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A Primer on the Economics of Supply Management and Food Supply Chains

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1. Introduction

Agricultural supply chains have intrinsic features that distinguish them from other supply chains. The supply of agricultural products is conditioned by many factors, some of which are under the control of agents operating at different levels along the supply chain, while others are beyond their control like climate shocks, pandemics originating in foreign countries or currency and interest rate changes.

The supply of agricultural products cannot be instantaneously adjusted in response to a change in price because production and marketing decisions are often separated by several months. This implies that the supply is rather insensitive to prices in the short run and that prices are likely to exhibit much volatility in the presence of demand shocks. In the cattle and hog businesses, states of low or high supply can last over extended periods and trigger price cycles. Not surprisingly, many programs have been implemented in agriculture in developed and developing countries to deal with supply issues (e.g., herd buyouts, acreage set-aside, payment-in-kind, production and input tax cum subsidies).

Agricultural supply chains have experienced significant technological progress at all levels during the last thirty years. Concentration has increased in the food distribution and retail sectors, the food processing sector and in industries supplying farm inputs (chemicals, machinery...). Breakthroughs in transport logistics and trade liberalization have allowed for the distance between production and consumption locations to increase dramatically. These changes have created market opportunities and also many challenges for Canadian agricultural producers and food processors. There are fewer but larger farms. For example, there were 12,746 dairy farms in Canada in 2011, compared to 31,200 in 1992, and this trend should continue because even very large dairy operations can still exploit economies of scale.[1] Even in the growing chicken industry, the number of chicken farms in Canada has remained constant at about 2800 since 2000, but production per farm has been rising.[2] In the egg industry, the number of registered producers has experienced a steady decline since the early 1990s even though federal allocations have been rising.[3]

Efficient supply chains rely on mechanisms to manage risks and facilitate vertical coordination among the different links of the chain. Efficient supply chains must also encourage innovation

[1] See www.dairyinfo.gc.ca/pdf/farms_shipping_milk.pdf for additional statistics and Mosheim and Lovell (2009) regarding economies of scale for U.S. dairy farms.

[2] See p. 2 of the document available at: http://dsp-psd.pwgsc.gc.ca/collections/collection_2010/agr/AB11-2-2010.pdf.

[3] See p. 23 of the document available at www.eggs.ca/Files/Resource/English_2009_Annual_Report.pdf and p.22 of the document available at www.eggs.ca/Files/Resource/CEMA%20Annual%20Report%202002.pdf.

and adaptability to changes in consumer demand, policies or technology. Supply chains can differ markedly because different marketing issues warrant different types of arrangements.

The organisation of supply chains is a continuous process shaped by historical events. Price instability and interprovincial conflicts were major concerns in the marketing of milk, poultry and eggs in the 1960s and supply management was regarded as a way to alleviate these concerns. The idea behind supply management is to stabilize and raise farm prices by restricting imports and domestic production in all provinces. A national production quota is allocated to individual producers through provincial marketing boards. For all supply managed commodities, domestic production is set to achieve a price sufficient to cover the cost of production of most producers. Still, there are important differences in the manner with which supply management is implemented from one sector to another.

Supply management policies have been praised for the stability and wealth they create for primary producers, processors, retailers and input and service providers like equipment manufacturers and financial institutions.[4] However, they have been criticized for being costly and regressive tools to transfer dollars from consumers to producers and for creating barriers to entry for young producers.[5] Canada's trade partners also complain that supply management policies unduly curb market access.[6]

Clearly, there are tradeoffs that need to be made in the conduct of public policy and these trade-offs need to be analyzed in light of the objectives pursued by policymakers. The costs and benefits of policies can change over time and so can the objectives of policymakers and this is why policies evolve. This is true of all policies, including supply management policies. There are no textbooks that address in details the economics of supply chains with supply management policies and the present document aims to fill this void.

This document is organized as follows. We begin by discussing the history and describing the institutions that are necessary to implement supply management. This sets the stage for a review of the economics of supply management and supply chains more generally. Because an earlier version of this document had been prepared for the *Farm Products Council of Canada*, more

[4] See www.cfo.on.ca/supply.cfm

[5] See for example www.iedm.org/main/show_editorials_fr.php?editorials_id=563

[6] See de Gorter and de Valk's review of the dairy and poultry disputes between Canada and the United States prior to 1997 available at /www.farmfoundation.org/news/articlefiles/904-degorter.pdf. Most of the disputes revolves around market access and GATT article XI. The WTO case pitting the United States and New Zealand against Canada regarding the importation of milk and the export of dairy products began in October of 1997 and was settled only in May of 2003 when Canada finally conceded. Currently, the United States and New Zealand are making the elimination of supply management programs a necessary condition for Canada's participation in the negotiations of the Trans-Pacific Partnership agreement.

emphasis is put on the chicken, egg, hatching egg and turkey supply management programs than on the dairy supply management program.

2. Overview of supply management: similarities and differences across sectors

The introduction of a milk marketing plan in 1970 marked the beginning of the SM system in dairy. In the egg sector, producer boards started to form in the late 60s, but it was not before 1972 that a national egg marketing agency was formed by special federal legislation. Even though the broiler hatching egg, chicken, dairy, egg, and turkey industries operate under national SM systems, there are many institutional differences across sectors that have important impacts in the manner with which markets operate. It is thus worthwhile to briefly introduce the regulatory framework in each of the sectors under supply management.

Production

A national body controls the supply management system of each sector. For example, Chicken Farmers of Canada (CFC) is responsible for the administration of the national production system. It determines the national production level and allocates production to provinces based on the different requests they get from the provincial producer boards. The Canadian Broiler Hatching Egg Marketing Agency (CBHEMA), Egg Farmers of Canada (EFC) and the Turkey Farmers of Canada[7] are the national bodies that govern their respective sectors at the national level. The Canadian Dairy Commission (CDC) sets support prices for butter and skim milk and presides over the Canadian Milk Supply Management Committee (CMSMC) which sets the national milk production target under the National Milk Marketing Plan.

Quota allocation across provinces in the chicken industry is based on historical market shares, but since 1995 the CFC has been using a so-called "bottom-up" approach to determine how to allocate increases in the national supply.[8] Chicken processors survey market opportunities about 12 weeks before actual farm production is to begin and relay their demand to producers' marketing boards in each province. The production quotas in each province are adjusted to sum to the quota allocation at the national level, as determined by CFC. Whether this system is a true bottom-up approach is debatable because processors' requests and the final allocations approved by the CFC can and often differ. However, buyers do have some input about the chicken farm production level.

[7] Turkey Farmers of Canada was formed under the Federal Farm Products Agencies Act in 1974 and has been known as the Canadian Turkey Marketing Agency (CTMA) until March of 2009 when it changed its name. Similarly, Egg Farmers of Canada was known before August 2008 as the Canadian Egg Marketing Agency (CEMA).

[8] Prior to 1994, a "top-down" approach was used through which the CFC allocated quotas to provincial marketing boards which then allocated quotas to individual producers.

Pricing

Provincial boards generally allocate production to producers and negotiate prices with buyers. Live chicken prices differ across provinces, but most are based on the Ontario price which is determined through a formula that accounts for the cost of feed and chicks and a profit margin for producers. This contrasts with the turkey sector which does not rely on a cost of production formula in the determination of producer prices. Prices of eviscerated chicken are negotiated between processors and retailers. Some provincial boards allow processors to contract directly with the producers of their choice. Some turkey and chicken processors offer premium above the regulated price to attract and retain efficient producers.

In the egg sector, all eggs are bought by graders at a price set by the provincial board according to a formula to insure that most producers can cover their cost of production. Cost of production data are collected by Egg Farmers of Canada. Pricing negotiations between retailers and graders set the market price for table eggs. Eggs are then marketed as table eggs or as processed eggs. Eggs not required for the table market are purchased by the national agency or provincial board to be sold later at a reduced price on the industrial market. Egg Farmers of Canada uses a levy to support its Industrial Product Program (IPP), that is the difference between the price paid by marketing boards and the U.S. price for processed eggs times the number of eggs processed.

In the turkey sector, producer prices are set at the provincial level. In the largest producing province, Ontario, Turkey Farmers of Ontario sets prices for broilers, hens and toms on a weekly basis. Prices reflect the evolution of input costs, but are not systematically linked through a formula, as well as processors' feedback.

The Canadian dairy sector is a little more complex. As mentioned before, CMSMC determines the volume of industrial milk to be produced by the provinces. Industrial milk is classified and priced according to end use. The discriminatory pricing practiced by marketing boards is meant to increase revenues for dairy producers. The amount of fluid milk to be produced in each province is determined by milk marketing pools which pool revenues from sales of industrial and fluid milk to produce a pooled price for producers. There are two such pools in Canada. The so-called P5 agreement regroups Ontario, Quebec, New Brunswick, Nova Scotia and Price-Edward Island and Western Milk Pooling Agreement regroups Manitoba, Saskatchewan, Alberta and British Columbia. All revenues in a province are shared with the pool, and the milk price at the farm level is a weighted average of the different milk class prices.

Provincial marketing boards buy milk from dairy producers and sell it to processors who in turn sell their products to retailers at negotiated prices. Milk is priced according to three components: butterfat, protein and other solids. Milk used for fluid milk and cream (class 1) is sold at a

premium compared to industrial milk used to produce ice cream and yogurt (class 2), cheeses (class 3), and butter (class 4a). Component prices for special classes (5a, 5b, 5c) are based on U.S. prices and hence are the lowest as they are meant to provide cheap milk ingredients to further processors whose products are not protected from import competition.

The CDC's support prices are set to achieve a target price to producers[9] and to guide provincial marketing boards in the pricing of components across milk classes. The support prices for butter and skim milk powder are enforced by the CDC's punctual purchases and sales of butter and skim milk powder. This is how the system copes with unexpected changes in demand and supply. At the retail level, some provinces like Quebec and New Brunswick, regulate the price of fluid milk by imposing minimum and/or maximum prices.

Import controls

The setting of domestic prices above world prices could not be done without import controls. Until 1995, imports were regulated through quotas. The tariffication of non-tariff barriers implemented at the end of the Uruguay Round of multilateral trade negotiations forced Canada to replace its import quotas by Tariff-Rate Quotas (TRQs) to protect supply managed commodities.

A TRQ is a three-pronged instrument consisting of 2 tariffs and a quota that typically allows a small volume (a minimum access commitment or quota) to be imported at a low tariff while taxing at a much higher rate any additional or over-quota imports. By having very high over-quota tariffs, TRQs mimic quotas. For chicken products, the in-quota tariffs vary between 4% and 8% while the over-quota tariffs exceed 200%. This means that an imported product must be three times cheaper than the competing domestic product to be competitive!

Import licenses are allocated to processors and retailers. The minimum access commitment for chicken under the World Trade Organization (WTO) is 39,844 metric tons, but the larger commitment under the North American Free Trade Agreement (NAFTA) of 7.5% of the previous year's domestic production takes precedence. For eggs and egg product, the NAFTA commitment is 3% of the domestic production and the WTO commitment is 21.4 million dozens while for turkey, the WTO requires that 5.6 million kg of eviscerated turkey be imported and NAFTA calls for 3.5% of domestic production. In some cases, part of the minimum access commitment must be filled with products from a particular area. This is the case notably for cheese with the European Union having a 66% share of Canada's minimum access commitment.

[9] The manner with which support prices for butter and skim milk powder translates into a target price is explained in a document available at www.dairyinfo.gc.ca/pdf/dm90904.pdf .

Quota values

By "shorting" the volume to be marketed, supply management policies generate higher prices along the marketing chain. The fact that these policies have lasted as long as they have suggests that the distribution of profits between producers, processors and retailers and across regions has generally been agreeable.[10] To insure that production is held in check, an individual producer's production must be limited by a production license or a "quota". The profits generated by production licenses/quotas are identified as an economic rent. Production quotas will acquire value if profits grow.

The value of "quotas" has generated a fair amount of controversy over the years. Part of the controversy has to do with the fact that older producers were given quotas when supply management programs were first implemented while younger producers have had to invest large sums of money to acquire quota. In the dairy business, many producers own for over 2 million dollars of quota which account for roughly 60% of the value of their farm. In the Quebec egg industry, the average quota per farm was 34,830 laying hens in 2007, with an average value per farm of $9,056,216.[11]

Production quotas are tradable among producers within a give province. Dairy quotas are openly traded through a double-auction in which potential buyers and sellers in a given province submit bids. Such mechanisms are not common in other supply managed commodities. Quebec egg producers put in place an auction in 2009 while Quebec turkey producers and Quebec chicken producers voted to establish auctions in April and December of 2011. The purpose of such initiatives is to make markets for production quotas more competitive and more efficient (i.e., quotas should end up with lower cost producers who value them most). The main problem with these new auctions is the limited number of participants.

The investment in quotas represents a formidable barrier of entry for "would-be" producers and a major constraint on producers wanting to expand. Concerns over intergenerational equity have brought about ceilings in the value of dairy quotas in P5 provinces like Quebec and Ontario. By reducing the value of dairy farms, these price ceilings penalize retiring producers and established producers by lowering their borrowing capacity. Because of the large differential in values

[10] There are a large number of examples of commodity agreements attempting to short the market that have failed because of perceived rent distribution inequities. The breakdown of the 1983 International Coffee Agreement in 1989 is a case in point. The longevity of Canada's supply management programs are a testimony to the strength and adaptability of the institutions governing these programs. However, the planned $76 million investment into a new plant to produce Chobani yogurt in Ontario by Agro-Farma, a US manufacturer, has created much uneasiness even among dairy producers who realize that incumbent processors may not defend supply management with as much conviction if their slice of the rents is getting too small.

[11] See section 3.2 of www.agr.gc.ca/poultry-volaille/prinde3_eng.htm

between provinces with and without ceilings, many would-be sellers are not selling, and when there are few transactions the gains from trade cannot be large. The point is that few can benefit from the regulation when there is too little volume.[12]

Rent creation and rent distribution is also at the heart of various conflicts like the complaint initiated by the Canadian Poultry and Egg Processors Council in 2008 regarding the CFC's quota allocation decisions[13], the opposition of large cheese manufacturers to compositional standards and the recent dispute in the egg industry about the application of criteria used to determine over-base quota allocation between provinces.[14]

It is often said that economics is about the optimal allocation of scarce resources. In the context of policy analysis, economics provides a framework to analyse the welfare effects of pursuing specific objectives under various constraints. As such, economics is most useful to analyze the issues and challenges facing supply managed industries. The next section provides a review of economic concepts needed to understand the working of supply chains and to be able to analyze various issues pertaining to supply management, like trade liberalization. The implementation of supply management policies hinges on the ability to accurately forecast domestic demand. Consequently, the next section begins with a discussion of the factors conditioning consumer demand and output supply.

3. Notions of Economic Theory to Understand Supply Management Programs and Agri-food Supply Chains

3. A. Supply and demand concepts

Any model is an abstraction of reality. Simplifying assumptions must be made to gain some insights about complex real-life phenomenon. As such, elements of reality that are less important are dropped to focus on what really matter. Some might criticize the setting aside of details, but we only have to think about a road map to understand the necessity of simplifying reality. What utility would a map provide if it was scaled one to one? Would you prefer to use a set of pictures of every street block instead of a one-page map? Assumptions in economic models can be relaxed to ascertain the robustness of the results to more general conditions and added complexity.

[12] Meilke and Cairns (2011) estimated that the regulation generate net losses of $4.1 million/year for Ontario.

[13] See fpcc-cpac.gc.ca/index.php?option=com_content&task=view&id=136&lang=english#_Toc220400765

[14] Saskatchewan was arguing that comparative advantage, approximated by the revealed comparative advantage metric and not the domestic resource cost, ought to be used to determine the allocation. Larue and Gervais (2008) explain why the revealed comparative advantage metric is not a valid measure of comparative advantage.

The one-sector supply and demand framework described below is the simplest tool in the economist's toolbox. It is crucial to be comfortable with this framework because we will build on it to analyze various issues confronting supply managed industries. Our presentation will make extensive use of graphs because it is the simplest way to do policy analysis. We begin by discussing the conditions behind the existence of an individual consumer demand and how we can aggregate individual demand functions into a so-called market demand.

The demand side

The individual consumer (or household head) is the fundamental unit in consumer theory. Each consumer makes choices according to his or her preferences. Consumer theory is based on axioms of choice which stipulates that consumers have well-defined preferences over goods. We assume that consumers are trying to please themselves when shopping by buying goods and services that they like and that they fully take into account prices and how much money they have.

In economic terms, we say that consumers face a budget constraint (and perhaps other constraints). In this optimization problem, prices and income are pre-determined. This situation depicts quite well the environment in large grocery stores where prices are non-negotiable. As a result, chosen quantities, also known as demand functions, are conditioned by prices and income. For example, the demand for chicken meat will be function of the price of chicken, the price of beef, income and many other prices and variables related to taste, etc.

The law of demand states that demand of a commodity will be decreasing in its price. Put differently, if the price of chicken goes up, all other prices and income remaining constant, the demand for chicken is expected to fall, as illustrated by the line D_1 in Figure 1 where the vertical and horizontal axes are respectively the price and quantity of chicken.

Figure 1 is a 2-dimensional representation of the demand function for chicken. The demand for chicken is impacted by more variables than just the price of chicken. It is not always clear how the demand for a particular good is influenced by the price of other goods and other factors like generic advertising and health information. One issue that attracted much attention was whether the growing demand for chicken in the 1970s and 1980s was caused by relatively low chicken prices and or by a structural change in the way consumers viewed the convenience and health aspects of chicken (e.g., Thurman, 1987). Graphically, the increase in the price of beef, a substitute, may cause an upward shift in demand, from D_1 to D_2.

A downward shift would be observed if we were to increase the level of a variable, other than the price of chicken, that has a negative impact on the demand for chicken. A study by Lambert et al. (2006) reveals that a 1% increase in the price of beef would induce an increase of 0.015% in

demand for chicken in Western Canada. Similarly, a 1% increase in meats and fish expenditures would bring about a 1.15% increase in chicken demand.

A downward shift of the demand D_1 in Figure 1 would occur if the price of a complement good were to increase. The nature of the relationship between a pair of goods (substitute versus complement) is not always easy to guess and this is when empirical estimates are most valuable. In Chern, Loehman and Yen (1995), corn oil is a complement for butter but butter is a substitute for corn oil in the sense that an increase in the price of corn oil (butter) causes a decrease (an increase) in the demand for butter (corn oil).

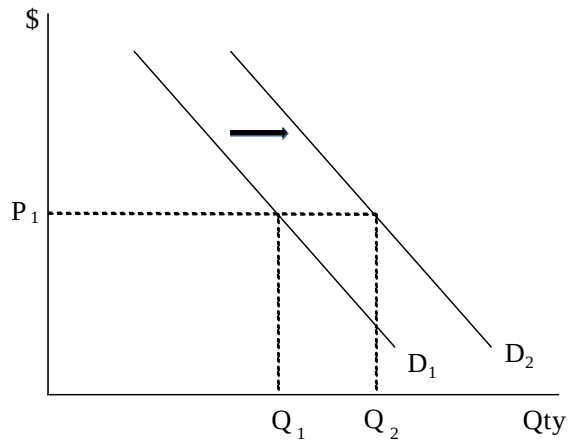

Figure 1. *We move along the demand for chicken D_1 when the price of chicken varies. An increase in the price of chicken contracts the demand, hence the negative slope of D_1. If the price of chicken remains at P_1, but the price of a substitute good like beef increases, then the demand for chicken will shift upward and quantity demanded will increase from Q_1 to Q_2.*

So far, we have focused on the demand curve of a single consumer. The market demand is simply the summation of all individual demands for a given commodity. As such, it is conditioned by the same variables, mainly prices and per capita income. Figure 2 illustrates the market demand curve.

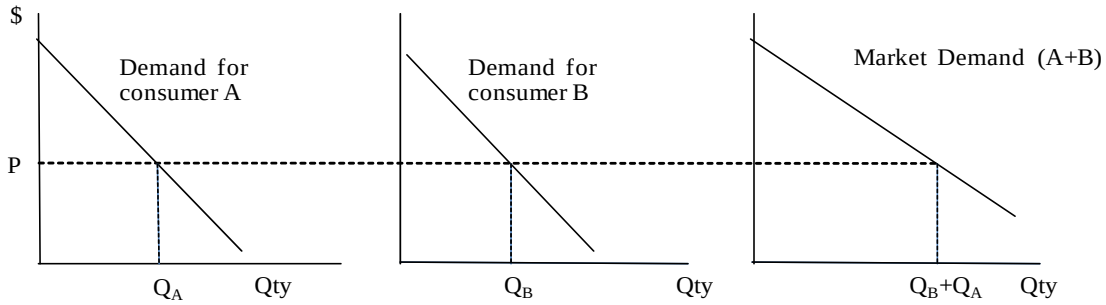

Figure 2. The market demand curve is the sum of the individual demand functions. At every price, the individual quantities demanded are added up. As a result, the slope of the market demand is less steep than the slopes of the individual demand functions.

