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*Structure et la Performance de l'Agriculture  
et de l'industrie des produits Agroalimentaires*

*Structure and Performance of Agriculture  
and Agri-products industry Network*

## **The Simple Economics of Hog Marketing Reforms in Quebec**

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Cahier de recherche/Working paper #2010-01

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### **1. Introduction**

There is no arguing that the North American hog/pork sector has been going through one of its worst crisis of the last two decades during the 2007-2009 period. The surge in commodity prices in the second half of 2007 raised feed prices and other input costs at the farm level. A global economic recession surfaced at the end of 2007 and subsequently lowered the global demand for pork products. The outbreak of a new strain of the flu virus, labeled swine flu at the early stages of the epidemic, accelerated the decline in the world demand for pork, weakening in the process an already fragile industry. Other shocks specifically affected the profitability of the Canadian hog/pork 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 likely both contributed to weaken the competitive position of Canadian hog producers and pork packers.

Two federal programs aimed at reducing the overall supply of sows in Canada as well as many other periodic provincial programs have helped a subset of hog producers transition towards other sectors. Still, the Canadian hog/pork industry has been hurting and is just beginning to emerge from its economic lethargy. While desperate times do not necessarily call for desperate measures, they almost always call for significant changes. Quebec hog producers and pork packers recently agreed to sweeping changes in marketing regulations. Hog marketing institutions in Quebec have continuously evolved. 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 on a hybrid marketing system in 1994 in which a percentage of hog supplies was pre-attributed to processors based on historical market shares, while the remaining hogs were auctioned off. This

system was quite successful in raising the average hog price above the reference price in the US market. However, the recent struggles of the industry pushed the average auction price at levels significantly below the reference price, much to the dismay of hog producers. Frustration vis-à-vis the hybrid marketing system also built up on the packers' side. In other provinces, hog procurement has moved away from spot markets towards models where packers own hogs or directly contract with hog producers to lower the overall transaction costs in the supply chain. This lowers transaction costs and allows packers to develop specific products to meet emerging food preferences. Processors viewed their inability to directly contract with producers as an important obstacle to getting the Quebec hog/pork industry back on its feet.

After long and painful negotiations, packers and Quebec hog producers' representatives agreed to significant reforms in hog marketing mechanisms. At the heart of the matter was the producers' conviction that a marketing board with exclusive marketing rights was necessary to best serve their interests. Producers believe that their collective bargaining strength had to be preserved to counterbalance concentration on the packers' side. Conversely, processors believed that no reform could lift the industry from its slump without the ability for packers to develop business relationships with individual producers. The new marketing agreement addresses each party's main concern. Packers committed to purchase all Quebec hogs at a price no lower than the reference price in the US market. In return, producers agreed to a system that gives packers access to producers to better manage the pork supply chain.

Three hog categories were created under the new marketing agreement: i) specialty hogs; ii) commodity hogs; and iii) packer-owned hogs. The producers' board remains in control of marketing the hogs through the different marketing channels conditional on a set of agreed rules. The purpose of this system is to lift prices paid to producers and allow packers to capture market

share domestically and abroad. Yet, there are potential costs of implementing the new marketing system. It could lead to structural surpluses if packers' revenues fall short from the level which would guarantee that the hog price commitment is a profitable strategy. Reforms to the producers' income support program (commonly referred to as ASRA) will likely also have an impact on production levels in the sector. The objective of this paper is to provide a simple analysis of the economics behind the new marketing rules in the Quebec hog/pork industry. This analysis also offers some valuable insights for other provinces as they try to address the struggles of their own hog/pork business.

A few studies in the literature have analyzed the structure of the Quebec hog/pork industry. Larue *et al.* (2000) reviewed the 1989 and 1994 hog marketing reforms and investigated the determinants of hog prices on the auction. Larue, Gervais and Lapan (2004) showed the benefits of pre-committing hog supplies in an imperfectly competitive setting. They also provided an efficiency rationale to the existence of a subsidy program in hog production. Gervais and Tamini (2005) proposed a coincident economic index to measure the economic environment of the Quebec hog/pork industry. They argue that the 1994 hog marketing reform was the most important trigger of the industry growth. Finally, Gervais and Doyon (2004) investigated different risk management strategies for Quebec hog producers, especially focusing on the complementarities between the futures market and ASRA. While all these papers touched upon different facets of Quebec hog marketing institutions, none have analyzed the current marketing mechanisms.

The remainder of the paper is structured as follows. The next section focuses on the recent business relations between Quebec producers and packers and details the chronology of events that brought changes in hog marketing mechanisms. It also provides a detailed description

of the new marketing arrangements. Section three presents simple analytical tools to discuss the efficiency of marketing reforms in the Quebec hog/pork industry. Section four provides an empirical counterpart to the analytics presented in the previous section. The final section concludes.

## **2. A Chronology of the events leading to the most recent reform**

As mentioned in the introduction, Larue *et al* (2000) provide a detailed account of the changes in marketing institutions prior to 2000. From 1989 to March 1994, Quebec hog producers marketed their hogs through an electronic auction. A reform led to a hybrid system in which a significant share of the hogs was pre-attributed to packers based on their historical market shares and sold at a pre-determined price while the remaining hogs were sold through the auction. The two mechanisms co-existed until very recently. Over the years, the proportion of hogs that were pre-attributed evolved between 50 and 80 percent. In 2000, short-term contracts were introduced as a third hog marketing mechanism. Both the importance of the electronic auction and pre-attribution were lowered to auction off fixed supplies of hogs over a period of one month.

Dissatisfaction with the hog marketing mechanisms emerged in the second half of this decade for many of the same reasons that transpired in the early 1990s. The frustration of producers with the auction was driven by prices lower than the US reference price. Figure 1 presents the weekly average price paid under the auction and pre-attribution mechanisms from early 2004 to the end of 2009. Following pressures by the Quebec hog marketing board (*Fédération des producteurs de porcs du Québec*, FPPQ), the *Régie des marchés agricoles du Québec* (RMAQ) suspended the auction mechanism in October 2006. Producers' representatives argued that prices on the auction should not be consistently below the US reference price given Quebec packers operate in a fairly open North American marketplace. In mid-2006, the

difference between the auction price and the US reference price reached as much as \$30 per 100 kg, as illustrated in Figure 2. The FPPQ launched an internal review of hog marketing mechanisms in December 2006 and the auction resumed in April 2007. Despite early indications that auction prices were going to hover around the US reference price, the price difference observed in mid-2006 quickly resumed. Given mounting acrimony between producers and processors, the Quebec Minister of Agriculture named a mediator to explore potential reforms of hog marketing institutions in September 2007. At the end of 2007, the difference between the US reference price and the average weekly price on the auction was more than \$25 per 100 kg.

