# The Welfare Effects due to Canadian Dairy Supply Management

By

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**Abstract**

Since the early 2000s, the price of dairy products in Canada has been increasing significantly. Moreover, relative to other major economies such as the United States, the European Union and the Oceania region, Canada's dairy products are consistently the most expensive.

This paper will analyze the welfare effects due to Canadian dairy supply management through measuring the Dead-Weight Loss (DWL) for the year 2010. Data such as blend prices, total production and quota values are obtained through the Canadian Dairy Commission and the Canadian Dairy Information Center. Other required data, such as the demand elasticities, are obtained through a technical report by Moschini and Moro (1993). Other data such as the supply elasticity and total discount rate is observed and/or assumed from past work.

Based on the calculated results, it is concluded that there was a DWL ranging from $307 million to $555 million in the year 2010.

# Chapter 1: Introduction

The issue of supply management of the Canadian dairy industry is not a new area of economic debate. Critics have addressed supposed economic inefficiencies such as the potential trade implications[1]; the inhibiting of economies of scale; the impact of closed borders and high tariffs on imports; the welfare transfer from consumers to producers; and the loss in output/consumption known as Dead-Weight Loss (DWL). This thesis will address the DWL resulting from Canadian supply management, which will aid in understanding the costs of sustaining Canada's current dairy policy. Moreover, this notion of economic inefficiency due to supply management has been advocated for years and there is value in re-estimating this inefficiency in order to paint an updated picture of the economic losses being sustained by Canadians.

The differences between a free market dairy industry and a supply managed system are important. In a free market approach, dairy farmers can produce any amount of milk and can expand or reduce the size of their operation freely without external/governmental regulations or restrictions. Free market dairy farmers also sell directly to the consumers of dairy products and receive a market price for their produce. In a supply managed system, output is restricted and controlled by a regulatory body. In Canada, this is the Canadian Dairy Commission (CDC). The CDC operates by first implementing a quota system, which requires dairy farmers to purchase a quota in order to produce milk up to the quantity that the particular quota allows. Second, the Canadian government heavily taxes imports of dairy products, which reduces the ability to purchase international dairy

[1] Trans-Pacific Partnership and European Free Trade negotiations are leveraging Canada to remove tariffs on imports, which would lead to the undercutting of Canadian dairy prices.

products at a price lower than the domestic one.  As prices are not subjected to free market competition in supply management, dairy farmers sell their dairy to their Provincial Milk Marketing Board. Provincial prices received by farmers (referred to as blend prices) technically vary from province to province but there are two major revenue-pooling agreements amongst Canadian provinces. The western region of British Columbia, Alberta, Saskatchewan and Manitoba represent the Western Milk Pooling Agreement. Ontario, Quebec, New Brunswick, Nova Scotia and Prince Edward Island represent the Agreement on All Milk Pooling, known as the P5.

Figure 1:DWL

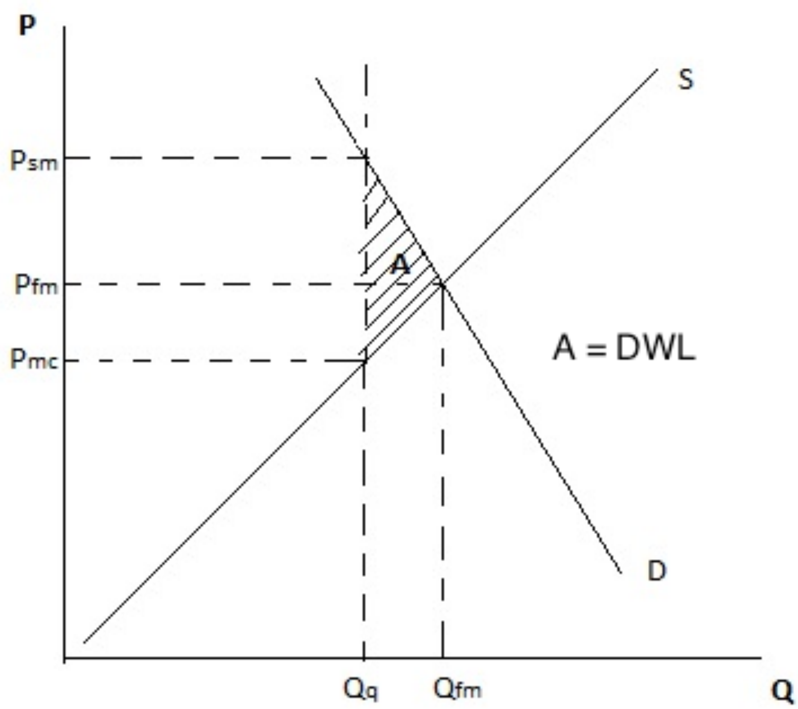



Figure 1 illustrates the typical market scenario under a supply managed system and is similar to that of Canada's dairy supply management. As illustrated, the market equilibrium output is at $Q_{FM}$, but this output is reduced and restricted by the quota system to $Q_q$. As output is reduced, prices received by farmers, $P_{SM}$, are higher than the free market price of $P_{FM}$. The reduction in output, created by under production, is represented in area 'A'. This is known as the Dead-Weight Loss (DWL) and represents the loss in economic efficiency and exchange. DWL illustrates an area of economic inefficiency in which producers and consumers are still able to obtain surpluses. Meaning, a producer would still produce and consumer would still consume/purchase if both were abled to. This effect happens because the marginal cost (supply) of producing more dairy goods is still lower (or cheaper) than the marginal benefit (demand), which represents the willingness of consumers to purchase more dairy goods.

The main reasons for a resurgence of the Canadian dairy supply management issue are twofold. First, Canadian prices have been consistently higher than those of other developed nations without supply management. Second, the rapid increase in quota values hinted at the potential growth in the rental rate for dairy farmers, which will be expanded on later within this paper. For example, British Columbia's dairy quotas have surpassed \$40,000 per Kg per day (denoted by: /Kg/day) of production for a year. This equates to roughly one cow's output per year (CDC 2013). Also, the rapid increase in quota prices has forced the P5 revenue pooling group to agree upon price ceilings for dairy quotas at \$25,000/Kg/day of production, which was implemented in 2010 (CDC 2013). Furthermore, the implementation of a quota price ceiling is the main reason this paper's estimation will be taken for the 2010 calendar year as it was the last year auctioned quota values could be observed or easily speculated on.

