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Liquidity Analysis of Leveraged Dairy Farms with Forest Land

-An application of Monte Carlo simulation to evaluate price risks impact on future liquidity

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Liquidity Analysis of Leveraged Dairy Farms with forest land– An Application of Monte Carlo Simulation to Evaluate Future Liquidity

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Summary

During the past decade, the indebtedness of Swedish agriculture has increased significantly. The degree of leverage differs between different branches of production in Swedish agriculture. Among Swedish dairy producers, over a thousand investments in automatic milking systems (AMS) have been completed. This along with other investments has led to an increased indebtedness among Swedish dairy producers. Meanwhile, the perceived profitability among Swedish dairy producers has never been as low as in 2013. Unfavorable fodder prices and settlement prices along with high levels of debt affect not only the operational risk, but also the financial risk. This may lead to bankruptcy, something that not only affects the farmer and the lender, but society as a whole loses key parts of a base industry.

Based on the farmer's and the lender's perspective, the purpose of this study has been to evaluate the impact price risk has on future liquidity of leveraged dairy farmers in Sweden. The study was conducted as a quantitative and partly qualitative case study. Two leveraged Swedish dairy farms with AMS, one organic and the other conventional, acted as objects of analysis.

Future liquidity has been analysed in a model constructed in Excel. By combining present value calculations of future cash flows with Monte Carlo simulation, i.e. stochastic simulation, of the price variables *milk price*, *interest rate* and *saw timber* and *pulp wood price,* probability distributions of future cumulative liquidity has been calculated. By then measuring the probability of future cumulative liquidity being less than zero, the Value -at-Risk and the mean value of the distributions calculated, the impact of price risk on future cumulative liquidity has been estimated. Different strategies with fixed and floating interest rates have been compared.

The result indicates a high probability of a future shortage in cumulative liquidity for one of the objects of analysis. This may be because that farm is more dependent on milk production since it is less diversified than the other farm analysed. A fixed interest rate generates a higher probability of a shortage in cumulative liquidity and therefore a floating interest rate is to prefer. One general conclusion is that the dairy farm with a larger share of their income deriving from its dairy production is more sensitive to fluctuations in milk price, interest rate and lumber and pulp prices.

Sammanfattning

Under det senaste årtiondet har skuldsättning inom svenskt lantbruk ökat markant. Graden av skuldsättning skiljer sig åt mellan olika företag och produktionsgrenar. Inom mjölkbranschen har under det senaste årtiondet över tusen investeringar i automatiska mjölkningssystem (AMS) genomförts på svenska mjölkgårdar. Detta tillsammans med andra investeringar har lett till en ökad skuldsättning inom den svenska mjölkproduktionen. Samtidigt har den upplevda lönsamheten inom den svenska mjölkproduktionen aldrig varit så låg som 2013. Ogynnsamma foder- och avräkningspriser tillsammans med en hög skuldsättning påverkar inte bara den operativa risken utan även den finansiella och kan på risk leda till konkurrs, något som inte bara påverkar lantbrukaren och långivaren, utan samhället i sin helhet som blir av med viktiga delar av en basnäring.

Utifrån lantbrukarens och långivarens perspektiv har syftet med denna studie varit att belysa vilka konsekvenser prisrisk har på framtida likviditet hos belånade mjölkbönder i Sverige. Studien har utförts som en kvantitativ och delvis kvalitativ fallstudie. Två belånade svenska mjölkgårdar med robotstall, den ena ekologisk och den andra konventionell, har agerat som fallgårdar.

Framtida likviditet har analyserats i en modell konstruerad i Excel. Genom att kombinera nuvärdesberäkningar av framtida kassaflöden i kombination med Monte-Carlo-simulering, det vill säga stokastisk simulering, av prisvariablerna mjölkpris, ränta och sågtimmer- och massavedspris har sannolikhetsfördelningar av framtida ackumulerad likviditet beräknats. Genom att sedan mäta sannolikheten för att framtida ackumulerad likviditet understiger noll, Value-at-Risk samt distributionens medelvärden har olika strategier med bunden och rörlig ränta jämförts.

Resultaten visar på att det för ett av fallföretagen finns en hög sannolikhet för en framtida brist på likvida medel om räntan binds på tio år medan resultaten för båda gårdar är bättre om en rörlig ränta används genom hela perioden. En generell slutsats av denna studie är att det fallföretag som har en större del av sin inkomst i mjölkproduktion är mer känsligt för svängningar i mjölkpris, ränta och timmer- och massapriser.

Abbreviations

AMS – Automatic milking system

ECM – Energy corrected milk

EU – European Union

FMP – Forest Management Plan

MCS – Monte Carlo Simulation

NPV – Net Present Value

SEK – Swedish currency

US – United States

VaR – Value-at-risk

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1. Introduction

During the last decade Swedish dairy producers have faced volatility in factor price and outputs. At the same time there has been an increase in the debt level among Swedish dairy farmers (Lantbruksbarometern, 2013). At the end of 2012 the total debt among agricultural businesses amounted to more than 254 billion SEK in Sweden. Most of the loans have been used for investments in new machinery, new acreage and new stables and facilities. The proportion of total debts divided by total assets, valuated at market price, in specialized Swedish milk production was 38 percent in 2009 (www, jordbruketisiffror, 1, 2012). On a general basis, farmers with a high debt level will be exposed to a higher level of financial risk than those with a lower debt level (Harwood *et al.*, 1999).

A common strategy to increase profitability among farmers is to increase production (Lantbruksbarometern, 2013). This is a strategy supported by 33 percent of the farmers in Sweden. Often, these types of larger investments call for the need to borrow substantial amounts of money (Lien, 2003). Since the debt level among Swedish farmers has rapidly increased according to Lantbruksbarometern (2013), this imply an overall increase in financial risk of the agricultural businesses leaving farmers further exposed to unforeseen increases in interest rates (Lien, 2003).

Among the different branches within the Swedish agricultural sector, the dairy farmers regard their profitability as poor or even very poor (Lantbruksbarometern, 2013). Since 1998 the total number of Automatic Milking Systems (AMS) has increased and by the end of 2011 more than 1 000 dairy farms had installed AMS (Bergman & Rabinowicz, 2013). One of the major reasons, supported by 82 percent of the respondents in accordance to Bergman & Rabinowicz (2013), for deciding not to invest in AMS is due to high costs. Generally, those farms that have installed AMS perceive an improved working environment but a perceived decrease in profitability and milk quality after the investment.

Forest as a part of an agriculture business is a normal phenomena in Sweden. In 1999 approximately 73 percent of Swedish farmers owned more than 0,1 hectares (Skogsstyrelsen, 1999, p. 1). Out of those 3,8 percent owned more than 200 hectares of forest land. Income from the forest could be used for restoration of buildings, investments or new machinery (Hugosson & Ingemarson, 2004). Investments in the real estate and mortgage payments are the most common use of harvesting payments (Ederyd, 2012).

There is an expectation that volatility in food prices will likely remain in the future (www, FAO, 2014). There are mainly two driving forces of future price volatility, namely enhanced volatility in production outputs and unpredictable energy prices as well as a tight balance in worldwide supply and demand for agricultural products (Schaffnit-Chatterjee, 2010). In the future, this will lead to a higher volatility in the net income among farmers in the EU. When it comes to the revenue risk in dairy farm production, the volatility in price is one of the main contributors (El Benni & Finger, 2013). According to empirical studies carried out, price risk account for the greatest source of risk affecting the net income among dairy farms (Martin, 1996; Harwood *et al.*, 1999; Meuwissen *et al.*, 2001; El Benni & Finger, 2013).

Unpredictable future variations in price variables such as milk price, fuel price, fodder price and interest rate, might pose an underlying risk for some agricultural business ability to generate liquidity sufficient to cover the company's costs and the farmers own personal withdrawals as well as an increased risk for external financial institutions. According to findings made by Högberg (2010), farmers with a high debt level perceive that the interest expenses accounted for the greatest risk since it was difficult for them to influence. Also, actions like not maintaining a low debt-equity ratio and not being able to pay bills in time are two examples of many that are important in order for farmers to decrease volatility in the net income (Hansson & Lagerkvist, 2012).

In the US a similar development to the aforementioned Swedish development took place between 1974 and 1980 (Briggeman, 2010). During this period the total farm debt rose annually with approximately 6 percent while farm interest rates doubled between 1976 and 1981 peaking at 18 percent. This resulted in a decline in farm incomes by 30 percent resulting in an increase in farm financial stress. A similar development once again took place in the US between 2003 and 2009 with an increase in total farm debt of 5 percent annually and as a result of weak livestock prices in parallel with rising fodder costs, nearly a third of all livestock producers faced severe financial stress due to falling net income. Historically, low interest rates and a rising net income among certain groups of American farmers have lead to an increase in the total farm debt level.

1.1 Risk

According to both Lien (2003), Hardaker (2004) and Morgan *et al*., (2011) agriculture is a typical example of a risky business activity. Since there is always uncertainty regarding the future there will be an exposure to risky variables in the future. If this is exemplified with a dairy farm these variables could be fodder price, milk price and loan rates affecting the agricultural business itself. These are hard to account for but important to consider, for example, when planning for investments (Lien, 2003). Since farming activities are risky it is important to properly account for risk before making a decision regarding an investment. Major investments, for example in production equipment, often mean that the investment's character becomes more long-term and often even more risky (Persson, 1999). Likewise, the ability to quickly change direction of the business decreases as a result of its long term character. According to Löfsten (2002), a decision maker needs to know every possible known consequence before an investment decision can be made. However, since every long term investment decision is often associated with risk, these decisions are often hard to make (Skärvad & Olsson, 2008).

One commonly used technique in investment assessment is the Net Present Value (NPV) methodology (Ross *et al.*, 2008). Although considered a superior capital budgeting technique, it has its flaws. For example, usually only one variable can be changed at the same time, while in the real world variables are more likely to move at the same time. Deterministic budgeting models, such as the NPV, are limited since they do not fully explain the full story (Lien, 2003).

If used, a stochastic budgeting approach will give a more realistic evaluation of an investment (Lien, 2003). The Monte Carlo simulation, in this thesis referred to as the MCS, is a further attempt to model real world uncertainty (Ross *et al.*, 2008). When using the MCS criteria methodology, historical volatility regarding different market factors, can be used in order to simulate future potential outcomes (Linsmeier & Pearson, 2000; Ross *et al.*, 2008).

Due to a market orientation towards further liberalization and deregulation within the agricultural sector there is a further need for evaluation methods regarding farm business exposure to market risk sources (Asfaha *et al.*, 2014). For example, market risk arises due to volatility in commodity price, interest rates or exchange rates. Although highly considered and widely used within the financial sector, Value-at-Risk (VaR) is a method for measuring worst potential losses within a specified time horizon, seldom used in the agricultural business sector. VaR is a financial tool that in combination with a MCS can be used to measure worst case potential losses under "*normal*" market risk simulation combined with a MCS (Linsmeier & Pearson, 1996, 2000; Asfaha *et al.*, 2014).

1.2 Exposure to Price Risk among Swedish Dairy Farmers

Investments in agriculture have traditionally been done using standard recommendations, with consultant advice or by the rule of thumb (Bewley *et al.*, 2010). In view of the fact that milk, at the farm level, is "non-storable" to its nature and the production is continual volatility forecasts are required in the long run when calculating investments (Bamba & Maynard, 2004). Since investing in AMS is capital-intensive, it often requires external finance which increases the exposure to changes in interest rates. Aforementioned conditions will lead to an increase in both *operational* as well as *financial risk exposure.* If both coincide at the same time it will have severe impact on the companies' profitability as well as its solvency, in the long run (Hedman, 1995).

At present, there is a big difference in the economic situation among Swedish dairy farmers (www, LRF-Konsult, 2013). Due to extreme market conditions, where low milk prices have correlated with high fodder costs, a lot of dairy producers have been affected. An enhanced volatility in future food prices are here to stay according to FAO (2014) and those with newly invested AMS have increased debts, leading to further exposure to interest fluctuations. This thesis will try to evaluate the future exposure to price risk that Swedish mortgaged dairy producers will be exposed to during the coming decade by applying Monte Carlo sampling on stochastic key price variables chosen in combination of a NPV calculation. The VaR-measurement will be used to express the maximum liquidity shortage or loss over the expressed time horizon at a confidence level of 95 percent.

This thesis intends to evaluate investment decisions that borrowers and lenders have made. This will be done through a MCS of the future liquidity of two Swedish mortgaged dairy farms. The simulation is based on farm specific production data, farm specific forest data and information from each farms annual report. The simulation will be based on the NPV-methodology. MCS will be used to account for variability in key price variables chosen within this thesis.

The simulations carried out will describe the sensitivity to volatility in interest rates as well as in milk price and the price for saw logs and pulp wood for real case study farms with varying production conditions as well as loan levels and forest ownership. A ten year time horizon has been chosen for illustrating the probability of future cash flows being less than zero. The time horizon has been chosen in order to compare a tied interest rate over a ten year horizon to a floating interest rate.

When evaluating risk in agricultural investments, Svenska Handelsbanken does not use stochastic simulation in order to account for risk (pers. comn., Åttingsberg, 2014). Important aspects when evaluating agricultural investments is the owner's personality, the repayment capacity and financial resilience. It is also of great importance that there are assets that can act as security for the borrower. Since the indebtedness have increased in agriculture, the perceived profitability among Swedish dairy farmers is low and there is predicted future volatility in food prices it is important to evaluate risk properly in order to decrease the risk for both farmers and financial institutions.

1.3 Aim and Delimitations

Given the introduction and the problem background the aim of this study will be to investigate whether Two Swedish dairy farms will face problems with liquidity within the coming decade. Due to the fact that investment decisions are made without properly accounting for risk the objective is to examine how future volatility in interest rate, saw log and pulp wood price and milk price might affect the liquidity among one ecologic and one conventional mortgaged Swedish dairy farm. The aim is answered with the following interconnected research questions:

- *Will there be a shortage in future cumulative liquidity within a decade among the two Swedish mortgaged dairy farms analysed that could increase the financial risk for external lenders as well as the farmers themselves.*
- *Calculate the probability of future cash flows originating from different operational strategies over a period of ten years being less than zero, i.e. NPV of future cash flows being < 0.*
- *Determine different interest rate strategies impact on future liquidity.*

Two different scenarios including two different interest rate strategies will be simulated and these are scenario:

1. *That uses a floating interest rate to calculate the average annual interest payment*
2. *That uses a fixed interest rate during the whole period under analysis to calculate annual interest payments*

Several different measures of risk have been chosen. The first is the probability of the NPV of future cash flows stemming from the farm operations being less than zero and the second is the 95 percent value-at-risk, i.e. VaR. These measures attempt to describe and quantify the impact of price risk and interest rate risk on future operations liquidity. In addition to aforementioned measures the mean value and the standard deviation of the generated distributions will be analysed. One organic dairy farm and one conventional dairy farm will act as objects of analysis within this study. The effect on the distribution generated of using either stochastic or deterministic saw log and pulp wood prices will also be measured.

The dairy farms analysed in this study have been chosen in agreement with Rolf Åttingsberg, Business Development Manager at Svenska Handelsbanken. These farms are customers of Handelsbanken. They have during the past decade taken loans in order to finance their operations. Both the ecological and the conventional farm are equipped with AMS. The farms also have significant proportions of productive forest land.

Key price variables have been chosen in agreement with supervisors at the Swedish University of Agricultural Sciences. Stochastic variables are milk price, interest rate, saw log price and pulp price. For each simulation, out of the 2 000 simulations, a price parameter will be generated from its own respective distribution. This is done through Monte Carlo sampling. Dairy operations are the core of the business and therefore milk prices have been chosen as a stochastic variable. Also, since both farms are highly leveraged, the interest rate has been used as a stochastic variable. The pulp and saw log prices have been chosen for this thesis since they are to fall within the confines of two separate programs at the Swedish University of Agricultural Sciences, namely forest industrial economics and economist agronomist.

The small number of firms analysed in this study, as well as the poor geographic coverage of firms, makes it difficult to draw any specific conclusions since there are regional differences in the farmland fertility, forest fertility and corporate structure. Therefore, in order to provide a deeper understanding for the problem stated, this thesis has been carried out in the form of a case study. The sole purpose with evaluating the future liquidity of mortgaged dairy farms with AMS is to enlighten not only financial institutions and dairy farmers, but the public as well, of the future business risk that these groups of companies are facing.

1.4 Demarcations

This thesis has been carried out in the form of a case study and the objects of analysis are two mortgaged Swedish dairy farms. Since the case study approach is used, this work has no purpose of creating any general conclusions regarding the future liquidity risk regarding Swedish dairy production at the farm level. Despite its limitations, the work carried out might act as a reference of the future impact price risk could have on mortgaged dairy farms future cumulative liquidity and give financial institutions, as well as farmers, an insight in risk simulation beyond "classical" capital budgeting methodologies.

Price variables chosen are milk price, interest rate and saw timber and pulp wood prices. Although risk variables such as fuel price, fodder price and grain price are of importance for the farms analysed limitations in time have lead to these demarcations in price variables. Production risk and institutional risk have not been simulated as random variables in the model and this is also due to limitations in time.

1.5 Outline

The outline of this thesis is arranged by chapter in order of appearance as illustrated in figure 1. Initially chapter one has described the current situation among Swedish dairy producers with high debt levels and low perceived profitability. Chapter two, theoretical framework and literature review, will describe relevant literature regarding the MCS and NPV as well as describe the elements of risk associated with agriculture. Furthermore, literature on why it is important to consider risk and how it can be implemented will be described. Finally the role of forest ownership in Swedish agriculture will be explained in chapter two. Chapter three explains the methodology used, i.e. how this thesis has been written, how information has been gathered and how the MCS, NPV methodology and VaR have been used as working tools to describe and illustrate the problem described in chapter one. Chapter four will give a thorough introduction to the development of the Swedish dairy farm sector.

Chapter five presents empirical information concerning the importance to this study whereas chapter six will present results generated from the 2 000 simulations carried out in the model. These will then be discussed in chapter seven before conclusions can be drawn.

Model

Introduction → Theory & Literature Review → Method → Background → ↕ → Result → Discussion → Conclusions

Empirical Information

Figure 1. Schematic illustration of the study outline (Own modification)

The next chapter will give a literature review as well as a description of the theoretical framework used in this thesis.