The government representative reported in March 2008 that he could not find middle grounds between producers and processors on the issue of reorganizing the hog marketing system. Producers named their own special negotiator in early 2008 and decided to continue negotiating with processors throughout 2008. A tentative agreement between producers and five packers was reached in June 2008, but only the largest packer in the province turned out to be willing to sign onto the final document in December 2008. As a result, the FPPQ asked the RMAQ to arbitrate a new marketing agreement between producers and processors. At the end of 2008, the difference between the US reference price and the average auction price had reached more than \$45 per 100 kg. With the prospects of a new agreement nowhere in sight, the FPPQ asks the RMAQ to suspend the auction mechanism. The RMAQ agreed and suspended the auction on February 13, 2009, setting the price of all hogs at the US reference price minus \$4 until April 17, 2009. Finally, after nearly 18 months of intense negotiations that involved the provincial government and special mediators, Quebec hog producers and packers settled on a new hog marketing agreement (hereafter referred to as the Agreement) on May 18, 2009. The Agreement was ratified on June 12, 2009 with an implementation date of September 7, 2009.

The core principles of the Agreement between producers and processors are:

- to send clear quality signals to producers so that buyers can secure high-quality supplies;
- to fix a fair price that accounts for North American market conditions;
- to tailor hog characteristics to buyers' needs;
- to preserve the exclusive marketing rights of the producers' board;
- to minimize transaction costs in the supply chain.

The Agreement links all Quebec hog producers (as identified by the *Plan conjoint des producteurs de porcs du Québec*), the FPPQ and buyers. The most important change to the marketing rules that existed prior to 2009 is arguably the introduction of three different hog categories:

1. *Packer-owned hogs*: 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*: a hog that was raised and/or fed according to specific buyer demands that imply 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. The specificity must be recognized by a committee that oversees differentiation in the Quebec hog/pork supply chain.
3. *Commodity hogs*: all other hogs not included in the previous two designations.

The marketing mechanisms rest on two important components: i) a price commitment by buyers; and ii) prioritized allocation of the hogs. Buyers commit to pay a reference price for all hogs purchased. This price is determined according to the following formula: the index 100 hog price in \$Can per 100 kg is equal to the USDA weighted average net price (weights are the

“*negotiated*” and “*swine or pork market formula*” hogs) in \$US per 100 lb times an adjustment factor for the American carcass (0.74), divided by an adjustment for the Canadian carcass (0.80), times the exchange rate, times the pound per kg conversion factor (2.2046).

In the first year of the Agreement, the FPPQ determines the allocation of hogs to each buyer according to the following rules:

1. The FPPQ assigns to a buyer 100 % of all hogs bought from the FPPQ between April 1 2008 and March 31, 2009;
2. hogs that remain available are offered to all buyers. If the buyers’ demand is greater than the supply of available hogs, the available hogs are allocated in percentage of the purchases made in the twelve months preceding the allocation period;
3. if hogs are still available, they can be allocated to buyers that express a demand for these hogs after the allocation period has started;
4. if hogs are still available, they could be assigned to a new entrant as long as this new buyer becomes a signatory to the Agreement.

Once the allocation process reaches step three above, the FPPQ can trigger the surplus disposal mechanism defined in the Agreement. The FPPQ revises allocations twice a year (August 1 and February 1). In each review process, the FPPQ repeats the four steps outlined above accounting for 100 percent of the hogs purchased in the last 12 months, with the exception of surplus hogs marketed under the surplus disposal mechanism.

The allocation priorities are the following: 1) packer-owned hogs; 2) specialty hogs; and 3) commodity hogs. Buyers get their hog allocation by first filling requests for packer-owned and specialty hogs. Commodity hogs are allocated to the closest slaughterhouse until the total number of hogs reaches the allocation of this particular plant. If needed, production sites are

assigned to the second closest slaughterhouse until reaching the allocation for this facility. Allocation is done for a full production site (no breaking lots to different slaughterhouses). The FPPQ plans hog allocations and it notifies producers and buyers of what the shipments and receipts are based on mandatory reporting of piglets going into finishing operations.

When a specialty hog is officially recognized by the differentiation control committee, the product specifications of this hog are posted on the FPPQ website, at the same time as the expert opinion of the committee relative to the premium paid for this type of hog. A first-come-first-serve system is implemented to determine which producers are assigned the rights to produce the specialty hogs. Buyers' requests for specialty hogs must include a detailed list of particular production methods, additional costs incurred by producers, a grading grid, requirements relative to input usage, premiums paid to producers and mechanisms to adjust these premiums following fluctuations in input prices. Packers need to detail also how the proposed specialty product is different than the commodity product, the markets that are targeted and list the attributes that will allow buyers to differentiate the product at the retail level from commodity meats.

A buyer is required to accept delivery of all hogs that are allocated to him in one of its slaughterhouse. Buyers that own multiple plants have the rights to decide where ownership hogs and specialty hogs will be slaughtered. Producers must confirm to his/her assigned buyer the number of hogs to be delivered at least 48 hours before delivery. Any increase in the production of specialty hogs must come from the pool of commodity hogs assigned to the particular buyer making the request. In other words, the demand for specialty hogs cannot be manipulated to increase the overall number of hogs assigned to a buyer. Any increase in the overall supply assigned to a buyer must be made in accordance with provisions set forth in the Agreement

relative to changes in packing capacity. A buyer must notify the FPPQ of any increase in packing capacity at least nine months before the allocation date.

Any decrease in capacity must be reported to the FPPQ three months before the implementation date. As mentioned before, a surplus program is administered by the FPPQ when some hogs remain to be allocated. The FPPQ posts available hog supplies and potential buyers (note that this includes buyers that are not signatories to the Agreement) have five days to respond to the FPPQ if they desire to purchase the hogs. Hogs are sold to the highest bidder and in the likely event that the auction price is lower than the reference price, the price difference of surplus hogs is pooled across producers.

### **3. An economic analysis**

This section analyzes the impact of reforming marketing mechanisms using simple analytical tools. There are many dimensions to the issue of marketing hogs. Product differentiation and the existence of potential market power are certainly two of the most important dimensions of the marketing reform; yet it is quite difficult to account for these aspects using two-dimensional graph analysis. Properly modeling imperfect competition in the supply chain needs to account minimally for the interactions between at least two processors. It is next to impossible to illustrate the implications of each firm's pricing decision on the industry output without relying on a three dimensional analysis. Hence, we first consider that none of the buyers are able to exercise market power. We are thus able to represent the demand and supply conditions in the Quebec hog/pork industry by well-behaved demand and supply schedules. Clearly, a chief concern of the industry is the ability to create value in the supply chain by offering differentiated products to consumers. For much of the same reasons mentioned before, we will abstract from

quality issues in the supply chain and argue that the price and quantity variables represent a weighted average of the different products marketed in the hog/pork supply chain.

One of the cornerstones of Quebec agricultural policy is the agricultural income support program, known under the French acronym ASRA. ASRA works much like a price support program as producers are guaranteed to receive a certain price no lower than the average production costs computed from a sample of representative farms. The compensation is funded by premiums that are set as a function of market conditions and are subsidized. The ASRA program is funded according to a one-third/two-third rule by Quebec hog producers and the provincial and federal governments, respectively. Before diving into the economics of hog marketing mechanisms, we will first focus on the impact of the price support policy.

