# Certified Organic Food: A Model of Producer Participation

by

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**Abstract**

It has been heavily contested the past few decades as to whether Organic agriculture is less damaging to the health of consumers than the outcomes of the Green Revolution. Many consumers, especially in the developed world, tend to believe that organic food is better for their health and in response to this belief they are willing to pay an organic premium. This organic premium can give producers the inventive to claim that they use organic production methods but in fact take advantage of the cost effectiveness of conventional production techniques (thanks in large part to the Green Revolution). With organic food being a credence good, the Government has responded by defining what "organic" is and then writes comprehensive rules that must be followed for a producer to use the term *certified organic*. Third Party Certifiers (TPC) are then responsible for enforcing the rules set out by the Government. Finally, a model is developed that gives insight into the decision process of producers and their choice as to whether to become a local organic, certified organic, or conventional operator based on their size and these results can be used to explain the trends and the composition of the current organic market.

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# 1 Outline

This paper will first look at many of the problems that surround organic food from the consumers' perspective, then to analyze the process of certification throughout the value chain which begins with the Government and ends with the final consumer. I will then look at the decision processes of the three different parties in the value chain, specifically the Government, Third Party Certifiers (TPC), and Producers (farmers). This paper will critically analyze the incentives and capabilities of the Government, the competitive aspects that exist in the value chain specifically among the TPC's, and the decision process to determine whether a given producer will produce organic products.

# 2 Introduction

The Green Revolution, started in the 1940's, was originally defined as the use of hybrid seeds and has progressed into the usage of genetically modified seeds, synthetic fertilizers, and pesticides.[1] It has brought a significant boost in yields which has assisted in feeding the world's people; the Green Revolution allowed for more food output per unit of land. Before the Green Revolution began there was no concept of *organic agriculture*, instead, the use of what most of today's developed world would call *organic* was just the act of planting the only available seeds and using irrigation and fertilizers

[1] Laidlaw (2003) (pg. 70-77) gives a concise history of the development of the Green Revolution in his book *Secret Ingredients: the brave new world of industrial farming*. Specifically, the Green Revolution was started during WWII by the development of hybrid corn and has since spread to include genetically modified seeds and animals, and synthetic crop additives.

that have zero synthetic content. The perception that a choice between an apple that was grown with only the use of water and any naturally occurring fertilizers, and an apple that was grown from a seed that was manufactured in a laboratory and then had a constant application of fertilizers and pesticides that was also developed in a laboratory never existed until the last few decades. As a result of the chemically treated and laboratory developed food, yields have increased large enough and fast enough causing the food developed from the Green Revolution to become the status quo. Whereas the status quo ex ante was the only choice for food that people had; a pure natural seed grown from the original plant or what many people now call *organic*. Therefore, in the past few decades many people have changed their perception of conventional food and have begun to question whether the increase in yields is worth the possible consequences to their health, the environment around them, or the health of their children.

In Canada we have seen that organic farms are on the rise since twenty years ago as seen from Figure 1. As expected, with an increase in the number of farms, there is also an increase in the acreage used for organic food production; this implies that organic farms are not shrinking, at least not rapidly. Although it is possible that with more farms producing organic food that their average acreage could be shrinking, but all that can be said at this point is that there has been an increase in the overall acreage used for organic food production. It can also be seen that most provinces are increasing their organic operations; there was a dramatic increase from 2001 to 2006 but then the number of organic farms for most provinces tapered off from 2006 to 2011 (Statistics Canada (2012)). A study conducted in 2008 indicated that there were $2 bil-

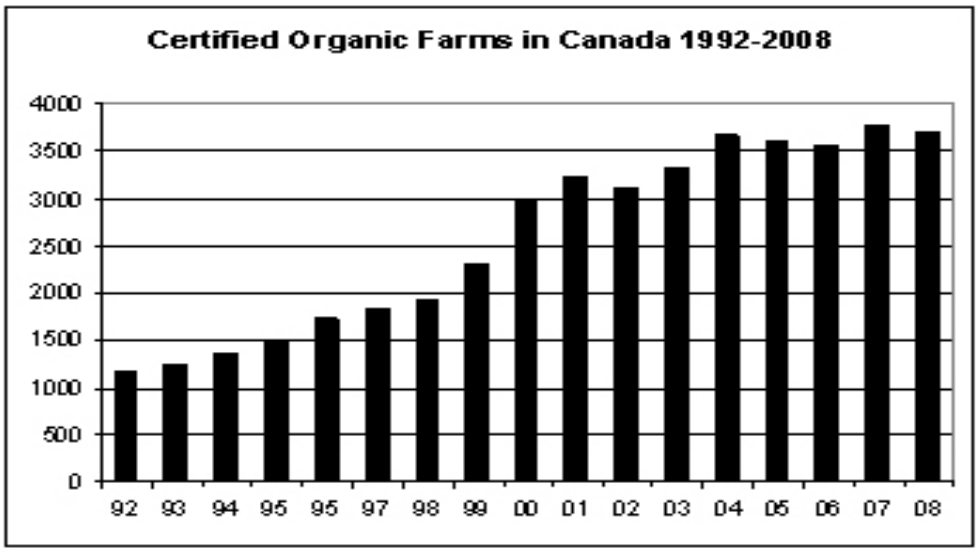


Figure 1: Certified Organic Farms in Canada: 1992 - 2008

lion of certified organic foods sold in Canada in 2009, 45% of which was sold through supermarkets (Agriculture and Agri-Food Canada (2011)). Since roughly half of certified organic food is sold through supermarkets, with the remainder being sold through farmer's markets or directly out of the growers operation, this indicates that the supermarket stream will be of upmost importance in the forthcoming analysis.

In 2009 there were approximately 3,900 certified organic producers working on 695,000 hectares (1,717,000 acres)[2], this accounted for 1.7% of the farms that were in operation in 2009 (Agriculture and Agri-Food Canada (2011)). There were also 1,200 handlers and processors that had certification (Agriculture and Agri-Food Canada (2011)). Using the number of farms gathered from Figure 1 and Figure 2, a rough estimate of the average size of an organic farm can be made. In 2006 an average organic farm

[2]The conversion is 1 hectare = 2.47105381 acres

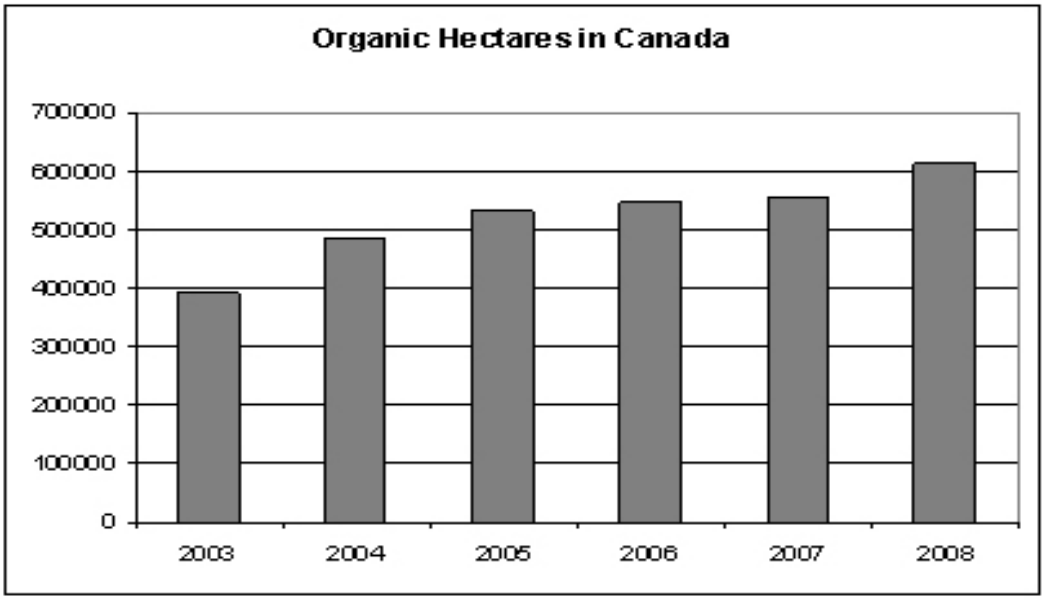


Figure 2: Certified Organic Hectares: 2003 - 2008

was 154.7 hectares, or 382.3 acres.[3] The average size of an organic farm in 2009 was 178.2 hectares, or 440.4 acres.[4] So Although the number of producers has increased, the size of operations has increased as well. In 2006, the average farm size in Canada was 294.6 hectares (728 acres) (Statistics Canada (2012)), with Saskatchewan having the largest average sized farms of any province. Since the overall average farm size is much larger than the average organic farm size in 2006, it is then sufficient to say that non-organic farms are indeed larger, on average than organic farms.

[3]The number of organic farms in 2006 was 3555 and the number of organic hectares that were cultivated in 2006 was approximately 550,000. Thus the average is just 550,000/3555 = 154.7

[4]In 2009 there were 3,900 organic farms and 695,000 hectares cultivated.

# 3 Consumers

The consumer of organic food suffers from many problems - the perceived quality attributes associated with organic food, asymmetric information as to whether the food they are purchasing was produced using organic methods, and issues surrounding trust with third party certifiers and producers. Some questions that need to be answered are whether organic food is better for an individual's health and the environment, whether there is significant uncertainty as to the validity of a specific organic label, and to try to pin down what category of good certified organic food follows.

Consumers have a tendency to care about the quality of the food that they are purchasing. Many people believe that organic food is better for their health, however they fail to realize that organic food is more susceptible to certain funguses and moulds. From this belief regarding their health, and perhaps their perception of organic food and its effect on the environment, they have formed demands for certified organic food. These demands reveal a higher willingness to pay for certified organic food; this higher willingness to pay can be represented as an organic premium. Research that has been previously conducted has taken market data to empirically determine what the organic premium is that consumers are willing to pay. However, since there is an asymmetric information problem where consumers are incapable of distinguishing between organic and non-organic food, organically grown food can then be categorized as a credence good. Finally, a widely agreed upon and implemented solution to the credence good problem, and what is currently used in the developed world, is the use of labels to allow the consumer to determine without too much difficulty which products are certified organic.

## 3.1 General

There is a significant amount of literature on consumer preferences of organic food and how they believe it will benefit them. Consumers are primarily concerned with food safety (Loader and Hobbs (1999), Ritson and Mai (1998), Bonti-Ankomah and Yiridoe (2006), and Hughner et al. (2007)), their own health (Bonti-Ankomah and Yiridoe (2006), and Hughner et al. (2007)), and perhaps the perceived positive effect that they believe organic food production will have on the environment. Even though consumers have these beliefs, the Organic Trade Association (2010) mentions that there is still a substantial amount of confusion over different types of labels such as *natural*, *non-GM*, and *organic*. The literature review on the consumer side of organic food can be broken down into five sections: quality, consumer preferences, organic food as a credence good, and labelling of organic food.

## 3.2 Quality of Organic Food

It has been fiercely debated as to whether organic food possesses properties that make it healthier than non-organic food, or at least less dangerous, for the consumer. These debates are primarily concerned with the physical nutritional value of organic food as compared to its non-organic counterpart. The scarcity of research and evidence in this matter is noted by Ritson and Mai (1998), Magkos et al. (2003), Siderer et al. (2005), Magkos et al. (2006), Hughner et al. (2007), and many more. In lieu of many calls for more research to be conducted, there has been significant advances in the measurements of the biological differences between organic and conventionally produced food.

### 3.2.1 Food Safety

This notion of having healthier food and less synthetically treated food is known as *food safety*. Henson and Traill (1993) define food safety as:

> The inverse of food risk - the probability of not suffering some hazard from consuming the food in question.

Notice here that the definition of food safety is based on the consumption aspect of food and *not* the abundance aspect, or lack there of, of food. Although there can be a risk of food shortages in times of drought and with the knowledge that conventional practices can increase the yields in a drought situation as compared to an organic counterpart,[5] I am going to assume here that there is no food shortage and therefore there is no concern about going hungry but instead the consumer is concerned about their health with respect to what type of food they choose to consume. People in general have some concerns about the safety and security of what they eat. This concern over food safety has been especially accentuated during the BSE[6] outbreak in the United Kingdom in 1996. Ever since this outbreak of BSE there has been widespread public fear about the disease infecting food (Kouba (2003)) and consequently this fear can translate into an economic, social, and political problem (Palmer (1996), Ritson and Mai (1998)).

[5] Fukai and Cooper (1995) have done research to try to develop rice that can withstand drought situations.

[6] Bovine spongiform encephalopathy (BSE) is commonly known as Mad Cow Disease.

### 3.2.2 Nutritional Aspects of Organic Food

One chemical that is common in many synthetic fertilizers, pesticides, and herbicides is nitrates. According to Bruning-Fann and Kaneene (1993), and Vermeer and van Maanen (2001) nitrates can eventually cause cancer in humans and animals. This can be a potential source of concern since nitrates are frequently added to the soil during conventional practices through the application of fertilizers, pesticides, and herbicides and since conventional production does not demand the employment of sustainable crop rotation, nitrates are often needed to help replenish the soil. Many crops, such as soybeans and corn, can draw a significant amount of nitrogen from the soil so the producer needs to replace the nitrogen to allow for next season's crop to have a comparable yield to his current crop.

Nitrates are a convenient marker to use for comparison between organic and conventional crops because they are reasonably easy to detect in the final product; many studies have been done to make a comparison between the two production methods. Magkos et al. (2006) gathered 18 published studies and stated that there seems to be some evidence that organic food is more likely to contain less nitrates than a similar conventional product; Worthington (2001), Williams (2002), Magkos et al. (2003), and Dangour et al. (2009) also claim from scientific studies that organic food is more likely to have fewer nitrates. Although this finding from Magkos et al. (2006) seems to be enlightening, the authors give a word of warning that there is still a high level of uncertainty regarding the actual scientific studies. Some potential problems as mentioned by the authors that were not seriously considered in the studies are the methods of cultivation, the composition of the soil and the irrigation water, and the dates at

which the product was harvested. It may be possible that having different methods of cultivation could make a significant difference to the final product. An example is the use of a plough or a disc. The former can turn-over the soil deeper than the latter and this may have an impact if it distributes the nutrients differently thus making it possible for one type of cultivation machinery to produce a larger yield than another. Another example is the use of a tiller which will be used less often than other methods of cultivation such as a disc or plough. However a tiller has the ability to mix the soil thoroughly whereas the disc or plough will not as effectively mix the soil and nutrients. So it may be very important for any future studies to consider these issues mentioned by Magkos et al. (2006), and this would appear to be a situation in which a controlled experiment would seem to be the best approach to answer the questions as to the difference in yields, difference in nutrients, and any difference in susceptibility to disease, fungus, and mould.