## Chapter 2: Literature review

One of the challenges pertaining specifically to calculating the DWL of the Canadian dairy supply managed industry is the lack of past academic literature estimating the DWL. The last paper to be released that estimated the DWL was by Owen Lippert (2001), which was not a peer-reviewed academic paper. This illustrates how little attention has been given to the market inefficiencies (welfare effects) due to supply management. Recently, literature has focused on issues of: obtaining a marginal cost estimate, focusing on the impact of potential trade, analyzing policy risk (something that will be explained further), or the recent growth in auctioned quota values.

There are numerous ways to estimate DWL. But before attempting to calculate DWL, it is necessary to find the needed variables such as marginal cost of production, price received by farmers and quantities produced. Past academic literature that does not directly calculate DWL can still present methods for estimating these needed variables.

### 2.1: Estimating Marginal Cost of Production

Theoretically, in perfect economic competition profits will be pushed down to the marginal cost of production, which results in making zero economic profit for the producers[2]. However, in supply management, this is not the case. Provincial milk marketing boards pay the farmers above marginal cost, typically at a price called the blend price (or mailbox price). Profits, or the economic rent, are seen by viewing the difference between the price received ($P_{SM}$) and the marginal cost ($P_{MC}$) on figure 1. Moreover, viewing these profits enables one to use an approximation of marginal cost,

[2] It is important to distinguish the difference between economic and accounting profit.

which is typically needed for a dead-weight loss calculation.

Recent literature measuring the marginal cost of production has come in several different forms. Cairns et al. (2010) illustrate one method to estimate marginal cost when they first set to look at the reason for the rapid increase in quota values. They presume that the total cash costs of production (from the annual farm accounting report) adequately can be substituted for a marginal cost estimate, which is $31/Hl[3]. Given this the marginal cost estimate, a rental rate (profit) of $35/Hl can be calculated[4]. Next, Cairns et al. (2010) calculated a quota value growth rate of 2.1% (over the period 2002-2006) and use a prime plus two as a discount rate. They use these rates plus their marginal cost estimate to solve for an appropriate policy risk value for numerous periods using the formula (1). Where the discount rate (R) is adjusted for 2006 levels. Cairns et al. (2010) calculate a policy risk (which will be explained further) of 5.2%.

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

The use of total cash cost of production as an estimator of marginal cost is also discussed by Meilke, Sarker and Le Roy (1996) but not employed by them. Meilke et al. (1996) focus on the many challenges of guessing marginal cost from an accounting style report. They have four main issues. First, marginal cost varies from size, locations and technology; secondly, as average cost varies substantially from various output levels, it is important that sample sizes are accurate; thirdly, the opportunity cost of farm supplied inputs (labor, capital) are unknown and hard to proxy; lastly, under supply management, there are incentives for farmers to inflate their cost which results in increased prices and

[3] Hl stands for hectolitre, which is 100 litres.
[4] Blend price of $66/Hl minus marginal cost of $31/Hl equals a profit of $35/Hl.

profits.

Moschini (1988) also provides a marginal cost estimate through a micro level analysis of the cost structure of Ontario farms. Moschini attempts to derive marginal cost through applying a multiproduct hybrid-translog cost function. This econometric method seeks to create an accurate estimation of the overall cost curves through various sized farms in Ontario. Moschini is able to use Ontario for a regression analysis as there is more data available that notes the cost and outputs of various sized farms. From there, they record the costs, revenues and incomes of these varying farm sizes.

Moschini derives a graph which includes a marginal cost curve and average total cost curve, along with indicators for the blend price of both fluid milk and industrial milk. Traditionally, at the intersection of marginal cost and average total cost it was possible to begin to illustrate a supply curve, but as the dairy industry is not in free market competition this is not as useful. On the other hand, Moschini illustrates that in 1980, a free market break-even quantity produced would have been roughly 5095 Hl/farm at a marginal cost of production around $30.33 per Hl. But supply management has allowed farmers a break-even quantity around 1042 Hl/farm, as farmers are paid prices above open market equilibrium.

### 2.1.1: Meaning and Implications of Quota Values

The importance of auctioned quota values is that one can use these provincially auctioned values to estimate the average economic rent per farmer. If the estimated rental value (R) is subtracted from the price of milk under supply management ($P_{MS}$), it ought to result in an approximate marginal cost of production ($P_{MC}$). This theory comes from the understanding that farmers will bid up a quota's price to the point that it is representative of their potential profits within the quota (or any asset). Simply put, as one attempts to purchase the right to produce at a profit, one will bid up to the amount that is representative of those profits (when properly discounted). Conversely, in an open and competitive free market, quota values would be zero. This is because there are no barriers to entry and any producer can seek to obtain any economic profits. Within supply management, dairy quotas restrict production and the legal ability to produce a good without permission. This hinders the ability for any other farmer to increase milk production (or enter the market) in order to attain those profits.

However, in recent years quota values have grown at unprecedented rates, which have initiated many to question why this is happening and what this represents. Meilke and Cairns (2011) illustrate that between the periods of the mid 1990s and 2006 the average quota price more than doubles, going from $15,000/Kg/day to more than $30,000/Kg/day. This represents an annual average real return of 11.7%. This rise led Ontario, Quebec, Nova Scotia, New Brunswick and Prince Edward Island to implement price ceilings for quotas at the $25,000/Kg/day level (CDC 2013)[5]. Furthermore, other provinces like British Columbia have implemented a unique auction system. British Columbia's auction incrementally increases or decreases the value of the quota by $500 depending on the rate/amount of buyers and sellers. If for three consecutive quota exchanges, (which happen once a month) the volume of bidders is above the volume of sellers at the going market price, the quota increases by $500. Conversely, if the volume

[5] Ontario, Quebec, Nova Scotia, New Brunswick and Prince Edward Island agreed to implement a price ceiling, first in 2007 with a cap of $30,000, then in 2008 to cap at $25,000 by July 2012.

of offers to sell exceeds the offers to purchase at the market price, prices will be reduced by $500 for the next quota exchange (BC Dairy Marketing Board 2013).

