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Canadian Agricultural Trade Policy And Competitiveness Research Network

SUPPLY MANAGEMENT AND PRICE CEILINGS ON PRODUCTION QUOTA VALUES: FUTURE OR FOLLY?

**CATPRN Working Paper 2010-05
June 2010**

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This paper was prepared for the joint AAEA/CAES annual meeting in Denver Colorado and has been submitted for review to the *Canadian Journal of Agricultural Economics*. Financial support for the project was provided by the Ontario Ministry of Food, Agriculture and Rural Affairs and the Canadian Agricultural Trade Policy and Competitiveness Research Network which is funded by Agriculture and Agri-Food Canada. The views expressed in the paper are those of the authors and should not be attributed to the funding agencies. The authors benefited from comments by Rick Barichello on an early draft of this paper.

Abstract

Since the inception of supply management in Canada during the 1970s, milk production quota has been used to regulate output and participation in the dairy industry. In recent years, milk quota values have increased dramatically, almost tripling in value since the mid-1980s. This led to the Dairy Farmers of Ontario intervening on the milk production quota exchange on two occasions: first, in November 2006 with a progressive transfer assessment and then in July 2009, replacing the former policy with a firm price ceiling – fixing the unit price of quota at \$25,000. These policies represent a significant redistribution of economic benefits within the Ontario dairy community from milk producers approaching retirement and selling their quota to those remaining in the industry. The objective of this study is to first explore the reasons for the increase in production quota values; and second, to assess the welfare and distributional effects of each of the two quota policy schemes. Our results suggest that the increase in quota values were driven by basic economic factors expected to influence asset values and that the efficiency losses from intervention in the quota exchange are non-trivial. We conclude by suggesting there are several alternative policy options that could minimize efficiency losses while moderating the escalation in quota values.

1.0 Introduction

The operation of the Canadian dairy industry is extremely complex and highly regulated (Goldfarb). However, its essential features entail: 1) farm level milk prices based on a cost of production formula¹; 2) classified pricing, by end use, of milk purchased for processing; 3) production quotas designed to supply all the milk and dairy products the domestic market requires at the formula price; and 4) high import tariffs to keep foreign dairy products, above Canada's WTO minimum access commitments, from entering the domestic market. Our study is focused on the Ontario dairy market which supplies about 32 percent of Canada's raw milk.

The Dairy Farmers of Ontario (DFO) regulate the production and marketing of milk in Ontario. One of their prime responsibilities is to establish the rules and regulations that apply to the transfer of milk production quota among dairy producers.² The value of production quota has been a controversial aspect of supply management since its inception (Barichello and Cunningham-Dunlop, 1987). In the early years of supply management attempts were made to keep the value of quota at zero – i.e. what the original recipients paid for it. However, it soon became evident that trying to deny that quota was a valuable asset was impossible. As a result in, March 1980 the DFO established an exchange where production quota could be traded amongst willing buyers and sellers, allowing the market to freely determine its price. The DFO states that the objectives of the exchange are to (DFO, 2010a):

¹ Although it is often stated that milk prices are based on a cost of production formula this is not entirely correct since changes in personal disposable income and changes in the consumer price index receive 60 percent of the weight in the formula used to set the price of table milk and cream while industrial milk prices are determined by the Canadian Dairy Commission in a different fashion (Goldfarb).

- Provide an equal opportunity for all producers to buy and sell quota;
- Operate independently and with a minimum of DFO involvement;
- Reflect the value or upper value limit of quota at all times;
- Not be subject to manipulation or exploitation; and
- Be the most cost-efficient quota transfer system at the least possible cost.

Economists have been frequent critics of supply management, beginning with reports by the Economic Council of Canada (Barichello, 1981; Forbes, Hughes and Warley) in the early 1980's and extending to recent reports by Goldfarb, and Robson and Busby because of the large transfers of income from milk buyers to milk producers and significant welfare losses. Still most economists would agree that, given supply management, an open and transparent production quota transfer mechanism is a positive aspect of the milk marketing system.

Figure 1 shows that, in constant 2006 dollars, a unit of milk production quota was worth about \$15,000 in the mid-1990,s.³ At that point the value of production quota exploded reaching more than \$30,000/unit in 2004, an average annual increase of 11.7 percent per year in real terms. The reasons for this rapid rise in quota values will be discussed later but the increase caused the DFO to intervene on two occasions; each time instituting a major change in quota transfer policy designed to slow or halt the growth in the value of production quota. It is these policies that are the primary focus of this paper.

In November 2006 the Progressive Transfer Assessment was implemented

² You must be an active milk producer to own quota.

³ A unit of milk production quota allows a milk producer to deliver one kilogram of butterfat per day and this is roughly equal to the annual milk (butterfat) production of an average dairy cow.

and it imposed a variable in-kind tax on producers selling quota on the exchange (also known as the pay-what-you-bid provision). This policy allowed producers purchasing quota on the exchange to bid what they were willing to pay for a unit of quota and to specify the quantity they were willing to buy at that price; at the same time an in-kind tax was imposed on the quantity of quota sellers put on the exchange, in order to impose a ceiling on the price they received at \$25,500/unit of quota. The idea behind establishing this policy was that purchasers would recognize that the resale value of the quota was restricted. It was felt that this change in quota policy would be sufficient to reduce bid prices over time, as producers realized that the capital gains previously experienced from quota ownership had been eliminated. As illustrated in Figure 1, while this policy change halted the rapid escalation of prices at around \$30,000/unit, it failed to achieve the anticipated result of sufficiently lowering the price to the resale value of \$25,500 per unit. In response, in August 2009 the quota system was changed again to impose a ceiling price on quota of \$25,500, with scheduled monthly reductions to \$25,000/unit by January 2010. Under this system buyers will pay and sellers will receive \$25,000 per unit of quota (after January 2010) if the ceiling price remains binding and less if it is not binding.

In the next section we review the basic welfare economics of supply management and quota transfer mechanisms. We then turn to a discussion of the factors driving milk quota price increases and to an explanation of the motivation of the DFO in first taxing quota transfers and then imposing a price ceiling. Following this in section 4 we conduct welfare analysis of the milk quota market and then conclude with some observations on the implications for milk production in Ontario.

2.0 Production Quota Value Basics

Figure 2 will be familiar to all students of supply management where S_m represents the supply curve for milk, D_m the demand for milk at the farm gate, and P_{mo} and Q_{mo} the equilibrium price and quantity. If P_{md} is the formula price of milk then output has to be reduced to Q_{md} to achieve this price. However, at Q_{md} the marginal cost of production is P_{ms} and its demand price is P_{md} . Consequently, a producer is willing to pay up to $P_{md}-P_{ms}$ for the right to produce milk at a marginal cost of P_{ms} and to sell it at P_{md} . Using Schertz and Learn's terminology the difference $P_{md}-P_{ms}$ is the rental rate of quota (R_m) and it can be split into the supply-restricting portion of the rental rate ($P_{mo}-P_{ms}$) and the price raising part of the rental rate ($P_{md}-P_{mo}$). Knowledge of the elasticity of milk demand and supply and the amount by which output is reduced from its equilibrium level would allow the value of R_m to be estimated. However, due to the prolonged existence of supply management, the free market values of milk, P_{mo} and Q_{mo} , are not observable and have to be implicitly derived. In addition, DFO regulations do not allow milk quota to be rented so all that can be observed in the market place is the capitalized value of the annual stream of benefits.