Worthington (2001), Williams (2002), Kouba (2003), Magkos et al. (2003), Magkos et al. (2006), Rembiakowska (2007), Williamson (2007), and Dangour et al. (2009) have all reviewed a substantial amount of the evidence that has been conducted on the nutritional quality of organic food versus non-organic foods and there is a general trend which suggests that organic food does in fact possess more nutritional attributes than non-organic food. For example, Williamson (2007) reviewed a study which suggests that some green vegetables contain more vitamin C than those same plants that were conventionally grown. Magkos et al. (2003) also reviewed studies that came to the same conclusion.[7] Other types of vitamins and minerals have been found in higher

[7]Magkos et al. (2003) did not compare all of the same studies nor all of the same green vegetables as Williamson (2007)

concentrations in organic food than a conventionally produced counterpart according to these studies. This would suggest that organically grown food would be healthier to consume from a nutritional aspect.

Although organic food has fewer nitrates and has a higher nutritional content, one concern is that organically produced food tends to have a higher presence of mycotoxins (Magkos et al. (2006)). Mycotoxins are developed from certain types of mould that grow on plant life (Peraica et al. (1999)) and they are carcinogenic which can lead to different types of cancers in humans and animals. Organic products may contain more mycotoxins because they are not exposed to chemical pesticides, herbicides, or fertilizers. Mycotoxins can enter into the food chain directly by having that food grow the specific fungus or mould, or indirectly by having an already contaminated food introduced into the food chain (Wood et al. (2001)). Tubajika et al. (1999) found that there is a negative relationship between nitrogen fertilizers and fungal (and mould) contamination which reaffirms the assertion that organic food is more susceptible to mycotoxins and perhaps other fugal or mould growth.

The aforementioned confirms consumers' perception that organic food is healthier for them, but only in the sense of fewer synthetic chemicals like nitrates and more vitamins and minerals. Even though there will be fewer nitrates and more vitamins, there is also a higher chance that organic food will contain certain types of carcinogenic funguses and moulds. Therefore, there still needs to be more research to conclude whether the increase in vitamins and minerals and the decrease in chemicals will outweigh, in health terms, the increase in carcinogenic funguses and moulds.

## 3.3 Consumer Demand/Preferences

As mentioned above there is this belief among a substantial proportion of consumers that organic food is better for them in the sense of internal effects (such as their personal health) and external effects (such as being better for the environment). This judgement leads to these people willing to pay the organic premium[8] (Hammit (1990), Beharrell and MacFie (1991), Collins et al. (1993), Hammit (1993), Hutchins and Greenhalgh (1995), and Gil et al. (2001)). Bonti-Ankomah and Yiridoe (2006) show that most organic foods have a positive premium, however a study conducted by Parsons (2002) demonstrated that raspberries and strawberries have a negative organic premium. This means that the purchase price for certified organic raspberries and strawberries is less than that of non-organic raspberries and strawberries.

Grossman (1972) has shown that there is a trade-off for certain characteristics or attributes that a product may have to improve the consumers' health, so consumers will have a willingness-to-pay that will represent this trade-off that they are making. If a consumer believes that organic food possesses these characteristics that are important to him then he will be willing to pay the organic premium in order to consume that good. It is not necessarily true that consumers have concrete evidence that certified organic food is better for them[9] but, as will be discussed below, they are still willing to pay the premium. If however, it is true that certified organic food has negligible effects on an individuals' health, then it is not necessarily clear whether paying the

[8]The *organic premium* is the price paid that is above the price for the same food without the certification or organic classification.

[9]Siderer et al. (2005) amongst others call for there to be more complete research to answer the questions as to whether the beliefs of the consumers is warranted.

organic premium is a rational decision regardless of the consumers' beliefs.[10]

As will be seen below, the organic premium is an integral component of the model that demonstrates the producer's production decision; it gives some producers the incentive to produce organic products. But how much of a premium are consumers willing to pay on average for organic food? Yiridoe et al. (2005) reviewed the literature (which includes Ott (1990), Jolly (1991), Buzby and Skees (1994), Hutchins and Greenhalgh (1995), and **?**) on the organic premiums and determined that the premium is positive for North America, Western Europe, and the rest of the World. However the rest of the World is only willing to pay a small premium, approximately 5-10%, as compared to North American and Western Europe who are willing to pay upwards of 50% (Italy being an exception by paying up to 100%). Lohr (1998) reports that the organic premium in Canada is approximately 30%. This is not a very surprising premium for Canadian consumers to have since most other developed countries as seen in Figure 3 have a premium that is around 30%. Turco (2002) compiled the organic premium ranges from twelve developed countries that have a growing organic food industry.

The evidence thus far suggests that wealthier countries are more willing to spend more money for organic foods rather than poorer countries. This complements the notion that organic food, or more healthy food, can be assumed to be income elastic (just as food safety is income elastic as suggested by Swinbank (1993)).[11]

[10] This rational decision is in regards to a consumer maximizing their utility subject to their budget constraint. If the health benefits are actually very small, then it may not make sense to buy organic food but rather buy better health care (as an example). But this question is still left unanswered.

[11] However, some estimates of the price elasticity of food done by Subramanian and Deaton (1996), and Andreyeva et al. (2010) suggest that the elasticity is around 0.5. This would then indicate that food is not as price elastic as would have been expected. Huang (1985) reviewed USDA reports and confirms these elasticity estimates. Yiridoe et al. (2005) also agrees with organic food being price elastic.

| Country | Premium (%) |
|---|---|
| Australia | 20-40 |
| Austria | 25-30 |
| Denmark | 20-30 |
| France | 25-30 |
| Italy | 35-100 |
| Germany | 20-50 |
| Netherlands | 15-20 |
| Sweden | 20-40 |
| Switzerland | 10-40 |
| United Kingdom | 30-50 |
| Japan | 10-20 |
| United States | 10-30 |

Figure 3: Organic premiums in developed countries (Turco (2002))

Another interesting point brought forth by Lohr (1998) is that the organic premium will only be paid when there is significant confidence in the label.[12] If a consumer believes that a product that is certified under a certain label was in fact produced using proper organic methods, then that consumer is more likely to purchase the good than if that belief was not there. If that product was certified by a suspicious label, then the consumer would more likely hesitate before purchasing, or they may not purchase the good at all for the lack of confidence in the label.

There are only two pieces of information directly available to the consumer while they are at the supermarket: the label and the price. The label aspect will be discussed in more detail later. The organic premium acts like the price that consumers pay for the good and it has two effects. The first is that it can act as a signal to the consumer by

[12]This can be abstracted away from the organic label to the trust that the producer and consumer have with each other; as will be discussed, there is no need for labels when the two parties know each other personally and trust each other.

giving them information about the quality of the product. For example, suppose there are conventional and organic apples in the supermarket and they are indistinguishable from one another. The consumer will then have to rely on information that is not tangible or based on appearance.[13] As demonstrated above, it is assumed that the prices between the two apples will be different since the organic premium is positive. The consumer will make note of the organic premium and will use this as a signal of the organic apple's quality and health characteristics. This is the notion that people are willing to pay for health in the form of food (Grossman (1972) implies this and Bonti-Ankomah and Yiridoe (2006) mentions this implication). Therefore the organic price premium will have the effect of increasing the amount of organic products sold as people believe they are buying a high quality product. The second effect that the organic premium has is that it will impact the amount of organic products purchased because the price is too high. This negative effect is noticed by Misra et al. (1991)[14] and implies that the higher price that consumers have to pay (i.e. the higher the organic premium) will decrease the amount of organic food purchased. This would indicate that organic food (and food in general) is price elastic (Yiridoe et al. (2005)), even though there is a perception that organic food is better for one's health.

There have been several studies to gauge the significance of the perceptions that consumers have about organic food. The consensus is that "consumers purchase organic foods because of a perception that such products are safer, healthier, and more environmental friendly than conventionally produced alternatives" (Bonti-Ankomah

[13]Essentially, the consumer cannot rely on the *search* aspect while shopping for organic products.

[14]Misra et al. (1991) did a study in Georgia but it seems reasonable to carry the conclusions more generally.

and Yiridoe (2006)). Studies performed in North America found that consumer perceptions ranged from concerns about chemical residue and health effects, to environmental effects and price (Hay (1989), Jolly et al. (1989), Huang (1990), Goldman and Clancy (1991), Baker and Crosbie (1993), Groff et al. (1993), Swanson and Lewis (1993), Byrne et al. (1994), Wilkins and Hillers (1994), and Moser et al. (2008)). Similar studies have been done in Western Europe and came to very similar conclusions as to the perceptions surrounding organic food as the North American studies (Ekelund (1990), Hack (1993), Hansen and Sorensen (1993), Davies et al. (1995), Grunert and Juhl (1995), Hutchins and Greenhalgh (1995), and Schifferstein and Ophuis (1998)). So the perception, not necessarily the reality, of organic food is very important to most people in the developed world. This belief could have been a result of the notion that applying synthetic chemicals on food is bad, or perhaps as Carson (1962) suggests in her book *Silent Spring*, using pesticides will harm the environment and all that is in it. Regardless of how consumers come to this belief that organic food is better, it is still unclear as to whether there is much merit to their claims. It is however, interesting to note that Swedish consumers have a particularly strong dislike towards genetically modified food (or gene modified) foods (Hursti and Magnusson (2003)). Keeping in mind that the Swedish people have positive feelings towards organic food (Magnusson et al. (2001)), they appear to dislike genetically modified food more than they like organic food.[15]

There are some consumers who purchase organic food locally. This is part of a consumer movement in recent years to 'buy local' and 'support your local farmers.'

[15] Perhaps their preference to organic food is not mutually exclusive to disliking genetically modified food.

Thilmany et al. (2005) explore different reasons as to why consumers may want to buy food locally versus from a supermarket where food is produced and processed from all around the world. The authors also use a conceptual methodology developed by Lancaster (1966) in that consumer goods can have multiple characteristics that traditional consumer theory is incapable of handling. The authors estimate willingness to pay for different attributes of local goods such as minimizing food miles, perceived safety and quality of food, and supporting local agriculture and economy. One result shows that the average local premium that consumers are willing to pay is 38.6% for melons. Iles (2005) stated that issues such as food miles have become a representation of the importance consumers place on their food since the mid-90's. Hunt (2007) found that the relationship between the consumer and the farmer can encourage the farmer to reduce the use of certain chemicals and pesticides, perhaps for monetary gain in the form of a price premium, while keeping in mind that these close relationships can only exist if the consumer and producer are in relatively close proximity to each other.

## 3.4 Organic Food as a Credence Good

The literature widely agrees that organic food is a credence good (Ritson and Mai (1998), Bonti-Ankomah and Yiridoe (2006), and many more). A credence good is a good that has certain qualities that are unknown to the purchaser unless they are informed of these characteristics (Nelson (1970, 1974)); the idea of a credence good started with Nelson (1970), Nelson (1974), and Darby and Karni (1973). Most goods fit well into at least one of two categories: Search goods and Experience goods. Search

goods are goods that the consumer can differentiate the quality as they are purchasing it and before they have consumed it, so they can tell the quality by sight, smell, or feel while in the store. Experience goods are goods that the consumer is able to tell the difference in quality after they have consumed it, much like a car; a consumer knows whether a car is good after they have driven it. Being a search or experience good allows consumers to easily determine the product's quality either ex ante or ex post consumption. However, the quality of organic food, as seen above, can be difficult to determine. Since consumers cannot always distinguish between an organic apple or a non-organic apple at the supermarket or farmer's market, nor can they easily discern any differences in taste or texture implies that organic food is a credence good. Therefore the assumption cannot be made that a consumer, on their own, can determine the quality of the organic food as compared to non-organic food. Golan et al. (2001) reaffirms this by mentioning that consumers cannot distinguish between the two goods and as a result they have to be told by a third party that what they are purchasing is an organic product.

Due to the lack of capabilities of the consumer to differentiate between the two types of food, there needs to be another party that will inform them of its quality. Credence goods typically involve asymmetric information that leaves the consumer more vulnerable than he otherwise would be if there was equal information. Dulleck and Kerschbamer (2006) defines a credence good as a good where the producer[16] knows more about the quality of the product than what the consumer knows about it. Dulleck and Kerschbamer (2006) use the example of a mechanic and how if a mechanic

[16] or "expert" as the authors put it

replaces a part in your car, there is no way of telling whether he replaced it properly or whether there was a need for it to be replaced. The authors use this example because many people have difficulty recognizing a high quality job when it comes to their automobiles. Another example that Dulleck and Kerschbamer (2006) use is that if a doctor makes a diagnosis, then it is very difficult, and almost impossible for the patient to recognize whether the doctor made the diagnosis in the best interest of the patient or whether the doctor made the diagnosis to maximize his own profits.[17] These problems mentioned with organic food make it easy for a consumer to be defrauded, Vetter and Karantininis (2002), Baksi and Bose (2007), and Bonroy and Constantatos (2008) suggest one possible method to mitigate this chance for the consumer to be cheated is by using labels and public monitoring.

## 3.5 Labelling of Organic Food

Since organic food is a credence good, the consumer has to be told whether the good in question is organic or non-organic, otherwise they will not be able to distinguish between the two. Although there are some foods that seem to have distinct differences between an organic and conventional version; some people claim that they can tell the difference between an organic pepper and non-organic pepper as an example. Some organically produced foods tend to be smaller and not necessarily as visually appealing to the average consumer.[18] However, it cannot be assumed that an average consumer

[17] Perhaps this is one reason (amongst others) why many patients like to have second opinions before taking any medical action.

