Master Thesis

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The study of municipalities` investment choices:

Eight Norwegian municipalities` investments in financial products during 2001 - 2007

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“The global liquidity is enormous and only a significant disruptive event could create difficulty in the market. As long as the music is playing, you’ve got to get up and dance. We’re still dancing.”

Charles Prince
Former CEO of Citigroup
July 2007

Summary

This paper investigates the change in riskiness of eight Norwegian hydro power municipalities' investments in complex financial products offered by Citigroup through the brokerage firm Terra Securities AS during the period 2001-2007. The investments were financed by restructuring the municipalities` annual revenue from concession fees and power. Using Monte Carlo simulations, this paper estimates the change in riskiness by comparing the Cash Flow at Risk between two portfolios comprising of (1) restructuring the concession fees and power and investing in Credit Linked Notes, and (2) no restructuring of the concession.

Evidence of increased riskiness is found for the eight municipalities when entering into these products.

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We sincerely hope that this thesis will be as interesting for you to read as it was for us writing it.

Oslo, August 25. 2013

Minh Nguyen

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Contents

Introduction to the research topic

This paper investigates the Norwegian financial scandal taking place between 2001 and 2007, later known as "The Terra-scandal", and how the risk profile of the involving municipalities changes.

In late 2007, it had become public knowledge that several Norwegian municipalities, with the help of Citigroup, through Terra Securities AS, had gambled on complicated, risky funds in the U.S.. They were advised by Terra to leverage their investments with their future income as collateral in order to obtain higher profits (Hofstad 2008).

Records showed that eight so-called *Kraftkommuner* (energy-producing municipalities) were badly affected by the scandal. The eight municipalities were Bremanger, Haugesund, Hattfjelldal, Hemnes, Kvinesdal, Narvik, Rana and Vik. Later research in 2010 (Forland, Pettersen and Røiseland 2011) also showed that Akershus Fylkeskommunale Pensjonskasse and the private investment company Langen Invest had invested in the securities as well.

It was revealed that the municipalities were misguided and/or kept in the dark by Terra about the various risks the financial products carried (Hofstad 2008). Further, none of the municipalities did research on how these investments would change the riskiness of their income stream, and whether or not the investments fulfill their low risk requirements (Sogn og Fjordane Revisjon 2008).

In addition, lack of communication between the financial advisers and Chief Municipal Officer led to the purchase of complicated products such as Credit Linked Notes (CLN) and Collateralized Debt Obligations (CDO). These were products that the municipalities had very little to no knowledge about. Sold by Citigroup (NTB 2008), the derivatives were backed by sub-prime mortgage loans, whose value decreased heavily as soon as the financial crisis hit the U.S..

Research problem reviewed

Ever since the story first was published in 2007, there has been, to the knowledge of the authors, no scientific research centering on this topic. The investments and structure of the products offered remains a mystery to many. The confidentiality clauses of the current ongoing lawsuit between the municipalities and Citigroup further compounds the difficulties obtaining information[1]. Nevertheless, the aim of this paper is to unveil more information about the scandal and to investigate how the investments changed the riskiness of the municipalities` income stream.

As the result, the research problem is presented as the following:

1. *How did the risk profile of the eight Norwegian municipalities change when investing in financial products during 2001 – 2007*

Kredittilsynet[2] published an article about how such complex products rarely have been investigated (Haugen 2007). Understanding these products will be a key part in order to answer the research question. While there has been some general research about such products, no research has been conducted on the specific products purchased by the municipalities. This paper will attempt to determine if the purchase of the products, given the available information at the investment time and objectives of the municipalities, could be justified. It is the belief of the authors that if the municipalities had conducted independent risk analyses of these products prior to investment, the decision to invest may have been more difficult to justify.

The paper is divided into three parts. In Part I the timeline of the investments will be presented. The risk profile of the municipalities, both with and without the products, is discussed in Part II. Part III concludes the findings.

Appendix 1 and 2 provides the reader with the fundamentals of how the products work in general.

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[1] The municipalities have taken legal actions against Citigroup who they believe were issuing illegal loans in contradiction to the Municipal Act.
[2] Now Finanstilsynet

Literature review

Mortgage-backed securities have and will continue to play an important role in the capital market. The reason for this is due to the various risk benefits managers receive when they strategically allocate their investments. All the risks investors have to take into account stem from the various functions financial markets have in the global economy (Jaeger, 2008: 138). While these functions give banks and insurance companies the opportunity to move undesirable risk to other partners and companies, they also introduce opportunities for abuse. Abuse of mortgage-backed securities, such as Collateralized Debt Obligations and Credit Linked Notes, were among the main reasons for the financial crisis of 2008 (Jo, Hoje et al 2008:10).