Nevertheless these fluctuations were not due to changes in the prices received by farmers nor the marginal cost. It was simply a change in the parameters affecting their willingness and abilities to buy quotas that led to the increasing values.

Cairns et al. (2010), Rajsic and Fox (2012), Meilke and Cairns, (2011) and Hall (2012) all discuss the causes and/or the impacts involved with the increasing quota prices. Cairns et al. (2010) attribute the dramatic increase in quota values to five main components: declining interest rates that reduce the cost of borrowing; Letters of Directions, which enables the loaning institution to be the first creditor paid in case of payment problems[6]; increased and easier attainment of credit available by Farm Credit Canada; the elimination of alternative export focused production; and the conclusion of multi-lateral trade agreements that threatened Canadian supply sanagement such as the Uruguay Round of trade discussions.

Furthermore, a concern made by Cairns et al. (2010) was that the rapid increase in quota values might have been partially due to market speculation. Meilke and Cairns (2011) refute that notion and state the rapid gains in quota values from the mid 1990s to 2006 were not due to increased profits or speculation. Meilke and Cairns (2011) argue that the increases were due to natural, market and regulatory forces, similar to the five reasons stated above.

Although the Meilke et al. (1996) paper was written before the major quota

[6] If a farmer is in financial trouble and sells the quota or goes bankrupt, Letters of Direction legally freeze revenues from any transaction until the lending institution has been paid.

increase, they can add to this list of potential causes if it is accepted that the natural tendency for farmers is to continually inflate cost knowing that they will receive a price/profit based on those costs. This notion comes from the fact that farmers self report their costs, which is one influential factor in setting the blend price, otherwise known as the "fair" price farmers receive from the provincial milk marketing boards.

Hall (2012) also states some challenges due to the increase in quota prices. Hall states that the increase of quota values has also lead to more economic inefficiency, as farms have to raise vast funds if they are seeking to expand or simply enter the market. As quota values reach $30,000/Kg/day, the capital needed to justify a significant expansion can be in the millions. The growth of these quotas also means that it is more challenging to exploit any economies of scale, which could possibly increase production efficiency.

Rajsic and Fox (2012) add an important element to this discussion, and assist in the analysis to come. They do so by predicting quota values for Ontario and Quebec in the year 2010. As quota values were capped in 2010, Rajsic and Fox (2012) use a linear projection from the years 2003 -2009 to predict the quota values for the year 2010 - 2011 in a system free from price ceilings. They conclude that Ontario's quota prices would be rising to roughly $33,015/kg/day and conversely, Quebec's quotas would be falling to roughly $27,711/kg/day butterfat[7].

2.1.2: Capital Asset Pricing Model

Another method for determining marginal cost has been the capital asset pricing

[7] This is assuming the awareness of a future price ceiling did not effect the auctioning mentality prior to its implementation.

model. It is possible to use the capital asset pricing model to calculate the potential profit (rental rate) per quota that farmers bid on. Given this profit margin, an estimate of marginal cost for provincial or national farmers can be established. This procedure of solving for unknown variables within the capital asset pricing model was employed by Cairns et al. (2010). However, they used the formula to solve for policy risk instead of marginal cost (they assumed marginal cost through a different methodological presumption). The problem with this calculation lies in the fact that only 1/3 of the variables are known with certainty, which is the current value (CV). The formula states that the current value (CV) is equal to the expected rental rate [E(R)], divided by the discount rate (r) (2). Through adding the growth rate aspect of the quota (g) and Borichello's (1996) facet of policy risk (j), one can observe the transition into the model used by Cairns et al. (2010) (3)[8].

Capital Asset Pricing Model

(2) CV=(E)R/r

(3) CV=(E)(1-j)/r-g+j

Referring to figure 1, the expected return would give the value in which one would subtract from $P_{SM}$ to get $P_{MC}$. Cairns et al. (2010) state that, on average, Canadian farmers received a $34.96/Hl rental rate which would make marginal cost of production roughly $31.39/Hl.

It is important to distinguish that the discount rate incorporates a systematic risk

[8] Barichello argues that both the expected returns and the discount rate are affected by policy risk, meaning that policy risk affects how farmers view the stability of their returns (1-j) (which geometrically decays over time) and the permanent loss of their return (j). As this paper uses the denominator as it discount framework, it assumes that the entire policy risk is captured in the (j).

(typically market risk). Barichello's policy risk, he argues, ought to be an embedded aspect of the overall discount rate as it accounts for the stability of supply management as a viable method of domestic production, which ultimately affects the prices of production quotas. Barichello (1996) states that adding a policy risk variable in this manner suggests that the quota's risk cannot be diversified and insured against. This means there is no way to diversify a quota based portfolio against the risk of policy change (besides lobbying). He argues that policy risk is "analogous to a to default risk faced by commercial banks lending to foreign governments that may repudiate their loans or default on their repayment." (Barichello 1996, 294)

2.1: Dead-Weight Loss

Prior to calculating the DWL, one must understand the differences in elasticities for both industrial milk and fluid milk. As individuals rather heavily require fluid milk and there are few good substitutes, fluid milk typically has a rather low demand elasticity as regardless of price fluctuations the quantity demanded will not change substantially. On the other hand, industrial milk, which may be used to create cheese or butter, has relatively more substitutes with the most popular alternative being soybean products. This enables consumers to switch from milk based products to alternatives if the price of these milk based goods increases, thus industrial milk has a higher elasticity (quantity demanded is more responsive to changes in prices). Supply elasticity is low in Canada as the CDC sets the supply more or less regardless of price.

The only recent literature attempting to measure DWL due to supply management comes from Lippert (2001). Lippert (2001) implements a formula derived by Dr. Borcherding when he was calculating the DWL for the supply managed Canadian egg industry. Lippert re-runs the formula, which results in a DWL of roughly $200 million for the year 2000.

But, there are some potential problems with that estimate. The marginal cost Lippert presumes is quite high at $40/Hl. Other academic papers, which estimate marginal cost both prior and after Lippert's estimate, still place the marginal cost at the low to mid $30/Hl range. This will cause his DWL measurement to be understated. Also, Lippert uses elasticities from Meilke et al. (1996), which were the middle values of range estimates needed for sensitivity analysis and not mean to represent specific estimates like some more technical reports aim to present.