The simplest capital asset pricing model states that the value of an asset (CV) is equal to the expected benefit stream (R) divided by the producer's discount rate r as shown in equation 1.

$$CV = R/r \quad (1)$$

We will return to this formula shortly but at this point it is important to note that we have one equation and two unknowns, R and r . The literature contains numerous innovative attempts to calculate either R or r , in the dairy industry, in order to obtain an estimate of the other variable but regardless of the method used the point estimates have to be considered with some caution.⁴ Nonetheless, given an estimate of R welfare analysis is possible and referring to Figure 2 the deadweight loss of supply management is area (c+d) and in the typical study the welfare analysis is concluded at this point. However, an implicit assumption contained in Figure 2 is that all producers in the industry are producing at a marginal cost of P_{ms} , and this implies that production quota is efficiently allocated. Even with a well functioning auction market this is a strong assumption given that quota was initially allocated on an historical basis, there are a number of regulations that inhibit the movement of quota and unless cost reducing technologies are adopted simultaneously by all producers there will always be producers with too much or too little quota. It is easily shown that if there are no restrictions on transfers and quota is misallocated among producers it will be traded until its value reaches the rental rate (R) determined in the milk market (Appendix I).

In the next section we examine the factors that seem to be driving the quota market and the DFO's reaction to them.

2.1 Valuing Production Quota

The first step in providing a deeper understanding of current quota values is to expand equation (2) following Barichello (1996) to get:

⁴ Chen and Meilke; and Meilke, Sarker and LeRoy contain discussions of the different methods used by researchers to obtain marginal cost estimates.

$$CV = E(R)/r-g \quad (2)$$

Where $E(R)$ is the expected value of R , r is the discount rate which incorporates a premium for systematic risk, and g is the expected rate of growth in $E(R)$ over time.

Barichello's (1996) major innovation was to incorporate "policy risk" into the estimate of the expected value of the stream of future returns as shown in equation 3:

$$E(R) = (1-j) R - j CV \quad (3)$$

Policy risk, represented by (j) , is the probability that quota rents under supply management will end, hence the expected value of the future stream of annual rents has to be multiplied by the probability of them continuing minus the likelihood that the value of the capital asset itself might fall to zero. Barichello (1996) argues that defining policy risk in this way implies it cannot be diversified or insured against.⁵

Incorporating equation (3) into (2) and simplifying gives:

$$CV = R(1-j) / (r-g+j) \quad (4)$$

Comparing equation (4) to equation (1) it appears the problem has become compounded because we now have one equation and four unknowns. Still the increased richness of

⁵ Barichello (1996) suggests that one way for the industry to minimize policy risk is to engage in lobbying activities and the supply managed industries have been very active in this area. From a political economy perspective it is easy to understand why the supply managed industries have been able to maintain the backing of all four of the political Parties represented in Canada's Parliament. So successful that the House of Commons unanimously adopted a motion giving Canada's WTO negotiators a mandate to "...at the end of the current round of negotiations Canada obtains results that ensure that the supply management sectors are subject to no reduction in over-quota tariffs and no increase in tariff quotas, ..." (House of Commons).

equation (4) allows us to discuss the probable time path of each variable and its implications for the capitalized value of quota.

As stated earlier there are many obstacles to calculating the rental value of production quota. We use a simple method and then examine the implications of using different values. Table 1 shows the deflated “mail box” prices of milk received by farmers in Ontario from 1994 to 2009.⁶ In real terms these prices have been quite constant generally ranging between \$64/hl and \$67/hl over the sample period. The estimates of the marginal cost of producing milk were obtained from the Ontario Dairy Farm Accounting Project, an annual survey of Ontario dairy farms conducted by the Canadian Dairy Commission and the DFO.⁷ The direct cash cost components (per hl) of the survey serve as our estimate of the marginal cost of milk production. However, a shortcoming of the survey is that the cost of home grown feed is valued at its cost of production rather than at its market price. This tends to make the feed cost component of marginal costs more stable than if spot feed prices were used due to market variability. Taking 2006 as an example, our calculated marginal cost is \$31.39/hl, out of total costs of \$46.90/hl of which \$11.84/hl is the cost of producing feed.⁸ Subtracting our marginal cost estimate from the mail box price of milk gives our estimate of the rental rate of quota in 2006 of \$34.97 (Table 1). Examination of the estimated rental values from 1994 to

⁶ The mail box price is the price per hectolitre that a farmer receives for their milk production after all deductions are taken into account. Table 1 also provides a comparison of the mail box price and the target price for milk.

⁷ The average direct costs reported in the survey are essentially average costs but for this analysis we have assumed they provide an adequate measure of marginal costs.

⁸ Using the survey data we calculate a single marginal cost whereas in reality marginal cost depends on farm size. However, using Quebec data Yelou, Larue and Tran find that technical efficiency is very high across all sizes of dairy farms in their sample.

2008 shows that most of the values range between \$32/hl and \$34/hl. In the capital asset pricing model we also need an estimated growth rate g in the rental values. Based on the figures in Table 1 any growth rate between zero and two percent could be justified but in our empirical model we set the growth rate at one percent.

In estimating the discount rate (r) we have selected the prime interest rate plus two percentage points as being indicative of what dairy farmers are paying for the money they borrow to purchase quota. There has been a gradual decline in interest rates since 1994 punctuated by a few upward spikes along the way (Table 1). In addition, over the study period there has been a significant expansion in the credit available to dairy farmers buying quota. This can be attributed to three factors: 1) the DFO's issuing Letters of Direction; 2) the use of existing production quota holdings as collateral; and 3) institutional changes at Farm Credit Canada (FCC).

Letters of Direction are formal agreements which an individual producer enters into voluntarily with the DFO and permits the DFO to arbitrate loans between a financial institution and the producer. Essentially the Letter of Direction establishes the institution who has loaned money, to buy quota, as the first creditor to be paid in the case of payment problems. If a farmer in financial difficulty sells their quota or goes bankrupt, the Letter of Direction legally freezes the revenue from the sale until the lending institution has been paid. It acts as credit insurance for the lender. Coupled with consistently escalating quota values, the Letter of Direction greatly reduced the chance of a loan default and financial institutions responded by permitting loans which used the

existing quota holdings of a producer as collateral and granted the borrower a longer pay back period beginning in the mid-1990's (DFO, 2009b).

Another factor that influenced credit availability was the institutional shift which occurred in 1996 within the FCC. As a crown corporation, prior to 1996, the FCC received its budget from the federal government, and loans were bounded by its annual allocation of funds. However, between 1996 and 2008, the government changed this practice, choosing to allow the FCC to borrow on the open market. This may have altered the FCC lending practices as dairy farmers could easily be perceived as ideal borrowers because of the use of quota as collateral and institutionalized policies (Letters of Direction) reducing the risk of default (DFO 2009b). In July 2008, the federal Minister of Finance reinstated the original conditions and the FCC stopped borrowing from the market and once again began to receive its budget from the federal government.

These changes in lending practices are difficult to capture in the capital asset pricing model but there is no question they put upward pressure on quota values. In our later calculations it will show-up as a reduction in policy risk. It also justifies using prime plus two percent as the discount rate since these loans are quite safe from the lenders perspective.

