UiT
THE ARCTIC UNIVERSITY OF NORWAY

School of Business and Economics

The future of Norwegian milk production

An investment analysis of dairy farms

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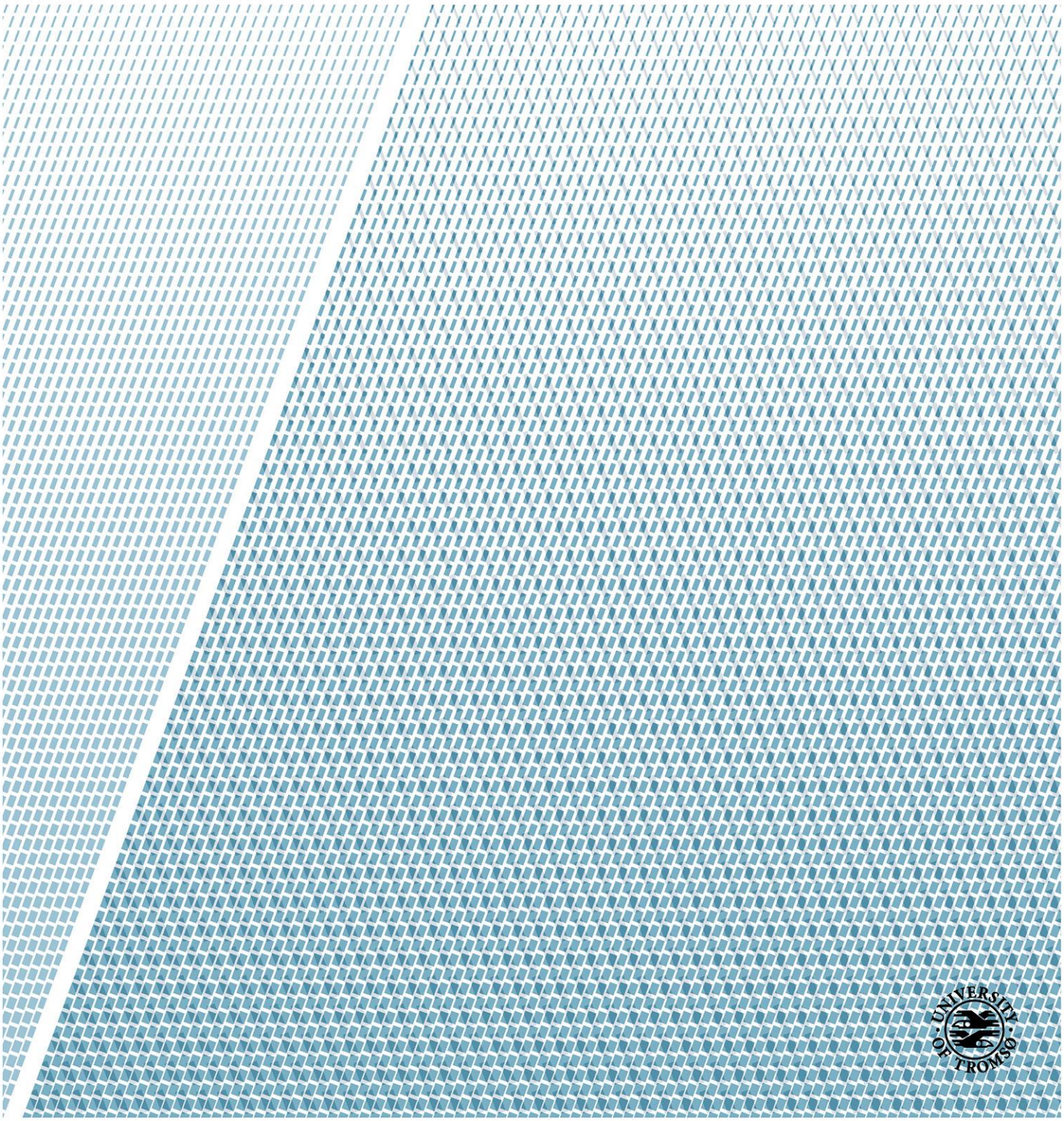
Master's Thesis in Economics – June 2015



I Preface

After five years of studies in Tromsø, it is with great pleasure I now deliver my master thesis. The past semester has been challenging and inspiring, and I finally feel I can read a research paper and actually understand some of it. Also my skills in the card game "boms og president" has risen significantly and thanks to my classmate I can now call me the grand president.

I would like to express my gratitude to Norsk Institutt for Landbruksøkonomisk Forskning and a special thanks to my advisors Klaus Mittenzwei and Eivind Brækkan for guiding and good advices. In addition, to all my classmates and those who contributed to this master thesis or hold my spirit up to the very end.

Tromsø, 1. June 2015
Ingrid Martine Romsaas

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V Abstract

This master thesis examines the dairy industry in Norway. Since World War 2 the total number of farms and farmers has decreased. Even though the dairy sector is developing and becoming more efficient, the milk production has stagnated and led to an increase in import of dairy products. To maintain the political goals; spread settlement, preserving the cultural landscape and food security, the development in the milk production needs a positive change. To increase milk production it is several possible solutions. This thesis examines the possibility of higher profitability for existing farmers if they invest in one more dairy cattle and if the size or area of the farm matter for the result, with and without the agricultural settlement of 2014. This analysis is based on all farmers as profit maximizers, and the result must be interpreted with the fact that this is not the case for several farmers.

The agricultural settlement of 2014 are central because changes in roughage subsidies and removal of production limits benefits larger farms. The main reason the government made these changes, was to strengthen Norwegian agricultural products against foreign competition. By increasing the size of farms, the idea is to increase effectiveness and lower costs, to achieve less expensive Norwegian agricultural products.

The results indicate that larger farms achieve better net present value of investing in one more dairy cattle than smaller farms. Smaller farms lost some of their income after the changes in the settlement of 2014, and achieve better results in the net present value analysis when the changes from 2014 is excluded. The areas in the middle and northwest of Norway achieve best results, which indicates that the investment and increase in milk production is likely to be largest in these areas.

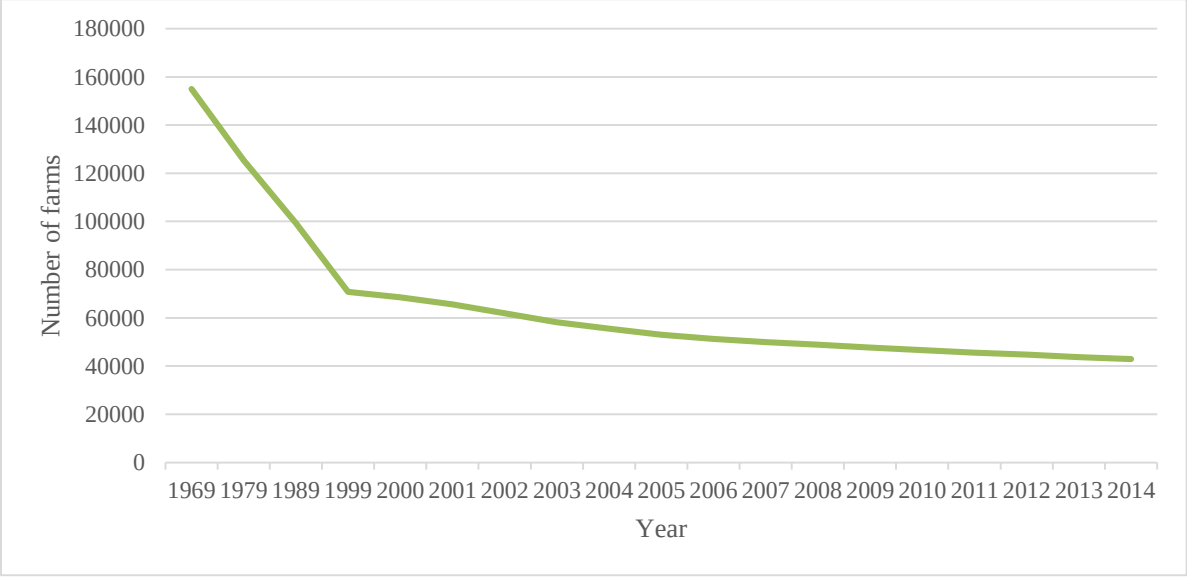
Keywords: agriculture, dairy sector, NPV analysis, agricultural settlement of 2014, milk production.

1 INTRODUCTION

1.1 Motivation and background

Milk production in Norway has stagnated, and the agricultural sector has had a continuous decrease in the total number of farms the last decades (figure 1), between 2004 and 2014 there has been a decline of 22,8 percent (Bjørlo and Bye, 2014). However, agricultural efficiency has increased since 1950. In 2005, 2.5 percent were employed in agriculture, and agriculture's share of gross domestic product (GDP) was 0.5 percent. The corresponding numbers for 1950 was 23.5 percent of the employed and 7 percent of GDP (Ladstein and Skoglund, 2005). The agricultural sector has an important role in several contexts, including terms of regional policy and food supply, the industry is still a subject of great political interest and discussion. In Norges offenttlige utredninger (NOU) 2 from 2004 several political goals for the agricultural sector are dicussed (Effektutvalget, 2004). The most important themes in NOU 2 is food security, peservation of the cultural landscape and regional policy, which all are political reasons to maintain the subsidies of the agricultural sector. Especially, preservation of the cultural landscap is connected to tourism and that tourists do not want see overgrown forest (Bryn and Flø, 2013).

Figure 1: Number of farms from 1969 to 2014



(Statistisk Sentralbyrå, 2015c)

Every spring farmers' income and work arrangments for the next year are negotiated and settled beetween the government and the agricultural organizations. Farmers' income is based on subsidies, import regulations and price regulation, and most farms are therefore dependent on subsidies to survive. This arrangment negotiated every year is called the agricultural settlement. In 2014 the government presented a settlement that farmers disagreed in, which led to protests and demonstartions. The government wanted to guide the agricultural sector in a more cost efficient path and simplify the settlement to strengthen the Norwegian products against foregin competition. To achive this goal, limits on quoatas were removed and subsidies changed, this is assumed to benefit the larger farms more than smaller farms, hence the protests espcally from smaller farms. The negotiations failed and the settlement of 2014 were decided in the Parliament, which means that other political parties needed to join the negotiations to achive an agreement. Several of the changes presented from the government were modified and moderated. The main focus in this thesis is milk production farmers, which was also affected by the changes in the agricultural settlement of 2014.

One of the most important part of the Norwegian agriculture is farms with combined milk and meat production. These farmers are mostly full time farmers, in contrast to other production forms in agriculture. Milk production is more time consuming than meat production or sheps. Dairy cattle needs to be milked twice a day, every day of the year, and demand care and feeding. There are no need to milk sheps or beef cattle, so farmers only need focus on care and feeding, which in many cases gives the farmer time to a second job.

Norway is a country of several small and large farms spread from north to south and only 3 percent of Norway has suitable soil for food production and around 20 % of this area is productiv forestry (Syverud et al., 2014). These areas are often small and not connected to each other, especily in rural areas. This foundation does not naturaly provide an efficient agricultural production, but because of regulations and subsidies this small scale-structure is possible.

As mentioned milk production has stagnated and the population in Norway is increasing (Statistisk Sentralbyrå, 2015a). The demand for dairy products increases, but consumers has the last years change preferences to more cream, sour cream and butter and less demand for drinking milk (TINErådgiving, 2013). The demand for milk increas and to meet the demand for dairy products, the milk production must increase or milk must be imported. There are several possible approaches to increase milk production, for example increase the number of farms, increase the production on existing farms or improved quality of feeding to dairy cattle so they can produce more milk each year. If Norwegian farms are capable of increasing milk production, they can meet the demand for milk in the market and increase profit on the farm. This master thesis examines the impact of the agricultural settlement of 2014 has on excisting farms, and what happends to the profitablility on different farms if they increase milk production with one more dairy cattle. Is there a difference on the profitability for small and larger farms and is there diffrences of which area the farm is located. After protests from farmers and headlines in the newapaper, it is in advanced expected that larger farms and the areas around Jæren will ahieve the best result in this analysis.

1.2 Research question

This master thesis examines the profitability of increasing milk production in different farms in Norway. Is it more profitable for larger farms than smaller farms to increase milk production or both small and large farms or none. In addition, which area in Norway is best fitted to increase milk production. This thesis also examine which affected the agricultural settlement of 2014 has on the different farms.