The elasticity of the demand curve measures the responsiveness of the market demand to price increases. This concept is extremely important because it tells us whether an increase in price ends up increasing or decreasing the value of sales. Because sales value is the product of price and quantity and that the latter decreases when price goes up, we cannot guess how sales value will be affected by a price change without knowing the elasticity of the demand. If demand is elastic (i.e., a 1% increase in price brings about a larger decrease in demand), then an increase in price will lower the sales value. Thus, the idea of "shorting" supply to achieve a higher price can pay if only the market demand is inelastic.[15]

Empirical own-price elasticity estimates vary from one study to another. For example, Lambert et al., (2006) for Canada find own-price elasticities for chicken that are close to -1 while the ones reported by Tonsor, Mintert and Schroeder (2010) for poultry meats in the United States are closer to zero. There are far fewer studies about eggs. However, a recent study showed that demands for eggs in two US cities associated with cage-free and organic processes are on the rise, but the reported own-price elasticities tend to be higher in absolute value for these types of eggs (at around -3) than for conventional eggs (at around -1) (Lusk, 2010).

The supply side

The supply curve is defined as the quantities of a particular good that the firm is prepared to offer at various prices for that good, holding other output prices constant and all input prices constant. It embodies the characteristics of the technology available to a firm. It is conditioned by input and output prices because it is the outcome of a profit maximization exercise done by firms/producers in doing their planning. Put differently, firms take into account input and output prices as well as the production possibilities associated with their technology when they make production decision.

In Figure 3, the own-output price is on the vertical axis while the quantity is on the horizontal one. In the case of a producer completely specialized in chicken production, there would be a single relevant output price and the producer's supply function would be increasing in the price of live chicken and decreasing in the price of inputs, like feed, chicks, labour, capital, and energy.

Forgetting about the existence of supply management for now, the supply curve has a positive slope, because profit from chicken production is increasing in the price of live chicken. At P_1, the producer would be willing to offer Q_1 units of chicken, but if the price of output was to fall to P_2,

[15] Revenue is said to be concave in price. When price is zero, an increase in price will increase revenue. At the other extreme, revenue is zero when the price is high enough to choke demand. Thus, starting at low prices, revenue increases as price goes up, but then reaches a maximum before embarking on a decline as price keeps on increasing.

the quantity offered would shrink to Q_2. Increases (decreases) in input prices would translate into upward (downward) parallel shifts in the supply curve because increases in input prices increase cost of production and decrease profit. As a result, producers facing input price increases respond by supplying less.

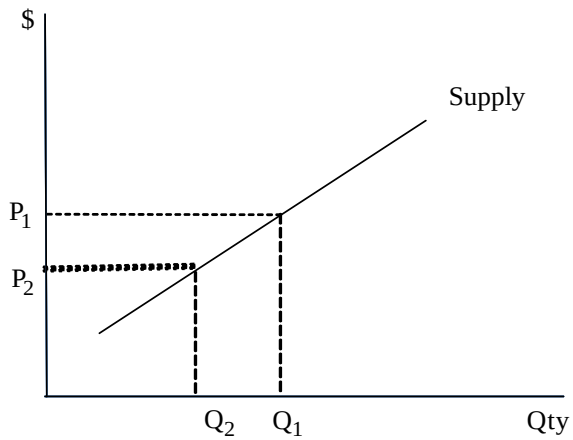

Figure 3. *The supply function of a good is increasing with the price of the good. This is why the supply curve has a positive slope. Input price variations bring about upward or downward shifts in the supply curve.*

The industry supply curve is the sum of all individual supply curves as illustrated in Figure 4. As in the case of the individual supply curve, the industry or market supply curve shifts up or down with variations in the prices of other outputs and the prices of the inputs. The supply curve depicts what can be produced at various prices given the state of the technology.

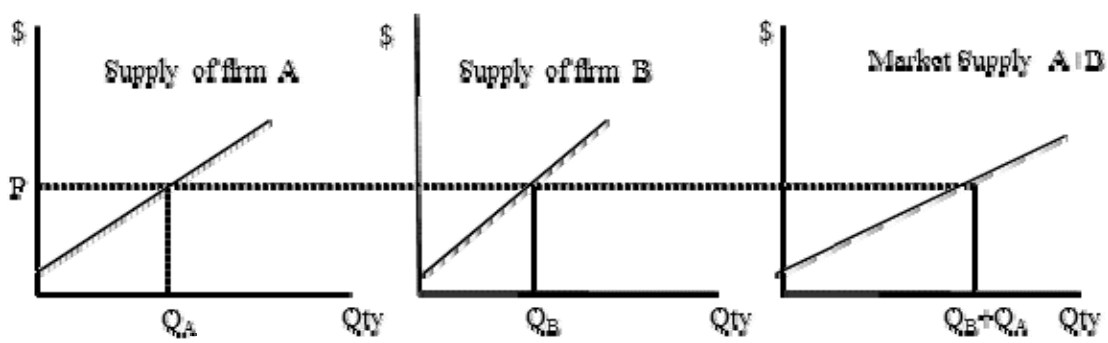

Figure 4. *The market or industry supply curve is the aggregation of individual supply curves. Output price increases induce increases in the quantity supplied or movements up along the supply curve, all other things being equal (like input prices). An increase in the price of an input induces an upward shift in the supply curve because higher prices are needed at all levels of supply for producers to cover their cost of production.*

The percentage increase in supply following a one-percent increase in the output price, the price of live chicken in our example, is called the elasticity of supply. The supply of agricultural

products is notoriously inelastic in the short run. The main reason is that there are significant constraints that prevent swift adjustments. For instance, it takes time to build a new dairy barn and there is not much that can be done except perhaps praying to respond to an increase in the price of corn once the corn has been planted and fertilized.

Market equilibrium

A perfectly competitive market is in equilibrium when the market supply is equal to the market demand. This corresponds to the intersection of the supply and demand curves. Figure 5 illustrates the equilibrium price and quantity (Pe, Qe). Naturally, the equilibrium would change if the supply curve was to shift up or down due to a change in input prices or if the demand curve was to shift due to a change in the prices of other goods and/or a change in income.

If at a given price supply was to exceed demand, the price of the good would have to decrease for the market to clear: that is for demand to sufficiently increase and for supply to sufficiently decrease so as to restore the equilibrium. At P_2 in Figure 5, there is an excess supply because producers offer Q_2 units of output and consumers want to buy only Q_1. The difference in quantities is the excess supply. Market forces will drive the price down till the equilibrium is re-established. By the same token, a low price (below Pe) would create an excess demand indicating that consumers want more than producers are willing to offer. In this instance, price increases would be observed lowering demand and increasing supply until the equilibrium would be restored.

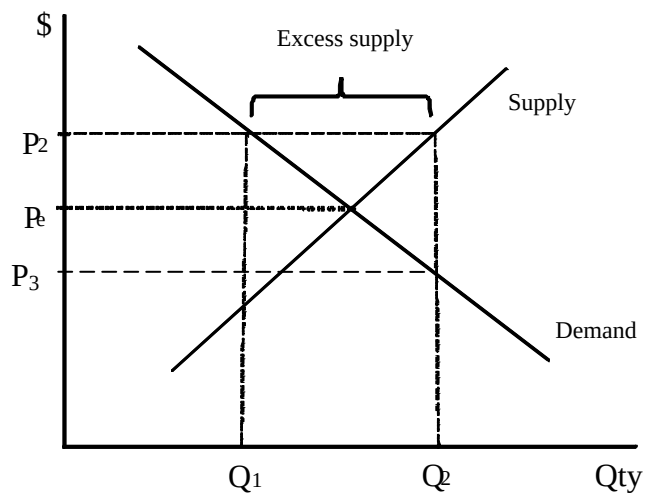

Figure 5. The market is in equilibrium when supply is equal to demand. An excess supply self-corrects through price reductions that increase demand and reduce supply until the equilibrium is restored. This self-correction mechanism makes the equilibrium stable in the sense that the market comes back to equilibrium after temporary shocks.

It was not lost on the people who designed supply management policies that one cannot force consumers to buy goods they consider too expensive. If P_2 in Figure 5 is to be observed, supply must be constrained not to exceed Q_1. This is why so much effort is devoted to insure that producers respect their quota of production. If too much is produced, prices must go down. If Q_2 must be sold, this can only be accomplished if the price goes down to P_3.

The fundamental assumption in a model of perfect competition is that each individual is a price taker. Thus, an individual consumer or an individual producer may not affect the market price by changing his/her quantity demanded or offered. The point is that there are so many consumers and producers in the market that any given consumer or producer has a negligible share of the market demand and supply. Thus, the demand facing an individual producer is a constant price and the same can be said about the supply facing an individual consumer even though the market supply is upward sloping and the market demand is downward sloping. The implication, as will be seen later, is that producers "working as one" by joining a cartel, would not be price takers if their joint output represents a large share of the quantity supplied on the market.

The model of perfect competition also assumes that goods are homogenous, hence the single equilibrium price. The existence of different varieties of a product does not mean that markets cannot be competitive. In fact, if there are many sellers and buyers for each variety, there could be a perfectly competitive equilibrium for each variety. Prices and quantities would likely differ from one variety to another, as some varieties may not be as popular as others or as the cost of producing some varieties may be higher than for others.

Even if there are few producers of a given variety, the market can be quite competitive if the varieties are close substitutes in the eyes of consumers. This is the case in so-called models of monopolistic competition where each firm has a monopoly on a given variety but so many varieties are available that revenues just cover costs in equilibrium. This sort of structure is more common for further-processed products that can easily be differentiated than for commodities which tend to be more homogenous as differences are typically accommodated through a simple grading grid. Price competition is more acute when products are homogenous.

We are also assuming that there is no uncertainty either on the demand side or the supply side. Consumers know the quality of the good they are purchasing before consuming it and producers make production decisions knowing the price they will get for their goods. For many agricultural and food products, these assumptions are not likely to hold. Markets can still be competitive, but the behaviour of consumers and producers changes when they are confronted to risk. We will relax all these assumptions in subsequent sections.

One final thing to note is that in most supply chains producers do not sell directly to consumers but to processors who then sell their products to vertically integrated distributors-retailers. Yet,

the demand curve that producers face is likely to have properties in common with the demand curve described above. Think of poultry processors transforming live chicken purchased from producers. Their demand curve for live chicken will be negatively sloped because processors will be willing to buy more when the price of live chicken is lower. However, the demand of processors of live chicken will be impacted by variables that condition their profit, like the price of eviscerated chicken and the price of other inputs, like labour and capital. Changes in these variables would bring about upward or downward shifts in the demand curve for live chicken.

Does this mean that an increase in consumer income would not have any effect on the demand for live chicken? The answer is no. An increase in consumer income would impact directly on the demand faced by retailers who in turn would offer higher price for eviscerated chicken to processor in order to secure a larger quantity. Clearly, our simple supply and demand can be "jazzed up" to better reflect the structure of food supply chains. The bottom line is that supply and demand concepts are very useful tools to rationalize market outcomes in many different situations.

3. B. Factors perturbing the market equilibrium

The concept of equilibrium is a powerful and comforting one in the sense that if we understand market forces affecting the equilibrium, we can shed light on its evolution. Furthermore, if we can predict how the variables conditioning the equilibrium will evolve, we can then make predictions about the equilibrium. A market equilibrium may not last long as agricultural prices can be quite volatile. In fact, some commodity prices follow cycles and market exhibiting price volatility will often induce entry and exit of firms which contribute to the variations in supply and hence to the volatility of prices. We discuss these issues more thoroughly below.

Price and quantity cycles

Production cycles are well known in agriculture, especially in the livestock sector. For example, historically, hog production was characterized by a period of expansion followed by a period of contraction. Rude and Gervais (2009) estimated an average cycle of 43 months (roughly two years of expansion followed by a contraction of two years) characterizes hog production.

A production cycle can be illustrated through our demand and supply framework. In Figure 6, the cycle begins when, following an increase in the market price at P_h, producers decide to increase their level of production to Q_h (point B). This excess supply will eventually induce a price reduction, to P_l (point C), for the market to clear. This lower price will in turn incite producers to reduce their production level to Q_l (point D). Because of biological and other constraints, such an adjustment cannot be instantaneous but once the decrease in supply is implemented, the price will rise again, bringing us back to point A and the cycle repeats itself.

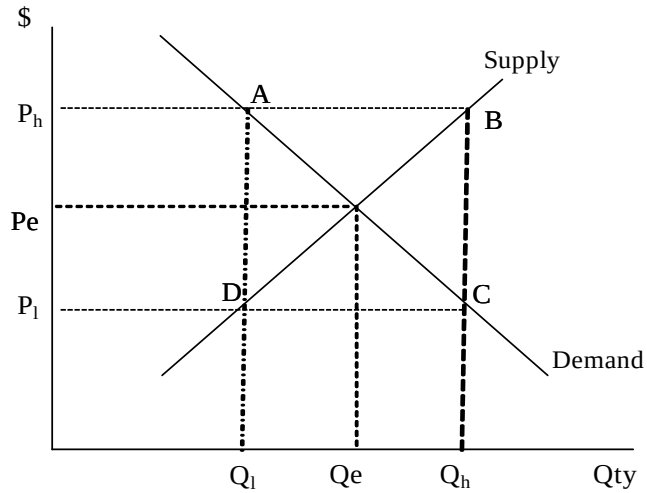

Figure 6. *Production cycles are common in agriculture because quantities take time to adjust. If the market price increases to P_h, producers will want to produce Q_h, but once Q_h is produced the price must go down to P_1 for consumers to buy it all. When price drops to P_1, producers want to market only Q_1 units. Once Q_1 is ready to market, competition between consumers for this short supply brings about an increase in price to P_h.*

Costs of production and how they relate to supply and entry and exit decisions

There are several types of costs. Fixed costs are costs that do not vary with the level of production. These are costs associated with inputs whose quantity cannot be adjusted in the short run. These costs must be borne by the firm/farm, even if production is zero (i.e. land, buildings, etc.). Variable costs pertain to inputs whose quantity varies with the level of production. The total costs correspond to the sum of variable costs and fixed costs. Total costs (TC) can be decomposed as the sum of variable costs (VC) and fixed costs (FC): TC = VC + FC.

For each quantity of output, it is possible for the manager to compute the average fixed costs AFC=FC/Q , where Q is the level of output, average variable costs AVC=VC/Q and average total costs ATC=TC/Q. Another import cost concept is marginal cost, MC=$\frac{\Delta TC}{\Delta Q} = \frac{\Delta VC}{\Delta Q}$, where Δ means "variation in". As such MC measures the increase in total cost needed to produce an additional unit of output.

Figure 7a presents graphically these different concepts. AFC are always decreasing since the fixed costs are distributed over a larger amount of output as the level of production expands. AVC is typically decreasing (increasing) at low (high) level of output because of economies (diseconomies) of size at low (high) output levels.

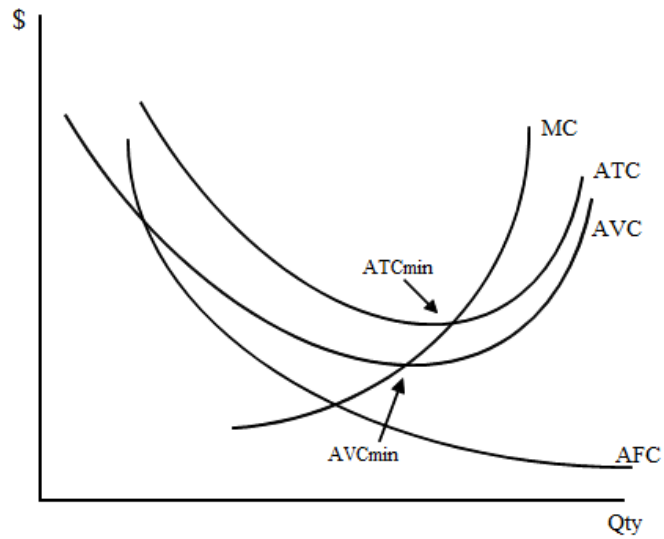

Figure 7a. *The average fixed costs AFC curve is downward sloping because fixed costs are distributed over a larger volume when the quantity produced increases. AFC is equal to the vertical difference between ATC and AVC. Variable returns to scale explains why the other cost curves are U-shaped. There are economies of size as long as it costs less at the margin to produce than on average (MC<AVC). The MC curve cuts the AVC and ATC curves at their minimum. At output levels when MC>AVC, the production of an additional unit raises average variable costs.*

Using the MC cost curve in Figure 7a and different output prices, we can determine the optimal level of production that will maximize the producers' profits. Figure 7b draws price lines (p_i) representing different output prices along with the cost curves drawn in Figure 7a. , Prices and marginal cost (MC) allows to draw firm's supply curve because a producer should increase his/her level of production until the cost of the last unit produced is equal to the price of this unit. We explain why below.

Let us assume that the price of the output is p_3. In this case, the optimal production level is Q_3. Just to be sure of that, consider an alternative production level like Q_2 where average (total) cost is minimized. At this level, we can see that the marginal cost for this last unit produced is equal to p_2. Since the price received for this last unit is $p_3>p_2$, it would be advantageous for the firm to produce more. If production increases from Q_2 to Q_3, each additional unit produced has a marginal cost below p_3 and is sold at p_3 thus increasing profit. This is true up to output level Q_3 where MC is just equal to p_3. For all units produced beyond Q_3, MC exceeds the price and each additional unit reduces profit.

A change in the market price induces a change in the profit-maximizing output level. For example, if the price was to decrease from p_3 to p_2, the optimal output would change to Q_2. At a price equal to p_1, the optimal level of production is Q_1. This confirms that the supply curve of the

firm is its marginal cost curve, as long as it is more profitable to produce than not to produce. This implies that below a so-called "break even" price it is best not to produce anything.

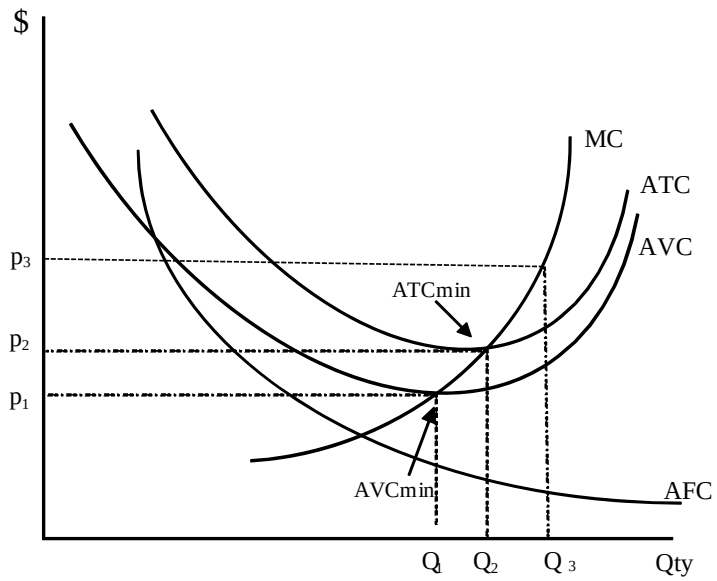

Figure 7b. The supply curve is the MC curve at "high enough" prices, but supply drops to zero when the price falls below the minimum average variable costs.

The cost curves that were just introduced can be used to explain why some firms decide to enter or exit a market. The example in Figure 7b illustrates that at price p_3, a producer would produce Q_3. At this level of output, the ATC is lower that the MC. The difference between ATC and the price of output is the profit for each unit produced or the profit margin. It follows that total profit is given by the product of the profit margin and the quantity produced. Knowing that the net profit is positive, some firms will be enticed into entering the market. New entrants will increase the quantity offered (supply will shift to the right) and the market price will fall. Entry continues until firms just break even.[16] Looking at Figure 7b, we can see that a decrease in price following the entry of new firms would force the manager to change his/her level of production.

Going back to Figure 7b, would a firm decide to exit the industry if the price was to fall just a little below p_2? The answer is no because optimal production would cover the variable cost and part of the fixed cost which is better than giving up all of the fixed cost by exiting. In fact, as long as the price is above the AVC curve, the firm will stay in production in the short run. Below this point, the firm will decide to exit the industry since the revenue from selling the last unit produced, does not cover any of the fixed cost and only part of the variable costs. The minimum

[16] It may seem peculiar that economists predict entry into an industry until profits are driven down all the way to zero. Economists believe that the relevant profits to explain firms' decisions are economic profits which are defined as revenue minus all costs – including implicit costs, like the opportunity cost of the business owner's time and money. When economic profits are zero, accounting profits will generally be positive.

of average variable cost is called the 'shutdown point'. In the long run, all inputs are variable so the firm must cover all of its costs. This means that the shutdown point in the long run is at the minimum of the average total cost curve.