Consider the market for hogs illustrated in Figure 3. The segment  $D_0$  represents the hog demand of processors while  $S_0$  represents the marginal cost of hog producers. A price support policy implies that the bold segment in Figure 3 is now the relevant supply curve. Output under price support increases from  $Q_0$  to  $Q_S$ . Buyers' willingness to pay falls to  $p_B$  given the increase in production and the extent of the subsidy is measured by the difference between  $p_S$  and  $p_B$ . One way to understand the significance of  $p_B$  in the market is to think of this price as the marginal valuation attached to the hogs marketed through the auction when some hogs are pre-attributed at the US reference price. The price  $p_B$  can be lower or higher than the US reference price. In a market with a declining demand for pork meat, the packers' demand for hogs would decline and push down the marginal valuation of the hogs sold in the auction. Of course, ASRA does not act as a pure price support scheme because producers pay one-third of the subsidy needed to guarantee the price  $p_S$ . Nevertheless, we will think of ASRA as a price support for the purpose at hand.

Figure 4 introduces the role of the reference price which is denoted  $p_{US}$ . Given the size of the Quebec industry relative to the North American market, changes in the Quebec hog/pork market have no impacts on the reference price. The Agreement implies a commitment by processors to purchase all hogs at the reference price. The auction price was below the reference price prior to the reform, and thus  $p_{US} > p_B$  in Figure 4. Under the same market conditions as in Figure 3, the valuation of the marginal hog would actually be lower than the US reference price. Yet, processors committed to purchase all hogs produced domestically (denoted by  $Q_S$ ) at a price  $p_{US}$  which has definitely been higher on average than  $p_B$  in the last few months or even years according to Figure 1. If we think of  $p_B$  as the average value of hogs purchased by buyers, the shaded area represents the costs of committing to purchase all hogs at the predetermined US reference price. Clearly, processors lose money if somehow the valuation they attach to the hogs does not increase following the marketing reform.

If the reform leads processors to develop new products and increase revenues such that their valuation of hogs implies a move from  $D_0$  to  $D_1$ , the market would then reach a new equilibrium which will be denoted by  $p_E$ . In other words,  $p_E$  is the price that would prevail in a free market after the reform is implemented (*i.e.* without the price commitment made by buyers). The insistence of processors throughout the overall negotiation process to gain flexibility in marketing may be understood as an effort to raise net revenues in order to cover the higher procurement costs. However, it raises important questions as to what happens in situations in which the reference price is higher or lower than  $p_E$ .

Consider the situation depicted in Figure 5. In this case, the shift in demand from  $D_0$  to  $D_1$  entails an equilibrium price that would be larger than the US reference price. In other words, there is an excess demand at the US reference price (equal to  $Q_{US} - Q_S$ ). Producers have no

incentives to increase production because the equilibrium price  $p_E$  is still lower than the support price, yet processors demand more hogs at the reference price because (presumably) successful and novel supply chains entail larger profit in the downstream market for pork products. The new marketing agreement plans for situations in which a processor wants to increase capacity and slaughter more hogs. Yet, there is no incentive to increase production at the farm level – the price support system trumps the market signal.

Obviously, the reverse situation could occur. Market conditions could be such that new pork products do not command as high a premium in the downstream market as initially believed, and thus the demand for domestic hogs is lower than what was anticipated following the reform. Consider the market situation illustrated in Figure 6. The US reference price is above the price that would clear the market ( $p_E$ ). The valuation of hogs by processors is too low and, as a result, there is an excess supply of hogs at the pre-determined reference price (equal to  $Q_S - Q_{US}$ ). In reality, the packers' commitment to purchase historical volumes solves this surplus situation in the short-run. In the long-run, this situation is untenable from the packers' perspective and some firms would certainly seek to lower their packing capacity according to the process laid out in the Agreement.

The obvious disadvantage of the current marketing system is the rigidity introduced in supply chain by the price commitment coupled with the existence of the price support policy. An excess supply or excess demand can potentially hurt the integrity of the marketing system if it occurs on a consistent basis. Excess demand can potentially harm a specific market segment over the long-run if packers cannot meet the demand for a new product. Usually, the hog price would adjust to lower the demand of packers and/or raise the output of producers. Alternatively, lower hog production costs could trigger an increase in the industry's output. However, without

proportional upward adjustments in packing capacity, the impact of an increase in production would have to be fully absorbed by producers through a lower pool price.

The kind of disequilibrium described above was to be addressed through the *Règlement sur la gestion équilibrée de la production* (regulation on balanced output management) that is mentioned within the Agreement. A first version of the regulation was approved by a majority of producers in September 2008 and called for an allocation of a base output to each production site (as opposed to each producer<sup>1</sup>) with provisions to allocate future production increases across producers. This regulation was however never brought in front of the RMAQ to be formally implemented.

A reform in ASRA almost certainly had an impact on the decision to push back the discussion on the regulation of production in the industry. As mentioned before, ASRA provides a compensation to hog producers when the average market price falls below an industry-wide estimate of producers' average cost. Producers pay a premium for the income insurance which is set at one third of the actuarially fair premium (*i.e.*, the premium needed to ensure that the insurance fund is balanced). The other two-thirds of the contributions are provided by the federal and provincial governments. Figure 7 details Quebec hog producers' ASRA support level in comparison to average market prices from 2000 to 2009. The solid line represents the stabilized income level while the dotted line measures the average market price. During this 10-year period, the market price exceeded the target price in four instances. Over the period, the average compensation (inclusive of the producers' contribution) was over \$36 per 100 kg. The compensation ballooned in the last three years going from \$37 to \$54 to \$59 as hog prices tanked and feed prices increased.

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<sup>1</sup> The idea is to preserve the balance of power between growers and integrators, but the issue is likely to create some controversy. Integrators generally own the hogs but contract individuals to bring their hogs to market weight. The contractant however owns the building and supply the inputs.

The global downturn in the industry is reflected in the accumulated deficit of ASRA measured on the right hand-side vertical axis of Figure 7. The accumulated deficit exploded to \$412 million in 2008. As a result, significant changes to the program eligibility and financial parameters have been approved by the government on March 31, 2010. Some of the most significant changes imply dropping the 25 percent least efficient farms from the computation of the average production cost<sup>2</sup>, raising the insurance premium of farms that exceed by three times the average farms size, and capping the individual producer's output eligible for payments. The exclusion of least efficient farms will lower the guaranteed price by an estimated three percent on average. The second measure will ask largest farms to make a greater effort towards erasing the deficit of the insurance fund. The third measure is especially important because it can be seen as a tool to limit production. While it does not establish binding caps on production, the fact that the cost-of-production guarantee will not be offered to producers exceeding a certain output can be considered an implicit ceiling (albeit imperfect) on industry output.

### *Imperfect competition*

How does the Agreement deal with producers' concern of increased concentration in the supply chain? From the producers' perspective, it is clear that they see collective marketing as the best tool to counterbalance the potential exercise of market power in downstream markets. Larue, Gervais and Lapan (2004) analyzed the Quebec hog/pork industry in the context of concentration and suggested that the existence of a price support program increased welfare for the industry. Their argument was centered on the existence of lags between when output plans are made and output is marketed (*i.e.* the lag between when hogs are fed and finally reach market weight). The

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<sup>2</sup> This particular provision of the ASRA reform is quite controversial and is currently debated between hog producers representatives and the government agency that oversees the provincial income support programs.

supply illustrated in Figures 3 through 6 can be thought as the long-run supply. In the short-run, the supply is (almost) perfectly inelastic.