The final element in the capital asset pricing model is the policy risk variable (j). We will provide estimates of this variable based on the data in Table 1 but it might be useful to think about its likely magnitude. In some of the early work on supply management large discount rates (which include policy risk) were estimated. For example, Barichello's (1996) estimates placed the annual average discount rate in Ontario

at 30 percent between 1980 and 1991. It seems likely that policy risk remained fairly high in the early 1990's because of the on-going Uruguay Round of trade negotiations. Following the tabling of the Dunkel Draft Text, in 1991, it was clear that import quotas for agricultural products were going to be tariffed but it was unclear what this would mean for Canada's supply managed commodities (World Trade Organization). However, following the completion of the negotiations in December 1993 it became clear that over-quota tariff rates, in the tariff rate quota scheme implemented, would be sufficiently high to prevent the importation of foreign dairy products and that any new import access created by the agreement would be minimal.

Finally, policy risk and quota values were influenced by two WTO cases lodged against Canada by the United States and New Zealand between 1995 and 2001. The United States and New Zealand challenged Canada's dairy product export programmes arguing they were illegal export subsidies under the Uruguay Round Agreement on Agriculture. Barichello (1999); Furtan, Romain and Mussell; Goodloe; and Meilke provide descriptions and economic analysis of the case but for our purposes it is sufficient to note that Canada lost. As a result, Ontario milk producers no longer had the option to supply milk outside the quota system if it was destined to be exported in the form of dairy products. The elimination of the export program left only one option for dairy farmers: to produce solely for the domestic market and to purchase more quota to cover the milk previously being used to make dairy products for export (Barichello, 1999).

Hence, beginning in the mid-1990's there was an accumulation of factors whose collective influence put upward pressure on milk quota prices despite the slow growth in the rental rate for quota. They are: 1) declining interest rates; 2) the Letter of Direction that changed lending practices for quota purchases and removed credit constraints; 3) easier credit availability at the FCC; 4) the elimination of alternative export-oriented production opportunities; and 5) the conclusion of the multilateral trade negotiations that insured that domestic milk producers were protected from cheap foreign products for at least another 15 years. This coupled with the maturity of the supply management system, its political support and the likelihood that it would not face major changes following the conclusion of the Doha Round (when ever, and if ever, that occurs) all served to lower policy risk to levels lower than previously experienced. Barichello (1999) makes many of the same points arguing policy risk fell from 30 percent in the 1980's to 10 percent in the mid-1990s.

3.0 The Quota Exchange and the Role of Speculation

Technological advances, additions to barn space, and expansion in the average size of dairy herds all increase the industry's productive capacity and the need for milk production quota. This is the foundation of the demand-side for quota on the quota exchange. In theory, the most efficient producers will seek to acquire more production quota so that they can expand output and minimize underutilized capacity (Mussell, Sparling, & Oginsky).

In contrast, producer life-cycles are the dominant force determining the supply-side of the exchange during a given period (DFO, 2009b). Thus, the number of retirees

and producers voluntarily exiting the industry in a given month will influence the amount of quota supplied to the exchange. The rapid increases in quota prices may have provided an additional incentive for existing producers to hang on to their quota, just as it would for any investor holding an asset with a rapidly advancing price.

However, the DFO viewed the rapidly escalating quota prices with some alarm. There are a number of reasons for this. First, the optics of ever increasing quota values is not good. With the cost of quota for a modest 100 cow dairy herd reaching \$3 million it is hard to argue that the system is saving the small family farm. Second, in-family transfers and secession planning become difficult with so much value attached to quota and the requirement that the dairy farm has to be operated by the quota holder. Third, those efficient producers wishing to expand into fairly large operations (300 to 600 cows) may have trouble raising the millions of dollars required to do so. Fourth, new entrants are essentially blocked from starting dairy operations as a result of the high quota prices, effectively creating a gentry of dairy producers and their families. Fifth, the non-supply managed sectors of agriculture have actively criticized supply management, claiming that the system permits dairy farmers to leverage their quota holdings in order to purchase land at prices cash crop farmers cannot afford. Finally, the DFO had a strong belief that there was a vicious cycle of speculation that was influencing quota values and it was not healthy for either the dairy sector or for individual producers should the “bubble” burst.

As a result the DFO took action to address what was in their view unsustainably high quota values. We turn to these policies in sections 3.1 and 3.2 but before doing so it is interesting to see if the capital asset pricing model can shed any light on the question of whether there has been “irrational exuberance” in the dairy quota market.

Let's start with 2006 when quota values peaked at \$321.67/hl (\$29,800/unit) as shown in Table 1.⁹ In 2006 our calculated rental rate is \$34.97/hl. If the growth rate of the rental value is set equal to the five year annual average increase (2002-2006) it is 2.1 percent, but this value is highly dependent on the years included in the sample so a more conservative estimate of one percent is chosen for this example. The interest rate in 2006 is 6.1 percent. Using these values and equation (5) you can solve for policy risk of 5.2 percent in 2006; a value that does not seem unreasonable to the authors; and significantly smaller than the estimates for the 1980's and the mid-1990's (Barichello, 1996, 1999).

$$j = (R - CV(r - g)) / (CV + R) \quad (5)$$

To continue the experiment, look at 1995 and assume that all of the figures calculated for 2006 are the same (including policy risk at 5.2 percent) except for the discount rate which was 9.1 percent in 1995. In this case the calculated value of quota is \$249.26/hl compared to the actual value of \$165.57/hl, a 50.5 percent undervaluation if policy risk was 5.2 percent.¹⁰ To generate the actual quota value policy risk would have had to be 10.7 percent – very close to Barichello's estimate (Barichello, 1999).

The trade-offs among the rental rate and the capitalized value of quota are illustrated in Figure 3. In Figure 3, capitalized quota values are shown on the vertical axis and rental rates on the horizontal axis. The three lines in Figure 3 differ by the value of policy risk ($r = 0.06$ and $g = 0.01$ are held constant along each line) ranging from four

⁹ Since our costs and returns are measured in dollars per hectolitre we had to convert the annual cost of quota, per unit, to the cost per hectolitre of milk. This requires dividing the per unit real quota price (\$29,800/unit in 2006) by 365 to obtain the daily price paid for quota (\$81.64 per day/unit). This was then multiplied by the annual average of the monthly provincial butterfat tests for each year (1994-2009) to obtain an estimate for the price of quota per hectolitre of milk (\$321.66/hl in 2006).

¹⁰ The undervaluation of quota is even higher (64 percent) if the rental rate (\$38.23/hl) calculated for 1995 is used instead of the 2006 value (\$34.97/hl).

percent along the top line, five percent along the middle line and six percent along the bottom line. A \$2/hl increase (decrease) in the rental rate raises (lowers) the capitalized value of quota by \$1,966/unit, \$1,751/unit and \$1,576/unit along the 4, 5, and 6 percent policy risk lines respectively. Conversely, at a rental value of \$28/hl a drop in policy risk from six percent to five percent raises the capitalized value of quota by \$2,463/unit and from five percent to four percent by \$3,011/unit; at a \$32/hl rental rate the corresponding changes in capitalized quota value are \$2,816/unit and \$3,441/unit. Hence, the larger the rental rate the larger the impact on quota values from a change in policy risk (or the discount rate). Figure 3 demonstrates how responsive quota values are to interest rates, policy risk and rental rates.¹¹

The discussion above leads us to a different conclusion than the DFO with respect to quota values. The rapidly rising quota values between 1995 and 2006 do not appear to represent excessive speculation, instead they appear to be the rational outcome of declining interest rates, declining policy risk and a “catch-up” in quota values with their intrinsic value as credit constraints were eliminated.¹²

However, in one important sense the cause of the rapid increase in quota values is immaterial. When interest rates increase quota values can fall quite rapidly, especially if perceived policy risk increases at the same time as might happen if the Doha Round is

¹¹ In Figure 3 the annual growth rate in $E(R)$ is held constant at one percent. While mathematically this is important in order for the policy risk variable to assume higher values, the authors feel this is an accurate depiction of the real price of milk, which holds relatively constant (Goldfarb). As can be observed in Table 1, the mail box price remains relatively stable over the sample period.