Not all farms have the same cost structure. This is true within and between sectors. Still, there is an unmistakable trend toward larger farms and firms in general. The average number of laying hens per producer has increased rapidly since 1990, especially in Quebec, and on average each layer was 52% more productive in 2004 than in 1970.[17] This implies that demand must increase rapidly if the same number of farms is to remain in business.

These statistics clearly suggest that the technology is evolving very rapidly and that there are significant economies of size. We did not find recent studies on chicken and egg production that documents the existence of economies of size, but a recent study by Mosheim and Lovell (2009) show that there are economies of size for small, large and even very large dairy farms. Large dairy farms enjoy a tremendous cost advantage over small ones. The study done by Yélou, Larue and Tran (2010) found Quebec dairy farms to be similar in their ability to get the most out of their inputs, but they also found low input productivity. Unlike Quebec egg farms, Quebec dairy farms are below the national average in terms of size.

The implications of the above two studies is that productivity of farms is likely to increase rapidly as their number keeps on decreasing and their size keeps on increasing. The cost curves of farms expanding will shift down and their minimum average cost will be at a much higher level of output. These farms will be able to be profitable at much lower prices than smaller farms. In supply managed sectors, the implication is that larger farms will be willing to pay more for quota than smaller ones. We will explain in section 3.E the rationale behind this economic argument.

Milk production quotas will be more valuable for larger farms than for smaller ones and this will be reflected in their bidding on the market for quotas. The fact that some Quebec and Ontario producers were willing to pay over $30,000/kg for dairy quotas more likely reflect low cost of production than irrational investment behaviour. Differences in the cost functions of farms also matter in the design and implementation of policies. In the presence of much heterogeneity, the implementation of a target price policy set up such that a representative producer be able to make ends meet implies that less efficient producers will not be able to cover all of their costs. The determination of the costs of a representative farm has been a controversial issue in supply management programs as well as in the reform of Quebec's Revenue Insurance Program, better known as ASRA.

[17] See section 3.6 of the document available at www.agr.gc.ca/poultry-volaille/prinde3_eng.htm#sec36

Economies of size are also significant in processing, distribution and retailing. Ollinger, MacDonald and Madison (2005) contend that even the largest US poultry processing plants face significant economies of size and conjecture that consolidation in poultry processing in the United States should continue. Distribution centers are fewer but much larger than before. Most distributors-retailers have closed or increased the size of their smaller supermarkets and distribution centers in recent years. Loblaws has been particularly active during the last decade (Larue and Bonroy, 2009).

3.C. Marketing of primary and processed agricultural products

It is not possible to produce chicken wings without chicken or to do butter without milk. Yet, primary producers are rarely involved in processing activities. In most cases, primary producers sell their primary products to processors who then "mix" the primary inputs with other inputs like specialized labour and capital to produce a different product that is then sold to a distributor who in turn will add inputs like energy, labour, capital and perhaps packaging material to deliver a product to be sold in supermarkets to consumers. At each level along the marketing chain, value is added.

The concepts of value added and supply chain

The concept of value added defines the economic value that is created within the firm. It is the value that the firm adds to the goods through its production activities. It can be expressed as follows: $VA = VP - CGP$; where VA is the value added, VP is the value of the goods sold and CGP is the cost of the goods and services provided by another firm. The value added includes all inputs used by the firm such as labour, capital (including the interest cost on the debt), profit, taxes and social burdens. Clearly VA is not equivalent to profit because it includes the cost of inputs. As a result, it is possible to have a positive VA and a negative profit at the same time.

The concept of value added is closely related to the concept of supply chain. The supply chain is a series of links and inter-dependencies, from farm input suppliers, farms, food processors to food distributors and retailers (Bourlakis and Weightman, 2004). At each of these stages, value is added. We have witnessed in recent years several changes in the way supply chains operate. These changes were driven by several factors, but in particular by the necessity for firms to reduce their inventory cost as well as by consumer concerns over food safety and the origin and the production process of the products. So the traditional fragmented management practices in buying, storing and transporting goods have been gradually replaced by what is known as supply chain management practices, where all stakeholders in the food chain develop close relationships.

The quest toward greater vertical coordination along supply chains have brought about changes in the way markets operate all over the world. There is a trend to replace spot markets by contractual arrangements. In many countries, meat processors contract directly with individual producers instead of buying their inputs on auctions. Contracts have become the norm in sectors such as pork, poultry and horticulture in the US and Europe. In fact, the US poultry industry is often cited as a pioneer in this area.[18] In the case of meat, it is one way to get more benefits from improved genetics. Because they control their input supplies, processors are less hesitant in investing in animal genetics.

Contractual arrangements are also a direct mechanism to share the risks and benefits from the development of new products. We have developed a short case study in the appendix to provide an example of a successful value chain. It emphasizes the importance to create value, to have all partners understand their role and that of others in creating value, to share information and to innovate.

The allocation of resources in a market economy is determined by the interactions of buyers and sellers. A competitive market will result in an efficient allocation of resources because goods will be produced by firms with the lowest costs and purchased by buyers who value them the most.

This efficiency result however relies on certain assumptions. The most important assumption is that there are many self-interested buyers and sellers in the market. When this assumption does not hold, unregulated markets usually fail to allocate resources efficiently. We argue below that the structures of certain agri-food supply chains are not likely to support competitive outcomes. This is true of supply chains with supply management because supply is restricted to achieve higher prices, but it is true of many supply chains without supply management as well. It is then necessary to investigate the implications of departing from the assumption of perfect competition.

Industry concentration

There is no arguing that agri-food markets' concentration has increased in recent years. One of the most popular indicators of concentration is the Concentration Ratio (CR) measure. Usually, the CR measure is computed by adding the market shares of the four or eight largest firms in a market. The idea is that a large CR implies that a few firms control a large share of the industry.[19] Concentration data for Canadian agri-food industries is generally difficult to obtain

[18] See p. 36 of the document available at http://12.35.11.68/PUBLICAT/ECONREV/PDF/2Q01Bark.pdf

[19] An alternative concentration measure is the Herfindhal Index (HI) which is computed by summing the square of the firms' market shares. The idea behind this index is that the degree of heterogeneity in firm size also matters in the computation of concentration.

due to the sensitive nature of the data. The meat industry is a notable exception. In the chicken industry, the CR-4 went from 26.9 percent in 1960 to 45.8 percent in 2005. A similar trend can be observed in the turkey industry for which the CR-4 in 2006 was 70.9 percent. We also see a similar trend in non-supply sectors. In the hog sector, the CR-4 went from 56 percent in 1999 to 74 percent in 2008. In other sectors, data on the number of firms and establishments are generally available, but it is not possible to infer the market share of the four or eight largest firms.

The trend in the US market is similar: the CR-4 in the beef packing and pork packing sectors went from 72% and 40%, respectively, in 1990 to 84% and 64%, respectively, in 2005. High concentration is also an issue in supply managed sectors. The three largest Canadian dairy processors, Saputo, Agropur and Parmalat, process 75% of the milk while owning only 14% of the processing plants.[20]

Industry concentration is closely related to the presence of economies of size. Firms producing more have lower cost of production and can secure a larger share of the market. When economies of size are still possible at very high levels of outputs, the market will not sustain a large number of firms. The good part is that these firms have very low costs of production. The bad part is that they can potentially exercise market power. This trade-off has been analyzed in detail by Azzam and Schroeter (1997) and Lopez, Azzam and Liron-Espana (2002) and we will discuss it graphically below.

Technical innovation is another factor explaining the trend towards more concentrated markets. Indeed, when a firm innovates and adopts a new technology, its cost structure will be affected. Innovation will push down the ATC curve of a firm. This would allow the innovating firm to reduce its price and gain a larger share of the market. The resulting price depends on the structure of the industry and need not be at the minimum ATC. However, as will be seen later, a cost-reducing innovation incites firms to lower their prices even when there is a single firm in the market.

Several stakeholders are concerned by the recent trend toward a more concentrated agri-food industry in Canada. However, if there is no barrier to entry in a market, any attempt by a firm to increase its price will increase the likelihood of new firms entering the market. Figure 8 illustrates the impact of a merger between two firms (and thus higher concentration). Let us assume that there are two firms with identical and constant marginal cost, as illustrated by C_f in Figure 8. If these firms must announce their prices simultaneously, two firms is sufficient to obtain a competitive outcome as each firm has an incentive to set a lower price than its rival and the price is P_f and total quantity offered is Q_f.

[20] See www.dairyinfo.gc.ca/index_e.php?s1=cdi-ilc for more details.

Let us now assume that the two firms decide to merge and in doing so, the new integrated firm becomes more efficient so its cost structure changes and its marginal cost drops to C_1. In this situation, and if the ability of the new firm to exert market power is not very high because of the threat of entry of new firms, the price could end up just below P_f and consumers would be better off than in the pre-merger equilibrium. The new firm would be making a profit as opposed to the zero profit made by the two firms in the pre-merger equilibrium. This would be a pro-competitive merger. Maximum gains could be achieved if the government imposed a price ceiling of P_i to force the firm to produce output Q_i at zero profit.

In the absence of competition, the newly created firm would most likely try to exploit its market power by choosing a high price like P_m to earn a profit equal to $(P_m\text{-}C_i) \times Q_m$. At this price, the quantity demanded would decrease to Q_m. A higher price and lower purchases hurt buyers. However, the firm would gain from the cost reduction. The magnitude of its gain is depicted by the area denoted 'cost saving' in Figure 8.

The firm also gains by raising its price above average costs. Total welfare will be increasing after the adoption of an innovation as long as the area 'cost saving' is larger than the triangle denoted by DWL (what economist refer to as the deadweight loss). The relative importance of these areas is an empirical question and each case has to be analyzed to determine the final effect on the market. Thus, the trend toward increased concentration is not necessarily bad.

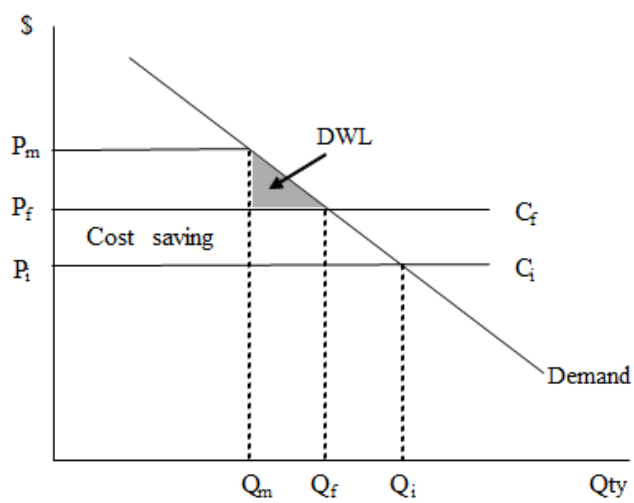

Figure 8. The pre-merger competitive equilibrium involves 2 firms with average cost C_f selling a combined output Q_f at price P_f. A merger can be pro-competitive even if the equilibrium is no longer a competitive one. This would happen if average production cost fell to C_i and the equilibrium price were between P_f and P_i, thus enabling the firm to make a positive profit. The merger would be anti-competitive if the equilibrium price was at P_m. This would create a deadweight loss DWL because only a part of the loss of consumers translates into higher profit for the firm. The net benefits of the merger are obtained by comparing cost saving and DWL.

Competition and innovation are encouraged when barriers to new entrants are minimal because the threat of entry tends to encourage incumbent firms to invest more in R&D. In this respect, one should not underestimate the harmful effects of overly restrictive regulations on the entry of new competitors in a market. Complex regulations discourage investments and development of new products and production processes by increasing the costs of existing firms and of new firms. On the other hand, regulations are a necessity, especially in the food business. This is why complex food regulations can be traced back many centuries ago as ruling classes attempted to minimize the devastating consequences of food security and food safety issues (Kaplan, 1984).

With or without restrictive regulations, the food industry would be highly concentrated. Concentration by itself need not be problematic as long as the threat of entry is strong enough to limit the market power of existing firms. In other words, it is not always necessary to have several firms competing with each other in a market to observe competitive prices. For example, concentration in food distribution activities is very high, but the threat of entry of large American and European distributors on the Canadian market impose constraints on Canadian firms.

Antitrust policies must be adapted to the new realities of food markets. Such policies must ensure that the gains from value creation are maximized which entails that the gains must be shared among all stakeholders along the food chain in a way to provide the right incentives. It is also crucial that consumers be able to choose from a diversified set of products.

Naturally, any country's antitrust policy must insure that firms do not collude or abuse of a dominant position. In this respect, it is necessary to track prices at the regional and local levels. Indeed, the negative impacts of concentration are more frequently felt at the local or regional levels because concentration is typically much higher at these levels. Thus, analyses of competition based on degrees of concentration calculated at the provincial and national levels could be misleading.

Imperfect competition

The validity of the hypothesis of perfectly competitive markets has been questioned for agricultural products because of concentration in upstream and downstream segments of the supply chains. Thus, it is important to understand the implications of imperfectly competitive market structures. A monopoly is a firm that is the sole seller of a product without close substitutes. The key difference between monopoly and perfectly competitive market structures is that a monopolist has the ability to influence the market price of the product it sells while competitive firms have no market power.

Many factors can explain the presence of a monopoly in an industry. The main source of monopolies is the existence of barriers to entry that prevent other firms from entering the market.

Barriers to entry can exist because: 1) a single firm owns a key resource that is otherwise not available; 2) the government gives a single firm the exclusive right to produce a particular good; and 3) a single firm can produce the entire market at a lower average cost than when multiple firms are present in the market. Monopolies emerging under the first category are often found in hi-tech industries. For example, Microsoft enjoys a virtual monopoly in computer-based office applications. It has been able to brand its product and become a leader in this market.

Monopolies falling under the third category are labelled natural monopolies. Utilities are obvious examples of natural monopolies. Electricity production requires large investments in specialized assets. Utilities must supply large quantities to be able to recoup their investments and thus it may not be viable from an economic standpoint to have more than one firm supplying the market. Patents and copyrights are examples of exclusive rights conferred to firms to allow them to generate enough revenues to cover for their successful and unsuccessful R&D investments. This is why new pharmaceutical products are so expensive even though average variable costs of production are very low. Without patent protection, it would not be profitable to invest in R&D and there would be too little innovation.

Marketing boards in agricultural markets are also examples of institutions upon which exclusive rights have been conferred. Often, the rights are limited to the marketing of products and do not include the power to control production as is done by supply management programs.

Any attempt to raise the price by a firm in a perfectly competitive market would bring the quantity sold by this firm to zero. In comparison, a monopolist is the only seller, so the market demand curve is the individual demand curve that it faces. A monopoly is free to position itself wherever it wants in the market. However, it must realize that to sell more, its price must be lowered to entice customers more. In this instance, increasing sales has two effects on the monopolist's revenue. Selling more boosts revenues, but at the same time the lower price required to sell more (remember the law of demand), will lower revenues.

We can define the marginal revenue of the monopolist as the additional revenue captured by selling an additional unit. The marginal revenue of the monopolist is lower than the price of the last unit sold because the additional unit sold lowers the price of all the units (assuming the monopolist sells all units at the same price). In fact, the additional revenue obtained by the monopolist could even be negative. This would happen if the positive impact of selling a higher output is smaller than the negative price effect.

As in the case of a competitive firm, a monopolist will maximize profit by selling the quantity where the marginal revenue obtained from selling its last unit is equal to the marginal cost of producing that unit. Once the monopolist identifies this quantity, it sets the highest price consumers are willing to pay for that quantity. This price will be found using the market demand

curve. A monopolist is a “price-maker,” not a “price-taker”. Its output does not depend on price as in the case of a competitive firm. The quantity and price are jointly determined by equating marginal revenue to marginal cost. The monopolist chooses a point on the demand curve. This is akin to predicting the national quota needed to achieve a target price by supply management agencies.

Let us review the concepts of marginal revenue and marginal costs in the context of a monopoly using Figure 9. As before the demand curve is represented by D_0. A competitive market equilibrium would be represented by the equilibrium price and quantity p_0 and Q_0, respectively. If we assume for simplicity that the industry cost structure would not change from going to a large number of firms to a single one, then the marginal cost of the monopolist and the supply curve could be the same. The marginal revenue function of the monopolist is lower than the price it receives for the product, except for the very first unit to be sold. In order to sell an additional unit from an arbitrary point on the demand curve, the firm must lower its price not only for the additional unit, but on all units to be sold. This is why the MR_0 curve is located below the market demand curve in Figure 9.

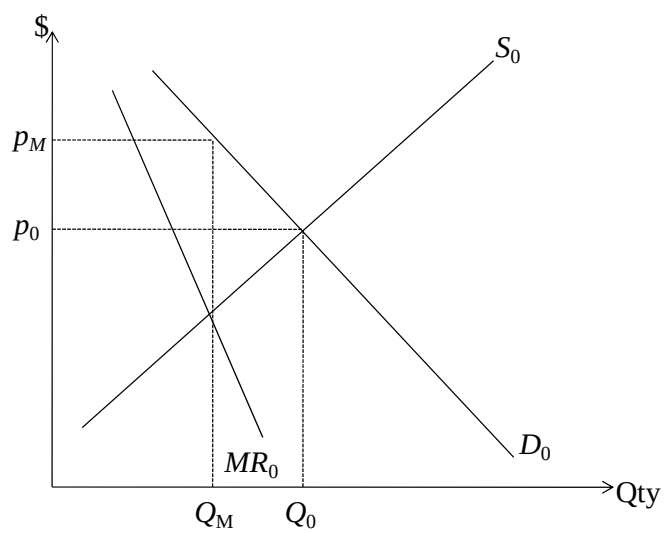

Figure 9. The monopolist maximizes profit by choosing an output level Q_M at which marginal revenue MR_0 is just equal to marginal cost S_0. Monopoly pricing entails social costs known as deadweight loss when compared to competitive pricing because the increase in the firm’s profit does not entirely make up for the losses from restricting supply A similar argument was made by economists studying supply management policies (e.g., Veeman, 1982).

Profits are maximized when marginal revenue equals marginal cost because at that output level, increasing output would result in additional revenue that would be more than offset by additional

cost of production.[21] So the profit-maximizing output solution of the monopolist is represented by Q_M in Figure 9 and the corresponding price is p_M. The existence of a monopoly implies a price in excess of the price that would prevail in a perfectly competitive market structure. The monopolist has an incentive to lower output in order to increase its profits. This lower output results in a higher price, but the monopolist must be careful about choosing not too high a price that could "choke" the demand.

An example of a monopolist in an agri-food supply chain would be a manufacturer that owns exclusive marketing rights of a particular seed. What the analysis above shows is that the exclusive marketing rights give an incentive to charge a higher price to customers (e.g., crop producers). Yet, this situation may not be all bad for the economy because the firm could have decided not to invest in costly R&D if it had no prior guarantees of earning back some of these investments. The regulatory challenge is to give a monopoly position to a firm just long enough for cumulative profits to cover R&D costs and put an end to deadweight losses that arise under monopoly pricing. Too short a period would discourage R&D and too long a period would unduly punish buyers (i.e., crop producers).

A similar market equilibrium occurs when there are many sellers in the market with only one buyer present. This market structure is called a monopsony and it will be covered in greater detail in a subsequent section. However, we can point out that a monopsonist has an incentive to lower its purchases of the good in order to reduce the price it pays. Sellers obtain a price below the one that would prevail in a market with many buyers. The creation of marketing boards is one way to counter the market power of processors in their dealing with producers.

The competitive and monopoly/monopsony market structures are two extreme cases. In between these extremes, you will find many different market structures that can directly be applied to Canadian agri-food industries. One important market structure is called an oligopoly. An oligopoly involves only a few sellers selling identical or differentiated (yet closely related) products. By the same token, an oligopsony involves a few buyers and many sellers. When firms in an oligopoly individually choose production to maximize profit, total sales exceed sales that would be observed under a monopoly, but fall short of the competitive sales level. Oligopoly prices are also between the competitive and monopoly prices. Similarly, oligopsony entails prices that are higher than the monopsony price but below the competitive price.

The concentration ratios reported before suggest that competitive prices may not be observed along certain agri-food supply chains. The market outcome in imperfectly competitive markets is the result of strategic interactions between firms present in the market. Each firm has some

[21] When there are several firms contributing to the production as in the production of supply managed commodities, the marginal cost curve is the aggregation of individual (farm) marginal cost curves which is the industry supply curve. This is why the marginal cost curve is labeled S_0 in Figure 9.

impact on the equilibrium price, but firms may also compete in R&D and/or advertising expenditures. Hence, there are several types of models of imperfect competition.

In general, oligopoly theory will predict outcomes that are located between or at the two extremes of perfect competition and monopoly extremes. A general rule of thumb is that the more homogenous is the product sold by oligopolistic firms, the closer the oligopoly equilibrium will be to a perfectly competitive equilibrium.

