebec tend to be negative, while the reverse holds true in British Columbia. Perhaps closeness to the lobbying effort in Ottawa generates more confidence that the policy will not disappear. When other policy changes are examined, they have no consistent significant effect on policy risk. This includes policy changes that would benefit

[17] *We also estimated all the models in tables 3 and 4 without the information variables, and the results were virtually identical.*

processors, reduce dairy subsidies, and provide export relief to processors. Finally, a variety of tests for robustness did not change the qualitative results outlined above.

Despite frequent discussion of the riskiness of certain investments due to the unpredictability of government policies, in Canada's milk quota system we have a useful laboratory within which to examine policy risk. The measure we have used, imperfect as it may be, demonstrates the substantial effect of policy risk and behaves as one would expect a policy risk variable to behave.

Canada's dairy industry is by no means the only context within which policy risk is important. In a micro environment, policy risk is relevant any time a stream of rents depends on government policies or regulations. This government policy could be a subsidy payment which is capitalized into land values, or import quotas or fisheries quotas that are tradable. In fact, for any resource that is managed by regulation and where property rights are defined, including tradable pollution permits and carbon emission permits, policy risk is likely to be involved and affecting the capital values of these tradable quotas or permits. Further, the potential for empirically applying the concept of policy (or default) risk in the markets for sovereign debt may have never been clearer than in recent months in Europe.

In addition to showing how policy risk can be analyzed, this article provides a cautionary tale for governments when establishing tradable property rights. Those rights can do more than become a large financial asset and be subject to possibly substantial policy risk, as is the case in the Canadian dairy industry. Indeed, these rights can also show graphically how owners of these assets not only have a stake in perpetuating their future policy-induced rents, but also, maybe more dramatically, a stake in perpetuating the other side of those rents, the capital value of their investment in permits or quota. Establishing the system so that quotas or permits are rented by individuals may be one way of protecting the user from policy risk and disentangling the capital value from the use value, as well as the incentives that each contains. As it stands, the government's hands are often tied from making beneficial policy changes that threaten the value of permits or quotas by the large financial stake that individuals have in the system.

Supplementary Material

The appendicies are available as supplementary material at Applied Economic Perspectives and Policy online (http://aepp.oxfordjournals.org/).

References

Alston, J. M. 1992. Economics of Commodity Supply Controls. In *Mechanisms to Improve Agricultural Trade Performance under GATT.* T. Becker, R. Gray, and A. Schmitzeds., pp. 83–101. Kiel: Wissenschaftsverlag Vaut.

Barichello, R. R. 1996. Capitalizing Government Program Benefits: Evidence of the Risk Associated with Holding Farm Quotas. In *The Economics of Agriculture, Volume 2: Papers in Honor of D. Gale Johnson.* J. M. Antle, and D. A. Sumnereds., ppp. 283–299 Chicago: University of Chicago Press.

——. 1999. The Canadian Dairy Industry: Prospects for Future Trade. *Canadian Journal of Agricultural Economics* 47(5): 45–55.

——. 2000. Canadian Dairy Policy: Focusing on the Quota Regime. Paper presented at the Western Economics Association Annual Meeting, Vancouver, B.C., Canada, July 3, 2000.

Barichello, R. R., J. Cranfield, and K. Meilke. 2009. Options for Supply Management in Canada with Trade Liberalization. *Canadian Public Policy/Analyse de Politiques* 35(2): 203–217.

Barry, P. J. 1980. Capital Asset Pricing and Farm Real Estate. *American Journal of Agricultural Economics* 62(3): 549–53.

Baylis, K., and W. H. Furtan. 2003. Free-Riding on Federalism: Trade Protection and the Canadian Dairy Industry. *Canadian Public Policy*, 29(2): 145–161.

Cairns, A., K. Meilke, and N. Bennett. 2010. Supply Management and Price Ceilings on Production Quota Values: Future or Folly. Canadian Agricultural Trade Policy Research Network Working Paper 2010–05.