2. Theoretical Perspective and Literature Review

Present chapter provides the reader with information and theory in order to understand the reasoning considering the model used to analyse the consequences of future volatility in milk price, interest rate and timber price and their impact on future cumulative liquidity of the objects of analysis, i.e. the dairy farms, studied in this thesis. At first risk and uncertainty will be defined and explained. This is done in order to further develop an understanding of risk and uncertainty and the difference between them. Secondly risk at the farm level and risk assessment is examined. This is done in order create a further understanding for risk in agriculture and forestry. Thirdly forest as a part of agriculture in Sweden will be explained since forestry and agriculture is often combined at the farm. The last part of this chapter consists of a clarification of the financial tools used in the model, i.e. cash flow analysis, NPV, MCS and VaR.

In order to find literature, financial tools and theory to support the structure of the thesis, several scientific data bases as well as Google have been used. The main focus of the literature search has been on finding empirical studies regarding risk and risk management in agriculture, different capital budgeting methods, cash flow analysis and MCS.
The bibliography consists of literature regarding financial management, risk assessment, capital budgeting, investment evaluation, preference risk, forestry and its importance for the farmer as well as risk in agriculture and financing.

2.1 Risk at the Farm Level

The true meaning of risk is not always obvious and therefore there is no universal definition of risk (Ross *et al.*, 2008). However, Hardaker (2004) defines uncertainty as imperfect knowledge of the future. As a consequence risk will be the uncertain consequences of imperfect knowledge. One way of distinguishing risk from uncertainty was made by Knight (1921) in accordance to Taylor (2003). He viewed risk and uncertainty as two opposite extremes. Pure uncertainty is unanalyzable due to the fact that uncertain events are beyond measure. At the same time pure risk can be expected or numerically calculated with probabilities gathered from physical data.

Lien (2003), Hardaker (2004) and Morgan *et al* (2011) view agricultural farms as examples of typically risky businesses. As a consequence it is important to account for risk when planning in agricultural businesses (Lien, 2003). For example, there are many sources of uncertainty and Taylor (2003) argues that there are: "*uncertainty about whether an individual producer can get a contract, especially a preferential contract, uncertainty about farm programs, uncertainty about the structure of agriculture, uncertainty about intimidation and retaliation by integrators, uncertainty about exchange rates, uncertainty about environmental regulations, uncertainty about the future existence of commodity markets, uncertainty about development of global antitrust laws, uncertainty about enforcement of current domestic and foreign antitrust laws, and so forth*"(Taylor, 2003, p. 253). These sources as exemplified above are only a small amount of sources creating uncertainty in the business environment at a farm.

2.1.1 Risk Assessment and Business Evaluation

Risk assessment is usually divided into two sub-categories: *Operational risk* and *financial risk* (Hedman, 1995). It is of importance for the company to obtain a balance between these two sources of risk. If there is a high level of financial risk the company should strive to reduce the level of operational risk and vice versa.

$$Re = Rt + (Rt - Rs) * \frac{S}{e} \tag{1}$$

Re=Total risk
Rt=Operational risk
Rs=Interest cost
S/e=Level of debt
*(Rt-Rs)*S/e=Financial risk*

The financial risk is for example affected by the interest rate and the level of debt taken by the company while the operational risk reveals how vulnerable the company is to changes in income and expenditures (Hedman, 1995). The theory can be linked to dairy production. For example the financial risk occurs or increases when the company borrows money from a financial institution in order to further invest in its production (Lien, 2003). If the interest rate increases and the debt level remains constant the total risk of the company increases, provided there is no change in income or expenditures (Hedman, 1995). The operational risk in dairy farm production can be affected by many different factors. For example disease, total cell count, milk price, fodder price and death rate among calves are only a few factors that have an impact on the operational risk on a dairy farm.

Both the operational risks as well as the financial risk are of great importance for an external part, for example a financial institution, to analyse and account for (Hedman, 1995). Both sources of risk affect the company's profitability and in the long term its solvency.

2.1.2 Sources of Risk in Agriculture

Risk within agriculture is just as inevitable as in any other form of business (Hardaker, 2004). Even though risk is something natural in every decision making process, it is usually viewed as crucially important in agriculture (Clancy *et al.*, 2012). As a result of the difficulty in predicting factors such as weather, future prices or changes in policies, farmers face uncertainty regarding economic consequences that will have impact on future net returns (Hardaker, 2004). Risk in agriculture could be exemplified by illustrating the situation at a dairy farm. If a dairy farmer believes that the future price of milk will drop, he hypothetically has three options: *further investments*, *business as usual* or *change of business focus*. If deciding upon further investments in his business, in order to for example achieve economies of scale, then there will be an increase in the financial risk provided part of the money used for the investment is borrowed. Not being able to, for example, pay supplier invoices or the interest rates might, in the long run, lead to bankruptcy. Not only will the farmers be more exposed to fluctuations in interest rate as the debt level increases, but to milk prices and fodder prices as well since this part of the business will become more important.

There are different types and sources of risk that affect an agricultural firm. Hardaker (2004) divides risk into four general categories and these are: *production risk, price and market risk, institutional risk and human risk*. These four categories of risk lead to a fifth category, namely *the business risk.* Agricultural production is mainly associated with price risk and production risk (Chavas *et al.*, 2010). According to Chavas *et al.*, (2010), business risk occurs due to variance in farm income affected by different sources of risk. Figure 2 illustrates the relationship between the different categories of risk in the agricultural firm.

Figure 2. Five categories of risk associated with agriculture (Own modification in accordance to Hardaker, 2004, p. 6)

The first category of risk, as defined by Hardaker (2004), is production risk. One major source that has an impact on production risk is weather. For example, long periods of rain could have a huge impact on the harvest. Another source that could lead to an increased production risk is the performance of crops and animals and their disease resistance. Production risk is predicted to have a major impact on European agriculture in the future due to climate changes (Schaffnit-Chatterjee, 2010). Fluctuations in factor inputs and outputs are part of the market and price risk (Hardaker, 2004). Future production volatility also affects the volatility in agricultural inputs and outputs, i.e. the price and market risk (Schaffnit-Chatterjee, 2010). Institutional risk might occur due to changes in policies and regulations (Hardaker, 2004). Two examples of institutional risk could be changes in the rules regarding the use of pesticides in crop production or the disposal of animal manure in the fields. The fourth risk factor, the human one, arises from the people who work at the farm. As a result of a divorce, death, illness or carelessness among employees these factors could have an impact on the business itself.

2.1.2.1 Risk Perception in Dairy Production

An important question is how farmers relate to risk and what tools they use to minimize risk in their farming business. A study concerning 237 Swedish farmers carried out by Hansson & Lagerkvist (2012) suggest that Swedish farmers are risk-averse.

Organic dairy farmers in Norway have a lower risk perception than their conventional opposites (Flaten *et al*., 2005). Production and institutional risk are especially perceived as important sources of risk. Above all, farm support payments as part of institutional risk are perceived as important. Conventional dairy farmers in Norway are generally more troubled by input costs. Financial measures like liquidity and costs of production are according to Flaten (2005) important in order to handle risk. According to findings in the US, organic farmers do not earn higher household income than conventional farmers (Uematsu & Mishra, 2012). If in the future EU are to abolish the milk quota this would lead to a decline in competitive advantage for conventional dairy farmers (Breustedt *et al.*, 2011).

New Zealand farmers believe that the market risk and its impact on product price as well as changes in the economic and political environment counts for a major source of risk in their farming businesses (Martin, 1996). This is according to the result of a study concerning 2 780 New Zealand farmers of which 750 were dairy farmers. Several empirical studies have come to the same conclusion, namely that dairy farmers perceive price risk as one of the major sources of risk (Martin, 1996; Harwood *et al.*, 1999; Meuwissen *et al.*, 2001; El Benni & Finger, 2013).

There is a relationship between farm size in relation to herd size and technical efficiency. Larger farms are more efficient in terms of total income and also in terms of technical efficiency (Hansson, 2008). Also risk management tools are more widely used by larger farm units according to the result of a survey recently carried out in Michigan analyzing dairy farmers use of price risk management tools between the years of 1999 and 2011(Wolf, 2012).

2.1.3 Financial Stress

A high degree of leverage increases the probability of financial stress (Franks, 1998). This is seen in equation 1 as S/e. According to Briggeman (2010) financial stress could be defined as the inability to pay mortgage interest. A lack of liquidity in the long run might therefore indicate financial stress. Further investments with borrowed money, undertaken in order to increase production, could lead to an increase in financial stress rather than improving the profitability (Franks, 1998). As mentioned earlier, only 18 percent of Swedish dairy farmers who have invested in AMS during the last decade have perceived an increase in profitability (Bergman & Rabinowicz, 2013, p. 4). A rule of thumb is that a high return on equity, ceteris paribus, reduces the financial stress while a high return on capital increases the financial stress (Franks, 1998). If a farm generates a high return on capital but is financed by loans it will still be sensitive to fluctuations in the interest rate.

A high degree of leverage among farmers could both be described as a risk-averse behavior as well as a risk prone behavior (Collins & Gbur, 1991). According Collins and Gbur (1991) some farm companies choose to finance their businesses entirely with equity while other farm companies undertake loans to the limit set by the financial institution. Ahrendsen & Collender (1989) according to Collins and Gbur (1991) indicates that, given safe circumstances, decision makers that are risk-averse choose large debt levels. Since Swedish farmers are risk-averse in accordance to Hansson and Lagerkvist (2012) this might explain the increase in total farm debt seen in Swedish agriculture during the last decade.

A similar development took place in the US between 1974 and 1980 (Briggeman, 2010). During this period the total farm debt rose annually with approximately 6 percent. But at the same time farm interest rates doubled between 1976 and 1981 peaking at 18 percent. This resulted in a decline in farm incomes by 30 percent resulting in an increase in farm financial stress. A similar development has taken place between 2003 and 2009 with an increase in total farm debt of 5 percent annually as a result of weak livestock prices in parallel with rising fodder costs. Nearly a third of all livestock producers faced severe financial stress due to falling net incomes affected by the aforementioned developement. Historically, low interest rates and a rising net income among certain groups of American farmers have lead to an increase in the total farm debt level.

2.2 Forest as a Part of Agriculture

In 1999 roughly 73 percent of the agricultural business owned more than 0, 1 hectares of forest area (Skogsstyrelsen, 1999, p. 1). The lion's shares of those companies are located in the middle and southern part of Sweden. One reason that forest and arable land is often found on the same property is due to mixed soil and topographic conditions (Johnsson, 1984). Although a majority of the farmers owned forested areas in 1999 only approximately 3, 8 percent owned 200 hectares and more. As an economic income is obtained from the forest it may be used by farmers for restoration of buildings, investments or purchase of new machinery or other equipment (Hugosson & Ingemarson, 2004). According to (Ederyd, 2012) investments in the real estate, mortgage payment and private consumption are the most common way of using the harvesting payment. Forest owners still settled on the real estate most commonly use their harvesting payment to invest in the real estate.

The importance of forest to farmers' differs depending on the business situation (Johnsson, 1984). For example forestry might increase the employment within the business or act as a supplement to other farm income, financial reserve or as an investment. Whether or not the farmers are able to work in their own forest depends on several factors. One example is if the perceived work effort is not sufficiently. Some agricultural enterprises might be more time consuming than others. According to Johnsson (1984) farmers working with livestock might have less time to put into their forestry during winter time than crop producers. Due to the Swedish climate the rotation period of the forest is relatively long. The possibility of using the forest as a financial reserve for investments in the real estate must be weighed against the possibility of adjusting harvesting to the market for forest products, which can vary significantly depending on the economic conditions of the forestry sector.

2.2.1 Sources of Risk in Private Forest Ownership

For private forest owners in Sweden, sources of risk that affect the profitability can be categorized in two different groups, namely: *biological* and *economic* (Svensson, 1997). These sources vary in importance depending on if the risk is analysed in the short term (<5 years), the medium term (>5 years and less than <10 years) or in the long term (>10 years). The price is also affected of the location of the timber and the quality. The forest owner can choose to receive the payment today by harvesting the forest or prolong the harvesting period and receive a future payment. The optimal harvesting time can be determined for each site but if money is needed by the farmer he can choose to harvest both earlier and later than the optimal time for the final cutting. Although it is important to notice the present current market situation is hard to estimate and will also limit the possible future sales options (ibid.).

In terms of economic risk factors, it is primarily fluctuations in timber price that have an impact on profitability in the short term (Svensson, 1997). The price can fluctuate at an average of 15 percent. Costs tend not to fluctuate as much as the price in the short term. However, in the medium term, there may be price differences of up to 60 percent in real terms and price cuts between 30 – 40 percent.

2.3 Cash Flow Analysis

A cash flow analysis is a method for compiling monetary streams within a certain period of time (Skärvad & Olsson, 2008). The cash flow analysis is important since it provides a good overview of the cash available in a firm. The cash flow is equally important in order to analyse the result affected by income and expenses. The cash flow itself can be generated from firm operations, changes in fixed assets or changes in working capital (Ross *et al.*, 2008). A description about the sources and the use of cash flow is given by the accounting statement enclosed in the annual report. The cash flow can increase due to equity or long term debt or a decrease in fixed assets.

Internally generated funds, basically have the same effect on the company's annual result has on its liquidity (Skärvad & Olsson, 2008). Another expression with the same meaning is the income effect on liquidity. One way of calculating a cash flow is done according to the following template:

1. + Operational revenue
2. – Operating expenses
3. = Earnings before depreciation
4. + Financial income
5. – Financial costs
6. + / - Extraordinary income and expenses excluding capital gains or losses
7. – Tax
8. = Generated liquidity from the year’s activities

2.4 Net Present Value

The NPV method is used to calculate the difference in future cash flows during the period of an investments life span and discount it back to present day (Ross *et al.*, 2008; Skärvad & Olsson, 2008). This method is commonly used as an alternative instead of calculating the economic outcome at the endpoint of an investment using compound interest (Olsson, 2005). A commonly used criterion when evaluating the future cash flows of an investment is that the present value must exceed zero (Persson, 1999; Olsson, 2005; Skärvad & Olsson, 2008). The NPV is one among several methods whose purpose is to evaluate the profitability with an investment (Persson, 1999). The mathematical formula for the present value method is as follows:

$$NPV = -G + \sum_{t}^{n} \frac{C_t}{(1+r)^t} \tag{2}$$

G=Initial investment
n=Time horizon used in years
t=year
r=discount rate
C_t=annual cash flow (benefits-costs)

The NPV expresses how much the investment is worth to the investor, in addition to the initial capital investment (Persson, 1999). In other words it expresses the exceeding amount of profit generated beyond the requirements formulated in the discount rate. It is difficult to determine future cash flows deriving from an investment in an NPV (Persson, 1999; Tham & Vélez-Pareja, 2003). Although firms try to estimate future cash flows they are still only predictions of an uncertain future outcome. Since there is a price and market risk there will be unforeseen changes in both business outputs as well as inputs that affect the profitability of the firm (Hardaker, 2004).

According to (Tham & Vélez-Pareja, 2003) there are four steps to be taken in order to valuate future cash flows:

1. Estimate an annual cash flow.
2. Analyse the risk profile by using historical data.
3. Determine a discount rate.

4. Discount future annual cash flow back to present day. Calculate the present value.

There are difficulties when it comes to estimating the real increase in price of outputs and inputs (Tham & Vélez-Pareja, 2003). A nominal price is the actual price paid for goods as of today. When it comes to evaluation it is of greater concern to analyse the real price. The difference in real and nominal price is the inflation but the inflation rate is hard to forecast. Although it is hard to forecast the inflation rate it is a necessary part in calculating the future cash flow since it affects the present value. Historical data of the inflation rate is often available. This can be used to estimate the inflation rate over the life of the cash flow analysed.

2.4.1 Estimation of Annual Cash Flow

This part of the NPV considers estimating the annual cash flow based on annual payments. One should not only take into account the result generated by an NPV in an investment decision. It is important to consider other factors as well since the data used in a NPV is based on approximated and expected values based on uncertain future economic consequences (Persson, 1999; Tham & Vélez-Pareja, 2003). Since future cash flows are uncertain and therefore can have an endless range of possible outcomes they should be treated as stochastic variables with different probabilities (Hardaker, 2004).

2.4.2 Discount Rate

The discount rate is an important part of the NPV calculation and is used to express the minimum required return that the companies place on the investment (Skärvad & Olsson, 2008). It is used to make future cash flows comparable over time at present day. There is no uniform approach to determining the discount rate, but there are a couple of aspects to take into account. One aspect to consider is at what level of interest the firm could borrow money from a financial institution. Another aspect of importance is the elements of future risk. A third aspect of importance is the rate of the firm's alternative investments of their capital. To determine an appropriate discount rate is not easily done as long as an element of risk is involved (Ross *et al.*, 2008). The value of money changes over time and therefore inflation is a part of the discount rate. Sweden has a target to keep the inflation at a low but positive level of 2 percent annually (www, Riksbank, 2014). If inflation is high, there is a risk of a more variable inflation rate trend than if inflation is low. This would then increase uncertainty regarding future price developments.

2.5 Monte Carlo Simulation

A scenario analysis is one method of the NPV-analysis (Ross *et al.*, 2008). It is also known as a "what if" analysis and the basic idea is to isolate and then change one variable at a time in order to examine what happens to the outcome. This is also the weakness of the scenario analysis since variables are likely related to each other and might change at the same time.

The MCS:s aim is to model real-world uncertainty (Ross *et al.*, 2008). Mun (2010) define the differences between risk and uncertainty the following way: "*The concepts of risk and uncertainty are related but different. Uncertainty involves variables that are unknown and changing, but uncertainty will become known and resolved through the passage of time, events and actions. Risk is something one bears and is the outcome of uncertainty. Sometimes, risk may remain constant while uncertainty increases over time"* (Mun, 2010, p. 16). Only risk will be accounted for in this thesis since pure uncertainty is unanalyzable as stated by Knight (1921) in accordance to Taylor (2003).

Risk analysis is best used when it comes to unknown factors (Mun, 2010). Unknown factors are what we do not know at present, but what will be revealed by time through future events or happenings. These unknown future events or happenings are associated with risk, but the risk itself is reduced over time.