1.3 Literature and structure

It is done a lot of research in agriculture, one obvious theme is subsidies levels but also other effects caused by farming are discussed. There are several organizations and universities that regularly publish articles, reports, statistics and other research. In this master thesis the most important source and the source of the dataset is Norsk Institutt for Landbruks økonomisk Forskining (NILF). NILF publishes several reports about agriculture and accountings from farms each year, which are used in the making of the

agricultural settlement each year.

Agri analyse is another distributer that does a lot of research on agriculture. In this thesis, reports that examines investments in the agricultural sector and the future of the dairy sector is most relevant. Statistics are from the official publisher of statistic in Norway Statistisk Sentralbyrå (SSB). In addition, Tine as the largest dairy in Norway, collects information about farms and is yearly presenting their results. The statistics relevant for dairy farms are presented in Kukontrollen. The government has presented political goals for the agricultural sector in NOU several times since 1994.

The structure of the thesis is as follows. The second chapter is the theory chapter and presents the economic theory used in the net present value analysis. Chapter 3 provides a brief presentation of the agricultural sector in Norway with focus on milk production and presents the data used in the analysis and examines the changes in the agricultural settlement of 2014. Chapter 4 presents the scientific methods used in this thesis, and presents information on the data's in the analysis. The structure of the net present value analysis and all the assumptions are presented in this chapter. Chapter 5, provides an in-depth analysis where the results are presented and discussed. The final chapter is the conclusion.

2 THEORY

The theory chapter presents the basic theory needed to make an net present value analysis and theory that explains how subsidies affects the market and how larger farms achieve fewer costs of production.

2.1 Risky decision and time.

Most investment decisions regarding production, marketing and finance have a long time horizon. Investments farmers make today, can have a large impact on income and cost levels for several years. These long-term investments make time essential. However, it is uncertainty related to any investment, you cannot know for certain how the market is in two years or how the prices will change the next year. Uncertainty generally increases in a longer time perspective, this affect the choice of investment the farmers take. The best investments has low uncertainty and high profitability.

There are mainly two types of investment decisions: the investment decisions only made once and a sequence of decisions that must be taken over time. The investment decisions made only once is to buy more land, invest in buildings or invest in new and expensive equipment. If a decision requires a sequence of decisions, the outcome is typically uncertain events that affect later choices, as well as the consequence of a decision taken earlier (Hardaker et al., 2004). If we assume a perfect world without uncertainty and perfect capital markets, investments would be predictable and there would be possible to maximize utility each period for all farms. Each farmer maximizes utility by consuming goods that maximises his welfare, as seen in equation (1).

(1) $U = U(c_0, c_1, \dots, c_T)$

U is the utility for the farmer. C is goods the farmer consume in different periods. The subscripts are related to time, where time T is a finite planning horizon. It is assumed that more income in future periods is always preferred to less and there are diminishing marginal utility of income $\frac{\partial U}{\partial c_t} > 0$ and $\frac{\partial^2}{\partial c_t^2} < 0$ for all t. Suppose that a farmer build a

new barn, this investment will provide negative cash flow the first years and later, hopefully, it will turn to a positive cash flow. If we assume perfect market conditions, it would be possible to convert any pattern of cash flow over time into any other pattern with the same net present value (NPV) without affecting the utility for the farmer. More formally, NPV is the discounted value of future net cash flows less the capital cost at time t = 0. If the net present value for the investment is positive, the farmer should allocate equity and invest in the project and achieve a higher utility in the future. If the net present value is negative, he should not invest in the project.

2.2 Net present value (NPV)

To examine how an investment influence the net income in the future, it requires a method that can calculate the effects on revenue and costs happening in different times. Traditionally, net present value is the most common method used for this purpose. All future income and costs are discounted with one interest rate, the discount rate, to the net present value. Revenue and costs are measured in constant real prices through the whole period. This assumption is built on the assumption that all prices are growing with the consumer price index (CPI). Some goods, like time and environmental goods, will have another growth than CPI over time. The difference between the present value of cash inflow and the present value of cash outflow gives the net cash flow for an investment. NPV is used in capital budgeting to analyse the profitability of an investment or project and consist of the elements; time of the cash flow, discount rate and net cash flow (equation 2).

$$(2) \quad NPV = \frac{C_t}{(1+r)} + \frac{C_t}{(1+r)^2} + \cdots + \frac{C_t}{(1+r)^n} - C_0 = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t} - C_0$$

C_t is the net cash inflow in each period, C_0 the initial investment. r is the discount rate and t is the number of time periods. The discount rate expresses the time references to the community, which means how future consumption is weighted compared to consumption today. The discount rate is an alternative cost of binding the capital to one project and compare the probability of the investment or project to the cost of capital. The cost of capital in this analysis is the discount rate.

The discount rate is a risk free rate and adjust for risk. When effects of investments have a long time horizon, there are more uncertainty and higher risk than for a shorter time horizon. Risk is considered the danger perceived to be looming, while uncertainty is considered as too many unknown variables or outcomes. Risk can be dividend in two: unsystematic risk and systematic risk. Unsystematic risk is risk associated with a specific project, like investing in more cattle gives less space for the animals without expanding the barn, which might influence negatively for the cattle's welfare. This type of risk is not correlated with other projects. When all projects in the community is summed up the unsystematic risk disappears. However, this type of risk does not increase the yield requirement of the project. Systematic risk is macroeconomic factors, like the interest rate, unemployment and inflation. This type of risk affect all projects and cannot be diversified away. The right horizon for the NPV analysis is from the effects of the investments starts till the effects of the investment ends (Perman, 2003).

2.2.1 Shortcomings of the NPV method

Traditionally the net present value approach is used for measuring the excess or shortfall of cash flows under present value terms. A farmer can make a decision to invest or abandon the investment, depending on whether the NPV is negative or positive. The net present value method assumes an irreversible investment, once the farmer decide to invest, he may give up the possibility of waiting for new information (Abel et al., 1995). This method ignores the value of flexibility and consider the investment as a static process. The opportunities to investment are considered of as "now" or "never". In other words, it means that the company loses the opportunity to invest in that project forever. Even if the NPV proves to be positive, the farmer can choose to reject the project for now, and get more information at a later point in time to reduce risk. In this situation, the value of the time waiting is not included in a standard NPV analysis. Furthermore, this method does not consider the reality while many projects could be implemented flexibly through defer, expand, growth, switch or abandon, to considerate these alternatives in the analysis is possible by using real options theory and will be discussed in chapter 2.5. In this NPV analysis, the farmer could decide to sell or slaughter the dairy cattle before it

stopped producing milk these alternative costs in not included in the analysis.

Another shortcoming of the NPV method is that it ignores the value of other investments or projects. The investment strategy only considers if the farmer should invest or not, and excludes a third option which would allow the farmer to wait and decide later. In fact, many investments could be delayed and invested in at a later point in time, by acquire more information in the future some uncertainty disappears and the value of the project do not decrease. Investments or project with a long time horizon is exposed to change in the market environment. There are possible that the result of the NPV analysis is positive and the farmer decides to conduct the investment, but after some year the market environment may be changing. Perhaps after several years, the market or the agricultural settlement is turned around and the farmer can no longer receive the expected profit. The best way to handle this situation may be to stop the project for a while and wait until the market environment or settlement improves (Boute et al., 2003). Under traditional net present method, the farmer has already invested in the project and has no opportunity to stop and run later on, even if the market condition are worse than expected and the prices decreasing. In this analysis especially if the farmer needs to expand and invest in larger building, there are not possible to reverse the decision, the only possible solution is to end the production, but he would still have loans to pay. However, if the farmer only invest in one more dairy cattle he can chose to sell the cow after two years. This is not done in this NPV analysis.

There are disagreement among economist concerning the right discount rate. The results in a NPV analysis is sensitive to the discount rate, both the size and the longer time horizon the more sensitive the NPV is. If the discount rate is set at a lower level than realistic, the investment seem more profitable than it is in reality and vice versa. The uncertainty among the discount rate can be reduced or eliminated by waiting for new information before making the final decision. The NPV analysis tends to be used where uncertainty is inconsequential (Mathews, 2009). It seems that this method has poor ability to manage risk. The risk-adjusted discount rate has to be determined to calculate the net present value. Different investments or project risks is not always the same and can have

both negative and positive outcome. As an investor, the farmer may not pay attention to high risk and focus more on the negative outcome, than make an effort to reduce or eliminate the risk on the alternative that might be more suitable. Most investors prefer less risk to more risk, such as people who would like to pay a premium to buy insurance. Hence, how to determine the appropriate discount rate is a challenge when using NPV method. In addition, a NPV analysis assumes a constant risk-adjusted discount rate each period. This means risk will never change during the investments lifetime and uncertainties are resolved continuously at a constant rate over time. In this thesis it is collected information from several research papers and these discount rates is taken in consideration to achieve the most accurate discount rate, with the fact that: The return on capital or interest in the bank, depending on whether the farmers owns capital himself or not. At the turn of 2013/2014, it is possible to get 4 percent risk-deposit rate. In addition, it is incorporate one percent risk premium, which must be considered low in view of the vulnerability that milk has for changes in the agricultural settlement and the long maturity of the investments (Fjellhammer and Thuen, 2014).

2.3 Internal rate of return (IRR)

A second and common method to examine an investment's profitability is the internal rate of return (IRR). According to Higgins (2012) "the IRR is the discount rate that makes the present value of future benefits equal to the present value of any costs, thereby causing NPV to equal zero." Mathematically, IRR can be found by setting the net present value equal to zero, and then solve for IRR (equation 3).

$$(3) \quad \sum_{t=1}^{n} \frac{C_t}{(1+IRR)^t} = 0$$

IRR is the internal rate of return, C_t is the future cash flow and t is the time. If IRR is positive and higher than the cost of capital, the investment are considered profitable and the farmer should invest and vice versa. IRR can be compared against rates of return in the securities market, also called cost of capital. In other words, if a farmer cannot find any investment with an IRR greater than the returns that can be generated by deposit in the bank, it may simply choose to invest its retained earnings into the market. However if

the cash flow during the investments life is negative, it is known as "non-normal cash flow" and the IRR calculations ends up with several IRRs. This is also occurring in the analysis later in the assignment and then the IRR is unknown. The cost of capital in this analysis is the discount rate.

2.4 Sensitivity analysis

The NPV analysis depends upon estimates of costs and future cash flows. A sensitivity analysis is another way to deal with uncertainty and complexity and is used to understand and quantify the possible errors in costs and the cash flow estimates. The process is to change one primary variable each time and keep others unchanged, then identify the result of the NPV analysis. By following this method it is possible to determine how variables affect the NPV analysis and possible to reduce errors in variables.

One limitation in this method is that it only modifies one variable that affects the NPV at the time and ignores the misestimate of more than one variable correlating. In addition, if the variables depend on each other there are no point in examine them separately. (Trigeorgis, 1996) In addition, because of false estimates of a variable, forecast error in one year may generate higher errors in the following years that may result in a large impact on NPV calculation. Monte Carlo simulations can be used to study correlation on several variables at once. However, for this NPV analysis, there are possible to change variables, it is possible to examine the difference of buying or rent quota or value the working hours differently, but because of the limits of this thesis, this not included in the results and the results must be interpreted with this in mind.

2.5 Option theory

In recent years, it is experimented and discussed about using option theory to examine investments in the agricultural sector, instead of the traditional net present value method. A NPV analysis is static and cannot incorporate the value of strategic decisions during the investment period (Tauer, 2000). A decision tree analysis is a more dynamic method to examine investment decisions, but still depends on the same risk adjusted discount rate through the investments life. Most investment decisions has strategic decisions that can

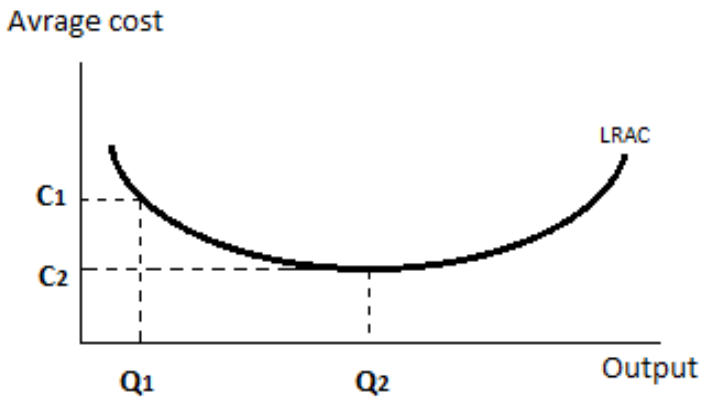
be made during the investments life. From that day the investments is completed, there can be made investments according to that first investment. If the farmer decides to build a new barn, there can be better ways to leverage the barn than the original solution or more profitable to change production form from milk too meat production at a later point in time. The value of those strategic decisions should be incorporated into the value of the project when the NPV is calculated. These strategic decisions, such as expanding or contracting the size of the investment, can be modelled as options and valued using techniques used to value financial options.

