# SHOULD OLD TECHNOLOGIES BE BANNED: THE CASE OF THE ORGANIC FOOD MARKET

by
Seher Merve Akbaş

Submitted to the Graduate School of Arts and Sciences
in partial fulfillment of
the requirements for the degree of
Master of Arts

Sabancı University
January 2009

*to my grandmom Gülizar Kayhan...*

# ACKNOWLEDGMENTS

Firstly, I would like to thank my advisor Professor Toker Doğanoğlu for his guidance, my committee members Professor Fırat İnceoğlu and Professor Burak Gürel for their precious time in evaluating my work.

I want to express my special thanks to my supervisor Toker Doğanoğlu for his support, encouragement, sound advice and his efforts to explain things clearly. I learned a lot from him and am happy to have the privilege to have worked with him.

I want to thank Burak Gürel for his existence and for everything he has taught me starting from the first day of my undergraduate studies at Bogazici University and allowing me to spend hours in TB 210, the best office in the best building of South Campus.

I am indebted to my friends Sinan Karadayı, Ilke Toygür, Sevgi Yüksel, Simla Yerlikaya, Zeynep Attar, Gabriela Farfan, Domenico Ferraro, Andrea Velasquez and Omür Kayıkçı. I am grateful to them for helping me get through the difficult times, and for all the emotional support and caring they provided.

I want to thank Esra Alpay for helping me to complete the paperwork for my thesis.

I want to thank my family, my beloved mother, father and my sister Serra for their unlimited love and patience for me.

Lastly but not leastly, I want to thank The Scientific and Technological Research Council of Turkey for providing me the necessary funds for completing my thesis.

SHOULD OLD TECHNOLOGIES BE BANNED : THE CASE OF THE ORGANIC FOOD MARKET

Seher Merve Akbaş

Economics, MA Thesis, 2009

Asst. Prof. Toker Doğanoğlu

Keywords: Technology, Industrial Policy

ABSTRACT

In this paper, we focus on a market which consists of a large number of consumers, who share identical tastes but have different income levels; a large number of firms using old technology and a monopoly using high technology. We analyze the market effects of a ban on the use of low technology and show that it can lead to welfare improvements and it results in more firms producing high quality products using high technology.

Specifically, we analyze the worldwide organic food market and propose that banning old technology (which corresponds to conventional methods used in agriculture, poultry and livestock) can be applied to this market as a viable policy considering its supply and demand properties. Broadening the perspective, we propose that in appropriate markets, banning old technology can lead to welfare improvements and should be considered as a policy option.

ESKİ TEKNOLOJİLERİ YASAKLAMAK : ORGANİK YİYECEK PİYASASI ÖRNEĞİ

Seher Merve Akbaş

Ekonomi, MA Tezi, 2009

Yar. Doç. Dr. Toker Doğanoğlu

Anahtar Kelimeler: Teknoloji, Endüstriyel Politika

ÖZET

Bu tez talep kısmı aynı beğeniye fakat farklı gelir seviyelerine sahip çok sayıda tüketiciden, arz ksmı rekabetçi olarak homojen bir ürün üreten çok sayıda firma ile aynı ürünü yeni bir teknoloji kullanarak daha yüksek kalitede üreten bir kartelden oluşan bir piyasayı incelemekte. Ayrıca, düşük teknoloji kullanımının yasaklanmasının piyasaya olan etkilerini analiz etmekte ve böyle bir müdahalenin daha fazla firmanın yüksek teknoloji kullanarak yüksek kalite ürünler üretip refah artışına yol açabildiğini göstermekte.

Spesifik olarak dünya organik yiyecek piyasası ele alınmakta ve bu piyasanın arz talep özellikleri yüzünden önerdiğimiz politikalara uygun olduğu savunulmakta. Bakış açısı genişletilerek, arz ve talep yapısının uygun olduğu piyasalarda yüksek teknolojiyi teşvik amacıyla düşük teknolojinin yasaklanmasının etkili bir politika olabileceği savunulmakta.

# TABLE OF CONTENTS

# List of Tables

# Chapter 1

# Introduction

The importance of technology in human life is enormous since the beginning of the 20th century. Upgrading to new technology enables the production of higher quality products and makes our life easier. However, adopting new technology is costly for firms as it requires the employment of qualified labor and investment in infrastructure. Very frequently we witness the introduction of all-new technology to be used in the production process of any product, but it takes time for firms to adapt this new technology. Usually, high quality products based on new technology exist in the market along with lower quality products. If new technology is adapted by very few firms, these firms gain market power and become able to set the price for their high quality products. In this way they can enjoy positive profits.

If a new technology is adapted by very few firms which enjoy market power and if the low technology is well established so that it has a competitive market there is a price difference between the high quality product and the low quality product in equilibrium, which is called price premium. This price premium depends on the number of firms using high technology and low technology, on firms' cost function, as well as on the consumer demand for both quality levels.

If the variable cost of producing high quality product is not very different than that of low quality product and at the same time if consumers value high quality product a lot, then a market intervention to spread the use of high technology and allow the consumers enjoy higher surplus might increase total welfare of the society, which we take as the sum of the consumer surplus and the producer surplus.

In this paper, we are trying to show with a basic model that in appropriate markets, banning the use of old technology might be a viable market intervention so that it increases total welfare and does not lead to serious harm to society.

A recent example for this policy was employed in European egg market. With a directive in 1999, European Council has banned the use of conventional egg production methods starting from January, 2012. In this paper we analyze the worldwide organic food market and propose that banning old technology (which corresponds to conventional methods used in agriculture, poultry and livestock) can be applied as a viable policy considering the supply and demand side properties of the market. Broadening the perspective we propose that in appropriate markets, banning old technology can lead to welfare improvements and should be considered as a policy option.

Before analyzing market properties, we will explain the history of "organic method". "Organic" is a labeling claim that describes how an agricultural food or fiber product was grown and handled before it reached the consumer. Pesticides, fertilizers, antibiotics, synthetic hormones, genetic engineering are inconsistent with organic production.Until early 20th century main aim of agriculture was to increase productivity through the use of various kinds of synthetic products such as pesticides and fertilizers. It was early 1900s when Rudolf Steiner's Spiritual Foundations for the Renewal of Agriculture has inspired the so called *bio-dynamic agriculture* in Germany, which shares the same principles with organic farming. Sir Albert Howard, who is seen as the father of organic movement has published his "Agricultural Testament" in 1940 where he has explored composting as an alternative to fertilizers. However it was late 1960s when consumer awareness of environmental issues grew up and organic farming techniques spread all over the world including not only European countries but also the United States, Canada, Australia and Japan. From 1990 on governments adopted legal frameworks in order to monitor the organic food market and to bring standards to the term "organic" as throughout its development consumers were confused about what exactly organic food means. European Union adopted its first regulation on June 24, 1991 with Council Regulation (EEC)No: 2092/91 which was implemented in 1992. It laid down basic rules for organic farming and led to its official recognition. Since then this regulation is updated or supplemented with new regulations. With the Council Regulation (EC) 834/2007 of 28 June 2007, which establishes a general framework to rules regarding plant, livestock and aquaculture production including rules on conversion, production of wine, feed and organic yeast,

- the use of EU organic logo will be mandatory
- the place where the products are farmed will be indicated
- to be able to carry an organic logo, at least 95 percent of the ingredients should be organic
- and genetically modified organisms (GMO) will be prohibited.

United States followed an almost simultaneous path with Europe. In 1990 Organic Foods Production Act proposed national standards for production, labeling and selling of "organic" labeled foods. After requested public comment and revisions held by United States Department of Agriculture (USDA), on October 21, 2002 *National Organic Standards* became effective as a federal law. National Organic Program (NOP) is the legal body which manages organic standards and certification of organic products. According to the law, products that make organic claims must be certified by a USDA-accredited organization. However, farms selling less than $5,000 per year are exempt from accreditation. As in EU, certified products contain a minimum of 95% organic ingredients. Most synthetic herbicides and pesticides as well as genetically modified seed are prohibited too. All organic livestock must be fed by organic feed and they may not be given growth hormones. The use of antibiotics and manure are not allowed.

Organic food can be seen as a "new technology which bears a fixed cost" in our framework as it is a new system which not only requires a costly conversion process but also bears higher variable costs. Specifically, the studies about the cost of organic egg production system will be covered in chapter 3. In chapter 2 we will discuss the organic market in Europe and in the US in detail. Chapter 3 gives information about the ban on conventional egg production system in Europe and the cost structure of the new egg production systems. Chapter 4 presents the model and Chapter 5 gives concluding remarks.

# Chapter 2

# An Overview of the Organic Market

## 2.1 Introduction

In the last ten years organic food market experienced an enormous growth worldwide. Although it has it's roots in Europe, more than 120 countries practice organic farming today. According to a survey conducted by Research Institute for Organic Farming (FIBL) [Willer and Yussefi, 2007] total area operated organically was almost 31 million hectares in 2007. The number of total organic farms exceeded 600,000 which made up 0.7 % of the whole agricultural land. The countries with largest organic land were Australia (with 11.8 million hectares), Argentina (3.1 million hectares) , China (2.3 million hectares) and the US (1.6 million hectares). In terms of regions, Oceania hosted 39 % of the total organic land, Europe held 23 % and Latin America 19 %. The expansion of organic farmland is in part a response to the increasing demand on the market. In 2005, sales of organic food and drink reached 33 billion US Dollars globally with a 43 percent increase from 23 billion US-Dollars since 2002.

Table 2.1: Organic Land and Farms by continent

| Continent | Organic land area(hectares) | Share of total agricultural area | Farms |
|---|---|---|---|
| Africa | 890’504 | 0.11% | 124’805 |
| Asia | 2’893’572 | 0.21% | 129’927 |
| Europe | 6’920’462 | 1.38% | 187’697 |
| Latin America | 5’809’320 | 0.93% | 176’710 |
| North America | 2’199’225 | 0.56% | 12’063 |
| Oceania | 11’845’100 | 2.59% | 2’689 |
| Total | 30’558’183 | 0.74% | 633’891 |
| Source:FIBL Survey 2007 | | | |

Although organic farming takes place in almost every part of the world, the demand is concentrated in a few regions. Particularly, consumer purchases in the European Union and the US composed 95 percent of the global retail sales of organic food products in 2003.[Dimitri and Oberh Since these two regions constitute the largest markets worldwide and and provide satisfactory data we will focus on them in the rest of this chapter and analyze the supply and demand structures in both and achieve some insights for policy recommendations.

## 2.2 Supply Side: Organic production in Europe and in US

According to FIBL's survey[Willer and Yussefi, 2007] 6.9 million hectares were managed organically in Europe, 6.3 million hectares of this were in EU. The former makes up 1.4 percent and the latter 3.9 percent of all agricultural land. The number of organic farms in EU was almost 160,000 and in Europe higher than 190,000.