Canadian Dairy Industry Profile. 2002. Agriculture and Agri-Food Canada. Available at: http://www.dairyinfo.gc.ca/pdf_files/dairyprofile.pdf.

Canadian International Trade Tribunal. 1998. Canadian International Trade Tribunal, Profile of the Canadian Dairy Industry. Staff Report (GC-91-001). March 16, 1998.

Eaton, J., and M. Gersovitz.1981. Debit with Potential Repudiation: Theoretical and Empirical Analysis. *Review of Economic Studies* 48(2): 289–309.

Grainger, C., and C. Costello. 2010. The Value of Secure Property Rights: Global Evidence from Fisheries. University of California Santa Barbara Working Paper.

Irwin, S. H., D. L. Forster, and B. J. Sherrick. 1988. Returns to Farm Real Estate Revisited. *American Journal of Agricultural Economics* 70(3): 580–587

Just, R. E., and G. C. Rausser. 2002. Conceptual Foundations of Expectations and Implications for Estimation of Risk Behaviour. In *A Comprehensive Assessment of the Role of Risk in Agriculture*, R. E. Just, and R. D. Popeeds., pp. 53–80. Massachusetts: Kluwer Academic Publishers.

Lermer, G., and W. T. Stanbury. 1985. Measuring the Cost of Redistributing Income by Means of Direct Regulation. *The Canadian Journal of Economics* 18(1): 190–207.

Newell, R. G., K. L. Papps, and J. N. Sanchirico. 2007. Asset Pricing in Created Markets. *American Journal of Agricultural Economics* 89(2): 259–272.

Nogueira, L., and K. Baylis. 2006. Quality in the Canadian Dairy Industry. *Advances in Dairy Technology*,18:115–134.

Noland, K. 2010. Returns to Farm Real Estate: Analysis of an Illinois Farmland Portfolio. MS thesis, University of Illinois.

Ramirez-Ramirez, G. 2006. *Agricultural Soil Carbon Sinks and the Design of a Domestic Emissions Trading Scheme.* Unpublished MS dissertation, Food and Resource Economics, University of British Columbia, Canada.

Richards, T. J 1996. The Effect of Supply Management on Dairy Productivity. *The Canadian Journal of Economics* 29(Special Issue, Part 2): S458–S462.

Richards, T. J., and S. R. Jeffrey. 1997. The Effect of Supply Management on Herd Size in Alberta Dairy. *American Journal of Agricultural Economics* 79(2): 555–565.

Romain, R. 2001. The Future of the Dairy Industry in Canada. *Discussion Series* SD.01.01 Centre de Recherché en Économie Agroalimentaire Université Laval (Center for Research in Agricultural Economics at University of Laval in Ste. Foy, Québec, Canada.)

Schmitz, A., and T. G. Schmitz. 1994. Supply Management: The Past and Future. *Canadian Journal of Agricultural Economics* 42(2): 125–148.

Sumner, D. A., and N. L. W. Wilson. 2005. Capitalization of Farm Policy Benefits and the Rate of Return to Policy-Created Assets: Evidence from California Dairy Quota. *Review of Agricultural Economics* 27(2): 245–258.

Task Force on National Dairy Policy. 1990. Consultative Document. July 10, 1990.

Task Force on National Dairy Policy. 1991. Evolution of the Canadian Dairy Industry. May 31, 1991.

Veeman, M. M. 1982. Social Costs of Supply-Restricting Marketing Boards. *Canadian Journal of Agricultural Economics* 30(1): 21–36.

——. 1987. Marketing Boards: The Canadian Experience. *American Journal of Agricultural Economics* 69(5): 992–1000.

Wilson, N. L. W., and D. A. Sumner. 2004. Explaining Variations in the Price of Dairy Quota: Flow Returns, Liquidity, Quota Characteristics and Policy Risk. *Journal of Agricultural and Resource Economics* 29(1): 1–16.

Wossink, A., and C. Gardenbroek. 2006. Environmental Policy Uncertainty and Marketable Permit Systems: The Dutch Phosphate Quota Program. *American Journal of Agricultural Economics* 88(1): 16–27.