Option theory calculations requires an investment with two possible outcomes at the end of the period and a twin asset to the investment. A twin asset is an asset or good that needs to correlate with net return on the investment and the value of the twin asset is known at the beginning of the investment period. In the agricultural sector, several of the net returns in an activity are highly correlated with the price of an underlying agricultural commodity. By this it is possible to calculate the risk adjusted discount rate using the investment and twin asset. This is too extensive to examine in this master thesis, but it might be an interesting approach to examine in an extended version.

2.6 Economies of scale

Pascucci et al. (2012) define economies of scale: "Collective action can allow farmers to exploit scale economies in processing and marketing and increase their bargaining power towards large-scale buyers." In other words, if it is produced one more unit of a commodity and the average input costs decline, economies of scale are achieved. The commodity become cheaper for consumers. Alternatively, this means that as a farmer increase production, the farmer will have a better chance to increase profit. Larger farms have according to this theory, opportunities to produce more for fewer costs and then sell the product to a lower price than competing farms, as seen in figure 2. When the farmer produces at level Q_2 the long run average cost (LRAC) per commodity produced is lower than at Q_1 and the costs are higher. If the farmer produce Q_1 the cost will be at C_1. Then the production level is lower and the production costs higher.

Figure: 2
Economy of scale

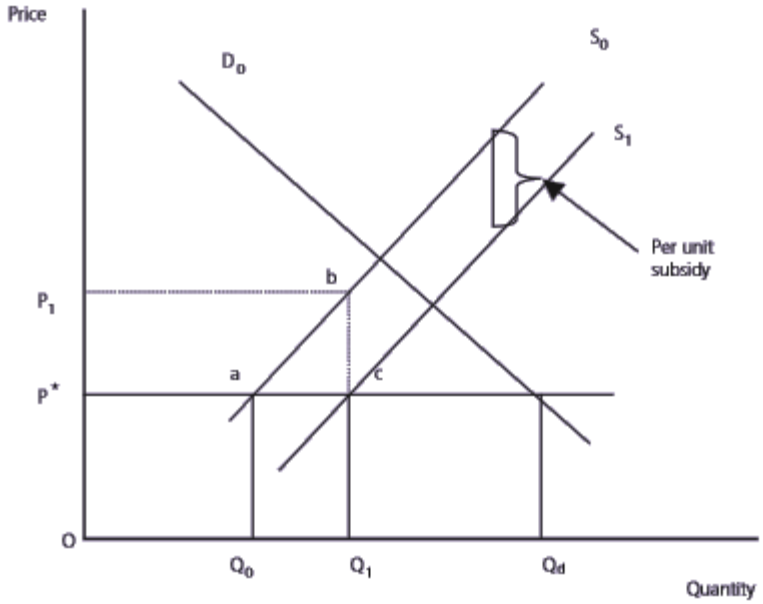


2.7 How subsidies affect production

When a commodity is subsidised the production increase, but the production cost will most likely not decrease, seen in figure 3. Assume that a milk farmer produce Q_0 without subsidies. Then he is subsidised per unit produced over the agricultural settlement and increase the production to Q_1. The supply will shift from S_0 to S_1 causing the domestic production to increase and the import to fall by Q_1-Q_0. Before the subsidy, import is Q_d-Q_0 and after the subsidy it is Q_d-Q_1 (WTO, 2006). The government are doing this today to maintain an agricultural sector in Norway. However, to prevent overproduction there are arrangements of maximum production per farm and quotas. This will be further discussed in chapter 3.5.

Figure: 3

How subsidies influence the market balance



(WTO, 2006)

3 THE AGRICULTURAL SECTOR IN NORWAY

This chapter is a short presentation of the structure in the agricultural sector today, with focus on the milk production part of the sector. It presents changes in the agricultural settlement of 2014 and the development for dairy farmers the last years. In the last part of the chapter, all the important subsidies to dairy farmers are presented with the changes from the settlement of 2014.

3.1 The main agricultural agreement

The main agreement for the agricultural sector was first in use in 1950. The agreement was significantly changed in 1984 and then in 1992. The purpose with the agreement is to regulate the agricultural sector to reach goals decided on a political level, secure farmers income and work arrangements. The main agreement regulates the parties' rights and obligations, and is a guide to the settlement negotiated every year. The two parts negotiating the settlement are the government, more specific Mat- og Landbruksdepartementet on one side and Norges Bondelag and Norsk Bonde- og Småbrukarlag on the other side. The two organizations are cooperating and all Norwegian farmers are presented by the two organizations even if they are member or not. If the negotiation between the organizations and the government breaks, it is possible to negotiate with only one of the organizations or the Parliament will take over and make a proposal for the agricultural settlement that year.

3.1.1 The yearly agricultural settlement

The main agreement provides guidelines for the negotiations of the yearly settlement and contracts or changes in the settlement. On a yearly basis, the settlement secures the income and a high production level for farmers and an agricultural sector all over Norway. In 2014, the increase in support for the total agricultural sector was 250 billion NOK (Norges Bondelag, 2014). The agricultural organizations are responsible to take measures according to the agreements. Even if the agreement is negotiated with only one of the organizations, both need to conduct them.

With the main agreement as a core, it is yearly negotiated about target price and other factors, which affect the farmers' income and work arrangements. The target prices is the price farmers' is suppose too receives form milk delivered in the marked, which is calculated in the settlement. All of subsidies are current from 1. January until 31. December. The target price is current in the period 1. July to 30. June. This is one of the main instruments to regulate and secure income for farmers. The target price for milk increased with 0.15 NOK in the settlement of 2014, from 5.05 NOK to 5.20 NOK (Norges Bondelag, 2014). However, it is not the negotiating parties that act as market regulators regarding price. The farm-owned cooperatives Tine, Nortura and Felleskjøpet act as market regulators.

There are several instruments discussed in the settlement and there are several instruments used to achieve the optimal agricultural production given the condition in the agricultural sector, such as:

- Production dependent subsidies
- Production independent subsidies
- Laws

Production dependent subsidies are subsidies the farmer receives for the fed to animals, areas or price subsidies, several of these subsidies decrease with higher production level. This form for support contributes to higher production and provide a stronger foundation for smaller farms. Production independent subsidies is given to all farmers, for example reduction on taxes. The value of production independent subsidies and production dependent subsidies is estimated to be 12 billion (Effektutvalget, 2004). In total, the government use around 20 billion NOK each year to support the agricultural sector, which is considered a strong regulation. There are also regulation by law, like different use of areal, environment, quality assurance, transfer of property, inheritance etc. These rules influence production, recruitment and employment and hence the prices. For example if a farmer decides to sell the farm someone related to him, has first priority to buy the farm (Landbruksdirektoratet, 2010b).

3.1.2 The agricultural settlement of 2014

The election in 2014 provided Norway with the first right wing coalition in years, which had an impact on that year's settlement. The government wanted to simplify the settlement and offered a decrease in the budget support of 250 million NOK and an increase of producer price of 340 million NOK. The total increase of the support to the agricultural sector would then be 150 million NOK. In total the average income per farmer would increase with 10 700 NOK, while the farmers demanded an income increase of 35 000 NOK (Norges Bondelag, 2014). The thought behind was to create a more effective agricultural sector that could be less expensive and more competitive against foreign products. However, the government and the organizations could not come to an agreement. The agricultural agreement was decided in the Parliament, where some of the presented changes were removed or moderated. In this master thesis, only the change for dairy farms are examined. That is, the change in the subsidies rates and the removal of maximum level of subsidies for cattle.

3.2 Norwegian milk production

Traditionally, combination farms with milk and meat production has been the most important part of Norwegian agriculture. These farms are important for sparsely populated regions, wide area use and value creation in rural areas. All are important political goals for the agricultural sector in addition to produce food (Landbruks- og matdepartementet, 2011). The most common income for dairy farmers are milk, slaughtered cattle, sale of animals and subsidies. Typically, variable costs are labour, concentrates, roughage (bought and produced home), fertilizer, medicine and bedding. Roughage is hay, grass, turnips, potatoes and straw, and concentrates are mostly imported protein rich feeding. Both roughage and concentrates is important in milk and meat production. Fixed cost is depreciation of buildings, new machines or tools, maintenance, accounting, electricity, phone, insurance and so on.

Dairy farms receive more of their income from their primary production, than other production forms in the agricultural sector. Milk production requires more time and need more presents of the farmer on the farm, which naturally provides less time to other

payable jobs. In addition, the dairy farmer needs to be present on–farm every day to milk the cows.

3.2.1 Combinations farming and specializing

The most traditional production form in Norway is combined production based on milk and meat. There are six national cattle breeds, where Norsk Rødt Fe (NRF) is clearly dominating. This is a combination cow that produce milk and meat. NRF has given an effective production and provides good economy for farmers, where most of the fixed expenses are covered by milk production. The meat production is considered a secondary production form and provides more value to the farm.

Combination farms provides several benefits; utilization of resources, more flexibility in production, is environmentally friendly and a stabile income for the famer (Fjellhammer and Thuen, 2014). On average, one NRF cattle live for five years. Theoretically, it is possible for NRF cattle to produce 10 000-litre milk per year with the right ratio and best quality of roughage and concentrates. Today the average is 7 100 litres of milk per dairy cattle per year (TINErådgiving, 2014a). NRF are fertile and injected one time a year. It takes approximately two years from the cattle is born until it starts producing milk (GENO, 2014). A full-grown NRF cattle's weight is between 550 kg and 650 kg.

3.3 Trend for Norwegian farmers

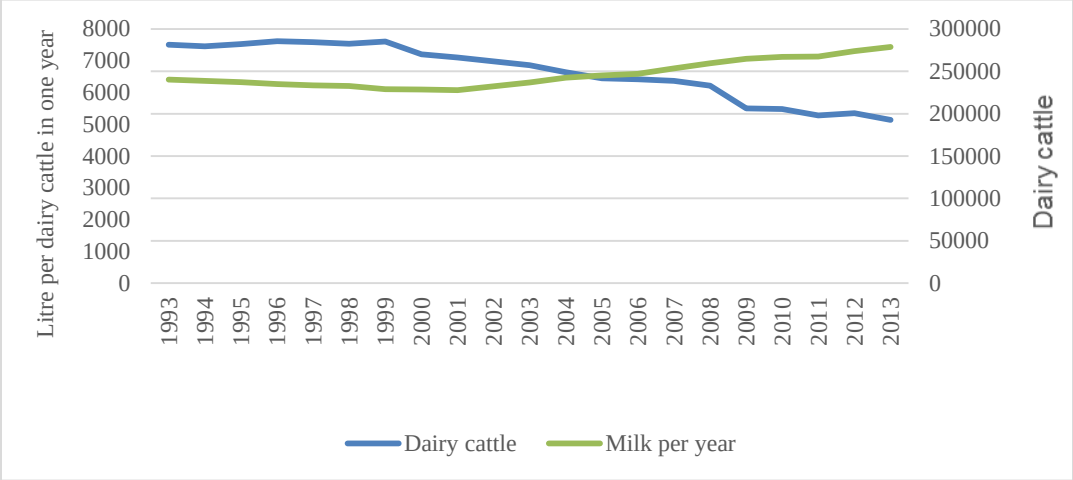
In 2015 it exist around 8 900 farms with dairy cattle, which is a decrease of 2 000 dairy farms from 2011. In the last years there has been a decrease in most sizes of farms, except farms with 30 cattle or more, which has had an increase from 2 003 to 2 447 farms from 2009 to 2013 (Statistisk Sentralbyrå, 2013). An average milk production farm is estimated to have 25 cows in 2015 against 22 in 2011 (Statistisk Sentralbyrå, 2013). Table 1 presents the distribution of farms form the dataset used in this analysis.

