WAGENINGEN UNIVERSITY AND RESEARCH CENTER

DEPARTMENT OF SOCIAL SCIENCES

BUSINESS ECONOMICS GROUP

M.SC. MINOR THESIS

Comparing risk in conventional- and organic dairy farming

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Preface

Spring 2008 was the time when my Hungarian supervisor István Szűcs mentioned a university in the Netherlands where I can improve my knowledge about the Business Economics. So we decide that I will go to Wageningen as a double degree student and learn something more something special and interesting at Wageningen University. The nice international atmosphere and several sport opportunities made me attached to Wageningen for a long time.

As a Research Master Variant student I had to start my minor thesis really early of my study, so I made an appointment with Prof Dr Alfons Oude Lansink the chair of the Business Economics Group, who welcomed me as a colleague and introduced Paul Berentsen for me. That time he was one of the best supervisors for me to start my international research studies.

Paul I would like to thank you for your kind hospitality since we met, thank you for your patience about my schedule and my mistakes. I am very grateful for that. (I know that it takes a lot of time for you to review my papers, thanks you for it). I learned a lot from your useful remarks. Now I have clearer view how I can manage a professional research, thank to you. I can not express how much I am grateful that you helped me to do my thesis. Thank you a lot (Dank u zeer!).

I would like to thank also Marcel van Asseldonk from the LEI, who helped me not only to collect a database about the Dutch organic and conventional farms, but he gave lots of advice how to implement and improve my analysis.

I would like to thank to István Szűcs, who is my friend and my Hungarian supervisor, who gave me a chance to continue my studies at international level and gave some useful advices about my work.

I would like to express my gratitude to all of my friends here in Wageningen and in Debrecen, especially, Gabriella Ujhelyi, Annamária Németh, Andrea Kovács, Dániel Oláh, Beáta Bittner, Erika Szabó and for my girlfriend Monika F. Kruger, who were always there for me and gave me some extra positive energy during these times. (Nagyon köszönöm! Muito Obrigado!)

Finally I would like to give an enormous thank for my family, especially my parents, Jolán Bózsvári and Béla Kovács who have always been there for me and who supported me. Kedves Édesanyám és Édesapám! Köszönöm, hogy mindvégig mellettem voltatok életem jó és a nehéz óráiban. Nagyon köszönöm a tőletek kapott szeretetet, bíztatást és támogatást, ami mindig átlendített a nehéz időszakokon. Nagyon szeretlek titeket!

There are so many people I could not list here, but I would like to say thank you for your contribution about my work and about my life.

THANK YOU VERY MUCH!

Abstract

The research objective was to identify the magnitude of the different sources of risk arising in conventional and an organic dairy farming in the Netherlands. The terms “risk” and “uncertainty” can be defined in various ways. One common distinction is that risk is imperfect knowledge where the probabilities of the possible outcome are known, and uncertainty exists when these probabilities are not known.

Literature on comparison of conventional and organic dairy farms in the Netherlands shows that the conventional farms average milk production is 30-40% higher than the organic one. Comparison of organic and conventional milk prices shows that the organic price is 10-15% higher than the conventional one.

To investigate the risk factors we use a database including yearly data for different dairy farms from the Agricultural Economics Research Institute (LEI) in the Netherlands. The number of the dairy farms in the sample is 348 of which 46 are organic and 302 are conventional farms. The farms in the database are either conventional or organic, so there is no farm in a transition period which means in between the conversion procedure to be organic farm. Data for conventional and organic farms are available from 2001 to 2007.

We have to be sure that there is no time trend effect in the data which might cause biased result, because of different weather condition differences. Thus the analysis has been used the error components implicit detrending (ECID) method which was shown to better describe the reality in most cases than individually detrending farm-level data. ECID eliminates the location and the weather condition differences between the farms to calculate a farm specific deviation. The computed standard deviations (SD) and the coefficient of variations (CV) were used to determine within farm risk. The computed time variant farm specific deviation (SD) equals the difference between the individual farm’s deviation from the national annual average and individual farm’s overall average deviation from national overall average. Our result will be farm average detrended within farm standard deviations (SD) for conventional and for organic farms and the coefficient of variation (CV), which is a relative value taking into account the different farm sizes. It equals the standard deviation divided by the mean.

In the research we mainly focused on the production and price risk, thus the variables selection depended on this goal. So the milk price and the concentrate price as a variable can give us some information about the price risk. For production risk, analysis is done for milk production per cow and for roughage production per hectare.

The final results of this research are the selected variable's averages, detrended within farm standard deviations (SD) and the coefficient of variations (CV) of organic and conventional farms. The main result is that the family farm income average is higher in the conventional farm like the total gross margin per farm. The revenue milk per dairy cow average is higher in the organic case, but includes significantly more risk which comes mainly from the milk yield and the milk price. The milk price risk comes from the fat% and protein% values. The roughage production per hectare averages is higher in the conventional farms but the CV value is higher in the organic farms. The prices of the concentrate in the organic farms are higher in average than the conventional once, because of the higher organic ingredients prices. The organic concentrate price significantly includes more risk, if we take a look at the CV or the SD values. Veterinary cost per cow is higher in the conventional farms but the CV is higher in the organic case.

To conclude in dairy farming there is production risk in milk production and roughage production and price risk in input and output prices.The risk is higher in the organic farms, although the difference is not always significant. We can conclude that the organic farming includes more risk, because of the higher coefficient of variations. This might be one reason why many dairy farms in the Netherlands do not shift to organic farming.

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Introduction

In conventional agriculture the negative environmental impact of many intensive production systems has increased the importance of more sustainable and environmentally friendly systems. Organic farming is recognised in the European Union (EU) as a possible way to improve the sustainability of agriculture (Rigby & Cáceres, 2001; Padel et al., 2002). The main aim of organic farming is to create a sustainable agricultural production system including economic, environmental and social sustainability (Padel, 2001). Organic farming claims to have the potential to provide benefits in terms of environmental protection, conservation of non-renewable resources, improved food quality, reduction in output of surplus products and the reorientation of agriculture towards areas of market demand (Lampkin, 1994). In addition to environmental benefits, standards for organic livestock production provide several pre-conditions that are required to achieve good living conditions for farm animals (Sundrum, 2001).

European governments have recognized these potential benefits and responded to them by encouraging farmers to adopt organic farming practises, either directly through financial incentives or indirectly through support of research, extension and marketing initiatives (Ács 2006). Thus organic farming in the EU showed rapid growth in the last few decades due to policy incentives and consumer demand (Dabbert et al, 2004).

The reason for dairy farmers not to convert to organic farming in spite of the advantages mentioned above might be a possibly higher risk in organic dairy farming. First of all relatively high proportion of the feed must be produced on the farm, which causes a higher production risk. Secondly the price of organic milk may be more volatile because of the relatively small, unprotected market which causes a higher price risk.

The objective of this research is to identify the magnitude of the different sources of risk arising in conventional and an organic dairy farming in the Netherlands. The research questions to examine: Which sources of risk arise in these two farming types? How large is the magnitude of the different sources of risk for conventional and organic dairy farming both from a technical and an economic point of view?

A literature study has been performed in two directions. Firstly, literature on organic and a conventional dairy farming is studied. Secondly, sources of risk and consequences of risk in the dairy sector will be studied. The next step is the determination of risk in the two farming systems. Determination of the size of risk will take place via statistical analysis of data on organic and conventional farming for the Netherlands from Dutch Agricultural Economics Research Institute (LEI).

1 Risk in dairy farming: literature overview

This chapter includes a literature review about conventional and organic dairy farming. First, the current situation in the World, European Union (EU) and the Dutch dairy sector is introduced. These sections focused mainly on milk production and -price tendencies. Next differences between the organic and conventional farming conditions are explained. This refers to: production, legalization, price of the milk and price of some inputs. The final part of this chapter introduces some sources and management of risk in conventional and organic dairy farming and the consequences of the risk factors.

1.1 Trends in the dairy sector

This chapter introduce World, European and the Dutch dairy sector core indicators, focussed on the milk production and milk price tendencies. At the end of this chapter some overview about the organic dairy sector main indicators is given.

1.1.1 Indicators of the World and the European Union dairy sector

The world milk production shows a continuous rising trend since 1961. In 2007 the world total fresh milk production was 560 million tonnes (Figure 2.1). Since the introduction of milk quotas in 1984 the EU production has stagnate around 150 million tonnes. The milk quota system was introduced to stop over-production in Europe. There have since 1984 been further reductions in quota of around 9%.

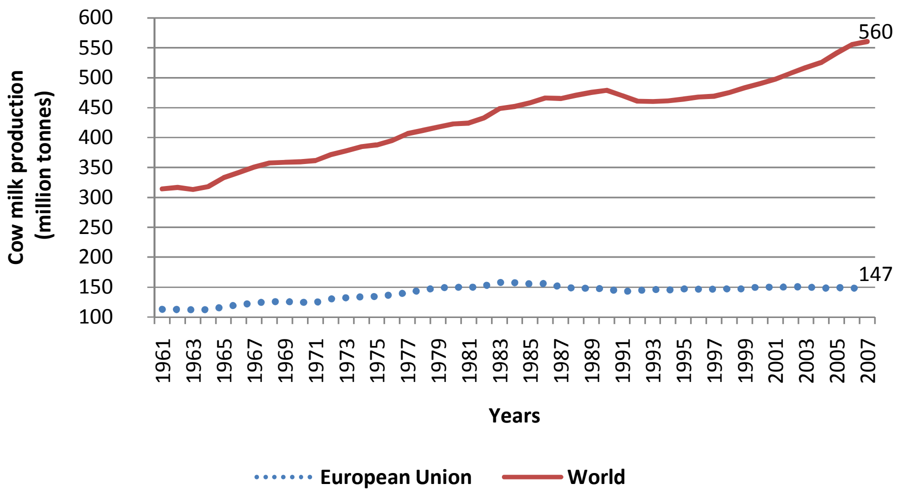

Figure 2.1: The World and the European Union cow milk production (whole, fresh) from 1961 to 2007 (Source: FAOSTAT 2009.a)

Figure 2.2 shows the milk production share in 2007 of the different continents. The biggest milk producer in the world is the European continent (37.08%) including the European Union (26.22%). The second largest milk producer is the American continent (North-, Central-, South America and the Caribbean) which represents 28.65% of the total milk production in the world.

