Pulling Back the Veil: What Quota Prices Can Reveal about Quota Buying Decisions and Milk Production Economics

Rick Barichello

Selected presentation for the International Agricultural Trade Research Consortium's (IATRC's) 2022 Annual Meeting: Transforming Global Value Chains, December 11-13, 2022, Clearwater Beach, FL.

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Focus of paper

- Canada's milk industry policy is well known to IATRC members due to its restrictive domestic farm milk quotas and relatively high milk prices
- However, the existence of these quotas constrains researchers who wish to determine various policy effects due to limited information about the industry supply curve
- Even though these quotas trade in most provinces, the price information revealed is also limited in many provinces, due, for example, to fixed quota prices and the lack of a rental market
- In those markets where quota prices are real market prices, their values have increased markedly over the past decade, raising the question of why this has occurred.
- That is the focus of this paper, using data from Alberta for the period from 2009 to 2022. We will not only examine various factors that are instrumental to quota buying decisions but also make selected comparisons with the US industry.

Background: features of Canada's dairy sector

- Canada has farm milk quotas, restricting farm production to one's quota level
- Milk quota trades with an observable market price in Alberta
- This price for an amount equivalent to one average cow's yield is strikingly high: in November 2022, roughly $44,000.
  - Assumes a cow that produces 10,000 liters of milk/year, or 30 liters/day, at 3.5% butterfat (3.5 kg of bf per 100 liters of milk).
  - This is the capital or stock price the quota for that quota, to be distinguished from its rental price
  - This quota should also be distinguished from existing import quotas (TRQs) for dairy products that also exist but cannot legally be purchased or rented

Canada-US price comparisons 2022

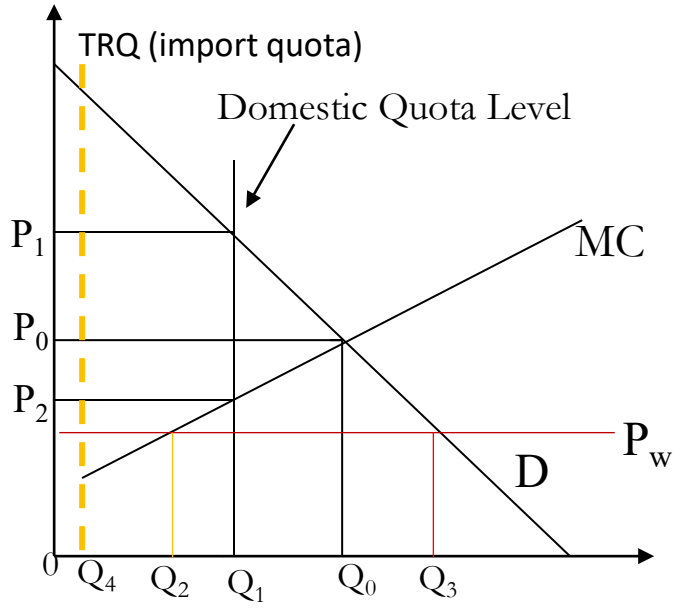
- Milk prices to farmers are relatively high.
  - US Farm Gate milk price, est average for 2022 = USD 25.50/cwt (https://www.ers.usda.gov/topics/animal-products/dairy/market-outlook/)
  - Equivalent to USD57.68/100 liters (2.26 liters/cwt)
  - Equivalent to CAD77.94/100 liters (CAD1.00=USD0.74)
  - Alberta milk price to farmers = CAD 91.55 (2022)
- So dairy farmers in Canada now receive CAD91.55/litre, or 17.5% more than the average US dairy farmer.
  - For 2023 prices, USDA est USD22.60/cwt, or CAD69/100 liters. If Canadian farm milk price and USD/CAD exchange rate do not change, next year Canadian farm milk will be priced 33% higher.
- Dairy product prices at retail are commensurately higher as well, varying by milk product

Basic version of Canadian dairy sector model

Policy Tools:
1. Formula-driven milk price
2. Domestic quota facing farmer
3. Small import quota (TRQ)

Policy/Market Sequencing:
1. Choose P_1
2. Calculate Q_1 from demand curve D
3. Note exogenous TRQ, Q_4
4. Set national production quota = $Q_1 - Q_4$

5. *Quota rent*: determined at margin of production: $P_1 - P_2$, shows profitability of buying 1 more unit of quota



Farm Supply Management Marketing Board

The key variables for our empirical work:
P_1 = farm milk price
P_2 = farm marginal cost
$P_1 - P_2$ = quota rent ("credit price")
We will not probe TRQ rents ($P_1 - P_w$), nor changes/shifts in demand, although those shifts do occur, will affect quota prices, and we can measure them.