In 2005, Italy had almost one-sixth of all organic land in Europe with about 1 million hectares, followed by Spain (807,569 hectares) and Germany (807,406) hectares. The smallest organic land was accounted by Bosnia Herzegovina (416 hectares). Austria had the highest share of agricultural land managed organically, 14.7 percent of total hectares, Switzerland's organic land made up almost 11 percent of the total and Italy's organic land was 10.4 percent of the total. In Europe, average share of organic land was 1.38 percent and in EU 3.18 percent.

Table 2.2: Organic land and farms in Europe

| Country | Year | Organic land area | Share of agricultural land | Organic farms |
|---|---|---|---|---|
| Albania | 2006 | 1'170 | 0.10% | 93 |
| Austria | 2005 | 360'972 | 14.16% | 20'310 |
| Belgium | 2005 | 22'996 | 1.65% | 693 |
| Bosnia Herzegovina | 2006 | 416 | 0.02% | 26 |
| Bulgaria | 2005 | 14'320 | 0.27% | 351 |
| Croatia | 2005 | 3'184 | 0.10% | 269 |
| Cyprus | 2005 | 1'698 | 1.12% | 305 |
| Czech Rep | 2005 | 254'982 | 5.97% | 829 |
| Denmark | 2005 | 145'636 | 5.62% | 2'892 |
| Estonia | 2005 | 59'862 | 7.22% | 1'013 |
| Finland | 2005 | 147'587 | 6.52% | 4'296 |
| France | 2005 | 560'838 | 2.03% | 11'402 |

| | | | | |
|---|---|---|---|---|
| Germany | 2005 | 807’406 | 4.74% | 17’020 |
| Greece | 2005 | 288’255 | 3.15% | 14’614 |
| Hungary | 2005 | 123’569 | 2.90% | 1’553 |
| Iceland | 2005 | 4’684 | 0.21% | 23 |
| Ireland | 2005 | 35’266 | 0.84% | 978 |
| Italy | 2005 | 1’067’102 | 8.40% | 44’733 |
| Latvia | 2005 | 118’612 | 4.78% | 2’873 |
| Liechtenstein | 2005 | 1’040 | 27.90% | 35 |
| Lithuania | 2005 | 69’430 | 2.49% | 1’811 |
| Luxemburg | 2005 | 3’243 | 2.51% | 72 |
| Macedonia | 2005 | 249 | 0.02% | - |
| Malta | 2005 | 14 | 0.13% | 6 |
| Moldova | 2005 | 11’075 | 0.44% | 121 |
| Netherlands | 2005 | 48’765 | 2.49% | 1’377 |
| Norway | 2005 | 43’033 | 4.14% | 2’496 |
| Poland | 2005 | 167’740 | 1.03% | 7’183 |
| Portugal | 2005 | 233’458 | 6.34% | 1’577 |
| Romania | 2005 | 87’916 | 0.60% | 2’920 |
| Russian Federation | 2005 | 40’000 | 0.02% | 40 |
| Serbia/Monte negro | 2005 | 591 | 0.01% | - |
| Slovak Republic | 2005 | 92’191 | 4.91% | 196 |
| Slovenia | 2005 | 23’499 | 4.84% | 1’718 |
| Spain | 2005 | 807’569 | 3.20% | 15’693 |
| Sweden | 2005 | 200’010 | 6.27% | 2’951 |
| Switzerland | 2005 | 117’117 | 10.94% | 6’420 |
| Turkey | 2005 | 93’133 | 0.24% | 14’401 |
| UK | 2005 | 619’852 | 3.90% | 4’285 |
| Ukraine | 2005 | 241’980 | 0.59% | 72 |
| Total Europe | | 6’920’462 | 1.38% | 187’697 |
| Total European Union | | 6’260’553 | 3.84% | 160’380 |
| Source:FIBL Survey 2007 | | | | |

**Organic Livestock in EU**

In 2003, total certified organic livestock amounted 3 million at EU-25 level, which made up 2.3% of the total livestock in European Union. 2.8 million of the total organic livestock was in the former 15 member states, where Italy, Sweden and Germany had each more than 400000 units. The number of organic livestock was 0.33 million in UK, 0.31 million in France, 0.26 million in Austria and 0.22 million in Spain. Some member states had a significant share of certified animals in specific livestock. For example, certified dairy cows were 16% of total dairy cows in Austria, 10% of the dairy cows herd was certified in Denmark, %6 in Sweden and %4 in United Kingdom.

The number of organic broiler and laying hens in EU-15 was more than 9 and 6 million respectively in 2003. The share of organic hens in total hens was 1.7% on average in EU-15 but in Denmark, this was significantly high with 22%. 5.1 million broilers which is more than half of total in EU-15, were in France and 1.4 million in UK.[EC, 2005]

### Organic Land in US

Certified organic farmland in US has been increased enormously since 1990 when the Organic Foods Production Act [1] was passed in Congress, however it's share in total agricultural land is still very small, especially compared to Europe and compared to the market size of US. Since the demand is far beyond the supply, imports of organic food are quite high. In 2002, US imports of organic food reached $1.0-1.5 billion and the ratio of imported to exported organic products was 8 to 1.[Dimitri and Oberholtzer, 2005]

According to USDA's Economic Research Service [ERS, 2006], in 2005 total certified organic farmland was about 1.65 million hectares (4 million acres) in United States. Almost 950,000 hectares (2.3 million acres) of this consisted of pasture land and about 700,000 hectares (1.7 million) of cropland. Total organic land made up 0.5 percent of more than 322 million hectares of agricultural land and the number of certified operations was 8,493. These numbers are considerably small in comparison to Europe, however it should be added that they still reflect substantial growth in the supply side. The change in total certified farmland was 43 % between 1997 and 2002, and 111% between 2002 and 2005. The major factor that contributed to the change in the latter period was the 272% increase in the organic pasture land. In 2005, for the first time all 50 states had some organically managed land. California was the leading state in certified organic cropland (about 90,000 hectares) and in the number of farms (1,916). The number of organic animals, although being small relative to the market, has been increased rapidly, reflecting the increasing demand especially to organic milk and eggs. US-wide number of livestock and poultry totaled almost 14 millions in 2005, with an almost 350% change from 3,2 millions in 2000. The number of organic milk cows jumped from 38,196 in 2000 to 87,082 in 2005 and the number of organic layer hens from 1,113,746

[1] Organic Foods Production Act was first to establish national standards governing the marketing of certain agricultural products as organic and was aiming at assuring consumers that organically produced products meet a consistent standard.

to 2,415,056 in the same period. There is still room for the market to grow since the demand expands every year and these numbers of organic milk cows and layer hens made up only 1% and .7% of the total respectively.

Table 2.3: Total organic acreage and animal herds, 2000-05

| U.S. certified farmland | 2000 in acres | 2001 in acres | 2002 in acres | 2003 in acres | 2004 in acres | 2005 in acres | 2000-05 % change |
|---|---|---|---|---|---|---|---|
| Total | 1776073 | 2094272 | 1925534 | 2196874 | 3045109 | 4054429 | 128 |
| Pasture/ rangeland | 557167 | 789505 | 625902 | 745273 | 1592756 | 2331158 | 318 |
| Cropland | 1218905 | 1304766 | 1299632 | 1451601 | 1452353 | 1723271 | 41 |
| certified animals: | | | | | | | |
| Livestock: | | | | | | | |
| Beef cows | 13829 | 15197 | 23384 | 27285 | 36662 | 36113 | 161 |
| Milk cows | 38196 | 48677 | 67207 | 74435 | 74840 | 87082 | 128 |
| Other cows | 0 | 993 | 10103 | 11501 | 36598 | 58822 | 0 |
| Hogs and pigs | 1724 | 3135 | 2753 | 6564 | 4883 | 10018 | 481 |
| Sheep and lambs | 2279 | 4207 | 4915 | 4561 | 4270 | 4471 | 96 |
| Total livestock | 56028 | 72209 | 108362 | 124346 | 157253 | 196506 | 251 |
| Poultry: | | | | | | | |
| Layer hens | 1113746 | 1611662 | 1052272 | 1591181 | 1787901 | 2415056 | 117 |
| Broilers | 1924807 | 3286456 | 3032189 | 6301014 | 4769104 | 10405879 | 441 |
| Turkeys | 9138 | 98653 | 305605 | 217353 | 164292 | 144086 | 1477 |
| Other | 111359 | 17244 | 1880115 | 670604 | 583269 | 792249 | 611 |
| Total poultry | 3159050 | 5014015 | 6270181 | 8780152 | 7304566 | 13757270 | 335 |
| Total certified operations* | 6592 | 6949 | 7323 | 8035 | 8021 | 8493 | 29 |
| Source: Economic Research Service, USDA | | | | | | | |

## 2.3 Organic Sales in US

United States experiences the expansion of organic products to almost every corner. Every year more and more restaurants and university cafeterias add organic meals to their menu. In contrast to the past, organic foods are not only sold in specialized shops or farmer markets, but also in mainstream supermarket chains such as Wal-Mart and Target. According to Mintel, top retail grocers in US now have more than 300 private organic Price Look-Ups (PLU), which are numbers identifying the fresh products in grocery stores and supermarkets. This is a very high number considering the fact that there are around 1300 universal PLU's assigned.

According to Organic Trade Association (OTA)'s 2007 manufacturer survey, organic industry in US grew up 21 % in consumer sales in 2006, with respect to 2005, reaching \$17.7 billion. Sales are estimated to reach \$21.2 billion in 2007 and projected to be more than \$23.6 billion in 2008. The largest segment within organic industry was the foods segment, which made up 95% of all organic product sales with \$16.7 billion and grew at an annual rate of 20.9% in 2006. The penetration rate of organic foods into the overall food industry was 2.8 percent in 2006, sustaining the uninterrupted increase from 0.8% in 1997.

US organic market is a demand driven market. As the demand grows rapidly, farmers and firms, which produce, process and distribute organic food were sometimes unable to meet the demand and faced some shortages in organic ingredients. In the same OTA survey, 52% of the respondents revealed that they faced shortages in raw materials.