When using the MCS methodology, historical volatility regarding different market factors, can be used in order to simulate future potential outcomes (Linsmeier & Pearson, 2000)(Ross *et al.*, 2008). While using the MCS the user chooses a statistical distribution based on historical data believed to approximate or capture future changes in the chosen market factors in an adequate way (Linsmeier & Pearson, 2000). Analyzing historical volatility provide a good idea of the potential future range of possible outcomes that the different market factors analysed can take. One difference between the MCS, and for example, a scenario analysis is that the MCS usually uses the outcome of thousands randomly generated numbers in a previously given range to describe the volatility of future earnings. A scenario analysis is based on fewer changes.

Compared to the deterministic approach the MCS methodology has several advantages (www, palisade, 1, 2014). Firstly it shows the likelihood of what may happen instead of just only what could happen. Secondly it is hard to determine which variables have the greatest impact on the outcome when using a deterministic analysis. This is easier using a MCS. Also, the MCS gives the user the possibility to model depending relationships between input variables.

It is of great importance to be careful while determining the range of different profit drivers used in a MCS (Gronow *et al.*, 2010). If the range used is too widely spread around a probable average value the outcome will not be realistic. At the same time using a narrow range only give small future volatility not taking the real long term volatility, which comes hand in hand, during a longer period analysed into account. It is also of importance to choose appropriate variables that fit the purpose of the analysis (Mun, 2010). Variables chosen should have an impact on what is to be described.

The NPV method works as a base tool for the MCS (Ross *et al.*, 2008). When used, the MCS forms the foundation for a risk analysis by building a model (www, palisade, 1, 2014).The NPV method will then be further expanded by defining stochastic variables and taking into account all possible values within the given probability distributions (Ross *et al.*, 2008). Every variable has its own range of uncertainties specified in a probability distribution. Usually historical data, if available, is used to analyse the range of uncertainty (Linsmeier & Pearson, 2000; Ross *et al.*, 2008). If any covariance exists between the stochastic variables given, it has to be accounted for mathematically (Ross *et al.*, 2008). The last step of the MCS is to run the simulations several times, letting the variables vary given their probability distributions.

2.5.1 Value-at-Risk

Widely used, the VaR-methodology is a model created for measuring portfolio risk (Herwartz, 2009). It is a suitable model to use when assessing portfolio risk, credit risk or liquidity risk. Uncertainty in future cash flows within a NPV can be measured with confidence intervals or with VaR (Dimakos *et al.*, 2006).

VaR is an easy way of expressing risk and gives a single quantitative measurement in monetary terms (Asfaha *et al.*, 2014). Answers that can typically be answered with VaR are:

- What is the maximum loss, for instance with a confidence of 95 percent to be expected?
- What is the maximum loss within the next year with a confidence level of 95 percent?

According to Mun (2010) a smaller VaR is obviously preferable to a large. Traditionally the VaR measurement has been used by financial institutions in order to measure the amount of capital reserves at risk, in a given period at a given probability of losses. VaR can be modified to fit different risk applications depending on the purpose of the analysis. If not used by banks, it is commonly used within the financial sector when evaluating market risk (Herwartz, 2009; Asfaha *et al.*, 2014). The measurement tool provides the potential loss of a risky portfolio or asset. This is given within a specified period of time and at a confidence level chosen by the user. Commonly used levels of confidence when using VaR are 95 percent or 99 percent (Manfredo & Leuthold, 1998). Figure 3 is an illustration of VaR.

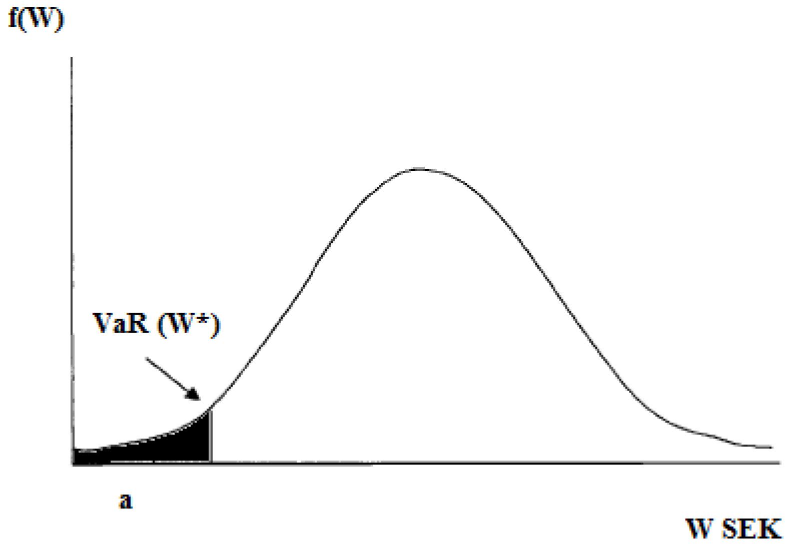


Figure 3. Illustration of Value-at-Risk (Own modification)

Within the agricultural business, as well as within the financial sector, financial returns are risky to their nature due to uncertainty in e.g. production outputs and volatility in demand (Asfaha *et al.*, 2014). Therefore VaR is a useful tool for decision making within the agricultural business sector. An example of a scenario where VaR is a good tool is when measuring the market risk that farm managers face when evaluating investments before borrowing money. VaR measures a future probable loss in a risky portfolio or asset during a specified time horizon. This tool is also useful for e.g. borrowers, lenders and policy makers when there is a need for evaluating risk. Even though it is a highly used method within the financial sector the use of VaR within the agricultural business sector is limited and only few studies have been carried out with this risk measurement tool. For example, Manfredo & Leuthold (2001) used VaR to forecast losses in cattle-feeding margin and examined the efficiency of different VaR measures.

2.5.2 Probability Distribution

A normal distribution is a commonly used term in probability theory and statistics. With its distinct bell formed shape, the normal distribution is symmetric around its mean (Ross *et al.*, 2008). The spread of the normal distribution is often characterized by the standard deviation.

Exemplified, this can be used for calculating annual stock returns. The probability of having a stock return from normally distributed stock data within one standard deviation of the mean is more or less 0. 60 or 2/3. Within two standard deviations of the mean the probability of a certain return is more or less 0. 95. Many natural phenomena can be described with the normal distribution (www, palisade, 1, 2014). Even such variables as energy price and inflation rate can be described with a normal distribution. But Bundt & Murphy (2008) disagree. They argue that: "*it is highly unlikely that residual economic relationships involving important macroeconomic variables follow a normal distribution, even in the long run"*(Bundt & Murphy, 2008, p. 10). According to Bamba & Maynard (2004) changes in commodity price distributions often show asymmetry. But when used in a MCS the assumption of commodity prices being normally distributed could be a realistic assumption. Hyde & Engel (2002) defined the milk price as a normally distributed stochastic variable when evaluating parlor and AMS investments.

A uniform distribution is another commonly used distribution in risk analysis (Mun, 2010). When applied, all values between the maximum and minimum value have the same probability of occurrence (www, palisade, 1, 2014). In February, 2010, the Svenska Riksbanken investigated what a normal future repo rate would amount to (Sveriges Riksbank, 2010). By looking at growth, market expectations and historical interest rates they found that in the long term, the interest rate should have a range of 3,5 to 4,5 percent. The fluctuations in timber price vary depending on the period of time (Svensson, 1997). In the short term the price usually fluctuate at an average of 15 percent and in the medium term there might be fluctuations of up to 60 percent in real terms.

A lognormal distribution is not symmetric, as in the case of a normal distribution (www, palisade, 1, 2014). Instead, values are positively skewed. A common usage of this distribution could be when values do not go below zero but theoretically has an unlimited potential on the positive side.

There are several methods of testing the data in order to examine if it is normally distributed or not (Harmon, 2011). One important aspect to consider is if the data is described by a different distribution. There are some statistical measures of importance when it comes to MCS and these are skewness and kurtosis (Mun, 2010). If normally distributed, the values of skewness and kurotis should be close to 0,00. Skewed values above or below zero indicates tail values, i.e. the result are skewed either to the left or the right of the mean value. A positive or negative kurtosis indicates the probability of extreme values occurring.

Another important aspect to consider while working with stochastic inputs is stochastic processes (Mun, 2010). For example, an interest rate often follow a mean-reversion stochastic process. This means that the interest rate cannot be extremely volatile away from economic reasoning.

2.5.3 Previous Studies Using a Combination of NPV and MCS

Stochastic variables have been used before in a MCS in order to analyse risk in different scenarios considering dairy farm investments. Bewley *et al* (2010) used the MCS to evaluate technology investments in dairy businesses regarding cost and benefit streams. They created a basic model in excel that accounted for the deterministic factors and then added the MCS in order to evaluate key variables affecting future cost and benefit streams. Subsequently they used the NPV to evaluate the investment. The findings of their study indicate that the cost of culling, days open and disease were sensitive to the stochastic input and output prices as well as the deterministic inputs.

Another study used the MCS in order to simulate production risk with data from Tasmanian dairy farms. The findings from the study indicate that on-farm profit drivers, like pasture quality and utilization and core cost, had a larger impact on profit variability than off-farm profit drivers, such as purchased fodder price, concentrate price and milk price (Gronow *et al.*, 2010). The results were generated by the use of a MCS in a biophysical and economic model. The model generated profit distributions of three model farms. Data regarding profit drivers were gathered from 60 Tasmanian dairy farms to generate minimum, maximum and most likely values to use in the model.

A third study used the MCS on a dairy farm in the US in order to estimate the breakeven value for AMS investments (Hyde & Engel, 2002). Given the costs of alternative milk production investments and factors such as prices and milk yields, the aim was to point out the maximum amount that could be paid for the AMS.

2.6 A summary of the Theoretical Framework and the Literature Review

Hardaker (2004) defined four general categories of risk that aggregately affect the fifth category, i.e. the business risk. The key stochastic variables' parameters are generated through Monte Carlo sampling in the model created in Excel. Those variables all fit into the category of price risk due to its importance on the profitability of the dairy farms according to the several studies mentioned earlier in chapter two (Martin, 1996; Harwood *et al.*, 1999; Meuwissen *et al.*, 2001; El Benni & Finger, 2013). A poor liquidity, which affects the business risk as defined by Hardaker (2004), is a common reason for companies going bankrupt (Skärvad & Olsson, 2008). Therefore future cumulative liquidity will be analysed with stochastic price variables in a MCS. Even though the other categories of risk are important they have been excluded in this thesis due to time constraints and constraints.

Analyzing risk in agriculture is of importance to the society (Hardaker, 2004). Especially financial measures like liquidity and input costs are important to handle risk in agriculture (Flaten *et* al., 2005). Examples of actors in society that need to concern about risk in agriculture includes actors like famers, commercial firms involved with farmers, policy makers and planners and farm advisers (Hardaker, 2004).

Since a high degree of leverage increases the probability of financial stress according to Franks (1989) and financial stress could be defined as the inability to pay mortgage interest according to Briggeman (2010) the future ability to generate a cash surplus is of importance to analyse. Future liquidity of two analysed Swedish dairy farms will be calculated with the NPV combined with an MCS. Key price variables have been analysed and simulated with the MCS and are chosen in order to reflect the price risk. A statistical distribution based on historical data believed to approximate or capture future changes regarding key variables have been used in order to capture future changes in an adequate way (Linsmeier & Pearson, 2000). Also VaR have been used in order to compare worst case scenarios.

The main objective of this thesis is to simulate the impact of future volatility in milk price, interest rate and saw log and pulp price will have on the probability of future cumulative liquidity being less than zero. With the assumption that history repeats itself and that historical volatility, according to Linsmeier & Pearson (2000) and Ross *et al.*, (2008) regarding market factors, can be used to simulate future potential outcomes when using an MCS future potential liquidity outcomes of the dairy farms will be simulated. Under the condition that the assumptions used in this thesis are correct, the simulation carried out might give a hint of the role price risk plays and how it will affect the future outcome of a mortgaged Swedish dairy farm.

The subsequent chapter describes the choice of method, what sources that have been used and why and how they have been found. Finally, an overall description of the model that had been developed in Excel will be given.

3. Method

This chapter will clarify why the chosen methods have been used and for whom the result will be of importance. It will also explain how information have been gathered as well as where from. Thirdly, the model used in this thesis will be firmly described.

3.1. Case Study

There are several methods that can be used in social science research. The case study is one of them (Yin, 2009). The methodology used when working with a case study is suitable for the purpose of this thesis since it is typically favorable when:

1. A question or questions such as "*How*" or "*why*", are being asked
2. There is little control over proceedings
3. Focus is based on a contemporary phenomenon analysed in a real-life context

Yin (2009) defines a case study as an "*empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident*" (Yin, 2009, p. 13). A case study approach, when working with research, could be defined as some form of strategy (Eisenhardt, 1989). A case study may combine both the methods surrounding the collection of data as well as the use of interviews or questionnaires. Information collected can be both qualitative and quantitative (Eisenhardt, 1989; Yin, 2009). When it comes to the aim of the research, the case study has the benefit of being able to support different aims in different kinds of study approaches (Eisenhardt, 1989). A case study can be used to both generate as well as test theory and / or provide description. One of the most important parts of the case study approach, when it comes to generating theory, is analyzing data. However using a case study approach in order to generate theory does have its disadvantages. It is important to realize that one's theory is but the tip of the iceberg. It is important to narrow the research and not try to illustrate or explain everything. A good analogy for working with case studies while having a too wide aim would be *to bite off more than one can chew*.

A case study is often characterized as descriptive (Merriam, 1994). This means that the case study studies a situation or phenomena in great detail. It is, in this thesis, represented by an in-depth analysis of the price risk associated with dairy production in Sweden and its impact on future liquidity.

The case study can be used in many different situations and is a commonly used research method in psychology, political science, social work, economics and business among many (Yin, 2009). Although commonly based on qualitative evidence, both quantitative and qualitative evidence can be used when conducting a case study. When it comes to the design of the case study, there are five components of special importance according to Yin (2009):

- The question of the study
- The propositions, if any used, of the study
- Unit(s) of analysis
- The logic connection linking data to the study's proposition
- The criteria used in the study for interpreting the findings

Although a commonly used method, the case study has its limitations (Johnston *et al.*, 1999). It is often criticized for, compared to other research methods, taking a lot of time and effort. Another frequently mentioned limitation is its lack of reliability and accuracy. The case study method does not address issues of generizability effectively handled by quantitative methods. According to Johnston (1999) this should not be a problem since the potential strength regarding any research method depends on two factors, namely the relationship between theory and method and how the researcher manages potential weaknesses of the study.

In the selection of appropriate case study firms it is important that these companies have a high level of representativeness for other companies in the same industry (Skärvad & Olsson, 2008). There have been several investments in AMS among Swedish dairy farmers during the last decade and this category of farmers is experiencing a lack of profitability and also has a high debt level. The two dairy farms analysed in this thesis are both leveraged and have recently invested in AMS. They cannot be statistically proven as representative but due to a high level of indebtedness and in a production branch of Swedish agriculture with a perceived low profitability; the analysis may give a hint on how development in liquidity may look like. A presentation of the objects of analysis, i.e. the dairy farms analysed, is found in chapter five and a presentation of the Swedish dairy sector is found in chapter four.

3.1.1 Quantitative Case Study

Two different methods of data collection are commonly used in research. These two are quantitative and qualitative data collection. These two methods can both be used separately and in combination within a case study (Yin, 2009).

Quantitative data is typically characterized by a large amount of information, usually in the form of large sheets of digits or written information from questionnaires. One way of handling such quantities of information gathered could be with the use of statistical analysis. Information gathered can either be numerical or non-numerical. If not numerical by nature, researchers can for instance convert the information with different methods. There are, according to Robson (2002), characteristics of importance in the data collected and these are its validity, generizability, objectivity and credibility.

Qualitative research aims to clarify the true nature of a phenomenon and/or its characteristics (Widerberg, 2002). Qualitative research aims to clarify the meaning of a phenomenon while the quantitative research method tries to find the frequency or incidence of a phenomenon.

This thesis is a combination of a qualitative and quantitative research approach. A large amount of information has been statistically analysed and modeled in order to, with the help of a qualitative literature review, support this thesis. The qualitative process within this thesis is interactive, meaning that the researcher can change the problem statement and collection of data during the process (Jacobsen, 2002). The starting point is still a problem statement but the statement itself might change during the process.

3.2 Ethics within Research

It is of great importance when working with a research project to think about ethical issues already at an early stage (Oliver, 2010). It is important to treat people, which data in different forms are collected from; involved in the research with the norms and the values that confirms their basic humanity. In conclusion, individuals who have participated in a research project should be treated with respect and dignity in order to avoid suffering, anxiety, harm or misery.

Before this study commenced, the participants were contacted via Handelsbanken. They were given the letter of introduction as seen in appendix 1. This was done since it is of great importance, in social research, to inform participants about the purpose of the research before any agreements are made (Oliver, 2010). This process has given the participants a possibility to evaluate their participation before being part of this study. Since the financial information and FMP are not public, the information about the participants' names and the companies' property names and other information have not been disclosed.

The dairy farms themselves will be analysed using data from both their balance sheet and income statements as well as their forest management plan, in this thesis referred to as the FMP. Since both companies are operated as sole proprietorships, the personal financial situation is closely linked to the company. Therefore no personal or farm specific information will be published in this thesis.

In chapter five, empirical information about the farms is presented. Since the number of dairy farms in the middle of Sweden is limited, information about hectares, years of specific investment, hectares of forest land and other information that could be interesting for a reader have been disclosed. Since anonymity, if agreed upon, is a cornerstone of research ethics according to Oliver (2010) this disclosure is a necessity in order to keep the agreement made and to prevent speculations in what specific dairy farms the objects of analysis could be.

3.3 Sources

Two different types of sources have been used in this thesis. The first being sources to the theoretical framework and the background of this thesis and the second being information about historical prices and volatility, farm data inputs and forest data from the FMP. Statistics regarding historical milk price movements have been gathered from Clara Secher at LRF-konsult (pers. comn., Secher, 2014). Data regarding the interest rate movements has been gathered from SEB (www, SEB, 2014).The floating interest rate have been analysed with empirical data gathered from 2005 until the end of 2013. Data regarding forest price statistics have been gathered from Skogsstyrelsen (www, Skogsstyrelsen, 3, 2014). Input information regarding the objects of analysis, i.e. farm specific inputs have been gathered from their annual reports. These reports have been compiled by their respective accountants. Also the FMP:s have been gathered from the organizations who compiled them.