[18] Laidlaw (2003) (pg. 118-119) describes his experience when conventionally and non-conventionally grown corn was presented to him. The conventional corn cobs were all uniform and the latter was "wormy."

is knowledgable enough to be able to consider organic food as a search good. Nor can it be assumed that consumers can treat organic food as an experience good even though there is evidence that some organic foods have a different taste or perhaps they may even cook a little differently. One such example is that organic potatoes have a different taste than non-organic potatoes according to a study by Siderer et al. (2005). In lieu of these exceptions, it cannot be assumed that the average consumer can distinguish between the two at the retail level or even post consumption, thus organic food is a credence good.

Credence goods have to have distinct markings or extra information, provided by a third party, that will easily inform the consumer that it is organic. The solution as presented by Vetter and Karantininis (2002), Baksi and Bose (2007), and Bonroy and Constantatos (2008) is the use of labels. This is why the Government of Canada has the *organic label* that is pictured below and can be placed only on products with at least 95% certified organic material (Government of Canada (2008)). It is also the reason as to why TPC's have to place their label on the final good. This gives the retailer the opportunity to claim that the good is *certified organic* allowing them to potentially earn higher profits and to allow the producer to earn the organic premium. There is a problem in that the consumer wants to purchase an organic product, but as will be formally presented, producers would like to produce conventionally and sell organically since it is less costly to produce conventionally because there is no cost of certification and there are no necessary and specific crop rotations unlike organic production. Therefore the label that is used has to be credible and the consumer has to trust it. Without credibility and trust, a label will lose its reputation and therefore the label will not have

the effect that it would otherwise.

Perhaps it would be prudent to give an example here to demonstrate how important trust is with regards to organic farming. Suppose there is a consumer who wishes to purchase only organic produce and there is a local farmer who claims that he only grows organic produce. The farmer will then charge a higher price than he would otherwise because, as explained above, it is more costly to produce organically than it is to produce conventionally; the farmer wants to cover the higher cost of production and earn a profit. Since the consumer can either purchase the organic produce from the farmer or the local supermarket, the farmer has to then rely on the trust built up with the consumer. The major difference between the farmer and the supermarket is that the supermarket has credible labels on its products and the farmer has no labels.[19] Suppose that the consumer knows the farmer very well and has a personal relationship with him. Therefore when the farmer claims that he follows the organic standards, but without certification, then the consumer will believe him. The consumer will then, less reluctantly, pay the organic premium and an exchange is made. This example is fairly common in smaller communities and eludes to the notion that when there is a personal relationship with the farmer, that the trust built up from it is more powerful than a label on products sold in the supermarket. The consumer then feels more assured that he has purchased a real organic product and the farmer earns a higher profit because he is not certified thus removing the fixed cost of certification from his profit function.

This example demonstrates how important trust is with a label. If the farmer were

[19] I am violating a key assumption here. I am going to assume that the consumer is purchasing organic food without certification. This is just an example of the importance of trust and it is also observed that many local farmers follow organic standards but do not get certified because their customers have a personal relationship with them.

to have had a label it would naturally increase the validity and trust that the consumer has with him, but since the consumer knows the farmer personally and a relationship is built, there is no need for it. The check on the farmer for not cheating and producing conventionally is that he would lose the consumer, the personal relationship, and the trust he held in the community. The third reason is very important because the farmer is not certified and therefore the community, once they discover that the farmer is producing conventionally and proclaiming that he is organic, will stop purchasing from him and he will then have to start selling as a conventional producer.[20] This trust is noted in Parsons (2004) and Moser et al. (2008) believes that it is able to affect demand. Perhaps as Thilmany et al. (2005) notes, it could be that "frequenting direct sources, rather than purchasing products with complex value chains and certifications such as the USDA organic program, is a more effective means of influencing environmental quality or reducing uncertainty about a particular claim." What Thilmany et al. (2005) means is that the consumer would be more willing to purchase a good with a certain quality or characteristic if they believe that that quality or characteristic is actually being presented to them. As seen from above, it is hard to guarantee these particular qualities to consumers, and so a relationship that builds up trust directly with the producer may be more efficient than having a long value chain involving certification and enforcement with parties whom the consumer does not personally know.

[20] Perhaps the community could punish the farmer for a certain length of time until trust can be restored.

# 4 Process

When a consumer purchases certified organic food from the supermarket, that product, whether it is an unprocessed apple or processed meat, will have a label on it. This label will inform consumers as to who certified the good. There is a general label offered by the Government of Canada and there are the individual Third Party Certifier labels. Putting labels on products will help consumers identify a certified product from a non-certified product,[21] and more importantly for the food company, it allows the consumer to identify a certain product with a certain label.[22] The figure below, Figure 4, shows the certified organic food label in Canada that the Government provides. And Figure 5 shows what the similar label looks like for the United States.[23]


Figure 4: Government of Canada Certified Organic Logo

[21] This labelling helps to circumvent the credence good problem.

[22] This would be similar to branding in that the label acts to signal the quality of the good and signals the reputation of the label.

[23] The United States Department of Agriculture allows this label on certified organic food in that country.


Figure 5: USDA Certified Organic Logo

However, even though this label can be used, the consumer may not see it as often as would be expected because the use of the logo is voluntary for products that contain at least 95% certified organic material that has been certified by an accredited body (Agriculture and Agri-Food Canada (2012)). Although consumers may not always associate certified organic products with this logo, they should know the logo of the certifying body because it is mandatory for the certifier to place their logo on the final product.[24]

The process of certification starts with the government. The Government first sets out the rules and guidelines that must be followed by producers, processors, and handlers in order to qualify to sell their products as certified organic. These rules are compiled in the *Organic Production Systems General Principles and Management Standards* (Government of Canada (2008)) which I will refer to as the *Organic Standards.* The certifying is performed by Third Party Certifiers (TPC) who go to the producer, pro-

[24]Some TPC logo's will be more common in supermarkets than others so it is expected that some consumers will become more acquainted with certain logos because of exposure at the retail level.

cessor, or handler to inspect and audit their operations to make sure they comply with the Organic Standards. This audit and inspection includes observing the records and physical operation to determine whether the producer, processor, or handler use only substances that are approved under the Organic Standards and to check other issues such as a sufficient buffer zone or barrier between an organic field and a non-organic one[25] or to see that the current crop is in accordance with the proper crop-rotation as stated by the Organic Standards. The TPC's have to get accreditation from the Government of Canada (specifically the Canadian Food Inspection Agency or CFIA), this accreditation will give the TPC the authority to put their label (and consequently the Government of Canada Certified Organic Logo) on the products of the producer, processor, or handler. If a producer, processor, or handler receives the status of *certified organic*, then they are allowed to sell their products with an organic premium and to take advantage of the organic label. The flow chart below (Figure 6) shows the main steps involved.

I will look at the different steps of this flow chart individually starting with the Government and whether they set the right standards, then the TPC's and whether they have the incentives to be non-competitive, and then the producer's problem of deciding whether to be an organic or non-organic producer. The consumer side of the flow chart has already been tackled above and has given some motivation as to why there needs to be an understanding of the roles that the various involved parties perform.

A more realistic flow chart considers that producers may want to follow foreign

[25] Buffer zones and barriers are meant to reduce the occurrence of contamination of an organic field by a neighbouring non-organic field.

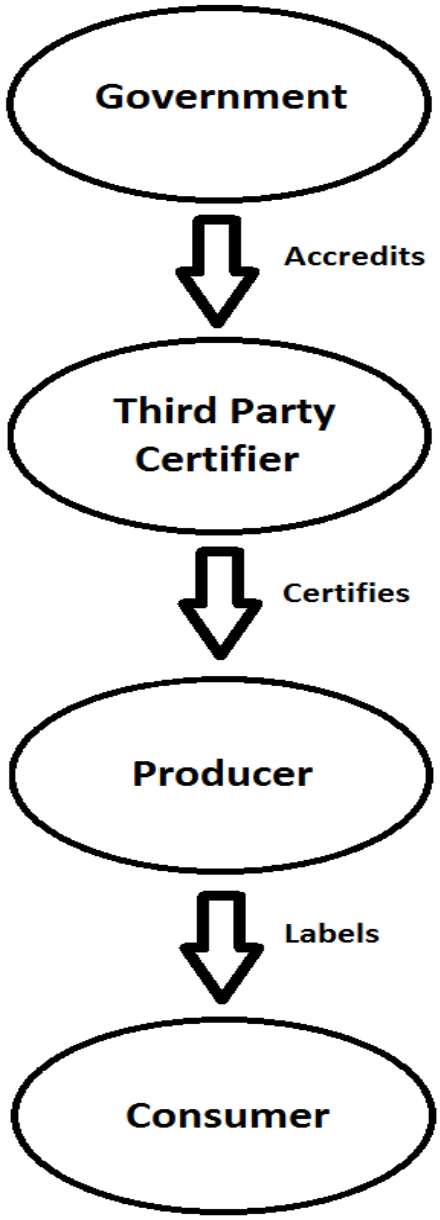


Figure 6: Flow Chart of Certification Process

standards as well as domestic ones in order to allow for the possibility of trade with other countries. Furthermore, the Government will try to align national standards to decrease the costs of trade, having an organic standard that is too different than its main trading partners will make it very difficult for producers to follow both standards. The modified flow chart also shows a more realistic path that the product follows to get to the consumer. Specifically, the producer has three main buyers of its product;

1. Processors, they will process and/or package the product and will therefore have to carry the label that the producer had as long as the final good has at least 95% certified organic material in it.

2. Retailer, the producer could sell the product directly to a supermarket or other retailer that will then sell it to the final consumer, the certified organic label will then have to properly remain on the product.

3. Consumer, the producer could directly sell to the final consumer, this is common in settings such as farmer's markets which are becoming a more popular source of organic food.[26]

So the label must remain with the product in order for consumers to be willing to pay the organic premium. The label will signal to the consumer that the product they are purchasing is in fact the product they want to buy and if they trust the label then they will not be reluctant to consume and believe that the good they are consuming is an

[26] A distinction needs to be made here (and will be discussed further in the *Producer* section and has already been discussed in the *Consumer* section) that often when the consumer buys directly from the producer then the label effect becomes irrelevant as a personal trust is established and reaffirmed between the consumer and producer allowing the producer not to become certified but still practice organic farming and the consumer believes this. But for the time being the assumption is that all organic producers are certified.

organic product.

# 5 Government

## 5.1 Certification and Trade

Canada exports a significant proportion of its organic food to the United States, the European Union, and Japan (Agriculture and Agri-Food Canada (2011)). All of these three countries and regions have their own definitions of what organic means and thus their own regulations that their domestic producers must adhere to in order to qualify for the *certified organic* distinction. This makes trade very difficult across countries because if a producer grows food in accordance with their domestic definition of organic then he may not qualify to be certified under the rules and regulations of another country. This will limit the available markets to which the producer can sell his product as adherence to multiple standards becomes too costly. In response to this problem, the Government of Canada and most other countries that trade organic food with Canada, have been trying to harmonize their definitions and regulations of organic food production (Canadian Food Inspection Agency (2012a), Canadian Food Inspection Agency (2012b)). Agriculture and Agri-Food Canada (2011) state that Canada has an equivalence agreement with many of its trading partners and that this agreement will unify the organic standard used which means that trade should increase for organic food by lowering the costs of trade. Without harmonization of standards, if a producer wanted to sell to a foreign processor or supermarket, he would have to investigate the

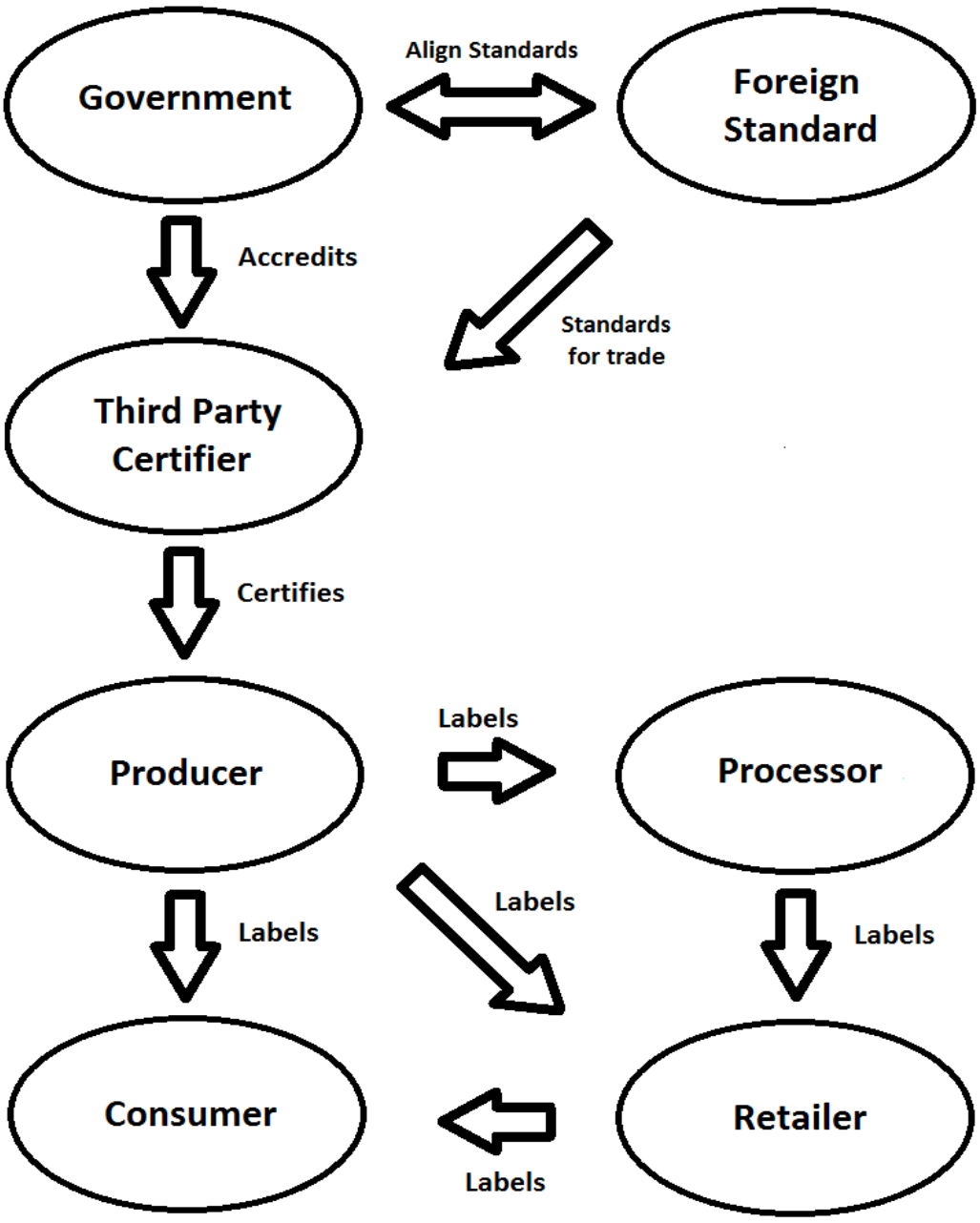


Figure 7: Modified Flow Chart of Certification Process

standards of the foreign country and get certified by a foreign accredited certifier - and he would also want to maintain the domestic standard of organic production. The producer would want to maintain his domestic certification because the cost to become re-certified is very high and maintaining domestic certification can act as a form of insurance against a poor foreign market.[27] Having a foreign certifier travel to different countries to audit foreign producers can become costly; although it is likely that a solution would be to set up a foreign office.. However, if a producer carrying a label from a foreign country was automatically credible in the domestic country, then this would reduce the certification and trade costs by a significant amount.