To begin with, mortgage-backed securities were intended to help investors hedge the risk connected to corporate bonds; especially since using complex swaps does not require the investors and speculators to actually own the bonds (Adam and Guettler 2011: 2). As soon as people saw the advantage of the swaps, the market became flooded with these investments (Morgensen 2008). Such derivatives are the kind of products the municipalities in Norway purchased during the 2001-2007 period. The growing amount of new derivative products, coupled with the lack of customer service and support from the financial institutions, has left municipalities and small firms in a difficult position (Hance 2008). One of the largest reasons for failure in the financial market was due to the lack of knowledge of the derivatives and in fully comprehending the legal risks associated with the instruments (Carlin 2008: 278–287).

Eventually, the lack of information led to an increase in demand for independent third-party experts that were hired to shed light on these opaque investments. At the same time, the demand of such products led to the establishment of shadow banks (Krugman 2009). With the influx of such shadow banks, the market became flooded with mortgage-backed securities, collateralized debt obligations and credit default swaps. As soon as the market prices of these products fell, a global financial crisis was unveiled.

Describing the risks of these products in an easy way has proved to be difficult. One possible way in approximating the risks can be achieved by measuring the cash flow at risk in portfolios. Calculating the cash flow at risk depends on the ability to estimate the future change of the variables in the portfolio. According to Hull (2003), variable changes can be simulated by the use of Geometrical Brownian Motions (GBM), the mean-reverting GBM (also known as the Ornstein-Uhlenbeck process) and the mean-reverting GBM with jump diffusion.

Part I - The Timeline

In the following sections a timeline from the 1990s up till 2008 is introduced (Figure 1). Reports from KPMG (Noreng 2008), PWC (Kvamme 2008) and SF Revisjon (Sogn og Fjordane revisjon 2008) give a basic understanding of how the investments were accounted for within the municipalities.

1.1. Main resources and goals

The main goal of a municipality is to redistribute resources from the community in order to provide a steady stream of services (Lund and Co 2013). The eight investing municipalities are energy-producing municipalities and have three main income sources[3]:

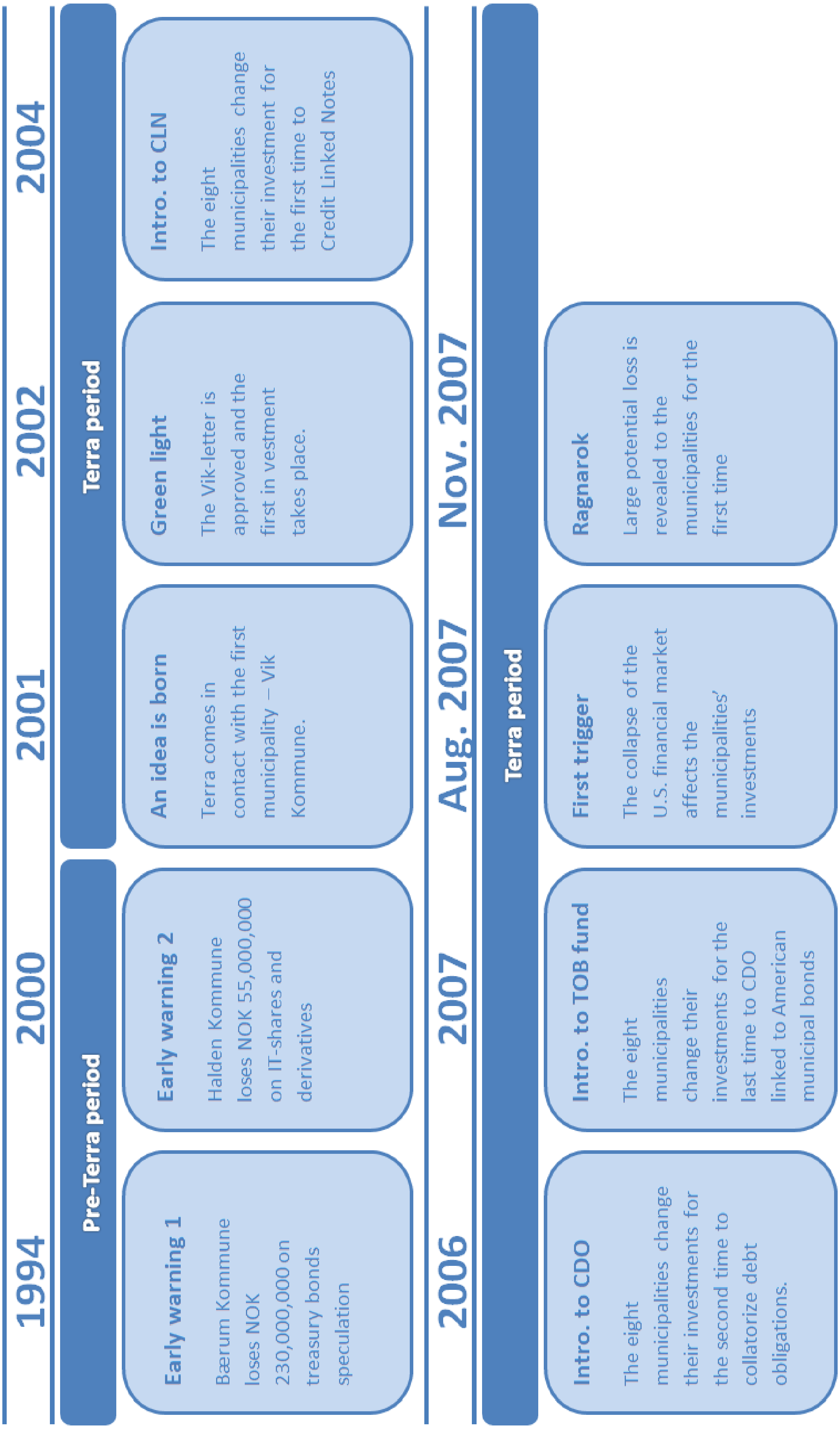
1. Concession fee (Konsesjonsavgift): An annual fee each municipality receives from the energy production plant as compensation for the utilization of its natural resource. The fee is calculated by the Norwegian Water Resources and Energy Directorate (Norges Vassedrag- og Energidirektorat) every five years. In this paper the fee is assumed to be fixed.