Table: 1
Total number of farms according to total number of cattle

Dairy cows	Total number of farms	Total number of dairy cows	Total number of other cows
1 - 10	6	48,5	72
10 - 20	100	1615	2598,5
20 - 30	84	2022,5	3221,5
30 - 40	33	1104	1834
40 - 50	20	881,5	1361,5
50 +	17	987,5	1775
Total	**260**	**6659**	**10862,5**

Figure 4 illustrates the total number of dairy cattle, farms and other cattle. As seen in table 2, the total number of dairy cattle decreases every year and the milk production stagnates. The right axis illustrates the total number of dairy cattle and the left axis shows the average litres of milk produced per dairy cattle a year. One dairy cattle produced more milk per year in 2013 than in 1993, but at the same time, the total number of dairy cattle decrease. Therefore, even if the milk production has become more effective, it has not covered the loss of the decrease in the total number of dairy cattle, seen in table 2. The population in Norway is increasing and the milk production has stagnated. The gap between production and demand for milk needs to be covered by higher import. Consumer preferences for dairy products are changing, the consumers drink significantly less milk, while demand for more fatty dairy products such as cream, sour cream and butter has increased (TINErådgiving, 2013). The demand for dairy products is increasing and milk delivered to TINE from farmers are decreasing (TINErådgiving, 2014b, TINErådgiving, 2015). In the appendix, figure 1 illustrates the import of milk products and cheese from 2000 till 2014 and the import of milk and cheese has increased through the whole period.

Figure: 4
Total number of dairy cattle vs how much each cattle produce per year



(TINERådgiving, 2014a)

Table: 2
Milk production in comparison with the population growth

Year	Total milk production, litre	Population
2004	1 520 254 000	4 577 457
2005	1 512 383 000	4 606 363
2006	1 500 414 000	4 640 219
2007	1 541 293 000	4 681 134
2008	1 526 771 000	4 737 171
2009	1 501 835 000	4 799 252
2010	1 506 006 000	4 858 199
2011	1 476 033 000	4 920 305
2012	1 531 209 000	4 985 870
2013	1 524 978 000	5 051 275
2014	1 509 190 000	5 109 056

(Statistisk Sentralbyrå, 2015a, Budsjettnemnda for jordbruket, 2015, Budsjettnemnda for jordbruket, 2006, Budsjettnemnda for jordbruket, 2007, Budsjettnemnda for jordbruket, 2008, Budsjettnemnda for jordbruket, 2009, Budsjettnemnda for jordbruket, 2010, Budsjettnemnda for jordbruket, 2011, Budsjettnemnda for jordbruket, 2012, Budsjettnemnda for jordbruket, 2013, Budsjettnemnda for jordbruket, 2014)

3.4 Subsidies

Production subsidies depends on the production level on each farm. Production subsidies are divided in different zones, where each zone has different rates. All subsidies rates can be change by Landbruks- and Matdepartementet in negations with Norges Bondelag and Norsk Bonde- og Småbrukarlag after the settlement are ended, if this become necessary. It is the farms location that decides which zone each farm receives subsidies from, except for land grants. Land grants depend on the location of the area and not the farm itself.

3.4.1 District subsidies

As discussed earlier, some political goals for the agricultural sector is to preserve the cultural landscape and maintain a spread population all over the country. District subsidies implement these goals and cover extra costs for farmers in rural areas. The regions are divided in geographical areas from A to J. The size and subsidy rate of the regions are decided in the settlement and can be changed every year. From 2014 to 2015 the subsidy rates was the same. However, in 2014 the rates were increased in every zone, except A and B. This benefited farms in rural areas; the dataset used in this analysis is from 2013 and the change from 2014 is relevant. The rates for each zone is different and is presented in table 1 in the appendix.

Region A consist of areas around Jæren, which is known as an area with flat fields and fertile soil and it is the area with highest milk production in Norway. Region B and C represent the flatter areas in the east, west and middle of Norway. D, E and F are areas placed in more rural landscapes, with surrounding mountains and hillsides. Region G is Nordland and parts of Troms. H, I and J are Troms and Finnmark.

Table 3 is a summary of the farms in each zone, except H. In total there are 260 farms divided in nine zones, with most observations in D and least in F. There are no data for farms in zone H in the dataset. Table 3 illustrates the average cost, revenue, subsidies, number of dairy cattle and number of farms for each zone, collected from the dataset.

Table : 3
Summary statistic for milk production farms

		Zone								
Variable	Total mean	A	B	C	D	E	F	G	I	J
Costs	2394,65	2323,85	2188,00	2361,95	2254,43	2605,44	1505,72	2732,43	3067,78	2512,21
Revenue	1824,84	1884,65	1698,48	1806,18	1759,69	2159,34	1197,04	1995,62	2166,47	1756,12
Subsidies	368,73	395,50	361,97	368,00	375,91	421,10	279,66	421,69	380,75	314,02
Number of dairy cattle	26,08	25,79	23,95	24,25	25,25	30,52	17,75	25,57	34,63	27,00
Number of farms	260	28	57	38	87	23	2	17	4	4

Notes: All amounts is in 1000 NOK. All variables are the calculated with the mean in each zone.

3.4.2 Subsidies per dairy cattle

Subsidies per dairy cattle depend on the size of the herd. Farmers with less cattle receive more subsidies per dairy cattle than farms with more cattle. The subsidies arrangement is built with a profile where farmers receives more for the first cattle, then the rate decreases at 16 dairy cattle, then at 25 and finally at 50 dairy cattle. Until the settlement of 2014 the maximum cattle possible to be subsidies was 50 dairy cattle, this limitation were removed in 2014. Farmers up to 26 dairy cattle receive the same amount as previous years, farmers with a herd of 26 – 50 dairy cattle receive 140 NOK more per dairy cattle and farms over 51 dairy cattle receive subsidies for the whole herd.

The same applies for other cattle, young cattle and meat production cattle. Before 2015 it was a maximum subsidies level of 250 cattle. This maximum level was removed in the agricultural settlement of 2014. The subsidy rate is 800 NOK per cattle and it is unchanged after 2014. The subsidies rates per dairy cattle is illustarted in table 2 in the appendix. The maximum level of livestock subsidies per farm is 560 000 NOK (Norges Bondelag, 2014).

3.4.3 Operating subsidies

All dairy farms can receive operating subsidies, which are paid in two halves, and has two registration dates. The number of cattle on the registration date decides which rate the farmer receive. In the settlement of 2014, this subsidy rate increased for each zone and the most in Finnmark. Since 2013, the rate has increased with 11 000 NOK for Finnmark and 9 000 NOK for the other zones if the farmer has more than five dairy cattle. Since all farms in the dataset has over five dairy cattle this increase applies to all. The operating subsidies rates is in table 3 in the appendix.

3.4.4 Roughage subsidies

Dairy cattle, and other cattle, is fed with roughage and concentrates. Concentrates are mostly imported, and consists of more proteins than roughage and are rich with energy. Roughage is pasture grasses, silage, hay, straw, potatoes etc. The right balance between these two types of concentrates and roughage is important for cattle's health and the optimal meat and milk production. This form of subsidising is received after the total area of decar the farmer owns. This is measured horizontally, which means that hills does not provide a larger area. Roughage subsidies are divided in zones where the most central farms receive less and farms in Troms and Finnmark is subsidised most per decar. Table 4 in the appendix shows the roughage subsidise rates.

Roughage subsidies are divided in five zones. Zone three and four has the same rate, while the others varies. Zone one is the central and flatter areas in Østfold, Akershus, Hedmark, Buskerud and Vestfold. Zone two is the area in Rogaland called Jæren. Zone four is the flatter areas in Sør- and Nord-Trøndelag, while zone five is the rest of Trøndelag, Sogn og Fjordane, Møre og Romsdal, Hordaland and some areas in Hedmark, Oppland and Buskerud. Zone six is Nordland and almost whole Troms and zone seven Finmark and the areas north in Troms. This rates were changed after the settlement of 2014. Before 2014, farmers with less than 250 decar had higher rates than farmers above 250 decar. It was changed to one flat rate for each zone no matter how many decar farmers own, the rates in the different zones varies.

3.4.5 Other subsidies

- Cultural landscape
- Grazing animals
- Corn
- Fruit and vegetables

In this dataset, there are not enough information to calculate the cultural landscape subsidies or subsidies for grazing animals. However, both subsidies for cultural landscape and grazing animals influence the farmer's income, but has not been possible to calculate in this NPV analysis. Nevertheless, change in other arrangements influence the farmer's income after the agricultural settlement in 2014, is not included in this analysis.

3.5 Quotas

As seen in chapter 2.7, production increase when products is subsidised and may lead to overproduction. To prevent overproduction in the dairy sector there are quotas connected to production region. The production regions are divided after counties, except Oslo and Akershus, which is considered one production region. Each production area has a certain amount of quotas. It is possible for farmers to sell and rent quotas from each other in the same region, but not with a farmer outside the particular production region. Since the demand for quotas varies in the different regions, the price for buying and renting quotas is also different. The full overview is in table 5 in the appendix. It is also a maximum limit of 927 000 litre of milk for each farm. If there is an overproduction on a farm, the farmer receive an overproduction fee on 3,20 NOK per litre of milk delivered to the dairy (Landbruksdirektoratet, 2010a).

4 METHOD

This chapter is presenting data from the dataset and other important information sources. Second, the structure of the net present value analyses and the assumption needed to calculate the analysis.

4.1 Data

This analysis mainly uses data collected by Norsk Institutt for Landbruks økonomisk Forskning (NILF) and it is the same data used for the agricultural settlement. This dataset has information on accountings for 260 dairy farms all over Norway, from 1972 to 2013. Some areas have data on several farms and others has fewer (see table 1), but enough data exist to compare the results between the district zones. There are no information on farms in zone H of the district subsidies of milk. That is Kåfjord, Skjervøy, Nordreisa, Kvænagen or Alta municipal government in Troms and Finnmark and farms in this areas is not included in the analysis.

The data includes information about income on milk, meat and other marked incomes. The amount of subsidies received, total number of cattle, land areas, milk delivered to the dairy, milk zone, prices and cost on fed to animals, labour, fertilizer and other costs. The data is collected every year, but it is not always the same farms included in the survey. Some farmers end their production and others are taken out of the survey and replaced with another farm, to provide a more comprehensive picture of the conditions in the agricultural sector. The data from NILF includes accountings and numbers each farmer has reported during the year. This means it might be some variations in how different people register different numbers. The total hours of work per farmer might vary, here are differences in what a person calls work. For example, some probably count the trip to the food store on his way to buy equipment at Felleskjøpet while others do not.

Other sources of data is collected at Tine, Agri Analyse and Statistisk Sentralbyrå (SSB). Tine is the largest dairy in Norway and publish statistic and reports every year. Tine collect data from 98,3 precent of the dairy farms to create Kukontrollen. Kukontrollen

includes information about the quality of milk, the total amount of litre a dairy cattle can produce in one year, number of cattle and so on. Agri Analyse publishes scientific reports about the agricultural sector regularly. The reports reflects on how the agricultural sector is developing today and how it may look in the future. In addition, they publish reports on the milk production part of the agricultural sector. Moreover, Agri Analyse presents "Landbruksbarometeret" each year, which gives a total picture of the industry. SSB is the public collector and publisher of statistic in Norway. Each year they publish statistic on the total number of farms, structure in the agricultural sector and so on.

4.2 Investment calculation

To maintain the milk production level or even increase the levels according to the population growth, milk production must increase. However, if a farmer wants to increase his production, he needs to make some investments. The following analysis examines which farmers are most profitable to do these investments. To calculate whether the investment is profitable or not, the net present value method is used. Naturally, the base year are 2013, since the data is from this year. Therefore, changes in subsidy rates from the agricultural settlement of 2013 are also included in the analysis, together with the settlement of 2014. By using these rates it has been possible to calculate the difference each farm experience from settlement to settlement. However, if the farmer delivered an application for subsidies after the dead line, this would lead to reduced subsidies. There are no information about this in the dataset but farmers have a huge incentive to receive their payments in time and it is assumed everyone deliver the application on time.

There are several possible opportunities to increase production on a farm. It is possible to increase the production by increasing the amount of concentrates in feeding and produce more milk per dairy cattle a year, but that would lead to a decrease in meat production and influence the income also negativly. The farmer can invest in more dairy cattle or a combination of increasing the feeding and more dairy cattle. In addition, it has to be considered if an increase in dairy cattle, will affect other production on the farm. If the farmer increase the production with one more dairy cattle; he might need to decrease the

meat production by reduce with one meat production cattle, to get enough space in the barn. In this master thesis, it is examined three possible investment alternatives. All alternatives examines the marginal effects of investing in one more dairy cattle and it is possible in all three alternatives to expand with one more dairy cattle. It is therefore not examined a larger increase than one more dairy cattle in each alternative. For the third alternative is never going to be profitable for a farmer to expand the barn to get space for one more cow, because of this it is examined marginal costs and revenue.
The investment alternatives are as follows:

1. The farmer has the opportunity to invest in one more dairy cattle without expanding buildings or need for larger milk quota.
2. The farmer has the opportunity to invest in one more dairy cattle. To do that he need a larger milk quota, but no need to invest in larger buildings.
3. The farmer has the opportunity to invest in one more dairy cattle. The farmer needs to expand the quota and buildings to expand the herd.