Suppose that a producer wanted to sell his product to a foreign country. In order to do this he would have to pay the certification cost to a foreign certifier, and since it is more difficult to certify a producer the further they are from the domestic country, it would be expected that this producer's certification cost would be much higher than if he were to only get domestic certification. If the cost of certification is higher then it would be expected that fewer producers would become certified. This, in effect, would lower the amount of exports of organic food for all countries. However, if all standards were unified, and assuming that everyone believes all labels, which implies that everybody has faith in the Third Party Certifiers, then a label from a foreign certifier would be as credible as a domestic certifier. This credibility across countries would allow any certified producer to sell their product to any of the countries in

[27]Lohr and Park (1992) reveal that organic lettuce growers keep their certification even if they sell in non-organic markets because the cost of becoming certified again is too high. This is similar to saying that a producer would rather (once he obtains the distinction of 'certified') keep it and sell in markets that do not require that distinction than to forfeit the certification and have to start the certification process again.

question. Therefore, with unification of standards across countries, there would be an increase in trade as the costs involved are minimized.

## 5.2 Setting the *Right* Organic Standard

The Government is responsible for setting the proper standards that adhere to a comprehensive definition of the term *organic*. The definition, along with the rules and regulations for certified organic food, is in the Organic Standards (Government of Canada (2008)) which gives the *General Principles of Organic Production* as to:

1. Protect the environment; this involves minimizing soil degradation and pollution and to maximize biological health.
2. Maintain soil fertility.
3. Maintain biological diversity.
4. Recycle as much as possible within the production process.
5. Promote health and care of livestock.
6. Process organic products with care to maintain the integrity of the term *organic*.
7. Use renewable resources to the greatest extent possible.

It is evident here that the largest component that makes organic food possible lies with the responsibility on the production side. Along with these general principles, the Organic Standard gives a comprehensive list of substances that can and cannot be applied to organic plants or animals. Some substances that are prohibited from

organic production are seeds or animals that have been genetically altered, synthetic pesticides, sewage sludge, synthetic allopathic drugs, storage or transportation containers that have traces of prohibited materials, and cloned animals just to name a few.[28] The Organic Standard also states the proper barriers and buffer zones that have to separate an organic field with a non-organic field.[29] It is also stated that the operator must maintain all records of seed and animal purchases to ensure that there is evidence that supports the claim that they adhere to the definition of organic. The Organic Standards also explicitly mention that an operator "shall fully record and disclose all activities and transactions in sufficient detail as to be readily understood" (Government of Canada (2008)).

There is a large array of practices that must be followed by a producer so that they can qualify to sell certified organic food, and since the organic standards are set by the Government, there could be a possibility that the Government would set an incorrect standard due to corruption or other non-desirable effect. An incorrect standard could allow for certain additives to be used in the production process that would otherwise not be allowed - this sort of behaviour could be the result of corruption or nepotism within the Government. It is also possible that the Government would want to increase the amount of organic production and use it for export, this would possibly give the Government an incentive to set a low standard; a lower standard would increase the number of organic producers because the certification cost is lowered.[30]

[28] Although there are some vaccines for animals which contain some synthetic material that are allowed in rare circumstances such as when the animal is sick.

[29] These buffer zones are usually a tree line to separate butting fields or a large neutral space in between fields.

[30] It is assumed that a higher standard is more costly to adhere to and consequently a lower standard is easier to follow, ergo less costly to adhere to.

However, since the Canadian Government and other Governments around the world are setting standards that are becoming increasingly similar, the chance of corruption in the organic definition can be ignored. Therefore I assume that the standard is being set efficiently because the (international) enforcement against an inefficient standard is that other countries would not import organic food products under an inferior standard, this leads to all countries setting the same standard. So it can be concluded that the Canadian Government is indeed setting the proper standard.

# 6 Third Party Certifier

As seen from the flow charts above (Figure 6 and Figure 7), the Government will set the organic standard and will also accredit Third Party Certifiers (TPC's).[31] The TPC's are then allowed to audit and upon approval allow a producer to use their organic logo thus making them a *certified organic producer*. Canada has 19 accredited certifiers as of July 2012 (Canadian Food Inspection Agency (2012c))[32] and some of the more common certifiers are: Quality Assurance International, EcoCert, and Pro-cert. According to the Government of Canada (2008), each of these TPC's have to place their own logo on the final product so that the consumer knows who certified the producer, processor, or handler of the good. Unlike the Organic label used by the Government, its use being optional, the label from the certifier is necessary.

As was seen in more detail above, consumers place a lot of value on labels with organic goods because the label will inform them that they are purchasing an organic

[31] This accreditation is done through the Canadian Food Inspection Agency (CFIA).
[32] The complete list can be found at the Canadian Food Inspection Agency (2012c)

good.[33] So with organic food, a consumer will not necessarily be able tell the difference between an organic apple and a conventional apple just from looking at it, it can even be difficult for consumers to notice a difference between organic and conventional foods from the taste. Therefore organic food is not a search or experience good. Although there is some evidence, as seen above, that a few specific organic foods such as potatoes have a distinct difference in taste (which would elude to them being experience goods), it seems that most, or a very large proportion of organic foods do not (Siderer et al. (2005)). Although there are possibly some physical differences such as size and appearance of organic versus conventional foods, for the most part it cannot be assumed that all consumers can recognize differences between the two.[34] So if a consumer cannot visually or palpably discern the difference between organic and conventionally grown food while searching for it, nor can they tell the difference from experience, then they must rely on being told that the food they are eating is organic. This information is transmitted through the labels that TPC's place on the final good.

The labels that TPC's are required to have on the final product will allow the consumer to first, determine with significant ease that the product they are looking at is indeed a certified organic product, and second, it will tell the consumer whether they can trust that the product they are looking at follows the Organic Standards. Albersmeier et al. (2009) says that credence goods need to be inspected by third parties, public groups, or competitors. In Canada, the third party approach is taken where the

[33] This is the credence good problem; refer to section 2.4 for the definition of a credence good.

[34] Dulleck and Kerschbamer (2006) use the example of a mechanic and doctor to show that consumers may not be able to discriminate between different products because they, the consumers, will likely have less knowledge about the product than the so called "expert." Since most people do not have extensive experience with organic production and conventional production, it can be assumed that they too will have difficulty in detecting differences between them.

TPC's are accredited by the Government of Canada (specifically the CFIA). However, even though these TPC's are accredited, the chance of finding a non-organic product being sold as organic depends on how much monitoring there is and whether the dispersion of any news of a falsely labelled product will reach the masses with enough impact to alter their perception towards that particular certifier and label (Albersmeier et al. (2009)). Therefore, the trust that consumers have for a specific label is critical to that label's success. Loader and Hobbs (1999) says that the reputation of the TPC (and to a degree the producer, processor, or handler) will act in part to deter the TPC from lowering the standard. If a TPC lowers the standard in which they use (i.e. they are more lax with the procedure of auditing the producer) then the final product will have a higher chance of being contaminated by non-organic components. For example, if a producer of wheat knows that the TPC will not come and audit him in order to cut costs, the producer will more likely produce using conventional methods (because it is assumed that conventional methods of production are less costly than organic methods) but sell his product as certified organic. As discussed above, the consumer has a difficult time telling organic food from conventional food, so if there is available information (i.e. news or word of mouth) that a specific certifier allows this offence to occur, then the consumers will be more hesitant to purchase products that have that TPC's label on it. Therefore, if consumers start refusing to purchase goods with a specific label on them, then the producers, processors, and handlers will not want to be certified under that label in fear that their product will also lose its reputation. This mechanism should help to keep the standard that is enforced by TPC's from diverging from the standard set out by the Government. Since each TPC is a supposed "ex-

pert" (as Dulleck and Kerschbamer (2006) would describe them as) on the subject of organic-production-certification, then there could also be the second form of defence as described by Albersmeier et al. (2009) which is that competitors will enforce the standard amongst themselves. Since the reputation of a label is critical to the success of a TPC and consequently a producer, processor, or handler, then if one TPC can discredit another then the former would gain market share while the latter would lose market share. This form of self-enforcement would cause competition amongst TPC's to enforce the labels for the betterment of ignorant consumers.

Even though a form of self-enforcement of the labels amongst the "experts" would bode well for the confidence of consumers, there could be a possibility of collusion amongst the TPC's in order to lower the standard that they are responsible for enforcing. TPC's incur a fixed cost to become accredited by the Government of Canada. This fixed cost can come in the form of training personnel or setting up proper equipment, nonetheless, this cost will effectively limit the number of certifiers because a cost to enter into the market will potentially force less efficient firms from entering. With a finite number of firms in the market there will be a higher chance of collusion. Any collusion could result in certification costs being too high, which would limit the number of certified organic producers, or it could act to decrease the standard.[35]

Fagan (2003) believes that independence of TPC's will increase the legitimacy of their certification. This would signal to consumers that the TPC, if independent of any outside influence, would be more trustworthy than another TPC who has ties to the Government, corporations, or other parties; independence means that the TPC

[35] However, if the CFIA notices that standards are diminishing, it will attempt to find the perpetrator and renege their rights to certify producers, processors, and handlers.

does not have any risk involved with the final product. If the TPC just has the responsibility of making sure that the producer adheres to the Organic Standard then they have nothing to lose by refusing to give a certified organic designation to a particular producer. This along with Tanner (2000) and his observation that generally in the agri-food industry, the TPC is independent, would indicate that there should be significant legitimacy to the labels.

Third party certification also benefits the supermarkets where the organic products are predominantly sold. Specifically, Hatanaka et al. (2005) believes that third party certification can provide retailers with:

1. Flexibility to differentiate products.

2. Provides for consistent implementation of the Organic Standard regardless of the products' origin.

3. Will minimize transaction costs and liability.

The third point is interesting in that TPC's can reduce the liability of the retailer. This is done because if there is a problem with the certified organic food that is being sold by a supermarket, then the liability lies with the TPC (and possibly the producer, processor, or handler). The liability does not lie with the retailer because he purchased the product under the same pretence and belief, that it was safe and truly organic, just as the consumer did. With the retailer being an integral part in the chain that leads to the consumer, and due to the higher market concentration of supermarkets,[36] they also have power over the TPC's (Hatanaka et al. (2005)). For instance, Blank (2003)

[36]There are only a handful of supermarkets in Canada that hold the majority of market share.

reviewed how the American supermarket, Whole Foods, decided in 2003 to become a certified organic grocer and that the TPC Quality Assurance International (QAI) would be its third party certifier for all of Whole Foods' products. This means that for QAI, Whole Foods is a major purchaser of goods that QAI certifies, therefore Whole Foods can exert power over it from down stream. Since there are several TPC's for Whole Foods to choose from - if QAI loses its reputation then Whole Foods would seek out another TPC - then this credible threat of Whole Foods choosing another TPC over QAI would help to insure that QAI certifies properly.

As a result of the aforementioned, there has never been much aggravation over the TPC's in Canada, they appear to have been fairly honest about their practice and tend to take it seriously. However, the costs that they impose onto the producers can have serious consequences as to who can and cannot afford to become a certified organic producer.

# 7 Producers

## 7.1 Basic Model

A given producer will have to make a choice as to whether he produces conventional food or certified organic food. To illustrate his decision assume that conventional production is subject to increasing returns to scale - Geder (1982) uses the argument that conventional production practices involve high yielding variety of grains and the usage of synthetic fertilizers and pesticides that will dramatically increase yields. However, with increasing returns to scale there is a risk that the producers will try to take

advantage of the economies of scale by purchasing infinite land. This problem is circumvented by assuming that it is difficult to purchase large tracts of land - it is very expensive - and with the total amount of land fixed it means that nobody can have infinite land. It is also assumed that a given producer, at the time of his operating decision, is *de facto* non-organic. This assumption is made because it will illustrate the effect that a fixed cost of certification will have on his production decision.