In other words, if the good sold by firms is homogenous, competition among the firms will be fierce, especially so under the situation in which they can easily respond to changing market conditions. That would be the case for example if firms do not face capacity constraints and can expand output easily. In the case of agri-food supply chains, the presence of lags between the moment production plans are made and output is marketed makes it difficult to believe that market outcomes are perfectly competitive. Lopez, Azzam and Liron-Espana (2002) found departures from the competitive outcome in 20 of the 32 US processing industries they have analyzed.

Market failures and government intervention

A market failure arises when the market does not function properly. This can arise when one or more agents can influence market outcomes or when some costs or benefits are not internalized by the market, thus creating a wedge between private and public costs and benefits. Air and water pollutions are examples of negative externalities. If a production process generates pollution as a by-product and firms are allowed to produce as much as they want, they will rely on the output price and their own private costs to determine their profit-maximizing level of output. Because private costs does not account for pollution costs and hence fall short of social costs, the output produced by the firms will be too large.

The presence of a significant market failure requires a government intervention to re-establish efficiency in the market. In our example, a tax on production would solve the problem. The presence of imperfect competition is another example of a market failure. If authorities believe that concentration is negatively impacting on the allocation of resources in a market, they have the power to break a monopoly or an oligopoly to re-establish competition in the market.

Agriculture is often mentioned as an example of both positive and negative externalities. The most common negative externalities are air and water pollutions. The positive externality refers to the production of services and goods that are valued by society, but for which there is no market. The concept of multifunctionality of agriculture is a prime example of a positive externality. Agricultural producers provide output, but also contribute to the preservation of rural

communities and agricultural land, two activities that can be valued by society but for which producers do not get paid.

As in the case of a negative externality, the government can step in and improve the market outcome. For a positive externality like multifunctionality, a subsidy to encourage the production of rural amenities may be desirable. The government policy must directly target the externality and needs to account for indirect effects in other sectors of the economy. It is thus a highly delicate exercise to correct a market failure and this is why economists generally doubt that government can improve market outcomes.

International issues

An important assumption of the analysis presented in previous sections was that that there was no competition from foreign products on the domestic market. This assumption is clearly unrealistic given current broad globalization pressures that affect all agri-food sectors including supply-managed ones. A simple measure of openness in a market is the import tariff imposed on a product. An import tariff is a tax on units imported into the country. The higher the import tariffs are, the higher the price of the foreign goods sold in the domestic market, and the lower the market access given to foreign products.

The world average import tariff on industrial goods is around 4 percent, but the average tariff on agri-food products is around 60 percent (Gibson *et al*., 2001). Much liberalization remains to be done in agriculture. Import tariffs are not the only impediments to trade. There are many other forms of border protection. Non-tariff measures to protect or shield domestic firms from foreign competition include sanitary and phytosanitary measures and domestic standards. However, it is useful to first concentrate on tariffs given that commodities produced in supply managed sectors are protected by tariffs in excess of 200 percent.

First consider the hypothetical case in which there are no trade frictions in the world, i.e., countries implement a free trade policy. Of the outmost interest is the question of which country will be able to export to other countries. We say a country has a comparative advantage in the production of a good if it produces the good at a lower opportunity cost than other countries. Countries will export the goods for which they have a comparative advantage. The notion of comparative advantage relies on the relative cost of producing two goods. A country can be better at producing everything, but still has an advantage in specializing in one or few sectors and letting other countries supply other goods to domestic buyers.

The notion of comparative advantage is powerful in predicting trade patterns, but is less than trivial. For the purpose at hand, we will simplify the concept a little. If the domestic price of the good in the absence of trade (put differently, under autarky) is lower than the world price, we say

that the country has a comparative advantage in the production of that good, and under free trade, the country will export the good. Conversely, if the domestic price in autarky is greater than the world price, we say that the country does not have a comparative advantage for that good, and under free trade, the country imports the good.

Consider the two possible situations illustrated in Figure 10. The world price is denoted by p_w and is assumed constant. This is consistent with the assumption of a small open economy that is price-taking on world markets. As such, its policies have no effect on the world price. This is not always true. Think of maple syrup production for which Canada controls over 80 percent of world production. In this case, Canada can certainly not be considered a small country. A similar story can be told for kiwis produced in New Zealand and possibly for wheat produced in the U.S. and Canada. Nevertheless, we make the small country assumption to simplify the analysis knowing that it will not taint the lessons to be learned below.

When a small economy engages in free trade, the world price is the only relevant price. No domestic firm would accept less and no domestic buyer would pay more and the world price is price prevailing in the domestic market. In the left hand-side panel, the world price is superior to the price that would prevail in an economy that does not trade (p_0). A quantity Q_2 will be supplied at the world price while a quantity Q_1 will be purchased by domestic buyers. The difference between Q_2 and Q_1 will be exports (E). The country has a comparative advantage because it can produce the good at a lower price in autarky than other countries. In the right hand-side panel, the world price is lower than the domestic price in autarky. Production is at Q_1 while consumption is at Q_2. The difference between Q_2 and Q_1 is imports (M).

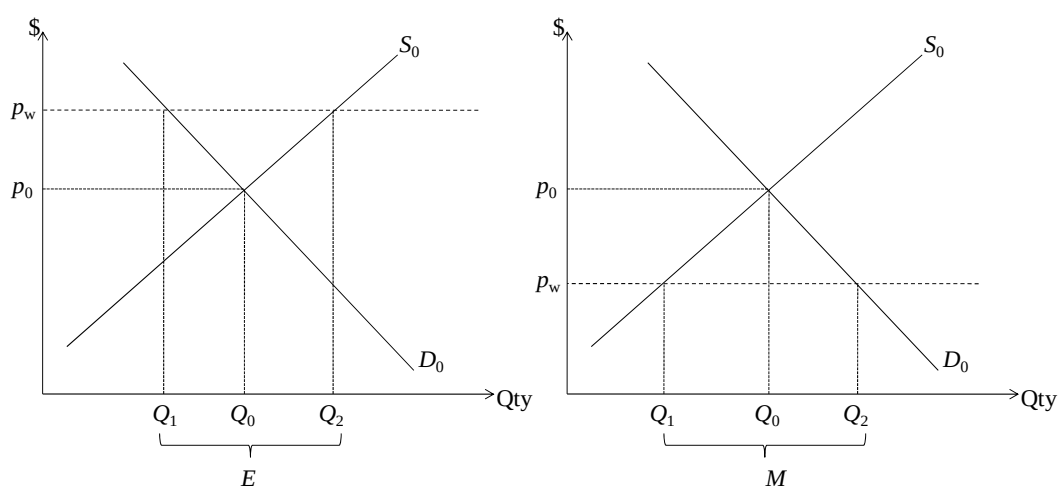

Figure 10. The autarky equilibrium price p_0 is the price that would be observed without trade. When the world price p_w is higher (lower) than the autarky price p_0, the country exports (imports) E (M)=Q_2-Q_1 units. The increase (decrease) in price in the left (right) diagram helps producers (consumers) more than it hurts buyers (producers). Therefore, whether the country is an exporter or an importer, the gains from trade are positive.

International trade brings many benefits to a country. In the right hand-side panel, consumers enjoy great benefits because they can purchase a larger quantity at a price lower than the one that would prevail in autarky. Of course, domestic firms lose in the process of opening up trade because they must cut down production, *i.e.* they sell less due to foreign competition. However, the gains of buyers outweigh the losses of domestic firms, and in the aggregate, income in the country goes up. The gain for consumers is determined by the area to the left of the demand curve between p_0 and p_w. This area is larger than the loss for producers which is defined by the area to the left of the supply curve between p_0 and p_w.

In theory, a policy could be implemented such that part of the gains of the winners would fully compensate the losses of the producers, leaving everybody better off. However, adjustment and compensation policies rarely provide full compensation. A similar story holds in the case illustrated in the right hand-side panel. Domestic firms benefit from free trade because they can sell to a larger market while domestic buyers end up paying a higher price than in the case when there is no trade.

There are benefits of trade other than the pure gains of selling (buying) more at a higher (lower) price. Under free trade, consumers enjoy access to a greater variety of goods. Firms that sell to a larger market may achieve lower costs by producing on a larger scale. International trade also increases the number of firms competing in a market and thus has positive impacts on the degree of competition in a market. Trade enhances the flow of ideas, and facilitates the spread of technology around the world. Despite all of these benefits, opposition to trade liberalization can be fierce in some sectors.

Agriculture was for the first time introduced within the normal trade disciplines of the General Agreement on Trade and Tariffs (GATT) at the conclusion of the Uruguay Round (UR) of negotiations in 1994. Efforts to liberalize the multilateral trade system began after the Second World War. But up to the conclusion of the UR, agriculture had always been for all practical purposes excluded from the talks. The UR Agreement on Agriculture (AA) lays out the principles and rules of agricultural trade. One component of the AA includes all questions related to market access. It spells out the rules used to convert all import quotas into bound tariffs, i.e. maximum trade taxes that can be used by WTO members. In the past, countries often relied on quantitative restrictions on imports to shield their domestic market from foreign competition.

Limiting the supply of foreign products on the domestic market has obvious implications. In the case illustrated in the right hand-side panel, any limitations on imports below the level of imports (M) at the world price (p_w) will raise the domestic price. The more stringent is the limit on imports, the closer the domestic price will be to the price (p_0) that would prevail in the absence of trade.

The conversion of import quotas into bound tariffs was an important outcome of the UR. Tariffs are more transparent than import quotas because the impacts of tariffs on prices are more readily measured. The transparency of tariffs also facilitates negotiations between WTO members. Figure 11 illustrates the impact of an import tariff. The variable t measures the tax in percentage terms applied to imports. It raises the domestic price compared to the free trade situation because domestic consumers must pay the world price plus the import tax. This allows domestic firms to sell their output at a higher price than under free trade. In the end, buyers purchase a lower quantity (Q_4) due to the higher price and firms sell a higher output (Q_3) than under free trade. The result is that imports decrease from M_1 to M_2.

The gains from trade are lower under the import tariff than under free trade. However, the import tariff has a redistributive effect. Losses of domestic firms are lower than under free trade while the gains of buyers are lower. However, an import tariff is an inefficient redistributive tool. Together, the higher revenues for domestic firms and the tax revenue for the government are less than the losses suffered by consumers. If the objective of a tariff is to redistribute income, there are better ways to achieve this objective.

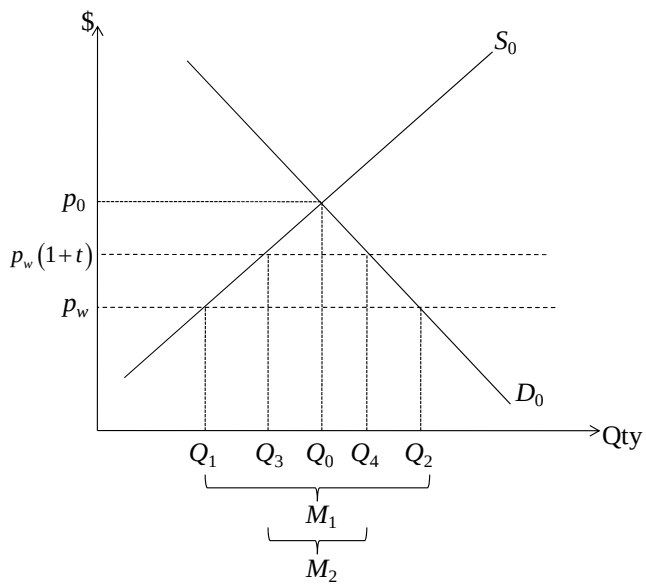

Figure 11. Under free trade, imports would be M_1. An import tariff reduces imports to M_2. Relative to free trade, the tariff improves the welfare of producers by the area to the left of the supply curve S_0 between prices p_w and $p_w(1+t)$ and generates a revenue represented by the area defined by $(p_w(1+t)-p_w) \times M_2$, but it decreases consumers welfare by the larger area to the left of the demand curve between p_w and $p_w(1+t)$. Thus, when the importing country's reduced imports cannot affect the world price, a tariff creates a net welfare loss.

If international trade brings so many benefits to an economy, why is there such fierce opposition to trade liberalization? The losses due to trade are often highly concentrated among a small

group of people while the gains are often spread thinly over many people. At the individual level, the losses of the losers are much larger than the gains of winners. Hence, the losers have more incentive to organize and lobby for restrictions on trade. One popular argument against trade is the "jobs argument". Economists have shown that rising imports do not cause rising unemployment because job losses in import-competing sectors are offset by job gains in growing export industries.[22]

Another argument for protection is the "infant industry argument". It states that temporary protection should be offered to an infant industry until it is mature and can compete with foreign firms. The problem with this argument is that it is difficult for the government to identify which industries will eventually be able to compete and whether benefits of establishing these industries exceed the costs of buyers due to restricting imports. A tariff is not the best policy instrument; a production subsidy or subsidizing loans would be more efficient. However, if it is obvious that a firm will be profitable in the long run, why would it be (or a private lender) unwilling to incur temporary losses?

Another argument is that producers in another country have an unfair advantage due to government subsidies. If this is the case, we should import all we can for as long as we can and thank this country for being willing to subsidize our consumption at their taxpayers' expense! If we feel sorry for their taxpayers or our import-competing producers, the best way to deal with the problem is to support proposals calling for significant cuts in domestic support at the WTO.

Finally, import barriers are sometime motivated by the desire to shield the domestic market from the volatility of world markets. From Figure 11, one can see that if the world price change and the tariff does not, the level of imports and the domestic price will change. To counter these effects (and thus insulate its market), the European Union used to impose variable levies. Such instruments are no longer legal under WTO rules. The variable levy was a "moving" tariff that increased whenever the world price would fall and decrease whenever the world price would increase to keep the domestic price equal to a target price. If domestic supply and demand were constant, the variable levy was equivalent to an import quota because the variations in the tariff would maintain the level of import constant under fluctuating world prices. It has been demonstrated (Larue and Ker, 1993) that large importing countries using variable levies can exacerbate the volatility of world markets.

Canada's defense of import quotas for supply-managed sectors in the Uruguay Round was motivated by its appreciation for predictable imports.[23] As we will see in more details in

[22] See Trefler (2004) for a thorough analysis of the Canada-US Trade Agreement on employment and productivity in Canadian manufacturing.

[23] Article XI:2 c of the GATT allowed quantitative restrictions on products that had domestic price support and production-control programs. With the tariffication of non-tariff barriers in the Uruguay Round, Canadian imports in supply-managed sectors are controlled through TRQs set up to mimic import quotas.

subsequent sections, supply management is about setting domestic production given forecasts about domestic demand and imports and stable imports makes for easier planning. The stability argument also motivates the special safeguard measures that some developing countries would like to insert in a future trade agreement at the WTO. Basically, the safeguard would be triggered whenever either imports growth or domestic price reductions would reach certain thresholds.

3.D. Domestic support programs

Another important component of the Agreement on Agriculture is the set of disciplines imposed on domestic support programs in agriculture. Domestic support can take many forms. We argued in the previous section that import tariffs are a form of support programs because it raises the price received by domestic firms. This section reviews the different forms of domestic support and explains where supply management falls into the overall picture of agricultural programs.

Income support

Government program payments are classified under either "subject to reductions" or "exempt from reductions" in the Agreement on Agriculture. The payments in the former category fall under the Amber box. Amber box programs include payments that are generally coupled to production decisions and that are thus considered trade distorting. An example of trade distorting payments is the payments made under the *Assurance stabilisation du revenu agricole* (ASRA) in Quebec. ASRA payments are tied to production levels. A larger production level will be associated with a higher level of payments. Because trade is tied to domestic production, the increase in production is regarded as trade-distorting.

The second category of payments falls either under the Blue box or Green box. Green box programs include payments made in return for environmental services, or are payments that are decoupled from production decisions. For example, direct commodity payments in the U.S. have been notified to the WTO as green box payments. They are based on historical yields and past acreage decisions and thus producers cannot increase their payments by producing more.

Blue box programs include payments made in return for production limiting actions. A popular trick question in undergraduate trade policy courses across Canada is to ask under which category Canadian supply management programs fall: Amber, Green or Blue box? Some are tempted to answer the Blue box because of the reference to production limiting actions (i.e. production quotas). In reality, the answer is that supply management does not belong in any of the boxes. Supply management involves transfers from consumers to producers. Limiting production in that case does not involve government payments. Hence, there are no restrictions on supply management per se.

As Veeman (1997, p.1559) puts it, the federal government acts more as a "facilitator of change", than as a supervisor of national supply management agencies.[24] Supply management is compatible with WTO rules and SM programs have proven adaptable when challenged by undergoing changes in response to challenges by some of Canada's trade partners and to changes in the GATT. Additional adjustments will be necessary if or when the Doha Round of negotiations at the WTO is completed.

Production limiting programs coupled with price support policies have also been used in other countries, but many were, or are in the process of being terminated because of either external pressures or internal wrangling. The U.S. government ended domestic production controls for tobacco production in 2004. Switzerland abolished milk production quotas in 2009 and milk production quotas in the European Union are scheduled to disappear in 2015. In most instances, production controls were tied to government payments and external and budgetary pressures led to the reforms in these markets. Finally, whenever government programs generate predictable profits, the latter get capitalized in land and buildings or in sector specific assets like production quotas for supply managed commodities.

Economic rents and quota values

We consider a generic case of a production limiting program using the supply and demand tools introduced earlier. Consider the market illustrated in Figure 12. Let us assume that producers sell directly to consumers. As before, the equilibrium price in a competitive market would be determined by supply and demand forces and would be p_0. The equilibrium quantity would be Q_0. Now suppose output in the market cannot exceed the level $\overline{Q}$. The relevant aggregate supply now is defined by the bold vertical segment due to production limits and the new equilibrium price is $\overline{p}$. The main impact of restricting output is that it raises the price of the units that are sold. However, fewer units sold at a higher price do not necessarily increase revenue. It is possible to show that if the demand for the product is inelastic, revenues will be higher at the higher supply management price $\overline{p}$ than at the competitive price of p_0. Recall that the supply function represents the marginal cost of sellers, and thus provides an estimate of the price firms are willing to accept in return for selling the last unit. Clearly, the restriction on output implies that the price in the market is higher than the marginal cost of sellers.

[24] For example, it is involved with the settlement of disputes pitting one province against another and disputes pitting producers against processors. The federal government is also responsible for trade policy. This includes the setting of trade taxes as well as responding to complaints from our trading partners through the trade dispute mechanisms of the World Trade Organization (WTO) or bilateral agreements like the North American Free Trade Agreement (NAFTA).

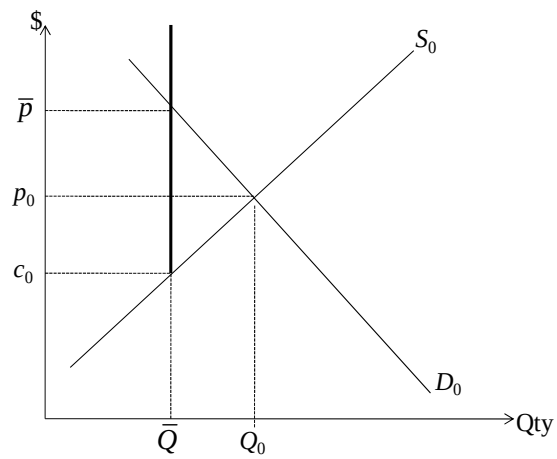

Figure 12. The initial competitive equilibrium is at the price-quantity pair p_0 and Q_0. A production quota constraining output not to exceed $\overline{Q}$ induces a price increase to $\overline{p}$, thus benefitting producers but hurting consumers.

When output is restricted through production quotas, the difference between the price $\overline{p}$ producers get and marginal cost c_0 is referred to as the unit economic rent of the quota. The seller that holds the right to sell the last unit obtains an economic rent because the selling price is above the marginal cost. This unit rent can be thought of as the rental value of the quota. This would be the price a seller would be willing to pay to hold the production quota for one period. The value of the production quota will generally be determined through a capitalization formula such as the rental value of the quota $\left(\overline{p}-c_0\right)$ divided by a discount rate.

In order to predict the value of a quota, one must be able to observe the market price, marginal cost and the discount rate. If one is willing to make an assumption about the value of one of these variables, it is then possible to infer the other variable of interest. Even then the task may be complicated by the availability of the data. For example, there is no centralized exchange market for chicken production quotas in Canada as opposed to dairy production quotas.