4.3 Assumptions

In a net present value analysis it has to be some assumptions that limits the analysis and makes it possible to calculate. The rest of the chapter is presenting these assumptions.

4.3.1 Quotas

If the farmer needs a larger quota to increase the milk production (alternative 2), quotas can be bought or rented. In 2014, the average price for renting quotas were 0,52 NOK per litre for the whole country (Tømmerås, 2015). There are regional differences in price for renting and buying quotas. In this NPV analysis it is assumed that farmers need to rent quotas, the renting price for each zone is in table 5 in the appendix. Farmers are only allowed to rent milk quotas in the same production region in order to secure the production in this area and to prevent overproduction in the market and production in all counties. If the farmer decides to sell his quota for some reason, half must be sold to the government for the price of 2.50 NOK and the rest can be sold on the marked (Landbruksdirektoratet, 2010a).

If prices on milk quotas are at the same level as today, it is assumed that milk quotas will exist for an infinite number of years. If the politicians decided to end the quota system in 10 years, the price would decrease (Nordlund et al., 2009). It is therefore assumed that milk quotas will exist in infinite years.

4.3.2 Labour

Farmers do not receive wage once a month as an industry worker. He is self employed and the income is based on milk delivered to the dairy, a slaughtered cattle, subsidies and other jobs. To calculate the amount of labour for each farm, the total amount of hours each farmer has reported in the data, is used as base. In alternative 3, the farmer needs to invest in a larger barn to make more space for more dairy cattle. This investment is assumed to be less time consuming than the old barn, because improvements in the new barn will make feeding etc. more efficient and automatic than before.

The assumption of changes in working hours and the value of working hours is significant for the results. There are differences in the cost of hired and own work at each farm in the dataset. In the third alternative, it is assumed that the extra time needed is covered by hired labour. The value of working hours will have an impact on optimal feeding and total litre of milk a dairy cattle can produce a year. These effects are not included in this NPV analysis. Young animals and beef production cattle is less time consuming than dairy cattle. It is assumed that young animals and beef production cattle take half of the time in working hours compared to dairy cattle.

4.3.3 Building costs

This is only relevant for the third alternative, when the farmer needs to expand the barn to create enough space for more cattle. There are several factors influencing costs of a new barn or an addition to the existing building. If the ground is flat and ideal to build on, this will be cheaper than uneven ground. The farmer needs to decide if he wants or needs a fully insulated barn, semi-insulated or not insulated at all. Prices varies for different building material and in different places in the country. Typically buildings in Rogaland

are cheaper, because higher frequents of farmers creates a higher competition among building entrepreneurs and more specialized entrepreneurs. There are more expensive to build in rural areas than more central places. In Troms it is necessary to secure from frost and other weather conditions, which makes it more expensive to build. Many factors affect the cost of new and improved buildings and milking robots, which makes the costs, vary a great deal.

Table : 4
The cost of investing in a larger barn per cattle

Number of cattle	20	30	40	50	60	70	80	90
Booths	200 893	169 643	151 786	140 179	131 250	124 107	118 304	113 661
Open solution	552 000	190 000	170 000	157 000	147 000	139 000	132 500	127 300

(Arbeids gruppe for løsdriftkravet, 2008)

Table 4 illustrates that larger farms has less costs per cattle than smaller. In this NPV analysis, the cost of building a barn by increasing the herd with one more dairy cattle is calculated with the cost in table 4. In other words, if the farm already has a total number of cattle of 49, the building cost of that extra cattle is 157 000 NOK. After 2003, the government decided that all farmers need to have a barn with an open solution, where the cattle can walk freely and not stand in a booth all day (Landbruksdepartementet, 2003). There are therefore only used numbers from the open solution barn in the NPV analysis. Because of all the different factors influencing the buildings costs, the numbers in table 4 are still assumed to be realistic today.

4.3.4 Interest requirement of agricultural assets

The discount rate is used to figure out what the cash flow of investing in one more dairy cattle is worth today. The discount rate is by this important, because a change of one or two precent can affects the results significantly. Use of a high discount rate discriminates against the future. There are variations from different research papers and reports about

which discount rate is most fitted. The Organization for European Economic Co-operation (OECD, 2002) argues for a discount rate of 10%. In an paper about the futures of the dairy sector in Norway Fjellhammer and Thuen (2014) has used a discount rate of 5%, and used the deposit rate from the bank as a base and added a premium for risk. Required return is affected by capital option value, optimal capital structure (the relationship between debt and equity), risk, tax and "non-economic" considerations. Milk farmers are sensitive to changes in the agricultural settlement each year. A discount rate of 6% is used in this master thesis (OECD, 2002, Fjellhammer and Thuen, 2014, Felleskjøpet, 2015, Smedshaug et al., 2013).

The borrowing rate is affecting the farmer's production. There are required high costs of investing in larger buildings or equipment to increase the production. Therefore, farmers need to take loans to invest in these assets. Innovasjon Norge has in several years assisted with grants, loans and interest support to make the investment payable. The last years the interest rates have decreased in the marked and this benefits farmers, because the interest rate on loans decline. Different banks has different interest rates, in this analysis an interest rate of 5% has been used (Hallesby, 2013).

4.3.5 Dairy cattle used for milk production

As mentioned earlier, the most common cattle breed is NRF, which is used as a base in this analysis. Each dairy cattle is assumed to live for five years and get one calf each year. It is assumed no changes in feeding, so the total amount of milk produced by one dairy cattle in the past applies for the new dairy cattle. To be able to produce milk, dairy cattle needs to receive calves. Therefore, dairy cattle is normally inseminated once a year. After five years, the cattle is slaughtered. It is normal to fed the calf in 17 – 18 months before it is slaughtered (GENO, 2014). In the NPV analysis, it is assumed that each calf is slaughtered after 17 months. A cow has a slaughter weight of about 97 kg. Young animals (calves and bulls) has a slaughter weight of 86 kg per animal, which is the average weight for calves and bulls. Young animals are calculated to get half the amount of feeding as a full grown dairy cattle (Norgesfôr, 2014).

It is assumed that the fed ratio between roughage and concentrates does not change, which provides the same amount of milk per dairy cattle a year. This will not affect the costs in feeding production or other cost connected to this, except for the extra dairy cattle how needs to be fed. The results in the NPV analysis are sensitive to this assumption. The availability to roughage is an important factor to the possible size of the herd. The total production of roughage a farmer can produce, is depending on the resources he has available. Moreover, roughage can be a limitation for the milk production level. This is most relevant for farms in rural areas. However, every farm should be able to increase with one more dairy cattle.

4.3.6 Subsidies and prices

Since 2013, it has been changes in subsidies levels for farmers. These changes apply for district subsidies on milk and meat, roughage- and production subsidies. The price on milk and meat are calculated after 2013 prices, and is calculated after the price each farm receive from the dairy in 2013. The price for meat depend on the quality on the meat. There are no information of this in the data, so the average price for 2013 is used as base.

4.3.7 Other costs

Fixed costs will change when milk production increases. Increasing production requires more electricity to cool down milk, medicine, water, insemination etc. these costs are covered in all alternatives in the NPV analysis. The fixed cost will also increase if the farmer decides to build a new barn, but this will only affect alternative three. Typically, cost that increases is increased loan. There are assumed a linear depreciation over 20 years to pay down the loan for a new barn.

5 ANALYSIS

This chapter is first examine how changes in the rates of subsidies are affecting farms. Then presenting the results from the investment calculations, using theory from the theory chapter and the presented assumptions.

5.1 How the agricultural settlement of 2014 affect farmers

In the agricultural settlement of 2014, the limit for quotas and some subsidies rates were removed, and farms over 50 cattle could now receive support for all cattle. The government did this to help large farms increase production even more and produce more effectively with fewer costs, with the goal that the agricultural sector can be a stronger competition against foreign products in the future. This influence farms differently depending on size and if the farms are located in central or rural areas. If farmers establish higher production, this might also require higher investment costs in more quotas and larger buildings.

In 2014, the possible support had a maximum limit of 50 dairy cattle and 250 beef production cattle. In 2015, these maximum levels were removed and farmers with 51 or more dairy cattle receive support for all their cattle. As seen in figure 5 farms with more than 54 dairy cattle receive more funds from subsidies in 2015 than they did in 2013. It was no changes in this rate from 2013 until 2014. For the largest farm in the data with 86 dairy cattle receives in total 26 200 NOK more. The rates for farmers with 25 dairy cattle or less, received the same amount of subsidies as before and farmers with between 26 and 50 dairy cattle received 140 NOK more per cattle.