# Chapter 3 Methodology

This paper will utilize the formula below in figure 2 for estimating DWL. The benefit of using this formula is that it does not require a marginal cost estimation.

Figure 2: DWL Formula

$$DWL = \frac{(r\hat{p})^2}{2} \frac{(Ed)(Es)(Q')}{Pd(Ed - Es) - r\hat{p}}$$

Instead of a marginal cost estimate, using the quota quantity of production and elasticity variables, the formula is still able to estimate DWL. For the demand and supply elasticities, instead of using a value that proxies for numerous past estimations, this calculation will take concrete values from past technical data. This ought to reduce uncertainty as the values come from solid foundational data.

(r) represents the total discount rate. ( $\hat{p}$ ) represents the value of the quota in $/hectolitre. (Ed) represents the elasticity of demand for dairy products. (Es) represents the elasticity of supply for dairy products. (Q') represents the quota quantity of production. (Pd) represents the blend price received by farmers per hectolitre.

## 3.1: Measuring Dead-Weight Loss

The advantage of this formula is that it does not require a marginal cost estimate. This is beneficial as it reduces the need for speculating on unknown variables. This formula only requires an estimation of the variables of supply elasticity, demand elasticity and policy risk. Moreover, estimations of policy risk have fluctuated greatly throughout the past decades. Barichello (1999) claims that policy risk in the 1980s was roughly 30% and fell to 10% in the mid 1990s (partially due to changes mentioned earlier). Cairns et al. (2010) stated that policy risk fell to slightly above 5% in 2006. It is these past volatile fluctuation and subjectivity of policy risk that requires a calculation of a large range of discount rates. For this analysis, the range will be from 5% to 15%. This range is quite large, but by calculating a large range, it should demonstrate the impact of multiple plausible total discount rates, which could come from a variety of perspectives/combinations of policy risk, growth rate and interest rate of the quota.

Certain aspects of the total discount rate are observable such as the interest rate and growth rate of the quotas. The last required variable, the weighted average values of quota prices and butterfat[9] can be calculated from available data.

Growth rate of dairy quota values in the year 2010 (using the projected values due to price ceiling on quota auction (Rajsic and Fox 2012)) can be projected and shown to be roughly 2%. The typical interest rates for purchasing quotas is prime plus two or three (Cairns et al. (2010) and FCC (2013)) Finally, auctioned quotas are sold and measured in Kgs of butterfat per day of production[10]. Therefore, to fit the model, the quotas need to be converted into price of quota per hectolitre. This is obtained by dividing the quota value by 365, the number of days in the year. This illustrates a cost per day of production per kg. Once this value is multiplied by the average Kg's of butterfat for that dairy year, it

[9] Butterfat is the term used to depict the fat content within dairy products typically measured in Kg's during production and percentage at the retail level. For example, two percent milk has roughly 2% butterfat.
[10] Dairy quotas give the right to the producer to produce a kg each day for the given dairy calendar year, which varies from the typical calendar year.

results in the quota cost per hectolitre[11]. The same method was used by Cairns et al. (2010) but for 2006 data.

## 3.2: Choosing Demand and Supply Elasticities

### 3.2.1: Supply Elasticity

By far the biggest limitation when trying to obtain an accurate estimate of the DWL is the lack of Canadian information regarding the supply elasticity of dairy production. This is because the Canadian dairy farmers responses to changes in prices are unobservable as output or quantity produced is controlled through quotas. This challenge has forced many Canadian estimations of supply elasticity to look to the United States dairy supply elasticities data as a proxy. There are institutional, regulatory and policy differences between the Canadian and United States dairy industries, but there are similarities in production practices and input prices which enable reasonable substitution. However, the second problem lies in the fact that many of the U.S. long-run estimations vary drastically. Table 1 from Meilke et.al (1998) illustrates many of the past U.S. estimations.

[11] One quota in kg roughly represents one dairy cow. In 2010, dividing number of litres produced by number of dairy cows in Canada, one gets approximately 8000 litres/cow. Additionally, A farmer who has1 kg of quota and whose herd has an average butterfat test of 4.0kg/hL can ship 25 litres of milk per day.

Table 1: Past Estimations of Supply Elasticity: Meilke et al. (1998)

| Source | Study Period | Supply Elasticity |
|---|---|---|
| Elterich & Masud | 1966-78 | 2.8 |
| Dahlgran | 1953-83 | 1.0(6) – 2.0(16) |
| Thraem &Hammond | 1949-78 | 1.15 |
| Chavas & Klemme | 1960-82 | .89(5) – 2.46(10) |
| LaFrance & de Gorter | 1950-80 | 4.8 – 8.0 |
| Kaiser et al. | 1949-85 | .8(5) |
| Howard & Shumway | 1951-82 | .23 |
| Helemberger & Chen | 1966-90 | .58 |

The parentheses illustrate the number of years allowed for the indicated supply response.

For this paper, a supply elasticity of +1 has been chosen and compared to the table above this may seem relatively modest as 5 out of 8 long-run estimations are above +1. Unit elastic supply was chosen for a few reasons. A strong majority of the Canadian academic content that requires an estimation of supply elasticity have chosen +1[12]. In addition, lowering the elasticity to +1 and making the supply less responsive seems reasonable. This is because the Canadian Milk Supply Management Committee (CMSMC) fixes prices yearly, and the needed quantity to meet Canadian demand is only changed a few times a year. The potential changes in quantities produced is discussed quarterly through the CMSMC.

[12] Barichello 198; Meilke et al. 1996,1998; Li and Ker, 2011; Abbassi et. al 2008; Veeman 1982 are a few examples of Canadian studies that assume unit elastic supply for dairy production in Canada.

3.2.2: Demand Elasticity

The process of determining demand elasticities for the purposes of this paper was also challenging but for different reasons than those of supply elasticity. The main problem in determining demand elasticities is that data on the elasticity of demand at the farm level production is not available. This means that as blend prices change, direct changes in demand cannot be seen. Therefore, this requires a determination of elasticities for each dairy product at the retail level. The challenge lies in that there is an abundance of demand elasticity estimates in the academic realm, albeit a strong majority are older than the data used by this paper.