Rude and Gervais (2006) provide an example of the linkages between quota values, the discount rate, marginal cost and farm price. They estimated the marginal cost of production for Ontario chicken producers by relying on an assumption about the discount rate of producers and unofficial quota values. According to industry sources, a unit of chicken quota in Ontario was valued around $47 in 2001. A quota unit represents production of approximately 12 kilograms of chicken (live weight) per year. The rental value of quota $\left(\overline{p}-c_0\right)$ can be inferred by multiplying the quota value (on a per kilogram basis) by an appropriate discount rate. If we assume that the discount rate is δ =10% (i.e. the rate at which producers discount future profits) and given that

the chicken price was around \$1.20 per kg in 2001, the capitalization formula $QV = \left(\overline{p} - c_0\right)/\delta$ implies that marginal cost was \$0.81 per kg.

3.E. The economics of supply management

The previous sections presented basic economic concepts necessary to the analysis of supply management programs. This section relies on the tools discussed previously to focus on specific issues confronting SM systems.

Demand and supply shifters and quota values

Figure 12 taught us that producer boards can only target one variable in the market: price or output. In the current static framework without uncertainty, once the output target is set, the price is determined according to the demand curve. Similarly, a producer board setting a price target for its producers implicitly determine output at the same time. Hence, it is not possible to control both output and price at the same time, unless a time dimension is introduced in the analysis. The time dimension could refer to inventory management.

In the real world, the demand curve (and even to a certain extent the supply curve or marginal cost) may be unknown to producers when the output target or price target is set. The demand curve producers face is influenced by a number of different factors whose impacts vary from one product to another. The demand curve faced by producers is the retail demand from which the retailers' and processors' margins have been deducted. Any factor affecting the retail demand or the margins of processors and retailers end up impacting the demand faced by producers.

An increase in income causes an increase in quantity demanded at each price. The same can be said about new health information that would increase the value of the product in the eyes of consumers. The demand for white meats like chicken experienced such an effect in the last decade. On the other hand, the demand for butter might have been negatively impacted by changes in consumer preferences. In the example illustrated in Figure 13, the demand curve would jump from D_0 to D_1. Under a production quota $\overline{Q}$, the domestic price increases from $\overline{p}_0$ to $\overline{p}_1$. If $\overline{p}_0$ was a target price, the production quota would have to be increased in response to the shift in demand.

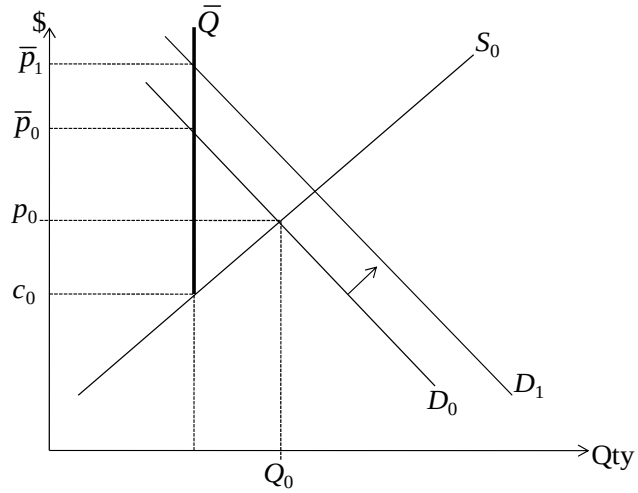

Figure 13. *Under a production quota, an upward shift in demand, due to an increase in income or a structural change in consumer preferences, induces an increase in the domestic price and in the value of production quotas*.

Consider the implications of the increase in income when the production quota is fixed. The price increase from $\overline{p}_0$ to $\overline{p}_1$ triggers an increase in economic rent associated with the production quota. The economic rent of the marginal producer increased from $\left(\overline{p}_0 - c_0\right)$ to $\left(\overline{p}_1 - c_0\right)$. The benefits of the increase in demand are being capitalized in the value of production quotas. Producers' revenue go up because they are selling the same quantity at a higher price. The cost structure is the same and thus profits necessarily increase, as does wealth because of the increase in quota values.

One potential response by the producer board following the increase in demand would be to increase the quota such that the price in the market is unaffected by the increase in income. This situation is illustrated in Figure 14. In order to mitigate the upward pressures on the price, the global production quota may be allowed to increase from $\overline{Q}_0$ to $\overline{Q}_1$. One interesting consequence of this response is that the quota value actually decreases following the growth in demand! This is because the upward-sloping supply curve reflects the assumption that production costs are increasing at an increasing rate. Because the market price is held constant at $\overline{p}_0$, the economic rent of the marginal producer is lower than before the increase in demand. The rent per unit produced went from $\left(\overline{p}_0 - c_0\right)$ to $\left(\overline{p}_0 - c_1\right)$, but total economic rent or the value of the national quota changes from $\left(\overline{p}_0 - c_0\right)\overline{Q}_0$ to $\left(\overline{p}_0 - c_1\right)\overline{Q}_1$.

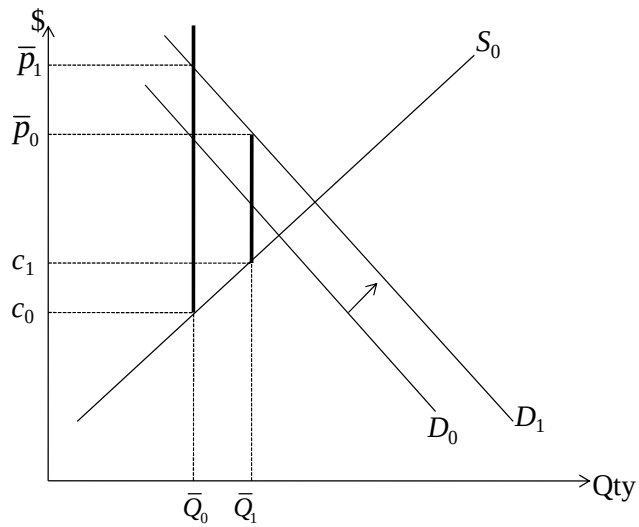

Figure 14. The upward demand shift can induce an increase in the production quota from $\bar{Q}_0$ to $\bar{Q}_1$, thus reducing the economic rent on each unit produced.

Figure 15 illustrates market adjustments in a supply managed sector when the price of a substitute good decreases and hence forces a contraction of the demand for the supply managed product. Let us consider the impact of a decrease in the price of bovine meat on the market for poultry meat. To keep things simple, we abstract from intermediaries that are present in the poultry supply chain. The role of these intermediaries will be considered in the next section. The decrease in the price of bovine meat triggers a downward shift of the demand for poultry products from D_0 to D_1. At any given poultry price, consumers buy less than before the decrease in the price of beef.

Consider the initial quota level set at $\bar{Q}_0$ for a price target of $\bar{p}_0$. If the global production quota is not adjusted downward and stays constant, the lower demand and the associated downward pressures on the price will imply a fall in the farm price from $\bar{p}_0$ to $\bar{p}_1$. Conversely, a producer board can decide to protect the farm price, but must then lower the quota. The decrease in quota needed to maintain the target price $\bar{p}_0$ is the difference between $\bar{Q}_0$ and $\bar{Q}_1$.

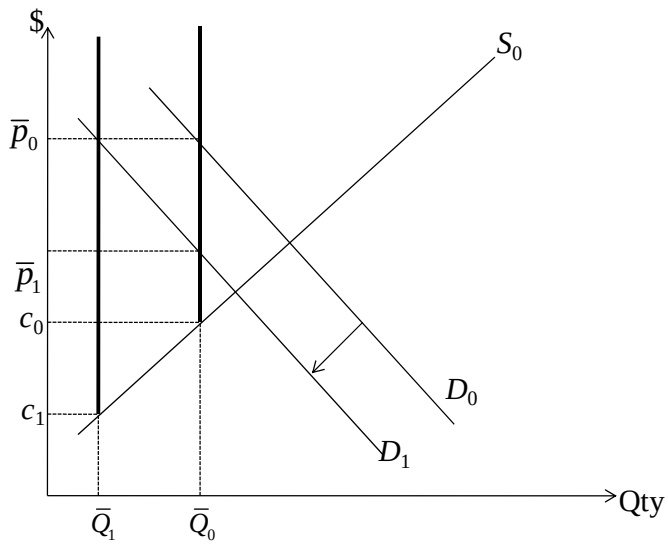

Figure 15. An increase in the price of a substitute like beef triggers a downward shift in the demand of chicken which forces either a reduction in the target price from $\overline{p}_0$ to $\overline{p}_1$ if the quota remains at $\overline{Q}_0$ or a reduction in the quota from $\overline{Q}_0$ to $\overline{Q}_1$ if the target price remains at $\overline{p}_0$.

The fact that the demand for supply managed product is influenced by many variables makes it extremely difficult for marketing agencies to precisely meet their price targets. As mentioned before, decisions are made based on expectations about the factors conditioning the final demand and hence about the expected demand. While demand uncertainty plays an important part in the implementation of supply management programs, so do the factors that impact on the marginal cost of producers.

A cost-saving technological improvement or a fall in input prices will shift the supply curve to the right. In a competitive market, a shift of the supply curve would result in a new price and quantity equilibrium. The supply shifters however have a different impact under supply management. Consider a productivity gain in an industry where producers sell directly to consumers. A global production quota is initially set at the level $\overline{Q}_0$ in order to reach a target price $\overline{p}_0$. The unit quota rent of the marginal producer is equal to the difference between the producer price and marginal cost $\left(\overline{p}_0 - c_0\right)$. The increase in productivity implies a decrease in marginal cost and the supply curve shifts to the right as illustrated in Figure 16.

The main result is that the value of the productivity gain is capitalized in the value of the production quota. If the global quota remains constant, the unit rent is now $\left(\overline{p}_0 - c_1\right)$. Note that Figure 16 also allows us to make some inference about market outcomes when input prices change. An increase in input prices will shift the supply curve upward, from S_1 to S_0, resulting in a decrease in the unit rent of the quota. To bring back the quota value to its initial value, the marketing agency can lower the production quota, knowing that the decrease in production will

trigger an increase in the price. However, this could lower producer revenues. Usually, increases in input prices are accompanied by lobbying efforts to raise the producer price. In Figure 16, this can only be achieved through a decrease in the national quota.

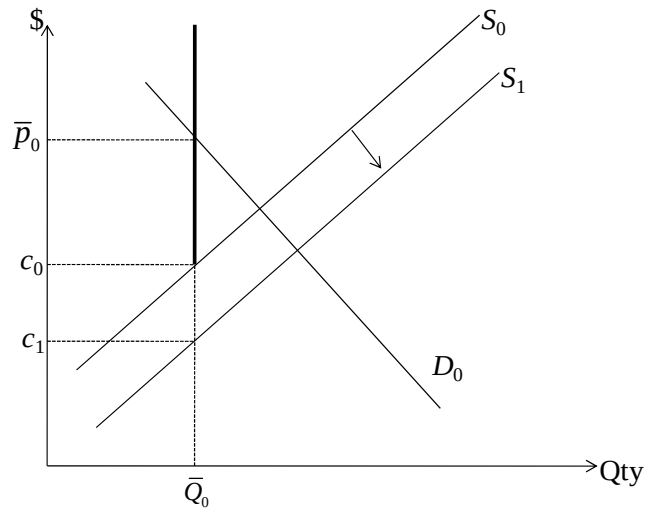

Figure 16. *An increase in productivity at the farm level causes an upward shift in supply that translates into an increase in quota value, from* $\overline{p}_0 - c_0$ *to* $\overline{p}_0 - c_1$ *for a total increase in the value of the national quota of* $\overline{Q}_0\left(c_0 - c_1\right)$.

Forecasting demand and managing supply

We now consider the issue of setting an output level for the global quota before knowing exactly what the demand for the product is. The issue arises in many supply chains. Even though the chicken sector is using a bottom-up approach to determine output in the industry, processors certainly can make errors in anticipating what the demand will be two months later.

Figure 17 illustrates the impacts of planning output before knowing the realization of demand. Three demand curves are plotted. The demand curve D_0 is the anticipated demand curve. The price target is $\overline{p}_0$ and thus the global production quota is set at the level $\overline{Q}$. If the actual demand for the product is lower than anticipated, the quantity demanded will be Q_1 at a price of $\overline{p}_0$. Hence, there exists an excess supply at $\overline{p}_0$. Buyers are only willing to purchase Q_1 units while producers want to $\overline{Q}$.

Many different scenarios can play out, but clearly this excess supply needs to be resolved. First, the excess supply can be purchased at the market price by a government agency. This is essentially what Egg Farmers of Canada does when it is purchasing excess table eggs to sell

them to be processed and exported. This is also the idea behind the system of support prices administered by the Canadian Dairy Commission (CDC).

The CDC purchases excess supply of butter and skim milk powder to balance unexpected fluctuations in demand. These stocks are eventually sold on the Canadian market when production falls short of demand. Another option is to export surpluses. This is a common practice in some agri-food markets.[25]

Another option would be for buyers to purchase all of the production available even though this production is worth less than the price paid for. This is what happens in the Canadian chicken market. Buyers (processing firms) commit to purchase all farm output at a given price before demand is known with certainty. In the case illustrated in Figure 17, buyers will not be able to resell the entire output to consumers, so some of the current period production will be stored and sold at a later date. However, inventories are costly and processors will certainly try to negotiate lower farm prices in future periods as they see their stocks of poultry products grow.

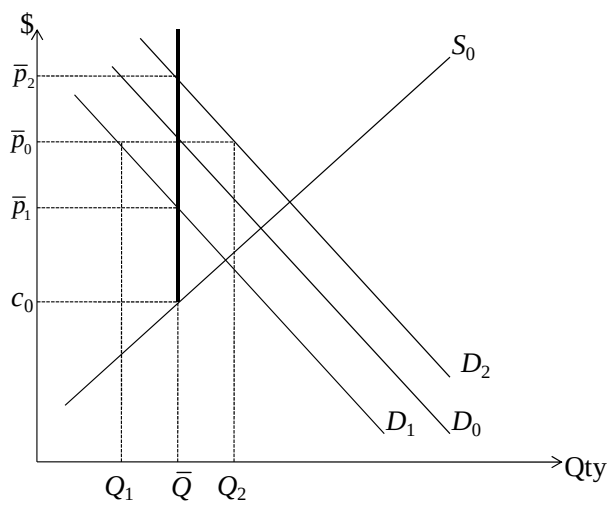

Figure 17. Having to determine a national quota when demand is random can be tricky. If the target price is $\bar{p}_0$ and the expected demand is D_0, then the national quota must be set at $\bar{Q}$. If demand is lower than expected at D_1, then the target price could be achieved only if the national quota was reduced to Q_1. If demand is higher than expected and D_2 is observed instead of D_0, then the price will be $\bar{p}_2$ if no adjustment is made to the national quota. In order to achieve the target price $\bar{p}_0$, the national quota would have to increase to Q_2.

[25] The European Union (EU) has used this system to support domestic dairy prices in the EU market. Domestic products are bought at a high domestic price and sold onto the world market at a lower price. The loss in this case is assumed by the EU treasury.

Demand could also be higher than initially anticipated. Suppose demand is represented by the segment D_2. At the target price $\overline{p}_0$, the demand would be Q_2 units. However a quantity of $\overline{Q}$ is produced and thus this leads to an excess demand of $\left(Q_2 - \overline{Q}\right)$ units. Many options are possible to resolve this excess demand. Products could be bid up until the market price increases to $\overline{p}_2$. This situation happens in the chicken market from time to time when processors offer premiums to sign up growers. The other alternative is that buyers are rationed in some way if the price is left unchanged at $\overline{p}_0$.

3.F. Interprovincial pressures under supply management

For most products, trade is more fluid between provinces or regions within a country than between countries, after controlling for factors such as distance, populations and incomes. In the case of Canada, the estimate from the pioneering study by McCallum (1995) suggested that trade between two provinces was 22 times larger than trade between a province and a U.S. state. This estimate inspired a tremendous number of studies on the so-called "border puzzle" as most economists did not anticipate such a result given that the Canadian and US economies are quite integrated.

Other studies (e.g., Anderson and van Wincoop, 2003) have managed to cut the border effect in half, but the border effect remains surprisingly high. This shows that products naturally "flow" most easily between provinces. This must apply to interprovincial trade in agricultural products, even though it is poorly documented. Thus, it is not surprising that fierce inter-provincial competition was allegedly one of the elements that motivated the establishment of supply management in the late 1960s and early 1970s. It is not surprising either that these competitive forces, while constrained, remain strong under today's supply management rules and regulations.

Interprovincial trade tends to be more fluid than international trade for several reasons. First, interprovincial trade is not taxed, unlike international trade. Secondly, national rules and regulations apply equally to two provinces or states, but differ across countries. Technical barriers can be highly potent instruments to curb trade even though the WTO insists that standards be science-based and applied in a non-discriminatory manner. Thirdly, business relationships flourish when transaction costs are low and transparent. Transaction costs include several other costs beside transport costs and pre-shipment inspection services. Invoicing in a foreign currency entails "currency risks" that can be reduced through hedging, but at a cost. Business laws vary across countries and collection costs can vary widely in case of non-payment.

To put an end to interprovincial "wars" was one of the motivations behind the creation of supply management programs, but interprovincial tensions have remained strong as shown by the recent controversy surrounding the behaviour of Quebec, Ontario and New Brunswick chicken

processors. Interprovincial purchases of live chicken have increased rapidly between 2007 and 2009 as shown by Table 1.

Year	Eviscerated weight 1-2kg		Eviscerated weight >2kg	
	Que. to Ont.	Ont. to Que.	Que. to Ont.	Ont. to Que.
2009	16.1 m.kg	26.3 m.kg	13.4 m.kg	2.4 m.kg
2008	8.2 m.kg	23.2 m.kg	11.6 m.kg	2.3 m.kg
2007	4.2 m.kg	21.3 m.kg	11.4 m.kg	1.4 m.kg

Table 1. Interprovincial trade in eviscerated chicken between Quebec and Ontario in millions of kg. Additional data can be found at http://www.agr.gc.ca/misb/aisd/poultry/ipm_eng.htm#poultry

The behaviour of chicken processors from different provinces can be explained by Brander and Krugman's (1983) model of bilateral dumping. The point of the example is to explain why producers and processors engage in interprovincial trade even at the risk of bringing the attention of regulators and paradoxically getting lower profit in the end. Let us assume that firms have the option of purchasing live chicken and selling processed chicken only in their province or purchasing live chicken and selling processed chicken in two provinces. To keep the analysis simple consider a hypothetical example involving a Quebec firm and an Ontario firm. The profits from dealing exclusively in their own province or dealing in both provinces are summarized in the following table. The first (second) number in parentheses is the payoff of the Quebec (Ontario) firm. The payoffs are conditional on the strategies adopted by both firms.

		Ontario Firm	
		Deal in own province only	Deal in two provinces
Quebec Firm	Deal in own province only	(50, 50)	(25, 60)
	Deal in two provinces	(60,25)	(35,35)

Table 2. A hypothetical example explaining the incentives of processing firms to buy and sell in more than one province.

If they both deal exclusively in their own province, they enjoy monopoly profits of 50 (say in thousands of dollars). If the Ontario firm deals in Ontario and in Quebec and the Quebec firm deals only in Quebec, the Quebec firm gets only 25 while the Ontario firm gets 60. This pair of payoffs is reversed when the Quebec firm deals in Ontario and in Quebec and the Ontario firm deals only in Ontario. Finally, both firms get 35 when they are active in both markets.

When the Ontario firm stays in Ontario, the best strategy of the Quebec firm is to be present in the two provinces as its payoff for doing so is 60 and hence in excess of its payoff from doing business only in Quebec. Its best strategy is also to do business in the two provinces when the Ontario firm is also present on both markets since 35> 25. The payoff matrix being symmetric, we can deduce that doing business in both provinces is best for the Ontario firm regardless of the strategy followed by the Quebec firm.

The simple example above shows that both firms have incentives to do business in the two provinces and they end up with lesser payoffs than by staying in their respective province. This is not a bad outcome, except for processors because the increased competition in the two provinces translates into lower consumer prices and higher producer prices. The resulting gains outweigh the additional transport costs. Forcing purchases and sales to be within a province to minimize transport costs is not a good policy response because the desired quantities to be marketed by processors are bound to be reduced.

Provincial boards and rent-seeking

The idea of supply management to reduce supply in order to generate prices high enough to allow producers to cover their cost of production, including the return on labour and assets, is "simple enough" in a static environment. Part of the difficulty with the implementation resides in the allocation of a national quota across provinces under changing market conditions. Base quota allocations reflect historical production patterns. Because supply management generates rents for producers and importers that depend on the size of the national quota and its allocation between provinces, provincial lobbies have incentives to engage in rent-seeking activities to acquire more rents.

Changing market conditions provide opportunities to provinces to secure a larger provincial quota from growth in the national quota or overbase quota. Increases in population and/or in per capita consumption are the sort of changing market conditions that start intense lobbying efforts. Ideally, the national quota should be allocated so as to minimize production and transaction costs to meet consumer demand in various regional markets. This could be accomplished by having producers from various provinces compete against one another in an auction to supply processors in a growing provincial market.