Suppose that a producer faces two profit functions; one is his profit if he produces conventionally and the other if he produces organically. Based on his size, or his acreage ($x$), being held fixed, he will then choose his production method based on a profit maximization decision. He has to choose, given his size, whether he would take advantage of the economies in scale that accompany conventional production or to take advantage of the organic premium. His profit for conventional production and organic production are as follows:

$$\pi_c = (p - c)x^2 = MU_c x^2 \tag{1}$$

$$\pi_o = (p + \theta - c - \gamma)x - \delta = MU_o x - \delta \tag{2}$$

Where $MU_i$ is the mark-up of a producer choosing method $i$. The parameter $c$ represents the basic cost per unit of output. This includes the price of fuel, the cost of machinery, and perhaps any labour costs that are involved. It is central that this basic cost is common to both conventional and organic operators. The parameter $\theta$ is the organic premium, it is assumed to be positive, however as seen above by Bonti-Ankomah

and Yiridoe (2006), the organic premium can be negative for some products,[37] but as established above, the average organic premium is positive. Since most goods, aside from strawberries and raspberries that Bonti-Ankomah and Yiridoe (2006) found, have a positive organic premium ($\theta > 0$) it will be assumed that this assumption will hold. There is also an extra cost, $\gamma$, associated with being organic since it requires more methodical practices, certified organic seed, proper crop rotation, and more labourious practices for eliminating weeds or pests. The parameter in the profit function for an organic producer, $\delta$, is the fixed cost of certification and transition[38] of going from a non-organic producer to an organic one. The cost of certification appears for the organic producer because, as Hatanaka et al. (2005) explains, the producer usually bears the cost of certification. However there are some exceptions to this, especially in developing countries where a small producer does not have enough capital or resources to sustain himself during the transition period, so in these rare instances the certifier *Fairtrade Labelling Organizations International* has developed a method whereby the consumer pays for the certification (Fairtrade Labelling Organizations International (2012)). However, it will be assumed that the producer must bear the cost of certification as a fixed cost.

Notice that $MU_c \leq MU_o$ as $\theta \geq \gamma$ and that the conventional production is subject to increasing returns to scale and organic production is subject to constant returns to

[37] Specifically for strawberries and raspberries.

[38] The Organic Standard requires that an operator has to produce using organic methods for at least 12 months before certification can be granted (which also means that there has to be full documentation). However, there can not have been any prohibited substances for at least 36 months prior to allow for certification to be granted. So the transition period is fairly long (3 years) where the producer cannot be producing conventional crops.

scale.[39] The returns to scale using these specific production functions cause $\pi_c' > 0$, $\pi_c'' > 0$ and $\pi_o' > 0$ and $\pi_o'' = 0$ which means that the profit for a conventional producer will increase faster than it will for an organic producer as land ($x$) increases. Since the amount of land is held fixed for producers [40] this means that there will be certain sizes of farms that will be better for conventional production versus organic production. A producer cannot very easily attain more land, if he could without any transaction costs then all producers would try to get an infinite amount of land to maximize their profits. But this, of course, is not reasonable to assume. Practically, a producer cannot effectively manage a farm with infinite size (Raup (1969)), and furthermore there is a fixed amount of land in the world. Using Geder (1982), it can be assumed that $\pi_c$ is increasing in scale (more so than $\pi_o$) because of the use of high yielding variety of grains or use of chemical fertilizers or pesticides which dramatically increase the yield of a crop. A high yielding variety would be a genetically modified (GM) grain which is not considered organic, and it will make the farm output much higher than if the producer were to use a generic variety (what would be considered organic). In fact, since the Green Revolution that sparked the use of pesticides and chemical fertilizers, farm yields have increased but at the expense of soil quality; soil degrades quickly because of the constancy of conventional practice and its use of fertilizers and chemicals (Doran (2002)). However, when using the tools and techniques that were spawned from the Green Revolution, a producer can realize substantial yields as compared to an or-

[39] Here it can be seen that the production functions for conventional and organic producers are $q(x)_c = x^2$ and $q(x)_o = x$, so to see that conventional producers are subject to increasing returns to scale it can be shown that $q(tx)_c > tq(x)_c \ \ \forall t > 1$. Similarly it can be seen that the organic production function is subject to constant returns to scale as $q(tx)_o = tq(x)_o \ \ \forall t > 0$.

[40] This is assumed because land tends to be constant for producers and the amount of new arable land is especially negligible in the developed world.

ganic producer. An organic producer, in the modern sense of the word, can realize a constant yield that will be lower than a similar conventional producer even though he may use practices of crop rotation and different forms of cultivation. However there is a potential limit to the size that any producer can attain before experiencing diminishing returns because he may then have trouble with management of the vast size (Raup (1969)) and the marginal labour costs may outweigh their marginal benefits. Therefore, only the region around where an organic producer would earn more profit than a conventional producer will be explored, as the main purpose of this section is to determine what size will determine whether a given producer will choose to be organic over conventional.

Although it is feasible that some producers have other motives for choosing to be organic, such as beliefs in the effect that the production techniques have on their own health or the perceived negative effects that conventional practices have on the environment (Carson (1962) has argued for both of these reasons). But these other reasons are based more on the preference of the producer. Nonetheless, whether the producer believes that his own health will be better while producing organically, he cannot continually operate at a negative profit, therefore the profit decision will be necessary in the long run.

Figure 8 shows what the profit functions will look like in the $x$ and $\pi$ space with the conventional profit subject to increasing returns to scale with respect to land and the organic profit subject to constant returns to scale.

If a producer were to produce organically then he would need to be a certain size

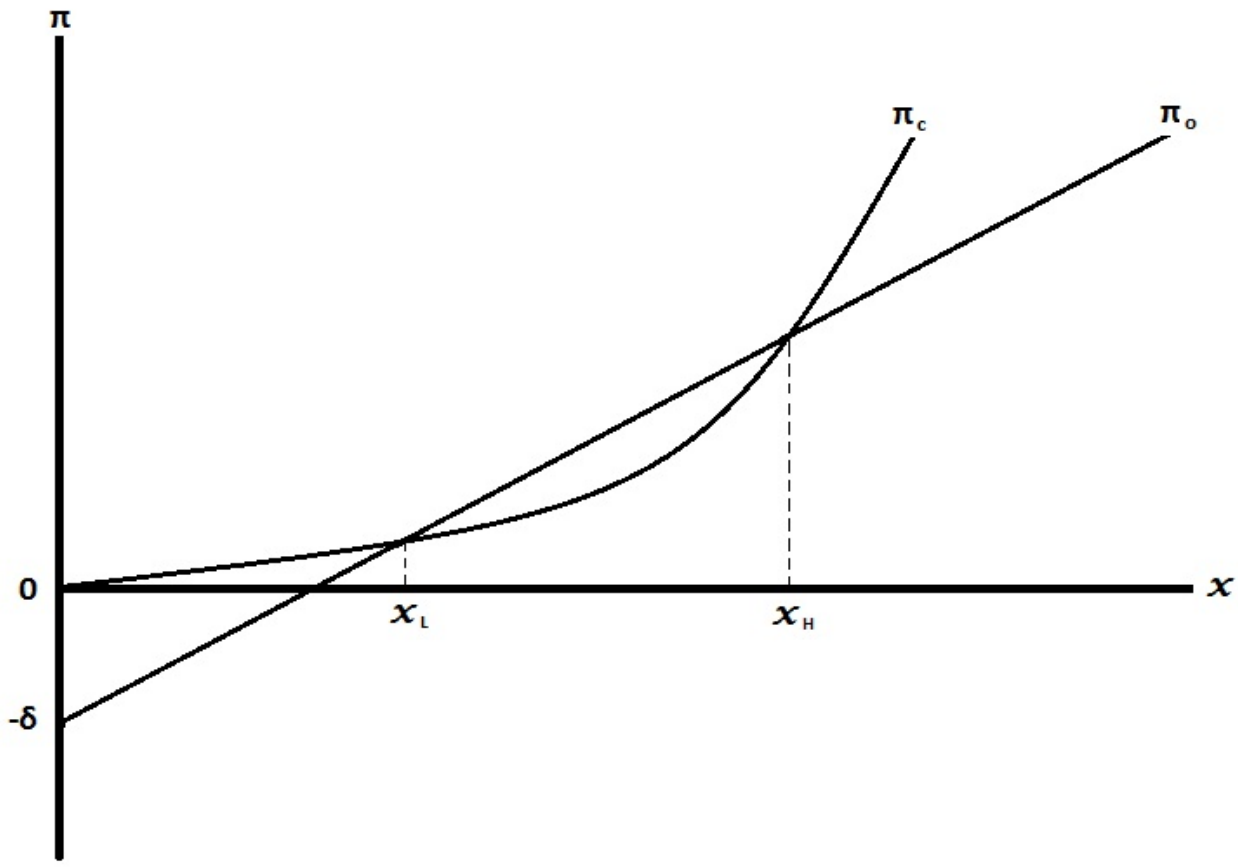


Figure 8: Profits for Organic and Conventional Producers in the $x$ and $\pi$ space

in order to earn enough profit to cover his large fixed cost.[41] The break even size ($x^*$) of a producer if he were to produce organically is:

$$x^* = \frac{\delta}{p + \theta - c - \gamma} = \frac{\delta}{MU_o} \tag{3}$$

$$\therefore x \geq x^* \ \Rightarrow \pi_o \geq 0$$

A producer needs to be at least as large as $x^*$ in order to make positive profits as an organic grower.

By comparing the profits from producing organically and conventionally it can be said that a producer would only produce organically if he is not too large nor too small. Specifically, the range in which $\pi_o > \pi_c$ is:

$$\frac{MU_o - (MU_o^2 - 4\delta MU_c)^{1/2}}{2MU_c} < x < \frac{MU_o + (MU_o^2 - 4\delta MU_c)^{1/2}}{2MU_c} \tag{4}$$

Ergo, the low and high acreage range, $x_L$ and $x_H$ respectively is:

$$x_L = \frac{MU_o - (MU_o^2 - 4\delta MU_c)^{1/2}}{2MU_c} \tag{5}$$

$$x_H = \frac{MU_o + (MU_o^2 - 4\delta MU_c)^{1/2}}{2MU_c}$$

If a producer has a size that lies in-between $x_L$ and $x_H$, then he would earn a higher profit by growing certified organic food than if he were to grow conventional food. It

[41] Also notice that if $\delta$ is too large, if the certification cost is too high, then it would never be worthwhile for a producer to be organic since he would never be able to earn more than if he were to produce conventionally. Therefore the certification cost is important, especially on the policy side, to control the number of organic producers. This will be discussed in more detail below.

may also be interesting to determine at what acreage an organic producer will earn the highest profit difference; what acreage will $\pi_o - \pi_c$ be the largest. This acreage is:[42]

$$x^*_{max} = \frac{p + \theta - c - \gamma}{2(p - c)} \tag{6}$$

If a producer has acreage below $x^*_{max}$ then if he were to increase his acreage by $\varepsilon$ (where $\varepsilon > 0$ such that $x + \varepsilon \leq x^*$) he would increase the profit difference ($\pi_o - \pi_c$). Similarly, if his acreage is above $x^*_{max}$ then increasing his acreage by $\varepsilon$ would decrease the profit difference ($\pi_o - \pi_c$).

The production functions used thus far have been very specific. The specificity of the production functions has allowed for a demonstration of the size range that a producer would have to lie in to rationally choose to produce as a certified organic grower. A more general formulation for the profit functions is:

$$\begin{aligned} \pi_c &= (p - c)\alpha_c x^{\beta_c} & \beta_c > 1 \\ \pi_o &= (p + \theta - c - \gamma)\alpha_o x^{\beta_o} - \delta & 1 < \beta_o < \beta_c \end{aligned} \tag{7}$$

It can be seen here that both organic and conventional production are subject to

[42] This is found by setting the first order conditions of $\pi_o$ and $\pi_c$ equal to each other.

$$\pi'_c = 2(p - c)x = (p + \theta - c - \gamma) = \pi'_o$$

increasing returns to scale.[43] More formally:

$$\begin{aligned} \frac{\partial \pi_c^2}{\partial^2 x} > 0 \quad \text{as } \beta_c > 1 \\ \frac{\partial \pi_o^2}{\partial^2 x} > 0 \quad \text{as } \beta_o > 1 \end{aligned} \tag{8}$$

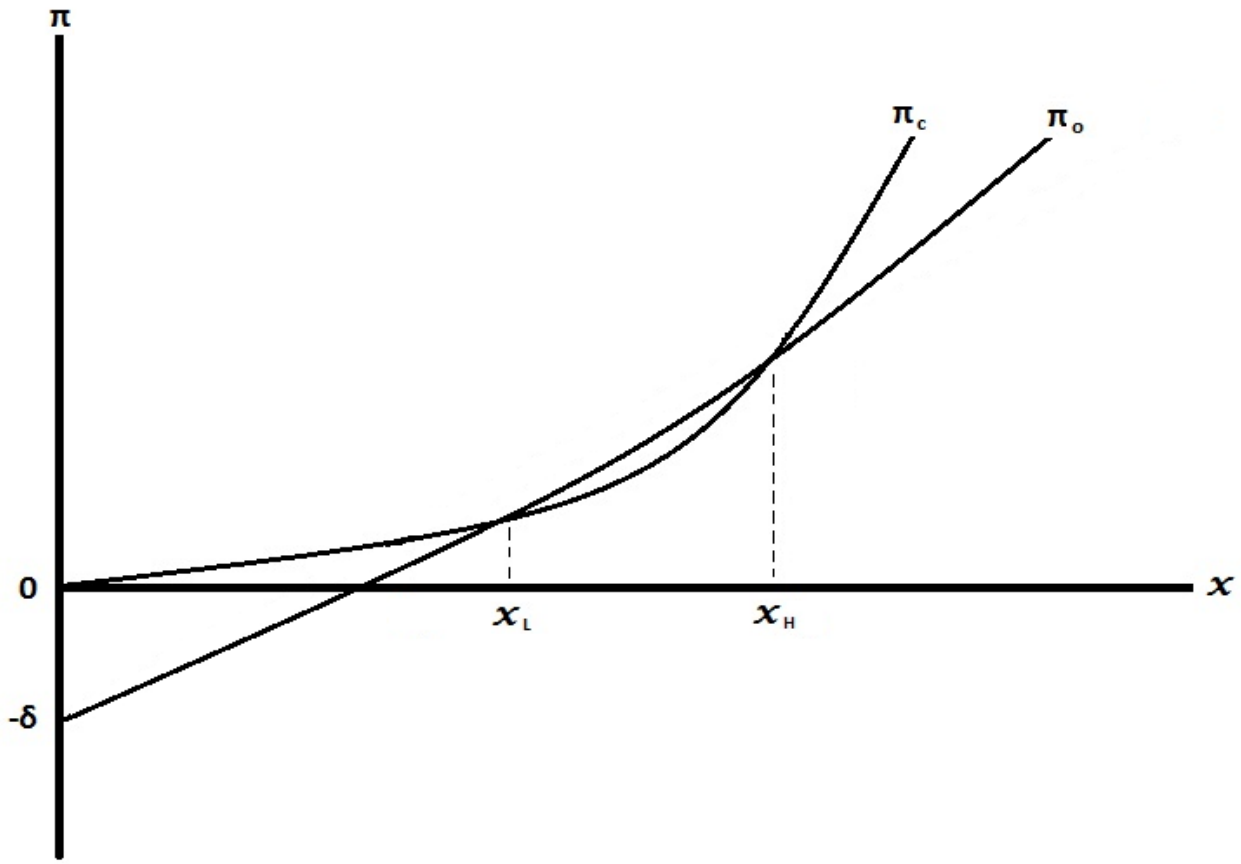


Figure 9: General Profits for Organic and Conventional Producers

[43]See Appendix A.1 for a note on diminishing returns to scale in the production functions of both organic and conventional producers.