Table 2.4: Total Foods and Organic Foods Consumer Sales and Penetration, 1997-2006

| | Organic Food Sales($ million) | Organic Food Sales Growth | Total Food Sales ($ million) | Organic Penetration |
|---|---|---|---|---|
| 1997 | $3,594 | N/A | $443,790 | 0.8% |
| 1998 | $4,286 | 19.2% | $454,140 | 0.9% |
| 1999 | $5,039 | 17.6% | $474,790 | 1.1% |
| 2000 | $6,100 | 21.0% | $498,380 | 1.2% |
| 2001 | $7,360 | 20.7% | $521,830 | 1.4% |
| 2002 | $8,625 | 17.3% | $530,612 | 1.6% |
| 2003 | $10,381 | 20.2% | $535,406 | 1.9% |
| 2004 | $11,902 | 14.6% | $544,141 | 2.2% |
| 2005 | $13,831 | 16.2% | $556,791 | 2.5% |
| 2006 | $16,718 | 20.9% | $598,136 | 2.8% |
| Source: OTA's Manufacturer Survey, 2006 and 2007 | | | | |

## 2.4 Organic Sales in Europe

Since there is no unified data collection system for organic market in Europe, information and statistics about the organic market vary among different reports, due to the differences in the degree of detail and the time period data collected and the country in focus.

According to FIBL's Report[Willer and Yussefi, 2007], European organic market was estimated to be worth of 14.2 billion Euros in 2005 with a growth rate of 10 to 15 percent in value. This is a significant increase compared to the market value estimated by the same institution in 2004, i.e 12 billion Euros, with a growth rate of 5 to 7 percent. The highest growth rates were recorded in Czech Republic (33 percent), UK (29 percent) and Spain (20 percent). However Germany continues to be the largest market in Europe with an estimated sales value of 3.9 billion Euros followed by Italy (2.4 billion Euros), Great Britain (2.33 billion Euros) and France (2.2 billion Euros). Swiss market was estimated to be worth 763 million Euros with a high 4.5 percent market share explaining the profile of Swiss consumer, who spent the highest amount for organic products per capita with 103 Euros. Danish consumers spent 57 Euros per capita for organic products, followed by Austrian consumers (56 Euros per capita), German consumers (47 Euros per capita), Italian consumers (42 Euros per capita) and British consumers (39 Euros per capita).

In Germany, the infrastructure of organic providing shops is well developed, which has been playing important role in the development of the market. These specialist shops include around 2500 independent heath food shops, 400 organic supermarkets, 2000 Reformhaeuser[2], 500 organic bakeries and 100 organic butchers. 41 percent of organic foods were sold in traditional multiple retail chains, while 31 percent was sold in the specialist shops mentioned. Specialized organic food market grew by 10 percent. The total number of organic food businesses including the producers, processors, importers and traders increased by 8.8 percent in 2006 reaching 23,978. In contrast to Germany, 76 percent of all organic sales took place in multiple retailers in UK, and 69 percent of all organic sales were reached in conventional retail stores in Austria. Similar to UK, conventional retail chains amounted 75 percent of all organic sales in Switzerland. Turkey has an infant organic market, mainly driven by the international demand. Most of the production has been exported to more than 30 countries, but mainly to Germany, Netherlands, Uk and Italy. In 2005, there were approximately 14,400 organic holdings in Turkey.

Table 2.5: The European market for organic food 2005: Shares of the individual countries of the European organic market

| | |
|---|---|
| Germany | |
| Turnover domestic organic food market | 3’900’000’000 |
| Population (million) | 82.5 |
| Per capita consumer expenditure for organic food | 47 |
| Italy | |
| Turnover domestic organic food market | 2’400’000’000 |
| Population (million) | 57.8 |
| Per capita consumer expenditure for organic food | 42 |
| UK | |
| Turnover domestic organic food market | 2’333’000’000 |
| Population (million) | 59.5 |
| Per capita consumer expenditure for organic food | 39 |
| France | |
| Turnover domestic organic food market | 2’200’000’000 |
| Population (million) | 59.9 |
| Per capita consumer expenditure for organic food | 37 |
| Switzerland | |
| Turnover domestic organic food market | 763’000’000 |
| Population (million) | 7.4 |

[2]a special name for food shops which just sell food which is environment-friendly and does not include preservatives

| | |
|---|---|
| Per capita consumer expenditure for organic food | 103 |
| Netherlands<br>Turnover domestic organic food market<br>Population (million)<br>Per capita consumer expenditure for organic food | <br>419’000’000<br>16.2<br>29 |
| Austria<br>Turnover domestic organic food market<br>Population (million)<br>Per capita consumer expenditure for organic food | <br>450’000’000<br>8.1<br>56 |
| Sweden<br>Turnover domestic organic food market<br>Population (million)<br>Per capita consumer expenditure for organic food | <br>433’000’000<br>9<br>48 |
| Denmark<br>Turnover domestic organic food market<br>Population (million)<br>Per capita consumer expenditure for organic food | <br>306’734’500<br>5.4<br>57 |
| Spain<br>Turnover domestic organic food market<br>Population (million)<br>Per capita consumer expenditure for organic food | <br>300’000’000<br>42.2<br>7 |
| Finland<br>Turnover domestic organic food market<br>Population (million)<br>Per capita consumer expenditure for organic food | <br>80’000’000<br>5.2<br>15 |
| Ireland<br>Turnover domestic organic food market<br>Population (million)<br>Per capita consumer expenditure for organic food | <br>66’000’000<br>4<br>17 |
| Portugal<br>Turnover domestic organic food market<br>Population (million)<br>Per capita consumer expenditure for organic food | <br>50’000’000<br>10.4<br>5 |
| Norway<br>Turnover domestic organic food market<br>Population (million) | <br>41’000’000<br>4.6 |

| | |
|---|---|
| Per capita consumer expenditure for organic food | 9 |
| Poland | |
| Turnover domestic organic food market | 30’000’000 |
| Population (million) | 38.2 |
| Per capita consumer expenditure for organic food | 0.79 |
| Czech Republic | |
| Turnover domestic organic food market | 12’000’000 |
| Population (million) | 10.2 |
| Per capita consumer expenditure for organic food | 1.2 |
| Hungary | |
| Turnover domestic organic food market | 5’635’000 150 |
| Population (million) | 10.1 |
| Per capita consumer expenditure for organic food | 0.6 |
| Ukraine | |
| Turnover domestic organic food market | 4’000’000 |
| Population (million) | 48.3 |
| Per capita consumer expenditure for organic food | 0.08 |
| Liechtenstein | |
| Turnover domestic organic food market | 2’500’000 |
| Population (million) | 0.33 |
| Per capita consumer expenditure for organic food | 8 |
| Source:The World of Organic Agriculture Statistics and Emerging Trends 2007 | |

## 2.5 Fixed Cost Faced When Switching to Organic

Organic farming can be considered as a new technology. As economic theory suggests it requires a fixed cost to be invested prior to enjoy the extra profit it brings. This fixed cost is not as simple as we think of capital investment, which can be measured in terms of the exact money we have to invest. Organic farming not only requires some investment in the farms, as it may require new buildings, shelters, vehicles etc, but also new labor, preferably experienced in organic farming techniques. On the other hand it has some risks related to experiencing a new technique and adaptation period. Unsuccessful trials may end up in less crop and considerable losses.

Organic standards require the livestock to be fed organically, hence as an example, a corn producer would consider to make use of small grains and forage he has, by adding some livestock to his farm in a conversion process. This requires the establishment of new pastures, building of fences and equipment to support the livestock.

Possible risks of converting to organic production include the delay of planting up to one month due to new cultural practices which may reduce the chance of pollen drift. Since crops need continuous scouting and hoeing, more labor is needed. Since pesticides are not allowed, there is always a higher probability to have weeds in crops than using conventional practices. In such a case, in order to begin harvest , a frost should be waited for, which means delay in the whole process. If this cannot help, pitchfork should be used to clean out the weed, which again requires additional labor.[Wolf, 2006]

Another major factor increasing the cost of organic production are longer crop rotations used for pest and disease suppression. Overall net returns may be lower in organic production systems since high-value crops are harvested less frequently than conventional systems.[Temple, 2003]

State and private certifiers charge a fee for the certification which is an ongoing expense in organic production. This may be not significant for large scale producers but certainly affects small farmers. (It should be added that each producer making more than $5000/year must be certified in US in order to claim organic) Before giving the organic certificate, these agencies ask for the documentation of the 3-year conversion period in which land must be managed according to the national organic standards. During this period, farmers cannot obtain high prices for their organic products, hence must rely on conventional prices with additional costs. This brings a need for financial self sufficiency for the conversion years.[Oberholtzer et al., 2005]

## 2.6 Demand side: Organic consumers

The US demand for organic food is mostly triggered by concerns about food safety and the integrity of the food consumed. As more food-borne illnesses appear in the media, consumers become more sensitive about what they eat, and the belief that organic food is safer than the conventional food makes them purchase more organic products. According to Foodborne Diseases Active Surveillance Network(FoodNet)of CDC(Centers for Disease Control and Prevention), in 2006 food supply was challenged by pathogens like Listeria (causes lethal infection called listeriosis, which has a 25% case fatality rate) and Shigella (causes Shigellosis which develops fever and stomach cramps). Since infections caused by Salmonella and E.coli are attributed to consumption of egg, poultry, meat and chicken, concern about food safety reflects itself mostly in the demand of organic eggs, poultry and meat. For example according to Mintel's survey, many consumers believe that organic foods are the answer to food-borne illnesses like BSE (mad cow disease).

**Who purchases organic? What is the reason not to buy?**

According to Mintel's survey in US, younger consumer's demand is considerably higher than olders. While 66% of the 18-24 age group consumed some organic food in previous year, this was just %32 in the 65+ age group. In total, 52 percent of the respondents purchased some organic food in the previous year. Income distribution of organic consumers is in line with the common sense that organic food is a luxury good. According to the same survey, higher income households are more likely to consume organic than lower income households. 56% of households with higher than 100K/year income bought organic, where just 36% of the ones with less than 25K/year could go for organic. The same pattern can be observed in the frequency of organic purchases. 39% of the 25-34 age group and 30% of higher than 75K/year income households have answered "often" to the question "How frequent do you buy organic?", whereas just 11% of 65+ age group and 19 % of less than 25K/year income group answered the same question as "often".

Table 2.6: Frequency of purchase of organic food and drink, by age, July 2008

| | All | 18-24 | 25-34 | 35-44 | 45-54 | 55-64 | 65+ |
|---|---|---|---|---|---|---|---|
| | percent | | | | | | |
| Often | 24 | 26 | 39 | 27 | 20 | 19 | 11 |
| Occasionally | 53 | 53 | 40 | 53 | 58 | 62 | 64 |
| Rarely | 21 | 21 | 22 | 20 | 23 | 20 | 25 |
| Source: Mintel | | | | | | | |

Table 2.7: Frequency of purchase of organic food and drink, by household income, July 2008

| | All | $25 K or less | $25K-$49.9K | $50K-$74.9K | $75K-$99.9K | $100K+ |
|---|---|---|---|---|---|---|
| | percent | | | | | |
| Often | 24 | 19 | 24 | 26 | 31 | 29 |
| Occasionally | 53 | 51 | 55 | 57 | 52 | 51 |
| Rarely | 21 | 30 | 21 | 17 | 17 | 20 |
| Source: Mintel | | | | | | |

The trend of more frequent organic purchases reveals the high potential of the market to grow further. Based on the same survey, more than half of all age groups purchased more organic in 2008 than the previous year. Especially 35-44 age group increased their consumption, with 64%. The awareness of organic consumers shows itself as 70% of all organic consumers reported that they look for a guarantee of 100% organic. A considerable 47% not only looks for any guarantee but also a USDA seal.