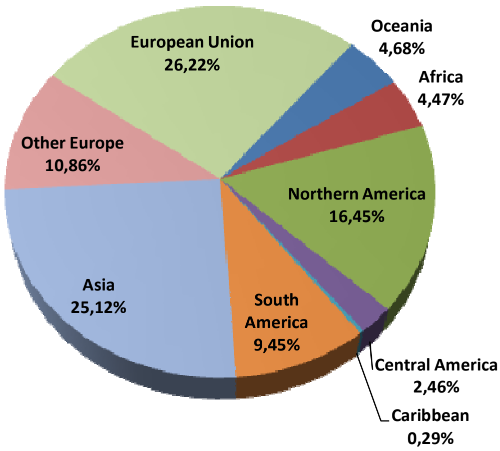

*Figure 2.2: The Share of the World cow milk production in different continents in 2007. (*Source: FAOSTAT 2009.a)

The biggest milk producer in the EU is Germany (18.98%) and the second (Figure 2.3) is France (16.13%) and 7.31 % are represents the Dutch milk production among 7.31 % of total EU-production.

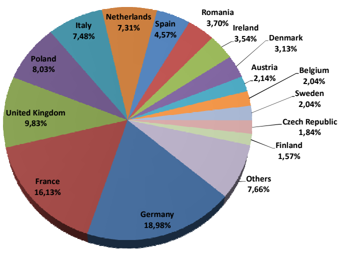

Figure 2.3: The European Union dairy milk production share in 2007. (Source: FAOSTAT 2009.d)

The focus of this research is the price tendencies and price fluctuation in the world and in the European market. Figure 2.4 shows cow milk prices from 1991 to 2006 in the European Union which has a protected market, the United States, where there is some milk support and from the absolute free Australian and New Zealand milk market. The World market price (which is the Austral and New Zealand milk price) is on average 30-40% lower than the European milk price. The USA milk price more or les follows the European tendencies, except the last few years where the USA price decreased and got near to the World market price. International dairy prices have risen so much that the equivalent international price of milk in 2009 is very close to levels prevailing in the United States and the EU, enabling them to export without requiring subsidies.

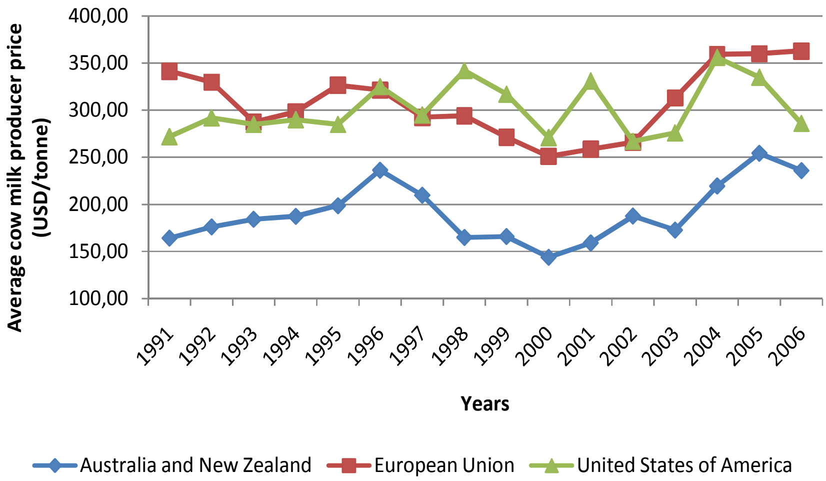

Figure 2.4: Average cow milk price tendencies from 1991 to 2006 (Source: FAOSTAT 2009c)

1.1.2 The Dutch dairy sector

Dairy farming is one of the most important sectors in the Dutch agriculture with an annual production value in 2005 of some 2.8 billion dollar. Approximately 60% of agricultural land in the Netherlands is used by dairy farmers. Milk alone accounts for approximately 17% of the total production value of Dutch agriculture (Prodzuivel 2009). The total milk production is 10.5 million tonnes, which makes the Netherland the 12th most biggest milk producer in the world (Table 2.1).

Table 2.1: Milk production per country in 2005.

Milk Commodity Rank	Country	Production (Int $1000)	Production (tonns)
1	United States of America	21,315,090	80,150,000
2	India	10,238,690	38,500,000
3	Russian Federation	8,137,764	30,600,000
4	Germany	7,339,944	27,600,000
5	France	6,723,495	25,282,000
6	China	6,435,748	24,530,080
7	Brazil	6,201,721	23,320,000
8	New Zealand	3,889,372	14,625,000
9	United Kingdom	3,876,608	14,577,000
10	Ukraine	3,586,068	13,484,500
11	Poland	3,297,656	12,400,000
12	**Netherlands**	**2,800,827**	**10,531,800**
13	Italy	2,792,370	10,500,000
14	Australia	2,699,291	10,150,000
15	Mexico	2,625,826	9,873,755

Source: FAOSTAT 2009.e

With a total surface area of about 3,735 million hectares the Netherlands is one of the smaller countries in Western Europe. As the population of the Netherlands is 16.5 million in the year 2009, it is one of the most densely populated countries in the world (Organic-World 2009. c)

The rapid rise in milk production since 1960 can be attributed to a process of increasing specialisation and mechanisation in dairy farming, coupled with scale enlargement. In 1960 average milk production per farm was 37,000 kg. Nowadays, the average Dutch dairy farm produces nearly 500,000 kg of milk a year.

Figure 2.5 shows The Netherlands counted circa 1.5 million dairy cows in 2008. Since 1995, cattle numbers have declined by on average 1.7% per year. In 2007, the overall, average milk yield was about 7940 kg per cow per year.

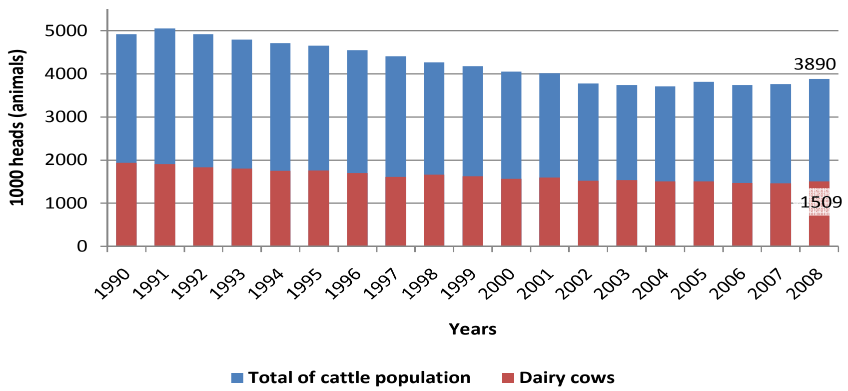

Figure 2.5: Total cattle and dairy cows population in The Netherlands from 1990 to 2008. (Source: EUROSTAT 2009)

1.1.3 Organic dairy farming in The Netherlands

The organic share in the total agricultural surface in the Netherlands is relatively small. In 2008, 2.6 percent of the total agricultural area was organically managed, which means 50 435 hectares land under organic management..

In the 1990s, the area increased considerably. Between 1993 and 1997 an average of 60 farms per year converted. In 1998 and 1999 more than 200 farms converted per year which is the equivalent in growth of more than 25 percent per year.

The number of organic dairy cow in the Netherlands shows (Figure 2.6) an extreme increase between 1998 and 2000. The cause might be the increasing EU subsidies for the organic farms. After that period the organic dairy cow number decreased a bit, but after 2004, it shows an increase, probably caused by the EU rural development incentive policy.

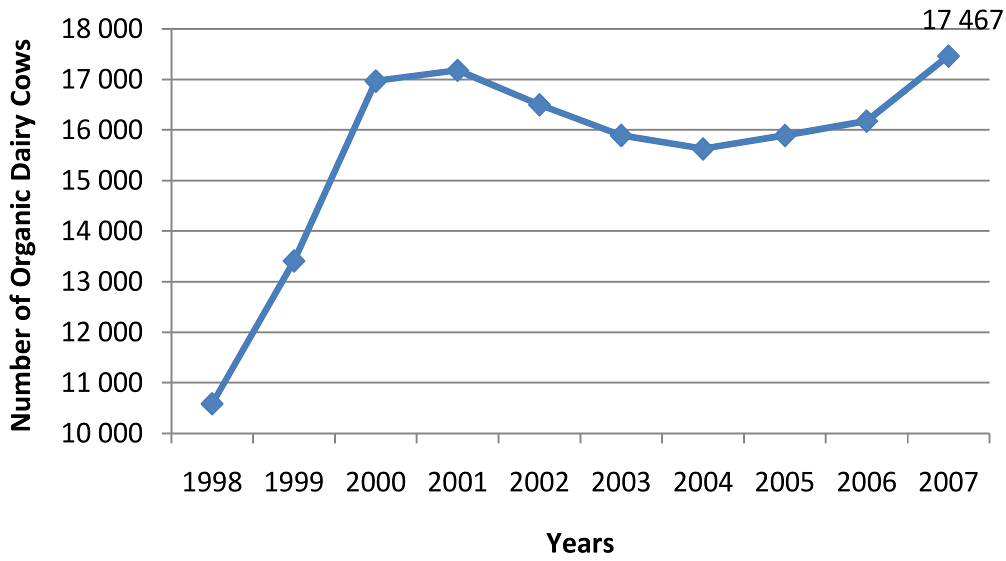

Figure 2.6: Number of organic dairy cows in the Netherlands from 1998 to 2007. (Source: EUROSTAT 2009)

1.1.4 The organic regulation in Europe

The basic rules of organic animal agriculture have been formalised in the Council Regulation (EC) No, 1804/1999 (1999). These rules constitute a supplement to the first regulation on organic production of agricultural products and foodstuffs in which livestock was not included (Council Regulation (EEC) No 2092/1991, 1991). If these rules are not followed then the food cannot be labelled as organic in the EU. Rules on production, labelling and inspection of the most relevant animal species (i.e. cattle, pigs, sheep, goats and poultry) were agreed on. The rules relate to foodstuffs, disease prevention and veterinary treatments, animal welfare, husbandry practices and the management of manure. Genetically modified organisms (GMOs) and products derived from GMOs are explicitly excluded from organic production methods.