Model of Quota Value

- Our model to explain how quota prices arise, and move, drawn from the asset pricing literature, specifically the capital asset pricing model (CAPM)
- Virtually all models of quota values begin with a basic PV approach, where the asset price (P_q) is equal to the discounted flow of annual profits (dividends).
- A more sophisticated model is augmented by some expectation of growth (g) in annual profits (or capital gains); this factor often important in quota values due to substantial and sustained increases in their value over time
- Our model is further augmented by a factor, L, which is the probability that the stream of profits will fall to zero, for example, due to a government policy change. This widely described as policy risk.
- Model is developed in Barichello (1996), and used with tests on the policy risk parameter in Nogueira *et al.* (2012)

Our Model of Policy Risk

- This gives us

$$P_q = R\,(1-L)/(r+L-g) \qquad (1)$$

where P_q = sale price of Quota (as a stock),

R = annual profits (price-MC) generated by quota from production or harvest (lease or rental rate),

r = real rate of interest

L = policy risk probability (probability that policy rents will be reduced to zero), and

g = expected (real) rate of growth in P_q due to possible new future benefits of quota ownership such as price increases *and* allocations of new quota

Re-focusing, dividend price ratio, or policy risk

- Re-arranging terms we can focus on the dividend price ratio or the policy risk
- If we have data on "dividend-price" ratio (rental rate/purchase price) [used by Grainger-Costello]
  - $R/P_q = (r+L-g)/1-L$ (2)
- To calculate *L* we have

$$L = (R + (g-r)P_q)/(P_q+R) \quad (3)$$

- This model has been applied to Canadian dairy industry for three decades to reveal high but widely varying levels of policy risk (Barichello, 1996, 2000)
  - It has also been used to explain those variations in policy risk with some success (Nogueira et al, 2012)