Table 2.8: Purchase of organic food compared to previous year, based on age group, July 2008

| | All | 18-24 | 25-34 | 35-44 | 45-54 | 55-64 | 65+ |
|---|---|---|---|---|---|---|---|
| | percent | | | | | | |
| More | 56 | 61 | 57 | 64 | 52 | 52 | 45 |
| Less | 6 | 9 | 5 | 4 | 4 | 4 | 9 |
| The same | 38 | 30 | 38 | 32 | 44 | 44 | 45 |
| Source: Mintel | | | | | | | |

Table 2.9: Criteria for purchasing organic food, July 2007 and July 2008

| | 2007 | 2008 |
|---|---|---|
| | percent | |
| 100% organic | 70 | 69 |
| No artificial ingredients | 71 | 62 |
| No preservatives | 66 | 57 |
| The USDA organic seal | 46 | 47 |
| Brands that give a percentage of their profits to charity | 13 | 16 |
| None of the above | - | 8 |
| Source: Mintel | | |

In order to understand the demand structure, understanding the reasons of not buying organic food is important. The answer to how much the demand would increase if prices were lower lies in these reasons. Price remains as a very big issue. 93 % of all respondents of Mintel survey in 2007 agreed that organic products are normally more expensive than non-organic products. Although the high 60% of all respondents are willing to pay a premium for organic products, 67% of them would buy more organic food if it were less expensive. Almost half of the respondents, who did not buy organic in the previous year, said that if it would be cheaper, they would go for organic. This shows that the possible demand increase in case of a price reduction would be huge. Not only switching non-buyers would drag the demand upward but also the increase in purchases of organic consumers. 84% of the organic consumers said that they would buy more if organic products would be cheaper. It is not only the budget constraint which drives the sensitivity to the price of organic, since a majority

(74%) of the highest income non-buyers (the ones with more than $100K/yr) believe that the price premium for organic products is not justified.

Overall consumer profile in the biggest organic markets in Europe is similar to that in US. According to another Mintel survey, 88% of all Spanish respondents ,84% of all German respondents,79% of al Italian respondents, 72% of all French respondents and 71% of all British respondents purchased organic food in the previous year. More than half of organic consumers in these countries believe that organic food is healthier for them. Additionally, almost half of the German organic consumers, and almost one third of French, Spanish and British consumers believe that organic food tastes better. As the income increases, positive beliefs about organic become more widespread. In Germany, 49% of consumers with less than an income of 15000 Euro/year agreed that organic is more healthier, whereas this is 60% among those with an income more than 30000 Euro/year. In France, 25-34 age group and those with highest income are the most likely to purchase organic food, where in Italy, typical organic shopper is 34-54 years old and has medium to high income and education.

Contrary to US, a small percentage of consumers in leading European organic markets are willing to pay premium prices for organic food. Just 33% of British respondents agreed that it is worth paying more for organic food, while just 22% of German respondents did so. More than 40 % of Italian non-consumer respondents find organic food too expensive as a reason for not buying it. 73% of British, 71% German and 68% of non-consumer French respondents think the same way.

## 2.7 Price premiums in organic products

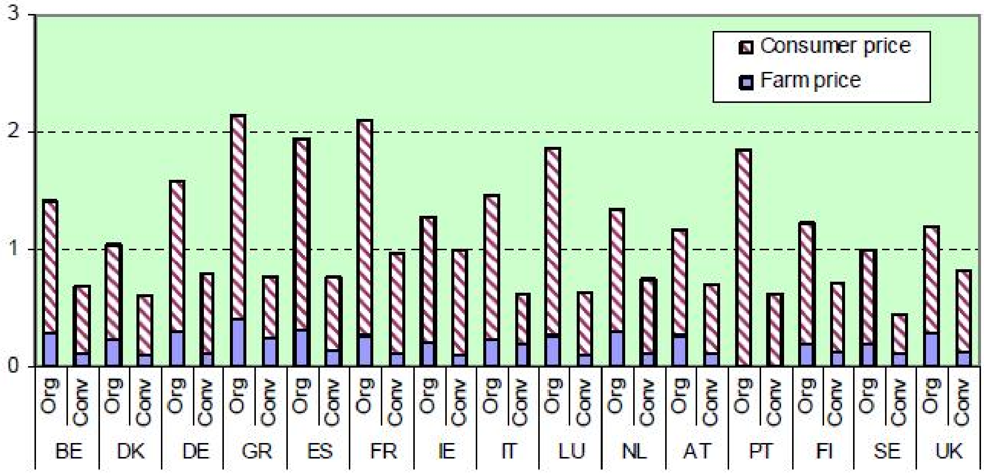
**Price Premiums in EU**

How much do prices of organic food differ in fact? The answer of this question gives us the price premium. Although in general organic costs more than conventional food, the price premium changes across countries and different product groups according EU -Report in which price premiums of different product groups were calculated in 15 EU member states in 2001[EC, 2005]. For farm gate prices, average of what farmers received when they sold their product to wholesalers or processors was taken. For consumer prices data was collected from shops chosen according to the important sales channels in each country.

Here are price premiums in farm gate and consumer prices for wheat, apples, potatoes, milk and egg which constitute a significant basket of most frequently bought organic food. For milk, eggs and potatoes price premiums for farmer prices are higher than for consumer prices, whereas for wheat and apples the opposite is true.

Consumer price for conventional wheat flour were considerably different in each country, for example 0.45€/kg in Sweden, 0.97€/kg in France and 0.80 €/kg in Germany. Consumer price for the same quality of organic wheat was however 1.49€/kg on average. Price premiums for wheat on average were 100% for both farm-gate and consumer prices.

Figure 2.1: Farm-gate and consumer prices for wheat flour in EU-15 (€/kg)



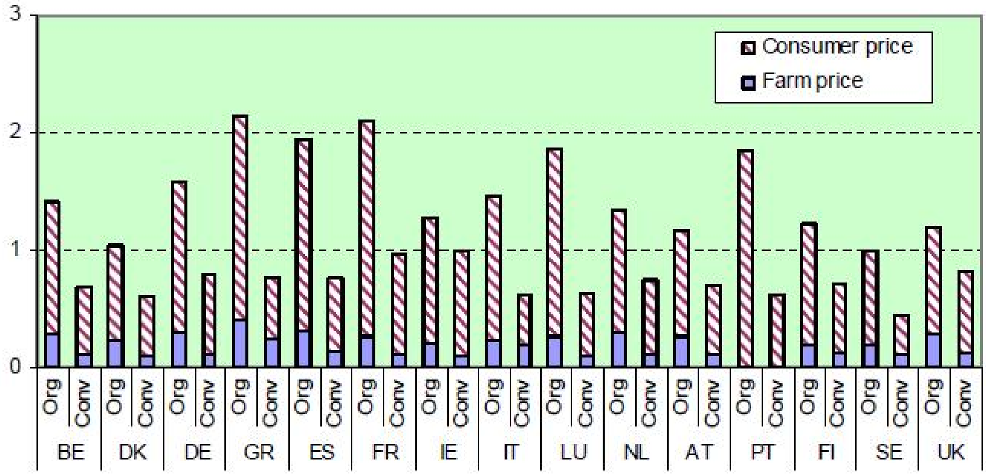

Farm gate prices for organic apples were lowest in Italy, (0.45€/kg), almost competing with conventional apple prices, but this is not a surprise considering the fact that 60 % of EU-15 organic apples sales originated in from Italy. Net imposters of organic apples on the other hand, like UK and Denmark faced high prices, 1.42€/kg and 1.48€/kg respectively. Except for Italy (2%), farm price premiums were higher than 50% for all member states, where consumer price premiums ranged from 37 % in Sweden to 283%in Portugal.

For organic potatoes, farm price premium was on average 166%, with relatively low level (71%) in Sweden and considerably high levels (293% and 285% respectively) in Italy and Austria. Highest prices for organic potatoes at farm-gate were charged in Ireland (0.70€/kg) and in Greece (0.64€/kg) where in Denmark (0.24€/kg), Germany (0.25€/kg) and Belgium (0.26€/kg) they were relatively cheap. Average consumer price premiums was relatively less than farm price premiums and ranged from 30% in Ireland to 170 % in Greece.

Farm gate price premiums for organic milk were relatively low with respect to other products, with an average of about 18%. On the other hand, consumer price premium was on average 50 %, with highest levels in Greece (129%), Portugal (124%) and in Italy (117%). Highest prices for organic milk were observed in these countries, 2.20€/l in Greece, 1.57€/l in Portugal and 1.12€/l in Italy.

Organic eggs costed highest in Greece both at farm level and as consumer price (0.30€/egg and 1.79€/egg respectively). Corresponding price premiums were huge: 329% and 231%.

Figure 2.2: Farm-gate and consumer prices for apples in EU-15 (€/kg)




Lowest price for organic eggs was charged in Netherlands at farm level (0.11€/egg) and as consumer price (0.25€/egg). Average price premium was 132 % at farm gate level.