> *"Organic farming should maintain the genetic diversity of the agricultural system and its surroundings. Animals should have at least access to outside areas and ruminants are largely fed through grazing on pasture. Housing conditions should allow farm animals to perform all aspects of their innate behaviour" (Borell-Sorensen 2004).*

Organic production shall pursue the following general objectives (EC No, 834/2007) establish a sustainable management system for agriculture that:

(a) respects nature's systems and cycles and sustains and enhances the health of soil, water, plants and animals and the balance between them;
(b) contributes to a high level of biological diversity;
(c) makes responsible use of energy and the natural resources, such as water, soil, organic matter and air;
(d) respects high animal welfare standards and in particular meets animals' species-specific behavioural needs.

Aim at producing products of high quality; aim at producing a wide variety of foods and other agricultural products that respond to consumers' demand for goods produced by the use of processes that do not harm the environment, human health, plant health or animal health and welfare.

Specific principles applicable to farming according to the EC No, 834/2007:

In addition to the overall principles set out in the EC No, 834/2007 regulation's fourth article, organic farming shall be based on the following specific principles:

(a) the maintenance and enhancement of soil life and natural soil fertility, soil stability and soil biodiversity, preventing and combating soil compaction and soil erosion, and the nourishing of plants primarily through the soil ecosystem;

(b) the minimisation of the use of non-renewable resources and off-farm inputs;

(c) the recycling of wastes and by-products of plant and animal origin as input in plant and livestock production;

(d) taking account of the local or regional ecological balance when taking production decisions;

(e) the maintenance of animal health by encouraging the natural immunological defence of the animal, as well as the selection of appropriate breeds and husbandry practices;
(f) the maintenance of plant health by preventive measures, such as the choice of appropriate species and varieties resistant to pests and diseases, appropriate crop rotations,
mechanical and physical methods and the protection of natural enemies of pests;
(g) the practice of site-adapted and land-related livestock production;
(h) the observance of a high level of animal welfare respecting species-specific needs;
(i) the production of products of organic livestock from animals that have been raised on organic holdings since birth or hatching and throughout their life;
(j) the choice of breeds having regard to the capacity of animals to adapt to local conditions, their vitality and their resistance to disease or health problems;
(k) the feeding of livestock with organic feed composed of agricultural ingredients from organic farming and of natural non-agricultural substances;
(l) the application of animal husbandry practices, which enhance the immune system and strengthen the natural defence against diseases, in particular including regular exercise and access to open air areas and pastureland where appropriate;
(m) the exclusion of rearing artificially induced polyploidy animals;
(n) the maintenance of the biodiversity of natural aquatic ecosystems, the continuing health of the aquatic environment and the quality of surrounding aquatic and terrestrial ecosystems in aquaculture production;
(o) the feeding of aquatic organisms with feed from sustainable exploitation of fisheries as defined in Article 3 of Council Regulation (EC) No 2371/2002 of 20 December 2002 on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy (1) or with organic feed composed of agricultural ingredients from organic farming and of natural non-agricultural substances.

Livestock production rules with regard to the EC No, 834/2007 council regulation:

In addition to the general farm production rules laid down in EC No, 834/2007 regulation's eleventh article, the following rules apply to livestock production:

(a) With regard to the origin of the animals: organic livestock shall be born and raised on organic holdings; for breeding purposes, non-organically raised animals may be brought onto a holding under specific conditions. Such animals and their products may be deemed organic after compliance with the conversion period referred to in Article 17(1)(c); animals existing on the holding at the beginning of the conversion period and their products may be deemed organic after compliance with the conversion period referred to in Article 17(1)(c);

(b) With regard to husbandry practices and housing conditions: personnel keeping animals shall possess the necessary basic knowledge and skills as regards the health and the welfare needs of the animals; husbandry practices, including stocking densities, and housing conditions shall ensure that the developmental, physiological and ethological needs of animals are met; the livestock shall have permanent access to open air areas, preferably pasture, whenever weather conditions and the state of the ground allow this unless restrictions and obligations related to the protection of human and animal health are imposed on the basis of Community legislation; the number of livestock shall be limited with a view to minimising overgrazing, poaching of soil, erosion, or pollution caused by animals or by the spreading of their manure; organic livestock shall be kept separate from other livestock. However, grazing of common land by organic animals and of organic land by non-organic animals is permitted under certain restrictive conditions; tethering or isolation of livestock shall be prohibited, unless for individual animals for a limited period of time, and in so far as this is justified for safety, welfare or veterinary reasons; duration of transport of livestock shall be minimised; any suffering, including mutilation, shall be kept to a minimum during the entire life of the animal, including at the time of slaughter; apiaries shall be placed in areas which ensure nectar and pollen sources consisting essentially of organically produced crops or, as appropriate, of spontaneous vegetation or non-organically managed forests or crops that are only treated with low environmental impact methods. Apiaries shall be kept at sufficient distance from sources that may lead to the contamination of beekeeping products or to the poor health of the bees; hives and materials used in beekeeping shall be mainly made of natural materials; the destruction of bees in the combs as a method associated with the harvesting of beekeeping products is prohibited;

(c) With regard to breeding: reproduction shall use natural methods. Artificial insemination is however allowed; reproduction shall not be induced by treatment with hormones or similar substances, unless as a form of veterinary therapeutic treatment in case of an individual animal; other forms of artificial reproduction, such as cloning and embryo transfer, shall not be used; appropriate breeds shall be chosen. The choice of breeds shall also contribute to the prevention of any suffering and to avoiding the need for the mutilation of animals;

(d) With regard to feed: primarily obtaining feed for livestock from the holding where the animals are kept or from other organic holdings in the same region; livestock shall be fed with organic feed that meets the animal's nutritional requirements at the various stages of its development. A part of the ration may contain feed from holdings which are in conversion to organic farming; with the exception of bees, livestock shall have permanent access to pasture or roughage; non organic feed materials from plant origin, feed materials from animal and mineral origin, feed additives, certain products used in animal nutrition and processing aids shall be used only if they have been authorised for use in organic production under Article 16; growth promoters and synthetic amino-acids shall not be used; suckling mammals shall be fed with natural, preferably maternal, milk;

(e) With regard to disease prevention and veterinary treatment: disease prevention shall be based on breed and strain selection, husbandry management practices, high quality feed and exercise, appropriate stocking density and adequate and appropriate housing maintained in hygienic conditions; disease shall be treated immediately to avoid suffering to the animal; chemically synthesised allopathic veterinary medicinal products including antibiotics may be used where necessary and under strict conditions, when the use of phytotherapeutic, homeopathic and other products is inappropriate. In particular restrictions with respect to courses of treatment and withdrawal periods shall be defined; the use of immunological veterinary medicines is allowed; treatments related to the protection of human and animal health imposed on the basis of Community legislation shall be allowed;

(f) With regard to cleaning and disinfection, products for cleaning and disinfection in livestock buildings and installations, shall be used only if they have been authorised for use in organic production under Article 16.

1.2 Differences between conventional and organic dairy farming

This section introduces the main differences between the conventional and organic dairy farming. The first part of the section use descriptive statistic to show the differences about milk production and milk prices between the two farming type. The second part introduce the technological differences, for instance the animal well fair, veterinary and give some overview about the organic farming rules. Finally the EU rules and the marketing part is introduced at the end of this section.

The milk production per cow tendencies shows that the conventional milk production level is 25-30% higher than the organic dairy production. In 2007 the average conventional milk production per cow in 7940 litter per cow, and the organic milk production is 6150 litter per cow (LEI, 2009).

Comparing conventional and organic dairy farms in the Netherlands shows that, also the conventional farms average milk production is 30-40% higher than the organic ones (Figure 2.7).

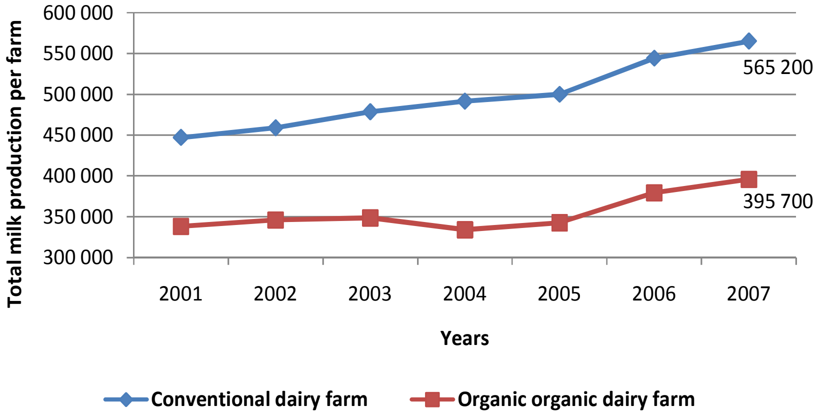

Figure 2.7: Conventional and Organic milk production per farm in The Netherlands (Source: LEI 2009)

Comparing organic and conventional milk prices shows that the organic price is much higher than the conventional one, because of the higher input price and strict EU regulations. Figure 2.8 show that the price tendencies follow each other. However the organic prices are always 15-20% higher than the conventional prices.