Preventing overt interprovincial competition does not eliminate interprovincial rivalries. Because quota allocation is a zero-sum game (the gain of one province are at the expense of at least one other), provinces end up engaging too many resources in rent-seeking activities. Even in cases where there is a mutual interest, as in the case of lobbying the federal government for trade protection, Bayliss and Furtan (2003) provide empirical evidence that provinces do not cooperate amongst themselves. They also find evidence of smaller provinces free-riding on larger ones.

3.G. International trade issues specific to supply managed sectors

The types of government interventions in agriculture that are most notorious can be classified into three categories: measures to limit market access to foreign suppliers, export subsidies and domestic support programs. The issue of domestic support has been addressed in a previous section. While we presented the basic economic implications of import tariffs early on in this document, the purpose of this section is to discuss the specifics of trade policies in agri-food markets. Tariffs on agricultural products tend to be higher than for non-agricultural products. For Canada (U.S.), the simple average Most Favoured Nation[26] tariff is 3.7% (3.3%) for non-agricultural products and 11.5% (5.3%) for agricultural products.

Supply managed commodities are protected by tariff-rate quotas (TRQs) with over-quota tariffs in excess of 200%. Under a TRQ, a minimum access commitment is imported and taxed at a low tariff rate. Additional imports are taxed at an over-quota tariff rate that is often high enough to prohibit the imports of additional units. Safeguard measures, like anti-dumping measures (ADMs) and countervailing measures (CMs), can also be used to restrict market access when certain conditions are met.

In short, an ADM is imposed when import prices are below a “normal” price and cause or have the potential to cause injury to a domestic industry. The definition of what constitute a normal price is highly debated in the international trade arena. It can be manipulated to justify protection offered to a domestic industry. A CM can be imposed when it is demonstrated that a foreign government provides a subsidy to its producers or firms and that imports from that country cause injury to the domestic industry.

Two international trade issues have been of concern to supply management stakeholders. The first one pertains to market access while the second one is about export subsidies. Market access became a key issue when it became clear during the Uruguay Round of multilateral negotiations that Canada would have to replace import quotas by tariffs. Canada fought hard to keep import quotas as its trade barrier of choice to protect supply managed products. Canada was one among many countries with sensitive products protected by import quotas. When these countries submitted their proposed tariff schedules for their sensitive products, exporting countries realized that their market access was to be curtailed below historical levels. To avoid this outcome, countries agreed to use TRQs with built-in Minimum Access Commitments (MACs).

[26] The Most Favored Nation term is used in international trade to mean that a country which is the recipient of a treatment must, nominally, receive equal trade advantages as the "most favored nation" by the country granting such treatment.

Figure 18 illustrates how the TRQ works in a supply managed sector. Recall that a TRQ has two tariffs and a minimum access commitment or quota. We denote the TRQ's within-quota tariff by t_1 and the MAC it is levied on by $\bar{M}$. The over-quota tariff is denoted by t_2. For all practical matters, the within-quota tariff in the poultry and dairy industries is zero and as such this tariff will not appear in the analysis that follows.

Consider the left hand-side panel representing the domestic market. A production quota is set at the level $\bar{Q}$ while the buyers demand is D_0. If there were no imports, the production quota would generate a domestic price $\bar{p}_0$. The right hand-side panel illustrates the import market. To determine the quantity imported in the country, we need to trace out the demand for imports. At any price level, the demand for imports will be the difference between the demand of domestic buyers and domestic supply. The latter is fixed at $\bar{Q}$ because of supply management and we end up with the excess demand *ED* in the right hand-side panel of Figure 18.

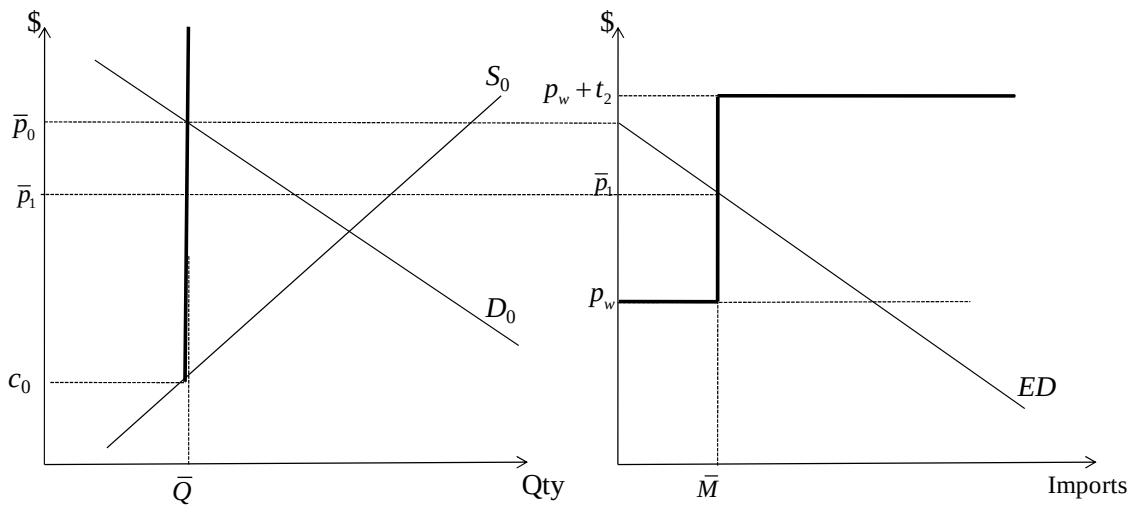

Figure 18. A TRQ, with a MAC of $\bar{M}$ units and within-quota and over-quota tariff levels of 0 and t_2, is used to control imports competing with a supply managed product. The excess-demand curve ED is defined as the difference between demand D_0 and the national quota $\bar{Q}$. The equilibrium price $\bar{p}_1$ is determined by TRQ-distorted foreign excess supply curve and ED. The over-quota tariff is set high enough to prevent any imports above and beyond $\bar{M}$ and any over-quota tariff reductions will not have any impact on the domestic price as long as the border price is greater than the equilibrium price ($p_w + t_2 \geq \bar{p}_1$).

We assume that foreigners can supply any given quantity at a fixed price p_w. Given the minimum access commitment level of $\bar{M}$ and the zero within-quota tariff, imports enter the domestic market up to the level $\bar{M}$. To determine whether additional imports enter into the

country, we must compare the cost of these additional imports with the price in the domestic market. Additional imports are taxed at a very high level, t_2.

In the right hand-side panel of figure 18, the above-quota tax rate t_2 is too high to allow imports in excess of the MAC which is equal to $\bar{M}$. The resulting domestic price is $\bar{p}_1$. Trade liberalization could bring about a reduction in t_2 that would allow for imports to enter in excess of $\bar{M}$. The reduction in the over-quota tariff would have to be substantial enough to make the tariff-augmented world price less than the domestic target price: $p_w + t_2 < \bar{p}_1$.

Trade liberalization could also bring about an increase in $\bar{M}$. In fact, Canada seems willing to face increases in MACs to prevent significant over-quota tariff reductions at the WTO. The tariff-MAC trade-off would entail having supply managed products designated as "sensitive". Figure 19 illustrates the impact of liberalizing trade through an increase in the minimum access commitment for foreign products.

Consider a MAC increase from $\bar{M}_0$ to $\bar{M}_1$. Given that domestic production is at the same level, the additional imports depress the domestic price from $\bar{p}_0$ to $\bar{p}_1$. Of course, the marketing agency could elect to decrease the national production quota. Cutting domestic production would lower the supply of available products domestically and raise the domestic price. The fundamental issue boils down to whether producers prefer to sell a lower volume at a higher price or the same volume at a lower price.

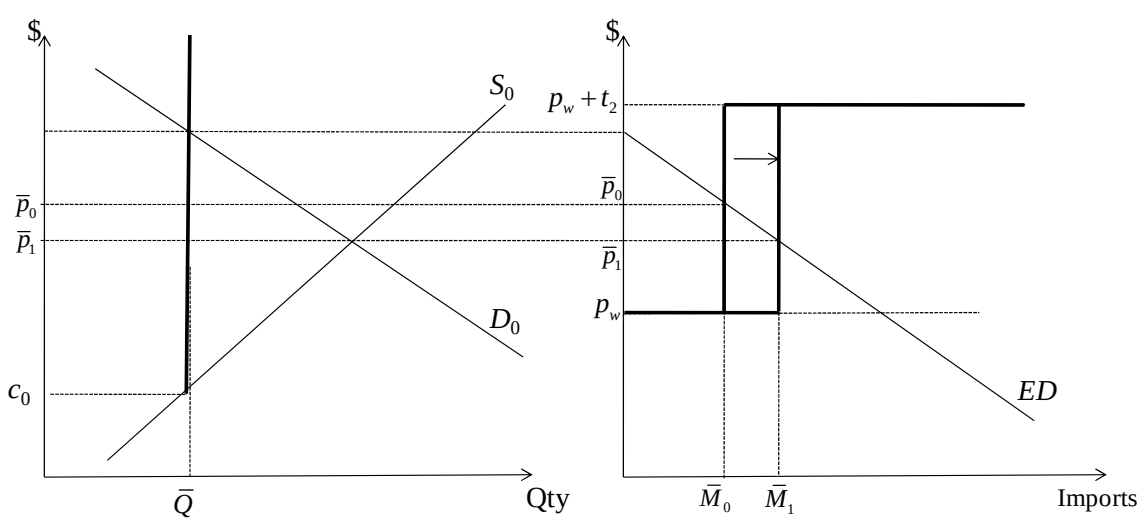

Figure 19. An increase in MAC from $\bar{M}_0$ to $\bar{M}_1$ under a fixed national quota increases the supply on the domestic market and hence induces a decrease in the domestic price from $\bar{p}_0$ to $\bar{p}_1$ and in the value of the national quota.

The tariff-MAC trade-off is likely to differ across sectors. The over-quota tariff acts as a ceiling on the domestic price. Larue, Gervais and Pouliot (2007) analyzed the welfare implications of reducing the over-quota tariff or increasing the MAC in the presence of a domestic price target. A lower domestic price target achieved with an over-quota tariff reduction (an increase in MAC) entails a higher (lower) level of domestic production. Under the MAC, a share of the domestic market is given to foreign products while under a tariff domestic producers can "squeeze" foreign competitors by producing more. Thus, if domestic producers are competitive enough to capture a large share of the domestic market under free trade, reducing the above-quota tariff is a better way to liberalize than to increase the MAC. This is assuredly the case in the chicken industry.[27] Even though the dairy industry is not as competitive as the chicken industry, liberalizing through MACs would exacerbate the scale problem and make the industry even less competitive. Thus, it would be best for Canada to favor tariff reductions.

Economists can also apply the tools developed in Figures 18 and 19 to specific industries. For example, Abbassi, Bonroy and Gervais (2008) simulated potential trade liberalization scenarios discussed at the WTO in order to estimate domestic price / domestic quota trade-offs in the dairy market. They found that holding the national quota constant would induce reductions in the wholesale prices of fluid milk and cheese of 5%. The national quota would have to decrease by 1.4% to keep producer prices constant.

The principal market access issue facing supply managed sectors is related to the introduction of "sensitive" products at the WTO. The most recent discussions around market access negotiations call for the reduction of over-quota tariffs according to a tier formula: higher tariffs should be reduced by higher percentages. WTO members also seem to agree that exemptions to these tariff cuts may be possible for "sensitive" products.

A country could identify a certain number of products as sensitive (as a percentage of the country's tariff lines related to agricultural products) and not be required to apply the "standard" tariff cuts to these products. As previously mentioned, the trade-off for the flexibility to shield some products from tariff cuts would be to offer increases in MACs. The issue for Canada is whether the number of sensitive products it would be allowed to have under a new WTO trade Agreement will be high enough to cover all supply managed sectors.

Supply managed sectors faced an important trade issue a few years after the completion of the Uruguay Round, this time related to export competition. New Zealand and the United States initiated a review of Canada's dairy export policies in 1998. The 2003 WTO ruling put an end to the dispute and to provincial export programs. Exports came naturally in the supply managed

[27] Pouliot and Larue (2012) found that MAC liberalization could be particularly bad in the chicken industry because the MAC is set up as a fraction of the domestic market. This can create perverse liberalization effects with domestic production contracting so much as to induce higher prices.

dairy industry because it allowed for increased profit through price discrimination. The marketing board can limit production intended for the domestic market and obtain a higher price. The possibility to export at the world price imposes a floor on the additional revenue obtained from selling an extra unit of output. The marketing board can then pool revenues from domestic and export sales and return a pool price to producer that is higher than in the absence of exports.

The WTO ruled that Canada's export of certain dairy products were "technically" subsidized because the dairy product exported used milk sold at a reduced price in comparison to the same dairy products sold on the domestic market and that this arrangement was the direct result of government actions.

Non-tariff barriers can also have significant impact on market access of foreign products. It is now widely recognized that despite the significant tariffs applied to agricultural products, non-tariff measures have as large a negative impact on trade flows. The recent changes in Canadian cheese compositional standards have been controversial and hence offer an interesting case study. The regulations amending the *Food and Drug Regulations* (FDR) and the *Dairy Products Regulations* (DPR) came into force in December of 2008 and require that a minimum proportion of the casein used to make cheese be derived from fluid milk and ultra-filtered milk rather than from other milk products, and that the whey protein to casein ratio for cheese be at most the same as that for milk. Felt, Larue and Gervais (2012) analyzed these regulations.

In addition, the casein content derived from milk must be at least as high as the percentage of the total protein content for a given cheese variety. The regulated proportions and ratios differ depending on the type of cheese. The regulations were a direct response to the greater reliance of cheese manufacturers on imported milk protein concentrates or MPCs. The regulations are compatible with trade rules because they apply to both domestic and foreign manufacturers. However, Felt, Larue and Gervais (2012) have shown that the anticipated incidence of the regulations on the domestic demand for milk may not materialize.

Well-documented non-tariff barriers in the poultry sectors revolve around sanitary issues. Ames (1998) discusses the case of US poultry exports to Russia. Brazilian chicken exports are not allowed by the USDA and while Brazilian chicken is allowed into Canada, Canadian slaughter and processing plants are not allowed to process Brazilian chicken if they want to export to the United States.[28] Of course, the main hurdle to import remains Canada's TRQ.

[28] See p.7 of a document published by the USDA and available at: http://gain.fas.usda.gov/Recent%20GAIN%20Publications/Poultry%20and%20Products%20Annual_Ottawa_Canada_09-17-2010.pdf.

4. Supply chains issues with or without supply management

4.A. Value chains

In most instances, primary producers do not sell directly to consumers and products often must go through several transformations before being sold to consumers. All of the agents involved in this process are part of a supply chain. We discussed already the concept of value chain, by noting that it entails the vertical coordination of different activities with the explicit purpose of creating value. We also stressed that each member of the chain must understand his/her role in the chain as well as the roles of other members of the chain. The idea is that it is easier to convince members of the chain to invest time and money into new practices if they understand the impact of these practices at all levels of the chain. Information sharing is also likely to encourage cost-saving and demand-enlarging innovations.

Trust is important between members of the chain, but it is helped by systematic record keeping and documentation of practice implementation and audits. While it makes sense for different firms to work together to "maximize the size of the pie", one should also expect that they will all try to get the largest possible "slice of the pie". Stories of adversarial relations along agri-food supply chains abound. In some cases, negotiations are particularly difficult because of bargaining power asymmetries between producers and processors. In others, one party has market power and can simply offer a "take it or leave it" ultimatum. We present in the Appendix an example of a value chain that has been profitable for all parties involved, but supply chains can also be an entrapment mechanism because of what are known as switching costs.

Switching costs

The exploitation of switching costs by an industry leader is a concern one must have about agricultural value chains because members of the chain must make investments that have value only as long as they stay in the chain. Switching to a different chain entails having to make another chain-specific investment. As explained previously, the chain leader requires its suppliers or buyers to make costly non-refundable investments in the value chain. These investments can be to support the purchase of value chain-specific assets (*e.g.*, changes in production facilities and investments in an identity preservation system) that would be lost if the supplier wanted to switch to a different chain. Typically, the industry leader offers generous terms to encourage the emergence of new business relationships.

For an input supplier, this translates into high prices early on. The industry leader has an incentive to offer high prices early on to get as many suppliers as possible. Once the investments are made, the input supplier is "locked in" and the terms offered become less generous as the

industry leader knows that the supplier is not keen on making a new investment to switch to a new value chain.[29]

4.B. Collective versus individual approaches

Agri-food supply chains are characterized by high degrees of concentration at all levels except at the farm. The supply of primary products is quite inelastic (insensitive to price) in the short run because of biological constraints in production (i.e., it is impossible to inseminate a cow, deliver the calf and feed it to market weight overnight to quickly take advantage of a surge in price). Because of these two stylized facts, farmers have been vulnerable to "hold-ups", situations that occur when a single buyer offers a ridiculously low price to a seller knowing that the seller has no other marketing options or poor alternative options. In essence, the buyer can make a "take it or leave it" offer to the seller that reflects the next best marketing alternative of the seller. The buyer could say something like "what I offer you is not much, but this is the most that you can get …".

In less developed countries, it is sometimes the case that the government is the only "legal" buyer. It can purchase crops from producers at low prices and sell them at higher prices on the world market. Producers in these countries end up engaging in black market activities to get better prices or simply exit the sector hoping to find better wages in urban areas.

The border closing during the so-called "Mad Cow" or ESB crisis had a significant depressing effect on cattle prices because cattle producers had lost an important marketing option. However, prices did not go down to zero, mainly because buyers/processors wanted supplies for subsequent periods and hence did not want to induce the exit of sellers. Historically, this is why farmers have initiated and supported the creation of marketing boards and cooperatives. This is also why the composition of the boards of supply management agencies are highly skewed in favour of primary producers. For example, chicken producers have 10 representatives on the 14-member board of directors of Chicken Farmers of Canada.

A key point in the rationalization of collective approaches is information asymmetry. An individual seller is most vulnerable to hold-ups when he is isolated from other sellers and hence clueless about prices paid to others and quantities being offered. Collective bargaining can be used to remedy the problem as the information held by each producer is pooled and the

[29] In less developed countries, credit is scarce in rural areas and producers must often agree to low prices in exchange for cash advances from brokers to buy inputs and basic necessities. The creation of cooperatives allowing producers to purchase inputs and sell their outputs together could be a viable institutional response to this problem provided that producers pool enough resources together to deal with cash flow problems. Opportunistic behaviour on the part of producers must also be deterred. In Canada, the creation of the Canadian Wheat Board and its initial payment scheme can be rationalized along the same lines.

bargaining power of producers is strengthened.[30] In what follows, we show the consequence of having a single buyer dealing with several unorganized producers. This market structure is called a monopsony.

4.C. Competition and opportunistic behaviour

Monopsony

We mentioned the vulnerability of primary agricultural producers to "hold ups". "Hold ups" arise when options are few and unprofitable. The exit of buyers can strengthen the market power of remaining buyers as sellers' marketing options dwindle. It could be argued that a seller has always some options. For example, a seller could wait for the buyer(s) to make a better offer as circumstances might change. The problem is that agricultural producers cannot wait very long in most instances because primary products are perishable and tend to depreciate quickly. Live animals exceeding a certain market weight can lose much value and must be fed and cared for while waiting to be sold. Similarly for processors dealing with a monopsonist distributor, inventories of products requiring to be refrigerated are costly to carry. The length of production processes and the perishable nature of agricultural products put producers in difficult situations.

Suppose producers have a single marketing option for their perishable product and would lose everything if they could not agree to terms with the buyer. The buyer knows this and makes the following ultimatum to producers: "accept a price just slightly above zero or get nothing". The seller would accept the lesser of the two evils and the buyer would get all of the gains from trade.

If sellers can sell any given quantity on the world market at a given price, then the domestic buyer could purchase any quantity at a price slightly above the world price. Offering a price below what can be obtained on the world market would not be a good strategy because sellers would prefer selling only to foreigners. On the other hand, the domestic monopsonist has no short run incentive to offer more because the supply of sellers is fixed in the short-run. The existence of an export market allows the sellers to capture some of the gains from trade compared to the situation when they had no real option other than to sell to the domestic buyer. Still, even when the border is open, partial hold ups can occur, and too little might end up being produced. In this case, a government can step in and try to correct the market failure arising because of the presence of a single buyer.[31]

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[30] However, collective institutions that were created to empower producers, like the Canadian Wheat Board (CWB), are being increasingly criticized. With the development of communication technologies, many producers feel that they have the capability to access and process information to market their products by themselves. Others counter that the CWB handles sufficiently large volumes to exert market power and negotiate better terms for western grain producers.

[31] For example, Larue, Gervais and Lapan (2004) rationalized the increasing importance of formula-priced pre-attributed supplies in the Quebec hog industry as a mechanism to get more hogs processed.