Figure 8 illustrates the impact of production lags when there is only a single buyer in the market. The segment  $D_0$  still represent the marginal valuation of hogs by the buyer, but we must now recognize that the more hogs it buys, the higher the final purchase price will be. For all practical matters, the relevant supply schedule in the short-run is  $S_R$ . What will be the price offered by the buyer? It depends on the marketing alternatives of producers. Assume that producers can sell their hogs across the border at the US reference price minus some transaction cost  $T$ . The domestic buyer only needs to offer a price slightly above  $p_{US} - T$  to capture all of the available supply. Without enforceable contracts that commit the buyer to pay a certain price before output is set at the farm level. Producers fully anticipate the behavior of the buyer and should lower their output accordingly, thus shifting the long-run supply curve to the left. This is what Larue, Gervais and Lapan (2004) labeled a low-price / low-capacity trap. The existence of the price support policy changes this welfare-inferior equilibrium. Production would be at level  $Q_S$  and this illustrates the benefits of the price support. The price commitment plays much of the same role here. It guarantees that buyers will pay a price higher than the next best alternative. Of course, the industry is not yet at the point where one would consider the market structure a quasi-monopsony. Yet, increased concentration can certainly lead to market outcomes that are approaching the monopsony equilibrium illustrated in Figure 8. The price commitment in the Agreement addresses some of the market inefficiencies potentially arising because of market power.

### *Vertical coordination and transaction costs*

The reform in the hog marketing system was also partially driven by the desire to improve vertical coordination in the industry through minimizing transaction costs<sup>3</sup> between packers and producers. The extent of transaction costs is determined mainly by three factors: *i*) uncertainty; *ii*) asset specificity; and *iii*) frequency of the transaction. When there is little uncertainty about the quality of a product, transactions will tend to be made on a spot market. Similarly, goods that do not require a high degree of transaction-specific assets (i.e. assets of physical or human nature that would be difficult to redeploy to a different sector) would tend to occur in spot markets as well. Finally, transactions repeated frequently tend to be carried out in the spot market because the buyer and seller have many chances to gather information about the other party and this leads to reputation issues.

The introduction of different hog categories and the emphasis on specialty hogs in the Agreement clearly raise concerns about opportunistic behavior. For example, producing a specialty hog requires investing in some specific human and physical capital that may in some instances be of little value if offered to a different buyer. Without mechanisms to prevent opportunistic behavior on the part of buyer (or sellers), a businesses could be tempted to exploit a situation to its own advantage (*e.g.*, by renegotiating the terms of a contract after investments in specific assets have been made). In that regard, the Agreement protects sellers and buyers from opportunistic behavior. It also addresses other coordination issues such as matching producers with packers by minimizing transportation costs and lining up incentives and rewards for hog producers based on packers' market requirements which are mainly derived from consumer preferences. The Agreement addresses coordination issues that have been dealt with in other producing regions such as Western Canada and the US for a number of years. The

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<sup>3</sup> Hobbs (1996) offers a good review of the theory of transaction costs.

challenge for the Quebec hog/pork industry has always been to solve these issues while preserving collective marketing tools at the farm level.

#### **4. Numerical example**

The purpose of this section is to complement the analytics presented in the previous section. As hinted throughout, the marketing reform clearly raises per-unit revenues for producers as packers commit to pay a reference price that has been higher than the average price paid on the auction between 2007 and 2009. The benefits for processors are less obvious. On the one hand, they commit to pay a higher average price for hogs and thus this increases their overall procurement costs. In return, they secure supplies (thus reduce some of the risk they face) and have the opportunity to directly work with producers to develop new marketing segments. The ability to develop a business relationship with individual producers can increase packers' revenues as well as lower their costs. In what follows, we develop a simple numerical example that illustrates the expected benefits that packers must receive to compensate the higher procurement costs they have committed to pay.

Given the presence of a price commitment in the Agreement, it seems important to measure the benefits and costs of the marketing reform in a framework that accounts for risk preferences. We will assume that packers maximize expected utility of profits which will be expressed in a mean-variance framework. Let the individual output of a packer be represented by the variable  $q$ . The output price will be denoted by  $p$  and the variable  $c$  will measure average variable costs which are assumed to be constant. Let the subscript "0" and "1" denote the pre-reform and post-reform periods, respectively. In the pre-reform period, we will focus on the pre-attribution and auction mechanisms. We will also assume that the pre-attribution price is equal to

the reference price under the new marketing agreement. Finally, let the symbol “ $\tilde{\cdot}$ ” denote a random variable. Profits in the pre-reform and post-reform periods are, respectively:

$$(1) \quad \tilde{\pi}_0 = (\tilde{p}_0 - c_0)q - \tilde{r}^{US} \alpha q - \tilde{r}^A (1 - \alpha)q$$

$$(2) \quad \tilde{\pi}_1 = (\tilde{p}_1 - c_1)q - \tilde{r}^{US} q$$

where  $\tilde{r}^{US}$  and  $\tilde{r}^A$  are, respectively, the hog price under pre-attribution and the auction mechanisms and  $\alpha (1 - \alpha)$  is the share of hogs that is pre-attributed (auctioned).

It is important to emphasize the differences between equations (1) and (2). The volume available to the packer is identical under the two situations. In reality, there is some uncertainty associated with the number of hogs bought on the auction  $((1 - \alpha)q)$  by a packer. However, to simplify the analysis, we will assume that the only difference in risk is with respect to the price paid for these hogs. Average variable costs are known to packers but are assumed to be potentially different in the two situations. The distribution of the output price is also assumed different under the two marketing systems. In what follows, we assume that only the first moment of the distribution is affected by the reform of marketing mechanisms. The objective is to estimate the minimum change in the expected output price and average variable costs that is required to make packers indifferent between the two marketing mechanisms. The analytics in the previous section emphasized that the reform can only be sustainable in the long-run if it raises the packers' demand of hogs above a certain threshold. This increase in demand will be triggered by increase revenues in the output market or cost savings in processing. What the simple analysis of section three did not address is that the marketing reform also decreases the risk faced by packers.

Expected utility in the two different marketing periods can be written as:

$$(3) \quad EU_0 = E[\pi_0] + 0.5\lambda V[\pi_0] = (\bar{p}_0 - c_0 - \alpha\bar{r}^{US} - (1-\alpha)\bar{r}^A)q - 0.5\lambda q^2 (\alpha^2\sigma_{r^{US}}^2 + (1-\alpha)^2\sigma_{r^A}^2 + \sigma_p^2 + 2\alpha(1-\alpha)\sigma_{r^A, r^{US}})$$

$$(4) \quad EU_1 = E[\pi_1] + 0.5\lambda V[\pi_1] = (\bar{p}_1 - c_1 - \bar{r}^{US})q - 0.5\lambda q^2 (\sigma_{r^{US}}^2 + \sigma_p^2)$$

where the symbol “-” denotes an expected value,  $\sigma_{r^{US}}^2$ ,  $\sigma_{r^A}^2$  and  $\sigma_p^2$  denote, respectively, the variance of the reference price, the variance of the auction price and the variance of the output price,  $\sigma_{r^A, r^{US}}$  denotes the covariance between the auction and pre-attribution prices and  $\lambda$  is the packers’ Coefficient of Absolute Risk Aversion (CARA). The potential covariance between the packers’ output price and the hog price has been set to zero in (3) and (4) given that the calibration exercise described below revealed minimal correlation between these two variables.