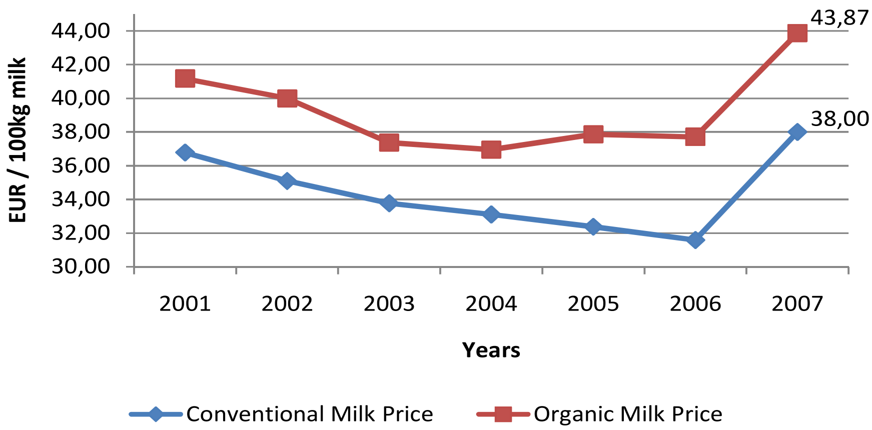

Figure 2.8: Conventional Milk and Organic milk price in the Netherlands (Source: LEI 2009)

There have been concerns as to whether restrictions on use of antibiotic treatment could lead to under treatment of sick animals in organic livestock production. In dairy production, several comparisons on disease and treatment levels in organic and conventional production has been carried out. The most frequent disease in dairy milk production is mastitis.

The following principles play important rules (Borell-Sorensen, 2004) about disease prevention in organic livestock production:

– Selection of breeds with abilities to coping to the required conditions, the viability, and resistance to disease. Breeds should be selected to avoid specific diseases or health problems, which prevail in conventional livestock production.

– Livestock should be raised in a manner which suits the requirements of the species and promotes a good resistance against diseases and infections.

– Application of good quality feeds, which together with application of outdoor areas and grazing strengthen the natural immune system of the animal.

– Securing a suitable space allowance in order to prohibit overcrowding and associated health problems.

The feeding level is, in general, less in organic compared to conventional dairy production (Hermansen, 2003). The milk production per cow is consequently less in organic production. There is, however, no evidence that this has led to more metabolic diseases. For metabolic diseases, it is generally reported that the incidence of treated cases is less in organic than in conventional dairy production (Sundrum, 2001; Bennedsgaard et al., 2003).

All cattle should be kept outdoor during the grazing period, except for fattening cattle for the last 3 months of the fattening period. In principle, all cattle should be kept in groups and tie-up systems are forbidden and all cattle should have access to an outdoor area throughout the year.

The high requirements for space allowance, for bedding and access to outdoor areas is in general seen as positive in relation to animal welfare allowing the cattle to move and to display normal behaviour. Since the disease level in general is not higher, the conditions for animal welfare may be better in organic than in conventional production. It should, however, be stressed that a complex of housing conditions (Sundrum, 2001; Rushen, 2003) affects animal welfare. Organic farming is consequently no guarantee for good animal welfare.

The low level of use of antibiotics reduces the risk of medicine residues in the milk and meat. In theory, the requirement of keeping the calf and cow together for 2 days after calving may increase the risk for infecting the calf with zoonotic pathogens such as

Salmonella dublin. The lower level of energy in the daily feed ration and the increased level of roughage may have a negative effect on the product quality of beef meat. The carcass quality may be affected negatively by a low energy input. However, it has been shown that with good clover pastures, the carcass quality can be satisfactory (Andersen et al., 2003). Sundrum (2001) emphasizes that selection of an appropriate breed for beef production may solve the carcass quality problem in organic beef production.

The aims of the EC regulation are somewhat different from the goals of organic farming set by International Federation of Organic Agriculture Movements (IFOAM) in that their scope is wider and reflect the consensus between interests of individual countries. The support by EC for organic farming is justified as an element in stimulating/regulating the agricultural sector to support rural development, for diversifying production and for reducing the environmental load of agriculture (Hermansen, 2003). As in all European Union countries, in the Netherlands Council Regulation (EEC) No. 834/2007 is in force. The Dutch government has appointed Skal as the only certification and inspection body in the Netherlands to check compliance with the EU regulation. Certified organic products can be identified by the EKO trademark. For bio-dynamic products there is also the Demeter trademark.

The market for organic products is constantly increasing. The most important marketing channel is the general retail trade but the specialized trade has an almost equal share of the organic market and is thus much more important than in most other European countries. A fast grower is the catering sector. The aim of the government to provide 100% sustainable catering in public canteens by 2010 gave a positive stimulus to the achievement of this goal (Bio-Monitor Jaarrapport 2008).

1.3 Sources and management of risk in dairy farming

This section introduces the phenomenon called risk, the sources of it and some management strategies to handle it. The terms “risk” and “uncertainty” can be defined in various ways. One common distinction is that risk is imperfect knowledge where the probabilities of the possible outcome are known, and uncertainty exists when these probabilities are not known (Hardaker el al. 1997.). Concluding from Hardaker et al. 1997 uncertainty is an imperfect knowledge and risk is the uncertain consequences, particularly exposure to unfavourable consequences. So risk is not value-free, and most of the time indicating an aversion for unfavourable consequences.

1.3.1 Sources of risk

The most articles which considering risks using more or less the same risk sources categories (Olson 2004, Hardaker at al 1997). The sources of risk can be grouped into five major categories: production, market, financial, legal and human resources.

Production risk: this type of risk comes from the unpredictable nature, the major sources of these kind of risk are weather, pests, diseases, technology, genetics, machinery efficiency and reliability, and finally the quality of feed and other inputs.

Price or market risk: farmers are being exposed to unpredictable competitive markets for inputs and outputs, so this type of risk always exist and are often significant. The price risk includes risks stemming from unpredictable currency exchange rates (Hardaker at al 1997).

Financial or business risk: Olson (2004), distinguishes four basic components of financial risk: (1) the cost and availability of debt capital, (2) the ability to meet cash flow needs, (3) the ability to maintain and grow equity, and (4) the increasing chance of losing equity by larger levels of borrowing against the same equity. The first three components mainly are influenced by internal and external forces; the last one depends on the farmer's decisions on how much debt to take, compared to his equity. Hardaker et al. (1997) state that the greater the proportion of debt capital to total capital, the higher the multiplicative factor applied to business risk. Only if the firm is 100 per cent owner-financed is there no financial risk.

Institutional or legal risk: The government is also a risk sources for the farmers. Changes in the rules can have far-reaching implications. For example: changing income taxes, new restrictions about the animal well-fair, compulsory disease prevention treatment. Risk can be present in the inability to follow the new rules or restrictions and in not knowing certain rules.

Human or personal risk: People can bring many risk factors. For instance: death, divorce, injury, illness. Prolonged illness of one of the principals may cause serious losses to production, and increased costs (Hardaker at al 1997).

1.3.2 Risk management strategies in dairy farming

The goal of risk management is to balance a farm's risk exposure and tolerance with the farm's strategic and financial objectives, such as income, wealth, environmental quality and personal goals. The goal of risk management is not to reduce risk only, other objectives might not be met then, this kind of management involves how we use our farm resources (livestock, land, labour, capital, machines etc.) best to achieve our personal objectives (Olson 2004).

Risk management is not something different from management of other aspects of a farm, since every farm management decision has risk implications. (Hardaker et al.1997)**.** According to Hardaker et al. 1997. *Figure 2.9* represents the steps in risk management.

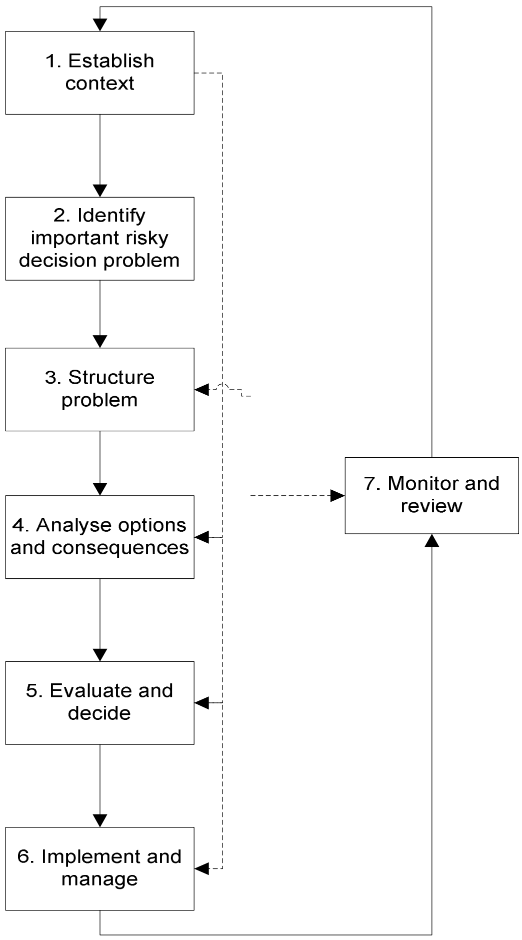

Figure 2.9: Risk management steps (Source: Hardaker et al, 1997)

The first step to manage risk is establish context, which means to setting the scene and identifying the parameters within which a particular risk or range of risks is to be considered. Hardaker et al. 1997 distinguish three types of risk management aspects: strategic, organizational and risk-management aspects, dependent on which management level would be examined. The second step is to identify important risky decision problem, which means to list all possible risk outcomes and considering what might happen, why and how and how the organization might be affected. Third step is to structure the problem which is similar to ask the following questions: W*ho faces the risk?, Who suffer if things go wrong?, What are the* *basic and proximate causes of the risk?, How is the risk currently managed?, Is there any alternative option to manage the risk?, Who is the decision maker?* It is important to ask these questions to understand what is at issue. The next step is to analyse options and consequences. The objective of this step is to divide the risks into low-probability and low impact that can be excluded from further study. The most common way to do that to use such a terms as “very likely”, “most likely”, “serious” etc. The fifth step in risk management is to evaluate the risky consequences and reach decision on what to do. After the decision the implementation and managing step is the next, which simply means doing what had been decided upon. Finally, there is the monitor and review step. Because risk management involves choices made with imperfect information, it is likely that some risk management option will turn out to be unsatisfactory. This part of the process is essential of learning about the nature of risk.