Empirical Steps

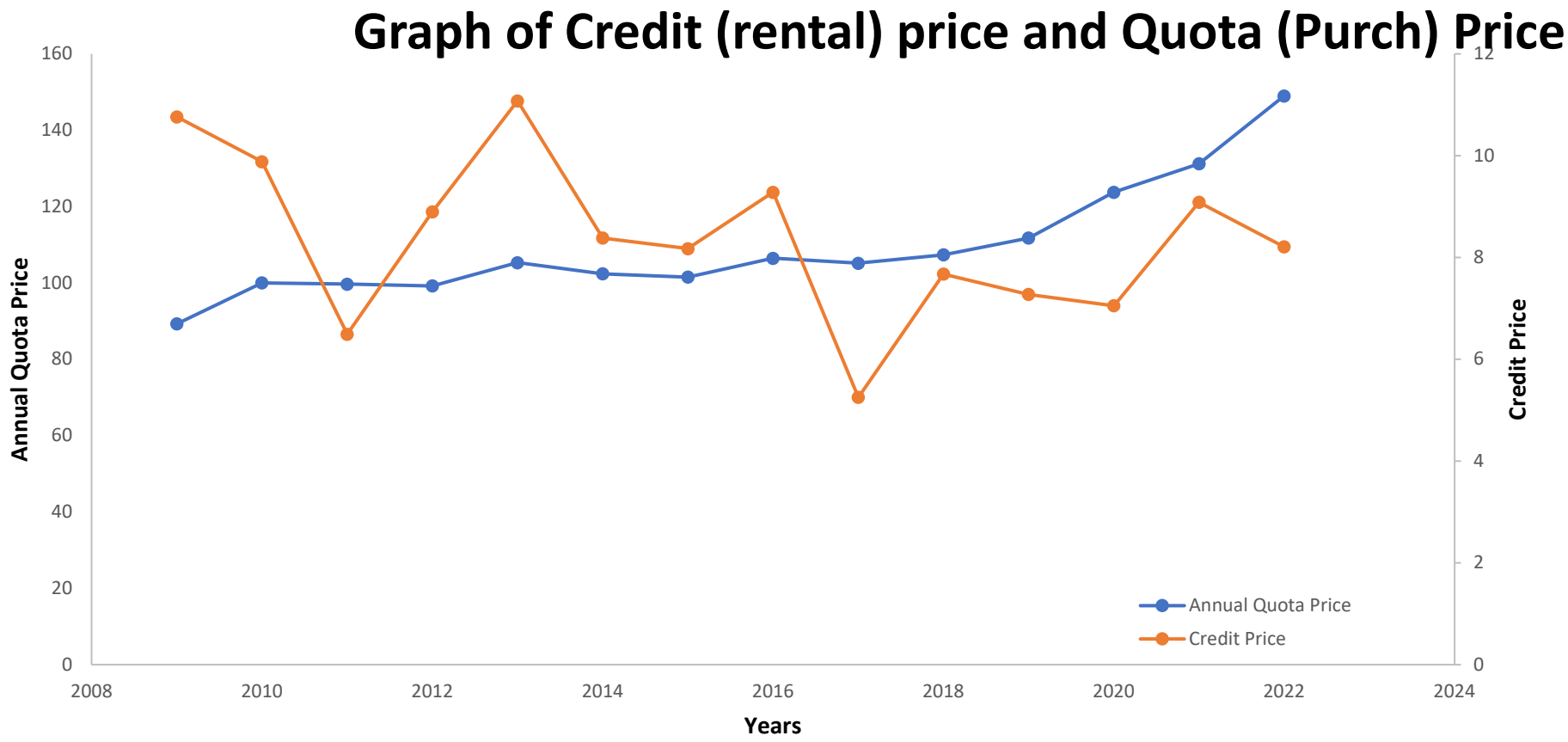
- Examine quota price, rental price, and marginal costs estimates, to explore time patterns in data
- Note counter-intuitive relationship between quota prices and rental prices
- Compare marginal costs over time with US cost data
- Calculate policy risk parameter for current 2022 data
  - The quota rental rate data is market data for a quota rental option, and market, that mimics a rental market; it is regulated by marketing board to be for temporary use

Summarizing the past decade of Alberta data

- Quota Prices (average prices by year), in kg of butterfat/day, nominal in table
  - Real quota prices growing at 0.9%/year from 2009-2022 (stat. significant)
- Rental prices ('credit prices'), average per year, kg bf annually, nominal in table
  - Quite variable. But in real terms falling over time, at -5%/yr, 2009-2022 (stat. significant)
- Because annual profit is declining but asset value rising, we explore further

Variable	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Quota P: $/daily kg	36503	36378	36212	38437	37366	37043	38929	38375	39179	40786	45160	47886	49710
$/annual kg	100.0	99.66	99.21	105.3	102.37	101.49	106.43	105.14	107.34	111.74	123.73	131.19	148.95
Rental P, $/kg	9.88	6.49	8.90	11.08	8.38	8.17	9.28	5.25	7.67	7.27	7.05	9.08	7.05
Rental p, cts/ liter	34.58	22.72	31.13	38.76	29.33	28.60	32.48	18.38	26.86	25.45	24.68	31.79	26.42

Quota price rising despite rental P declining (nominal)



Quota stock/rental price puzzle

- Recall that our model shows the capital price of quota depends on more than rental price, so other factors such as r, g, or L could explain this.

$$P_q = R\,(1\text{-}L)/(r+L\text{-}g)$$

- To probe further we regressed real rental rates on the real quota price for our data for Alberta, $P_q = f(R)$

And not surprisingly the relationship was statistically insignificant

	Coefficients	Standard Error	t Stat	P-value
Intercept	142.8403634	8.315464725	17.17767655	8.17251E-10
Real rentP gdp-deflator	-0.944571871	0.785912703	-1.20187887	0.252592615