Many demand elasticity estimations in academic papers, such as Meilke et al. (1996), use ranges for the elasticities of dairy products such as -.05 to -.40 for demand elasticity of fluid milk and -.20 to -.90 for demand elasticity of industrial milk. They are typically able to do this because they are calculating relations using econometrics models and use the ranges for sensitivity analysis. Also, in 2005, Agriculture and Agri-Food Canada released a report estimating food demand elasticities in Canada. They quote Moschini and Morro (1993) as the most recent estimators of food demand elasticity. Moreover, this report only updates one estimation for the entirety of the dairy system in 2005, which it states the overall weighted elasticity of dairy is -.88.

This paper will take its elasticities from Moschini and Morro (1993). The reason for choosing this report for demand elasticities is that it has demand elasticities for numerous dairy products and does not restrict elasticities to just fluid and industrial milk; this enables a more accurate estimation. Additionally, as this is a technical report for

Agriculture Canada, it gives specific values. This paper will limit its elasticities to fluid milk, crème, ice cream, yogurt, cheese and butter, as these represent the major bulk of dairy consumption.

Through the Canadian Dairy Commissions annual report it is noted that fluid milk production in 2010 was: 118,800,000 kg, or 38.87% (CDC 2010) of total production. Industrial milk production in 2010 was: 186,870,000 kg or 61.13% (CDC 2010) of total production. These percentages are needed in determining an accurate total weighted demand elasticity.

Table 2: Weighted Industrial Dairy Demand Elasticity

| Demand Elasticity Moro & Moschini (1993) | Dairy Product | Percentage of overall production: (CDC 2013) |
|---|---|---|
| -.92 | Butter | 7% |
| -.4 | Cheese | 37% |
| -1.02 | Crème | 21% |
| -1.02 | Ice Cream | 15% |
| -1.02 | Yogurt | 21% |

Crème, ice cream and yogurt are given the same elasticities of -1.02 as they fall under the "other dairy" values of Moschini and Moro (1993). Through these values, the weighted industrial dairy demand elasticity is: -.7938 at 61.13% of total production. Fluid milk elasticity is: -.34 at 38.87%. This results in an overall market demand elasticity in

2010 of -.6174[13].

3.3: Other Required Variables

There are two other required variables that need to be calculated, the blend price received by farmers and the weighted average quota price in Canada in 2010. The average butterfat content is needed for the conversion of quotas into hectoliters. It is observed in table 3 that the average blend price for Canadian farmers was $74.947/Hl in 2010.

Table 3: Blend Price Calculation

Data from CDC annual report 2010

| Revenue Pooling Group | Price | Percentage of Production |
|---|---|---|
| P5 | $74.32/Hl | 76.6% |
| WMP | $77/Hl | 23.4% |

Table 4 illustrates a weighted Canadian average quota value of $31,000Kg/Bf/day. The required weighted average of butterfat/Kg in 2010 was 3.92466 (CDIC 2013). This data is obtained from the "farm milk composition average test" of the Canadian Dairy Information Center. Converting the dairy quota into its cost per hectolitre results in an average value across Canada of $333.33/Hl.

[13] For all industrial dairy products, this paper assumes uniformity in production requirements regarding butterfat content. For example, it is assuming the same butterfat requirements are needed for a litre of ice cream and litre of yogurt. This is assumed as the production ratios of inputs to outputs regarding butterfat content are not known. This rational is also used for justifying the initial split between fluid milk and industrial products, which is separated while in Kgs.

Table 4: Weighted Provincial Quota Values
(Measured in Kg's of butterfat per day)

Quota Values from Rajsic & Fox (2012), production rates from CDC annual report 2010.

| Province: | B.C. | Alberta | Sask. | Man. | On.* | Qc* | NB | NS | P.E.I. |
|---|---|---|---|---|---|---|---|---|---|
| Quota Price: (Rajsic & Fox, 2012) | $39,063 | $36,713 | $26,653 | $29,491 | $33,015 | $27,711 | $27,399 | $27,317 | $27,375 |
| Percentage of Production | 8.6% | 8.5% | 2.9% | 4.0% | 32.5% | 37.5% | 1.22% | 2.22% | 1.4% |

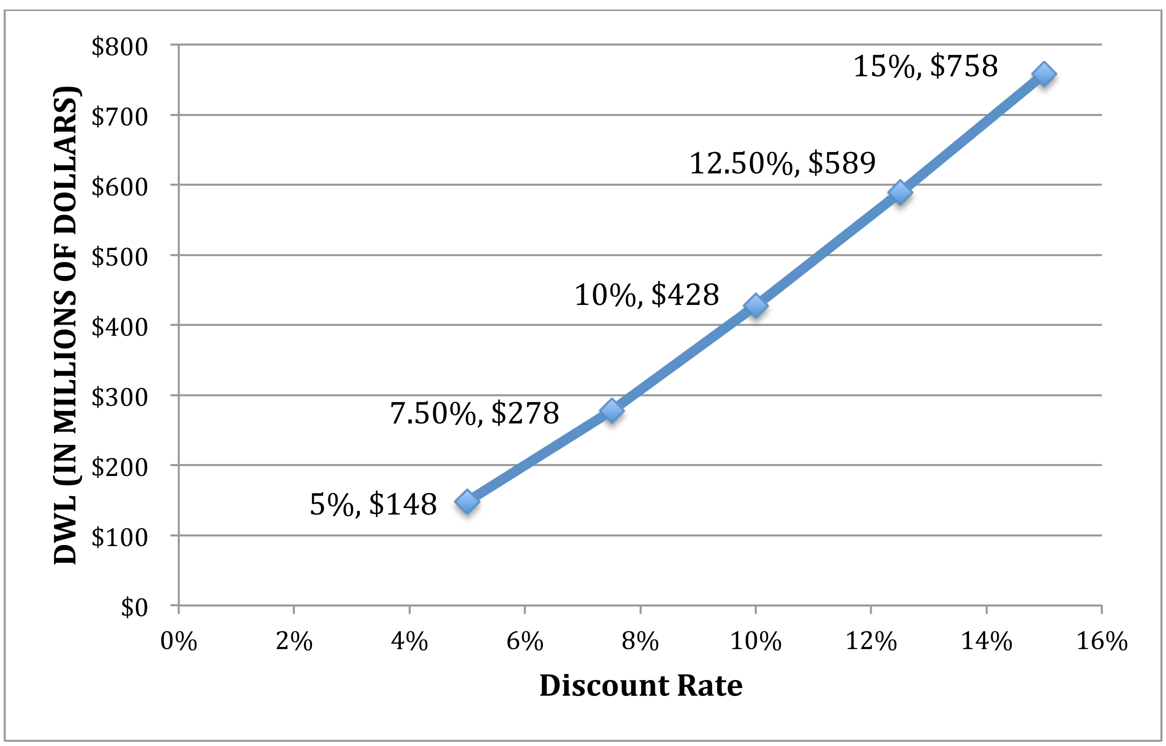
*Indicates projected rate due to price ceiling policy