Double marginalization

Highly concentrated supply chains are a like a cascade of monopolists. We have already seen that a monopoly induces socially inefficient market outcomes because the single seller sells too little at too high a price. What could be worse? How about a supply chain in which a monopolist sells inputs to another monopolist which then sells final goods to consumers? This phenomenon is called double marginalization (successive monopoly pricing in the supply chain). Having two monopolists is bad because they take two large profit margins.

The quantity marketed when two monopolists take successive margins is lower than the quantity that would be produced under a single monopoly (that would be the case for example if the two monopolists were vertically integrated). In this instance, vertical integration is beneficial as only one margin is being levied.

A supply chain confronted to a double marginalization is inefficient. The downstream monopolist (the input-user) has an incentive to offer a smaller quantity to consumers that translates into a reduced demand for inputs. The upstream monopolist (input seller) has an incentive to exploit the demand for inputs by offering fewer inputs. As a result, buyers pay a very high price. Welfare losses are even larger when there are economies of scale and the average cost of production and processing activities decrease with the volume produced/processed. The problem with the cascading of margins is a concern in the food industry because there are few retailers and few processors. One could think that supply managed supply chains are especially vulnerable to this sort of problem, but such concerns do not apply equally across supply managed supply chains. The OECD Producer Single Commodity Transfer estimate, defined as the value of specific transfers relative to the value of production, jumped from 2.83% to 16% for chicken between 2004 and 2011 and from 19% to 29% for eggs and from 49% to 60% for milk. The cascading of margins along the supply chain was not a problem in Canada's poultry sector until recently. The industry is not growing as fast as before and there end up being more pressure to raise margins. Still, the problem is not as acute as in the dairy sector. The price for a 4-litre sack of 2% milk in Quebec City in 2011 was $5.87, almost double $3.09, the 30-city US average price for one gallon of 2% milk transformed to 4-litre.

Vertical integration is sometime the answer because it means than fewer firms are taking margins. However, it does not always improve efficiency and it need not always lower consumer prices. Similarly, full integration is not always profitable. Larue and Bonroy (2009) discuss some of these issues as well as regulations in the context of the food industry. They explain why large food distributors are only partially forward-integrated even though they might have a cost advantage in retail over small independent retailers. Independent retailers can be exposed to "cost-predation" because they must buy their supplies from the large distributors who can also

affect their output prices through the prices in their integrated retail stores. Vertical integration is one way to deal with the greater issue of vertical coordination discussed below.

Vertical coordination

Vertical coordination refers to how transactions are conducted between the stakeholders along a supply chain, from input suppliers, farmers, processors, distributors, retailers to consumers. The coordination mechanisms may have considerable impact on the economic performance of a supply chain. Stakeholders respond to incentives and it follows that mechanisms must provide for an efficient distribution of rents.

Supply chains with efficient mechanisms are more competitive and better positioned to fight foreign competitors in the Canadian market and abroad. Improved vertical coordination mechanisms have become all the more important given that consumers want product diversity and assurances about the safety, the origin and the integrity of the production process of the foods they consume. This requires coordination between farm input suppliers, farmers, processors, distributors and retailers. Transaction costs are a key element in determining the optimal structure of an industry. In some cases, it is more profitable for a firm to contract the services of other firms to accomplish certain tasks as opposed to performing them "in-house".

Pioneering transaction costs analyses by Coase (1937) and Williamson (1975)[32] recognized that economic theory up to that point took firms as given in markets, but could not explain the existence of the firm. Coase pointed out that transaction costs could rationalize the existence and organization of the firm and the theory of transaction costs was born.

This transaction cost theory attempts to explain the form or mode of coordination that prevails in a market. A firm must choose between using the market to acquire an input or integrate activities related to the production of this input (vertical integration). Gradually, the size of the firm increases as the firm integrates various activities previously performed by third parties. Transaction costs decline because the firm now performs certain activities itself. It no longer needs to transact with other firms. However, the integration of new activities within the firm brings about additional costs in terms of internal management. These additional costs increase with firm size. Figure 20 illustrates these two costs as a function of firm size.

There is a trade-off to be exploited between transaction and internal management costs. Thus, transaction costs explain the existence and organization of the firm and, along with the traditional production costs and economies of scale, influence the optimal size of the firm.

[32] Williamson was the student of Ronald Coase. Williamson won the Nobel Prize in economics in 2009 for his analysis of economic governance, especially the boundaries of the firm. Coase won the Nobel Prize in 1991 for his work on transactions costs, property rights and externalities.

Other forms of coordination are implicit in Figure 20. For example, if a firm develops an efficient business relationship (through a strategic alliance) for supplies, it could benefit from a decline in transaction costs. We would then observe a leftward shift of the transaction costs curve, thus lowering the cost of contracting services. In this case, the strategic alliance allows the firm to operate at lower cost and to be smaller in size. The Internet has reduced transaction costs by making it much cheaper for firms to acquire and exchange information.

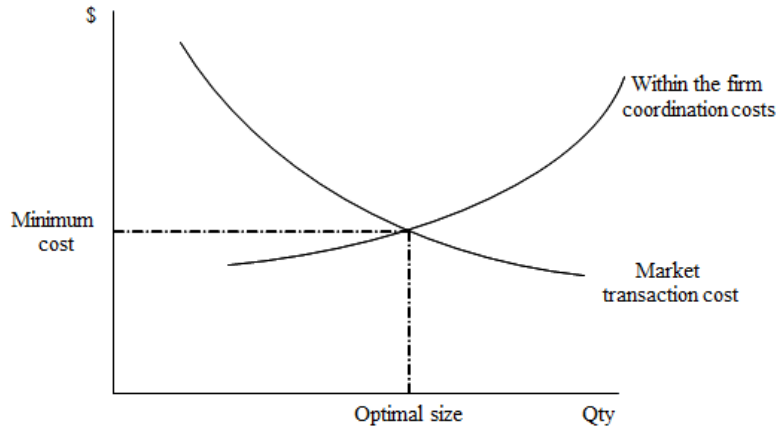

Figure 20. As size of the firm increases, transaction costs decrease but coordination costs increase. Thus, there is an optimal firm size in terms of the organization of the firm.

A good understanding of transaction costs theory is important because it shows how firms that are modest in size can, in a universe of large enterprises, be competitive through efficient coordination mechanisms. It is also important for the development of policies in the agri-food sector where a large number of small firms compete against large multinationals.

4.D. Price transmission along the supply chain and mark-ups

From time to time, there are events that make the general public question the functioning of markets. Most of the time, the issue revolves around price transmission, and more precisely, the lack of price transmission. The two following examples illustrate these problems:

1. *The bovine spongiform encephalopathy or "mad cow" crisis*: Following the discovery of a BSE case in May of 2003, cattle prices decreased rapidly, but producers were quick to complain that downstream prices were not responding. A report showed that retail prices for beef and veal actually decreased, but with several weeks of delay (Jacob et al., 2003).

2. *France - the rise in food prices*: Some agricultural commodities experienced significant price increases in France in 2008 and it was alleged that French processors and distributors responded by increasing their prices more than proportionally to the detriment of French consumers.

The above cases suggest that changes in farm prices can take some time to be transmitted and that the transmission may not be the same for price decreases and price increases. Prices at all levels of the chain depend on several factors that may change simultaneously. Unless great care is taken to isolate the effect of one factor from the effects of others, one can overestimate or underestimate the impact of one factor.

For example, a sudden reduction in the price of livestock may not trigger a similar decrease in consumer beef prices if meat inventories are low and/or the prices of other meats are high. As another example, consider that we have observed high corn and barley prices and low hog prices in 2008 and 2009. Does this mean that feed cost is insignificant in hog production? No. The problem was that the supply of hogs on the North American market was large and stayed large because it is slow to adjust (i.e., piglets that were being fed when grain prices increased continued to be fed and were marketed in spite of the low hog price/high grain prices). AAFC created in 2009 the Hog Farm Transition Program to provide assistance to producers committed to leave the industry to reduce the national herd.[33]

It is also important to note that the size of the price adjustment at the retail level may be small or large even if the firm making the adjustment has market power. More specifically, it is well known that a monopolist facing a linear demand curve will pass on to consumer only a fraction of a cost increase while a monopolist facing a demand characterized by a constant-elasticity[34] will pass on a more than proportional increase in cost.

One problem often mentioned about price transmission is the asymmetric response to price increases and price decreases. We can distinguish two types of asymmetry in the transmission of prices: asymmetry in the size of the response and asymmetry in the speed of the response (Meyer and von Cramon-Taubadel, 2004). Asymmetry in the size of price transmission can arise when downstream firms have adjustments and menu costs when they change prices. If firms must reprint lists or incur other costs to make price changes, it is likely that small changes in input costs will not prompt them to adjust their prices. Under these circumstances, the smallest input price increase needed to trigger a retail price increase is larger than the smallest input price decrease needed to force a decrease in the retail price. This is because profit decreases at a

[33] For details see www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1277909097671&lang=eng.

[34] The slope of the demand curve becomes steeper as the price increases to maintain the own-price demand elasticity constant. Recall that the elasticity is the percentage reduction in demand divided by the percentage increase in price.

decreasing rate as input prices increase due to substitution in inputs. However, the presence of inflation can reduce the need to lower the retail price as the status quo implies a reduction in real terms. Therefore, it would take a larger input price cut to induce a decrease in the nominal retail price.

Several other explanations are discussed in Meyer and von Cramon-Taubadel, (2004). Asymmetric speed of transmission can arise for the same reasons as asymmetries in the size of price changes. Changes in input prices or exchange rates can be short lived and in many instances, people making pricing decisions often prefer delaying their decision in order to have a better idea about trends in input prices and exchange rates.

It should also be pointed out that for some food items, the expense on a given agricultural commodity represents a small portion of the cost of production. In such cases, raising commodity prices (as experienced when the price of corn was over $7/bushel) does not have a large impact on food prices. From the retailers' point of view, the effects of sales or low prices wear off when repeated too often simply because consumers like variety. If pork is on sale one week, consumers will buy more to take advantage of the lower price. However, if pork has been on sale for six weeks in a row, consumers will likely not buy much because they are tired of eating pork. Selling small quantities at discount prices is not profitable for retailers and this is why sales are rarely extended over long periods even when commodity prices are low.

There are various types of mechanisms to regulate the transmission of prices. Contracts between buyers and sellers may have clauses about how and/or when prices should be adjusted in response to changing market conditions. Prices can be negotiated at fixed intervals or automatically adjusted in relation to a reference price. Prices can also be renegotiated based on a set of trigger variables.

4.E. Risk

One of the reasons behind the creation of supply management is to reduce the exposure of producers to price risk. However, there are many sources of risk in agriculture. Producers must face production risks like weather risk, risks of animal and plant diseases, and risk of pest infestations. They face output price risk because in most cases production decisions need to be made long before prices are known. They also face input price risk. For example, they might borrow funds to expand their production capacity, but interest rates can increase unexpectedly and provoke cash flow problems.

Producers also face policy risks. There are risks stemming from changes in the policies of our trade partners. Policies like the mandatory Country of Origin Labelling (COOL) are designed to segment markets and for countries with smaller domestic markets, like Canada, this is

particularly bad because large plants need not be able to operate at their optimal capacity and the lack of competition will hurt livestock producers.

There are also policy risks at home. This is particularly germane to producers in supply-managed commodities because they have to make significant investment in production quotas. These assets could lose some value because of trade-induced pressures. In the event that supply management programs were to be phased out, the hypothetical after-supply management period could be difficult for dairy producers because producers with small herds that intend to stay in business would need to invest in production capacity and might not have the net worth needed to borrow the funds needed once the value of their production quotas has melted.

Processors have always had to deal with output price risk, exchange rate risk, input price risk and input quality risk. Live animals that are too small or too large are not worth as much to meat processors. They are also confronted by the possibility of food safety risks, stemming from bacterial contamination or animal diseases. In 2004, one-third of global meat exports were affected by animal disease outbreaks according to the FAO.[35] The consequences can be dire all along the supply chain even when the problem is contained and regionalized.

Risks and profits must be shared to maximize performance at all levels of supply chains. This is easier said than done because mechanisms and regulations used to deal with risk must be tailored to the specificities of the supply chains. Risk by itself is not a market failure. In fact, insurance markets arise because of risk. Agricultural markets can work efficiently when there are markets for various types of risks or institutions designed to correct market failures that would arise because of incomplete markets for risks.

Risk sharing and risk mitigation strategies - Quality

Supply chains that work well rely on efficient risk sharing strategies. Grading systems with premia and discounts are commonly negotiated to reduce the problem of quality uncertainty when live animals are delivered. The challenge is to identify pertinent quality criteria that can be measured cheaply and to have the ability to update them as technology and quality concerns evolve. Various protocols like HACCP[36] can also be adopted to reduce quality risks. When a crisis occurs, governments can help by designing new efficient standards and regulations. For example, Canadian regulations adjusted quickly to regain the confidence of foreign buyers of Canadian beef during the so-called mad cow crisis.

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[35] The report is available at www.fao.org/newsroom/en/news/2004/37967/index.html.

[36] HACCP stands for Hazard Analysis Critical Control Point. HACCP is used in the food industry to identify potential food safety hazards, so that key actions can be taken to reduce or eliminate the risk of the hazards being realized. It does not replace quality control programs or inspections. The Canadian Food Inspection Agency has a generic HACCP model for poultry slaughter. Ity is described at www.inspection.gc.ca/english/fssa/polstrat/haccp/polvol/polvole.shtml#a1

Risk sharing and risk mitigation strategies - Price

Price risk can be decreased through output diversification. However, the gains from such a strategy must be weighed against the gains from economies of scale. Diversification also entails costs such as getting production and marketing expertise in another sector, etc. Trends toward specialization strongly suggest that scale effects are strong.

Price and exchange rate risk can also be dealt with to some extent through hedging. By taking offsetting positions on futures markets, a firm can lock in on a price months before it is ready to deliver its output to the cash market. In practice, deciding when to hedge (how close to delivery) is not that obvious and the temptation to speculate if cash prices go up instead of down as the delivery date approaches can be high. Furthermore, hedging cannot help against the probability a multi-year spell of low prices. Still, hedging is a powerful tool and this is why it is widely used to deal with short run price volatility.

Government programs also help producers cope with price risk. For example, the AgriStability program pays producers when their current year program margin, defined as allowable income minus allowable expenses, falls below a percentage of their reference margin defined as the average program margin for three of the past five years once the lowest and highest margins are excluded.

In the absence of markets for risk, price risk usually incites a competitive firm to reduce its output. Processors dealing with risk-averse producers might take on some of the risks in order to get a large enough supply. Different strategies/mechanisms can be used to reduce the risk faced by upstream producers. Following a bad 2008 production year, maple syrup buyers offered a premium to producers to incite them to tap more trees. Yields were very good and the response from producers very strong and as a result there was a large supply of maple syrup. Prices received by buyers went down and they still had to pay premia to producers. They took a risk and the ones that reportedly reneged on their commitment might end up paying dearly later on. Typically, buyers/processors and sellers/producers find a mutually beneficial mechanism to share the risk.

Formula pricing based on cost of production, like in the chicken and egg industries, are mechanisms to internalize unexpected changes in input prices. The mechanism introduced in 2003 in the chicken industry reduces risk faced by processors and producers because the price is known when output decisions are made. However, benefits perceived under risk must be weighed against the level of these returns. Therefore, while risk reduction tends to increase benefits, it may not have an overall positive effect if it entails too large a reduction in expected returns.

Gervais, Guillemette and Romain (2007) provide an illustration of risk sharing. They found that Ontario chicken producers (processors) are worse (better) off under formula-based pricing than under the bargaining pricing mechanism that was used prior to 2003. The point is that a producer profit margin still need to be negotiated under formula-based pricing scheme and it plays a critical role in the assessment of producer benefits under uncertainty. However, a more recent study (Abbassi and Gervais, 2010) argues that producers' expected profit is higher and profit variability lower under the formula-based pricing scheme if the role of inventories in smoothing out unexpected fluctuations in demand is accounted for.

Formula pricing based on a reference price, like a US price, is used so that domestic producers and processors can make decisions reflecting conditions prevailing on an integrated North American market. The hog/pork industry offers an interesting case study.

There is no arguing that the North American hog/pork sector has been going through recently one of its worst crisis of the last two decades. The surge in commodity prices in the second half of 2007 raised feed prices and other input costs at the farm level. At the end of 2007, a global economic recession emerged and worsened throughout 2008. This lowered global income and the overall demand for pork products which, combined with increases in input costs, put significant downward pressures on profit margins in hog production as well as pork processing activities. The outbreak of a new strain of the flu virus, labeled swine flu at the early stages of the epidemic, accelerated the decline in world demand, weakening in the process an already fragile industry. Country of origin labeling requirements in the United States (US) as well as an appreciation of the Canadian dollar relative to the US currency both contributed to weaken the competitive position of Canadian hog producers and pork packers.

If desperate times do not necessarily call for desperate measures, they almost always call for significant changes. The evolution of hog marketing mechanisms in the Quebec hog/pork industry illustrates many different approaches to managing price risk as well as coordination issues between processors and producers. Quebec hog producers and pork packers recently agreed to sweeping changes in marketing regulations. Hog marketing institutions in Quebec have continuously evolved and the current reform is not the first reorganization of the industry. Prior to 1994, hog supplies were marketed through an auction. Hog producers grew disillusioned of the auction because prices consistently failed to reach price levels observed in the US market. Producers and processors agreed to a hybrid marketing system in 1994 in which a percentage of hog supplies were pre-attributed to processors based on their historical market share, while the remaining hogs were auctioned off.

The pre-attribution system was quite successful in raising the average hog price above the reference price in the US market as documented in Larue *et al*. (2000). However, the recent

struggles of the industry pushed the price on the auction at levels significantly below the reference price, much to the dismay of hog producers. Frustration about the hybrid marketing system also built up on the packers' side. In other provinces, large packers have moved away from spot markets toward models where they own hogs or directly contract with hog producers to lower transaction costs. This allows packers to develop specific products targeted to meet emerging consumer preferences. The processors' inability to directly contract with producers was seen by some as an important obstacle to the industry's economic rebound.

After lengthy negotiations, the major packers and Quebec hog producers' representatives agreed to significant reforms. At the heart of the matter was the producers' conviction that a marketing board with exclusive marketing rights was necessary to best serve the interests of producers. In other words, producers believed that their collective bargaining strength had to be preserved to counterbalance concentration on the packers' side. On the processors' side, it was believed that no reform could lift the industry from its slump without the ability for packers to develop personal business relationships with individual producers.

The new marketing agreement is believed to achieve each party's main objective. In the new marketing agreement between Quebec hog producers and pork processors, processors committed to purchase all hogs at a price no lower than the reference price in the US market.[37] In return for this commitment, packers can now sign up producers to specific contracts. The producers' board is in charge of marketing the different hogs through the different channels. The purpose of this system is to lift prices paid to producers and allow packers to capture market share domestically and abroad. In essence, three hog categories were created:

1. *Packer-owned hogs*: Defined as a hog assigned to a specific slaughterhouse owned by a buyer for which the producer controls at least ten percent of the voting shares, or owned by a legal entity for which a producer owns 50 % or more of the voting and equity shares.

2. *Specialty hogs*: Defined as a hog that was raised and/or fed according to specific buyer demands that imply a differentiation from a standard commodity hog. The different characteristics of a specialty hog must be verified at all stages of the supply chain and must have the purpose of creating additional value along the supply chain.

3. *Commodity hogs*: All other hogs not included in the previous two definitions.

[37] The choice of a US reference price that is suitable to producers and processors is not trivial. This is true for hogs, but it can also be a concern in the egg sector considering that the Industrial Product Program requires a US price.

The Quebec hog/pork industry is a relevant case study for supply managed sectors because so much of the growth in food markets in the last ten years has come from evolving consumer food preferences. It is important for the overall supply chain to be responsive to the new food demands, otherwise it is easy for consumers to substitute away from the products sold by a sector. This is one of the main objectives of the reforms in the hog/pork sector.

The chicken, turkey and egg industries have been successful in exploiting innovations in the area of product development to suit demographic and lifestyle changes. These industries in the United States were among the first to implement the concept of supply chain and put in place efficient vertical linkages.

In the dairy industry, the Canadian Milk Supply Management Committee approved the domestic dairy product innovation program to increase the overall demand of milk. In short, the program sets a percentage of the market sharing quota (2%) that is accessible to processors outside their "normal" plant-level allocations if they develop a new dairy product. Eligibility conditions are attached to the program, but it nevertheless introduces a bit of a bottom-up approach in a process that can otherwise be described as top-down.

5. Conclusion

The objective of this document is to introduce the basic principles of economics related to agricultural supply chains with a particular emphasis on supply management. The first part of the document presents the basic notions of market demand, supply and equilibrium. The second half analyzes departures from the standard assumptions of perfectly competitive markets in the context of agri-food supply chains with a particular focus on supply managed sectors.