Before the empirical material was gathered, a thorough and comprehensive literature search in several databases was conducted. The literature search is important in order to create a deep understanding for the topic analysed in the thesis surrounding future price risk and its impact on mortgaged dairy farms future cumulative liquidity. Typical keywords used to find the correct credentials have for example been: *Monte Carlo simulation, net present value, investing in AMS, risk analysis, stochastic simulation, uncertainty, commodity price volatility historical distribution and price risks impact on dairy farms profitability, net income and liquidity.*

The main part of the literature search regarding the topic has been gathered from literature and data bases available through SLU. Examples used are Epsilon, Web of Knowledge, Jstor and Science Direct.

3.4 Choice of Method

3.4.1 Five design components

As previously mentioned by Yin (2009) there are five components of special importance in the design of a case study. To be exact, these are:

- The question of the study
- The propositions, if any used, of the study
- Unit(s) of analysis
- The logic connection linking data to the study's proposition
- The criteria used in the study for interpreting the findings

3.4.1.1 The Question of the Study

This thesis is a case study that consists of a combination of a qualitative and a quantitative analysis. The aim of the thesis is to investigate whether Two Swedish dairy farms will face problems with liquidity within the coming decade. The scientific approach in this thesis is to some extent similar to the case study approach with its particularistic view. The questions asked in this thesis are of typical *how* and/or *why* character as defined by Yin (2009) and therefore suitable within the boundaries of a case study.

3.4.1.2 Proposition

Since there will most likely be an enhanced volatility in future food prices according to FAO (2014) and this will lead to a higher volatility in income among farmers in the EU according to Schaffnit-Chatterjee (2010) it is important to account for this category of risk when evaluating further investments in agriculture. Especially among dairy farmers where the perceived profitability according to Lantbruksbarometern (2013) is low. According to empirical studies carried out, price risk account for the greatest source of risk in dairy farm production (Martin, 1996; Harwood *et al.*, 1999; Meuwissen *et al.*, 2001; El Benni & Finger, 2013). Therefore key variables such as milk price and interest rate have been determined as stochastic within the boundaries of the model used in this thesis in order to account for their impact on future liquidity of two mortgaged Swedish dairy farms. The purpose is to enlighten not only financial institutions and dairy farmers, but the public as well, of the future liquidity risk that this group of companies is facing.

3.4.1.3 Units of Analysis

In order to define the unit of analysis one need a question as well as a proposal in order to be able to identify what information to be gathered (Yin, 2009). This thesis focuses on:

- The dairy farms chosen for this thesis. They will be analysed in order to simulate probability of future liquidity being less than zero within the next decade.
- The use of historical data regarding milk price, saw log and pulp price and interest rate in order to account for possible future outcomes.
- Simulate different interest rate strategies in order to evaluate different outcomes.

Dairy operations are the core of the two dairy farms analysed and therefore the option of using milk prices as a key price stochastic variable was obvious. Also, since both farms are highly leveraged, the interest rate has been used as a stochastic variable. The pulp and saw log prices have been chosen since both dairy farms have large parts of production forest on their properties. In order to deepen the analysis one could include more variables such as fodder prices, grain prices and fuel prices, but due to limitations in time those variables have not been analysed as stochastic.

3.4.1.4 Linking Data to Propositions and Criteria for Interpreting the Study's Findings

This part of the thesis focuses on the linkage between data and the proposition since the analysis itself requires the case study data to be a reflection of this thesis initial proposition. This part can consist of linking time-series analysis, explanation building or cross-case synthesis with the proposition (Yin, 2009). One way to address and analyse the findings made is to identify and address other explanations made in other studies.

3.4.2 Procedure

The question of the study is presented in the initial part of this thesis. The main working tool used for creating the model has been Excel. This is an active choice due to its capacity to handle large amounts of data. Excel is equipped with the proper tools to create a MCS but it also has the ability to, in a schematically way, quantify data and illustrate these in graphs. Moreover, there are already many formulas including random selection, what-if analysis and Data Analysis Tool Pack included in the program which is of use while working with MCS. A programme in Excel labeled @Risk developed by Palisade has been used to fit the historical price data to distributions (www, palisade, 1, 2014).

3.4.2.1 Basic Calculations within the Model

The main task of the model created in Excel is to calculate the NPV of future cumulative liquidity generated during a period of ten years among two mortgaged Swedish dairy farms. The period is ten years since this is the longest period that the farmer could tie the interest to a fixed level. The model will, through the structure of a NPV calculation based on annual cash flow, generate a quantitative number in SEK representing real money, i.e. in today's money. Monte Carlo sampling is used for each year in order to generate price parameters based on each variables own distribution. The simulations are repeated 2 000 times in order for the random functions to vary within their given distributions representing the stochastic variables. The result will be a distribution of 2 000 different outcomes.

The simulation period will begin in 2013 and ends in 2022. This is due to the fact that the financial statements have not been completed for 2013. All inputs used in the model are based on the closing balances, information from the income statements and forest information from 2012. However, information regarding annual milk production for 2013 has been used as this is assumed to represent the continued level of production as a result of changes in the respective company's productions in 2012 and 2013. No account has been taken of taxes and their impact on the objects of analysis's liquidity. This is due to complex taxation laws in Sweden that are hard to account for within the limitations in knowledge and time surrounding this thesis.

Since all prices in the model are nominal prices the discount rate is nominal. The discount rate, r, as seen in equation two has been set to four percent. Both Hyde and Engel (2002) and Bewley *et al* (2012) used an eight percent discount rate to represent a typical alternative investment. The model created by Bewley *et al* (2012) analysed different scenarios of investments during a period of ten years. Since the dairy farms in this thesis have already invested in AMS a discount rate of eight percent would be too much. The discount rate used will be higher than the inflation target of two percent and lower than eight and has been set to five percent in the model used within this thesis. No consideration has been for e.g. alternative investments or other factors influencing the choice of discount rate.

The annual cash flow calculation within the model, C_t as seen in defined in equation two, will follow the subsequent order. A snapshot of the model is seen in appendix 5. * means it is affected by Monte Carlo sampling:

1. Opening cash balance from previous year
2. + Annual milk income*
3. + Forest income*
4. + Other fixed annual cash flows
5. – Annual interest payments *
6. – Own withdrawals from the firm
7. – Reinvestments*

Further explanations of each step in the annual cash flow calculation are explained below in the same following order as above:

1.
The opening cash balance 2013 is based on cash available according to each company's balance sheet. The opening cash balance in 2014 will be what is eventually left from the previous year.

2.
The annual milk income will be calculated the following way:

$$Income\ Milk = Cows * Production * Delivery\ index * Price$$

3.
The felling volume is multiplied with 0,83 in order to transform m^3sk into m^3fub (www, Skogssverige, 2014). The volume will then be divided into 70 percent saw logs and 30 percent pulp material (Ringborg, 2013). During the simulations the first logging takes place in year two, the second logging in year four and the third logging in year eight. The share, by volume in S_1 and S_2, felled will be 30 percent year two, 50 percent year four and 20 percent year eight. Logging costs and other costs related to forest maintenance such as soil scarification and planting are assumed to be embedded in *other fixed annual cash flows*. The annual payments from the forest activities are calculated the following way:

$$Income\ Forest = ((S_1 + S_2) * 0{,}83 * 0{,}7 * Saw\ Log\ Price) + ((S_1 + S_2) * 0{,}83 * 0{,}3 * Pulp\ Price)$$

4.
Other fixed annual cash flows will be used to represent other operating expenses and income. Those fixed inputs are based on information collected from annual reports for the years 2010, 2011 and 2012.

5.
Floating interest rates are rather uncertain while fixed interest rates are numerically certain but more costly (Lien, 2003). The fixed 10 year interest rate and a floating annual interest rate have been used in order to calculate annual interest payments the following way:

$$Interest\ Payment = Debt * Interest\ Rate$$

6.
Annual personal withdrawals are assumed to symbolize an annual salary that the farmer withdraws from the business. When operating as a sole trader, it is profits of the firm that personal withdrawals can be made from. However, taxes and social securities are based on profit and not withdrawals. In the model, it is assumed that the farmer will annually withdraw an amount of money representing a salary. This is done in accordance to the following formula:

$$Annual\ withdrawl = 12\ months * 25\ 600$$

7.
Reinvestments in the model are based on the average annual depreciations from each company's balance sheet between the years 2010 and 2012. The annual depreciations are randomly generated each year and amounts between 50 percent or 110 percent of the average depreciations between 2010 and 2012. Monte Carlo sampling is based on the Uniform distribution since it is hard to fit a distribution based on three samples.

3.4.2.2 Overall Description of the Model

For each year, a net cash flow is calculated. The procedure of the model is illustrated in figure 4.

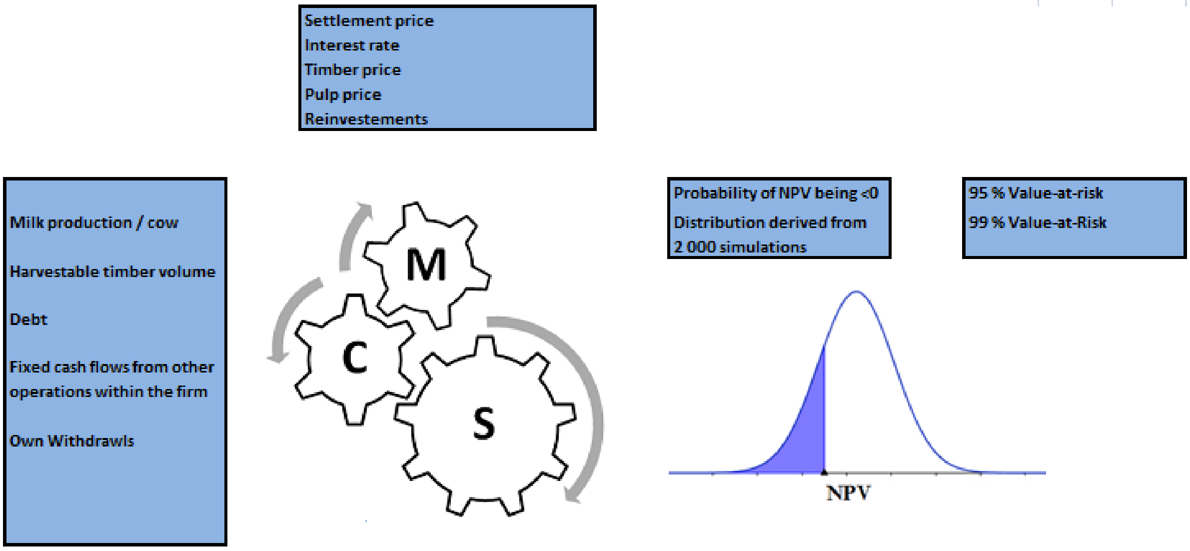


Figure 4. Description of the model used (Own modification)

As seen above, probability distributions of the NPV of future cash flows is obtained from 2 000 simulations. From this probability distribution there will be a risk of the NPV being < 0, namely that future cash flows over a period of ten years are less than zero. Also the 95 percent VaR will be calculated. A short derivation of VaR is calculated in the following equations:

$$\alpha = P(X \leq VaR) = \phi\left(\frac{VaR-\mu}{\sigma}\right) = \phi(\frac{-(\mu-VaR)}{\sigma}) \tag{3}$$

Denote

$$\lambda_\alpha = \frac{\mu-Var}{\sigma} \tag{4}$$

Since $VaR < \mu$, we have a negative value in ϕ, and according to Alm & Britton, 2008, p 483

$$\phi(-t) = 1 - \phi(t). \tag{5}$$

This gives us

$$\alpha = 1 - \phi(\lambda_\alpha) \rightarrow \phi(\lambda_\alpha) = 1 - a. \tag{6}$$

The value of λ_α can be taken from a normal distribution quantiles table (Alm & Britton, 2008, p. 484). For the value of α=0,05 the table gives λ_α=1,6449. μ is estimated by the mean and σ the sample standard deviation s.

This will give

$$VaR = \mu - \lambda_\alpha \sigma \tag{7}$$

Within the boundaries of this thesis the most part of the input data in the NPV calculation have been deterministic, i.e. nonstochastic. Among the stochastic variables, different distributions have been analysed and thereby chosen. The organic milk price variable is normally distributed and are simulated with a *random function* in excel around its mean and standard deviation. The milk price was better fitted with another distribution as seen in appendix 4 but is assumed to be normally distributed. Arguments for this assumption are seen in chapter two. The saw log price and pulp wood price are normally distributed while the interest rate is log normally distributed. These variables have been tested with the "fit distribution" function in @Risk in order to analyse what statistical distribution that is most suitable to fit the data.

4. Background for the Empirical Study

This chapter will give an introduction to the development of Swedish dairy production at farm level in Sweden. This part of the thesis will also explain the problems with high debt levels, low perceived profitability and future volatile prices that Swedish dairy farmers will be facing.

Today Swedish dairy farmers have relatively high debt levels and at the same time they consider the profitability to be poor (Lantbruksbarometern, 2013). This is an alarming situation that could lead to financial stress as well as an increase in both operational risk and financial risk.

Between Swedish dairy farmers the economic situation differs a lot (www, LRF-Konsult, 2013). In 2012 low milk prices correlated with high fodder costs and those least affected were the dairy farms with a high proportion of farm produced fodder. Due to relatively low interest rates during the last decade there has been an increase in the demand for capital in parts of the agricultural sector. Farmers who have recently taken loans in order to invest in their businesses might be sensitive to future interest rate fluctuations (Lantbruksbarometern, 2013). In figure 5 the development of different mortgage interest rates offered by SEB has been illustrated.

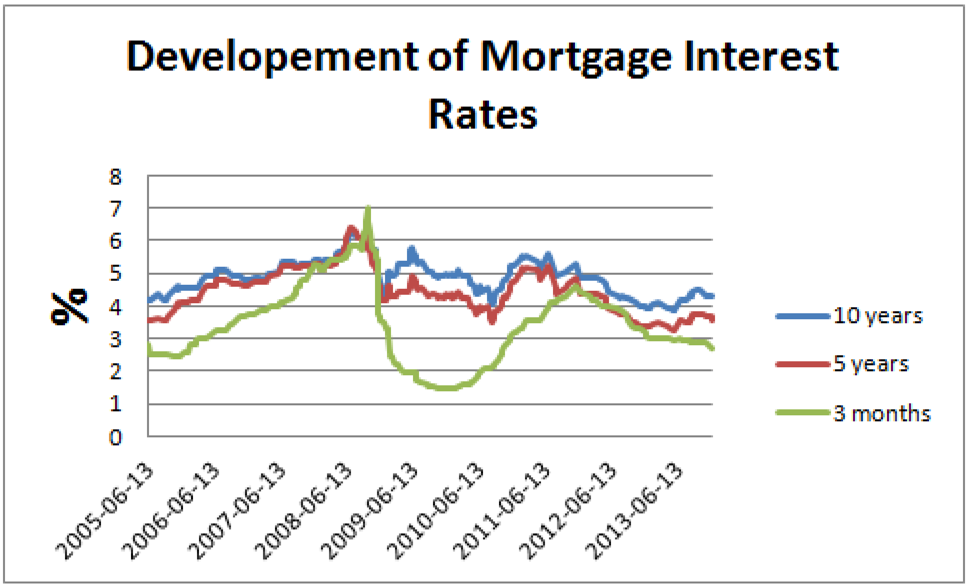


Figure 5. Development of mortgage interest rates in Sweden (Own modification according to www, SEB, 2014)

As illustrated above there is a high volatility observed in both the fixed mortgage interest rates for five and ten years as well as the short three months fixed mortgage interest rate. Also the milk price has been volatile during the same period. Figure 6 illustrates the development of historical milk prices from 2004 until 2014.

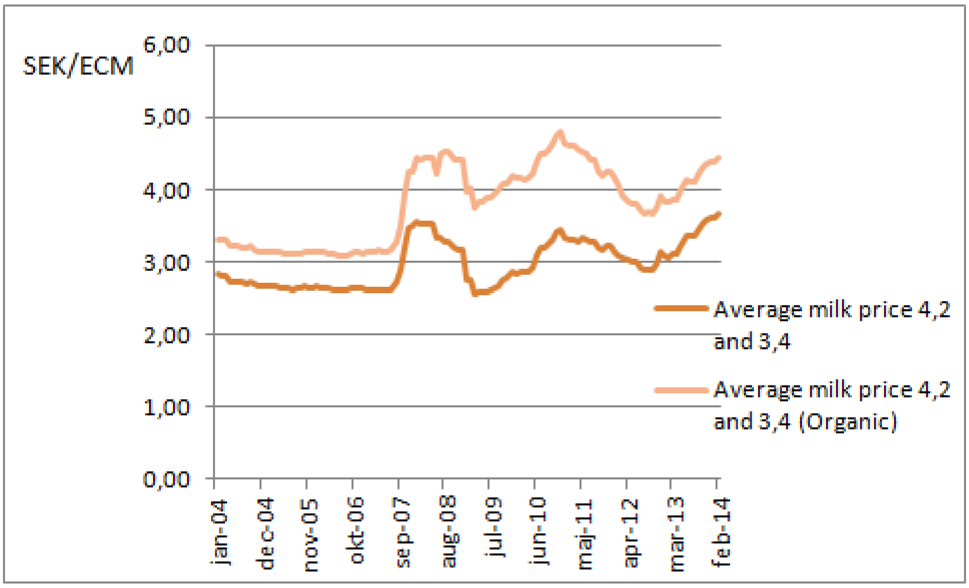


Figure 6. Development of average milk prices (Own modification according to pers. comn., Secher, 2014)

4.1 Swedish Dairy Production

During the twentieth century there has been a change in the structure among dairy farmers. From small herds evenly diffused across Sweden in the first half of the twentieth century to large units concentrated to more suitable areas during the late twentieth century and the twenty-first century (Antonson & Jansson, 2011).