¹² An alternative hypothesis is that we have grossly overestimated rental rates. In 1995, with $r = 0.091$, $g = 0.01$ and $j = 0.052$ to generate a quota value of \$165.57/hl would require the rental rate to be \$23.23/hl about one-third less than the \$34.97/hl used in our experiment. This would imply that the marginal cost of milk production is \$41-\$43/hl a value we find unrealistically high. For comparison purposes C\$42/hl equals US\$18.48/cwt a price that would be considered “high” in the United States market.

concluded.¹³ With quota fully priced in our view, or overpriced in the view of the DFO, rising interest rates would have serious consequences for dairy producers who are highly leveraged.¹⁴

We now turn to a description of the policies the DFO adopted to try and constrain quota price increases.

3.1 A Progressive Transfer Assessment

A progressive transfer assessment policy was adopted in November 2006, it utilized a variable in-kind tax on the quantity of quota put on the quota exchange to restrict the price received by farmers selling quota to \$25,500/unit. This was implemented through a pay-what-you-bid provision in which buyers compete for quota on the exchange, and if they are successful pay their bid price. As shown in Figure 4 with $R_s = \$25,500/\text{unit}$ the progressive transfer assessment affects the amount of quota that sellers are willing to put on the exchange. At first glance the policy appears to be counterproductive because the quantity sold on the exchange declines and selling prices increase from their free market level. However, if there is a speculative element in the bid prices for quota the cap on the price of future sales at \$25,500 might shift the demand curve for quota sufficiently to the left to lower bid prices to, or below, the ceiling price. In short, the underlying assumption governing the introduction of the progressive transfer assessment was that speculation in quota was an important driver of quota values and

¹³ With current interest rates and given that the cost of capital cannot fall below zero it is a question of when interest rates will rise, not if they will rise. The extent to which the perception of policy risk will increase under new trade rules, yet to be determined, is unclear.

¹⁴ How highly leveraged dairy farms are depends on what value you put on quota but should it fall to zero many dairy farms would be insolvent. In 2002, for larger dairy farms (sales greater than \$500,000) the ratio of farm debt to non-quota equity exceeds one for Alberta, Ontario, and Quebec (1.1, 1.1, and 1.2, respectively) (Mussell et. al., 2005).

putting a ceiling on the resale price would help to deflate the expectation of future capital gains.

As shown in Figure 4, in the absence of a policy intervention, the equilibrium quota price would be R , resulting in buyer surplus equal to $(a + b + e)$ and seller surplus equal to $(c+d+f)$.¹⁵ As a result of the transfer assessment the quantity sold on the exchange declines from Q_e to Q_d , decreasing seller surplus to (d) and buyer surplus to (a) . Under this policy the transfer assessment is $(b + c)$. The in-kind tax on sellers imposes a dead weight loss in efficiency equal to $(e + f)$. The value of the deadweight loss depends on the supply and demand elasticities of the excess supply and excess demand curves for quota and the size of the in-kind tax.

On the demand-side, producers seeking to purchase quota face no direct restrictions, allowing competition among producers to allocate the quota available for sale to the highest bidders.

Finally, it is important to acknowledge the distributional effects of this policy. In Figure 4, area $(b + c)$ represents the value of the quota acquired by the DFO under the progressive tax assessment. This accumulated quota is then redistributed amongst all active producers engaged in dairy production relative to their current quota holdings, regardless of whether they participate on the quota exchange during that period. Thus, this policy results in a welfare transfer from producers participating on the exchange to the collective dairy sector.

¹⁵ In discussing the welfare implications of intervention on the quota exchange we use the terms “buyer” and “seller” surplus to describe the effects on each side of the milk production quota market. The terms consumer and producer surplus are only used when discussing the primary milk market.

3.2 The Price Cap System

In July 2009, the DFO changed their quota transfer policy from a progressive transfer assessment to a firm price ceiling. This decision appears to have been driven by the successful adoption of a price cap on dairy quota in Quebec; a number of legal actions by Ontario dairy producers arguing they should not have to pay the progressive transfer assessment (Ontario Ministry of Agriculture Food and Rural Affairs); and the fact that bid prices for quota had not dropped significantly with the progressive transfer tax.

Under this policy, the price ceiling, at $R_s = \$25,500/\text{unit}$ illustrated in Figure 4 applies to both buyers and sellers of quota and consequently there is no market mechanism to allocate the quota offered for sale. As a result, any milk producer whose marginal costs justify a bid price greater than $\$25,500/\text{unit}$ is foolish not to bid for quota. As shown in Figure 4 the demand for quota at $\$25,500$ is Q_f and the quantity offered for sale is Q_d and there is a shortage of quota equal to $Q_f - Q_d$ at that price.¹⁶

Figure 4 illustrates the welfare implications of fixing the price on the exchange. Instituting a price ceiling at $\$25,500/\text{unit}$ reduces seller surplus to (d), while buyer surplus becomes (a + b + c). This also leads to a deadweight loss equal to (e + f) the same as with the progressive transfer assessment. Seemingly, producers purchasing quota are the dominant beneficiaries of the policy change while sellers are no worse off than under the progressive transfer assessment. However, under the progressive tax assessment the available quota is purchased by producers willing to pay the highest price; in contrast with a price ceiling any producer with a reservation price above the ceiling price should

¹⁶ The ceiling price began at $\$25,500/\text{unit}$ in August 2009 and was scheduled to decline to $\$25,000/\text{unit}$ by January 2010. For simplicity, the ceiling price in our analysis is fixed at $\$25,500$.

bid and there is no market based way to allocate the quota. Consequently, the DFO had to develop rules to ration the available quota among all the producers who bid for quota.¹⁷

3.3 Stalemate

As this paper is being written, in April 2010, the Ontario dairy quota exchange has essentially been shut down by thousands of producers bidding for quota on the exchange and little or no quota being offered for sale.¹⁸ As predicted, by January 2010 there was a severe shortage of quota available on the exchange, which could not even facilitate the first round of distribution (0.1 kg per bid) as called for under the new policy. This has resulted in discontent among producers who are frustrated by their inability to purchase quota. As a result criticism has arisen, blaming both the New Entrant Quota Assistance Program (NEQAP), and the DFO's inability to sufficiently expand the demand for milk at a rate which would permit an increase in the aggregate quota (Anderson; DFO, 2009a).¹⁹

¹⁷ If the quantity demanded on the exchange exceeds the quantity supplied at the ceiling price the DFO allocates quota to each successfully bidding producer in 0.1 unit increments (the right to produce a tenth of a kilogram of butterfat). This method of allocation among all bidding producers continues until 50 percent of the quota supplied on the exchange for a given month is exhausted (DFO, 2009a). Then the remaining quota is distributed amongst those producers bidding on the exchange who have not completely acquired the quantity of quota listed in their bid. It is distributed proportionately to the quantity that each individual producer has demanded. A producer is not allowed to bid for more than ten percent of their current quota holdings. While this method may be equitable, it is arbitrary and inefficient.

¹⁸ The February 2010 quota exchange was canceled after one out of five existing producers placed a bid for quota and no one got any in the January exchange (Anderson).