Figure: 5
Farms with more than 50 dairy cattle

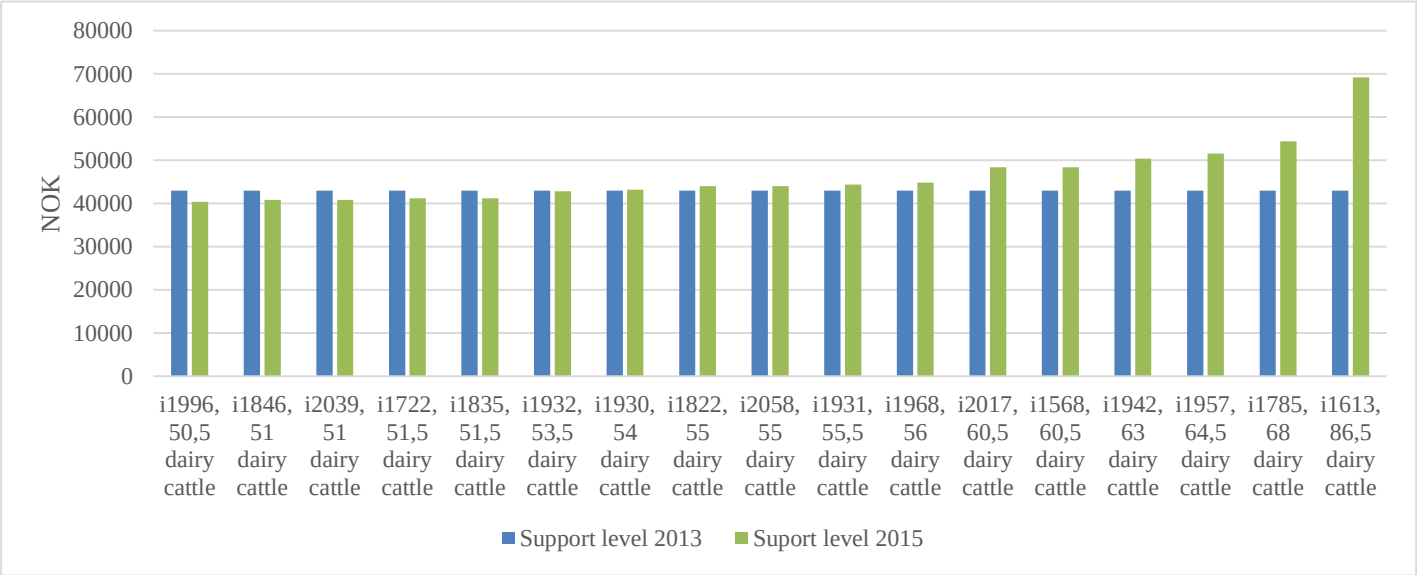


Figure: 6

The change in roughage subsidies compared to decar per farm

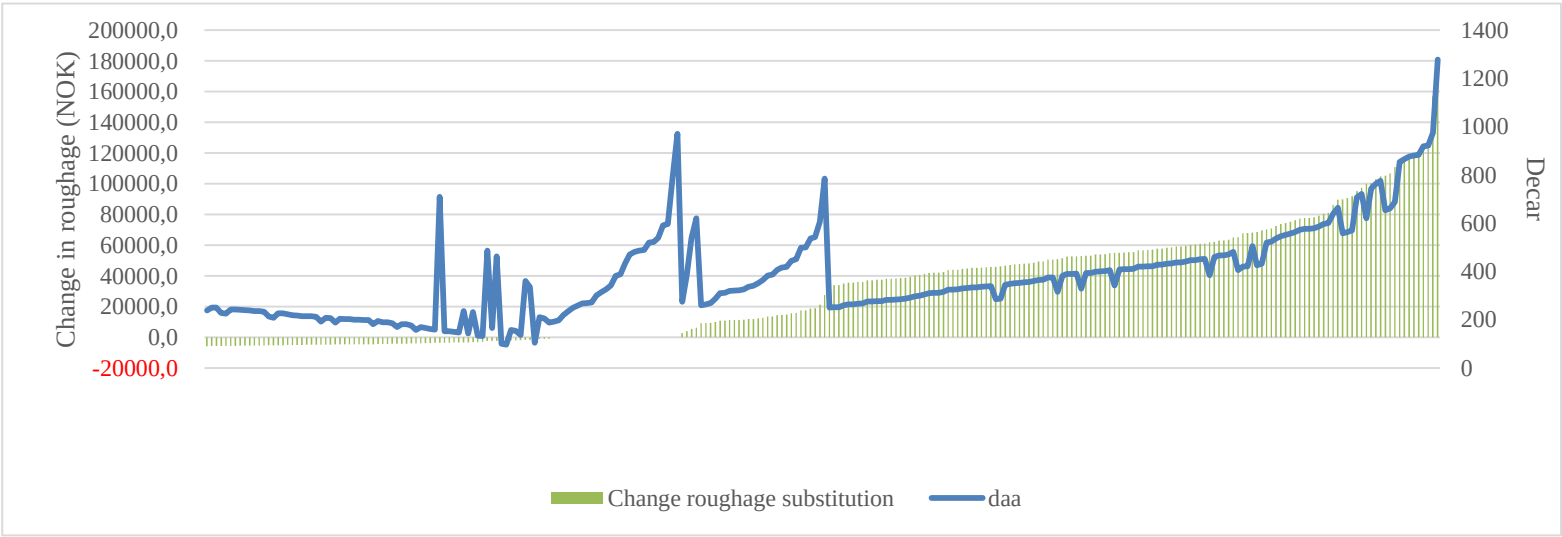


Figure 6 illustrates the changes in roughage subsidies from 2014 to 2015. The blue line is the total decar belonging to each the farm. In zone 2 the rate is zero, this is the areas around Jæren (the area in the middle with no green). As mentioned, this is one of the most productive dairy production areas in Norway. All farms under 250 decar and the farms in Finnmark receive less roughage subsidies after 2014, as illustrated in the first

part of the graph. In the last part, figure 6 illustrate that the more decar the farms owns the higher increase in roughage subsidies. This increase is mainly because the rates for farms over 250 decar have increased from 2014 to 2015 and for smaller farms decreased.

5.2 Investment calculation

The results from two representative farms in each milk district zones, one small farm and one large, are presented for each alternative, both with and without the changes from the agricultural settlement of 2014. The last table in all alternatives, are the average of all farms in each zone, to see which area is best fitted to increase milk production. The alternatives are presented one at the time. Finally, the three alternatives are compared, discussed and a discussion of how reliable the analysis and results are.

5.2.1 Alternative 1

The areas with milk production is divided into ten different zones. Each zone has a different rate of subsidies depending on where farms are located geographically. It is naturally to present the results according to these zones. Two farms from each zone, one large and one smaller, are chosen. However, in zone F it is only data from two farms and the difference between them are small. The cost and revenues for all farms are collected from the data and the aggregated data for each zone is the average of the farms in each zone.

Table : 5
Alt. 1 NPV with changes from the agricultural settlement of 2014

	Zone								
Large farms:	A	B	C	D	E	F	G	I	J
Number of dairy cattle	60,50	42,50	40,50	68,00	30,50	19,50	34,00	60,50	25,50
Cost	1706,62	3054,08	2296,07	3390,77	2296,07	1652,98	2720,38	4717,96	1687,80
Revenue	1795,58	2797,75	1708,06	3438,26	1708,06	1274,84	2087,04	3442,99	1516,58
Net present value	36,42	53,10	179,62	214,25	179,62	0,16	146,70	-9,25	68,21
Internal rate of return	174,00 %	80,29 %	358,03 %	582,62 %	358,03 %	10,13 %	183,04 %	0,03 %	97,37 %
Small farms:									
Number of dairy cattle	25,00	12,00	12,00	6,50	14,00	16,00	15,00	24,50	14,00
Cost	2075,77	1387,59	1226,43	1050,11	1674,22	1358,45	1560,55	2246,49	1538,82
Revenue	1481,70	963,10	930,39	563,28	1076,57	1119,25	1231,37	1724,74	1060,22
Net present value	-14,89	-29,65	-61,18	-74,77	-1,79	-14,98	214,31	45,55	10,24
Internal rate of return	-12,76 %	-2,15 %	NA	-27,58 %	8,58 %	-2,15 %	258,54 %	54,81 %	16,80 %

Notes: All amounts is in 1000 NOK. NA indicates that the cash flow for the farm is negative in all periods and IRR cannot be calculated.

The large farm in zone A has a positive NPV which indicates investing in one more dairy cattle is profitable. Zone A is an area with high agricultural production, fertile soil, warm climate by Norwegian standards, and flat areas. These conditions make a good foundation for larger production and less costs per cattle, but it is also the zone with lowest subsidies.

All farms over 25 dairy cattle, except the farm in zone I, should invest in one more dairy cattle under these assumptions. The large farm in zone I, has an IRR of approximately zero and the NPV is negative, which indicates that this farm should not invest.

Six of nine smaller farms has a negative NPV and a negative IRR. This indicates that these farms should not invest in one more dairy cattle. Zone E, G, I and J has positive NPV and IRR. The IRR are higher than the discount rate (capital of cost) which is a good sign. Zone G, J and I are placed in Nordland, Troms and Finnmark and are the areas with highest subsidies. Clearly, the small farm in zone G, with the best results, should invest if he has the opportunity to invest without quotas or expand the barn.

Under the same assumptions, table 6 presents the results if the agricultural settlement of 2014 had not occurred.

Table : 6
Alt. 1 NPV without changes from the agricultural settlement of 2014

	Zone								
Large farms:	A	B	C	D	E	F	G	I	J
Number of dairy cattle	60,50	42,50	40,50	68,00	30,50	19,50	34,00	60,50	25,50
Cost	1706,62	3054,08	2296,07	3390,77	2296,07	1652,98	2720,38	4717,96	1687,80
Revenue	1795,58	2797,75	1708,06	3438,26	1708,06	1274,84	2087,04	3442,99	1516,58
Net present value	22,33	35,71	76,66	1,26	76,66	13,09	-3,41	-10,75	63,13
Internal rate of return	72,73 %	42,57 %	97,10 %	6,42 %	97,10 %	14,67 %	2,21 %	-4,83 %	92,42 %
Small farms:									
Number of dairy cattle	25,00	12,00	12,00	6,50	14,00	16,00	15,00	24,50	14,00
Cost	2075,77	1387,59	1226,43	1050,11	1674,22	1358,45	1560,55	2246,49	1538,82
Revenue	1481,70	963,10	930,39	563,28	1076,57	1119,25	1231,37	1724,74	1060,22
Net present value	-5,54	-67,39	-60,45	-78,76	13,52	-9,11	30,60	57,90	5,48
Internal rate of return	-0,05 %	-1,09 %	NA	-28,55 %	14,18 %	-1,09 %	26,69 %	53,09 %	13,68 %

Notes: All amounts is in 1000 NOK. NA indicates that the cash flow for the farm is negative in all periods and IRR cannot be calculated.

Table 6 shows what the farms NPV could be if the changes in subsidise level from the settlement of 2014 never happened. It has the same structure as table 5 and the same farms included.

All the large farmers are calculated to get a lower NPV compared to table 5. In this case only five of nine large farms achieve a positive NPV and IRR. The large farm in zone G and I is no longer indicating a profitable investment when increasing with one more dairy cattle. The large farmers has no longer subsidies for all cattle and has a lower income compared to table 5.

Now, five of nine smaller farms with a negative NPV and IRR. The small farms in zone A, C, E, F and I gets better results when the changes from the agricultural settlement are

removed. The larger farms achieve lower NPV if the changes form the settlement of 2014 are removed, in all zones except zone F. Mainly the small farms achieve better results without the agricultural settlement because of increased roughage subsidies.

We have seen that there are differences in the NPV for large and small farms. Table 7 presents the results of the differences in each zone in total.

Table : 7
Alt. 1 aggregated data for all farms in each zone*

	Zone								
	A	B	C	D	E	F	G	I	J
Number of dairy cattle	25,79	23,95	24,25	25,25	30,52	17,75	25,57	34,63	27,00
Cost	2323,85	2188,00	2361,95	2254,43	2605,44	1505,72	2732,43	3067,78	2512,21
Revenue	1884,65	1698,48	1806,18	1759,69	2159,34	1197,04	1995,62	2166,47	1756,12
Net present value	-18,82	49,59	83,39	134,63	146,80	-40,23	179,19	-19,09	-7,01
Internal rate of return	-7,73 %	41,76%	74,19 %	116,51 %	130,63 %	-20,28 %	126,90 %	-6,16 %	4,94 %

Notes: *It is the average for all farms in each zone. All amounts is in 1000 NOK. NA indicates that the cash flow for the farm is negative in all periods and IRR cannot be calculated.

In table 7, all farms in each zone is aggregated to one and then taken the average, to examine which zone that is most profitable too expand the milk production. Zone A, F and I has negative NPV and IRR, which indicates that in is not profitable for the farmer to expand the total number of dairy cattle in this regions. In Finnmark (zone J) the NPV-analysis results in a negative outcome. However the IRR is positive, but not higher than the discount rate, which indicates that this zone should not invest.

According to the results in table 7, the most profitable zones are B, C, D, E and G. All zones are geographically placed east and in the middle of Norway and in Nordland. Nordland (zone G) has the highest NPV and IRR, the main reason is that the roughage subsidies for this area has increased a lot after the settlement of 2014.

5.2.2 Alternative 2

The second alternative presents the results of the NPV analysis where the farmer expand with one more dairy cattle, but have to rent more quota. The results are presented with the same farms as for the first alternative and in the same format with two farms from each zone, both with and without the changes after the agricultural settlement of 2014, and finally the average for farms in all zones.

Table : 8
Alt. 2 NPV with changes from the agricultural settlement of 2014

	Zone								
Large farms:	A	B	C	D	E	F	G	I	J
Number of dairy cattle	60,50	42,50	40,50	68,00	30,50	19,50	34,00	60,50	25,50
Cost	1706,62	3054,08	2296,07	3390,77	2296,07	1652,98	2720,38	4717,96	1687,80
Revenue	1795,58	2797,75	1708,06	3438,26	1708,06	1274,84	2087,04	3442,99	1516,58
Net present value	25,36	30,95	150,65	180,78	152,37	-26,11	105,06	-14,98	44,38
Internal rate of return	150,42 %	61,79 %	177,02 %	579,02 %	308,74 %	-27,48 %	164,76 %	-8,35 %	79,83 %
Small farms:									
Number of dairy cattle	25,00	12,00	12,00	6,50	14,00	16,00	15,00	24,50	14,00
Cost	2075,77	1387,59	1226,43	1358,45	1674,22	1358,45	1560,55	2246,49	1538,82
Revenue	1481,70	963,10	930,39	1119,25	1076,57	1119,25	1231,37	1724,74	1060,22
Net present value	-20,65	-61,41	-61,38	-110,45	-28,12	-39,05	163,82	24,78	-16,46
Internal rate of return	-24,00 %	NA	NA	NA	-25,85 %	-27,48 %	235,70 %	40,17 %	-5,44 %

Notes: All amounts is in 1000 NOK. NA indicates that the cash flow for the farm is negative in all periods and IRR cannot be calculated.

In table 8, seven of nine large farms has a NPV and an IRR that indicates that investing in one more dairy cattle produces a positive profitability, even if he needs to rent more quota. Compared to alternative one, zone A, F and I also get a negative NPV and IRR without the extra cost with quotas.

Like in the first alternative, the larger farms NPV is better than the smaller farms.
All the small farms have a negative NPV and IRR, except in zone G and I. By examine the numbers closer the small farm in zone G and I receives a lot more of roughage subsidies than before the agricultural settlement in 2014, which also the reason they has

such high NPV and IRR.

If the changes for the agricultural settlement of 2014 is removed, the results also change like in alternative one. The results are presented in table 9.