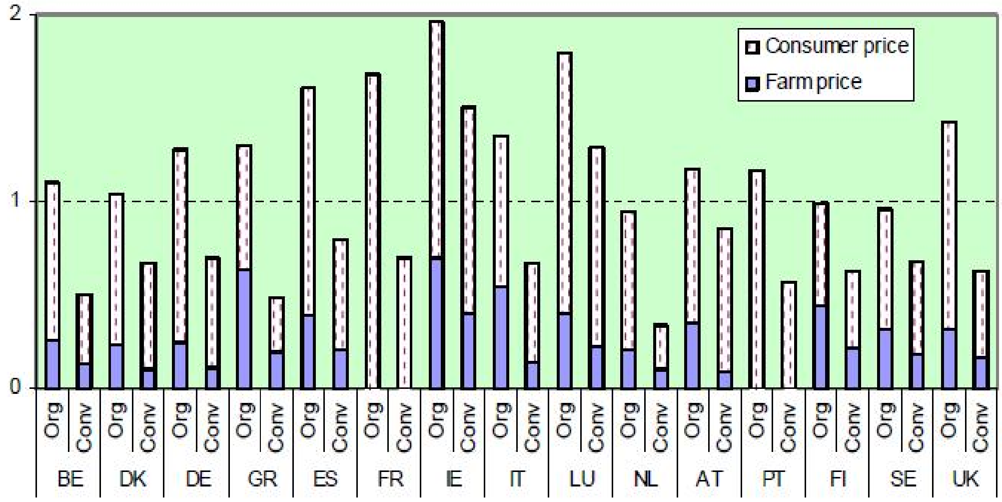
**Price Premiums in US**

Monthly organic prices at wholesale level for a few products such as broccoli, carrots, eggs and poultry are released by Economic Research Service of USDA. According to the available data, price premiums stay high even though there is rapid market expansion in all of the products each year. This suggests that demand is still larger than supply and that there is still room for new producers to enter the market.[Lydia Oberholtzer and Lopez, 2006]

As can be seen in the graph below, price for organic whole broilers stayed at a steady $2.17/pound from March 2004 to February 2006 and at $2.21/pound from April 2006 onwards whereas the price for conventional broiler ranged from a low $0.59/pound in April 2006 to the high $0.82/pound in June 2005. There is continuous fluctuation in conventional prices but no significant downward or upward pattern. Due to this fluctuation, average quarterly price premiums ranged from 169 percent in the second quarter of 2004 to 262 percent in the second quarter of 2006. The average price premium in the whole period was 200 percent.

A similar pattern for organic eggs can be observed between 2004 and 2006. Starting from July 2004 first receiver prices for organic large eggs remained at a monthly average of $2.34/dozen. However conventional egg prices varied in a larger but lower range than for poultry, resulting in more variable and much higher price premiums. Except for March 2004 (when the price was $1.14 per dozen), conventional egg prices were below $1 per dozen,

Figure 2.3: Farm-gate and consumer prices for potatoes in EU-15 (€/kg)




leading to an average of 273 percent premium.

Although are not representative for the whole range of vegetables, sustained price premiums for organic carrot and broccoli can give some insight about the evolution of the market. In the last quarter of 1999, price premium for wholesale organic broccoli was 126%, whereas it was 105% in the third quarter of 2004. However the erratic pattern of the premium (in which it saw a bottom 65% in the last quarter of 2001 and a top of 223% in the last quarter of 2003) suggests that organic sellers can still sustain high premiums due to the high demand and willingness to pay of organic consumers. Contrary to broccoli, wholesale prices for organic and conventional carrots did not fluctuate between the third quarter of 2001 and 2004, sustaining a premium above 130% for the whole period.[Oberholtzer et al., 2005] This is probably due to the formal and informal contracts between retailers and producers.

Figure 2.4: Farm-gate and consumer prices for milk in EU-15 (€/kg)

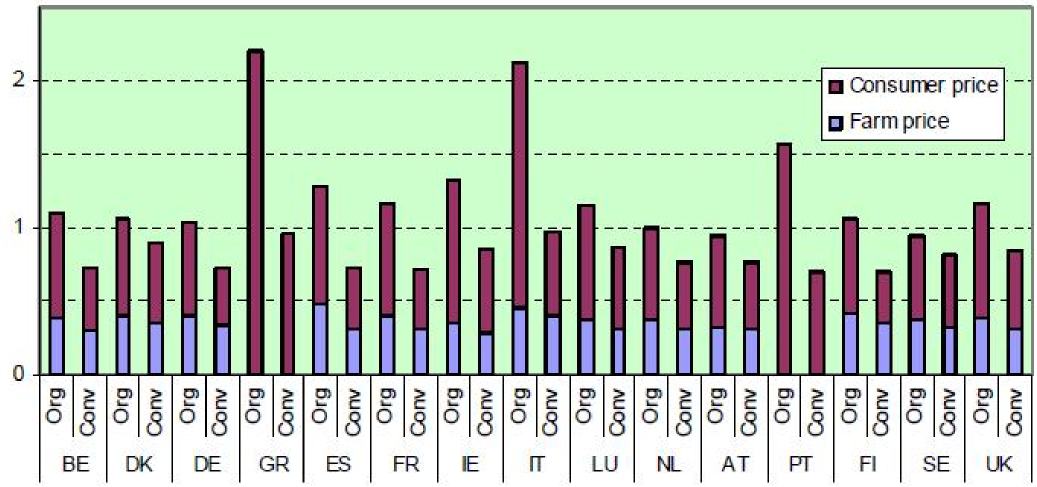



Figure 2.5: Farm-gate and consumer prices for eggs in EU-15 (€/kg)

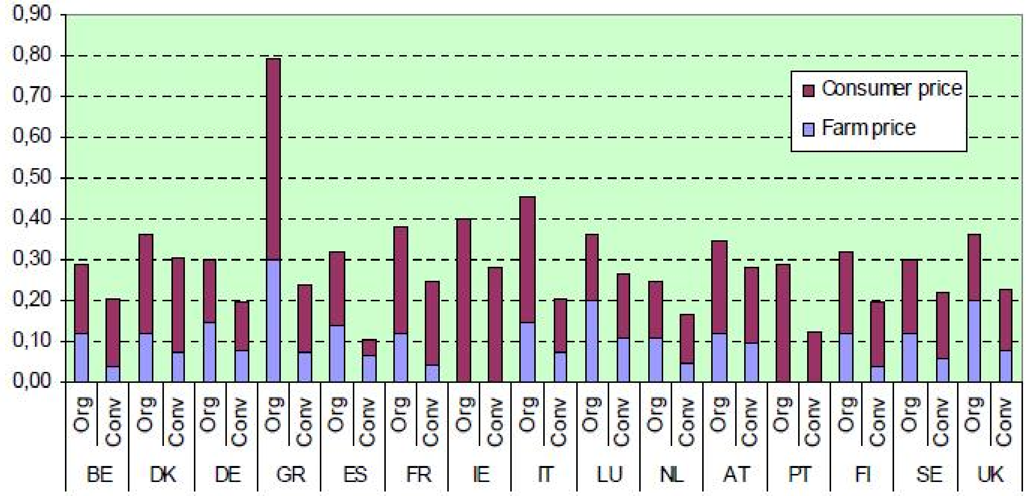


Figure 2.6: Prices and quarterly price premiums for organic whole broilers Source:ERS/USDA

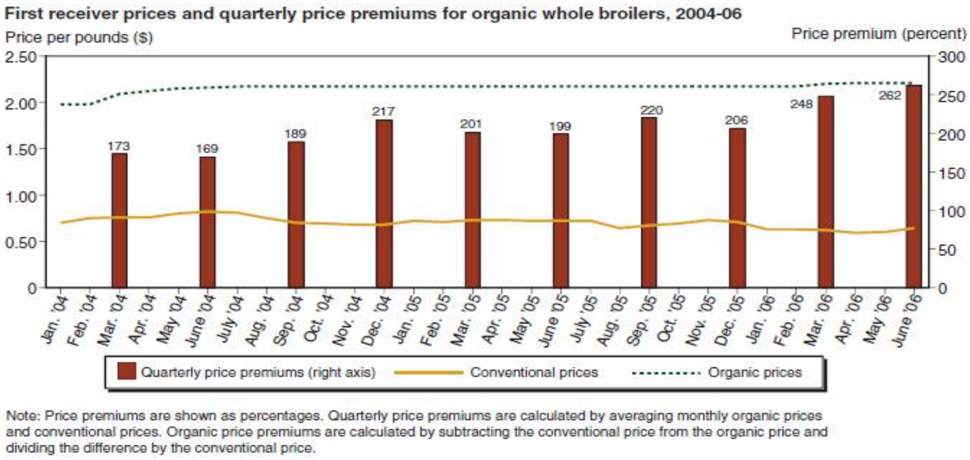



Figure 2.7: Prices and quarterly price premiums for organic large eggs Source:ERS/USDA

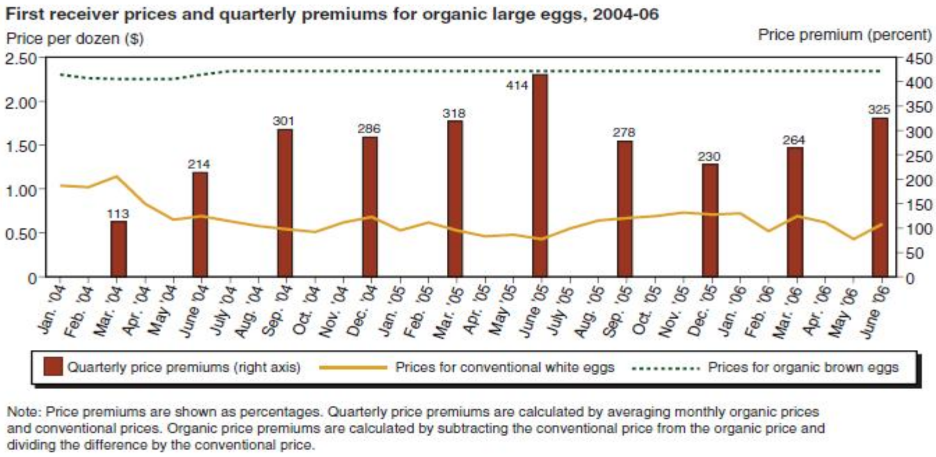


Figure 2.8: Quarterly price premiums for wholesale organic broccoli Source:ERS/USDA