¹⁹ Established in August 2009, the New Entrant Quota Assistance Program (NEQAP) is designed to assist new producers enter the industry. As such, some of the quota offered for sale on the exchange is set aside for the NEQAP. Applicants for the NEQAP cannot have produced or be the spouse of someone who has previously produced milk in Canada. Furthermore, each applicant must present a ten year financial plan certified by a qualified third party, coupled with a letter from a financier or lender stating its intention to finance future expansion of the operation. After the successful issuing of a license and an approved order to issue quota from the DFO, up to ten applicants are selected. Each successful applicant is allocated up to 12 units of quota (DFO 2009a).

In most markets where there are binding price ceilings a “black market” will develop to allow cagey individuals to circumvent the controls. A well known example is the offering of “key money” in markets where apartment rental rates are held artificially low. Another example is the unofficial black market currency exchanges in developing countries with overvalued official exchange rates. So, how can dairy producers circumvent the price ceiling on the dairy quota exchange? The most obvious way is to buy an ongoing dairy which includes the land, barn, cows and quota. However, because it is so obvious and the DFO wants at least some quota to be sold on the exchange, in March 2010 the DFO announced a number of quota transfer policy revisions (DFO, 2010b). With respect to on-going dairy farm operations the seller must have produced milk continuously for five years to be eligible to sell the farm as an on-going operation. Purchasers of on-going operations are : 1) required to purchase the dairy facilities and associated land base in order to obtain the quota; 2) purchasers cannot relocate the quota for five years; and 3) the purchased quota can never be merged with quota on another licence to produce or market milk. In addition, the DFO reaffirmed the policy that quota cannot be rented.

Since the DFO must approve all requests to transfer or acquire quota it appears they can make the above regulations stick, although the cost in terms of transaction costs and lost efficiency can be very high if producers continue to withhold quota from the exchange. There are also restrictions on the transfer of quota from a parent to a child at a different location, although transfers to a child at the same location seem to remain unrestricted. We will return to the quota transfer rules in section 5 but in the next section we provide some empirical evidence on the cost of restrictive quota transfer policies.

4.0 Modelling the Quota Transfer Market

In order to quantify the effects of the quota policies a simple linear, synthetic model of the Ontario quota exchange calibrated to 2007 data (Table 1) was constructed. The calibration to 2007 data was selected because it was the first full year after the imposition of the transfer assessment policy (November 2006 – July 2009).

The model contains two equations: the excess supply curve for quota and the excess demand curve for quota. In order to calibrate the model estimates of the excess supply and excess demand elasticities for Ontario dairy quota are required. Lambert et al. address the price responsiveness of the excess supply and excess demand and provides estimates of -5 for the demand elasticity and 10 for the supply elasticity. Although these estimates seem quite elastic, after the imposition of the progressive transfer assessment the volume of quota sold on the exchange declined from approximately 4.7 percent of the total stock of quota to around 2.5 percent in 2006 and 2007 (Mussell, Sparling and Oginsky).²⁰ This substantial decline (approximately 50 percent) in the volume traded suggests that the excess supply and excess demand curves for quota are in fact quite elastic and that the elasticity estimates reported in Lambert et al. (1995) provide a reasonable starting point for our model.²¹

The demand elasticity is imposed at the annual average bid price on the quota exchange in 2007 (\$28,653) and the supply elasticity at the ceiling price (\$25,500). Both are calibrated to the total quantity of quota traded in 2007 of 6,892.8 kilograms.

²⁰ In March 2010, the total stock of quota in Ontario was 268, 000 kg (Mann).

²¹ Alternative elasticity estimates were utilized to see how robust our reported results are with respect to the elasticity assumptions. Nine different pairs of supply and demand elasticities are reported in Table 2. The choice of elasticity pair influences the quantitative results but not the essential story.

Equations 6 and 7 are the excess supply (ES_q) and excess demand (ED_q) curves for quota used in the analysis where P_q is the market clearing price of quota.

$$ES_q = -61,957.2 + 2.70 P_q \quad (6)$$

$$ED_q = 41,276.4 - 1.20 P_q \quad (7)$$

Based on these two curves the unrestricted equilibrium price for quota in 2007 would have been \$26,470 and 9,512 kilograms of quota would have traded. Hence, the equilibrium price was only marginally (3.8 percent) above the initial price ceiling but at the equilibrium price 40 percent more quota (9,512 kg vs. 6,892.3 kg) would have been traded.

4.1 Welfare Analysis of the Quota Transfer Policies

The welfare analysis of the transfer assessment policy and the price ceiling policy are contained in Table 2 where the value of buyer and seller surplus and the value of the in-kind tax are shown for the baseline model and the two policy scenarios for nine different pairs of elasticity estimates. In this discussion we will concentrate on the results for the excess supply elasticity of 10 and the excess demand elasticity of -5.

The results are consistent with expectations. Under the progressive transfer assessment policy buyer surplus declined by \$17.9 million and seller surplus by \$7.9 million in comparison to the baseline figures. The in-kind tax revenue equals \$21.7 million and the deadweight loss from the policy is \$4.1 million. Hence, the progressive transfer assessment policy transfers \$21.7 million from the buyers and sellers of quota to the general dairy sector at a cost of \$4.1 million. The deadweight loss in the quota market represents about two percent of the farm cash receipts from the sale of dairy products in Ontario in 2007: a non-trivial sum of money (Statistics Canada). For this

policy we present three measures of efficiency in Table 2. The first is the deadweight loss divided by the undistorted total economic welfare (seller surplus + buyer surplus) which shows that in the base case 7.6 percent of total welfare is lost by levying the in-kind tax. The second is the change in buyer surplus divided by the change in seller surplus which shows the relative losses of the buyers and sellers of quota. This ratio, in the base case, is 2.26 showing that the buyers of quota suffer losses more than twice as large as the sellers of quota. Finally, we provide the traditional measure of transfer efficiency which in this case is the deadweight loss divided by the in-kind tax revenue and it equals \$0.19, indicating it wastes 19 cents to transfer a dollar of income to the beneficiaries of the in-kind tax. Clearly, the beneficiaries of the transfer assessment policy are the milk producers remaining in the industry who receive an asset that is worth at least \$25,500/unit for free, albeit in very small quantities.

In contrast to the transfer assessment policy, under the price cap system which utilizes a price ceiling of \$25,500/unit, no tax revenue is collected and there is a direct welfare transfer from the sellers of quota to the buyers of quota. This is clear from the negative ratio of the change in buyer surplus divided by the change in seller surplus which equals -\$0.48 indicating it is costing sellers a dollar for every 48 cents gained by buyers. Since the deadweight loss from the price cap and the transfer assessment are the same the deadweight loss divided by total welfare remains at 7.6 percent. Since this is a policy clearly designed to transfer welfare from quota sellers to quota buyers transfer efficiency is defined as the deadweight loss divided by the change in buyer surplus. Table 2 shows this ratio equals 1.08 indicating that it costs \$1.08 to transfer one dollar to quota purchasers under the price ceiling policy – an extremely inefficient policy if this is

truly the policy objective.

Table 2 illustrates that different elasticity combinations result in subtle differences in the analysis of the two policies but they do not change the story in any meaningful way.