Table : 9
Alt. 2 NPV without changes from the agricultural settlement of 2014

	Zone								
Large farms:	A	B	C	D	E	F	G	I	J
Number of dairy cattle	60,50	42,50	40,50	68,00	30,50	19,50	34,00	60,50	25,50
Cost	1706,62	3054,08	2296,07	3390,77	2296,07	1652,98	2720,38	4717,96	1687,80
Revenue	1795,58	2797,75	1708,06	3438,26	1708,06	1274,84	2087,04	3442,99	1516,58
Net present value	10,44	11,64	22,79	-15,32	59,10	-21,73	-30,69	-18,41	39,76
Internal rate of return	41,96 %	20,73 %	24,07 %	-37,45 %	82,35 %	-20,15 %	-35,13 %	-13,36 %	74,16 %
Small farms:									
Number of dairy cattle	25,00	12,00	12,00	6,50	14,00	16,00	15,00	24,50	14,00
Cost	2075,77	1387,59	1226,43	1358,45	1674,22	1358,45	1560,55	2246,49	1538,82
Revenue	1481,70	963,10	930,39	1119,25	1076,57	1119,25	1231,37	1724,74	1060,22
Net present value	-31,05	-109,25	-64,74	-130,69	-21,63	-21,73	-1,80	33,70	-20,79
Internal rate of return	-39,55 %	NA	NA	NA	-17,17 %	-0,20	3,25 %	38,34 %	-9,95 %

Notes: All amounts is in 1000 NOK. NA indicates that the cash flow for the farm is negative in all periods and IRR cannot be calculated.

If the changes form the settlement of 2014 are removed, they influence the outcome for small and large farms. Especially for the large farms, where the NPV and IRR become negative for four of the nine farms (table 9) and when only two of the large farms had a negative NPV and IRR after the settlement of 2014. The only change for the smaller farms is that the farm in zone I become positive, also because of the roughage subsidies increase, since this farm receives less after the agricultural settlement of 2014.

For alternative two the most profitable zones to invest in more milk production is presented in table 10.

Table : 10
Alt. 2 aggregated data for all farms in each zone

	Zone								
	A	B	C	D	E	F	G	I	J
Number of dairy cattle	25,79	23,95	24,25	25,25	30,52	17,75	25,57	34,63	27,00
Cost	2323,85	2188,00	2361,95	2254,43	2605,44	1505,72	2732,43	3067,78	2512,21
Revenue	1884,65	1698,48	1806,18	1759,69	2159,34	1197,04	1995,62	2166,47	1756,12
Net present value	-41,39	19,11	71,15	105,50	115,10	-72,03	139,19	-46,53	-29,33
Internal rate of return	NA	23,53 %	67,46 %	108,51 %	118,30 %	NA	115,66 %	-34,28 %	-20,95 %

Notes: *It is the average for all farms in each zone. All amounts is in 1000 NOK. NA indicates that the cash flow for the farm is negative in all periods and IRR cannot be calculated.

As in alternative one, table 10 indicates that the best zones to maintain or increase the total milk production at today's level, are zone B, C, D, E and G. Zone A, F, I and J has a negative NPV and IRR, which again indicate that in total it would be more profitable to expand the total number of dairy cattle in one of the other regions.

5.2.3 Alternative 3

Alternative three consider the option where the farmer needs a larger barn and more quotas, to invest in one more dairy cattle. The results from the NPV and IRR analysis are presented in the same way as the two former alternatives and with the same farms, and finally the aggregated farms results. The borrowing rate on the loan is assumed to be 5%.

Table : 11
Alt. 3 NPV with changes from the agricultural settlement of 2014

	Zone								
Large farms:	A	B	C	D	E	F	G	I	J
Number of dairy cattle	60,50	42,50	40,50	68,00	30,50	19,50	34,00	60,50	25,50
Cost	1706,62	3054,08	2296,07	3390,77	2296,07	1652,98	2720,38	4717,96	1687,80
Revenue	1795,58	2797,75	1708,06	3438,26	1708,06	1274,84	2087,04	3442,99	1516,58
Investment cost	127,30	127,3	190	127,3	170	552	139	132,5	132,5
Net present value	-74,97	-82,99	123,50	257,96	207,02	-1 012,47	-25,87	-425,11	-19,13
Internal rate of return	13 %	3 %	17 %	36 %	22 %	NA	7 %	NA	9 %
Small farms:									
Number of dairy cattle	25,00	12,00	12,00	6,50	14,00	16,00	15,00	24,50	14,00
Cost	2075,77	1387,59	1226,43	1050,11	1674,22	1358,45	1560,55	2246,49	1538,82
Revenue	1481,70	963,10	930,39	563,28	1076,57	1119,25	1231,37	1724,74	1060,22
Investment cost	147,00	552	190	552	170	552,00	-552	132,5	-552
Net present value	-136,97	-1 240,81	-627,85	-1414,85	-444,32	-528,53	-419,39	-266,13	-1 142,28
Internal rate of return	NA	NA	NA	NA	NA	NA	-4 %	NA	NA

Notes: All amounts is in 1000 NOK. NA indicates that the cash flow for the farm is negative in all periods and IRR cannot be calculated.

For the large farms in table 11, the NPV in zone A, B and J are negative, which indicates that the farmer should not invest in one more dairy cattle if he needs to expand buildings. However, the IRR is positive which indicates that he should invest. Nevertheless, all IRR are lower than the discount rate, it is a long time horizon, and since the NPV is negative, this does not indicate a profitable investment. However, the large farms in zone C, D and E has a positive NPV and IRR, which indicate that it would be profitable to invest.

Neither of the small farms gets a positive NPV and IRR. In fact all except the small farm in zone G has a negative cash flow in all periods. The results without the changes from the agricultural settlement of 2014 is presented in table 12.

Table : 12
Alt. 3 NPV without changes from the agricultural settlement of 2014

	Zone								
Large farms:	A	B	C	D	E	F	G	I	J
Number of dairy cattle	60,50	42,50	40,50	68,00	30,50	19,50	34,00	60,50	25,50
Cost	1706,62	3054,08	2296,07	3390,77	2296,07	1652,98	2720,38	4717,96	1687,80
Revenue	1795,58	2797,75	1708,06	3438,26	1708,06	1274,84	2087,04	3442,99	1516,58
Investment cost	127,30	127,30	-190,00	127,3	-170,00	170,00	139,00	-132,50	132,50
Net present value	-81,49	-131,47	-172,50	-375,44	80,49	-430,27	-456,96	-563,92	-18,25
Internal rate of return	9,63 %	-4,62 %	-3,12 %	NA	8,30 %	NA	NA	NA	8,67 %
Small farms:									
Number of dairy cattle	25,00	12,00	12,00	6,50	14,00	16,00	15,00	24,50	14,00
Cost	2075,77	1387,59	1226,43	1050,11	1674,22	1358,45	1560,55	2246,49	1538,82
Revenue	1481,70	963,10	930,39	563,28	1076,57	1119,25	1231,37	1724,74	1060,22
Investment cost	-147,00	-552,00	190,00	-552,00	170,00	-552,00	-552,00	132,50	-552,00
Net present value	-137,65	-1639,75	-722,73	-1769,93	-422,15	-1224,52	-967,14	-180,90	-1072,43
Internal rate of return	NA	NA	NA	NA	NA	NA	NA	-10,08 %	NA

Notes: All amounts is in 1000 NOK. NA indicates that the cash flow for the farm is negative in all periodes and IRR cannot be calculated.

Without the changes from the agricultural settlement from 2014 there are only the large farm in zone E that achieve a positive NPV and IRR. Some other farms have a positive IRR, but it is low, even though it is higher than the capital of cost these farms should not invest in one more dairy cattle.

All of the smaller farms have a negative NPV and IRR. The building cost gets too high compared to the income level the farmer can achieve. The cost per dairy cattle is also too high.

Table: 13
Alt. 3 Aggregated data for all farms in each zone

	Zone								
	A	B	C	D	E	F	G	I	J
Number of dairy cattle	25,78	42,5	12	68	14	19,5	34	24,5	25,5
Cost	2324	3054	1226	3391	1674	1653	2720	2246	1688
Revenue	1885	2798	930	3438	1077	1275	2087	1725	1517
Investment cost	127,30	127,3	552	127,3	-552	552	139	132,5	132,5
Net present value	-112,79	-200,06	-702,23	173,38	-431,38	-618,26	212,11	-557,64	-196,25
Internal rate of return	NA	NA	NA	15 %	-9 %	NA	17 %	NA	-14 %

Notes: *It is the average for all farms in each zone. All amounts is in 1000 NOK. NA indicates that the cash flow for the farm is negative in all periods and IRR cannot be calculated.

Table 13 presents the zones in total for alternative 3. When examine each zone there are only zone D and G that has a positive NPV and IRR. This indicates that these zones are best to invest in, but especially zone G (Nordland), where there are limited resources for roughage and the climate is colder than southern areas. These conditions are not included in the numeric calculations and sets a limit for the size of farms in this zone.

5.3 Discussion

If the goal is to increase the total amount of milk produced each year according to the population growth, the production trend needs a positive change (table 2). For alternative one and two, the most profitable areas to increase milk production are south of Trøndelag, except Jæren, and in parts of Nordland. Even if Jæren is in the best geographically area for agricultural production in Norway, this is not one of the zones with positive NPV. One reason can be fewer subsidies arrangements applicable for Jæren and most rates are zero. Apparently the cost are too high or the income too low to make profit on one more dairy cattle, according to this analysis. Finnmark, Troms and some parts in Nordland (zone F, I and J) are the areas with highest subsidies, but still not profitable. These regions receive less roughage subsidies after the settlement of 2014, which affect income negatively.

This analysis has generally proven that smaller farms have lower NPV than larger farms. This is seen in all of the three alternatives. One reason that smaller farms underperform in this analysis, because of change in roughage subsidies. As seen in figure 5, that they receive less support compared to larger farms, which creates a decrease in the income level. Another reason is that building cost for smaller barns are more expensive per cattle than for larger barns.

Smaller farms have generally higher other costs than larger farms. It can be several reasons for this. A small farm needs the same equipment as larger farms, but smaller farms has less cattle to divide the expenses on than a larger farm. A second reason is that most of the small farms are located in the district. It entails higher transportation costs of transport feeding, animals to the slaughterhouse and so on. Some of these costs are covered by subsidies that are only given to the districts. Moreover, there are less competition in the market in rural areas. In the areas around Jæren it is a high frequency of farms and cheaper building cost. There are several companies specializing in buildings for farms and therefore a lower price. In addition, the working hours per dairy cattle is much higher for smaller farms. A logical explanation is that feeding animals takes no longer time for a farmer with 15 cattle than for a farmer with 25 cattle. Moreover, farms with higher production often have automatic systems that helps the farmer in daily routines, like automatic feeding system, milking robot etc.

Larger farms benefit from several of the changes made in the agricultural settlement of 2014. Two important parts are roughage substitution and removing the maximum limitation of dairy cattle possible to be subsidies each year. In addition, larger farms have the benefit of economies of scale. The change in the rate of roughage subsidies, is one important factor that affect this analysis. As seen in figure 6, the farms under 200 decar and farms in Finnmark and Troms receive less roughage subsidies and the larger the areas belonging to the farm the more it receives. In addition, the removal of maximum levels of subsidies dairy cattle influences positively for larger farms. As seen in figure 5, farms over 51 dairy cattle receives more than former years. There are also an increase for farmers between 26 and 50 dairy cattle, and farms smaller than 26 dairy cattle receive the

same rate as before 2014.

The agricultural settlement from 2014 has an impact on the NPV results. After 2014, the larger farmers achieve a higher NPV and IRR than without these change, this is seen in alternatives one, two and three. This is mainly because of the roughage subsidies and the removal of the maximum limits of subsidies for dairy cattle.

In alternative three, the farmer needs to expand the barn and quotas, to invest in one more dairy cattle. For the farms in this analysis, there is almost never a positive NPV and IRR, which indicates that this investment is not profitable. The large farms in zone C, D and F have a positive NPV and IRR, which indicates a profitable investment. These zones are placed in rural areas, and limitations on resources or smaller areas with fertile soil, which can make them inefficient. In light of this, there are not certain that building a new barn is possible because it is not enough recourses to build big enough to be profitable. These factors are not included in a NPV analysis.

The biggest surprise is that zone A (Jæren) do not achieve better results in the NPV analysis. Since this is such a good agricultural area, and has a lot of advantages compared to farms in rural areas, but it is also the area with the lowest subsidies. This is also seen in the data, were Jæren is one of the area with lowest cost per cattle. Roughage subsidies has been an important factor for the larger farms and this rate is zero in zone A, both before and after the agricultural settlement of 2014. If the change in roughage subsidies had been removed zone A had been one of the zones with best results.