Table 1. Description of the Swedish dairy sector (Own modification)

ECM	9 535	(www, Växa, 2013)
Average herd size	76	(www, Växa, 2013)
Dairy farms > 50 cows Dairy farms > 99 cows	50 % 20 %	(www,jordbruketisiffror, 2, 2012)

As seen in table 1 the average milk production in Sweden is 9 535 ECM. The average herd size is 76 cows. Dairy farms with a herd size greater than 50 cows represent 50 percent of the Swedish dairy farms.

The first AMS was installed in 1998 (Bergman & Rabinowicz, 2013). By the end of 2011 there were approximately 1 000 dairy farms with AMS in Sweden. Those who have installed an AMS believe that there have been improvements in working environments. But there has often been a decrease in perceived profitability as well as in milk quality. According to Bergman & Rabinowicz (2013) several studies point out the main reason for investing in AMS have been social aspects rather than economic. Among those who have chosen not to invest in AMS, the main reason has been that it is regarded as too expensive. Also the price has led to problems with external finance.

Decisions regarding investment in agricultural businesses have traditionally been done using standard recommendations, consultant advice or simply just by rule of thumb (Bewley *et al.*, 2010). Today's dairy farm managers are presented with constant new technologies. When it comes to investing in new technologies, the standard approach is often by using a NPV. Due to underlying uncertainties this method is quite often misleading. Also, future cash flows deriving from new investments are hard to account for since multiple variables often are non-linear and intuitive (ibid.).

5. Empirical Information

Chapter five contains the input data used for the analysis made in this thesis. A detailed description of all inputs will be given. First of all the sources of the price data and some general circumstances will be described. Secondly the objects of analysis will be described, i.e. the two Swedish dairy farms chosen. Thirdly the stochastic key variables analysed with the help of a MCS will be described.

The average yearly milk production of a Swedish dairy cow during a 305-day lactation is measured in kg energy corrected milk (ECM) (pers. comn., Ström, 2014). The delivery index is used to describe the percentage of delivered milk in relation to the total milk production in the herd. The delivery index differs between dairy farms. Generally it is lower in organic dairy production since the calves need to be fed with raw milk according to rules and regulations for the organic dairy production in Sweden (www, KRAV, 2014) .When used in the model, the delivery index has been calculated as:

$$Delivery\ index = \frac{Annualy\ delivered\ quantity\ of\ milk}{Annual\ total\ milk\ production}$$

The inputs used to calculate cash flows stemming from forest ownership in the model data have been obtained from the FMP. The cutting classes are a system used in the FMP and it describes the age development of various areas in the forest (www, Skogsstyrelsen, 1, 2014). The "$S_{1\text{-}3}$-classes" describe forest area available for felling and will be the volume used in the model.

In Sweden, it is not allowed to fell forest in certain areas until it have reached a certain age (www, Skogsstyrelsen, 2, 2014). For coniferous forests the age of the forest available for felling varies between ages of 45 years up to 100 years. It depends on the production capacity of the forest. For forest units > 50 hectares there are certain rules regarding the forestry. Not more than half of the forest unit may consist of bare land and forest younger than 20 years.

5.1 Farms Analysed

Two Swedish dairy farms are objects of analysis in this thesis. Both are located in the middle part of Sweden, i.e. Svealand. The following information used as inputs in the model has been collected through Växa Sverige, from the farmers themselves, through the annual reports and external partners responsible for the FMP.

A description of both dairy farms input data is presented in the following table 2. If compared to average data for Swedish dairy farms as presented in previous chapter four, both farms analysed are representative in both herd size and milk production per cow. Dairy farm A is located in the group with more than 99 cows. This group represents 20 percent of the dairy farms in Sweden (www, jordbruketisiffror, 2, 2012). Dairy farm B is located in the group with more than 50 cows that represent 50 percent of the dairy farms in Sweden (ibid.).

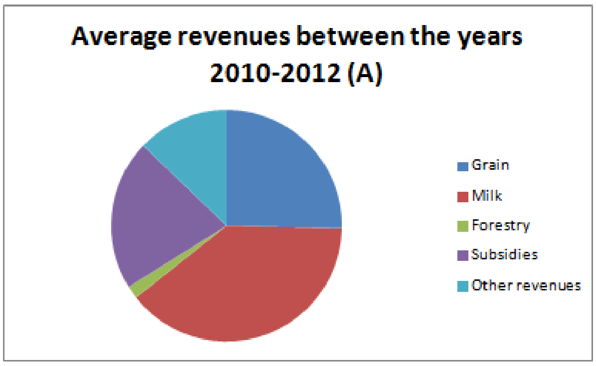
Table 2. Input data for both dairy farms (Own modification)

	Dairy farm A	Dairy farm B
Average production / cow	9 154 ECM	9 200 ECM
Milking cows	117	71
Delivery index	95 %	94 %
Loans (SEK)	17 930 234	12 085 686
Volume standing timber	37 568 m^3sk	9 456 m^3sk
Harvestable timber	15 772 m^3sk	3 723 m^3sk

Dairy farm A is a conventional farm. It is equipped with two robots in an AMS. The annual average production per cow at dairy farm A was 9 154 ECM during the year 2013 according to data received from Växa Sverige (pers. comn., Ström, 2014). During 2013 there was an average of 105 cows in the herd. However the herd has expanded since and therefore, in order to give a more representative picture of future production conditions, a herd size of 117 cows have been used as an input in the model. The delivery index is approximately 95 percent (pers. comn., Ström, 2014). The total volume of standing timber on the property was 37 568 m^3sk by the end of 2012. Harvestable timber amounted to 15 772 m^3sk by the end of 2012.

Dairy farm B is an organic farm with one AMS. The annual average production per cow at dairy farm B was 9 200 ECM during the year 2013 according to data received from Växa Sverige (pers. comn., Ström, 2014). The number of cows annually in production at dairy farm B amounts to 71 (pers. comn., Ström, 2014). The delivery index at dairy farm B is approximately 94 percent (pers. comn., Ström, 2014). The total volume of standing timber on the property is 9 456 m^3sk. Harvestable timber amounts to 3 723 m^3sk.

Figure 7 illustrates average operational revenue streams deriving from dairy company A between the years 2010 and 2012.



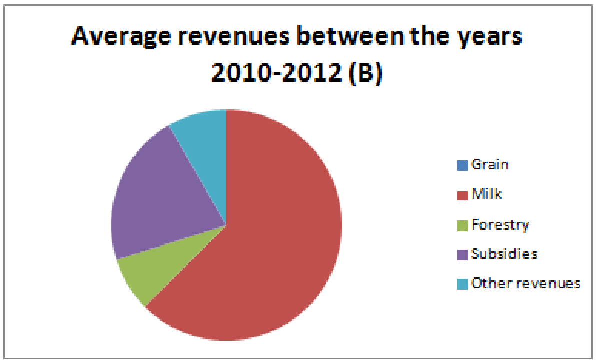


Figure 7. Average revenues between the years 2010-2012 for both dairy farms analysed (Own modification)

For dairy farm A the major parts of the revenues are generated from milk production. Since the investment in the AMS, the farm decreased its cost of labour. Dairy farm B depends largely on revenues from the milk production. Furthermore, subsidies play an important role in providing the agricultural business with cash.

5.2 Stochastic Variables

The stochastic variables' possible values and probability distributions have to be defined in order to be properly used in the model used in this thesis. These variables: *milk price, saw log price, pulp price and interest rate* can vary within their assumptions and are therefore defined as stochastic variables. A description of these variables and their distribution function will be described in this section of chapter five. The analysis of each variables distribution is found in appendix 4. No co-variance has been defined between the milk price and the interest rate since any relationship between these variables are weak (Hardaker, 2004). But a co-variance has been noticed for the pulp and saw log price historical movements as seen in appendix 2.

5.2.1 Milk Price

The historical milk price used to predict a future probability distribution has been gathered from Clara Secher at LRF Konsult. The milk price is calculated exclusive price adjustments. Descriptive statistics of the historical milk price and organic milk price movements are illustrated in appendix 3.

The mean value indicates that the milk price has a mean around 2,97 SEK and that the organic milk price has a mean value around 3,81 SEK. The standard deviation is 0,33 SEK for the milk price and 0,55 for the organic milk price. The standard error indicates whether the sample mean is close to the true population mean and is calculated by dividing the standard deviation of the sample with the square root of the total number of observations (www, Princeton, 2014). As seen above the standard error is low at a level of 0,03 for the milk price and 0,05 for the organic milk price. This indicates a rough certainty for the mean of the two samples. The kurtosis is negative, which indicates that the distribution of the two samples is relatively flat. Skewness characterizes the level of asymmetry. A negative skewness indicates a distribution with an asymmetric tail on the left side of the mean while a positive skewness indicates the opposite. The kurtosis is negative, which indicates that the distribution of the two samples is relatively flat. Skewness characterizes the level of asymmetry. A negative skewness indicates a distribution with an asymmetric tail on the left side of the mean while a positive skewness indicates the opposite. If the confidence level is set to 95 percent with a = 0,10. Then there is a probability that $u = \bar{x} \pm confidence\ level$. This means that there is a probability of a that the true value of u lies outside the confidence limits set. As seen above the distribution is not truly normally distributed. This might be due to small samples used with no more than approximately 120 price observations. More observations might indicate a normal distribution. As seen in appendix 4, the organic milk price is likely to be normally distributed and is ranked second in the fit distribution test carried out in @Risk. In their study, Hyde & Engel (2002) defined the milk price as a normally distributed stochastic variable. And therefore, even though it is not proven statistically, the assumption of the milk price being normally distributed is assumed to be realistic.

5.2.2 Saw Log and Pulp Prices

The time series line in both figure 8 as well as in figure 9 is broken between the years of 1995 and 1996. This is due to the fact that before 1995 annual prices were measured in felling years and after 1995 in calendar years (www, Skogsstyrelsen, 3, 2014). Figure 8 illustrates the development of saw log prices in the price level of 2012.

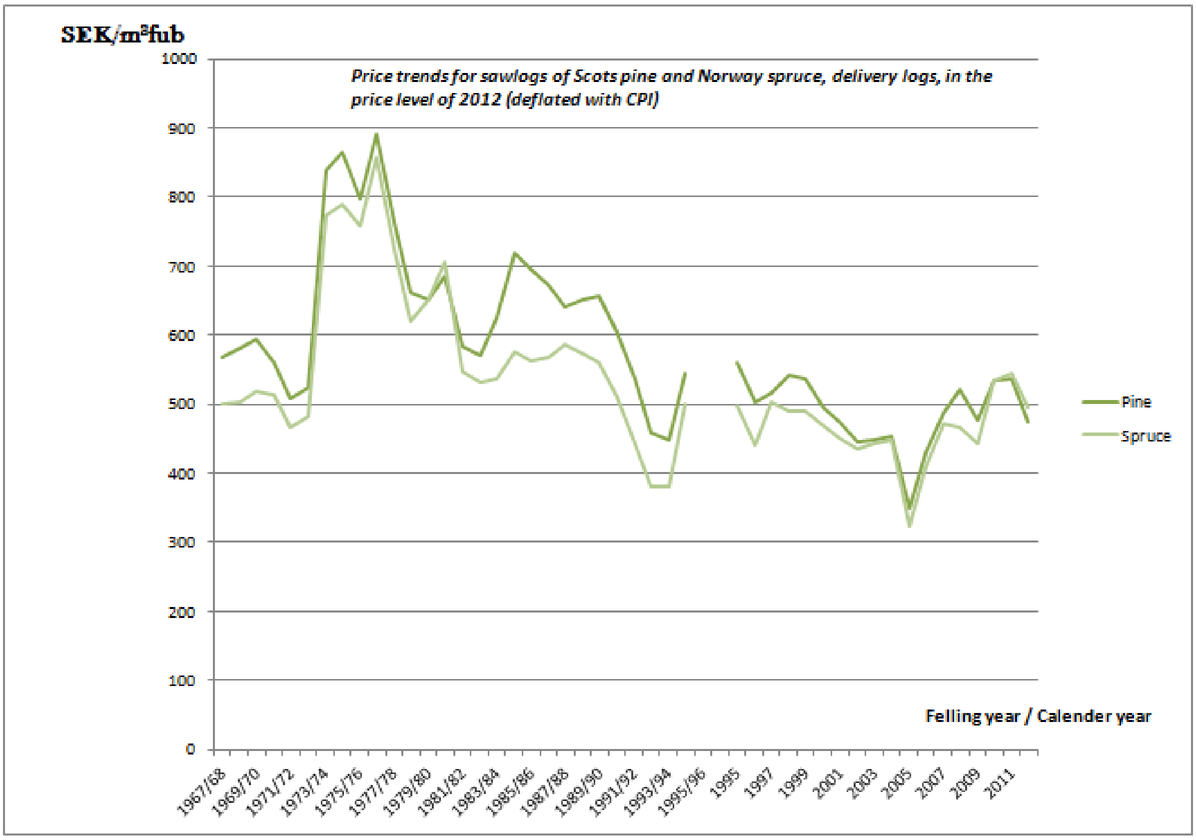


Figure 8. Price trends for saw logs in the price level of 2012 (Own modification according to www, Skogsstyrelsen, 3, 2014)

The saw log price, in the price level of 2012, has been highly volatile during the last four decades. As visualized above, the price of pine saw logs follow the price of spruce saw logs quite well. This is also seen in appendix two were a co-variance have been analysed between the two price variables.

Figure 9 illustrates the development in price of pulp in the price level of 2012. It is noticeable that the pulp price and the saw log price movements are interconnected. On an average the difference between these prices movements have been approximately 61 percent.

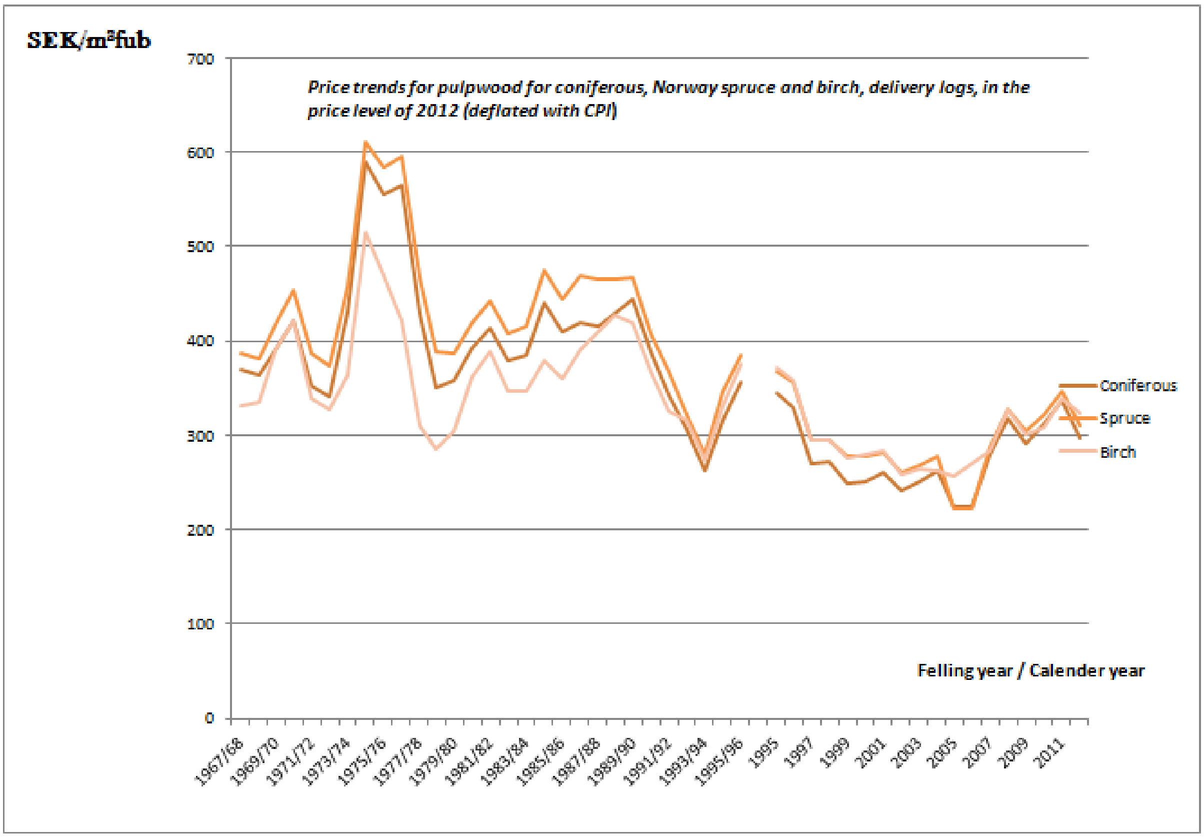


Figure 9. Price trends for pulp in the price level of 2012 (Own modification according to www, Skogsstyrelsen, 3, 2014)

The timber price has been assumed to be normally distributed. Even though it is not the highest ranked distribution, as seen in appendix 4, in @Risk the difference in the A-D values generated is small. This might also depend on the small amount of price observations used. Energy prices are normally distributed (www, palisade, 1, 2014). Therefore a commodity price such as the timber price can be assumed as normally distributed. Kangas *et al (*2000) assumed that price peak in timber price were normally distributed in their article. Scarpa & Alberini (2005) argue that "*Timber prices are independent and identically normally-distributed with mean price μ and standard deviation σ*"(Scarpa & Alberini, 2005, p. 300). Even though other distributions are better ranked in appendix 4, the normal distribution has been chosen due to the fact that the sample analysed is small and that several aforementioned references argue that it is a realistic assumption.

5.2.3 Interest Rate

The average historical development of interest rates tied at 3 months offered has been gathered from the financial institution, SEB. In appendix 2 descriptive statistics of the historical developments can be observed. The mean value indicates that the 3 month interest rate has a mean value of 3,52 percent. As earlier mentioned the standard error indicates if the sample mean is close to the populations mean and is calculated by dividing the standard deviation of the sample with the square root of the total number of observations (www, Princeton, 2014). The standard error of the 3 month interest rate is 0,09. There is a negative kurtosis and a positive skewness. This indicates a relatively flat distribution with a tail on the right side of the mean. The interest rate is clearly not normally distributed, since the probability of *a* lies outside the confidence limits. Still, variables typically described by the normal distribution include commodity prices like energy price as well as inflation rates (www, palisade, 1, 2014). But a normal distribution could generate negative values and therefore the lognormal distribution would be a more realistic assumption. Also, as seen in appendix 4, the lognormal distribution is the most realistic assumption when analysed in @Risk.