In order to compare expected utility under the two marketing scenarios, the variables and parameters in (3) and (4) need to be calibrated. We collected data from the red meat market statistics website of Agriculture and Agri-food Canada (AAFC). Table 1 summarizes the value of the baseline variables used in the calibration exercise. The variance of the auction price was obtained from the residuals of a linear regression of the auction price on the pre-attribution price. Given the pre-attribution price is based on a US reference price and is exogenous from the perspective of the Quebec hog/pork industry, an Auto-Regressive (AR) process of order 1 was specified to estimate its variance. The output price was computed as a weighted average of wholesale prices for four different pork cuts (shoulder, ham, loin and belly). An AR(1) process was fitted to the constructed series to estimate the variance. The packer’s output in (3) and (4) is based on one-half of the average monthly output in 2009, and thus the simulation may be thought of as representing the largest packer in Quebec. Expected prices are the 2009 average of weekly prices. The share of pre-attribution is set at 50%.

Table 1. Summary of the baseline variables used in the calibration exercise

Variables	Pre-reform	Post-reform
$q$ (pre-attribution)	164,500	329,000
$q$ (auction)	164,500	<i>n.a.</i>
CARA	<i>tbs</i>	<i>tbs</i>
$c$	25	$x$
$\bar{p}$	157	$x$
$\bar{r}^{US}$	125	125
$\bar{r}^A$	<i>tbs</i>	<i>n.a.</i>
$\sigma_p$	19.0	19.0
$\sigma_{r^{US}}$	5.8	5.8
$\sigma_{r^A}$	13.0	<i>n.a.</i>
$\sigma_{r^A, r^{US}}$	5.4	<i>n.a.</i>

Note: All dollar values are expressed in \$ per 100 kg on a carcass basis. The notation *n.a.* means “not applicable” while *tbs* means “to be simulated”. The variable  $x$  identifies the values that will be solved by the numerical simulation.

The value of the CARA and the extent of the difference between the auction price and pre-attribution price will be calibrated such that the packer is indifferent between the two marketing scenarios. The objective of the simulations is to uncover the necessary adjustments in the packer’s expected gross margin for the firm to be indifferent between the two marketing systems. The expected gross margin is computed as the expected output price minus average variable cost (*i.e.*,  $\bar{p}_1 - c_1$ ). In reality, both of these variables may be adjusting as a result of the marketing reform. The expected output price can increase because it is easier for packers to now supply differentiated products that command a premium in the retail markets. Alternatively, variable costs can be lower following the reform because packers can now tailor their input requirements so that processing costs fall.

We expect that the increase in the expected gross margin which is needed for the packer to be indifferent between the two marketing mechanisms will be a decreasing function of the degree of risk aversion and of the expected auction price. The higher is the degree of risk

aversion, the more benefits a packer will derive from the new marketing system because it committed to purchase a pre-determined volume at a pre-determined price instead of actively bidding up for hog supplies. Given procurement risk, it may not need a large increase in the expected gross margin because it obtains benefits from a partial reduction in risk. The closer is the auction price to the pre-attribution price, the higher are total procurement costs of the packer. In that case, it does not make a major impact to commit to purchase all hog supplies at the reference price (which be assumption is equal to the pre-attribution price). Once again, the processing firm would not need a significant increase in the expected gross margin to be indifferent between the two marketing systems.

Table 2 presents the results of the simulation. We chose to report the results using a Constant Relative Risk Aversion (CRRA) coefficient instead of CARA because the former is easier to understand. The CRRA coefficient is computed as the CARA coefficient multiplied by expected profits and can be thought of as an elasticity. The results are in accordance with the intuition laid out in the above paragraph. When the expected auction price is 95 percent of the average pre-attribution price (\$118.80), the packer only needs an increase of \$2.97 in the expected gross margin to be indifferent between the two marketing systems at a low level of relative risk aversion (CRRA = 1). Any amount above this threshold will bring additional benefits to the packer. If the expected auction price decreases to 75 percent of the expected pre-attribution price, the required increase in expected gross benefits jumps to \$15.19 per 100 kg. In other words, when the expected gross margin  $(\bar{p}_0 - c_0)$  in the pre-reform system is \$127, a packer must be able to gain 12 percent in cost efficiencies and/or increased revenues following the reform. This gain does not have to be this large for a moderate level of risk aversion. When the CRRA is equal to 5, the difference in the expected gross margin is a more reasonable \$6.40,

an increase of around 5 percent from the price level of the pre-reform. The negative numbers in the southeast corner of the table indicate that the Agreement would generate significant benefits for the packer without accounting for potential cost savings.

Table 2. Minimum gain in net revenues for packers to prefer the marketing reform to the status quo

		Expected auction price (in \$ and as a percentage of the reference price)		
		\$93.80 (75%)	\$106.30 (85%)	\$118.80 (95%)
	1	15.19	8.78	2.17
CRRA	5	13.47	6.40	(1.65)
	10	11.31	3.43	(6.42)

## 5. Concluding remarks

The last three years have been quite tumultuous for North American hog producers. While the hog/pork industry is a notoriously cyclical industry, many economic factors converged to create a perfect storm for the hog/pork industry. These external factors contributed to acrimonious business relationships between hog producers and pork packers. On one side, packers argued that the depressed world demand for pork products and the appreciating value of the Canadian dollar tightened margins in packing activities and inevitably leading to lower hog prices. On the other side, producers argued that packers compete in a fairly open marketplace and thus these factors alone could not explain the significant differences in hog prices between the Quebec and US markets. Both groups however recognized that the industry evolved over the years and that the marketing mechanisms developed in the mid-nineties needed to be adjusted.

Other provinces have also experienced some turbulence, albeit to different degrees. Western hog producers rely a lot more on the US market to sell their production and thus the implementation of mandatory country of origin labeling in 2008 has had a more significant

impact on their business (Rude, Gervais and Felt, 2010) than for the industry in Quebec. Financial stress was perhaps greater for hog operations in Alberta, Manitoba and Ontario than in Quebec because of the existence of income support in the latter province. Nevertheless, marketing mechanisms have been studied and debated almost everywhere.

The Ontario Minister of Agriculture, Food and Rural Affairs recently overturned some of the findings of its own tribunal on appeals of a decision of the Ontario Farm Products Marketing Commission with regards to the existence and future of the Ontario Pork Producers' Marketing Board. In essence, the recent ministerial decision confirms the role of OPPMB in regulating hog production in the province and the importance of its role in collecting and disseminating information about volumes and prices in the industry. However, the ministerial decision opens the door to an open hog marketing system in Ontario through which producers are free to choose how to market their hogs effective December 4, 2010. In that regards, this decision follows closely the open market system in Alberta. Producers can directly contract with packers, but a significant share of producers chooses to market their output through the Western Hog Exchange (WHE) which was formed as a result of this transition away from a mandatory board.