- Our next step, to calculate policy risk, helped show us why rental values are a small part of quota price growth

Calculating the Policy Risk parameter

- From eqn (1), 4 independent variables to help explain quota (asset) prices, P_q:
  - Rental rate of quota (annual dividends or earnings), R
  - Interest rate (properly chosen to reflect opportunity cost of capital for farm buyer), r
  - *Expected* growth in quota values (appreciation rate; due to its importance over time), g
  - Policy risk parameter L: no doubt that purchasing the quota is a risky investment due to the possibility that the policy rules that underpin the high milk prices, hence annual profits or earnings, can change due to changes in government policy or trade rules

$$\text{Policy risk } L = [R + P_Q (g\text{-}r)]/(P_Q + R)$$

- The challenge in using our data to calculate the risk parameter is to **estimate g**; the quota price, rental price and interest rate are all accessible
- Because this variable is an expectation, we have no direct measure of it; we must assume a price expectation process
- It is also a critical variable in this formulation because our estimate of policy risk (equation 3) is linear in g, making our risk estimates sensitive to errors in measuring g

Expected growth in quota returns: preliminary steps

- The normal procedure would be to calculate an expected growth rate from increases in the rental values over time, or from increases in the stock price over time
- We followed the latter approach, calculating the growth rate of quota prices in 2022 looking back the previous 10 years (2012-2021)
  - This takes a long run perspective, and we will fine-tune this in later work
  - This annual price growth rate (nominal) is 2.87%
- However, there is also growth in an average farm's quota stock value from increments on the quantity side. Rarely acknowledged or known
  - This averaged 2.60%/yr, following same expectation over the previous 10 yrs from 2012 to 2021 (see next slide)
- Total growth in value of farm quota stock was their sum, 5.47%

Annual data on quota amounts, total Canada

Growth distributed to producers annually

Year	Quota Amount (million kg bf)	Growth rate from preceding year
2011	307.77	
2012	306.74	-0.33
2013	315.34	2.80
2014	321.44	1.93
2015	342.91	6.68
2016	362.69	5.77
2017	369.17	1.79
2018	380.71	3.13
2019	388.12	1.95
2020	397.92	2.52
2021	397.01	-0.23

Source: Annual Reports, Canadian Dairy Commission various years

Policy Risk values

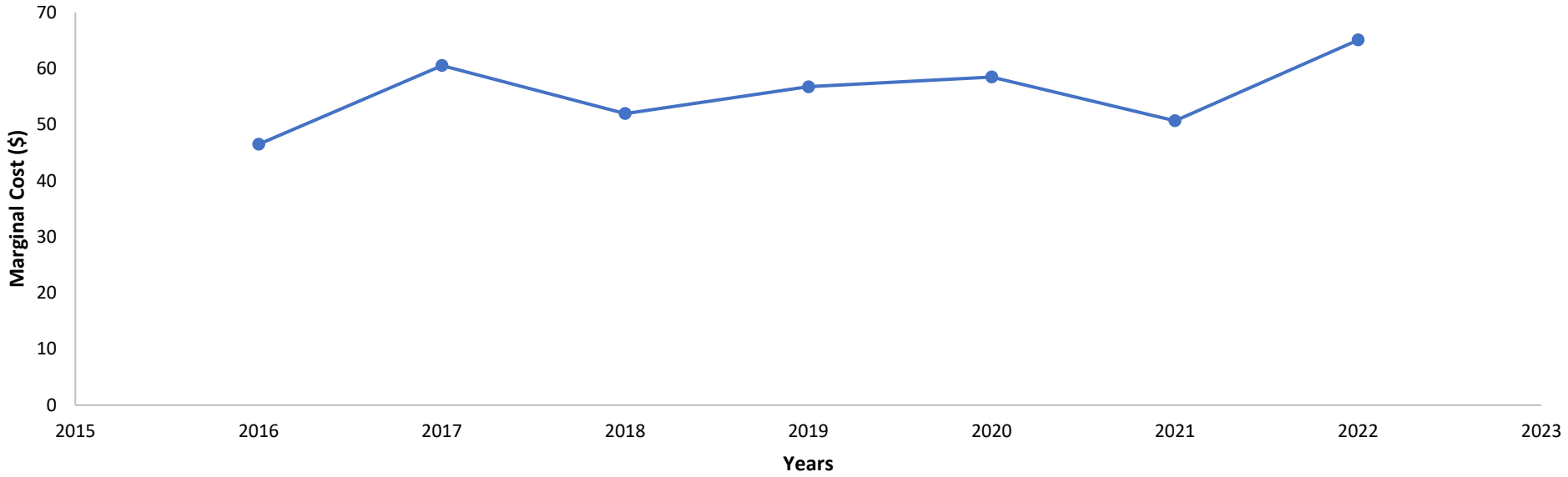
- When our model was solved for our risk parameter, L, using the prime interest rate for the previous year (2021), r=2.45% and g=5.47%, the policy risk is 3%.
- This is the lowest value we have calculated over the past 30 years
  - In 2021 this value for Alberta was 7%, over the 1998-2009 period for Canada it averaged 15%, and in the 1980s the value for Canada was ~20%
  - Comparable risk parameters from the BC sablefish quota over the 1998-2009 period was 14%
- This shows that policy risk has fallen so much that it is now not really much of a factor in pricing Alberta milk quota
- It is consistent with farmers believing there is little risk the policy will be changed significantly, that pricing is in their hands well enough that costs can be readily passed on, and that even with the pandemic, demand grew.