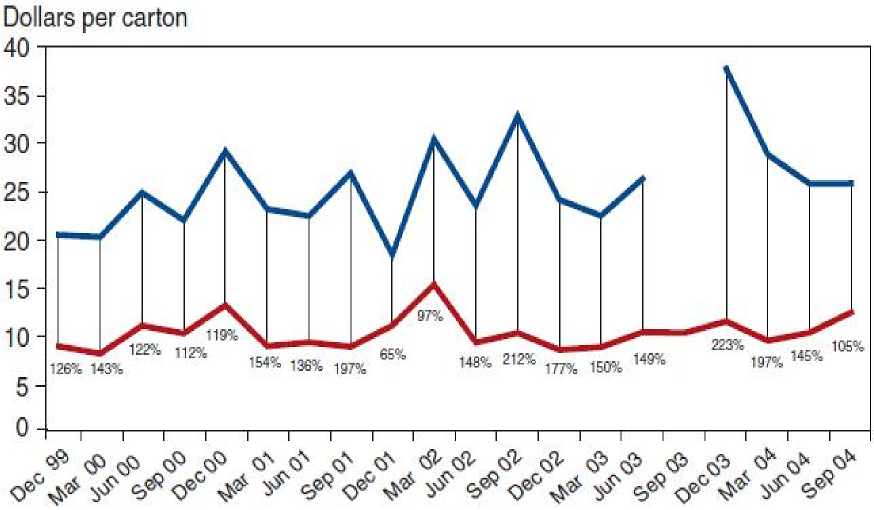
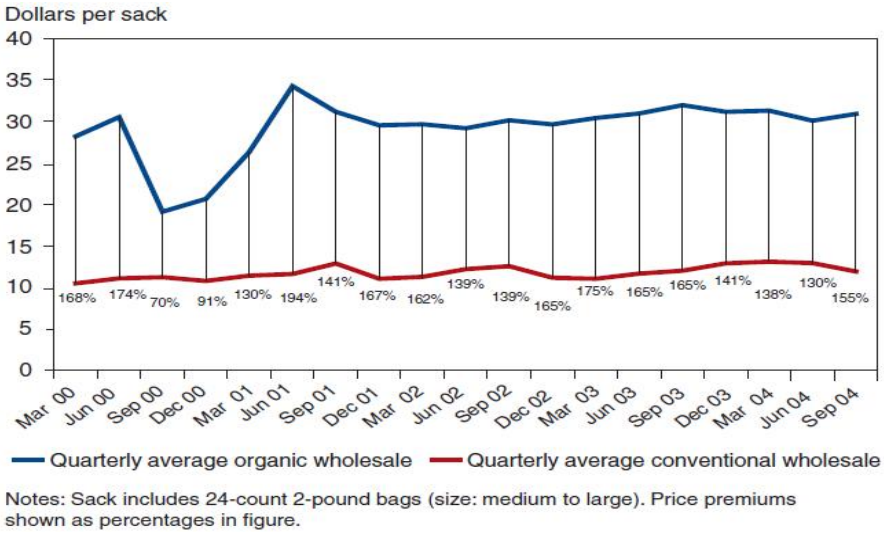



Figure 2.9: Quarterly price premiums for wholesale organic carrots Source:ERS/USDA



# Chapter 3

# Prospective ban of conventional egg production in Europe

An example for banning the old technology to spread the new technology and achieve welfare improvements happened in Europe in the last ten years. With the directive 1999/74/EC, European Council set down standards for egg production including the prohibition of the use of conventional cage systems as of 1 January 2012. Since there are several systems used as an alternative to cage system, this does not mean that all egg producers switch to organic immediately, but we can assume that there will be increases in conversion to the organic system since it enables the producers to capture attractive price premiums and the necessary fixed cost should be invested in any new system because of the new legislation. In this chapter we will explain the different egg production systems with a particular focus on the conventional and most widely used battery cage system and as an alternative, organic system. Then we will examine the cost differences between these two systems and finally will mention some works forecasting overall welfare increase as a result of the ban.

As egg is an indispensable component of daily diet we can assume that everyone consumes it periodically. Just in EU-25, 6'349 million tons of eggs were produced for human consumption in 2003 and yearly consumption per head was about $14.2$ kg.[Timmis, 2004]There are several different systems used in production of eggs. These are the cage system, the barn system, free range system and organic system. Cage system is the most widely used system throughout Europe (89$\%$ of the total production) but also the most controversial one. The cages used to host the hens in this system are also called battery cages since they are arranged in batteries of rows and tiers. They allow 550 $cm^2$ cage area per hen and hens generally have no access to direct sunlight or outdoor. In the barn system there are perches and feeders in the hen house. According to directive 1999/74/EC, there should be "either linear feeders providing at least 10 cm per bird or circular feeders providing at least 4 cm per bird and at least one nest for every seven hens. If group nests are used, there must be at least 1 $m^2$ of nest space for a maximum of 120 hens" In the free range system, hens have continuous access to runs with vegetation with a maximum density of 2,500 birds per hectare, in addition to the housing regulations of the barn system. In organic system, additional to continuous outdoor access, hens have to be fed with organic feed.Until 2003, Spain, Portugal, Italy and Greece had very low proportions of their national flocks kept in alternative systems (just about 1-2 %). On the other hand, some member states had large proportional use of alternative systems such as Austria (28%), Denmark (34.5% of which 14.1% was organic), Sweden (52% with 6% in organic systems) and UK (31%). In France and Germany, the use of alternative systems was at 12-13%, where it was 4-5 % in Belgium and Finland.

The bad conditions hens face in the cage system raised a lot of opposition from different parts of society, including non-governmental organizations and political parties. As a result, European Council took action against the poor welfare conditions of animals with it's Directive/1999/74/EC which laid down minimum standards for the protection of laying hens. According to this, as of 1 January 2003, battery cages have not been allowed to be built for the first time and they will be totally abandoned as of 1 January 2012. However, the so called 'enriched cages' which provides 750 $cm^2$ cage area per hen and somewhat better conditions, are allowed from then on. Only Sweden has been quick to respond to the new legislation so that in 2005, the transition to alternative systems was almost complete.[Taylor, 2005])Besides, Switzerland has banned caged systems in 1981 with a ten year transition period and now all eggs are produced through alternative systems in this country, where 60% of which is free range and the rest is barn system.

Based on data from EU-15 in 2000, egg production was generally large scale and increasingly concentrated. 65% of laying hen places had flocks with more than 30,000 birds and compared to 1995, the number of holdings decreased where the number of their laying hen places increased. Average flock size has increased by 31 % between 1995 and 2000, where this increase was 148% in Portugal, 123% in Denmark and 111% in Finland. These increases along with the 10% increase in the average number of laying hens per unit for places with more than 30,000 hens show the increasing concentration in the sector.[Timmis, 2004]

Based on the results of a survey of egg producing enterprises in England, production costs of cage and organic systems, calculated by Russell et.al[Russell et al., 2005] are summarized in the table below.

Here, *gross margin* is defined as enterprize gross output minus variable cost. The value of produced eggs including the ones sold and consumed in the farm give the gross output, where variable cost includes feed cost, cost of disposal of old hens, veterinary charges, contract charges, casual labor cost and miscellaneous cost. *Net margin before marketing cost* is

Table 3.1: Comparison between two production systems

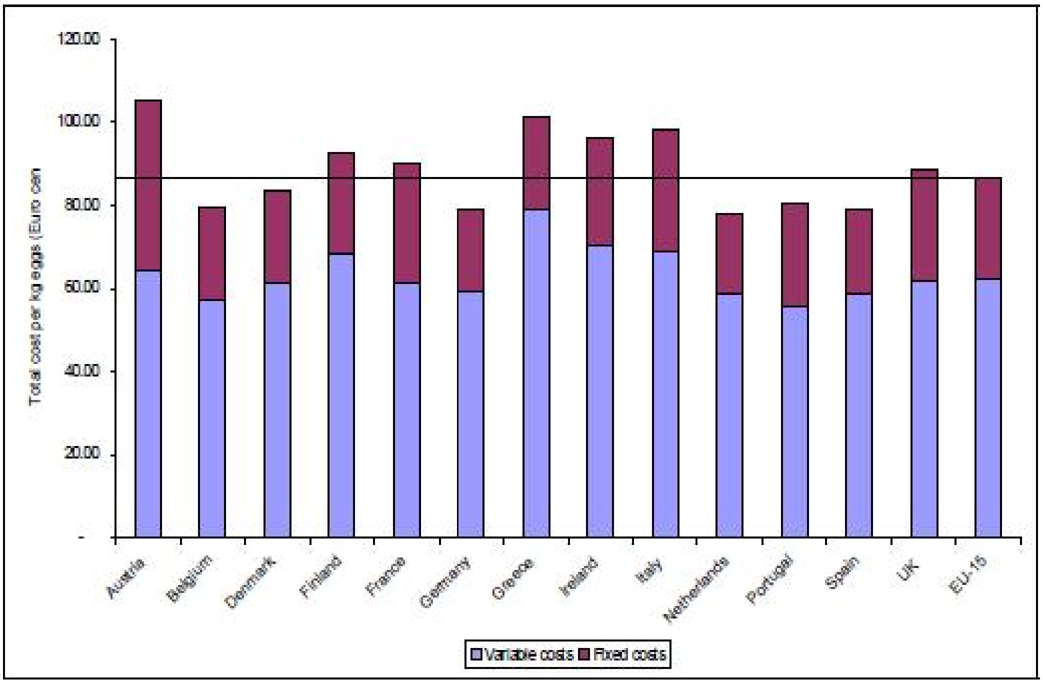
| | Cage | Organic |
|---|---|---|
| Number of units in the sample | 56 | 15 |
| Average number of birds | 76,944 | 9,370 |
| Egg yield per bird | 279 | 277 |
| Mortality percentage | 6.0 | 10.8 |
| Average feed price (£/ton) | 111 | 227 |
| Production labor cost per 1000 birds (£) (paid and unpaid labor) | 958 | 3261 |
| Price of own produced eggs sold (p/doz) | 44.8 | 112.7 |
| Feed cost of egg produced (pence/dozen) | 19.8 | 47.9 |
| Total production cost a (pence/dozen) | 37.74 | 88.86 |
| Gross and Net Margins:(pence/dozen) | | |
| Gross revenue | 45.18 | 113.49 |
| Bird depreciation | 8.00 | 10.57 |
| Variable production costs | 20.77 | 49.75 |
| Gross margin | 16.42 | 53.17 |
| Fixed production costs | 8.97 | 28.45 |
| Net margin (before marketing costs) | 7.45 | 24.72 |
| Marketing costs | 2.47 | 4.69 |
| Net margin (after marketing costs) | 4.98 | 20.03 |
| Farmer and spouse labor cost:(p/doz) | | |
| included in the fixed cost | 0.43 | 4.50 |
| included in marketing cost | 0.30 | 0.43 |
| Gross margin (£/bird) | 3.82 | 12.27 |
| Net margin (after marketing costs) (£/bird) | 1.16 | 4.62 |

Source: The Economics of Egg Production:2003

defined as "enterprize gross output minus all variable and fixed production costs". The fixed production cost includes "depreciation of buildings and equipment used in production-related activities, paid and unpaid labor for production activities, land rent, electricity, water, insurance, office expenses and other miscellaneous costs." Total cost of egg production consists of all variable costs plus fixed costs. Marketing cost includes packing materials, paid and unpaid labor used for marketing activities, advertising and promotion costs. Net margin measures "what is left to reward resources used in management and those used for investment in the enterprize after all other factors of production have been paid an appropriate return" As can be observed in the results, although the cost of organic system is fairly high with respect to the traditional cage system, it cannot explain the difference in gross margins between two systems. This means that higher costs of organic system is not the only reason for the organic price premiums but also consumers' higher willingness to pay. This suggests that if the competition in the organic egg sector increases, we can expect a price decrease.