2. Property taxes (Eiendomsskatt): Annual taxes levied from energy producers are considered a fixed income.

3. Concession power (Konsesjonskraft): The producers are obligated to supply a certain amount of production to the municipality. The amount is determined by the production volume. Since the mid-1990's energy can be bought at production cost, which has been fixed at 0.09 kr/kWh (Sogn og Fjordane revisjon 2008). The opportunity to buy concession power can be described as an option.

[3] There are actually 4 sources, the last one being "natural-resource tax". However, this tax was not restructured by any of the municipalities.

Figure 1 - Timeline



1.2.1. Early warnings (1990 - 2001)

It is prudent to note that the investments in Terra products were not the first of their kind. There have been similar investments made by Norwegian municipalities in complex financial products earlier. For example, it was revealed in 1994 that the pension fund of Bærum Municipality had lost NOK 230 million due to speculation on Norwegian treasury bonds (Haraldsen 2007). Six years later, Halden Municipality suffered a similar speculation loss when NOK 55 million of their pension fund disappeared due to a failed investment in IT-related shares and derivative products (Meyer 2003). Reports from these two incidences showed that both municipalities violated the municipality laws pertaining to safe investments by increasing their risk exposure in an attempt to increase their expected returns on holding assets.

1.2.2. An idea is born (2001)

By law, hydro concession municipalities are allowed to buy a specific amount of concession at a low fixed price and resell it at market price. In early 2000 the market price of electricity was at an all-time low and experienced substantial volatility. As a result, the municipalities were no longer earning the kind of profits as expected.

The mayor of Vik Kommune actively searched for new opportunities and came up with an idea (Sogn og Fjordane Revisjon 2008): Why not get a fixed price deal? The fixed price would generate a certain income stream that could be reinvested in interest carrying accounts or in the financial markets to further secure their future. He consulted the municipality’s own bank, Vik Sparebank, to help him with the problem and was referred to their financial partner, Terra Securities AS.

Terra Securities AS was a securities company owned by the holding company Terra Group, who had built up a reputation in Norway as one of the leading companies in the sales of financial instruments, index options, hedge funds and other investments securities.

The proposed solution to the problem came in the form of a reversed zero coupon swap[4] (Reversed ZCS). A reversed ZCS is a swap of future income for a onetime installment between two parties. The proposal took into consideration two important factors: the interest rate in Norway during this period was at an all-time low, and Norwegian municipalities are granted access to very favorable loans. For these two reasons, Terra proposed an investment opportunity: Take up a loan from a local bank that is calculated against the net present value of the concession's future cash flow, use the future cash flow from concession to pay back the interest and installments and invest the borrowed amount in the financial market for a higher return. The idea was to invest in a diversified portfolio consisting of low risk bonds and assets. Due to the low interest rate environment and Vik Kommune's favorable borrowing rate, this would according to Terra yield an arbitrage opportunity for Vik Kommune.