Hardaker et al (1997) give a good overview about the different risk management strategies in the agricultural sector. He distinguishes six strategies, which are the following:

- Collecting information, which means the better decision is always made if more and better relevant information is available from that specific topic. It is essential that the collected information comes from an objective source; otherwise it makes the decision biased.
- Avoiding or reducing exposure to risk strategies has three possibilities. The first is postponing a decision to change the existing situation until more information is available in the current situation, the second is stick to the safety standards, and the third is to make a decision which does not depart too much from the status quo.
- Preferring less risky technologies means to choose those kinds of activities which has some kind of guaranty. For example the conventional dairy sector has fix prices for the output but the organic dairy sector prices dependent on the world market fluctuation which is more risky rather than the conventional one.
- Diversification as a risk reducing strategy is the most commonly use in the agriculture. The idea of diversification is to reduce the dispersion of the overall return by selecting a mixture of activities that have net returns with low or negative correlation (Hardaker et al 1997.).
- The flexibility strategy means that the farmers can respond to the exogenous and endogenous changes relatively easily. Flexibility can be: asset flexibility, product flexibility, market flexibility, cost flexibility and time flexibility.

- Finally the most popular risk managing strategy is the “the sharing risk with others”. Insurance is very common way to share the risk with other farmers. Many type of insurance are available for farmers, including fire, theft cover for assets, death and natural calamity. Contract marketing is another way to reduce the risk, where the farmers usually use various marketing agreements to reduce the price risk and other types of risks. Finally future trading is another way to ensure the output price and delivery. In this transaction the future contracts are standardised, widely traded contracts, so prices are more competitively determined rather than an ordinary contract. The farmer might get a better price by hedging on the future market than by selling on contract (Hardaker et al 1997.).

1.4 Consequences of risk in conventional and organic farming

Organic farm has more revenues because of the higher price, but why the farmers don’t want to convert to organic. The key to solve this question is about the effect of risk. Hardaker et al (1997) mentioned several times, that most of the farmer’s decision are risk-averse. Ács (2006) examined in their studies about converting conventional to organic decision, shows that the degree of risk aversion has strong effect on the optimal decision of a farmer to convert. The risk neutral farmer optimal decision is to convert the whole area to organic production. These studies presents that the hardly risk averse farmer more optimal to stay farming conventionally, however this farmer can convert to organic in an optimal solution if policy incentives are applied such as taxes on pesticides or subsidies on conversion, or the third alternative that the product of the organic market gets more stable.

As the payments for organic farming according to the agri-environmental programmes provide a reliable base of income, they have the *positive effect of reducing risk*. Though no studies exist that have thoroughly analysed whether the income of organic farms is prone to higher yearly fluctuations than that of conventional ones, risk reduction is one of the positive effects of the payment scheme. Especially during the conversion process, risk and uncertainty are perceived high by many farmers, not only with respect to technical problems and crop loss, but also with respect to the access to the ‘organic’ market (Offermann – Nieberg 2000).

2 Material and methods

This chapter firstly introduces the database which includes yearly data for different dairy farms from the Agricultural Economics Research Institute (LEI) in the Netherlands. The second part presents the variables that have been used in the research. Finally the method that has been used to determine the difference between organic and conventional risk factors is introduced as using an example how to calculate the variances with one variable, for instance the milk yield.

2.1 Description of the data

The number of the dairy farms in the database is 386. Because we are interested in within farm variance, those farms that have only one year in the database are skipped. The remaining number of farms in the sample is 348 of which 46 are organic and 302 are conventional farms. The number of years per farm which presents, how many years of data on average is in the database per individual farm is 4.4 years for organic and 5.5 years for conventional farms. On average the conventional farms are longer in the database than the organic farms. The farms in the database are either conventional or organic, so there is no farm in a transition period which means in between the conversion procedure to be organic farm. Data for conventional and organic farms are available from 2001 to 2007 and include different variables for instance: the numbers of dairy cows per farm, kg protein production per farm, kg milk production per farm, FPCM (fat and protein corrected milk) per dairy cow, number of hectare per farm, gross margin per dairy cow, total feeding cost per dairy cow, concentrate cost per dairy cow, roughage cost per dairy cow, other variable cost per dairy cows (veterinary cost, fertilizing cost, pesticide cost, insemination and breeding cost), milk price received per 100 kg milk, and concentrate price.

Table 3.1: Organic and conventional milk production per dairy cow in the Netherland

Farm type		No. of hectare per farm	Milk quota (kg)	No. dairy cows	Gross margin per farm (EUR)	FPCM per cow (kg)
Conventional	**Farm average in 2007**	51.85	623542	78.40	158408	8048
	Standard deviation in 2007	31.10	379496	44.59	99433	1182
Organic	**Farm average in 2007**	56.40	393571	62.71	133564	6459
	Standard deviation in 2007	20.71	155762	25.10	45987	1128
Significances	*t-value (between averages in 2007)*	*0.83*	*-6.32*	*-2.40*	*-3.38*	*-8.68*
	p -value	*0.41*	**0.00*	**0.02*	**0.00*	**0.00*

Source: LEI 2009; own calculations

Table 3.1 presents some important variables of farms in the sample in 2007. The average organic farm size in the sample is significantly smaller considering the number of dairy cows and the milk quota they have, but the number of hectare per farm is significantly higher than the conventional farm. The milk production (FPCM) per cow is higher in a conventional case. So the data in table 3.1 show that the average organic farm is less intensive and is more depending on own feed production.

2.2 Selection of variables to analyse

This research focused on the production risk and price risk. Dairy farming is often carried out in the open air and always has a difficulty to manage living creatures like animals and plants, this kind of activities especially exposed risk. The variables that have been used in this paper are presented in *Figure 3.1*, which is a scheme for analyzing economic and technical results of dairy farms. The main variable is the net result or profit, which is the main goal of every business activities. We divide this net result into: fixed cost, gross margin from the core activities and other gross margin. In this research we focus on the gross margin from the core business. The reason why the gross margin is preferred in this research instead of the net result is, because fix cost have low variance (because it is rather constant), so there is low effect for the risk. We will examine the gross margin variances at farm level. In the database we have only gross margin per dairy cow. So we have to calculate the total gross margin by gross margin per dairy cow times the number of dairy cows per farm.

In *Figure 3.1* the grey boxes represents the variables, which are most important to compare between organic and conventional farming with regard to variances. The milk price and the concentrate price can give us some information about the price risk.

The calculation of the production risk in feed production is more complicated, because we have to determine feed production per hectare. The next paragraph contains the details about the calculations. For production risk, analysis is done for milk production per cow and for roughage production per hectare. Milk production per cow is in the database, but roughage production per hectare needs to be calculated from other variables using the following equations:

$$Roughage\ production\ per\ hectare = \frac{Total\ feed\ requirements - Total\ purchased\ feed}{Total\ area\ of\ roughage\ and\ grassland} \quad (1)$$

$$Total\ purchased\ feed\ (KVEM) = (Additional\ feeding\ cost\ /\ concentrate\ price\ per\ kg)*0.94 \quad (2)$$

Eq. (1) shows that the specific roughage production per hectare is determined through dividing the farm feed production (total requirements - purchased feed) by the feeding areas (roughage and grassland together). The total purchased feed volume in KVEM equals the total feeding cost divided by the concentrate price per kg times 0.94. This 0.94 is because of the currency change between the KVEM and the kg. So 0.94 KVEM is equal 1 kg concentrate.