According to a report to European Commision to analyze the effects of the Directive/1999/74/EC[T at EU 15-level, variable costs made up 73% and fixed costs 27% of total costs in the traditional cage system, whereas variable cost's share in the total cost was 68% in the organic system. Total costs per kg eggs in 15 member states can be seen in the figures below.

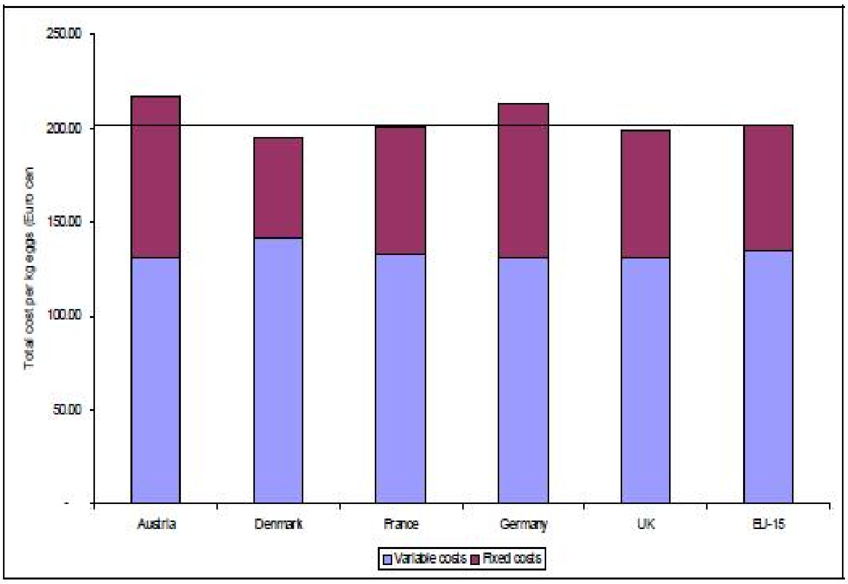
Figure 3.1: Total costs in the traditional cage system per kg eggs




As the production costs in UK suggested, the difference in variable costs between traditional cage system and the organic system is not high enough to explain the high price premiums for organic eggs, suggesting that price cuts in the market are possible in the future with the increased competition in the organic sector.

The analysis of the reaction of the market to some shocks, utilizing a popular method in agricultural economics, i.e. Equilibrium Displacement Modeling, proposes that "as a result of an increase in demand for alternatively produced eggs both producers and consumers show a gain in surplus, the latter partly as a result of an increase in utility from increased consumption of alternatively produced eggs (with more desirable characteristics).This amounts to some 77 million for producers and €19 million for consumers in the case of a 20% increase in demand in the EU-15 (and respectively €65 million for producers and €15 million for consumers for

Figure 3.2: Total costs in the organic system per kg eggs




the EU-25).”[Timmis, 2004]

# Chapter 4

# The Model

## 4.1 Consumers

There is a large number of consumers with identical tastes but different income levels in our model. Let the income of consumer $i$ is denoted by $\theta^i$. We assume that $\theta^i$ is distributed uniformly between $t$ and 1 where ($0<t<1$). Consumers spend their income on a given product and a numeraire good and derive utility from both. Assuming that the quantity of the numeraire good is denoted by $Y$, the quantity of the product by $X$, and the price of the product by $p_X$, consumers' budget constraint can be described as

$$p_X \cdot X + Y = \theta^i$$

There are two quality levels of the product, high and low, denoted by $s_H$ and $s_L$. Suppose that high quality product is sold for $p_H$ and low quality product is sold for $p_L$. The product is indivisible and if consumers buy the product, they buy either high or low quality. Hence, $X = 1$ in the budget constraint. Moreover,

$$U^i(s_H, p, \theta^i) > U^i(s_L, p, \theta^i), \quad \text{for all } \theta^i, p$$

This means that at each income level, high quality product is preferred to low quality product given that they have the same price. As used in [Gabszewicz and Thisse, 1979] such preferences can be described by a utility function as given below

$$U^i(s_H, p_H, \theta^i) = (1 + s_H)(\theta^i - p_H) \tag{4.1}$$

$$U^i(s_L, p_L, \theta^i) = (1 + s_L)(\theta^i - p_L) \tag{4.2}$$

where $s_H > s_L$. If nothing is bought, utility is simply $\theta^i$.

Given the utility functions and prices, we can determine the relative size of the consumers buying each product. In order to derive the demand for each quality level we need to find the income $\theta^*$ of the consumer who is indifferent between the two quality level. Then, for this consumer the following must hold.

$$U(s_H, p_H, \theta^*) = U(s_L, p_L, \theta^*)$$

By using 4.1 and 4.2 it is easy to verify that

$$\theta^* = \frac{p_H(1+s_1) - p_L(1+s_L)}{s_H - s_L}$$

Since income is assumed to be uniformly distributed between $t$ and 1, the number of consumers purchasing the high and low quality products (note that this is equal to the number of products sold) are given by

$$Q_H = \int_{\theta^*}^{1} \frac{1}{1-t} dx$$

$$Q_L = \int_{t}^{\theta^*} \frac{1}{1-t} dx, \text{ if } U^i(s_L, p_L, t) > t$$

In the following we assume that $t$ is sufficiently large so that $U^i(s_L,p_L,t)>t$ is satisfied and hence the market is covered. Substituting $\theta^*$ in $Q_H$ and $Q_L$, we get the demand function for each quality level of the product.

$$Q_H = \frac{s_H - s_L - p_H(1+s_H) + p_L(1+s_L)}{(1-t)(s_H - s_L)}$$

$$Q_L = \frac{p_H(1+s_H) - p_L(1+s_L) - t(s_H - s_L)}{(1-t)(s_H - s_L)}$$

Inverse demand for high quality product, which we will use later is derived from above as

$$p_H = \frac{s_H - s_L + p_L(1+s_L) - (1-t)(s_H - s_L)Q_H}{1+s_H} \tag{4.3}$$

## 4.2 Firms

We assume that the low quality product is based on a well established technology and there are many firms which can produce it at a per unit cost of $c_L$. We assume that this segment is competitive, hence the price is given by the marginal cost $c_L$. Unit cost of producing high quality product is $c_H$ and high quality product requires a new technology, hence a fixed investment cost of F. Therefore the number of firms which would produce it is endogenous. For simplicity we will concentrate on the case where without intervention high quality product is produced by a single firm.

We assume that firms compete by selecting their quantity as strategic variable.

**Proposition 4.2.1.** *If*

$$\underline{F} \leq F \leq \overline{F}$$

*where*

$$\underline{F} = \frac{(s_H - s_L + c_L(1+s_L) - c_H(1+s_H))^2}{9(1+s_H)(s_H - s_L)(1-t)}$$

$$\overline{F} = \frac{(s_H - s_L + c_L(1+s_L) - c_H(1+s_H))^2}{4(1+s_H)(s_H - s_L)(1-t)}$$

*then the high quality product is produced by a single firm. In this case;*

*(i) equilibrium price is*

$$\widehat{p_m} = \frac{s_H - s_L + c_H(1+s_H) + c_L(1+s_L)}{2(1+s_H)}$$

*(ii) the quantity of the high quality product sold in equilibrium is*

$$\widehat{q_m} = \frac{s_H - s_L + c_L(1+s_L) - c_H(1+s_H)}{2(s_H - s_L)(1-t)}$$

*(iii) equilibrium profit of the firm is*

$$\widehat{\pi_m} = \frac{(s_H - s_L + c_l(1+s_L) - c_H(1+s_L))^2}{4(1+s_H)(s_H - s_L)(1-t)} - F$$

*Proof.* If without intervention high quality product is produced by a single firm, producing high quality product should not be profitable when there are two firms. In this case, let the profit of firm i, producing the high quality product be denoted by $\pi_i$. Then,

$$\pi_i = (p_H - c_H)q_i - F, \text{ for } i = 1, 2$$

where $p_H$ is the inverse demand derived by equation 4.3 as

$$p_H = \frac{s_H - s_L + c_L(1+s_L) - (1-t)(s_H - s_L)(q_1 + q_2)}{1 + s_H}$$

Note that the profit functions are concave. This means that first order conditions describe a pure strategy Nash equilibrium of the Cournot game where profits are maximized for both firms.

First order condition (FOC) for firm i=1,2 is given by

$$\frac{s_H - s_L + c_L(1+s_L) - (1-t)(s_H - s_L)q_L - 2(1-t)(s_H - s_L)q_i}{1+s_H} - c_H = 0$$

Solving FOCs we get the quantity produced by each firm in equilibrium, which is;

$$\widehat{q} = \frac{s_H - s_L + c_L(1+s_L) - c_H(1+s_H)}{3(s_H - s_L)(1-t)}$$

and the equilibrium price would be

$$\widehat{p} = \frac{s_H - s_L + c_H(2s_H+2) + c_L(s_L+1)}{3(1+s_H)}$$

With these equilibrium price and quantities, the profit of each firm is negative if

$$F > \frac{(s_H - s_L + c_L(1+s_L) - c_H(1+s_H))^2}{9(1+s_H)(s_H - s_L)(1-t)}$$

and producing high quality is not profitable for both. This gives us the lower bound for F as defined in proposition 4.2.1.

We should also check that the profit is positive when there is only one firm producing high quality product. In this case, the profit of the monopoly is given by

$$\pi_m = (p_m - c_H)q_m - F$$

where the inverse demand is given by

$$p_m = \frac{s_H - s_L + c_L(1+s_L) - (1-t)(s_H - s_L)q_m}{1+s_H}$$

As the profit function is concave, first order condition describes a pure strategy Nash equilibrium of the game as before.

FOC for the monopoly is given by

$$s_H - s_L + c_L(1+s_L) - c_H - 2(1-t)(s_H - s_L)q_m = 0$$

where equilibrium quantity is:

$$\widehat{q_m} = \frac{s_H - s_L + c_L(1 + s_L) - c_H(1 + s_H)}{2(s_H - s_L)(1 - t)}$$

and equilibrium price is:

$$\widehat{p_m} = \frac{s_H - s_L + cH(1 + s_H) + c_L(1 + c_L)}{2(1 + s_H)}$$

At equilibrium, the profit of the firm is positive if

$$F < \frac{(s_1 - s_2 + c_2(1 + s_2) - c_1(1 + s_1))^2}{4(1 + s_1)(s_H - s_L)(1 - t)}$$

This gives us the upper bound of F as defined in proposition 4.2.1.