## Chapter 4: Results

Briefly, it may be beneficial to summarize the used values for the required variables. For demand elasticity, a weighted value of -.62 is used. For a supply elasticity, a value or +1, or unit elastic is used. The converted price of a quota per hectoliter is \$333.33 in 2010. The quantity produced under quota restricting production was 76.7 million hectolitres in 2010. The weighted blend price per hectolitre for Canada in 2010 was \$74.95. Finally, a discount rate range of 5% to 15% will be calculated which will later be restricted to 8% to 12% due to purposes to be mentioned within the results.

### 4:1 Dead-Weight Loss

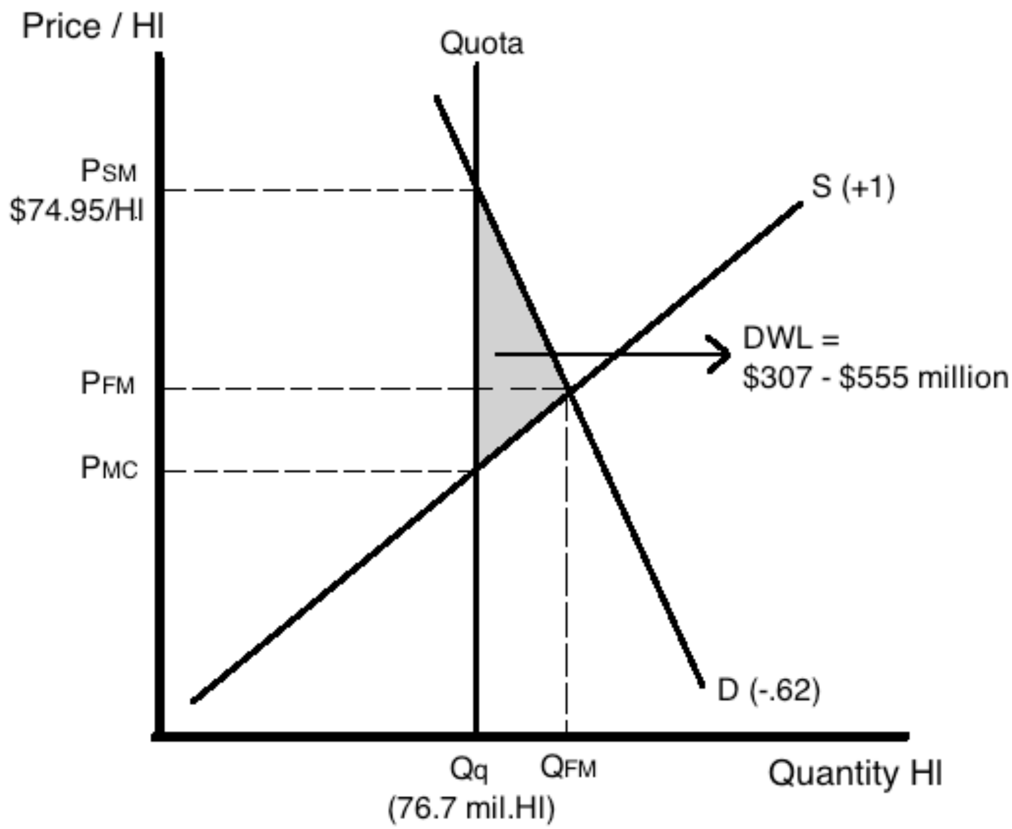
Figure 3: DWL Ranges with Discount Range



The DWL results illustrate the high sensitivity to fluctuations in the total discount rate as the difference between a 5% ($146 million) discount rate and a 15% ($757 million) is $611 million. Moreover, one can speculate on the increased challenges and instability if this DWL calculation also required a marginal cost estimate, or if policy risk were to increase/become volatile. However, by looking rationally at the economic and political landscape, a viable range for total discount rate can be discerned. With a lending of prime rate plus two or three percentage to get an interest rate of 5-6%; a growth rate of 2% from Rajsic and Fox (2012); and a policy risk of 5-8% from Cairns et al.(2010) (with a minor increase for sensitivity purposes), one can estimate a total discount rate range from 8% to 12%[14]. This range results in a DWL between $307 million and $555 million due to Canadian dairy supply management in the year 2010.

[14] Lending rate comes from Cairns et al. (2010) and Farm Credit Canada. The policy risk was an estimate from Cairns et al. (2010), which their data was calculated for the year 2006. However, they calculated a policy risk of 5.2%, but considering the time between 2006 and 2010, political and economic scrutiny in the following years may require to increase this rate, which is the reason for the range of 5-8%.

Figure 4: Model of Canadian Dairy Industry




To illustrate the varying results due to a possible change in the elasticity of demand, calculating the change in DWL with the estimation given by Agriculture and Agri-Food Canada the sensitivity of the model can be observed[15]. Assuming again a discount rate of 8% and changing the overall dairy industry elasticity to - .88, the model calculates a DWL of approximately $672 million, an increase of $365 million over an elasticity of - .62.