2016-2022 Data for MC calculations, from Farm Milk Prices and 'Rental P'

MC can be calculated from Fig 1 as P(milk)-MC. The graph shows this, nominal MC, and there is no statistically significant trend. When put in real terms (right col, table), again, no signif. Trend; results below.

Date	Milk Prices $/hl	credit_price (cents/l)	Marginal Cost, Nom, real
2016	78.99	32.48	46.5 58.1
2017	78.93	18.38	60.6 73.7
2018	78.85	26.86	52.0. 62.3
2019	82.22	25.45	56.8 67.0
2020	83.18	24.68	58.5. 68.5
2021	82.50	31.79	50.7 54.9
2022	91.55	26.42	65.1 65.1

	Coefficients	Standard Error	t Stat	P-value
Intercept	785.9643028	2649.412897	0.296656027	0.778656947
Year	-0.357479254	1.312239523	-0.27241921	0.796191744



Comparisons with US cost data

- We can now compare our MC data for Canada with US dairy costs, and prices received, to see if patterns of changes are comparable.
  - All data are in real terms, deflated by GDP deflator
  - Canadian cost data are only for 7 years, 2016-2022, measured implicitly from quota rental prices
  - US data are from USDA surveys, best described as average costs, for 12 years from 2010 to 2021
- Key results: US: farm costs are falling at 2.2%/yr

  Real farm milk prices falling at 1.3%/yr
- For Canada: Real farm MC falling at 0.7%/yr

  Farm milk prices falling by 0.9%/yr

Summary

- Using 2009-2022 Alberta quota market data, reflecting both market prices for quota (stock) and quota rental values, plus our milk and quota market models, we find:
  - Real Alberta quota prices are not just high but growing @ 1%/yr
  - Real Alberta quota rental prices are falling at 5%/yr, giving surprising result that annual profits are not driving quota stock prices
  - This result borne out in regression showing quota rents are an insignificant variable in explaining quota prices
  - Policy risk calculations can be made, showing that policy risk in Alberta quota buying is now almost irrelevant, at only 3%.
    - This has fallen considerably in two decades from 15%, and from 20% in the 1980s
  - In undertaking this calculation we observe that growth in the value of farm quotas comes from both price appreciation and quantity allocation increases, @ 5.5%/yr.
    - This factor now driving growth in farm milk quota values.
  - Comparing Canada and US, real farm costs falling at 0.7 and 2.2%, respectively, and real farm milk prices are falling at 0.9 and 1.3% per year respectively.

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