□

## 4.3 Is banning the low quality product a viable policy option?

Sometimes social policy makers take actions which may seem restrictive but in the long run increase social welfare. We will consider the case where low quality product is banned by the local authority. This may be done directly through a law issued by the government as European Union is planning to ban conventional battery cages for egg laying hens as of January 2012 to promote new "enriched cages" which will provide hens more space and include a nest, litter, perch and clawing boards. Such a ban can also be thought of increasing the price of the low quality product to a prohibitively high level. In this case high quality product competes with an alternative that has a very high price and can not survive in the market. We will look at the consequences of such a ban in the market and investigate its effects on the welfare of the actors i.e. consumers and producers. If such a ban is implemented, the consumer with the lowest income $\theta_b^*$, who buys the high quality product will have to be indifferent between buying the high quality product and nothing at all. Our intuition suggests that his income should be less than the income $\theta^*$ of the consumer who was indifferent between low and high quality product in the previous case. This means that there must be some consumers who were buying the low quality product before, but decide to *buy* high quality product now. However, at the same time there may be some consumers who were buying the low quality product but will opt for buying nothing at all as a consequence of the ban. If $\theta_b^*$ is sufficiently low, i.e. if the number of consumers buying high quality product increases sufficiently, there may be a potential for new firms enter the market and pull the equilibrium price down which in a chain effect leads to a further increase of the demand.

**Proposition 4.3.1.** *If low quality product is banned and* $F < \widetilde{F}$ *holds, where*

$$\widetilde{F} = \frac{(c_H(1+s_H) - s_H)^2}{9s_H(1+s_H)(1-t)}$$

*then at least two firms produce high quality product contrary to the previous case.*

*Proof.* Let the income of the consumer who is indifferent between buying and not buying the high quality product be denoted by $\theta_b^*$. For this consumer, $U(s_H,p_b,\theta)$=$U(0,0,\theta)$ holds. $\theta_b^*$ is easily derived as:

$$\theta_b^* = \frac{p_b(1+s_H)}{s_H}$$

The number of consumers buying the high quality product is given by:

$$Q_b = \frac{s_H - p_b - s_H p_b}{s_H(1-t)}$$

and inverse demand function derived from above is

$$p_b = \frac{(1 - Q_b(1-t))s_H}{1+s_H}$$

If there are two firms producing high quality product, their profit is

$$\pi_{ib} = (p_b - c_H)q_{ib} - F, \text{ for } i = 1, 2$$

where

$$p_b = \frac{(1 - (q_{1b} + q_{2b})(1-t))s_H}{1+s_H}$$

FOC for firm $i = 1, 2$ is given by:

$$\frac{\partial \pi_{ib}}{\partial q_{ib}} = \frac{(1 - 2q_{ib}(1-t) - q_{ib}(1-t))s_H}{1+s_H} - c_H = 0$$

In equilibrium, quantity produced by each firm is:

$$\widetilde{q}_b = \frac{1}{3(1-t)} - \frac{c_H(1+s_H)}{3(1-t)s_H}$$

Equilibrium price is:

$$\widetilde{p}_b = \frac{2c_H}{3} + \frac{s_H}{3(1+s_H)}$$

In equilibrium, profit of each firm is:

$$\widetilde{\pi_{ib}} = \frac{(c_H(1+s_H) - s_H)^2}{9s_H(1+s_H)(1-t)} - F$$

which is positive if $F < \widetilde{F}$ given in proposition 4.3.1.

□

**Welfare improvement**

If the low quality is banned and if the assumptions of proposition 4.3.1 hold, then two firms produce high quality product and consumers either buy the high quality product or nothing at all. To make welfare analysis we have to consider the well-being of everyone in society, i.e. consumers' as well as producers' well-being before and after the ban. Although it looks like simply adding consumer and producer surpluses in each case and comparing them, this way of computing the welfare is problematic. We should note here that the utility function describing consumer preferences was not quasilinear, hence there exist wealth effects of any price change which need to be taken into account in welfare analysis. Therefore we will construct a money metric indirect utility function because it will allow us to measure the welfare change in dollars. We will use a well-known measure of welfare change, equivalent variation (EV) for consumers and add it to the change in total profits to make an overall welfare comparison. EV can be thought of as the change in consumer's wealth which is equivalent to the welfare effect of the change in consumption good and its price. In our model, it is given by:

$$EV(p^0, p^1, \theta) = e(p^0, u^1) - e(p^0, u^0)$$

where $p^o$ corresponds to the price level before the ban, $p^1$ to the price level after the ban, expenditure function is denoted by $e(.)$. Finally, $u^0$ and $u^1$ denote utilities gained before and after the ban.

Since the ban affects members of society differently we have to consider its effects separately. For any consumer, who was buying high quality product before the ban, EV is defined as:

$$(1+s_H)(\theta - \widetilde{p_b}) = (1+s_H)(\theta + EV - \widehat{p_m})$$

Hence, for those consumers EV is simply $\widehat{p_m} - \widetilde{p_b}$. It must be added that some consumers change their choice before ban, if they are compensated with EV. To find out these consumers we need to compute the income $\theta_{cr}$ of the critical consumer, who is the last of those at the income scale. $\theta_{cr}$ can be thought of as the income of the consumer buying high quality product after the ban who has the same utility with the consumer who was indifferent between high and low quality before the ban. Hence;

$$(1+s_H)(\theta^* - \widehat{p_m}) = (1+s_H)(\theta_{cr} - \widetilde{p_b})$$

For those who were buying the low quality product before the ban but switch to the high quality product after the ban, EV is defined as:

$$(1+s_H)(\theta - \widetilde{p_b}) = (1+s_L)(\theta + EV - c_L)$$

Finally, for those who were consuming low quality good before the ban but decide not to buy anything afterwards, EV is given by:

$$\theta = (1+s_L)(\theta + EV - c_L)$$

Total equivalent variation for consumers is then:

$$EV = \frac{\int_t^{\theta_b^*} EV(\theta)\, d\theta + \int_{\theta_b^*}^{\theta_{cr}} EV(\theta)\, d\theta + \int_{\theta_{cr}}^{1} EV(\theta)\, d\theta}{1-t}$$

Because of the cumbersomeness of resulting equations, we do not present them here but they are easy to derive.

Through numeric substitution of the parameters satisfying binding conditions, we find that positive total welfare change for consumers is possible although those at the bottom of the income scale become worse off. However, if $t$ is not extremely low, i.e. if the lowest income in society is not extremely low, the negative welfare change is slight and can be restored very easily through transfers. As a result, consumers achieve higher utility levels while high technology is more widely used. Hence for a social policy maker primarily focusing on consumers' well-being, banning old technology can be a viable and desirable policy option.

In the case where we add total EV for consumers to the difference in firms' profits, we were not able to find numeric values for parameters which result in positive total welfare change because of the additional fixed cost the entering firm has to spend while switching to high technology. However as we mentioned before, for a social policy maker valuing consumers' well being primarily, banning is still a desirable policy since it results in widespread use of high-tech products increasing consumers' overall well being.

# Chapter 5

# Conclusion

In this paper, we develop a model in which a large number of consumers with identical tastes are identified with their income levels and split their income to buy a specific product and a numeraire good. There are two quality levels of the product, high and low, and high quality product is preferred to low quality product by all consumers. According to their budget, consumers decide on consuming the high quality product, the low quality product, or nothing at all. The production of high quality product necessitates the use of high technology, while low quality product is based on old technology. Use of high technology requires initial investment, hence it bears a fixed cost. Due to this fixed cost, there is only one firm which produces it, where low quality good is produced in a competitive market. We analyze the effects of a ban on low quality product in the market. We find that as a result of the ban, the number of firms using high technology increases which leads to a decrease of the high quality product's price and the number of consumers enjoying high quality increases.

Since a recent example of banning old technology is the ban of conventional egg production system, the so called "battery cage system" throughout Europe, we focus on this market and explain different technologies used in the production of eggs. We also look at the cost structures of firms and mention some works forecasting welfare improvements with the complete application of the ban.

Moreover, we focus on the organic food market in United States and Europe, investigate its evolution and try to understand the structure of this market. By doing this first we look at the supply side and see how far the production and sales grew in the last decade. We explain the fixed costs needed to be invested in during the conversion period. Then we look at the demand side and observe that the demand is far beyond supply especially in US, and price premiums resulting from high consumer willingness to pay remain high. We observe that younger and richer consumers are more inclined to consume organic, as in our model setup. As our analysis shows, organic food market is consistent with our model and we propose that banning conventional methods can lead to welfare improvements and should be considered as a policy option. Broadening our perspective, we conclude that in any appropriate market banning old technology should be considered as a possible market intervention to increase total welfare of the society.

# Bibliography

[Dimitri and Oberholtzer, 2005] Dimitri, C. and Oberholtzer, L. (2005). Market-led versus government-facilitated growth, development of the u.s. and eu organic agricultural sectors. Technical Report WRS-05-05, Economic Research Service United States Department of Agriculture (USDA).

[EC, 2005] EC (2005). Organic farming in the european union facts and figures. Report, European Commission.

[ERS, 2006] ERS (2006). Technical report.

[Gabszewicz and Thisse, 1979] Gabszewicz, J. J. and Thisse, J. F. (1979). Price competition, quality and income disparities. *Journal of Economic Theory*, 20(3):340 – 359.

[Lydia Oberholtzer and Lopez, 2006] Lydia Oberholtzer, C. G. and Lopez, E. (2006). Organic poultry and eggs capture high price premiums and growing share of specialty markets. Technical Report LDP-M-150-01, Economic Research Service/United States Department of Agriculture (USDA).

[Oberholtzer et al., 2005] Oberholtzer, L., Dimitri, C., and Greene, C. (2005). Price premiums hold on as u.s. organic produce market expands. Technical Report VGS-308-01, Economic Research Service United States Department of Agriculture (USDA).

[Russell et al., 2005] Russell, N., Zhuang, Y., Farrar, J., and Clare, M. (2005). The economics of egg production: 2003. Report.

[Taylor, 2005] Taylor, J. (2005). Situation and outlook report for sweden. Report 73, EuroEgg and Business AB.

[Temple, 2003] Temple, S. (2003). The transition from conventional to low- input or organic farming systems: Soil biology, soil chemistry, soil physics, energy utilization, economics and risk. Technical Report SW99-008, Sustainable Agriculture Research and Education(SARE).

[Timmis, 2004] Timmis, K. (2004). Study on the socio-economic implications of the various systems to keep laying hens. Report, AGRA CEAS Consulting.

[Willer and Yussefi, 2007] Willer, H. and Yussefi, M. (2007). The world of organic agriculture statistics and emerging trends 2007. Technical report, International Federation of Agricultural Movements (IFOAM) and Research Institute of Organic Agriculture(FIBL).

[Wolf, 2006] Wolf, T. (2006). Assessing producer options and obstacles for organic agriculture. *Crop Management*.