Nevertheless, this follows economic intuition as a value of -.88 is more elastic than -.62. A more elastic (or sensitive) demand curve would mean greater alternations in

[15] It should be noted that there is no presented supporting evidence for this estimate.

consumption when prices change. Therefore, if demand is assumed to be more elastic (-.88), when prices are higher ($P_{SM}$), it indicates that more consumers would reduce their quantity of dairy demanded compared to changes in demand with a more inelastic demand elasticity (-.62). Thus, this decrease in demand (purchasing) with a more elastic demand curve would increase the loss of economic exchange/efficiency and also DWL due to a price increase.

Similar sensitive results would be seen if the supply curve was more elastic. If the supply elasticity was increased to a value greater than 1, this would result in an increase in the DWL. Considering this estimation of unit elasticity is conservative when compared to many U.S. estimations it is not unrealistic to support the notion that the DWL may likely be higher.

As many other academic papers aim only to determine and interpret policy risk, it is important to validate estimations of policy risk**.** Taking Cairns et al. (2010) estimate of 2006 policy risk of 5.2% and looking at the major political and economic conditions until the calendar year 2010, it is clear that there was no major threat to supply management in Canada. It may be possible, however, to justify the beginning of a realistic threat to supply management stability in the mid-later year of 2011. This is when there were indications that Prime Minister Stephen Harper reversed his stance from supporting supply managed industries, to opening up supply management for discussion if it enabled negotiations within the Trans-Pacific Partnership agreement and the EU free trade agreement (The Star 2011)(Globe and Mail 2011). Prior to 2011, the years 2008-2010 were mainly headlined by the economic collapse, and reports in 2009 even stated that the WTO Doha agricultural trade agreements would not threaten Canadian supply management (Grainews 2009). However, considering even the presence of a possible EU free trade agreement, Trans-Pacific Partnership agreement, and/or WTO agricultural trade negotiations, a minor increase in policy risk equating to a few percentage points may be reasonable.

As mentioned prior, Barichello (1999) calculated a policy risk drop from 30% in the 1980s to 10% in the mid 1990s. During the mid 1990s, there were numerous events or market forces that impacted the policy risk variable according to Barichello (1999). Some examples within the mid 1990s he discusses are the Uruguay Round Table discussions on agriculture, the next World Trade Organization Round of trade discussions (which focused on agriculture) and pressure from the U.S. and New Zealand to reverse Canada's dairy trade policy position. Although these events were never suspected to truly threaten supply management, they still contributed to a policy risk in the mid 1990s of 10% according to Barichello (1999). This paper assumes the highest plausible policy risk of 8%, an increase of 3% from Cairns et al. (2010) estimate in 2006. This may seem relatively high considering the lack of direct agricultural policy risk between 2006 and 2010. But, as there were potential trade agreements in the public realm (as mentioned prior) and a conservative government in power (with a open market/pro-trade mentality), farmers could have perceived theses factors as a risk to supply management.

## Chapter 5: Conclusion

By looking at the results of the DWL calculation, it is clear that there was a substantial economic welfare loss of roughly $307 million to $555 million in the year 2010. The variance in this result was mainly due to the range of policy risk estimates (5%-8%) that could be plausible in the Canadian dairy market for 2010. Choosing only one discount rate, however, would be a naïve approach that assumes that one can obtain a single policy risk, interest rate and growth rate combination. Moreover, as there are no recent academic papers with which to compare this DWL estimate or to approximate the change/growth in DWL over time, this estimation becomes even more important in understanding the economic inefficiencies that result from Canadian dairy supply management.

In summary, this paper provides a recent estimation of DWL within the field of Canadian dairy supply management. This enables discussion regarding the costs and benefits of Canadian supply management. One of the main objectives of this paper was to present viable numbers that represent the economic/welfare loss to Canadians, which will shed light on the opportunity cost of keeping supply management. In addition to determining the DWL caused by supply management, an earlier rendition of this thesis sought to calculate the consumer wealth transfer. Please see appendix 1 for the reason behind the exclusion of this calculation.

As the Harper Government seeks international trade agreements, such as the Trans-Pacific Partnership and the European Union free trade agreement, it is likely that this will create more pressure to scrap supply management. In order to make an accurate cost –benefit analysis for Canadians, one needs to have an estimation of the DWL due to supply management. It is completely feasible that a majority of Canadians may support paying higher dairy prices in order to have a safer, stable and less volatile dairy market. This is something this paper cannot conclude on, but it is important to note. Likewise, if Canadians support supply management, and view potential free trade agreements as beneficial (to any extent), a cost-benefit analysis is required for both scenarios. Again, this decision requires a dairy DWL estimation, which is something this paper can contribute to. Conversely, if Canadians view supply management as a cost to society, one would hope to see a removal of Canadian supply management regardless of possible trade agreements, which would themselves provide additional benefit.

**References:**


Abbassi, Abdessalem, Olivier Bonroy, and Jean-Philippe Gervais. "Dairy Trade Liberalization Impacts in Canada." *Canadian Journal of Agricultural Economics/Revue Canadienne D'agroeconomie* 56.3 (2008): 313-35. Print.

British Columbia. B.C. Milk Marketing Board. *CONSOLIDATED ORDER*. Abbotsford: n.p., 2010. Web. Mar. 2013. <http://bcmilkmarketing.worldsecuresystems.com/governance/consolidated-order>.

Barichello, Richard R. *The economics of Canadian dairy industry regulation*. Economic Council of Canada, Regulation Reference, 1981.

Canada. Canadian Dairy Commission 2010. *Annual Reports*. Government of Canada,2010. Web. Sept. 2012. <http://www.cdc-ccl.gc.ca/CDC/userfiles/file/ENG%202010%202011.pdf>.

Cairns, Alex, and Karl Meilke. "An Evaluation of Milk Quota Exchange Policies." Thesis. University of Guelph, 2011. CATPRN. Web. Sept. 2012. <http://www.uoguelph.ca/catprn/PDF-TPB/TPB-11-02-Meilke-Cairns.pdf>.

Cairns LMeilke, Bennett. "SUPPLY MANAGEMENT AND PRICE CEILINGS ON PRODUCTION QUOTA VALUES: FUTURE OR FOLLY?" *CATPRN Working Paper* (2010): n. pag. Print.