Roughage is important for milk production. This one factor can limit the sizes of farms in the whole country, especially in rural areas. If, in an extreme case, the smaller farms no longer is profitable and end their production, several areas used for roughage production will disappear. Moreover, because of the cost of transportation, larger farms will only use the fields and resources close to the farm. This will reduce the production, and consequently, the larger farms must increase the production even more to fill that gap and increase milk production according to the population growth. Another loss is the other

political goals from the politicians; cultural landscape, spread population and food security. When smaller farms end their production several of the employed, whether it is on the farm or a veterinarian, they need to find work another place. This will not provide spread population. Moreover, the cultural landscape will no longer consist of grassing animals and grow wildly.

5.4 Is this realistic

This analysis assumes that all farmers are running the farm for the purpose to maximize profit. This is one of the ground rule in economic theory and in the NPV analysis. However, this is not always the case for farmers (Gasson and Errington, 1993). Lien et al. (2006) found out in their study that "Full-time farmers ranked producing high-quality food as the most important goal and reliable and stable income second". They also found that it is a significant difference between part-time and full-time farmers. Where full time farmers consider income more important than part time farmers.

It is not realistic that farms placed in rural areas can invest in and expand buildings and invest in more cattle forever. One of the biggest challenge for a farmer can be access to enough resources to produce roughage. In this analysis it is only assumed one more dairy cattle and most farmers should not have any problem to feed that one cow, but if the number of cows increased even more it might be an issue. To achieve the optimal amount of milk from a dairy cattle in one-year, roughage in combination with concentrates is important. If the farmer will invest in more cows, there might be too long distance to the next field to produce roughage or too expensive to buy from somewhere else. Farms in more central and flatter areas have better conditions for investing in larger buildings and herds with big enough resources close to the farm.

The dataset is limited and is not a complete picture of the dairy sector today. Since there are no observations of farms in zone H, it is not possible to know the sizes of farms or the production in this area. In addition, there are only two observations in zone F that may give a false picture of the farms in this area. Zone I and J has kind of the same problem, but twice as many observations. However, both G and I are placed in Northern Norway

and the agricultural sector is small in this area. This means that relative to the other zones with more observations it is not so bad.

In the third alternative the net present value and internal rate of return is estimated 20 years in the future. This is a long time horizon and lot of uncertainty. It is certain that there will be changes in the agricultural settlement the following years that will affect the farmers in different ways. That may change the outcome during the next two decades.

It is also important to notice that all changes in the agricultural settlement are not included in this analysis. Only the changes that has a direct effect on investing in more dairy cattle and possible to calculate. Other arrangement in the settlement that changed in 2014 may affect farmer's income or costs, like subsidies for cultural landscape, grazing animals, vacation arrangement and so on, but are not included.

6 CONCLUSION

This master thesis examined the dairy sector in Norway. I determine in which areas it is most profitable to increase milk production in Norway and if the size of farms matter for the result. Specifically, it has examined how the agricultural settlement of 2014 has influenced the profitability of increasing production for Norwegian dairy farmers, I determine whether the settlement of 2015 have an impact on the profitability of increasing production for different farm sizes and locations.

In advance, it was expected that changes in the agricultural settlement of 2014 were increasing the profitability more for larger farms than for smaller farms, considering the focus on efficiency, changes in subsidies rates and removal of production limitations. In addition, the areas around Jæren were assumed to be more profitable than other areas in Norway, because the condition for agricultural production in this area is one of the best.

The net present value analysis indicates the most profitable areas to increase milk production is south of Trøndelag, except Jæren, and parts of Nordland, then with focus on larger farms in these areas for all investment possibilities. However, the smaller farms in these regions should also invest if they do not need to expand buildings or rent more milk quota. Finnmark, Troms and Jæren has too high costs compared to the income, and therefore this analysis indicates expansion in these areas are not profitable for neither small nor large farms. However, it is worth noticing that Jæren receives least and Finnmark and Troms most subsidies.

The agricultural settlement of 2014 is focusing on simplify subsidies rates and removal of production limitations. The results from the NPV analysis indicates that this changes benefits larger farms, especially roughage subsidies is proven to be an important factor that affects farms. Smaller farms receive less roughage subsidies and larger farms more after the settlement of 2014. In addition, the removal of limits on subsidies for farms over 50 dairy cattle benefits larger farms. The results without changes in the settlement of 2014 indicates that smaller farm achieve better results. However, even without changes from the settlement of 2014 the larger farms achieve better results than smaller.

Several factors are pointing towards that smaller farms are losing according to larger farms. According to economic theory, it is natural that farms with larger production is more cost efficient, a phenomenon called economy of scale. However, if the government want to reach the goals of spread population and prevent the cultural landscape from being reclaimed small farms are needed too. As mentioned before, the agricultural sector is creating workplaces all over the country and grassing animals control the cultural landscape, which is connected to tourism. Tourists do not want a cultural landscape that is marked by deterioration. These effects are not included in this NPV analysis. Nevertheless, they are important parts of the political reason for subsidies the agricultural sector. The results in this thesis indicates that the agricultural settlement of 2014 may point the agricultural sector in a direction away from some of these political goals. If the farms become larger and fewer, the effect might be a decline in the spread population and cultural landscape might change. However, to secure food production in Norway might strengthen by the settlement of 2014, if the Norwegian agricultural products become more competitive against foreign products. Then it is possible to prevent higher import of milk and rather produce domestically, of course still with subsidies.

All calculations in this thesis assume farmers to be profit maximizing. That is not the case for several farmers; not all farmers are working full time on the farm, some has the farm as a hobby next to a different job, even though this is less common in the dairy sector. It is no standard answer for which size, production form or kind if investment a farmer should do. Nevertheless, this master thesis is pointing in the direction that larger farms generally achieve better profitability when increasing the milk production. The agricultural settlement of 2014 is strengthening this results and providing growth for larger farms more than for smaller farms. However, it is not possible to only have large farms in the whole country nor to achieve the political goals with only large farms.

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8 APPENDIX

Table 1: District subsidies from 2013 to 2015

District subsidies					
	2013		**2014**		**2015**
Region	Rate (NOK/litre)	Change	Rate (NOK/litre)	Change	Rate (NOK/litre)
A	0	0	0	0	0
B	0,12	0	0,12	0	0,12
C	0,3	0,01	0,31	0	0,31
D	0,42	0,02	0,44	0	0,44
E	0,52	0,02	0,54	0	0,54
F	0,65	0,02	0,67	0	0,67
G	0,9	0,02	0,92	0	0,92
H	1,11	0,02	1,13	0	1,13
I	1,69	0,02	1,71	0	1,71
J	1,78	0,02	1,8	0	1,8

(Norges Bondelag, 2012, Norges Bondelag, 2014)

Table 2: Subsidies per dairy cattle from 2013 - 2015

Subsidies per dairy cattle									
2013				**2014**			**2015**		
Animal	Interval	NOK per animal per year	Max support limit	Interval	NOK per animal per year	Max support limit	Interval	NOK per animal per year	Max support limit
Dairy cattle	1 - 16	4 028	340 100	1 - 16	4 028	340 100	1 - 16	4 028	340 100
	17 - 25	2 072		17 - 25	2 072		17 - 25	2 072	
	26 - 50	860		26 - 50	860		26 - 50	1 000	
							51+	800	
	51+	500		51+	500				
Other cattle	1 - 250	800	648100	1 - 250	800	648100	all	800	648100

(Norges Bondelag, 2012, Norges Bondelag, 2013, Norges Bondelag, 2014)

Table 3: Operating subsidies for 2013 to 2014.

Operating subsidies					
2015	**5 diary cattle or more**	**4 diary cattle or more**	**3 diary cattle or more**	**2 diary cattle or more**	**1 diary cattle or more**
Nordland, Troms og Finnmark	133 000	106 400	79 800	53 200	26 600
Jæren	118 000	94 400	70 800	47 200	23 600
Others	125 000	100 000	75 000	50 000	25 000
2014					
Nordland, Troms og Finnmark	130 000	92 000	69 000	46 000	23 000
Jæren	115 000	92 000	69 000	46 000	23 000
Others	122 000	97 600	73 200	48 800	24 200
2013					
Nordland, Troms og Finnmark	122 000	97 600	73 200	48 800	24 400
Jæren	109 000	87 200	65 400	43 600	21 800
Others	116 000	92 800	69 600	46 400	23 200

(Norges Bondelag, 2012, Norges Bondelag, 2013, Norges Bondelag, 2014)

Table 4: Roughage subsidies from 2013 to 2014

Roughage subsidies							
2015							
	Interval daa	**Rate NOK/daa in zone**					
		1	**2**	**3**	**4**	**5**	**6**	**7**
Roughage subsidies	All area	75	0	110	210	236	286
2013/2014							
	Interval daa	**Rate NOK/daa in zone**					
		1	**2**	**3**	**4**	**5**	**6**	**7**
Roughage subsidies	0 - 250	90	0	124	233	261	291
	over 250	65	0	75	75	75	291

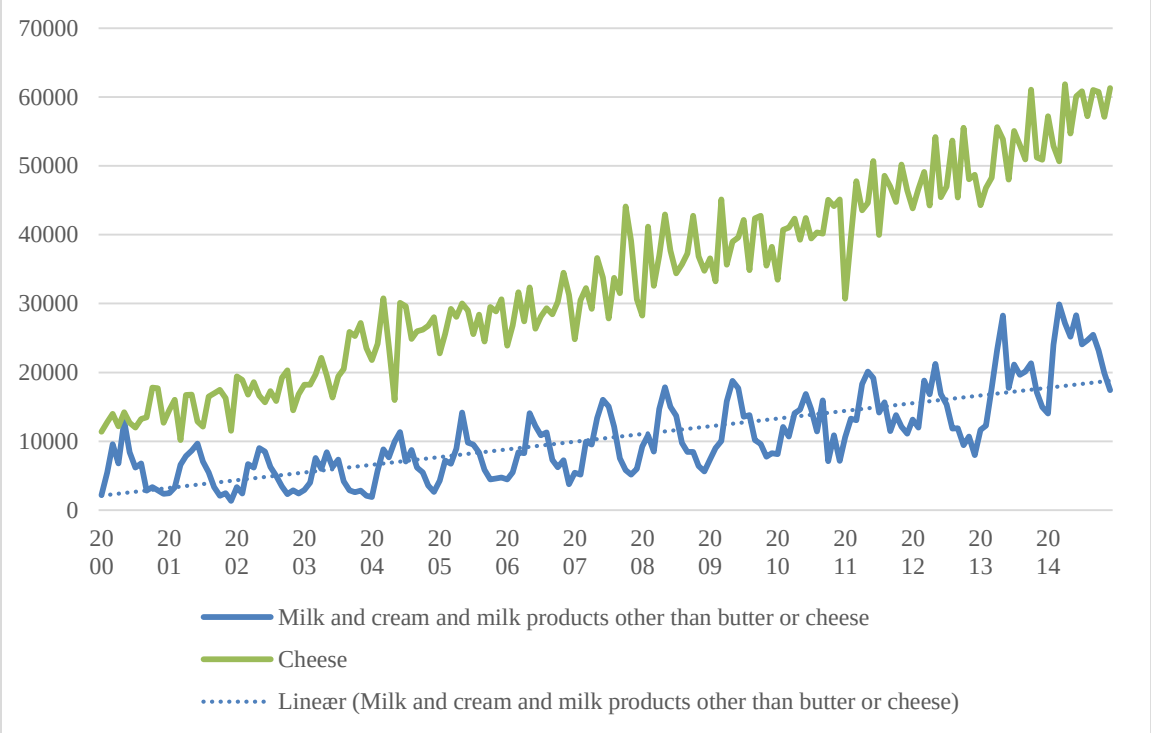
(Norges Bondelag, 2012, Norges Bondelag, 2013, Norges Bondelag, 2014)

Table 5: Prices of buying and rent quotaus in the different regions, in 2013 prices.

Region	**Price (NOK)**	
	Buy	Rent
Finnmark	4,80	0,52
Troms		0,35
Nordland	6,00	0,50
Nord-Trøndelag	4,40	0,51
Sør-Trøndelag	3,45	0,55
Hedemark	6,30	0,50
Oppland	5,00	0,33
Møre og Romsdal	3,45	0,30
Sogn og Fjordane	4,10	0,52
Hordaland	3,00	0,30
Buskerud	3,60	0,52
Telemark	4,00	0,52
Aust-Agder		0,40
Vest-Agder	5,90	0,52
Rogaland	4,00	0,60
Vestfold	5,00	0,52
Østfold	5,50	0,52
Oslo / Akershus	4,00	0,52

(Tømmerås, 2015)

Figure 1: Import of milk products and cheese from 2000 to 2014



(Statistisk Sentralbyrå, 2015b)