6. Results

This chapter present the results generated from 2 000 simulations in the Excel model. The results will be presented in the form of distributions of net present future liquidity. Also the 95 percent VaR as well as the probability of future liquidity being less than zero will be presented.

There are two different scenarios including two different interest rate strategies. These are scenario:

- That uses a floating interest rate to calculate the average annual interest payment

- That uses a fixed interest rate during the whole period under analysis to calculate annual interest payments

Dairy farm A is the bigger conventional farm with two AMS installed and dairy farm B is the organic dairy farm with one AMS installed.

6.1 Floating Interest Rate

6.1.1 Dairy Farm A

Figure 10 presents the probability distribution from simulations carried out under the conditions set for Scenario 1 for dairy farm A.

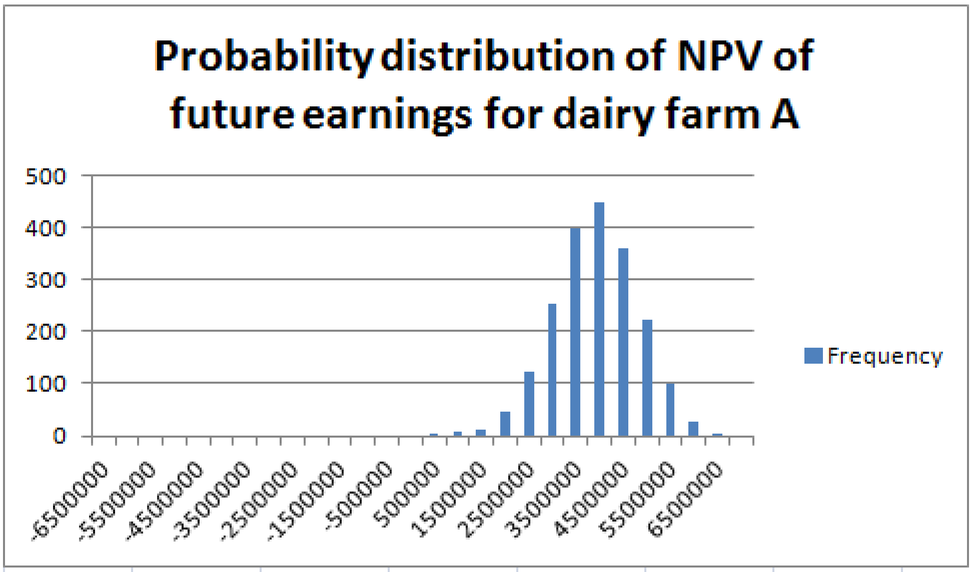


Figure 10. Probability distribution of future liquidity for dairy farm A (Own modification)

As seen above the outcome is positive. The results have a mean value of 4 183 779 SEK with a standard deviation of 901 583 SEK.

Table 3 illustrates different statistical measures of the probability distribution generated in scenario 1 for dairy farm A. As seen there is a 95 percent VaR, i.e. the 5 percent worst scenarios amounts to 2 700 765 SEK. There is no probability of future cumulative liquidity being less than zero.

Table 3. Descriptive statistics of net present values for dairy farm A under scenario 1 (Own modification)

Probability (%) NPV < 0	0,0%	Mean	4 183 779 kr
95 % VaR	2 700 765 kr	STDAV	901 583 kr

6.1.2 Dairy Farm B

Figure 11 presents the probability distribution from simulations carried out under the conditions set for Scenario 1 for dairy farm B.

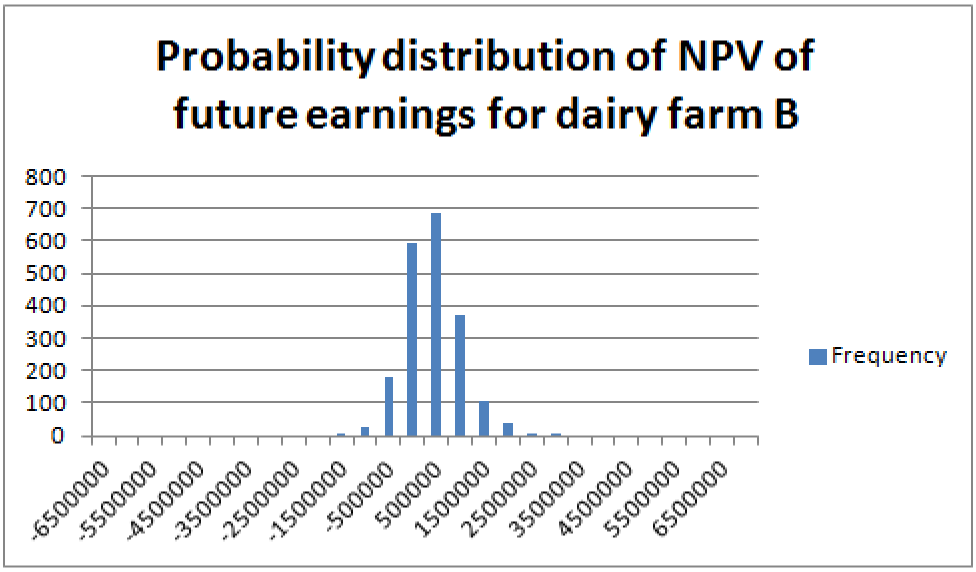


Figure 11. Probability distribution of future liquidity for dairy farm B (Own modification)

As seen above, the distribution is concentrated around the mean value of 972 410 SEK. There is a probability of future liquidity being less than zero of 9,45 percent under the conditions set for dairy farm B in scenario 1.

Table 4 illustrates statistics generated from the distribution. The 95 percent VaR is -269 937 SEK. This means that five percent of the net present values will be lower than -269 937 SEK.

Table 4. Descriptive statistics of net present values for dairy farm B under scenario 1 (Own modification)

Probability (%) NPV < 0	9,45%	Mean	972 410 kr
95 % VaR	-269 937 kr	STDAV	755 272 kr

6.2 Fixed Interest Rate

6.2.1 Dairy Farm A

Figure 12 below presents the probability distribution from simulations carried out under the conditions set for Scenario 2 for dairy farm A.

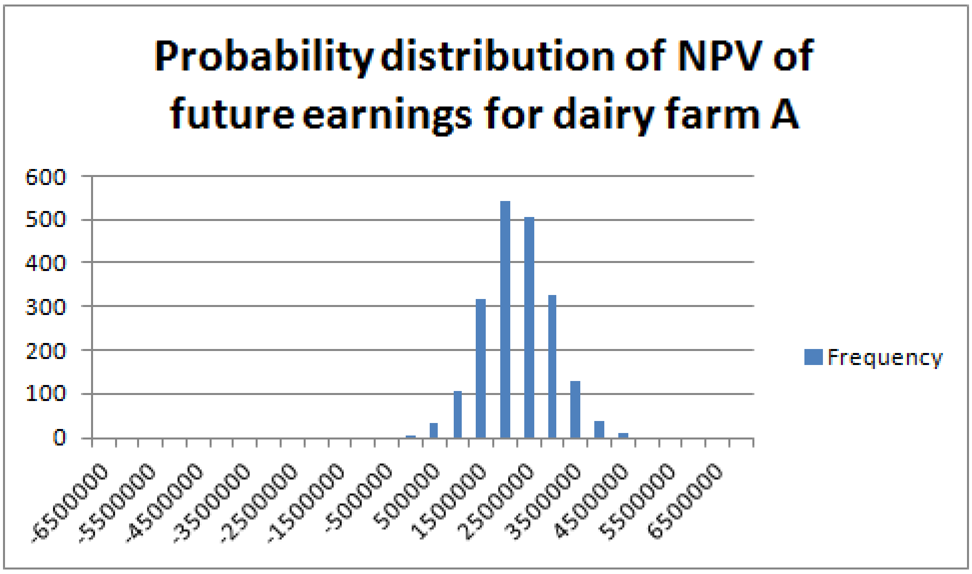


Figure 12. Probability distribution of future liquidity for dairy farm A (Own modification)

The distribution illustrated above has a mean value of 2 529 122 SEK with a standard deviation of 698 046 SEK. The spread between the extreme values is small. In table 5, seen below, the 95 percent VaR amounts to 1 380 906 SEK.

Table 5. Descriptive statistics of net present values for dairy farm A under scenario 2 (Own modification)

Probability (%) NPV < 0	0,0%	Mean	2 529 122 kr
95 % VaR	1 380 906 kr	STDAV	698 046 kr

6.2.2 Dairy Farm B

The probability distribution of future accumulated liquidity for dairy farm B under scenario 2 is presented in figure 13 below.

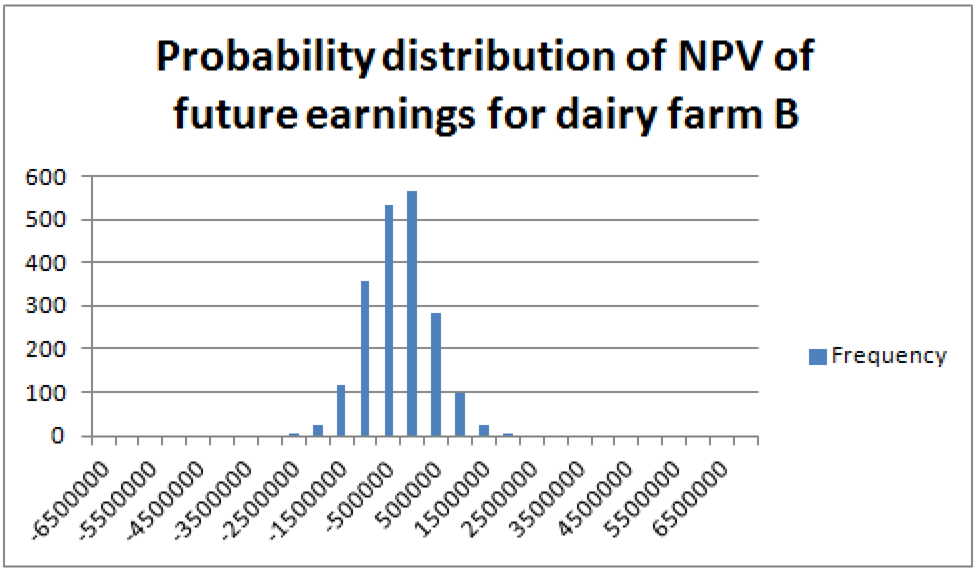


Figure 13. Probability distribution of future liquidity for dairy farm B (Own modification)

The mean value of the distribution is -18 831 SEK. As seen in table 6 below, the results from the model specified for scenario 2 indicates that there is a probability of future accumulated liquidity being less than zero is 50,8 percent. In table 6 below the 95 percent VaR is -1 082 378 SEK. This means that five percent of the net present values will be equal to or lower than -1 082 378 SEK.

Table 6. Descriptive statistics of net present values for dairy farm A under scenario 2 (Own modification)

Probability (%) NPV < 0	50,8%	Mean	-18 831 kr
95 % VaR	-1 082 378 kr	STDAV	646 573 kr

6.3 Summarizing Results

Table 7 presents comparative statistics. The highest expected probability of having a shortage of future cumulative liquidity was measured in scenario two, but only for dairy farm B with a fixed interest rate over a period of ten years.

Table 7. Comparative statistics from simulations for both scenarios and both dairy farms (Own modification)

	Dairy Farm A			**Dairy Farm B**		
	Fixed rate	**Floating Rate**	**Fixed saw log price**	**Fixed Rate**	**Floating Rate**	**Fixed saw log price**
			with floating interest rate			***with floating interest rate***
Probability NPV < 0	*0,00%*	*0,00%*	*0,00%*	*50,80%*	*9,45%*	10,35%
Mean Value	*2 529 122 kr*	*4 183 779 kr*	*4 139 900 kr*	*-18 831 kr*	*972 410 kr*	957 777 kr
STDAV	*698 046 kr*	*901 583 kr*	*867 140 kr*	*646 573 kr*	*755 272 kr*	751 099 kr
95 % VaR	*1 380 906 kr*	*2 700 765 kr*	*2 713 541 kr*	*-1 082 378 kr*	*-269 937 kr*	-277 705 kr

There is a zero probability of a liquidity shortage for dairy farm A given the conditions stipulated for the simulations.

The standard deviation is a measure of how much the different values deviate from the mean. Even though the probability of having a NPV less than zero is higher for dairy farm B when using a fixed interest rate, the standard deviation is higher when using a floating interest rate. This indicates that there is a higher probability of values deviating from the mean when using a floating interest rate and not having the added certainty associated with a fixed interest rate. Even though there is a zero probability for dairy farm A having a NPV less than zero, the standard deviation is larger when not having a secured interest rate. Figure 16 is a graphic illustrating of the probability of having a present value of future liquidity being less than zero for both dairy farms analysed.

A fixed interest rate causes lower VaR values for both farms in the two scenarios even though the VaR is positive in both cases for dairy farm A. If the two strategies are compared for the same object of analysis, the VaR is greater in both cases when a fixed interest rate is being used. This indicates that a fixed interest rate is more costly than the floating interest rate. Even though the standard deviation is greater when using a floating interest rate, the VaR is larger when using a fixed interest rate.

If the saw log and pulp wood prices are fixed, e.g. deterministic, during the period analysed there is only a small difference between expected values, VaR and the standard deviation. Figure 14 illustrates the probability of having a NPV less than zero.

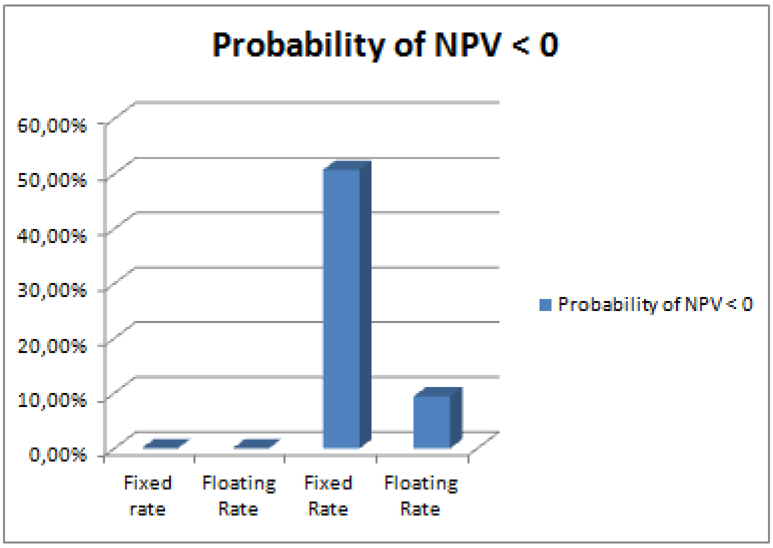


Figure 14. Probability of future liquidity being less than zero (Own modification)

The highest expected probability of having a liquidity shortage was measured at dairy farm B in scenario two, with a fixed interest rate.

7. Analysis and Discussion

Present chapter aims to deal with the research questions stated in chapter one. The analysis is based on the theoretical framework, the empirical data and the results. The discussion aims to contextualize the study and explain its limitations as well as its contributions to its field of research. These are the research questions stated in chapter one:

- *Will there be a shortage in future cumulative liquidity within a decade among the two Swedish mortgaged dairy farms d that could increase the financial risk for external lenders as well as the farmers themselves.*
- *Calculate the probability of future cash flows originating from different operational strategies over a period of ten years being less than zero, i.e. NPV of future cash flows being < 0.*
- *Determine different interest rate strategies impact on future liquidity.*

7.1 Analysis

This part of chapter seven will examine the results. As a concluding remark to the results, a smaller negative VaR is preferable to a large VaR according to Mun (2010). Either object of analysis should choose a fixed interest rate since it generates a VaR not as good as if a floating interest was used. At the same time the floating interest rate generates higher expected values. But if chosen, the floating interest rate provides a higher standard deviation for both objects of analysis.

7.1.1 Dairy Farm A

As seen in the results there is no probability of a future NPV being less than zero. The results are the same both when a floating interest rate is used as well as a fixed interest rate. The expected value of the distribution is higher when a floating interest is used. The same goes for the VaR. If negative, a higher VaR is to prefer but since there is no risk of having a NPV less than zero the floating interest rate, which generates a higher positive VaR, is preferable.

The surprisingly good results might depend on the fact that the grain price as well as the fuel price will not be considered as stochastic variables even though they are of importance. As seen in chapter five, the grain production is of importance to the average revenues generated from the farm. The enhanced debt level has been included in the model but volatility in grain price as well as production risk in grain production has not been accounted for. This fact would probably change the outcome of dairy farm A, generating more extreme tail values in the distribution of net present values.

7.1.2 Dairy Farm B

Opposite to dairy farm A, this farm has a probability of a negative NPV. If used the floating interest rate will give a probability of the NPV being less than zero of 9,45 percent. On the other hand the fixed interest rate, if used, will give a probability of the NPV of future earnings being less than zero of 50,8 percent. The floating interest rate is preferable to the fixed interest rate since the VaR is larger if a fixed interest rate is used. This indicates a worse potential loss in future earnings.

The results of this farm are more accurate than for dairy farm A. The milk production is of great importance since more than 65 percent of the revenues are generated from it as seen in chapter five. Therefore, the stochastic milk price will capture the risk in a more adequate way. Fluctuations in milk price have a larger impact on future earnings

7.1.3 Forestry

If saw log prices and pulp wood prices are fixed during the period there are small differences in both expected values, standard deviation as well as VaR. As seen in chapter 5, forestall income is not as important as milk income, subsidies and grain income. The results are the same for both dairy farm A and dairy farm B.

7.2 Discussion

This part of chapter seven will compare results with information presented in the literature review. The discussion will focus on risk, the methodology used and how these affect the results generated. Also, for whom the results are of importance will be discussed.

7.2.1 Risk

Price risk only accounts for one of four categories of risk affecting the fifth accumulated category, i.e. the business risk, of an agricultural firm in accordance to Hardaker (2004). The price risk consists of a large number of variables and only a few have been chosen as stochastic within the model used in this thesis. Grain price and fodder costs are examples of price variables of importance for the results of this thesis. Due to limitations in time and writing space, these variables have been excluded even though they are of importance. As a result, the distribution of the outcome will not have as extreme tails as it could have had if all variables had been stochastic.