5.0 Implications for Policy

The actions of the DFO in attempting to halt the growth in quota values are well intended but at the same time they have created new problems and new sources of inefficiency. While the DFO may be able to “ride out” the current stalemate in the quota market, the current rules making it uneconomical to purchase an on-going dairy enterprise, coupled with a price ceiling and the absence of a market based means to allocate available supplies on the exchange will seriously inhibit the rationalization of the dairy industry. Of course, if interest rates and/or policy risk begin to rise this might drive the equilibrium price of quota below the ceiling price, but the restrictions on sales of on-going dairies will remain and increase transfer costs that are not captured in our analysis.

If the DFO wants to lower quota prices there are a number of ways (some radical, some not so radical) that this can be done at far lower transaction costs than the current policy. In addition, there are changes that could be made to help the industry compete, if and when it faces more pressure from imported products.

The first best policy that every economist would mention is to lower the milk price. This would have an immediate impact on rental rates and hence the value of quota. However, this would entail a major change in the *status quo* and would likely require a national policy change rather than just an adjustment of policy in Ontario. It would also

be interesting to see the impact on quota values if the Canadian Dairy Commission announced that it was fixing the target price for milk for the next five years. This would clearly influence the outlook for the growth in the rental rate and also put downward pressure on quota values with no decline in nominal milk prices.

Another option (again in the radical change camp) would be to introduce a tax on the sale of all quota, whether through the exchange or as part of an on-going operation. This would be a modest tax of, say 2-5 percent. It would be a fixed tax rate unlike the variable tax rate used under the transfer assessment program. The innovation would be for the DFO to sell the quota raised by the tax to producers; but this quota would pay the producer a lower price of milk, say 80 percent of the target price. This would implement the two-quota scheme discussed in Barichello, Cranfield and Meilke (2009). As a result there would be two classes of quota, one that returns the target price and one that returns a lower price – giving producers an option of which class of quota to purchase.²² Over time a lower average milk price and quota value would be established and there would be some increase in market demand.

A third, and less radical, option would be to move back to an unfettered market for quota while at the same time relaxing the rules governing the purchase of on-going operations. With interest rates set to rise, and based on the equilibrium quota price we calculated for 2007 market clearing prices might soon drop below or close to \$25,000. At the very least this policy change would remove some of the costly inefficiencies in the quota transfer market. If a “bubble” should develop (although we think this is highly unlikely) and “pop” the DFO could say “we told you so”.

²² Operationally the scheme could be operated in the same fashion as when industrial and fluid milk were priced differently and had different quotas.

Finally, if the only realistic options are a progressive tax assessment or a price ceiling, then the DFO should revert back to the progressive tax assessment. Imposing a strict price ceiling on both sides of the exchange is going to prove impossible to rationally allocate quota amongst bidders unless the equilibrium price drops below the ceiling price. We would suggest a three month warning before changing back to the in-kind tax so that active producers can adjust their decision to account for the policy.

6.0 Conclusions

Our findings suggest that the rapid increase in quota values between 1995 and 2006 were largely the outcome of market forces (a declining discount rate and policy risk) and the relaxation of credit constraints on lending money for quota purchases. The introduction of first a in-kind tax and then a price ceiling in the quota market to halt the growth of quota values achieved its objective but at a high cost in terms of inefficiency in the quota market. The *status quo* (a price ceiling) with little quota being sold on the exchange and tight restrictions on the sale of on-going operations does not seem sustainable as long as the ceiling price remains binding. With the ceiling price, even if quota is offered for sale on the exchange, it entails the arbitrary distribution of small quantities of milk production quota to the many bidders with reservation prices above the price ceiling. This stifles the ambitions of those producers wishing to expand their low-cost operations.

If radical changes in the milk market, such as lowering support prices or creating two classes of quota are impossible then it would be better to move back to a tax system rather than the current ceiling price. It is interesting to note that the problems

surrounding the exchange of quota were studied more than 20 years ago by the well known expert on supply management systems Richard Barichello and his student Catherine Cunningham-Dunlop (1987). Their advice is as relevant today as it was in 1987 (Barichello and Cunningham-Dunlop, p. 223-224):

The economic effects of these [quota transfer] restrictions are not benign. In fact, when enforced they usually have significant negative effects on the economic efficiency of the industry; indeed, generally speaking, the greater the number of rules, the less efficient the industry becomes. The ideal system for managing the transfer of farm quotas should be very simple, for reasons of both administrative simplicity and industry efficiency. If an efficient industry is to be sought, administrators of quota schemes are advised to resist as much as possible any temptation to achieve too many objectives with their quota regulations or otherwise fine-tune them.

Appendix I

Consider a firm i deciding how much to produce y_i in a supply managed industry where p is the output price, and q is the cost to rent the quota required to produce one unit of output y_i per production period.²³ The firm has an initial allocation of production quota equal to Q_i . There is a market for quota so that the firm can sell all of its Q_i at q , or purchase as much as it wants at q . If the firm's initial allocation of quota is greater than the amount it wishes to produce then it can sell quota and this produces revenue for the firm, if it wants to produce more than its initial allocation of quota then it must rent additional quota and this represents a cost. In this case the firm's profit function is:

$$\text{Max } \pi_i = py_i - C(y_i) + q(Q_i - y_i) \quad (8)$$

The first order condition for profit maximization is:

$$d\pi_i/dy_i = p - dC/dy_i - q = 0 \quad (9)$$

This equation shows that the rental rate of quota is the difference between the output price and the marginal cost of production (Moschini, 1988).

$$q = p - dC/dy_i \quad (10)$$

Further, if a firm purchased quota we know

$$p - dC/dy_i > q \text{ when } y_i = Q_i \text{ and} \quad (11)$$

if a firm sold quota we know.

$$p - dC/dy_i < q \text{ when } y_i = Q_i \quad (12)$$

As a result, the rental value of quota will be established in the aggregate milk market and depend on the degree to which milk output is reduced relative to the free market equilibrium, the price of milk and the marginal cost of producing milk. Given the

²³ The fact that you cannot rent milk quota introduces "friction" into the market but does not change the basic economics.

rental value of quota individual firms will trade quota until the price of milk minus their marginal cost of production equals the rental rate (equation 10). The fact that no rental market exists for quota does not change the basic economics but makes it more difficult for firms/farms to easily adjust their output and quota holdings as a result of short-run variations in marginal costs. Note, that even if all firms are identical there can be quota transactions if the quota is not efficiently allocated.

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Figure 1: Nominal and Real (2006 = 100) Quota Values 1994-2009