It is clear that all hog/pork supply chains have evolved toward models where packers and producers can work out coordination issues in production and marketing between themselves. Quebec hog producers fought hard to retain collective marketing tools, but the fact that direct contractual relationships in other provinces offer more flexibility cannot be overlooked. Quebec hog producers are betting that their collective bargaining strength outweigh the rigidities introduced in the supply chain.

## 6. References

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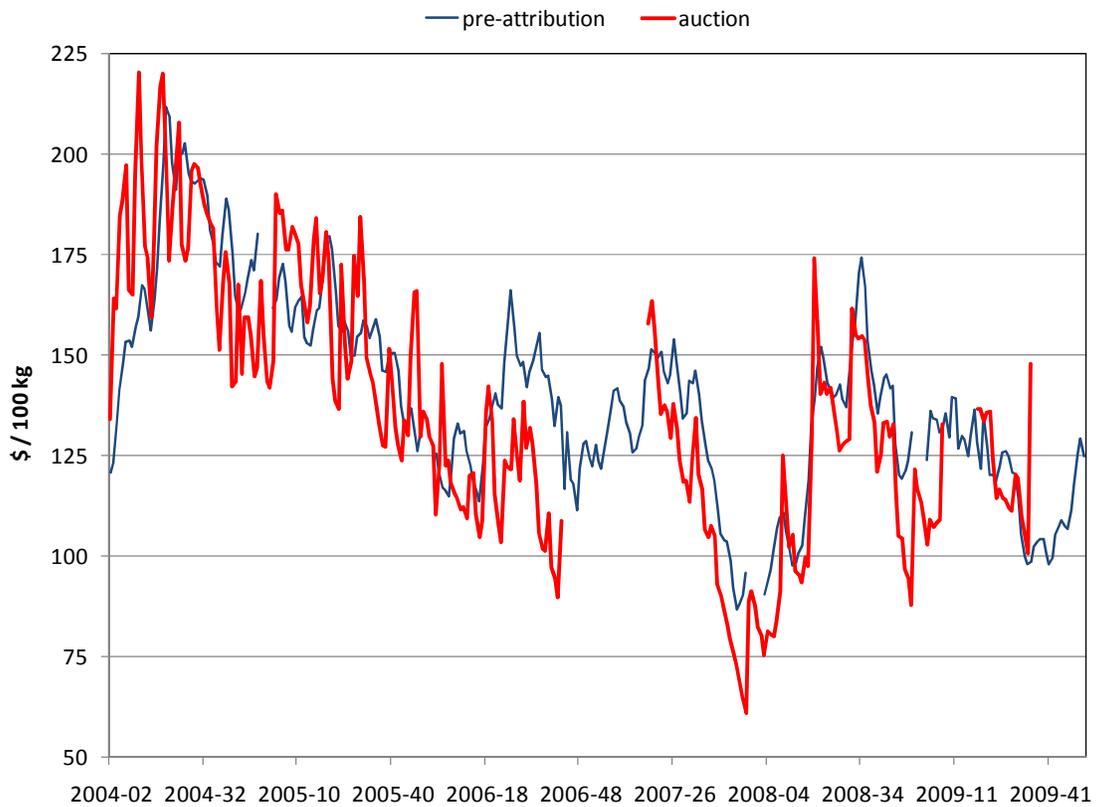


Figure 1. Average weekly hog price under the auction and pre-attribution systems, January 2004 to December 2009.

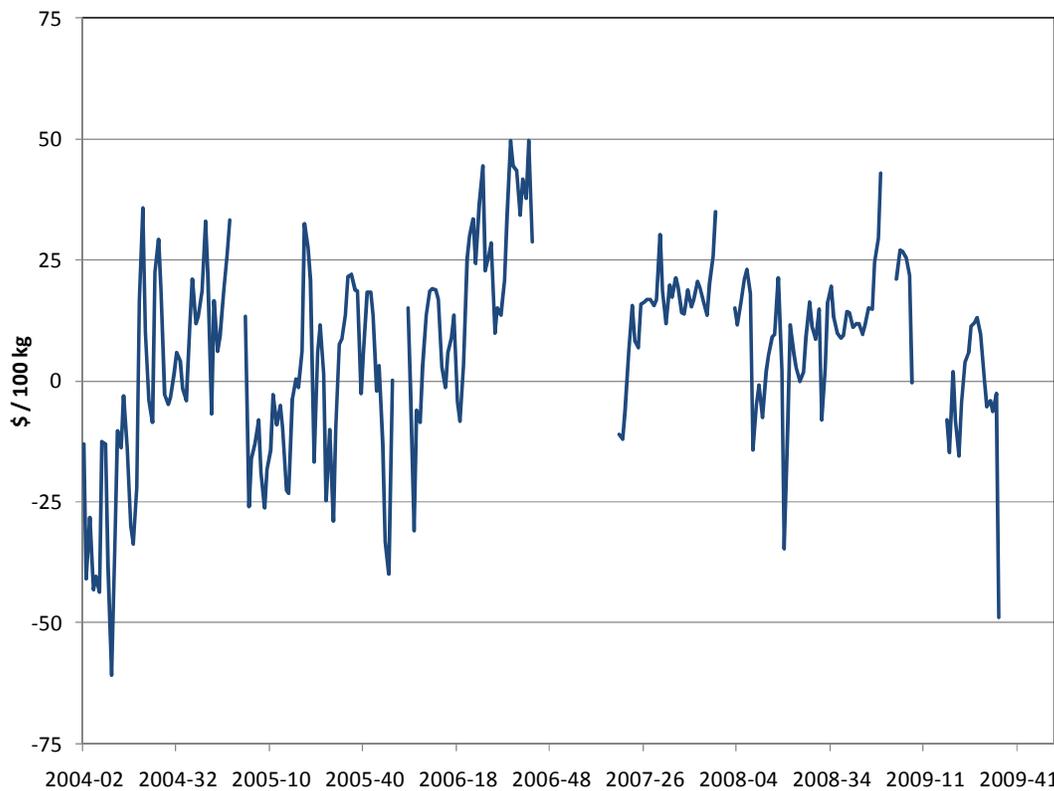


Figure 2. Difference between the average weekly hog price under the auction and pre-attribution systems, January 2004 to December 2009.