Feed requirements are calculated in KVEM which is the Dutch feed energy unit for dairy cattle. Energy is required for milk production, for maintenance of dairy cows including pregnancy and for growth and maintenance of young stock. Requirements are taken from CVB (2007):

- Energy requirements for milk production are 0.46 KVEM/kg
- Daily requirement for maintenance of dairy cows is 5.3 KVEM. Assuming grazing in summer during day time leads on average to an extra 5% energy requirement for maintenance. Additional daily requirements for pregnancy are 0.45, 0.85, 1.5, and 2.7 for month 6, 7, 8, and 9 of the pregnancy respectively. Assuming a one year calving interval total requirements per year for maintenance of dairy cows including pregnancy are 365 x 5.3 x 1.05 + 30.5 x (0.45 + 0.85 + 1.5 + 2.7) = 2190 KVEM
- Daily requirements for young stock vary from 2.5 KVEM in the first months up till 7.5 KVEM in the last months before calving for the first time. The total growing period spans 24 months. Based on the increasing requirements per day as given by CVB (2007) total requirements for the growing period of 24 months amounts to 3986 KVEM. Per year this is 1993 KVEM. Assuming 0.7 young animals per dairy cow this gives a feed requirement for young stock per dairy cow of 0.7 x 1993 = 1395 KVEM

Energy requirements determined above are net energy requirements. During the processes of grazing, roughage harvesting and roughage and concentrate feeding losses occur. Here it is assumed that on average 10% of the energy is lost during these processes. This leads to the following final equation for total feed requirement of the farm:

Total feed requirement = [total FPCM * 0.46 + number of cows * (2190 + 1395)] / 0.9

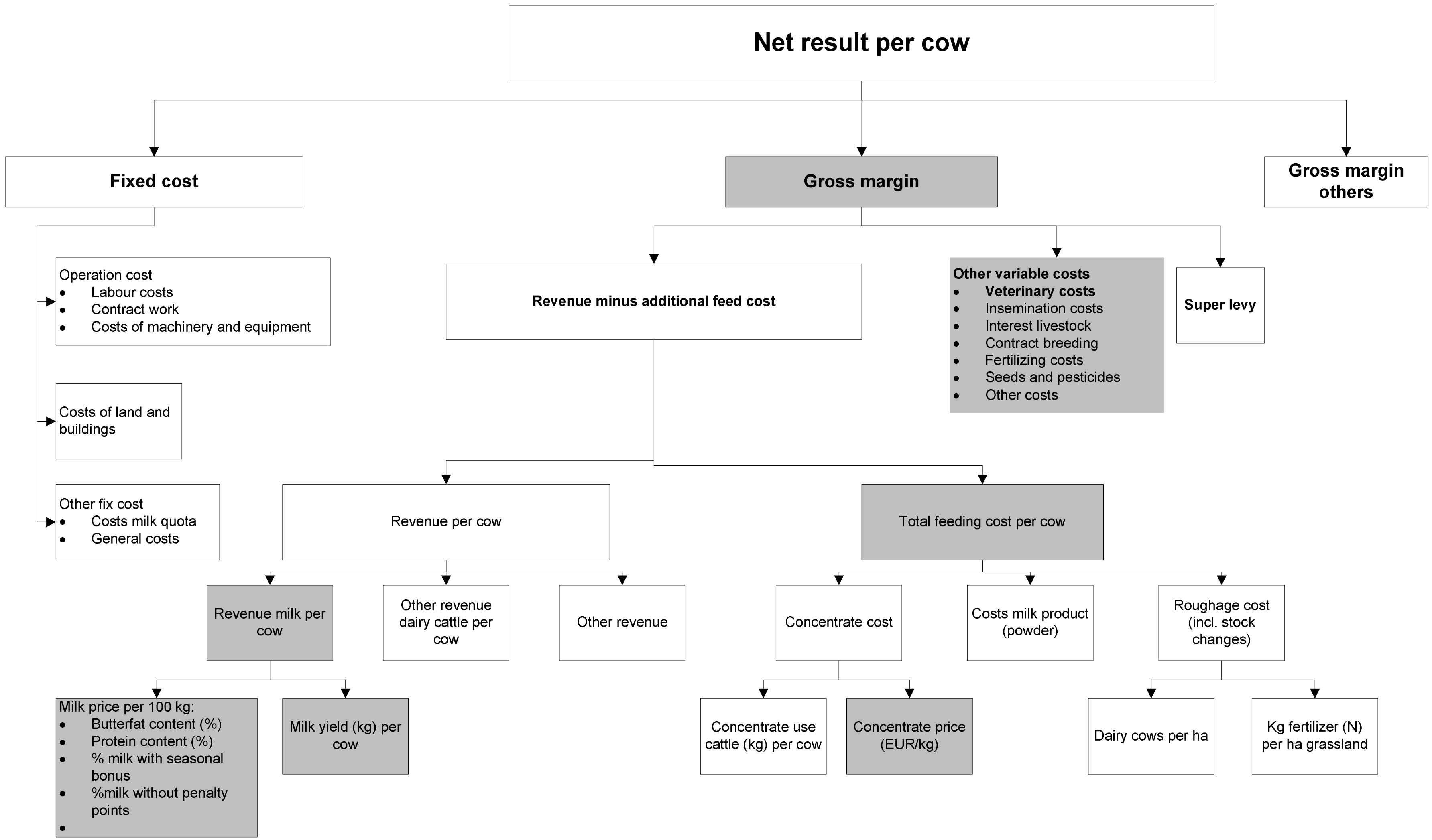

Figure 3.1: Risk Variable from the Dairy Business

2.3 Method of analysis

Differences in risk between conventional and organic farming follow from differences is standard deviation of the variables mentioned in the previous section. Before we start to analyse the data to get correct standard deviation, we have to be sure that there is no time trend effect in the data. Atwood et al (2003) and Flaten et al (2008a) mention three statistical methods for detrending. First, no time trend adjustment, which is likely to overestimate the variability since no trend is removed. The second is the estimation of individual farm-level trends. If most or all farms in an area have a similar underlying trend, estimating individual trends for each farm may result in non-robust trend parameters. The third statistical procedure is: An error component method, that removes any common national trend from the farm yields series (Atwood et al., 2003). Flaten et al (2008b) suggested that this statistic procedure, *error components implicit detrending* (ECID), was shown to better describe the reality in most cases than individually detrending farm-level data. Atwood et al. (2003) presents their ECID procedure using the example for milk yield per cow as the follows:

First calculate the "national" FCPM (fat and protein corrected milk) yield per cow in year *t*, Y_{avt}, which is the average of farm yields in the Netherlands. The average national yields from 2001 to 2007 are shown in Table 3.2:

Table 3.2: Overall average milk production (Y_{avt}) in a particular year

Year	2001	2002	2003	2004	2005	2006	2007
Y_{avt}	7533	7605	7778	7754	7806	8041	8063

Source: LEI 2009

Secondly compute each farm's "yield" deviation from the national yield, like:

$\boldsymbol{\Delta_{it} = Y_{it} - Y_{avt}}$, where Y_{it} is the average yield of farm *i* in year *t*. (3)

Table 3.3 presents the one individual farm's yield (Y_{it}) deviation from the national average yield (Y_{avt}).

Table 3.3: Farm deviation from the national yield

Year	2 001	2 002	2 003	2 004	2 005	2 006	2 007
Y_{it} (FPCM per cow)	6922	6818	6389	6269	6673	7115	6339
Y_{avt}	7533	7605	7778	7754	7806	8041	8063
Δ_{it}	-611	-787	-1389	-1485	-1133	-927	-1724

Source: LEI 2009

The third step to compute the time invariant farm specific deviations between the particular farm average (Y_{iav}) and the overall averages for the years each particular farm is in the sample (Y_{avyi}). Table 3.4 shows the particular farm average (Y_{iav}) which is the average of the individual farm's yield (Y_{it}). The overall average for the years about each particular farm is in the sample (Y_{avyi}) is the averages of the national average yield ($Y_{avt.}$).

Table 3.4: Time invariant farm specific deviation

Year	**2 001**	**2 002**	**2 003**	**2 004**	**2 005**	**2 006**	**2 007**
$\mathbf{Y_{it}}$ (FPCM per cow)	6922	6818	6389	6269	6673	7115	6339
$\mathbf{Y_{iav}}$	6646	6646	6646	6646	6646	6646	6646
$\mathbf{Y_{avt}}$	7533	7605	7778	7754	7806	8041	8063
$\mathbf{Y_{avyi}}$	7797	7797	7797	7797	7797	7797	7797
$\mathbf{Y_{iav}-Y_{avyi}}$	-1151	-1151	-1151	-1151	-1151	-1151	-1151

Source: LEI 2009

So on average the farm's milk production per cow is 1151 kg, lower than the national average. The fourth step to compute the time variant farm specific deviation (ε_t):

$$\boldsymbol{\varepsilon_t = Y_{it} - Y_{avt} - (Y_{iav} - Y_{avyi})} \qquad (4)$$

The first part of the equation represents the farm deviation from the national yield in year *t* and the second part the farms average deviation from the average national yield. After getting this time-variant farm-specific deviations ε_t , standard deviation (SD) of this variable per farm can be calculated by using Eq. (5).

$$SD = \sqrt{\frac{\sum_{t=1}^{i} \varepsilon_t^2}{t-1}} \qquad (5)$$

The next table 3.5 shows the calculation in details. The sum of square is the cumulative ε_t square, equal 971868. So the SD for this individual farm is square root ε_t divided by the number of years minus one, so $\sqrt{\frac{971868}{7-1}}$ = 402

Table 3.4: Farm specific standard deviation

Year	2 001	2 002	2 003	2 004	2 005	2 006	2 007
Y_{it} (FPCM per cow)	6922	6818	6389	6269	6673	7115	6339
Y_{avt}	7533	7605	7778	7754	7806	8041	8063
Δ_{it}	**-611**	**-787**	**-1389**	**-1485**	**-1133**	**-927**	**-1724**
Y_{iav}	6646	6646	6646	6646	6646	6646	6646
Y_{avyi}	7797	7797	7797	7797	7797	7797	7797
Y_{iav}-Y_{avyi}	**-1151**	**-1151**	**-1151**	**-1151**	**-1151**	**-1151**	**-1151**
ε_t	**540**	**364**	**-239**	**-335**	**18**	**224**	**-573**
Cumulative sum of squares	291844	424113	481061	592990	593313	643606	971868
SD	**0**	**0**	**0**	**0**	**0**	**0**	**402**

Source: LEI 2009

The next step is to classify and compute the average standard deviation for conventional and for organic farms using Eq. (6).

$$SD_{conventional} = \frac{\Sigma SD_{conventional}}{Number\ of\ conventional\ farms\ in\ the\ sample} \qquad (6)$$

The total number of conventional dairy farms number is 302. The sum of the standard deviation of all conventional farm is 108 694. The average standard deviation is 108 694/302 = 359.91 for the conventional dairy farms milk yield.