Thus far, it has been assumed that the cost per unit of output is constant at $c$. However there may be differences in $c$ for different producers. One explanation for a difference in this cost is that if the physical land only allows for smaller tracts then the cost per unit of output will be higher since a field will be smaller versus a region that has a landscape that allows for large tracts.[44] The latter will compliment large equipment whereas the former will compliment smaller equipment and it can be assumed that larger equipment takes advantage of economies of scale. So it is useful to examine whether the decision criteria for a producer changes depending on different levels of $c$. This can be done by taking the first order conditions of the profit functions with respect to $c$ and looking at which first order condition will get smaller, faster, than the other as land ($x$) increases.

$$\begin{aligned} \pi_o' &= \frac{\partial \pi_o}{\partial c} = -x \\ \pi_c' &= \frac{\partial \pi_c}{\partial c} = -x^2 \\ \therefore \quad \pi_c' &< \pi_o' \ \ \forall x > 1 \end{aligned} \tag{9}$$

This means that as the cost ($c$) gets larger, a conventional producer will lose profits faster than an organic producer. This implies that if basic costs rise it will encourage a larger range of producers to convert over to organic. To illustrate, suppose that the cost increases to $c'$ from $c$ ($c' > c$). Then the acreage range for which producers are

[44] One example would the Georgian Bay area - which is hilly and crowded - and the prairies - which are flat and relatively unpopulated. Statistics Canada (2012) has reported that Saskatchewan has the largest sized farms on average as compared to any other province.

organic gets larger because:[45]

$$x_L = \frac{MU_o - (MU_o^2 - 4MU_c\delta)^{1/2}}{2MU_c} \leq x'_L = \frac{MU'_o - (MU_o'^2 - 4MU'_c\delta)^{1/2}}{2MU'_c} \tag{10}$$

$$x_H = \frac{MU_o + (MU_o^2 - 4MU_c\delta)^{1/2}}{2MU_c} \leq x'_H = \frac{MU'_o + (MU_o'^2 - 4MU'_c\delta)^{1/2}}{2MU'_c} \tag{11}$$

Putting equations (10) and (11) together it can be seen that the organic range increases as the basic cost increases. Specifically equations (10) and (11) demonstrate that:

$$|x_L - x'_L| \leq |x_H - x'_H| \tag{12}$$

This means that there will be an increase in the range in which a producer will choose to be organic. If an assumption about the distribution of producers is made then a comparison of the change in the number of organic producers as $c$ increases can be made. For example, if producers are uniformly distributed (i.e. $x \overset{d}{\sim} U[0, x_h]$) then if the general cost increases, there will be more organic producers. As stated above, this cost parameter can be thought of as the cost of fuel, the cost of machinery, or the labour that is used. So the intuition here is that as the per unit costs increase, then the organic price premium becomes more profitable for the producers on the higher margin than the economies of scale from producing conventionally. The increase in $c$ will also hurt those on the lower margin because they have to pay out more to produce.

[45] Recall that:

$$MU_o = p + \theta - c - \gamma$$
$$MU_c = p - c$$

It should also be noted that an organic producer has to be larger than before in order to break-even as his profit curve has shifted downward. Specifically the original break-even size ($x^*$) is smaller than the new break-even size ($x'^*$)

$$x^* = \frac{\delta}{p + \theta - c - \gamma} < x'^* = \frac{\delta}{p + \theta - c' - \gamma} \qquad c' > c \tag{13}$$

This will decrease the amount of small operators that will consider being organic since they cannot operate at a negative profit.

As seen above, in 2006 the average size of an organic farm was 154.7 hectares, and in 2009 it was 178.2 hectares. Perhaps this increase in the size of organic farms could have been caused, in part, by the increases of the cost parameter in the form of higher oil prices or due to higher costs of machinery and equipment.

As previously mentioned, the fixed cost $\delta$ could be used as a policy tool. If the Government decides that there should be more organic food produced, then it could enact policies or give subsidies that will lower the cost of conversion and certification. The certification cost can also be too large because there is a certain $\delta$ that will cause there to be zero organic producers. The level of delta that will see zero organic producers is:

$$\delta^* = \frac{(p + \theta - c - \gamma)^2}{4(p - c)} \tag{14}$$

If $\delta \geq \delta^*$ then there will not be any organic producers.[46] Thus, it may be advanta-

[46] This is derived by finding a $\delta$ that will make

$$MU_o^2 = (p + \theta - c - \gamma)^2 = 4\delta(p - c) = 4\delta MU_c$$

geous for policy makers to set different levels of $\delta$ to encourage more (or less) amounts of organic production. If it is determined that organic food is better for the health of the consumer and the environment, then the Government could decrease $\delta$ to allow for more organic production which would hopefully result in a lower price of organic food and therefore more organic consumption.[47] If decreasing the cost of certification and conversion will cause a lower consumer price then it would be expected that, as the price elasticity of organic food is assumed to be fairly elastic, there would be more consumption of organic food.

As suggested by the model, producers need to have the organic premium, $\theta$, in order to offset the organic cost, $\gamma$. One place where the costs can be lowered would be at the processor level by utilizing economies of scale. Since a processor needs to have separate (or properly cleaned) assembly lines to reduce the possibility for cross-contamination, they will want to have a lot of product that they process in order to make a reasonable profit. As is known from Ollinger and MackDonald (2005), processors can realize economies of scale,[48] so as they handle more product the per unit cost will decrease. This suggests that once a processor begins handling a large amount of product that the per unit cost savings will be translated into a reduced price for the consumer (Ollinger and MackDonald (2005)). Even though the cost for the consumer is being reduced, the producer will still realize the organic premium. This is necessary in order to keep the incentives for producers to be certified organic growers. So this is another method to lower the price of organic food for the final consumer while still

[47] With more organic production then the supply will increase resulting in a decrease in the price, *cet. par.*

[48] Ollinger and MackDonald (2005) specifically found that poultry processors take advantage of economies of scale in production better than cattle or hog processors.

giving the producer the incentive to produce organic food.

## 7.2 Local Producers

### 7.2.1 Local Producers with the Organic Premium

If a producer is growing organic food just for local consumers, then there will be a trust that will build up between the consumer and the producer. This is allowed to happen because as Thilmany et al. (2005) notes, there is frequent interaction between the two parties. This interaction is directly between the producer and consumer and therefore a relationship will be established and trust can be earned by both parties (Parsons (2004), Thilmany et al. (2005), and Moser et al. (2008)). Parsons (2004) also states that the consumer "may place a greater premium on the relationship with the producer than on any particular method of production." Since the consumer will learn a lot about the producer and start to learn about his production methods, the need for certification will decrease as the consumer begins to trust the producer more than the certifier. Thus, if a producer only serves a local market, and consequently does not participate in larger markets (i.e. supermarkets), then he will not need to pay the fixed cost of certification. However, he will still have to follow the organic standards[49] and he will get paid the organic premium. So the profit functions for a producer following

[49] I assume for now that the producer is honest.

conventional and *local organic* practices can be rewritten as:[50]

$$\begin{aligned} \pi_c &= (p-c)\alpha_c x^{\beta_c} & \beta_c > 1 \\ \pi_l &= (p+\theta-c-\gamma)\alpha_l x^{\beta_l} & 1 < \beta_l < \beta_c \end{aligned} \tag{15}$$

Using the previous production function example of an increasing returns to scale production function for a conventional producer and constant returns to scale for an organic producer, the profit functions become:

$$\begin{aligned} \pi_c &= (p-c)x^2 \\ \pi_l &= (p+\theta-c-\gamma)x \end{aligned} \tag{16}$$

Where $\alpha_l = \alpha_c = 1$, $\beta_l = 1$, and $\beta_c = 2$

Now a given producer will produce organically for local consumers only if:

$$0 = x_L < x < x_H = \frac{p+\theta-c-\gamma}{p-c} = \frac{MU_o}{MU_c} \tag{17}$$

This means that a producer with these options will choose to only produce conventionally if he has acreage larger than the ratio of organic to conventional markups. This can help explain why in some small communities there are small producers who produce organically but are not certified and only sell their products locally.[51]

[50] Notice that the markup for the local organic producer is the same as a certified organic producer ($MU_l = MU_o$).

[51] There is plenty of examples in the authors experience and many farmer's markets have vendors who claim to be organic growers but have never been certified nor have the intention of attaining that distinction.

A major concern with individual producers claiming that they are organic is whether they will be honest. So to work with the example above I will assume that if a local producer cheats - produces conventionally but sells organically - that the consumers will find out in the next period. Although it may be hard for consumers to learn that a producer is cheating, because of the credence properties of organic food, but since there are close relationships between the two parties it can be assumed that somebody would notice the production methods used. Then it is important to know how large the discount factor, $\nu$, for a local organic producer to have in order not to cheat and be dishonest about his product. If the producer does cheat, then he will produce using the conventional production function ($x^2$), will charge the organic premium, and he will not have to pay the organic cost ($\gamma$).[52]

$$\frac{(p+\theta-c-\gamma)x}{1-\nu} \geq (p+\theta-c)x^2 + \frac{\nu(p-c)x^2}{1-\nu} \tag{18}$$

This can be rewritten in terms of markups:

$$\frac{MU_o x}{1-\nu} \geq MU_{cheat}x^2 + \frac{\nu MU_c x^2}{1-\nu} \tag{19}$$

$$\frac{MU_o x}{1-\nu} \geq MU_c x^2 + \theta x^2 + \frac{\nu MU_c x^2}{1-\nu} \tag{20}$$

The minimum discount factor that the producer would have to have to be honest can then be solved for. Specifically, $\nu$ has to be at least a certain size in order to prevent

[52] The markup for a producer who cheats is:

$$MU_{cheat} = p + \theta - c$$

the grower from cheating:

$$\nu \geq \frac{MU_c x + \theta x - MU_o}{\theta x} \tag{21}$$

It can be shown that $\nu$ is indeed greater than zero because this can be rewritten as:

$$\nu \geq \frac{(p+\theta-c)x^2 - (p+\theta-c-\gamma)x}{\theta x^2} \tag{22}$$

So it can be shown that as $\theta > \gamma$ and $x^2 > x \ \forall x > 1 \ \therefore \ \nu > 0$. However, if $0 < x < 1$ then it can be seen that $\nu \lesseqgtr 0$ as $x \lesseqgtr MU_o/MU_{cheat}$.[53] This means that if a producer is sufficiently small, $x < MU_o/MU_{cheat}$, then he cannot take advantage of the economies of scale that are inherent with conventional production. So this small operator just needs a discount factor that is at least zero to be trustworthy - thus cheating will never be worthwhile for him. Also, if $(p-c)x^2 > (p+\theta-c-\gamma)x$ then $\nu > 1$.[54] If $\nu > 1$ then the producer will never be honest because he will not value

[53] Notice that for $\nu \lesseqgtr 0$ the necessary condition is:

$$(p+\theta-c)x^2 \lesseqgtr (p+\theta-c-\gamma)x \qquad 0 < x < 1$$

$$x \lesseqgtr \frac{p+\theta-c-\gamma}{p+\theta-c} = \frac{MU_o}{MU_{cheat}}$$

So for the necessary discount factor to be greater than a negative value, it has been shown that the markup for cheating ($MU_{cheat} = p+\theta-c$) has to be larger than the organic markup. So if $x$ is sufficiently small, then $\nu < 0$, specifically:

$$x < \frac{p+\theta-c-\gamma}{p+\theta-c} = \frac{MU_o}{MU_{cheat}} \ \Rightarrow \nu < 0$$

[54] Since

$$\nu = \frac{(p+\theta-c)x^2 - (p+\theta-c-\gamma)x}{\theta x^2} > 1$$

$$(p+\theta-c)x^2 - (p+\theta-c-\gamma)x > \theta x^2$$

the future by more than he values the present (ergo $\nu$ is less than 1 for an individual) and he will therefore produce conventionally rather than organically.[55] This behaviour is reasonable because it was originally stated that he would earn a higher profit from producing conventionally to begin with, therefore he would produce conventionally forever.

### 7.2.2 Local Producers without the Organic Premium

Parsons (2004) has shown that when producers sell directly to the consumer in the form of selling out of a farmer's market or perhaps just out of ones own operation, he will not receive an organic premium. Therefore the profit functions would have to be rewritten as:[56]

$$\begin{aligned} \pi_c &= (p-c)\alpha_c x^{\beta_c} \qquad & \beta_c > 1 \\ \pi_l &= (p-c-\gamma)\alpha_l x^{\beta_l} \qquad & 1 < \beta_l < \beta_c \end{aligned} \tag{23}$$

Where the producer will not receive $\theta$, so in order for a local organic producer to have positive profits it is necessary that $p > c + \gamma$. This is a stronger assumption than the previous one where only $\theta > \gamma$ and $p > c$. The producer, if only producing locally

$$(p-c)x^2 - (p+\theta-c-\gamma)x > 0$$
$$(p-c)x^2 > (p+\theta-c-\gamma)x$$

[55] It may be reasonable to assume that in this case the producer would claim that he was organic only to capture the rents from the organic premium and henceforth be advertised as conventional.