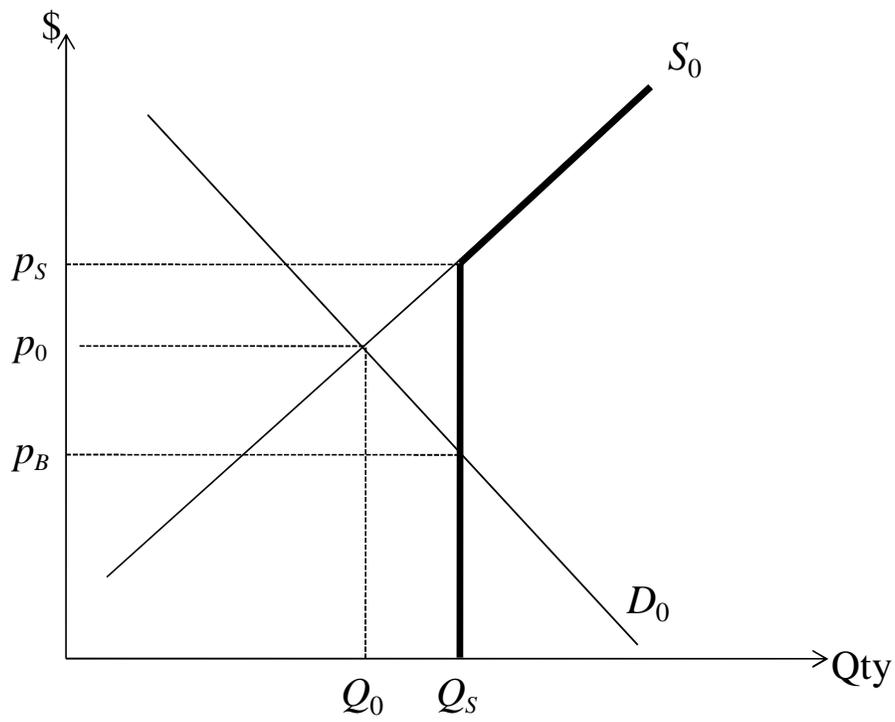


Figure 3.

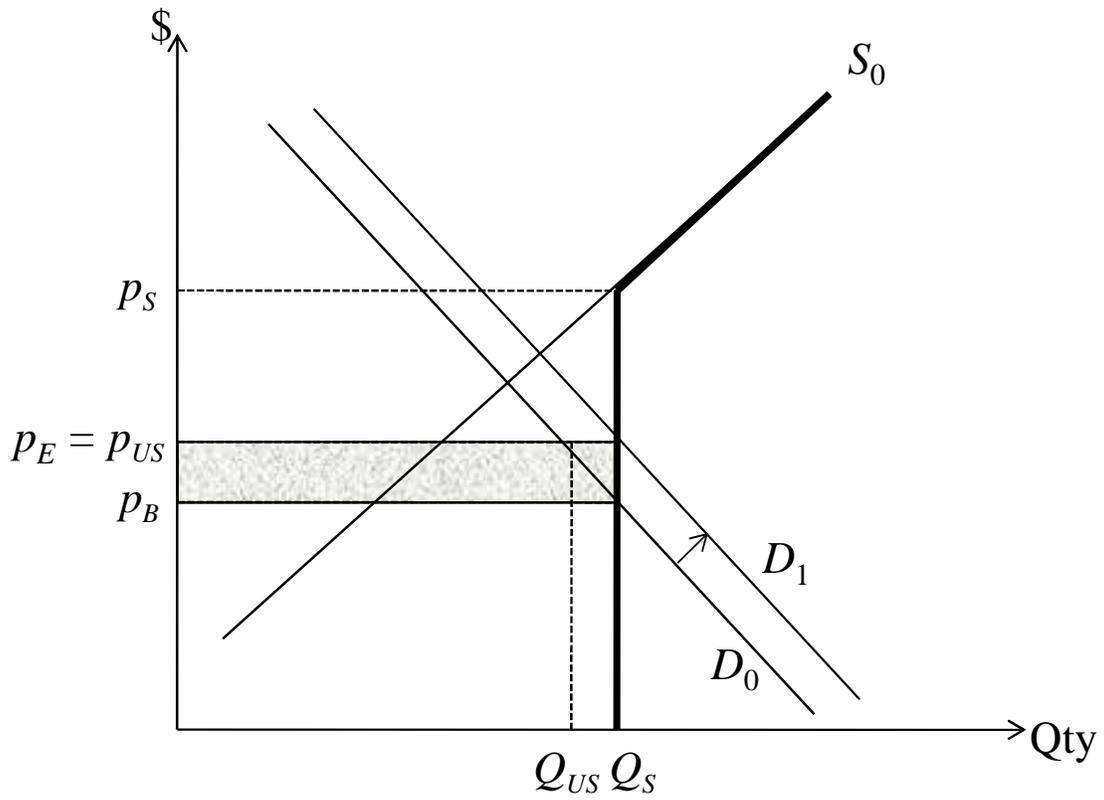


Figure 4.

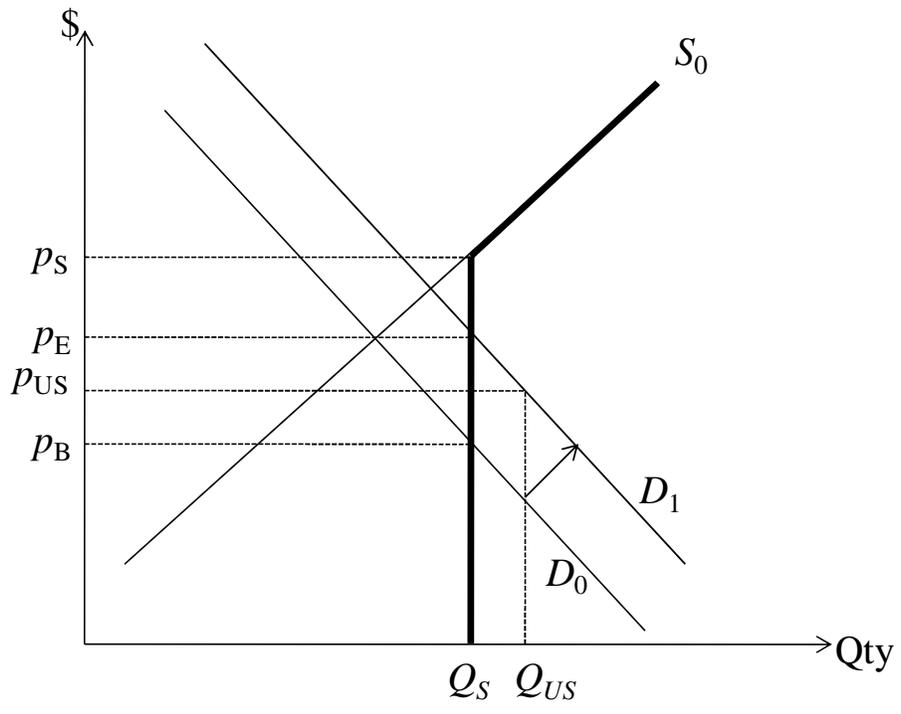


Figure 5.