In the organic case there are 46 dairy farms in the sample. The sum of the standard deviation is 21624. The average standard deviation is 21 576/46 = 469.04 for the organic dairy farms milk yield. So we can observe the difference between variance in milk yield of conventional and organic farms. This means that milk production risk in organic dairy farming is higher than in conventional farming.

Flaten et al (2008) state that "*it can be shown that the resulting farm residual values have been implicitly detrended to the degree that farm yields follows a common national yield trend. If there are reasons to believe that producers' underlying yield trends could vary widely within a nation, it is likely that the ECID procedure might generate biased residuals. However with short-term panel data, it will always be extremely difficult to identify whether a difference in an individually estimated trend occurred because of differences in actual trend or resulted from sampling anomalies.*"

In this study the original version of the ECID procedure of Atwood et al. (2003) has been used. Figure 3.2 graphically present the ECID procedure using in the same example of milk production per cow. Time-variant, farm-specific deviations ε_t , show variation in yields between years on a farm caused by management including the technology used (e.g. conventional versus organic).

Figure 3.2 shows the core equation; Eq. (4) in a graphical way. If the value of the time invariant farm specific deviations between the particular farm average (Y_{iav}) and the overall averages for the years about each particular farm in the sample (Y_{avyi}) is higher than the farm deviation from the national yield (Δ_{it}) then the time variant farm specific deviation $\varepsilon_{t,}$ is positive otherwise negative.

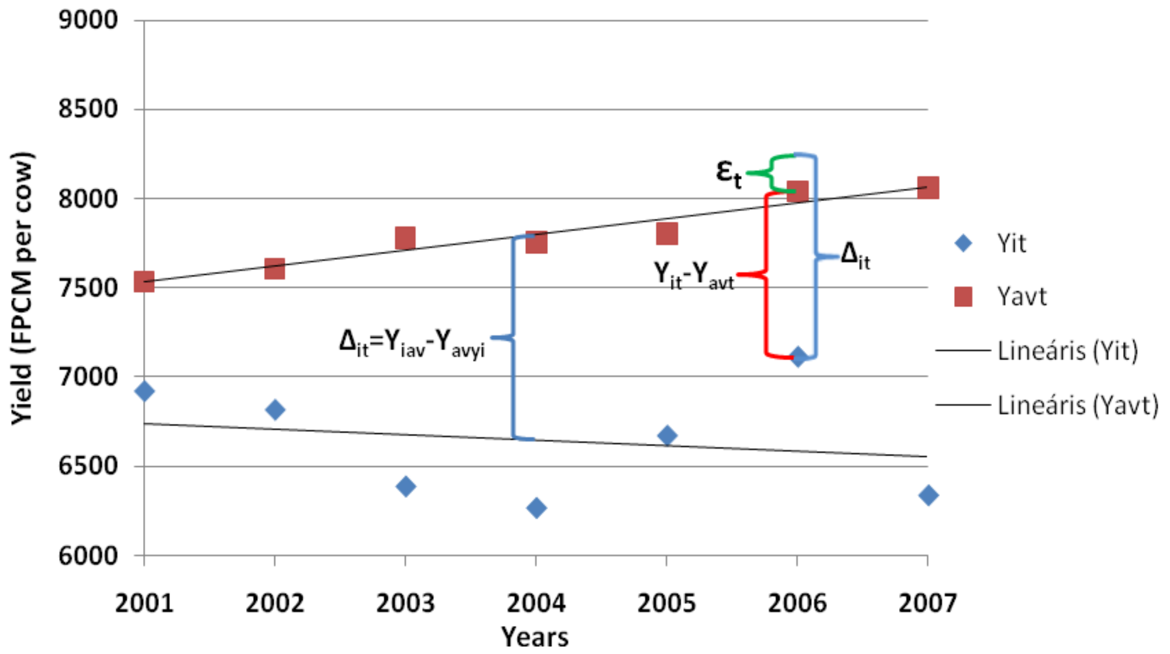

*Figure 3.2: ECID procedure applying to individual farm level conventional milk (FCPM) yield (*Source: LEI 2009; own calculations)

To decide that the difference between the two groups averages and standard deviations are significant or not, we used the t-test method (Eq.7). In this case the null hypothesis (H_0) is that the two average (H_0: $\bar{x}_1 = \bar{x}_2$) are the same in 0.05 significant level. We assume that the two population distributions are normal. If the absolute value of $t_{empirical}$ is higher than the $t_{critical}$, that means we have to reject our null hypothesis, so that means the two sample means are different. The $t_{empirical}$ can be calculated with the following formulas (Eq.7), where $\bar{x}$ is the sample mean, s_p common standard deviation, n is the sample size:

$$t_{\text{empirical}} = \frac{\bar{x}_1 - \bar{x}_2}{s_p \sqrt{\frac{1}{n_1}} + \sqrt{\frac{1}{n_2}}} \qquad (7)$$

Our result will be farm averages, average detrended within farm standard deviations (SD) and we will introduce a statistical measure the coefficient of variation (CV), which equals the current variable standard deviation divided by their mean.

3 Results

Table 4.1 shows averages, time variant within farm specific standard deviation (SD) and the coefficient of variation (CV) of organic and conventional farms for different variables. The family farm income average is 24.1% higher in the conventional farm like the total gross margin per farm which is 16.3% higher. The average standard deviation and the coefficient of variation part of the table represent the risk which is also higher for variable's SD in the conventional case, but the difference is not significant. But the CV of the family farm income is higher for the organic case, which means higher risk.

The next row presents the gross margin per dairy cow, where the average value is 10.3% higher in the organic farms. The result of gross margin is interesting, because if we examine the whole farms the conventional farm's gross margin is higher, but if we examine the gross margin at dairy cow level, the organic farm is significantly better. This is so because the organic farm's size is smaller. Look at the CV values the organic farms are more risky than the conventional concerning the gross margin per dairy cow but the differences are not significant. The milk revenue per dairy cow average difference is relatively small. SD of revenue milk per DC on the organic farms is 64.1% higher than the conventional farms. Important part of the economic analysis is to reveal the riskiness of the milk yields and milk price, which has a main impact on milk revenues. The milk revenue depends on the milk price and the milk yield. The milk yield has a significantly higher SD in the organic farms and the CV value is also higher, which means that milk production in organic farming includes more risk than in conventional farming. The organic milk price is higher than the conventional, but the SD and the CV are also 2-2.5 times higher in the organic farms. The milk price in the dairy business depends among others on the milk quality which includes the fat%, protein% and low quality milk. SD and CV show that the higher variation in the organic milk price goes along with higher variation in fat%, protein% and low quality milk.

The next variable to examine in the database is the roughage production. The roughage production per hectare averages is 24.2% higher in the conventional farms. The SD is higher in the conventional case, but the difference is not significant, although the organic CV value is higher, but the difference here is also not significant.

The price of concentrate in the organic farms is 0.24 EUR/kg and in the conventional farm it is 0.18 EUR/kg, which is a 33.6% differences. The price difference is most probably caused by the higher organic ingredients in the organic concentrate. The organic price significantly includes more risk, if we take a look at the CV or the SD values.

Table 4.1: Comparison of financial and technical variables in the organic and conventional farms

	AVERAGE				AVERAGE DETRENDED WITHIN FARM STANDARD DEVIATION				COEFFICIENT OF VARIATION			
	Conventional	**Organic**	*t-value*	*p-value*	**Conventional**	**Organic**	*t-value*	*p-value*	**Conventional**	**Organic**	*t-value*	*p-value*
Family farm income (EUR)	62492	47407	*2.59*	**0.01*	21177	21027	*0.05*	*0.96*	0.30	0.48	*1.02*	*0.31*
Total gross margin per farm (EUR)	153431	128366	*2.60*	**0.01*	19633	17121	*1.11*	*0.27*	0.16	0.16	*0.04*	*0.97*
Gross margin per DC (EUR)	1945	2145	*2.86*	**0.00*	199	252	*2.20*	**0.03*	0.11	0.13	*1.16*	*0.25*
Revenue milk per DC(EUR)	3441	3530	*0.66*	*0.51*	134	220	*3.90*	**0.00*	0.04	0.06	*3.54*	**0.00*
Yield (FPCM)	7924	6417	*8.19*	**0.00*	361	470	*2.38*	**0.02*	0.05	0.08	*3.37*	**0.00*
Milk price (EUR/100kg)	34.32	39.06	*10.60*	**0.00*	0.82	1.90	*6.04*	**0.00*	0.02	0.05	*5.22*	**0.00*
FAT (%)	4.31	4.15	*1.56*	*0.13*	0.06	0.10	*1.73*	*0.09*	0.02	0.05	*1.44*	*0.16*
Protein (%)	3.40	3.26	*2.14*	**0.04*	0.06	0.10	*1.63*	*0.11*	0.02	0.04	*1.32*	*0.19*
Low quality milk (kg)	9588	13329	*1.01*	*0.32*	13617	15245	*0.43*	*0.67*	0.71	0.72	*0.06*	*0.96*
Roughage production per hectare (kg)	9140	6928	*7.23*	**0.00*	1093	906	*1.98*	*0.05*	0.12	0.15	*1.40*	*0.17*
Concentrate price (EUR/kg)	0.18	0.24	*11.36*	**0.00*	0.01	0.03	*3.24*	**0.00*	0.07	0.14	*4.13*	**0.00*
Veterinary cost per DC(EUR)	86.57	60.31	*4.30*	**0.00*	17.08	12.46	*2.91*	**0.00*	0.21	0.24	*1.19*	*0.24*

*: the difference is significant in the level of 0.05

(Data source: LEI 2009; own calculations)

Veterinary cost per cow is 30.3% higher in the conventional farms, the standard deviation difference is 27% but the CV is 16% higher for the organic farms, which means the organic farms are bearing more risk about the animal health field al well.