Consumer demand for a given product is impacted by the price of that product, prices of close substitutes and complements, income, seasons and socio-demographic variables. We explained that an increase in price in sectors for which consumer demands are not price responsive will reduce revenues because the percentage increase in price is more than offset by the percentage decrease in volume. The reverse is true in sectors with demands highly responsive to price changes. Therefore, a supply management policy can only be effective in raising revenues along a supply chain in sectors with demands that identified as inelastic, i.e. for which prices do not trigger large adjustments in quantities purchased.

Agricultural products are different from most manufactured products because their production process is characterized by long biological lags and because they are perishable. Hence, the supply is very insensitive to prices in the short run and price variations can take a long time to be transmitted along an agricultural supply chain. These are not market failures, but constraints that can exacerbate market failures. Similarly, the presence of risk in agriculture is not a market

failure as long as there are markets for risk allowing risk-averse firms to pass on some of their risk at a competitive price, undistorted markets will produce efficient outcomes.

Perfectly competitive markets generate prices that perfectly reflect the wants of consumers and the competitiveness of producers/suppliers. When there are no externalities, government intervention involves a trade-off between efficiency and equity. Government intervention must be geared toward correcting market failures and to achieve wealth distribution objectives at the lowest possible cost. Historically, most industrialized countries have been concerned with the so-called "farm income problem" and have designed programs to raise farm household income and reduce the variability of that income.

Agriculture has experienced spectacular productivity growth in the past, thanks in large part to technological advances and size effects. At the firm level, we showed that technological improvements translate into downward shifts per unit costs that typically bring about increases in industry supply.

Technological advances and size effects exert a downward influence on real agricultural and food prices and on the number of farms, even in highly protected sectors. These productivity trends are of particular concern for sectors relying on domestic markets exhibiting slow growth. In these markets, competition across regions can only increase in intensity, even more so if trade liberalization was to provide foreign goods improved access to our domestic markets. The resulting shrinking domestic markets would force farms to produce at a lower scale until some decide to exit.

Agricultural supply chains are highly concentrated at all levels except at the farm level. This situation has incited producers to work collectively, by setting up cooperatives from which they can buy their inputs, and by setting up marketing boards to harness their joint bargaining power and to have more control over the marketing of their products. Supply management came about from a desire to empower dairy, chicken, eggs and turkey producers. The concept is to reduce supply to obtain higher prices.

Supply management is easy enough to understand from a theoretical standpoint, but it is not that easy to implement. Given that it is a national policy, coast to coast participation must be secured. Therefore the terms must be sufficiently appealing for all provinces to sign on and for all the firms along the supply chains to sign on. The fact that supply management has existed over such a long period of time signals that participation issues (or incentive compatibility constraints) have been successfully addressed.

Secondly, a national quota must be determined and allocated across provinces (the division of total economic rent). This entails making prediction about consumer demand and finding a

volume that would permit most producers to cover their cost of production. Mechanisms must be developed to deal with the consequences of unexpected demand and supply shocks. The higher prices stemming from supply controls imply producers with low production costs will always want to produce more. Mechanisms are in place to keep these urges in check. Quota prices are excellent indicators about such urges. The recent cap put on dairy quota prices and the recent growth in chicken quota prices suggest that these activities are highly profitable for a significant share of producers.

Supply management is confronted to several challenges. An immediate concern is the pressure from some of our trading partners, like the United States and New Zealand, who consider the phasing out of supply management programs as an essential condition for Canada to join the current negotiations of the TransPacific Partnership Agreement. Even though the multilateral negotiations of the Doha Round are stalled, an eventual breakthrough limiting the number of so-called sensitive products might impose greater liberalization effort on some supply managed products than on others. This could pit one supply chain against another or pit one level of supply chains against another and ultimately alter the overall level of support for supply management as a policy. The biggest and most important challenge is to increase the productivity of farms and processing plants under stagnant or slow growing national and provincial demands. Increasing productivity would entail lower cost of production, greater volumes of production and lower prices. Because of economies of scale, larger production levels would induce gains in productivity. This virtuous circle would benefit consumers who would enjoy lower prices. Our supply chains would be more competitive and better positioned to cope with trade liberalization. For this to happen, the institutions must evolve. Tariff-rate quotas must be replaced by tariffs as trade liberalization through tariff reductions induce larger levels of domestic production than increases in minimum access commitments generating the same domestic prices. Cost of production formulae used in the determination of national quotas must be revised to provide more incentives to increase productivity. Provincial boundaries segmenting markets might have made sense in the 1970s when the number of farms in each province was much higher, but they are difficult to justify in 2012. Producers and processors would gain by having the opportunity to sell/purchase “out-of-province”. The markets for production quotas would be a lot more efficient if provincial boundaries were enlarged. This way, producers who can profit the most from additional quota would have a higher probability of getting quota. Addressing the productivity problem would make supply management less controversial at home and abroad.

We hope that tools introduced in this document will help find answers and policy responses to these challenges.

6. Appendix - A Case Study of a Successful Supply Chain: Warburtons Bakery

Warburtons is an interesting example of supply chain management (St-Amour, 2009). This bakery located in Great-Britain provides bread and others bakery products to large distributors. Founded in 1876, Walburtons is the oldest independent bakery. It operates 16 processing plants and distribution centers. One of the objectives of this company is to sell fresh quality products. To do so efficiently, it is constantly analyzing and improving its operations and processes along the entire supply chain.

In the early 1990s, the main supplier of Walburtons was the Canadian Wheat Board (CWB). In 1992, Walburtons could not rely on that year's wheat crop because of its lower quality and it was forced to use wheat harvested in previous years. This situation was a major problem for Walburtons and its reputation was at risk. The quality of the wheat purchased from the CWB was increasingly variable and this issue had to be addressed. One of the main problems was that the quality criteria used by Walburtons were different than those used by the CWB. The CWB was using the color of the wheat and favoured uniformity without taking into account the particular needs of its clients. For Walburtons, quality was based on internal characteristics such as the proteins content as well as flour viscosity.

To solve the problem, Walburtons decided to create two value chains, a Canadian one and a British one. The first step in creating its value chains was to develop a classification system to price wheat. Information transmission and coordination along the supply chain are key ingredients for success. Finally, Walburtons made certain that all wheat producers understood that they are individually responsible for the quality of the final product. In this process, all producers have to follow strict procedures, from the variety of seeds to use, cultural practices and the way to harvest and to deliver the products to the elevators. If producers act in accordance to the directives and provide the desired quality, Walburtons is committed to pay a price equivalent to CWB grade 1 plus a premium of $18 per ton.

The decision to create value chains has been a profitable one. For Walburtons, profits increased by 18.5% in 1996 only. For farmers, the guaranteed price and premium constitute a net advantage. Furthermore, many farmers benefited from decreases in production costs because the value chain forced them to acquire a better understanding of their production activities. This example illustrates very well the importance of closer links between stakeholders in the supply chain. Value can be created based on the regularity of the supply, synergy between partners arising from the establishments of long term relationships (Vincelette, 2007).

7. Review questions

Indicate whether the sentence of statement is true of false

Notions of economic theory applied to agri-food supply chains

1) *The price elasticity of demand is defined as the percentage change in quantity demanded divided by the percentage change in price.*
   Answer: True.

2) *If chicken and pork are substitutes in the eyes of consumers, then an increase in the price of pork will increase the demand for chicken, all else equal.*
   Answer: True. Graphically, an increase in the price of pork will induce an upward shift in the demand curve for chicken.

3) *Economic growth translates in higher per capita income which in turn translates into increased demand for "normal" goods like chicken and beef.*
   Answer: True. A normal good is a good whose demand increases in response to increases in consumer income.

> **Application:** Lambert *et al* (2006) found that a 1% increase in expenses on fish and meat increases chicken and beef demands by 1.2% and 0.9% respectively.

4) *The demand for fluid milk is elastic*
   Answer: False. The demand for basic food commodities at the retail level is generally considered price inelastic.

> **Application:** Zheng and Kaiser (2008) found a price elasticity of -0.153 which implies that a 10% increase in price reduces demand by only 1.53%.

5) *In a competitive market, sales go to those producers who are willing to supply the product at the lowest price.*
   Answer: True.

6) *When markets fail, public policy can potentially remedy the problem and increase economic efficiency.*
   Answer: True. Public policy can be used to restore efficiency in a market. Policy is generally used however (especially in agricultural markets) out of equity concerns.

7) *If a good or service has only one seller, it is called a monopsony.*
   Answer: False. This situation is called a monopoly. A monopsony exists when there is only a single buyer in the market.

8) *If a country's domestic price of a good is lower than the world price, then that country has a comparative advantage in producing that good.*

Answer: True. If a country does not trade and the domestic price is lower than the world market price, there is an opportunity for firms in this country to increase sales by exporting and thus to increase their profits.

9) *In principle, trade can make everyone better off, since the gains to the winners exceed the losses to the losers.*
Answer: True. Trade improves efficiency but also affects equity. Trade liberalization can be seen as making the size of the pie as big as possible, but also as having implications on how the pie is divided. In theory, a government can use the gains of the winners to compensate the losers, but these types of policies have always been difficult to implement.

Lessons to be learned from other supply chains

10) *The supply of agricultural products tends to be elastic in the short run.*
Answer: False. The supply is very inelastic in the short run. If the price of hogs doubles overnight, producers will not be able to get new piglets to reach market weight to be slaughter the next day. It takes time to produce agricultural commodities. This is why there is such a thing as accidental dumping. Canadian beef producers were accused of dumping a few years ago but successfully argued that they have to bring their cattle to market once market weight has been reached even when prices are lower than what was expected when the production process started.

11) *The new marketing agreement in the Quebec hog/pork sector came about because processors wanted the opportunity to directly contract with producers to better respond to changes in consumer demand.*
Answer: True. Contracts give more flexibility for processors and producers to respond to new demand trends. As shown in our case study about the Warburtons bakery, it is also important for regulations (like grading, grain licensing) to evolve.

Vertical coordination in supply chains

12) *Integration of new activities for a firm is motivated by high transaction costs in dealing with other firms. Hence, there is no limit to integration.*
Answer: False. The more activities are integrated by a firm the higher are its internal management costs.

13) *Food retail can be seen as a non-tradable service. Therefore, food retailers do not have to fear foreign competition.*

Answer: False. It is true that food retail is very much a localized activity that cannot be traded. However, Canadian food retailers are aware that giant foreign retailers like Carrefour and Walmart operate and have secured dominant positions in several countries. They cannot raise their margin at will; otherwise this would invite other retailers to enter the local market.

14) *There are two types of asymmetric price transmission.*
Answer: True. The first type pertains to size of the price adjustment in response to a decrease and increase of similar magnitude in the price of an input. The second type pertains to different speed of adjustment for similar decrease and increase in the input price.

Inter-provincial and international trade under supply management

15) *A decrease in price will increase sales of a product but selling more at a lower price always generate lower revenues*.
Answer: False. At the price that chokes demand (the minimum price that makes demand equal to zero), revenue is zero. At the other end of the demand curve, demand is maximized when the good is free and revenue is necessarily zero. In between these extremes, revenue is positive and reaches a maximum when the marginal revenue is zero.

16) *Profit maximization for a price-taking firm entails producing a quantity that minimizes average cost.*
Answer: False. In the long run, there are no economic profits as labour and other inputs are rewarded in terms of the value they generate and price-taking firms end up producing at a quantity at which price is equal to the marginal and average costs. In the short run, profits can be earned. Naturally, profits induce entry of new firms and the number of firms keeps on increasing until profits are driven to zero. The best response to a price increase on the part of a price-taking firm is to move up along its marginal cost curve (thinking at the margin).

17) *A permanent increase in consumer demand for a particular food product due perhaps to a newly found health benefit generates gains. Abstracting from the health effects that can take years to emerge, the gains for society in the short run can be constrained.*
Answer: True. Supply of agri-food commodities is very inelastic in the short run and the increase in demand will generate an important increase in the price of the product in the short-run that mitigate the benefits of the increase in demand.

18) *It is never optimal for a monopolist that experiences a decrease in costs (perhaps because some imported inputs are cheaper after a currency appreciation) to pass on some of the decrease in cost to consumers*.

Answer: False. It is generally more profitable to pass on part of the decrease in cost to consumers. Following the law of demand, a decrease in price will increase sales. Depending on the price elasticity of demand, these changes may increase or decrease revenues. In the former case higher revenues and lower costs will undoubtedly increase profits and make it profitable for firms to pass on the cost savings to buyers. If the sales revenues are lower, it is still possible for the lower costs to generate an increase in profits and thus also give an incentive to pass on some of the cost savings to buyers.

19) *A national composition standard on the domestic market for cheese will have no impact on the price of cheese and quantity sold if domestic processors already meet this standard*.

Answer: False. If the standard is binding, it will raise the marginal cost of production of all cheese manufacturers. If the cheese market is competitive, this will translate into a lower volume and a higher price. If the standard is binding only on foreigners, this should give a competitive advantage to national cheese manufacturers. Given that cheese is a differentiated product, it can be conjectured that the standard would have a stronger impact on the cost of lower quality/less expensive cheeses as opposed to higher quality/more expensive cheeses. Relative prices of high quality/low quality would encourage a substitution toward the higher quality.

8. References

Abbassi, A., Bonroy, O. and J.P. Gervais. 2008. Dairy Trade Liberalization Impacts in Canada. *Canadian Journal of Agricultural Economics*, 56:313-335.

Abbassi, A. and J.P. Gervais. 2010. Evaluating Reforms in Canadian Chicken Marketing Mechanisms Using a Linear-Quadratic Inventory Model. Journal of Agricultural and Food Industrial Organization, 8:1-22.

Abbott, P. and L. Young. 1999. Wheat-Importing State Trading Enterprises: Impacts on the World Wheat Market. *Canadian Journal of Agricultural Economics*, 47:119-136.

Agriculture and Agri-food Canada (AAFC). 2007. Profile of the Canadian Turkey Industry. Animal Industry Division. Ottawa.

AAFC. 2006. Profile of the Canadian Chicken Industry. Animal Industry Division. Ottawa.

Ames, G.C.W. 1998. Non-Tariff Barriers and Political Solutions to Trade Disputes: A Case Study of U.S. Poultry Exports to Russia. Applied Economic Perspectives and Policy, 20:238-247.

Anderson, J. and E. van Wincoop. 2003. Gravity with Gravitas: A Solution to the Border Puzzle. *American Economic Review*, 93:170-192.

Azzam, A. and J. Schroeter. 1995. Trade-offs between Oligopsony Power and Cost-Efficiency from Horizontal Consolidation: An Example from Beef Packing', *American Journal of Agricultural Economics*, **77**, 835–836.

Bayliss, K. and H.W. Furtan. 2003. Free Riding of Federalism: Trade Protection and the Canadian Dairy Industry, *Canadian Public Policy*, 29.145-161.

Bourlakis, M.A. and P.W. H. Weightman. 2004. Food Supply Chain Management. Wiley-Blackwell. Oxford.

Brander, J. and P.R. Krugman. 1983. A Reciprocal Dumping Model of International Trade. *Journal of International Economics*, 15:313-323.

Chern, W., Loehman, T. and S. Yen. 1995. Information, Health Risk Beliefs, and the Demand for Fats and Oils. Review of Economics and Statistics, 77:555-564.

Felt, M.H., Larue, B. and J.P. Gervais. 2012. Compositional Standards, Import Permits and Market Structure: The Case of Canadian Cheese Imports. SPAA working paper 2012-1. Also forthcoming in *World Economy*.

Gervais, J.P., Guillemette, K. and R. Romain. 2007. Output and Price Determination in the Canadian Chicken Industry: Which Should Come First? *Canadian Journal of Agricultural Economics*, 55: 255-273.

Gibson, P. J. Wainio, D. Whitley, and M. Bohman. 2001. *Profiles of Tariffs in Global Agricultural Markets*. ERS-USDA, Washington, DC.

Gundersen, C. and S. Offutt. 2005. Farm Poverty and Safety Nets. *American Journal of Agricultural Economics*, 87:885-899.

Hendrickson, M. and W. Heffernan. 2007. *Concentration of Agricultural Markets*. University of Missouri.

Hennessy, D. A. 1998. The production effects of agricultural income support policies under uncertainty. *American Journal of Agricultural Economics*. 80:346–357.

Lambert, R., B. Larue, C. Yélou and G. Criner. 2006. Fish and Meat Demand in Canada: Regional Differences and Weak Separability. *Agribusiness*, 22:175-199.

Larue, B., Gervais, J.P. and H. E. Lapan. 2004. Low-Price Low-Capacity Traps and Government Intervention in the Quebec Hog Market. *Canadian Journal of Agricultural Economics* 52:237-256.

Larue, B., G. West, C. Gendron and R. Lambert. "Consumer response to functional foods produced by conventional, organic or genetic manipulation" *Agribusiness-an International Journal*. 2004, 20,2:155-166

Larue, B., Gervais, J.P. and S. Pouliot. 2007. Should TRQs be Liberalized to Look more like Quotas? Implications for Trade Liberalization under a Supply Management Policy. *North American J. of Economics and Finance*, 18:247-261.

Larue, B and J.P. Gervais. 2008. The Assessment of the Concept of Revealed Comparative Advantage and its Applicability in the Allocation of Egg Overbase Production. Report prepared for the National Farm Product Council, December.

Larue, B. and O. Bonroy. 2009. Seemingly Competitive Food Retail Regulations: Who Do They Really Help? *Canadian Journal of Agricultural Economics*. 57:305-324.

Lopez, R. A. A. M. Azzam and C. Liron-Espana. 2002. Market Power and/or Efficiency: A Structural Approach. *Review of Industrial Organization* 20: 115-126.

Lusk, J. 2010. The Effect of Proposition 2 on the Demand for Eggs in California. *Journal of Agricultural and Food Industrial Organization*, 8,1: article 3.

McCallum, J.C.P. 1995. National Borders Matter:Canada-US Regional Trade Patterns, *American Economic Review*, 85:615-623.

Meilke, K. and A. Cairns. 2011. An Evaluation of Milk Quota Exchange Policies. CATPRN Policy Brief 2011-02. http://www.uoguelph.ca/catprn/PDF-TPB/TPB-11-02-Meilke-Cairns.pdf

Mosheim, R. and K.Lovell. 2009. Scale Economies and Inefficiency of U.S. Dairy Farms. *American Journal of Agricultural Economics*, 91:777-794.

Ollinger, M, J.M. MacDonald and M. Madison. 2005. Technological Change and Economies of Scale in US Poultry Processing. *American Journal of Agricultural Economics*, 87:116-129.

Pouliot, S. and B. Larue. 2012. Import Sensitive Products and Perverse Tariff-Rate Quota Liberalization. *Canadian Journal of Economics*, forthcoming.

Rude J., and J-P. Gervais. 2006. Tariff Rate Quota Liberalization: The Case of World Price Uncertainty and Supply Management. *Canadian Journal of Agricultural Economics* 54: 33-54.

Rude, J. and J-P Gervais. 2009. Biases in Estimating Dumping Margins: The Case of Cyclical Products. *Review of Agricultural Economics* 31:122-142.

St-Amour Y. 2009. Compétitivité par les chaînes de valeur, les cas de Walburtons et des Moulins de Soulanges. *Bioclips*, April Vol. 12, No. 1.

Sumner, 2003. D.A. Implications of the US Farm Bill of 2002 for Agricultural Trade and Trade Negotiations. *Australian Journal of Agricultural Economics*, 47:99-122.

Thurman, W. N. 1987. The Poultry Market: Demand Stability and Industry Structure. *American Journal of Agricultural Economics*, 69:30-37.

Tonsor, G.T., J.R. Mintert and T.C. Schroeder. 2010. US Meat Demand: Household Dynamics and Media Information Impacts. *Journal of Agricultural and Resource Economics*, 35:1-17.

Trefler, D. 2004. The Long and the Short of the Canada-US Free Trade Agreement. The *American Economic Review*. 94:870-895.

Ulrich, A., Furtan, H. and A. Schmitz. 1987. The Cost of a Licensing System Regulation: An Example of Canadian Prairie Agriculture. *Journal of Political Economy* 95:160-178.

USDA. 2010. http://www.ers.usda.gov/Briefing/WellBeing/farmhouseincome.htm#income

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

Veeman, M. 1997. Marketing Boards: The Canadian Experience Revisited. *American Journal of Agricultural Economics* 79:1154-1562.

Yélou, C. Larue, B. and K. Tran. 2010. Threshold Effects in Panel Data Stochastic Frontier Models of Dairy Production in Canada. *Economic Modelling.* 27 :641-647.

Zheng, Y. and H. M. Kaiser. 2008. Estimating Asymmetric Advertising Response: An Application to US Non-Alcoholic Beverage Demand. *Journal of Agricultural and Resource Economics*, 40:837-849.