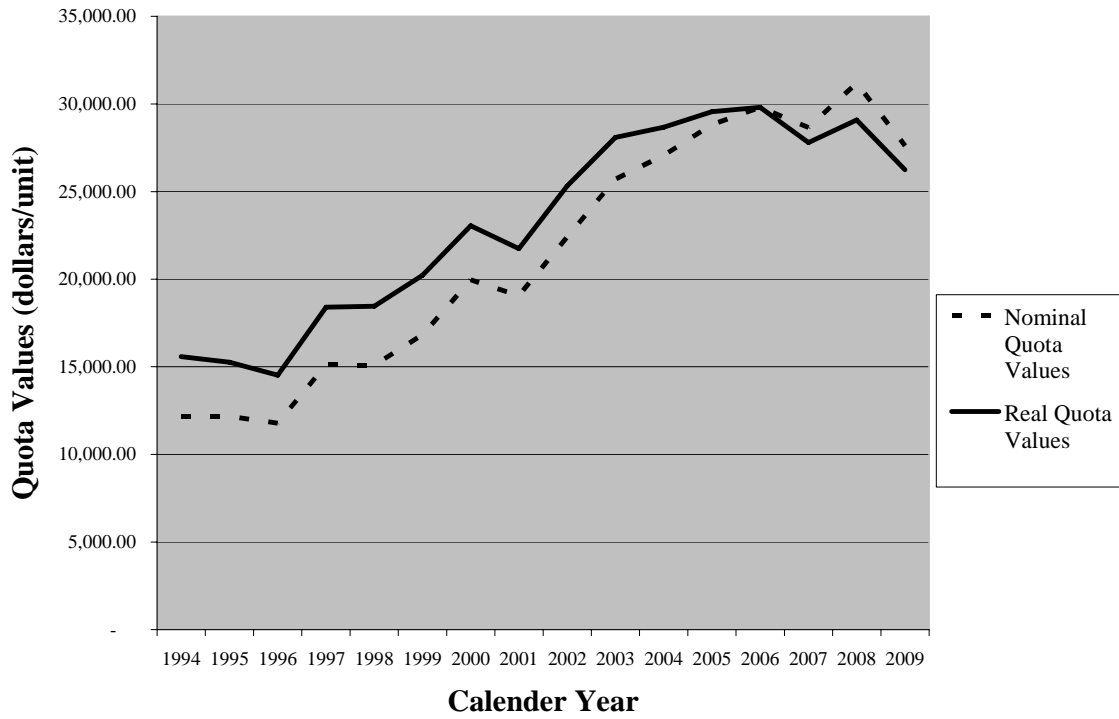


Figure 2: The Welfare Analysis of Supply-Management

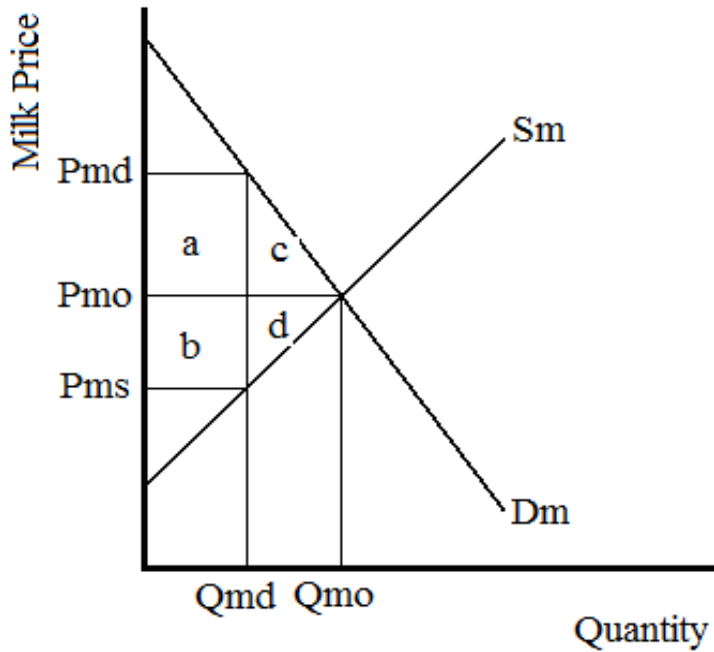


Figure 3: The Relationship of Rental Rates, Policy Risk and Capitalized Quota Values