Milk price is a natural option since it is the main activity of the farms d. Also, due to expensive investments in AMS, the interest rate has been chosen since the farm businesses have high debt-levels. Further studies with a similar approach could go even deeper when analyzing risk and its impact on liquidity, both of investments and operations. For instance, price risk could be broadened to involve more stochastic variables. But production risk could also, and should be accounted for in order to more adequately account for real world uncertainty. Since only price risk has been accounted for, the full effect of including production risk and institutional risk in the form of random variables would probably change the outcome. Especially for dairy farm A which has a major part of its income from subsidies. This exposure to institutional risk is supported by findings in Norway where organic dairy farmers especially perceive farm support payments as important sources of risk (Flaten *et al.*, 2005). Saw log and pulp wood prices have been included as stochastic price variables since both farms have a large share of forest land.

Bewley (2010) suggested that agricultural investments are usually made without properly accounting for risk. Both agricultural firms are costumers of Svenska Handelsbanken and they do not use stochastic risk simulation when evaluating agricultural business investments (pres comn., Åttingsberg, 2014). Therefore the use of a MCS in order to account for risky price variables might give the user a further understanding of price risk and its impact on future liquidity, which is of great importance for Svenska Handelsbanken when evaluating an agricultural business investment. Price risk affects both the operational as well as the financial risk as defined by Hedman (1995) and in the long run an enhanced operational and financial risk will affect the firm’s solvency. Within the framework of this thesis investments have already been made and therefore the cash flows of future operations of a portfolio of fixed assets have been d.

The thesis has been built on the premise that investors and borrowers have found the investment in AMS and other assets at the dairy farm acceptable. The goal has then been to illustrate price risk's impact, throughout stochastic simulation, on future cumulative liquidity of Two Swedish dairy farms in order to enlighten not only financial institutions and dairy farmers, but the public as well, of the impact price risk has on future liquidity of mortgaged Swedish dairy farms.

7.2.2 The Model

A model has been created in Excel as an important part of the process to properly address the problem stated in the introduction. This was done in order to account for price risks impact on future cumulative liquidity among two mortgaged Swedish dairy farms. Financial measures in the form of liquidity or costs of production are important in order to handle risk (Flaten *et al.*, 2005). In the model, the objects of analysis, i.e. the dairy farm, is viewed as a portfolio of assets. These assets will not change during the simulation period except of an annual stochastic sum of reinvestments. The cumulative liquidity of future the future business at both objects of analysis is d and the probability of the NPV being less than zero will be estimated as well as the VaR. The model does not account for risk aversion among dairy producers. Instead, it will provide quantitative measures on future liquidity generated from a portfolio of assets give a planning environment.

The MCS approach was used to account for key stochastic variables as part of an NPV calculation. It was a relatively simple approach to account for price risk, but it also had its limitations. The variables proved to be difficult to fit into distributions properly. This might depend on the amount of price data being too small. The milk price proved to fit the normal distribution quite well according to the distribution test. Also the floating interest rate was best suited with a lognormal distribution. On the other hand timber price was assumed to be normally distributed even though the distribution test suggested did not rank it as the most suitably distribution. The results could be affected by the small number of price observations d. Results are presented in Appendix 4.

Another important notion is that there is no relationship or connection between last year's randomly generated price variables and the upcoming year's randomly generated price variables. Even though it is more realistic that the next year will have a higher probability of a high interest rate if the interest rate already is high this year, this connection has not been accounted for. This is due to limitations in time, lack of the right software and lack of knowledge. The combination of NPV and MCS has proven to be a good combination to handle lots of input and output variables and at the same time be able to produce understandable results that could be used by policy makers as well as farmers or employees of financial institutions for analyzing risk.

It is of great importance when analyzing the results of the different scenarios that these are based on several assumptions that are presented in chapter three and five. Results generated from the model are only of relevance if these assumptions are considered relevant. Chosen distributions are especially important to consider since they are of substantial importance for the results of the model.

The usage of the VaR-measurement tool gives the user an important insight into the worst case scenarios developed during the simulations given the choice of confidence level. This is important since it gives a hint of the worst outcome under normal market circumstances. It is important to remember that pure uncertainty is unanalyzable as defined by Knight (1921) in accordance to Taylor (2003). Therefore future political uncertainty in the form of, for instance free trade agreements affecting prices or decease prohibiting production cannot, and has not, been accounted for.

It is of great importance for the reader to note that the aim of this study has never been to give any general conclusions regarding price risks impact on the NPV of future earnings but to act in the form of a case study and give a further understanding of the subject. The results of this study indicate that if operational revenues and expenses, financial income and costs, extraordinary income and expenses as well as reinvestments have been considered and aforementioned stochastic variables have randomly been simulated in accordance to their chosen distributions there is a risk of a negative NPV for one of the farms d. This indicates that there is a need for both farmers and financial institutions to further understand and account for before investing.

8. Concluding Comments

The aim of this study has been to investigate whether two mortgaged Swedish dairy farms will face problems with a liquidity shortage within the coming decade due to the impact of price risk. The objective has been to examine how future volatility in interest rate, saw log and pulp wood prices and milk price might affect the liquidity among one organic and one conventional mortgaged Swedish dairy farm. The aim has been answered with the following interconnected research questions:

- *Will there be a shortage in future cumulative liquidity within a decade among the two Swedish mortgaged dairy farms d that could increase the financial risk for external lenders as well as the farmers themselves.*
- *Calculate the probability of future cash flows originating from different operational strategies over a period of ten years being less than zero, i.e. NPV of future cash flows being < 0.*
- *Determine different interest rate strategies impact on future liquidity.*

According to findings there is a substantial risk of future liquidity being less than zero for dairy farm A, especially with a fixed interest rate over a longer period. This indicates that risk has not fully been accounted for when investing in AMS and other assets. Since the 95 percent VaR is relatively low, for dairy farm A, further loans could be taken in order to account for a shortage of liquidity. There might also be a further increase in the value of land which could act as a further security for borrowers in a situation of liquidity shortage. Two different interest rate strategies were d. For both dairy farms the floating interest rate is to be preferred since it generates higher expected values.

Another notion made is that the forest income is not as important as other sources of income. If saw log and pulp wood prices are fixed instead of stochastic, there are only small variations in the probability distribution generated compared to if a the farm uses a fixed of floating interest rate.

8.1 Further Studies

Based on the results from this thesis there is undoubtedly a potential risk for a liquidity shortfall for dairy farm A within the coming decade suggesting a need for further external financing in order to maintain a positive balance of liquidity.

In order to model risk in capital budgeting models in a more comprehensive way, focus should be on all aspects of risk in order to be able to make just investment decisions, especially production risk and institutional risk. By including, not only price risk, but the other categories of risk as mentioned by Hardaker (2004) one would model real world uncertainty in a more adequate way. Further studies could focus on evaluating different investments options in milking systems with Monte Carlo sampling of price, institutional and production risk with respect to the risk preference of the dairy farmer.

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Appendix 1: Introduction Letter

This is a translation of the original introduction letter originally written in Swedish.

SLU
Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

Department of Economics

Uppsala 2013-12-10

Dear Mr/Mrs,

My name is Marcus Hallenberg and I am a student at the Swedish University of Agricultural Sciences (SLU). I am currently working on my Master thesis and have previously combined studies as an agronomist and forest industrial economist. I am writing this letter to because I need your help with my final stage of my education, specifically my Master Thesis.

The aim of this thesis is to conduct a liquidity analysis of mortgaged Swedish dairy farms in order to measure the impact that future volatility in price might have on the liquidity, i.e. the risk of the Net Present Value of future cash flows being less than zero. A model will be created in order to measure:

- Risk of NPV of future cash flows within a period of ten years being less than zero
- Analyzing key variables such as milk price and interest rate
- the impact of different forest management strategies have on the liquidity

If you through your participation will help me with this thesis is a follow-up be done over the phone with me personally.

Participation in the study is of course voluntary. There will be full confidentiality regarding your participation. In order for YOU to feel safe if participating, information regarding the name, property and other non public information will not be reported in this thesis. After completion of the thesis, non public material will be destroyed.

Do you have any other questions, or if simply curious about the results, you can contact me at maha0022@stud.slu.se or 072-732 81 31

Thanking you in advance,

Marcus Hallenberg, Agronomist & Forest Industrial Economist.

Appendix 2: Stochastic Dependency between Real Pulp Prices and Saw Log Prices

The covariance is a descriptive measure of the linear association between two variables (Alm & Britton, 2008). The covariance is formulated the following way:

$$C_{xy} = \frac{1}{1-n}\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})$$

$\bar{x}$ and $\bar{y}$ are the each samples average value and n is the size of the sample.

The covariance is a statistical tool used to measure the level of dependency between two random variables (Alm & Britton, 2008). In this case the dependency of real average yearly pulp prices and saw log prices has been compared. How the generated value of the covariance should be interpreted depends on the units specified of the input variables. The correlation coefficient, which is:

$$r_{xy} = {C_{xy}}\Big/{(S_x * S_y)}$$

where C_{xy} is the covariance divided by each variables standard deviation, i.e. $S_x * S_y$.

The benefit of using the correlation coefficient is that it is easier to interpret and always generate a value between $-1 < r_{xy} < 1$ (Alm & Britton, 2008).

Results indicate that the covariance between the pulp price and the saw log price are approximately 7631. With a standard deviation of 78,7 for pulp price and 116.1 for saw log price this will give us:

$$r_{xy} = {7631}\big/{(78{,}7 * 116{,}1)}$$

which approximately equals 0,8347 and indicates a positive correlation between the two samples measured.

Appendix 3: Descriptive Statistics

Descriptive statistics have been generated through the Analysis Toolpak in Excel. It is an add-in program with the ability to carry out statistical, financial and engineering data analysis. Information on how data is to be interpreted have been collected from an excel guide at Princeton's homepage (www, Princeton, 2014).

Descriptive Statistics		
	Organic milk price	Milk price
Mean	3,81	2,97
Standard error	0,05	0,03
Median	3,89	2,89
Standard deviation	0,55	0,33
Variance	0,30	0,11
Kurtosis	-1,52	-1,22
Skewness	-0,07	0,42
Variation width	1,71	1,12
Minimum	3,09	2,55
Maximum	4,80	3,68
Confidence level (90%)	0,10	0,06

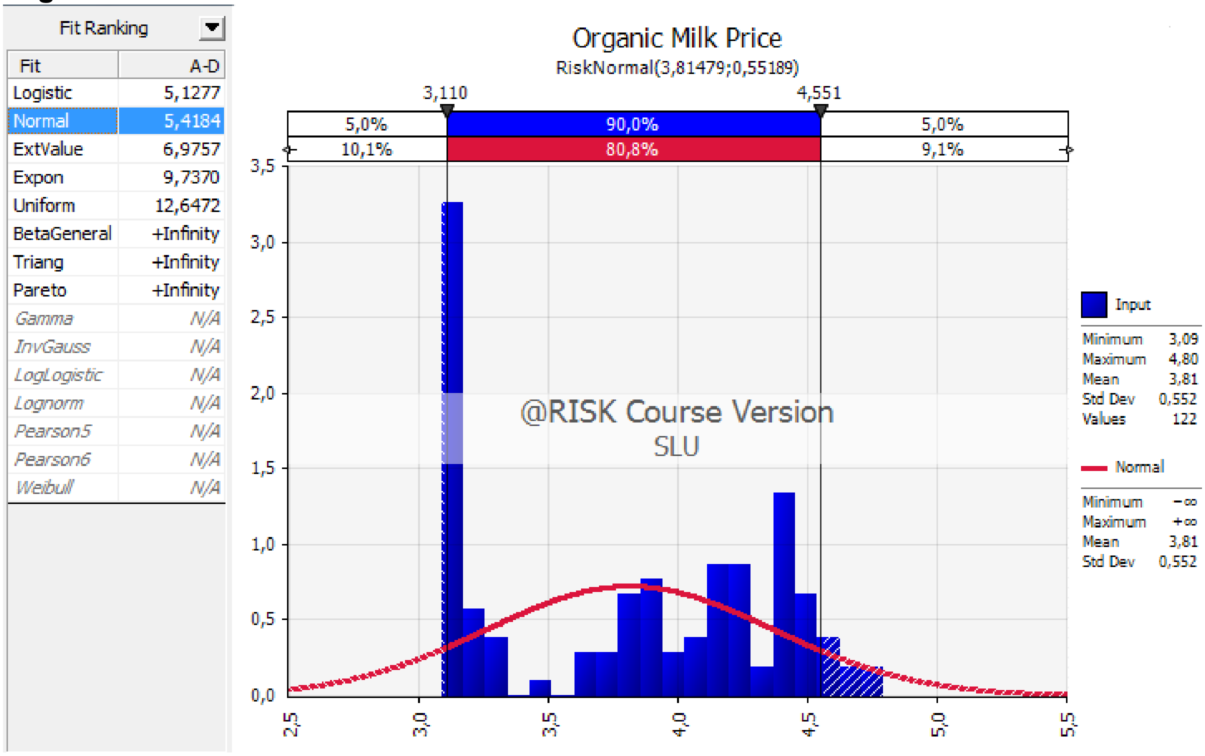
Interest rate 3 months	
Mean	3,521612
Standard error	0,088577
Median	3,29
Standard deviation	1,377935
variance	1,898704
Kourtosis	-0,79695
Bias	0,397111
Variation width	5,51
Minimum	1,48
Maximum	6,99
Total	852,23
Number	242
Confidence level (95%)	0,174484

Appendix 4: Fitted Distributions

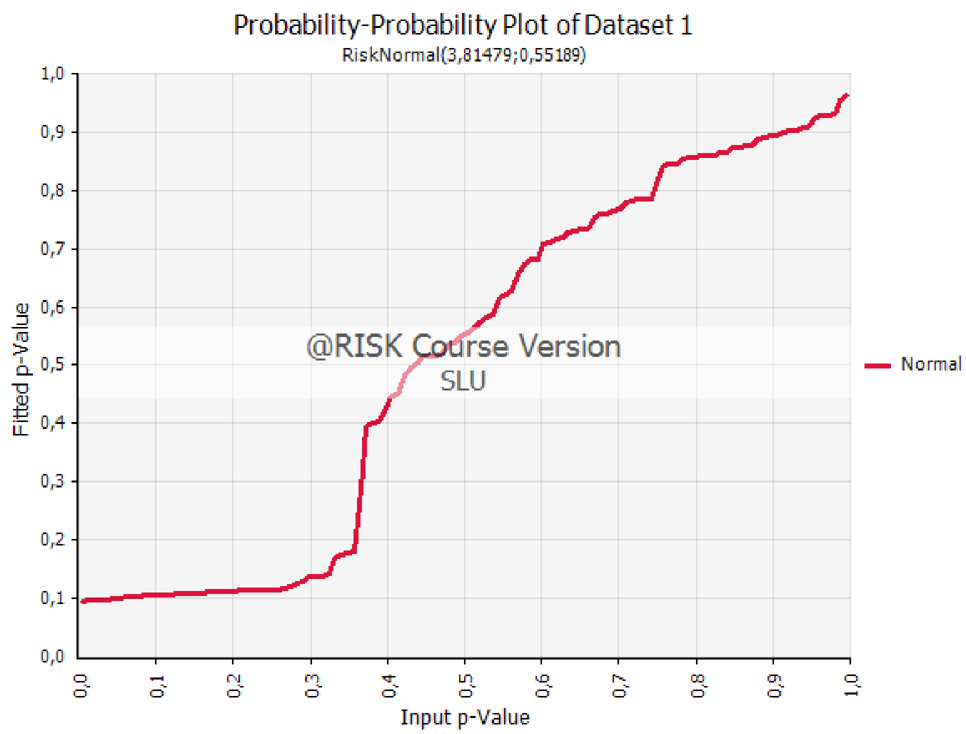
@Risk, which is an application to excel, is developed by Palisade. In @Risk, the fit distribution tool has been used to the distributions of the stochastic variables used in the model.

One of three methods was used in @Risk in order to test the different distributions to the samples and the Anderson-Darling Test was used to fit the distributions. The A-D value generated is a measure of the average squared difference between the empirical cumulative function and the fitted one (www, palisade, 2, 2014).