[56] Now notice that the markup for the local organic grower is now:

$$MU_l = p - c - \gamma$$

with no premium, will have a different range than before:[57]

$$0 = x_L < x < x_H = \frac{p - c - \gamma}{p - c} = \frac{MU_l}{MU_c} \tag{24}$$

A local organic producer also has the choice or getting certified and selling his product in supermarkets. So it has to be determined what acreage range is necessary for a grower to have in order to produce as a local organic producer versus a certified organic producer. For $\pi_l > \pi_o$, the acreage range is:

$$x < \frac{\delta}{\theta} \tag{25}$$

If a given producer has acreage that is less then the ratio of the cost of certification to the organic premium, then it is more advantageous for him to produce for local consumers only (i.e. he does not have to pay the cost of certification) than it would be for him to produce for supermarkets (i.e. he would have to pay the large fixed cost of certification and receive the organic premium). Specifically he is small enough that the benefits of the organic premium do not outweigh the cost of certification.

[57] Notice that

$$x_H = \frac{p - c - \gamma}{p - c} = \frac{MU_l}{MU_c} < 1 \quad \forall \gamma > 0$$

## 7.3 Putting it all together

So now there are three different types that a given producer can choose to be; conventional, certified organic, and local organic.[58] As seen in Figure 10, the acreage ranges that determine a given producer's choice of what kind of goods he will produce are as follows[59]:

$$\begin{array}{lllll} \text{Local Organic:} & 0 < x \leq \frac{\delta}{\theta} & \text{and} & 0 < x \leq \frac{MU_l}{MU_c} \\ \text{Certified Organic:} & x > \frac{\delta}{\theta} & \text{and} & \frac{MU_o - (MU_o^2 - 4\delta MU_c)^{1/2}}{2MU_c} < x \leq \frac{MU_o + (MU_o^2 - 4\delta MU_c)^{1/2}}{2MU_c} \\ \text{Conventional:} & x > \frac{MU_l}{MU_c} & \text{and} & x > \frac{MU_o + (MU_o^2 - 4\delta MU_c)^{1/2}}{2MU_c} \end{array} \tag{26}$$

For an operator to be a local organic producer he must be sufficiently small, otherwise the fixed cost of becoming certified and the subsequent benefits of the organic premium would increase his profits beyond what he would get if he were to not get certified and not receive the organic premium, and he has to be small enough such that he cannot take advantage of the economies of scale that are associated with conventional production. To be a certified organic producer he must have enough land so that it would be profit maximizing for him to pay the certification cost and thus earn the organic premium and he must be small enough so that he cannot fully enjoy the benefits of economies of scale that are involved with conventional production. And finally, for a producer to be conventional, he must be large enough so as the economies of scale involved with his production will increase his profits to a higher level than if

[58] Since there is empirical evidence to suggest that the organic premium for local organic producers is zero, $\theta = 0$, that will be the assumption that I use henceforth.

[59] To see the decision rule with the markups substituted in for their actual values see Appendix A.2

he were to be local or certified organic; so the economies of scale outweigh the organic premium, from the certified organic operation, and the constant returns to scale without the certification cost from being local organic.

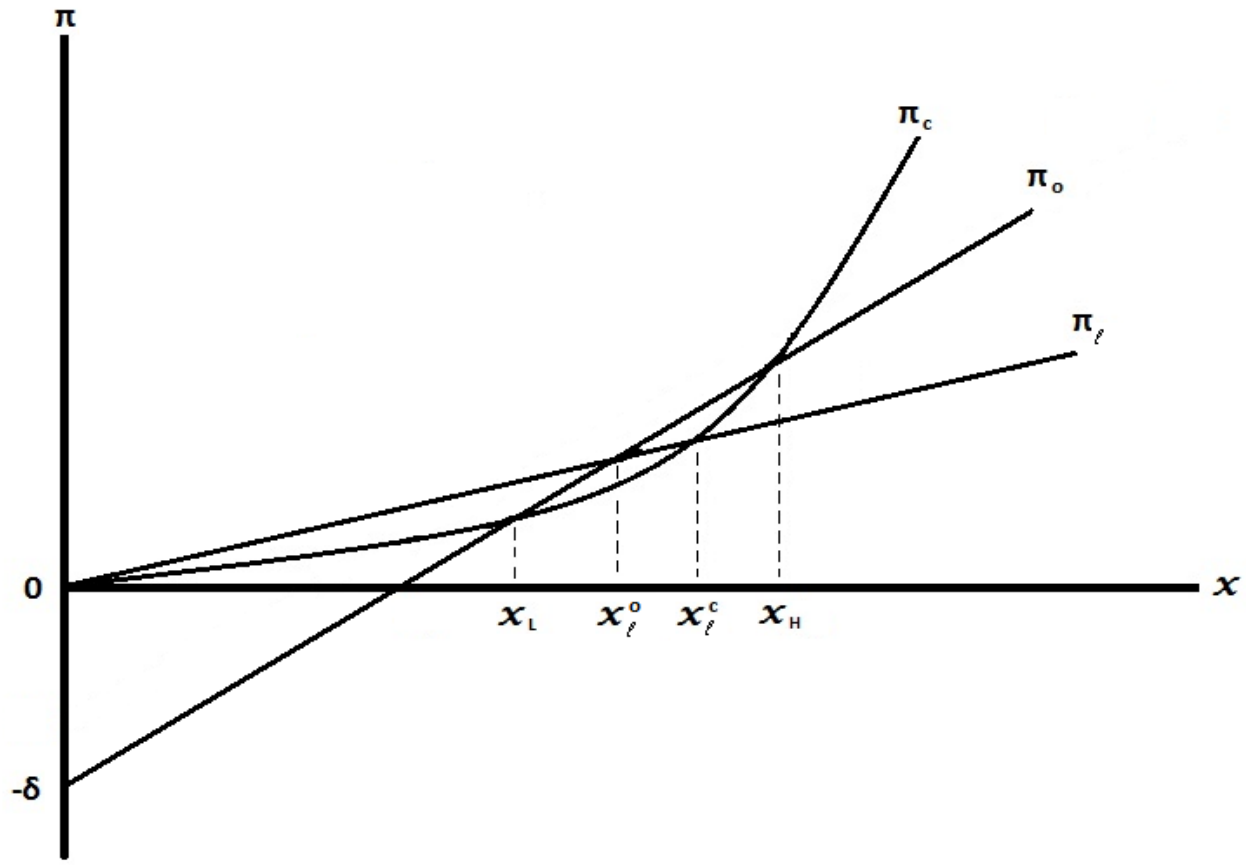


Figure 10: Profits for Conventional, Certified Organic, and Local Organic

I can rule out one alternative for the conventional decision since it is known that the local organic profit will always be greater than the conventional profit for acreage near the origin (or $x$ close to zero), therefore for $x$ that is infinitesimally small the operator will certainly choose to be local organic.

There could be some issues involved with being a local organic producer because there has to be a large enough market to serve, i.e. enough demand, in the community to make this a viable option. However, the current trend of consumer behaviour, their preference towards organic products, and their growing support for local agriculture indicates that a lack of demand should not be of any concern for these producers.

The decision rule essentially states that if a grower is very small then he would choose to produce organic food, non-certified, and sell it only locally. If a producer is not certified then it is assumed that they cannot sell their product to processors, supermarkets, or internationally because they do not possess the use of an accredited organic label. If a producer is a medium size then he would choose to take advantage of the organic premium and the only method to do so is to become certified and sell to supermarkets both domestic and internationally. If a producer is very large then he would choose to take advantage of the increasing returns to scale and only produce conventionally and will therefore not receive the organic premium nor would he be subject to the organic cost ($\gamma$). It is possible, as seen above, that if the profit curve for organic producers lies below the conventional profit curve, then a producer would only choose between being local organic and conventional. More specifically, if a variable such as the certification cost is too high $\left(\delta > \delta^* = \frac{(p+\theta-c-\gamma)^2}{4(p-c)}\right)$ then it would never be worthwhile to produce certified organic products. In this case, the producer's decision

rule is just between being local organic and conventional:

$$\begin{aligned} &\text{Local Organic:} \quad 0 < x \leq \tfrac{MU_L}{MU_c} \\ &\text{Conventional:} \quad x > \tfrac{MU_L}{MU_c} \end{aligned} \tag{27}$$

A similar result follows if the organic premium is too low. If $\theta$ is too small ($\theta < \theta^* = 2((p-c)\delta - (p+c+\gamma)^{1/2})$ then it would never be the rational profit maximizing decision for a producer to produce certified organic food. Similarly, if the organic cost is too high ($\gamma > \gamma^* = p + \theta - c - 2((p-c)\delta)^{1/2}$) then the decision rule will only be between local organic and conventional.

Shown here is a format for producers, with a given size, to think about what type of producer they should be in order to maximize their profits. The conclusion is that there is a size range for each type of output. It can be thought of as a small operator would choose to be local organic, a medium sized operator would choose to be certified organic, and a large operator would choose to be a conventional operator. There is some evidence that supports these producer decisions, as established above, non-organic farms had an average size that was much larger than organic farms as of 2006.[60] This means that large farms tend to be conventional growers and medium sized farms tend to be certified organic.

[60] Since the average size of a farm in Canada in 2006 was 294.6 hectares (728 acres) and the average size of an organic farm was 154.7 hectares (382.3 acres) (Statistics Canada (2012)), and because organic farms are a subset of the overall average, it must mean that the average non-organic (or what would be considered conventional in the context of the model) farm size is much larger than the average organic farm size.

# 8 Conclusion

There are many problems surrounding organic food, especially on the consumer end, in that organic food is indistinguishable from non-organic food which classifies organic food as a credence good. With consumers willing to pay a premium for what they believe is food that will make them healthier and possibly improve the health of the environment, there has to be parties that will protect these consumers from being sold non-organic food when they are being told otherwise. This position is taken up, in large part, by the the Government and Third Party Certifiers. The former sets a standard that must be adhered to in order for a product to be considered organic. This standard is comprehensive in what is allowed onto an organic field and when certain crops can be planted relative to others (crop rotation). This standard is also meant to protect organic production from non-organic production through the usage of physical barriers and buffer zones around fields, processing plants, and handlers. The latter, TPC's, are responsible with enforcing the standard set out by the Government. TPC's have to physically audit a production site and check records to determine the validity of the organic claims being made. Finally, it is important to understand when a producer would choose to operate as a certified organic or conventional grower. The caveat was added in lieu of recent evidence that personal relationships between the producer and consumer is sufficient to eliminate the third parities (the Government and TPC's) and have the consumer enforce the organic claims of the producer. The results show that for a small, medium, and large operator, their choice of what kind of product to grow is local organic, certified organic, and conventional respectively. Understanding the decision rule for operators allows for the usage of policy to obtain the desired amount

of organic food supplied; whether the desired effect is more or less organic food. If the Government wants more (or less) certified organic food in the marketplace then one possible solution would be to subsidize (or tax in the sense of tightening the standards, implementing certification quotas, or increasing the costs for TPC's) the certification process.

With consumers being a vulnerable group, it has been demonstrated that there are methods in which to help them, and with a better understanding of the organic system from the Government to the consumer, there is now a framework for discussing such issues. The model presented here demonstrates that farm size has a major impact on the producer's decision as to what type of food they should produce. One possible extension to this model would be to allow for different categories of food, such as bulk grains versus vegetables, however this extension should reveal similar outcomes in the sense that the producer's decision rule is based on size ranges that will mimic the results shown from above. There is evidence to support this model as non-organic farms are in fact larger than organic farms on average.

# A Appendix

## A.1 Diminishing Returns to Scale in Organic and Conventional Production

Using diminishing returns to scale production functions, the profit functions can be rewritten as:

$$\begin{aligned} \pi_c &= (p-c)x^{\beta_c} \\ \pi_o &= (p+\theta-c-\gamma)x^{\beta_o} - \delta \end{aligned} \tag{28}$$

Where $0 > \beta_c > \beta_o > 1$. The solution to this will be very similar to the increasing returns to scale case - there will be a range in which a given producer would choose to operate as organic and outside that range he would choose to operate conventionally. The rest of the analysis from Section 7 would follow similarly if these production functions were to be used instead. As mentioned before, there will most likely be a size at which all types of producers begin to experience diminishing returns to scale, but since the size region of interest is where the certified organic producer's profit is greater than that of the conventional producer's profit then the diminishing returns to scale at very large farm sizes is not a concern.

## A.2 Production Decision - Expanded

Substituting in the values for the markups it can be seen that for a producer to choose to be local organic, he would have to have a sufficiently small farm size so that his profit would be greater than if he were able to attain the organic premium from being

certified organic:

$$0 < x \leq \frac{\delta}{\theta} \tag{29}$$

And he has to be small enough such that his profit would be greater than producing conventional food:

$$0 < x \leq \frac{p - c - \gamma}{p - c} \tag{30}$$

Notice that $x < 1 \; \forall \gamma > 0$, so this would indicate that for the decision between producing local organic and conventional, a producer would choose the former if he had a very small farm.

For a producer to decide to produce certified organic products he would have to have a size that will give him a profit larger than if he were to produce local organic:

$$x > \frac{\delta}{\theta} \tag{31}$$

And he has to be within the range that will give him a larger profit than if he were to produce conventionally:

$$\frac{(p+\theta-c-\gamma)-((p+\theta-c-\gamma)^2-4\delta(p-c))^{1/2}}{2(p-c)} < x \leq \frac{(p+\theta-c-\gamma)+((p+\theta-c-\gamma)^2-4\delta(p-c))^{1/2}}{2(p-c)} \tag{32}$$

For an operator to grow conventional products, he has to be significantly large so as to have a larger profit than if he was to produce local organic:

$$x > \frac{(p - c - \gamma)}{(p - c)} \tag{33}$$

And he will have to be large enough such that his profit will be larger than if he were to produce certified organic:

$$x > \frac{(p+\theta-c-\gamma)+((p+\theta-c-\gamma)^2-4\delta(p-c))^{1/2}}{2(p-c)} \tag{34}$$

# References

Agriculture and Agri-Food Canada (2011). Canada's organic industry at a glance - 2009. Retrieved May 25, 2012.