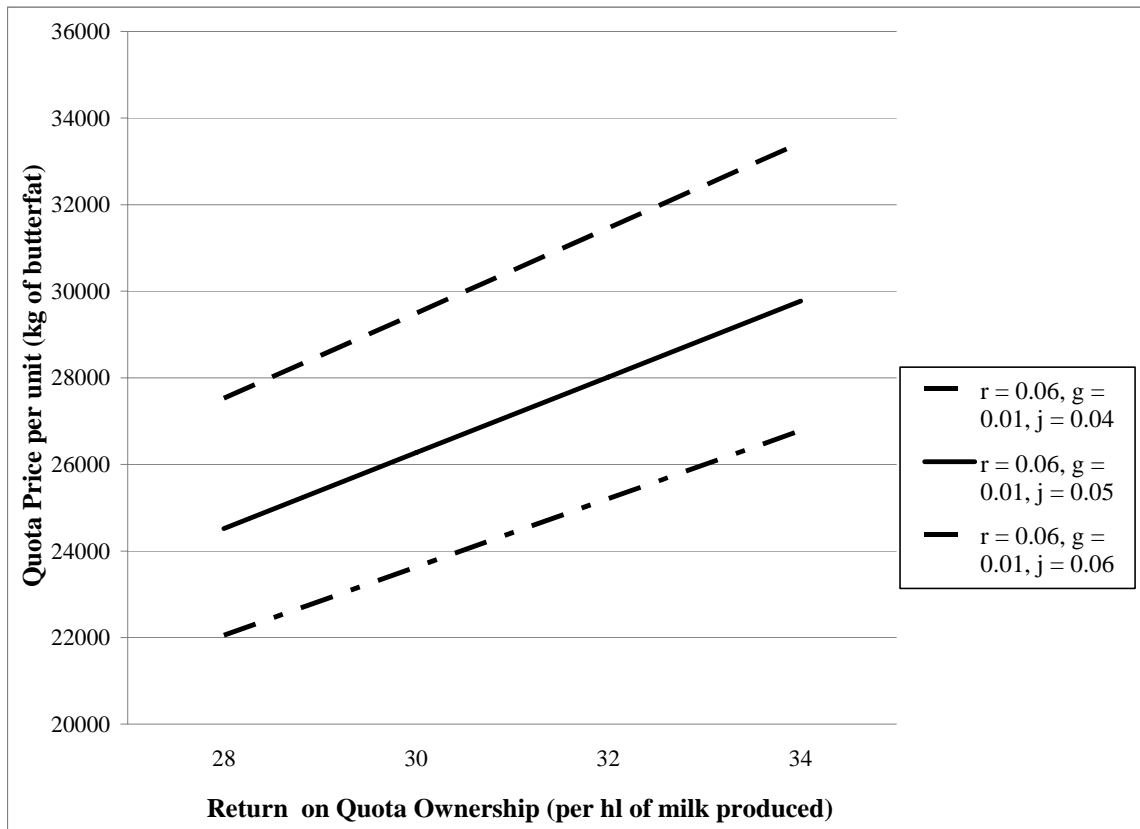


Figure 4. Welfare in the Milk Quota Market

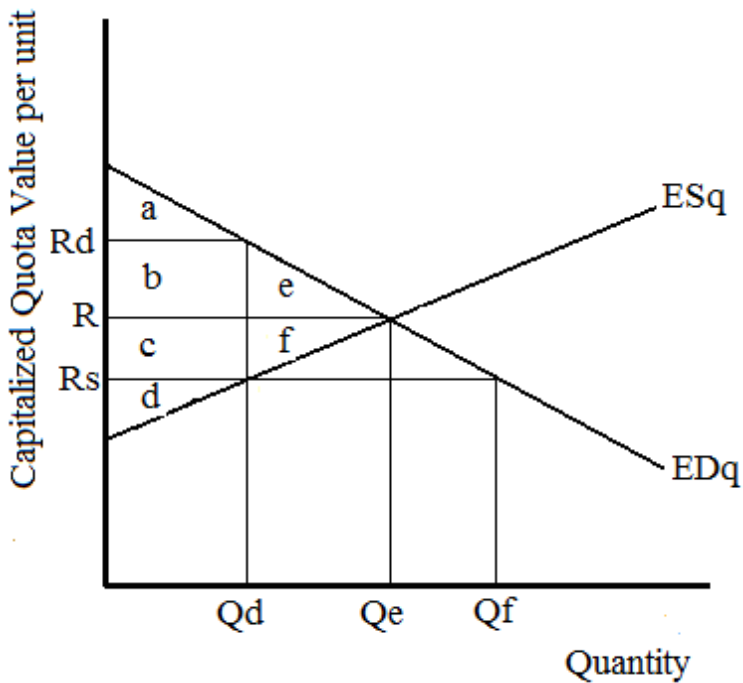


Table 1. Milk Production and Quota Market Data, 1994-2009²⁴

Year	Quota Value (\$/unit)	Quota Value (\$/hl)	Volume of Quota Exchanged	Milk Target Price (\$/hl)	Mail-box Price (\$/hl)	Cash Costs (\$/hl)	Rental Rate of Quota (\$/hl)	Interest Rate (Prime +2%)
1994	\$15,583	\$172.04	Na	\$66.94	\$68.33	\$26.26	\$42.07	7.3%
1995	\$15,260	\$165.57	Na	\$66.85	\$66.41	\$28.18	\$38.23	9.1%
1996	\$14,525	\$157.97	7740.9	\$66.87	\$64.54	\$30.36	\$34.18	6.3%
1997	\$18,403	\$196.64	12914.0	\$66.05	\$63.71	\$30.82	\$32.89	5.5%
1998	\$18,457	\$197.22	12343.1	\$67.82	\$67.82	\$28.88	\$38.94	7.0%
1999	\$20,212	\$216.50	10159.2	\$67.01	\$64.75	\$29.74	\$35.01	6.9%
2000	\$23,050	\$247.55	13182.2	\$65.33	\$65.15	\$31.95	\$33.20	7.6%
2001	\$21,738	\$232.88	11023.7	\$66.05	\$66.08	\$34.46	\$31.62	6.0%
2002	\$25,324	\$270.58	11898.4	\$66.52	\$64.67	\$32.69	\$31.98	4.5%
2003	\$28,098	\$302.53	12946.3	\$67.78	\$65.74	\$32.64	\$33.10	4.9%
2004	\$28,668	\$306.31	12003.8	\$68.02	\$63.95	\$32.53	\$31.42	4.3%
2005	\$29,558	\$316.63	11407.7	\$70.98	\$66.31	\$33.32	\$32.99	4.7%
2006	\$29,800	\$321.66	11536.0	\$71.00	\$66.36	\$31.39	\$34.97	6.2%
2007	\$27,792	\$297.71	6893.3	\$69.95	\$67.12	\$30.83	\$36.29	6.5%
2008	\$29,091	\$314.82	5563.2	\$67.58	\$64.92	\$32.61	\$32.31	5.2%
2009	\$26,246	\$284.75	5405.6	\$70.95	\$67.08	Na	Na	2.6%

²⁴ All of the dollar values in this table are real 2006 dollars deflated using the GDP deflator.

Table 2. Results of Welfare Analysis of the Progressive Transfer Assessment and Price Ceiling Policies with Different Elasticity Assumptions

Policy	Supply Elasticity	Demand Elasticity	Seller Surplus (SS)(\$mil)	Buyer Surplus (BS)(\$mil)	In-kind Tax (\$mil)	Δ SS ²⁵ (\$ mil)	Δ BS (\$ mil)	Δ In-kind Tax (\$ mil)	DWL ²⁶ (\$ mil)	DWL/BS+SS	Δ BS/ Δ SS	Δ DWL/ Δ Tax	Δ DWL/ Δ BS	
No Intervention	8	-4	\$18.9	\$42.2	\$0	N/A	N/A	N/A	\$0	0	0	0	0	
		-5	\$20.1	\$36.2	\$0	N/A	N/A	N/A	\$0	0	0	0	0	
		-6	\$21.4	\$32.1	\$0	N/A	N/A	N/A	\$0	0	0	0	0	
	10	-4	\$15.3	\$43.4	\$0	N/A	N/A	N/A	\$0	0	0	0	0	0
		-5	\$16.6	\$37.7	\$0	N/A	N/A	N/A	\$0	0	0	0	0	0
		-6	\$17.9	\$33.7	\$0	N/A	N/A	N/A	\$0	0	0	0	0	0
	12	-4	\$13.1	\$44.4	\$0	N/A	N/A	N/A	\$0	0	0	0	0	0
		-5	\$14.4	\$38.8	\$0	N/A	N/A	N/A	\$0	0	0	0	0	0
		-6	\$15.5	\$35.0	\$0	N/A	N/A	N/A	\$0	0	0	0	0	0
	Progressive Transfer Assessment	8	-4	\$11.0	\$24.7	\$21.7	-\$7.9	-\$17.4	\$21.7	\$3.4	0.062	2.21	0.155	N/A
			-5	\$11.0	\$19.8	\$21.7	-\$9.1	-\$16.4	\$21.7	\$3.8	0.071	1.80	0.176	N/A
			-6	\$11.0	\$16.5	\$21.7	-\$10.4	-\$15.6	\$21.7	\$4.3	0.079	1.50	0.198	N/A
10		-4	\$8.7	\$24.7	\$21.7	-\$6.6	-\$18.6	\$21.7	\$3.5	0.065	2.83	0.162	N/A	
		-5	\$8.7	\$19.8	\$21.7	-\$7.9	-\$17.9	\$21.7	\$4.1	0.076	2.26	0.190	N/A	
		-6	\$8.7	\$16.5	\$21.7	-\$9.1	-\$17.2	\$21.7	\$4.7	0.086	1.88	0.215	N/A	
12		-4	\$7.3	\$24.7	\$21.7	-\$5.8	-\$19.6	\$21.7	\$3.7	0.068	3.37	0.169	N/A	
		-5	\$7.3	\$19.8	\$21.7	-\$7.0	-\$19.0	\$21.7	\$4.4	0.080	2.70	0.200	N/A	
		-6	\$7.3	\$16.5	\$21.7	-\$8.2	-\$18.5	\$21.7	\$4.9	0.091	2.25	0.228	N/A	
CAP policy (Price Ceiling)		8	-4	\$11.0	\$46.5	N/A	-\$7.9	\$4.3	\$0	\$3.4	0.062	-0.54	N/A	0.788
			-5	\$11.0	\$41.5	N/A	-\$9.1	\$5.3	\$0	\$3.9	0.071	-0.58	N/A	0.724
			-6	\$11.0	\$38.2	N/A	-\$10.4	\$6.1	\$0	\$4.3	0.079	-0.59	N/A	0.702
	10	-4	\$8.7	\$46.5	N/A	-\$6.6	\$3.1	\$0	\$3.5	0.065	-0.47	N/A	1.134	
		-5	\$8.7	\$41.5	N/A	-\$7.9	\$3.8	\$0	\$4.1	0.076	-0.48	N/A	1.081	
		-6	\$8.7	\$38.2	N/A	-\$9.1	\$4.5	\$0	\$4.7	0.086	-0.49	N/A	1.035	
	12	-4	\$7.3	\$46.5	N/A	-\$5.8	\$2.1	\$0	\$3.7	0.068	-0.37	N/A	1.734	
		-5	\$7.3	\$41.5	N/A	-\$7.0	\$2.7	\$0	\$4.4	0.080	-0.38	N/A	1.613	
		-6	\$7.3	\$38.2	N/A	-\$8.2	\$3.3	\$0	\$4.9	0.091	-0.40	N/A	1.512	

²⁵ Δ denotes the phrase “a change in” from a DFO policy intervention

²⁶ DWL denotes the phrase Dead Weight Loss