Figure 4.1 shows the coefficient of variation for the different risk factors in a graphical way. The differences between the organic and the conventional farms coefficient of variation are observable. We can conclude in general that organic farming includes more risk, because the higher coefficient of variations.

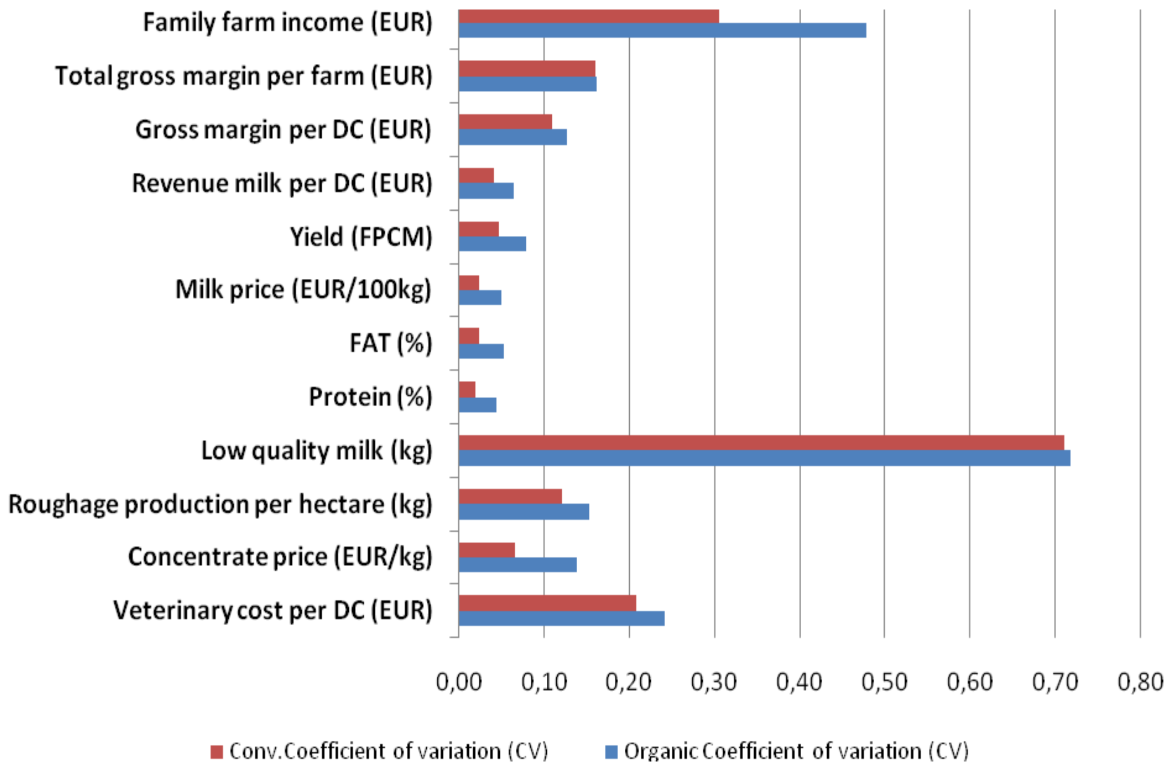

*Figure 4.1: Coefficient of variation among the different risk factors (*Source: LEI 2009; own calculations)

Table 4.2 presents the correlation between the conventional within farm deviations. Table 4.3 shows the correlation among the organic within farms deviations.

In general the sign and the level of the correlations between deviations of income or gross margins and the explaining variables are as could be expected. Tables are similar.

Table 4.2: Correlations between the conventional within farm deviations

	Family farm income	Gross margin per farm (EUR)	Gross margin per dairy cow (EUR)	Revenue milk per DC	FPCM per cow (kg)	Milk price	FAT (%)	Protein (%)	Low quality milk (kg)	Roughage production per hectare	Concentrate price	Veterinary cost per DC
Family farm income (EUR)	1.0											
Gross margin per farm (EUR)	0.6	1.0										
Gross margin per dairy cow (EUR)	0.4	0.5	1.0									
Revenue milk per DC (EUR)	0.2	0.2	0.4	1.0								
FPCM per cow (kg)	0.1	0.2	0.3	0.8	1.0							
Milk price (EUR/100kg)	0.1	0.2	0.2	0.3	0.0	1.0						
FAT (%)	0.0	0.0	0.0	0.1	0.0	0.3	1.0					
Protein (%)	0.0	0.1	0.1	0.2	0.1	0.3	0.5	1.0				
Low quality milk (kg)	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	1.0			
Roughage production per hectare (kg)	0.2	0.2	0.1	0.0	0.0	0.0	0.1	0.1	-0.1	1.0		
Concentrate price (EUR/kg)	0.1	0.0	0.0	0.1	0.0	0.0	-0.1	0.0	0.0	0.2	1.0	
Veterinary cost per DC (EUR)	-0.1	-0.2	0.0	0.1	0.1	0.0	0.0	0.0	0.0	-0.1	0.0	1.0

(Source: LEI 2009; own calculations)

Table 4.3: Correlation between the organic within farm deviations

	Family farm income	Gross margin per farm (EUR)	Gross margin per dairy cow (EUR)	Revenue milk per DC	FPCM per cow (kg)	Milk price	FAT (%)	Protein (%)	Low quality milk (kg)	Roughage production per hectare	Concentrate price	Veterinary cost per DC
Family farm income (EUR)	1.0											
Gross margin per farm (EUR)	0.4	1.0										
Gross margin per dairy cow (EUR)	0.3	0.5	1.0									
Revenue milk per DC (EUR)	0.3	0.3	0.5	1.0								
FPCM per cow (kg)	0.2	0.1	0.3	0.6	1.0							
Milk price (EUR/100kg)	0.2	0.2	0.3	0.4	-0.1	1.0						
FAT (%)	0.0	-0.1	0.0	0.0	0.1	0.2	1.0					
Protein (%)	0.1	0.0	0.1	0.1	0.2	0.1	0.4	1.0				
Low quality milk (kg)	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	-0.2	1.0			
Roughage production per hectare (kg)	0.2	0.1	0.0	0.1	0.1	0.1	0.1	0.2	-0.1	1.0		
Concentrate price (EUR/kg)	-0.1	-0.2	-0.1	0.2	-0.1	0.1	0.1	0.1	-0.1	0.3	1.0	
Veterinary cost per DC (EUR)	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.1	-0.1	0.1	0.0	1.0

(Source: LEI 2009; own calculations)

4 Discussion

The method in this research was suitable to compare conventional and organic farms risk factors. The method that has been used in this research eliminates the location and the weather condition differences between the farms to calculate within farm deviations. Thus standard deviations (SD) and the coefficient of variations (CV) are more valid to determine within farm risk.

The database of the research has been collected by the LEI from 2001 to 2007. Thus the time horizon of the data is 7 years, but it can be longer like 10 or 20 years to get more valid results for the comparison. The number of dairy farms in the sample is 348 of which 46 are organic and 302 are conventional farms. In the future research it is desirable to increase the numbers of organic dairy farms in the sample as high as the conventional farms number to get more clear view about their management and for the comparison.

The number of years per farm which presents, how many years of data on average in the database per individual farm is 4.4 years for organic and 5.5 years for conventional farms. Because the low number the organic farms in the database, we have to keep the two years farms in the database. In the organic case this could be starting farms that can have rather extreme financial and technical results at the beginning of their lifetime.

The database we used does not contain any information of the farms roughage production, so we have to calculate it using averages. So this result perhaps includes some bias results. In this calculation we assumed number of young stock of 0.3 calf, and 0.4 heifers per dairy cow.

This research present several indicators from the organic and the conventional farms like averages, time variant within farm specific standard deviation and the coefficient of variation. However, interpretation of differences in averages and SD's are tricky because of the different farm size and different technologies. Thus the proper way to interpret the results is to use the CV values, which is a relative value taking into account the different farm sizes. In that way the results show that the organic farming includes more risk, because of the higher coefficient of variations.

The usability of this method for other country or region is possible, if they have proper data for the analysis. The method is available to compare not just countries but regions inside the counties which have different natural resources. The adaptability of this model is wide so we can analyse different sectors in the agriculture and different industrial sectors as well.

5 Conclusions

The research objective was to identify the magnitude of the different sources of risk arising in conventional and in organic dairy farming in the Netherlands. The study uses error components implicit detrending (ECID) method to present more realistic results, than presenting individually detrending farm-level data.

Literature on comparison of conventional and organic dairy farms in the Netherlands shows that the conventional farms average milk production is 30-40% higher than the organic one. Comparison of organic and conventional milk prices shows that the organic price is 10-15% higher than the conventional one.

The main variable concerning the comparison is the family farm income, which is the main goal of every business activities. We divide this net result into: fixed cost, gross margin from the core activities and other gross margin. In this research we focus on the family farm income and the gross margin from the core business. The final results of this research are the selected variable's averages, detrended within farm standard deviations (SD) and the coefficient of variations (CV) of organic and conventional farms.

The main result is that the family farm income average is higher in the conventional farm like the total gross margin per farm and includes more risk in the organic farms. The revenue milk per dairy cow average is higher in the organic case, but includes significantly more risk which comes mainly from the milk yield and the milk price. The milk price risk comes from the fat% and protein% values.

The roughage production per hectare averages is higher in the conventional farms but the CV value is higher in the organic farms, but the differences are not significant. The prices of the concentrate in the organic farms are higher in average than the conventional once, because of the higher organic ingredients prices. The organic concentrate price significantly includes more risk, if we take a look at the CV or the SD values. Veterinary cost per cow is higher in the conventional farms but the CV is higher in the organic case.

We can conclude that the organic farming includes more risk, because of the higher coefficient of variations, although the difference with conventional farming is not always significant. This might be one reason why so many dairy farms in the Netherlands don't want to shift to organic farming.

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