Chen, Kevin, and Karl Meilke. "The Simple Analytics of Transferable Production Quota: Implications for the Marginal Cost of Ontario Milk Production." *Canadian Journal of Agricultural Economics/Revue Canadienne D'agroeconomie* 46.1 (1998): 37-52. Print.

Dawson, Laura. "No Guarantees on Pacific Trade, despite Harper's 180." *The Globe and Mail*. N.p., 14 Nov. 2011. Web. 06 Mar. 2013. <http://www.theglobeandmail.com/commentary/no-guarantees-on-pacific-trade-despite-harpers-180/article4200489/>.

"Farmgate Milk Price." *Australian Dairy Farmgate Milk Prices*. Dairy Australia, n.d. Web. Feb. 2013.

Fox, Glenn, and Predrag Rajsic. "QUOTA PRICES AS INDICATORS OF COMPARATIVE ADVANTAGE IN SUPPLY MANAGED INDUSTRIES." *CATPRN* (August 2012): n. pag. Aug. 2012. Web. Jan. 2013. <http://www.uoguelph.ca/catprn/PDF-WP/CATPRN-WP_2012-04_Rajsic-Fox.pdf>.

Giancarlo, Moschini, and Daniele Moro. "A Food Demand System For Canada." *Agriculture Canada -Policy Branch* (1993): 89. Print.

Hall Findley, Margret. "The School of Public Policy." *Supply Management: Problems, Politics and Possibilities*. University of Calgary, June 2012. Web. 28 Oct. 2012.

Levitz, Stephanie. "Canada Wants in to New Asia Pacific Trade Pact but Won't Pre-negotiate." *Thestar.com*. The Canadian Press, 12 Nov. 2011. Web. 06 Mar. 2013. <http://www.thestar.com/news/world/2011/11/12/canada_wants_in_to_new_asia_pacific_trade_pact_but_wont_prenegotiate.html>.

Li, Na, and Alan Ker. "Political Market Power Reflected in Milk Pricing and Production Quota under Supply Management." *Working Paper* (2011): n. pag. *University of Guelph*. Aug. 2011. Web. <http://www.uoguelph.ca/fare/institute/WorkingPapers/Dairy%20Paper_7.pdf>.

Lippert, Owen. "The Perfect Food in a Perfect Mess: The Cost of Milk in Canada." Fraiser Institute, 2001.

Meilke and Cairns. "AN EVALUATION OF MILK QUOTA EXCHANGE POLICIES." University of Guelph, Mar. 2011. Working paper.

Meilke, K.D., R. Sarker and D. Le Roy. 1998. The Potential for Increased Trade in Milk and Dairy Products between Canada and the United States under Trade Liberalization. Canadian Journal of Agricultural Economics 46: 149-169.

Canada. Agriculture Canada. Policy Branch. *A Food Demand System for Canada*. By Giancarlo Moschini and Daniele Moro. N.p.: n.p., 1993. Print.

Moschini, Giancarlo, and Karl D. Meilke. "Sustainable Rates of Return for Milk Quotas in Ontario." *Canadian Journal of Agricultural Economics/Revue Canadienne D'agroeconomie* 36.1 (1988): 119-26. Print.

Moschini, Giancarlo. "The Cost Structure of Ontario Dairy Farms: A Microeconometric Analysis." *Canadian Journal of Agricultural Economics/Revue Canadienne D'agroeconomie* 36.2 (1988): 187-206. Print.

Skjei, Scott. "Dead Weight Loss Formula." Acadia University, Wolfville, Nova Scotia. 15 Mar. 2013.

Sumner, Daniel A., and Joseph V. Balagtas. "United States' Agricultural Systems: An Overview of US Dairy Policy." *the Encyclopedia of Dairy Sciences, ed. Hubert Roginski, John W. Fuquay, Patrick F. Fox. (Maryland Heights, MO: Academic Press, 2002)* (2002): 20-25.

"Transitional Loan." *Farm Credit Canada*. N.p., n.d. Web. Feb. 2013. <http://www.fcc-fac.ca/en/products/lending/transition_loan_e.asp>.

Vannahme, Alana. "Grainews." *Expert Sees WTO Deal, Supply Management Co-existing*. Livestock, 25 Mar. 2009. Web. 06 Mar. 2013. <http://www.grainews.ca/news/expert-sees-wto-deal-supply-management-co-existing/1000092428/?issue=03252009>.

Veeman, Michele M. "Social Costs of Supply-Restricting Marketing Boards." *Canadian Journal of Agricultural Economics/Revue Canadienne D'agroeconomie* 30.1 (1982): 21-36. Print.

# APPENDIX

An earlier rendition of this thesis sought to calculate the consumer wealth transfer—the rectangle between $P_{SM}$ and $P_{FM}$ to $Q_Q$ in figure 1. Out of the required variables of $P_{SM}$, $P_{FM}$, $Q_Q$, elasticity of demand and supply, only the price received by farmers ($P_{SM}$) and quantity produced in hectoliters ($Q_Q$) were known through the Canadian Dairy Commission's annual report. The price of equilibrium ($P_{FM}$) (known as global farm-gate price) is typically taken from the Oceania region, which includes Australia and New Zealand. This is because globally, these two countries represent the freest global dairy market. By assuming production capabilities at this price point, one could first estimate the increased price felt by Canadian Consumers. Multiplying this increase by the quantity produced could show the total consumer wealth transfer to producers. Taking this even further, by dividing this number by the population of Canada, one could estimate the transfer per Canadian on average. Despite establishing these relationships, this estimation was removed due to a significant number of unknown variables, which jeopardized the accuracy of the calculation.

This assumes first, that obtaining the Oceania price of production/consumption is achievable. Secondly, it assumes that the elasticity curves are homogeneous, meaning that the elasticities of the countries we attain the free market price from have the same demand preferences and supply responses to changes in price. This leap of faith was too substantial to present a consumer wealth transfer that could be actively defended as accurate. Lastly, this estimation can be calculated but it would require more in-depth research into the production practices both in the reference region for the global free market price as well as Canada's production practices. Additionally, an analysis would be needed to compare the elasticities of supply and demand within the region of the global free market price and those of Canada in order to more accurately estimate the total consumer wealth transfer.