Organic Milk Price

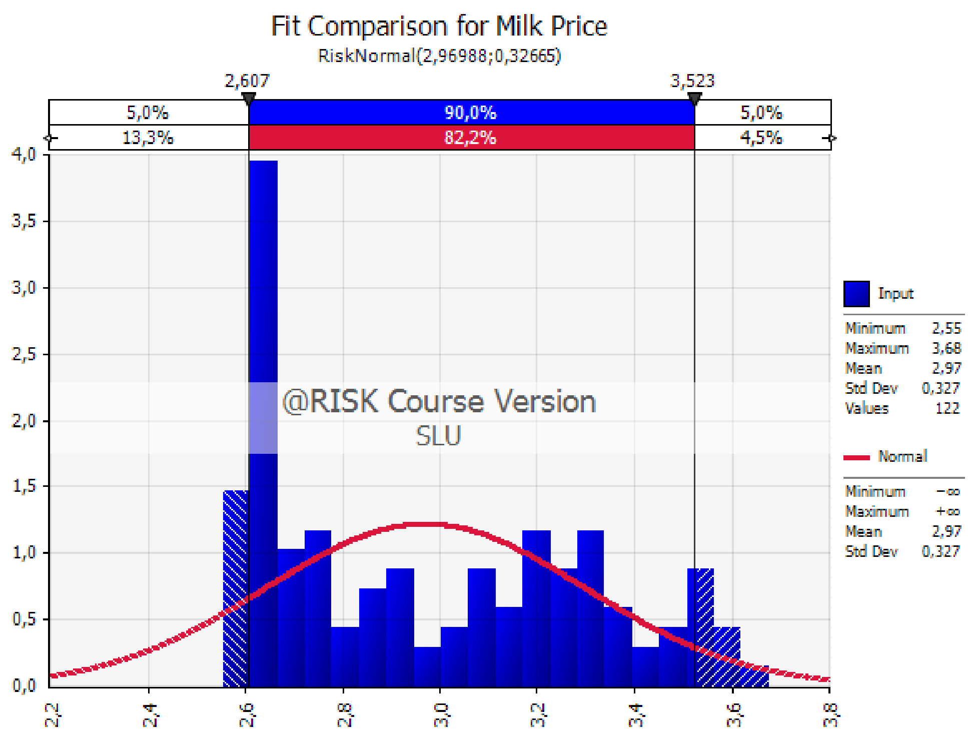


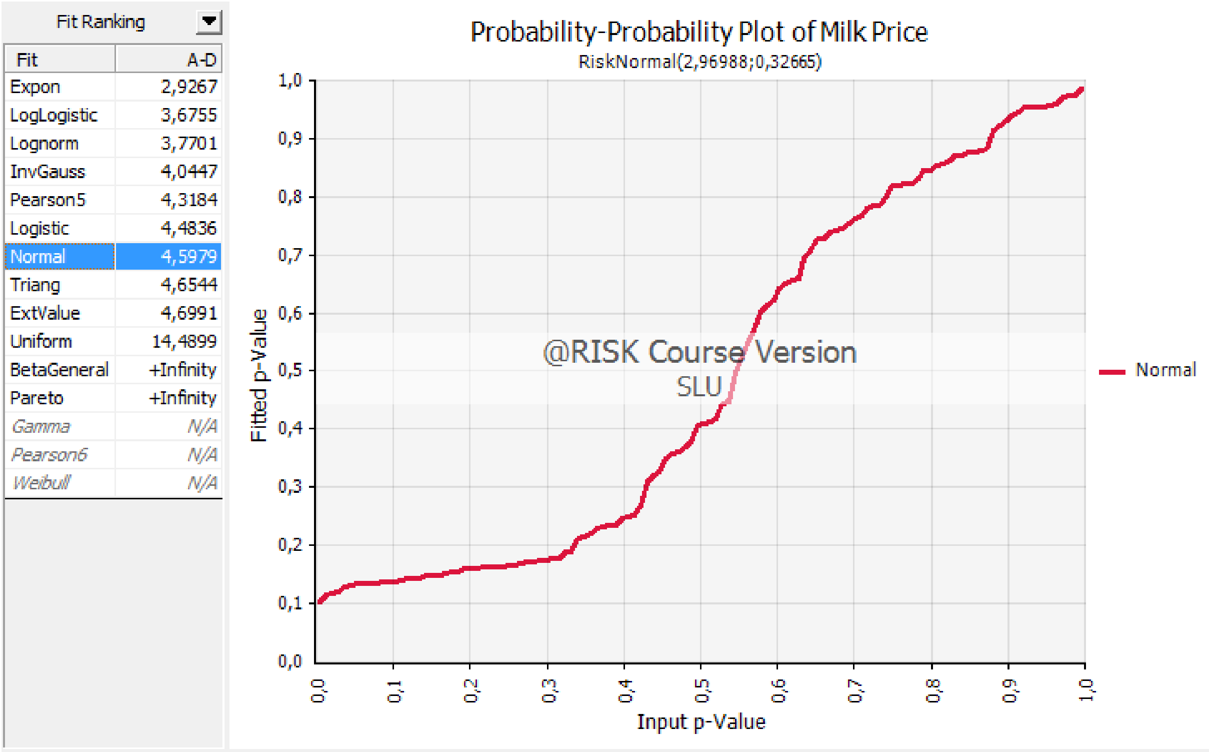
Fit	A-D
Logistic	5,1277
Normal	5,4184
ExtValue	6,9757
Expon	9,7370
Uniform	12,6472
BetaGeneral	+Infinity
Triang	+Infinity
Pareto	+Infinity
Gamma	*N/A*
InvGauss	*N/A*
LogLogistic	*N/A*
Lognorm	*N/A*
Pearson5	*N/A*
Pearson6	*N/A*
Weibull	*N/A*



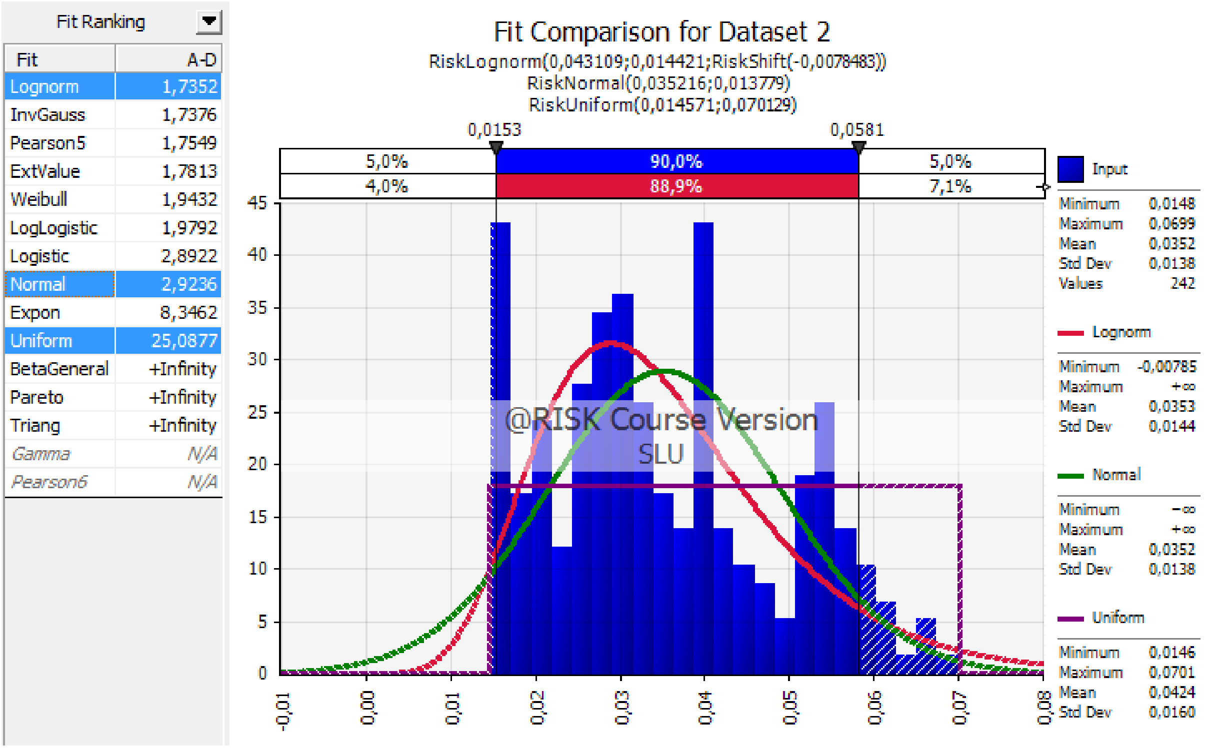
Milk Price

Fit	A-D
Expon	2,9267
LogLogistic	3,6755
Lognorm	3,7701
InvGauss	4,0447
Pearson5	4,3184
Logistic	4,4836
Normal	4,5979
Triang	4,6544
ExtValue	4,6991
Uniform	14,4899
BetaGeneral	+Infinity
Pareto	+Infinity
Gamma	*N/A*
Pearson6	*N/A*
Weibull	*N/A*

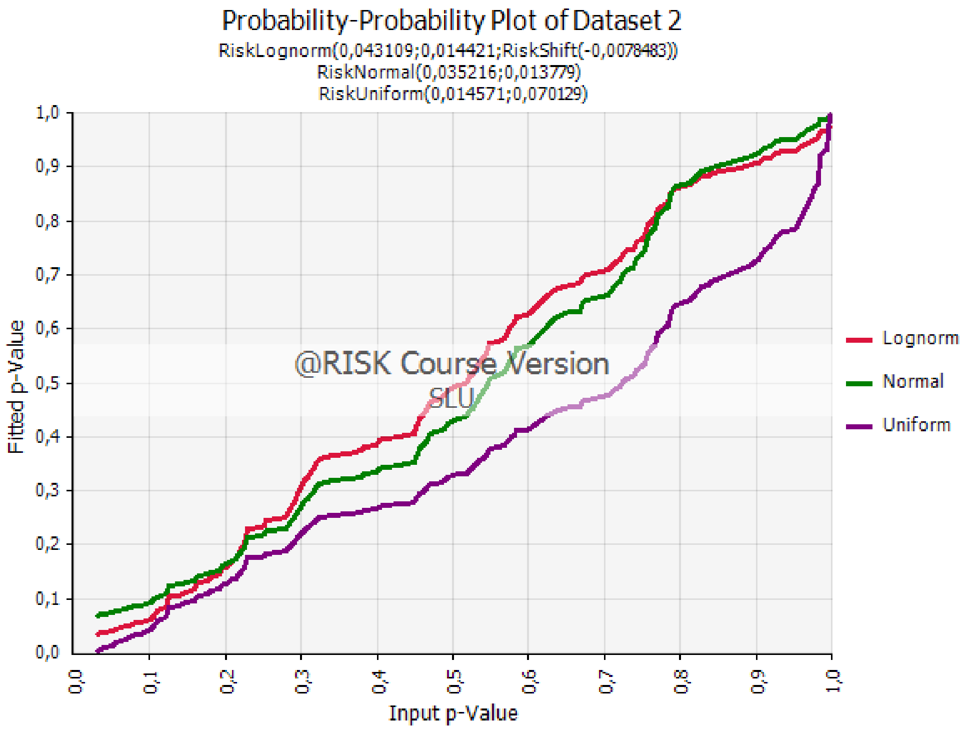




Three Month Interest Rate

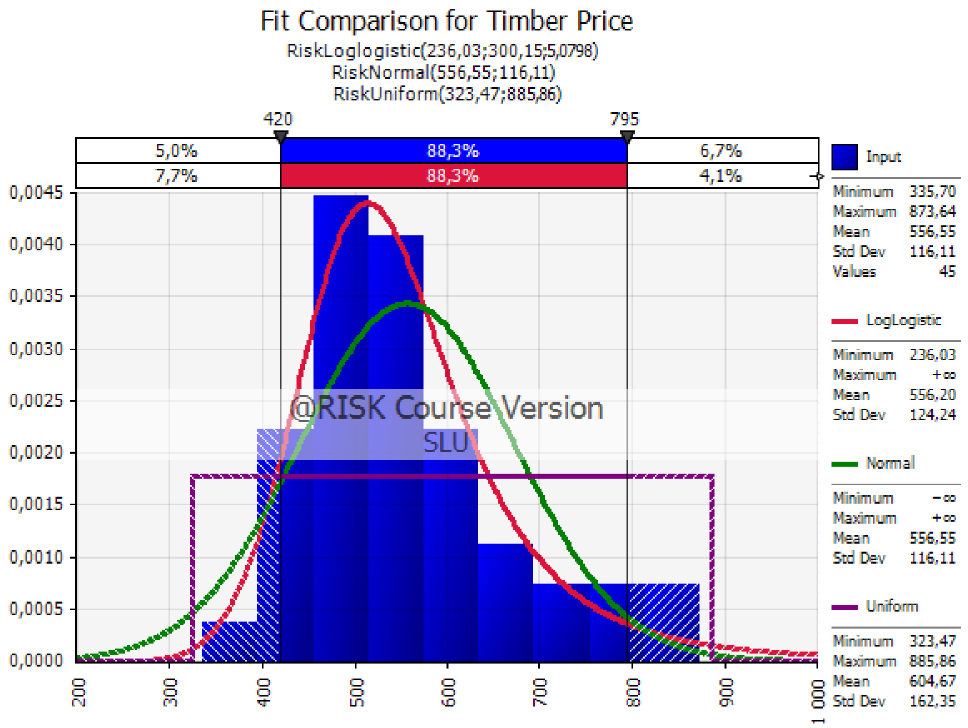


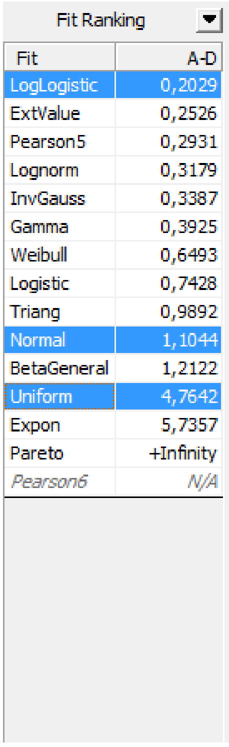
Fit Ranking	
Fit	A-D
Lognorm	1,7352
InvGauss	1,7376
Pearson5	1,7549
ExtValue	1,7813
Weibull	1,9432
LogLogistic	1,9792
Logistic	2,8922
Normal	2,9236
Expon	8,3462
Uniform	25,0877
BetaGeneral	+Infinity
Pareto	+Infinity
Triang	+Infinity
Gamma	*N/A*
Pearson6	*N/A*



Timber Price

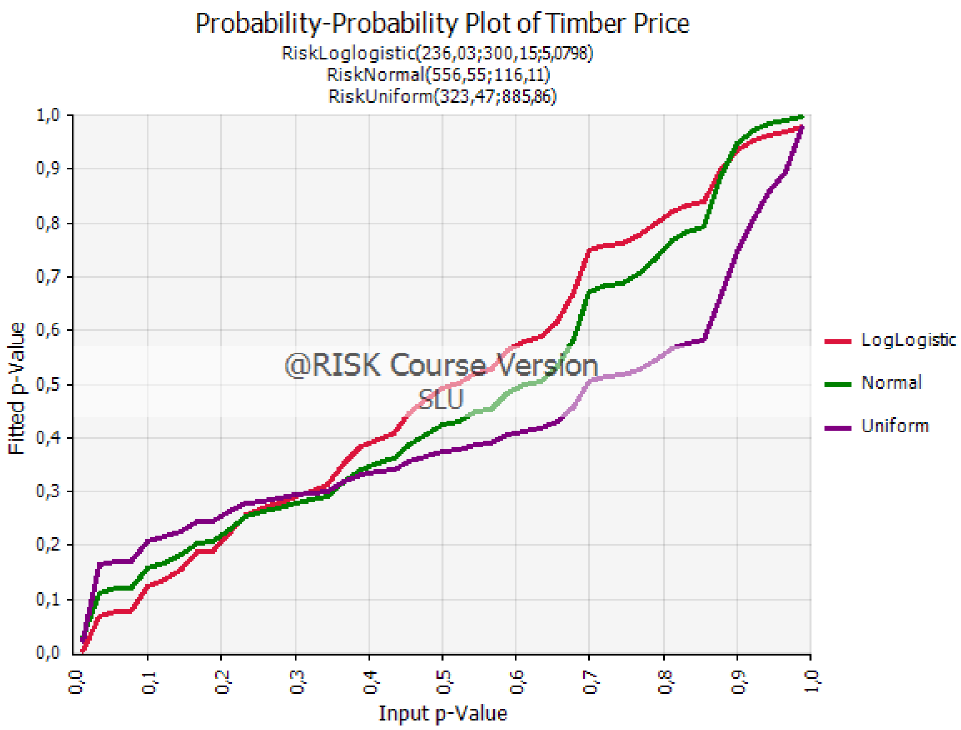
Fit Ranking	
Fit	A-D
LogLogistic	0,2029
ExtValue	0,2526
Pearson5	0,2931
Lognorm	0,3179
InvGauss	0,3387
Gamma	0,3925
Weibull	0,6493
Logistic	0,7428
Triang	0,9892
Normal	1,1044
BetaGeneral	1,2122
Uniform	4,7642
Expon	5,7357
Pareto	+Infinity
Pearson6	*N/A*





Fit Ranking

Fit	A-D
LogLogistic	0,2029
ExtValue	0,2526
Pearson5	0,2931
Lognorm	0,3179
InvGauss	0,3387
Gamma	0,3925
Weibull	0,6493
Logistic	0,7428
Triang	0,9892
Normal	1,1044
BetaGeneral	1,2122
Uniform	4,7642
Expon	5,7357
Pareto	+Infinity
Pearson6	N/A



Appendix 5: Excel model

This is an excerpt of one of 2 000 simulations run in the model created in Excel.

		Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
	Cash flows affected by stochastic variables											
	Input year (n-1)		971000	746 889,20	702 678,78	533 877,37	840 813,56	661 645,19	909 391,69	1 003 688,92	1 503 992,81	1 280 980,49
S	Milk Price*		3,62	3,77	3,31	3,94	4,24	4,16	3,59	4,60	3,25	4,64
T	Total annual cash flow milk	+	2 214 245,39	2 309 768,94	2 028 443,41	2 410 194,88	2 594 771,48	2 547 073,14	2 200 674,29	2 816 617,13	1 992 444,33	2 842 039,67
O												
C	Pulp price* SEK/m³fub	+	323 kr	311 kr	261 kr	293 kr	337 kr	247 kr	285 kr	305 kr	277 kr	285 kr
H	Harvested forest --> pulp			278,11		324,46				64,89		
A	Timber price* SEK/m³fub		529 kr	510 kr	426 kr	480 kr	551 kr	405 kr	467 kr	500 kr	453 kr	434 kr
S	Harvested forest --> timber			648,92		757,07				151,41		
T												
I	Total annual cash flow forest	+	0,00	334 053,75	0,00	360 740,14	0,00	0,00	0,00	76 029,01	0,00	0,00
C												
	Annual average interest rate*		4,40%	5,81%	2,73%	4,96%	6,69%	2,69%	1,67%	3,61%	1,77%	4,60%
	Annual interest payment	-	531 317,33	702 098,55	329 871,56	599 426,49	807 967,46	324 608,28	202 177,86	436 268,37	213 772,65	555 626,24
	Other fixed annual cash flows											
F	An average of internally generate	-	1 397 225,62	1 397 225,62	1 397 225,62	1 397 225,62	1 397 225,62	1 397 225,62	1 397 225,62	1 397 225,62	1 397 225,62	1 397 225,62
I	Own withdrals from the firm	-	307 200,00	307 200,00	307 200,00	307 200,00	307 200,00	307 200,00	307 200,00	307 200,00	307 200,00	307 200,00
X	Reinvestement	-	202 613,24	281 508,94	162 947,65	160 146,72	261 546,77	270 292,74	199 773,57	251 648,27	297 258,38	224 385,86
E												
D												
		NPV-------------->	746 889,20	702 678,78	533 877,37	840 813,56	661 645,19	909 391,69	1 003 688,92	1 503 992,81	1 280 980,49	1 344 208,31
		Amortization, take away										
NPV	1 344 208,31 kr											
	2%	Inflation										