Agriculture and Agri-Food Canada (2012). Canada organic regime: A certified choice. Retrieved May 28, 2012.

Albersmeier, F., H. Schulze., G. Jahn., and A. Spiller (2009). The reliability of third-party certification in the food chain: From checklists to risk-oriented auditing. *Food Control 20*, 927–935.

Andreyeva, T., M. Long., and K. Brownell (2010). The impact of food prices on consumption: A systematic review of research on the price elasticity of demand for food. *American Journal of Public Health 100*(2), 216–222.

Baker, G. and P. Crosbie (1993). Measuring food safety preferences: identifying consumer segments. *Journal of Agricultural and Resource Economics 18*, 227–287.

Baksi, S. and P. Bose (2007). Credence goods, efficient labelling policies, and regulatory enforcement. *Environmental and Resource Economics 37*, 411–430.

Beharrell, B. and J. MacFie (1991). Consumer attitudes to organic foods. *British Food Journal 93*, 25–30.

Blank, D. (2003). Natural food store pursue organic seals of approval. *New York Times June 29*.

Bonroy, O. and C. Constantatos (2008). On the use of labels in credence goods markets. *Journal of Regulatory Economics 33*, 237–252.

Bonti-Ankomah, S. and E. Yiridoe (2006). Organic and conventional foods: A literature review of the economics of consumer perceptions and preferences. *Organic Agriculture Centre of Canada*.

Bruning-Fann, C. and J. Kaneene (1993). The effects of nitrate, nitraite and n-nitoso compounds on human health: A review. *Vetrenarian Human Toxicology 35*, 521–538.

Buzby, J. and J. Skees (1994). Consumers want reduced exposure to pesticides in food. *Food Review 17*(2), 19–22.

Byrne, P., J. Bacon., and U. Toensmeyer (1994). Pesticide residue concerns and shopping location likelihood. *Agribusiness 10*(6), 491–501.

Canadian Food Inspection Agency (2012a). Canada - us organic equivalence arrangement - overview. Retrieved August 4, 2012.

Canadian Food Inspection Agency (2012b). Canada-european union organic equivalency arrangement - overview. Retrieved August 4, 2012.

Canadian Food Inspection Agency (2012c). Certification bodies providing organic certification services - canada. Retrieved May 25, 2012.

Carson, R. (1962). *Silent Spring*. New York: Mariner Houghton-Mifflin.

Collins, J., G. Cuperus., B. Cartwright., J. Stark., and L. Ebro (1993). Consumer attitudes on pesticide treatment histories of fresh produce. *Journal of Sustainable Agriculture 3*(1), 81–98.

Dangour, A., S. Dodhia., A. Hayter., E. Allen., K. Lock., and R. Uauy (2009). Nutritional quality of organic foods: a systematic review. *American Journal of Clinical Nutrition 90*, 680–685.

Darby, M. and E. Karni (1973). Free competition and the optimal amount of fraud. *Journal of Law and Economics 16*(1), 67–88.

Davies, A., A. Titterington., and C. Cochrane (1995). Who buys organic food? a profile of the purchasers of organic in northern ireland. *British Food Journal 97*(10), 17–23.

Doran, J. (2002). Soil health and global sustainability: translating science into practice. *Agriculture, Ecosystems and Environment 88*(2), 119–127.

Dulleck, U. and R. Kerschbamer (2006). On doctors, mechanics, and computer specialists: The economics of credence goods. *Journal of Economics Literature 44*(1), 5–42.

Ekelund, L. (1990). Vegetable consumption and consumer attitudes towards organically grown vegetables - the case of sweden. *Acta Horticulturae 259*, 163–172.

Fagan, J. (2003). Cert id, a successful example of an independent, third-party, private certification system. *Symposium: Product Differentiation and Market Segmentation in Grains and Oilseeds: Implications for Industry in Transition*. USDA.

Fairtrade Labelling Organizations International (2012). Retrieved July 23, 2012.

Fukai, S. and M. Cooper (1995). Development of drought-resistant cultivars using physiomorphological traits in rice. *Field Crops Research 40*(2), 67–86.

Geder, G. (1982). Adoption of interrelated agricultural innovations: Complementarity and the impacts of risk, scale, and credit. *American Journal of Agricultural Economics 64*(1), 94–101.

Gil, J., A. Gracia., and M. Sanchez (2001). Market segmentation and willingness to pay for organic products in spain. *International Food and Agribusiness Management Review 3*, 207–226.

Golan, E., F. Kuchler., and L. Mitchell (2001). Economics of food labelling. *Journal of Consumer Policy 24*, 117–184.

Goldman, B. and K. Clancy (1991). A survey of organic produce purchases and related attitudes of food cooperative shoppers. *American Journal of Alternative Agriculture 6*(2), 89–96.

Government of Canada (2008). Organic production systems general principles and management standards.

Groff, A., C. Kreidor., and U. Toensmeyer (1993). Analysis of the delaware market for organically grown products. *Journal of Food Distribution Research 24*, 118–125.

Grossman, M. (1972). On the concept of health capital and the demand for health. *Journal of Political Economy 80*(2), 223–255.

Grunert, S. and H. Juhl (1995). Values, environmental attitudes and buying of organic foods. *Journal of Economic Psychology 16*(1), 63–72.

Hack, M. (1993). Organically grown products: Perception, preferences and motives of dutch consumers. *Acta Horticulturae 340*, 247–253.

Hammit, J. (1990). Risk perceptions and food choice: An exploratory analysis of organic-versus conventional-produce buyers. *Risk Analysis 10*, 367–374.

Hammit, J. (1993). Consumer willingness to pay to avoid pesticide residues. *Statistical Sinica 3*, 351–366.

Hansen, J. and H. Sorensen (1993). The importance of price for the sale of ecological products. *MAPP Working Paper No. 13 Aarhus School of Business, Aarhus.*

Hatanaka, M., C. Bain., and L. Busch (2005). Third-party certification in the global agrifood system. *Food Policy 30*, 354–369.

Hay, J. (1989). The consumer's perspective on organic food. *Canadian Institute of Food Science Technology Journal 22*(2), 95–99.

Henson, S. and B. Traill (1993). The demand for food safety: Market imperfections and the role of government. *Food Policy 18*(2).

Huang, C. (1990). Consumer preferences and attitudes toward organically grown produce. *European Review of Agricultural Economics 23*(3), 331–342.

Huang, K. (1985). *U.S. demand for food: A complete system of price and income effects.* Washington, D.C.: U.S. Department of Agrigulture.

Hughner, R., P. McDohagh., A. Prothero., C. Shultz., and J. Stanton (2007). Who are organic food consumers? a compilation and review of why people purchase organic food. *Journal of Consumer Behaviour 6*, 94–110.

Hunt, A. (2007). Consumer interactions and influences on farmers' market vendors. *Renewable Agriculture and Food Systems 22*, 54–66.

Hursti, K. and M. Magnusson (2003). Consumer perceptions of genetically modified and organic foods. what kind of knowledge matters? *Appetite 41*, 207–209.

Hutchins, R. and L. Greenhalgh (1995). Organic confusion: sustaining competitive advantage. *Nutrition and Food Science 95*(6), 11–14.

Iles, A. (2005). Learning in sustainable agriculture: Food miles and missing objects. *Environmental Values 14*, 163–183.

Jolly, D. (1991). Differences between buyers and non-buyers of organic produce and willingness to pay organic price premiums. *Journal of Agribusiness 9*(1), 97–111.

Jolly, D., G. Schutz., K. Diaz-Knauf., and J. Johal (1989). Organic foods: Consumer attitudes and use. *Food Technology November*, 60–66.

Kouba, M. (2003). Quality of organic animal products. *Livestock Production Science 80*, 33–40.

Laidlaw, S. (2003). *Secret Ingredients: the brave new world of industrial farming.* Toronto, Ontario: McClelland and Stewart Ltd.

Lancaster, K. J. (1966). A new approach to consumer theory. *Journal of Political Economy 74(2)*, 132–157.

Loader, R. and J. Hobbs (1999). Strategic responses to food safety legislation. *Food Policy 24*, 685–706.

Lohr, L. (1998). Implications of organic certification for market structure and trade. *American Journal of Agricultural Economics 80*(5), 1125–1129.

Lohr, L. and T. Park (1992). Certification and supply response in the organic lettuce market. *Journal of Agricultural and Resource Economcis 17*(2), 253–265.

Magkos, F., F. Arvaniti., and A. Zampelas (2003). Organic food: nutritious food or food for thought? a review of the evidence. *International Journal of Food Sciences and Nutrition 54*(5), 357–371.

Magkos, F., F. Arvaniti., and A. Zampelas (2006). Organic food: Buying more safety or just peace of mind? a critical review of the literature. *Critical Reviews in Food Science and Nutrition 46*, 23–56.

Magnusson, M., A. Arvola., K. Hursti., U. Aberg., and P. Sjoden (2001). Attitudes towards organic foods among swedish consumers. *British Food Journal 103*, 209–226.

Misra, S., C. Huang., and S. Ott (1991). Georgia consumers preference for organically grown fresh produce. *Journal of Agribusiness Fall 1991*.

Moser, R., R. Raffaelli., and D. Thilmany (2008). Identifying influential attributes in wtp for agro-food with credence based public good attributes: The state of the art

and some implications for ce. *Presented at Workshop on Valuation Methods in Agro-Food and Environmental Economics, Barcelona, Spain*.

Nelson, P. (1970). Information and consumer behavior. *Journal of Political Economy 78*(2), 311–329.

Nelson, P. (1974). Advertising as information. *Journal of Political Economy 82*(4), 729–754.

Ollinger, M. and J. MackDonald (2005). Technological change and economies of scale in u.s. poultry processing. *American Journal of Agricultural Economics 87*(1), 116–129.

Organic Trade Association (2010). White paper: Consumer confusion about the difference "natural" and "organic" product claims.

Ott, S. (1990). Supermarket shoppers' pesticide concerns and willingness to purchase certified pesticide residue-free fresh produce. *Agribusiness 6*(6), 593–602.

Palmer, C. (1996). A week that shoot the meat industry: The effects on the uk beef industry of the bse crisis. *British Food Journal 98*(11).

Parsons, W. (2002). Organic fruit and vegetable production: Is it for you? *Catalogue no. 21-004-XIE Statistics Canada Ottawa*.

Parsons, W. (2004). Organic fruit and vegetable production: Do farmers get a premium price? *VISTA on the Agri-Food Industry and the Farm Community, Statistics Canada February 2004*.

Peraica, M., B. Radic., A. Lucic., and M. Pavlovic (1999). Toxic effects of mycotoxins in humans. *Bulletin of the World Health Organization 77*(9).

Raup, P. (1969). Economies and diseconomies of large-scale agriculture. *American Journal of Agricultural Economics 51*(5), 1274–1283.

Rembiakowska, E. (2007). Quality of plant products from organic agriculture. *Journal of the Science of Food and Agriculture 87*, 2757–2762.

Ritson, C. and L. Mai (1998). The economics of food safety. *Nutrition and Food Science 5*, 253–259.

Schifferstein, H. and P. O. Ophuis (1998). Health-related determinants of organic food consumption in the netherlands. *Food Quality and Preference 9*(3), 119–133.

Siderer, Y., A. Maquet., and E. Andlam (2005). Need for research to support consumer confidence in the growing organic food market. *Trends in Food Science and Technology 16*, 332–343.

Statistics Canada (2012). Snapshot of canadian agriculture. Retrieved July 15, 2012.

Subramanian, S. and A. Deaton (1996). The demand for food and calories. *Journal of Political Economy 104*(1), 133–162.

Swanson, R. and C. Lewis (1993). Alaskan direct-market consumers: Perceptions of organic produce. *Home Economics Research Journal 22*, 138–155.

Swinbank, A. (1993). The economics of food safety. *Food Policy 18*(2), 83–94.

Tanner, B. (2000). Independent assessment by third-party certification bodies. *Food Control 11*, 415–417.

Thilmany, D., C. A. Bond., and J. K. Bond (2005). Going local: Exploring consumer behavior and motivations for direct food purchases. *American Journal of Agricultural Economics 90*(5), 1303–1309.

Tubajika, K., H. Mascagni., K. Damann., and J. Russin (1999). Nitrogen fertilizer influence on aflatoxin contamination of corn in louisiana. *Journal of Agriculture and Food Chemistry 47*, 5257–5260.

Turco, G. (2002). Organic food - an opportunity at who's expense? *Industry Note, Food and Agribusiness Research Rabobank International, Sydney Australia.*

Vermeer, I. and J. van Maanen (2001). Nitrate exposure and the endogenous formation of carcinogenic nitrosamines in humans. *Rev. Environment and Health 16*, 105–116.

Vetter, H. and K. Karantininis (2002). Moral hazard, vertical integration, and public monitoring in credence goods. *European Review of Agricultural Economics 29*(2), 271–279.

Wilkins, J. and V. Hillers (1994). Influences of pesticide residue and environmental concerns on organic food preference among food cooperative members and nonmembers in washington state. *Journal of Nutrition Education 26*(1), 26–33.

Williams, C. (2002). Nutritional quality of organic food: shades of grey or shades of green? *Proceedings of the Nutrition Society 61*, 19–24.

Williamson, C. (2007). Is organic food better for our health? *British Nutrition Foundation: Nutrition Bulletin 12*, 104–108.

Wood, G., Y. Lee., K. Egan., and M. Bolger (2001). Us food and drug administartion's monitoring and surveillance programs for mycotoxins, pesticides, and contaminants in food. *Journal of Environmental Monitoring 3*, 79N–83N.

Worthington, V. (2001). Nutritional quality of organic versus conventional fruits, vegetables, and grains. *The Journal of Alternative and Complementary Medicine 7*(2), 161–173.

Yiridoe, E., S. Bonti-Ankomah., and R. Martin (2005). Comparison of consumer perceptions and preference toward organic versus conventionally produced foods: A review and update of the literature. *Renuewable Agriculture and Food Systems 20*(4), 193–205.