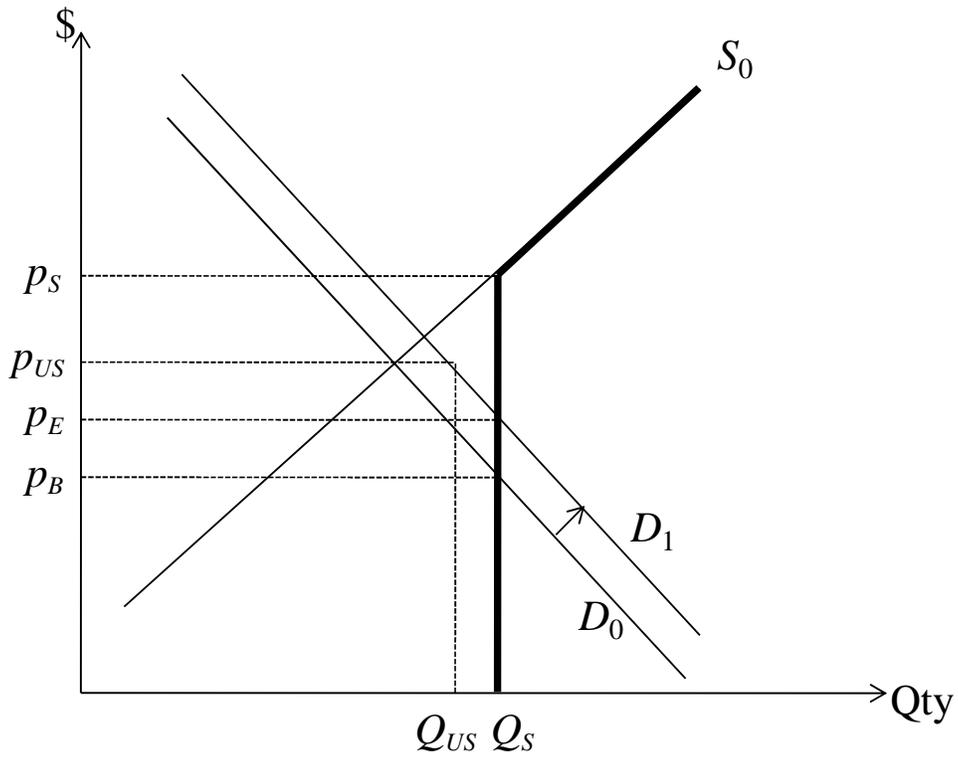


Figure 6.

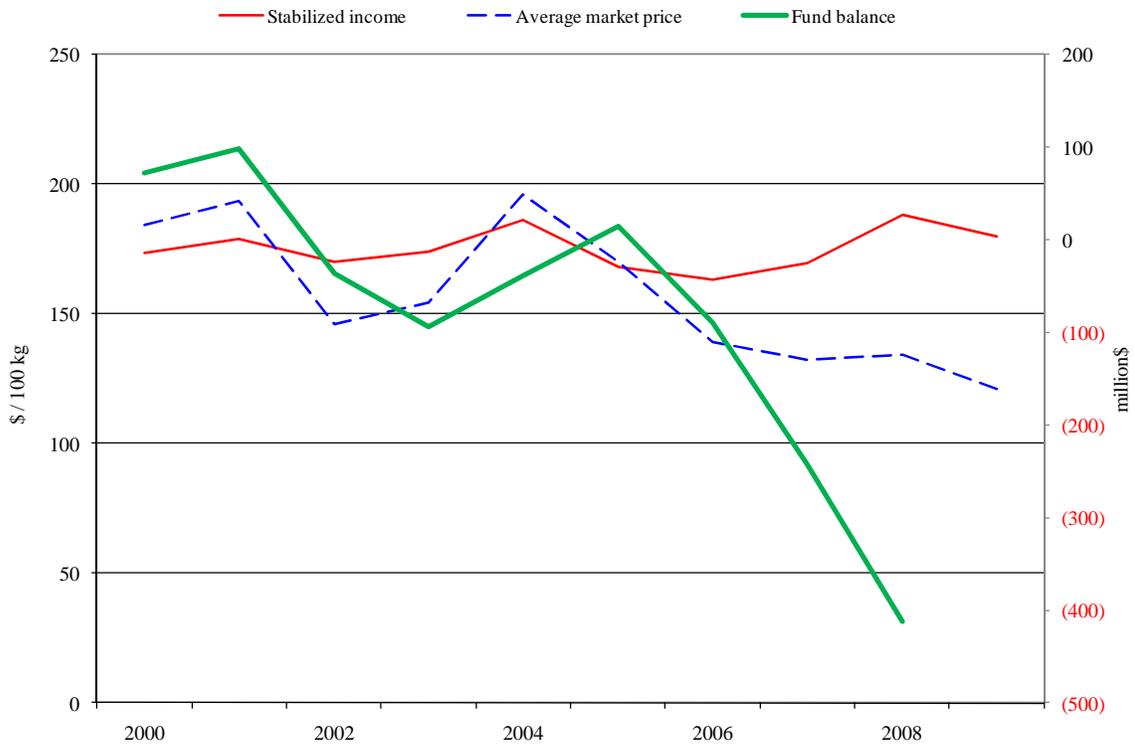


Figure 7.

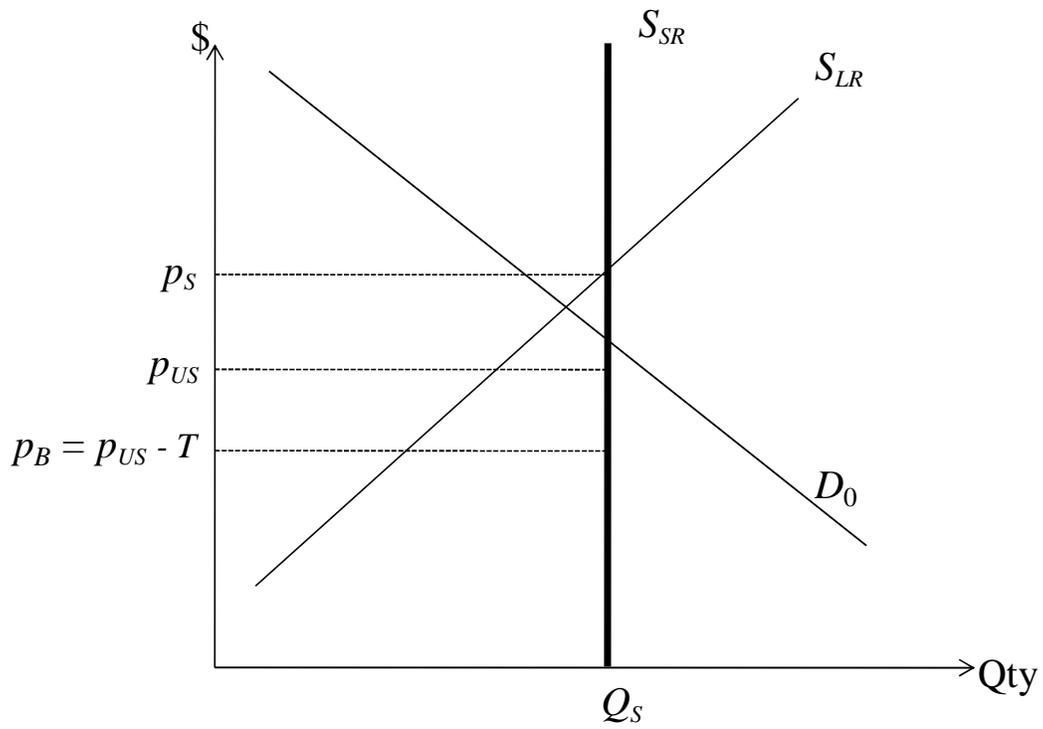


Figure 8. Low-price / low-capacity trap under a monopsony