1.2.3. Green light (2002)

The Norwegian Local Government Act (Kommuneloven, §50. Låneopptak) defines what products each municipality is legally allowed to invest in, and how it can be financed. According to this paragraph, municipalities can only borrow money with the sole purpose of investing in the construction of buildings, property, plant and equipment. The rationale is that the future income generated from the investment should be secure enough to cover the interest payments and installments. Borrowing in order to invest in risky investments is not granted since the expected return combined with the risk can reduce the ability of the municipality to provide basic services to the public. Notwithstanding the above, investing equity funds in financial markets is allowed at own risk.

A letter from the Ministry of Local Government and Regional development (KRD 2013), dated September 20th 2002, concerning the legality of their proposed investment plan concluded that the 10 years of future energy power revenue trading with a one-time installment from DNB NOR was not to be considered as a loan, and would therefore not fall under §50. The reasoning behind this decision was that the future income was *guaranteed* and could as such be considered as

[4] See Appendix 1, section 1.2. and 1.3.

part of the municipality's equity. The restructuring through reversed ZCS would thus be a prepayment of a future guaranteed income, and not a loan. This conclusion was based on the assumption that there was no change in the risk profile and that the municipality would familiarize itself with the increase in risk exposure.

This letter, also known as the "Vik-letter", later became the loophole each of the Terra-municipalities used to justify their investments. Vik and Terra entered a mandate agreement to restructure the ownership rights of the future energy power with the goal of increasing future profits. With the success of this investment structure, Terra became the financial advisor for Vik's investments, and subsequently for the other seven municipalities.

1.2.4. Introduction to the Credit Linked Notes and Citigroup (2004)

Approximately two years after being introduced to the first deal, Terra proposed a new deal. Since the first deal generated satisfying returns for the municipalities, they decided to raise the stakes (Hofstad 2008). This time, instead of investing in diversified portfolios, the municipalities' money would be placed in Credit Linked Notes (CLN) that were arranged by the American bank, Citigroup. A CLN is a security that includes a Credit Default Swap (CDS), basically making it a security that sells insurance in order to boost returns from underlying debt assets. The interested reader may find detailed explanations in Appendix 1, part 1.4 and 1.5.

This strategy changed the investments from being a well-diversified portfolio to a portfolio that essentially consists of one type of securities: debt.

1.2.5. Introduction to the Collateralized Debt Obligations (2006)

In 2006, Terra called some of the municipalities' financial advisers with regards to the occurrence of a credit event. The main reason for the credit event was that some of the CLN's had its credit-rating lowered. No further information was given about why the ratings had been lowered (Noreng 2008), but according to

Terra, reinvesting in a Collateralized Debt Obligations (CDO) would make it possible to reduce the amount of “badly rated securities”. CDO`s are asset-backed-securities (Dodd-Frank 2013) where the cash flow to the security owners is distributed after seniority. The process transfers credit risk from the owner(s) of the underlying asset(s) to the holder(s) of the CDO’s. A more detailed description of the process is found in Appendix 1, part 1.6.

While the risk of CLN`s are low, the risks of the CDO`s should, according to Terra, be as low or even lower (Noreng 2008). Reports later revealed that the reinvestment into the CDO’s was done without a credit rating of the new investment products (Kvamme 2008).

1.2.6. Introduction to the Collateralized Debt Obligations linked with a Tender Option Bond fund (2007)

One year later, prior to the summer in 2007, the municipalities were again contacted by Terra. This time, the municipalities were informed that Terra had found a new and exciting investment opportunity that could further improve their profit margin. By gearing their investments 8 to 10 times through a tender option bond (TOB) program in the U.S. (Citigroup 2013), the municipalities would be able to take advantage of a theoretical arbitrage opportunity within the TOB-program by issuing LIBOR bonds and going long in U.S. municipal bonds. In order for the hedge to be successful they would depend on a high positive correlation between LIBOR and U.S. municipal bonds. This is further explained in Appendix 2.

Presented in a prospectus issued by Citigroup (Citigroup 2013), the Norwegian municipalities are shown a nearly perfect correlation of 0.9689 between the municipal bonds and LIBOR. A hedging strategy between LIBOR and the municipals was in theory supposed to make it impossible to lose money (Starling 1 2007). However, a closer examination of the prospectus revealed that Citigroup had, intentionally or unintentionally, based its correlation regression on the change in basis points instead of on the percentage change of the basis points (Plaintiff Court New York 2013). As a result, the correlation is widely overestimated and the strategy of never losing money cannot hold since the hedge fails.

1.2.7. First trigger effect (August 2007)

When the financial turmoil started to unveil itself in the U.S. financial markets, the CDO`s linked to the TOB fund decreased rapidly in value. Thus, the so-called safe investments of the Norwegian municipalities started to lose money. The losses further triggered clauses allowing Citigroup to force sell the investments at the market price (not necessarily the fair price the municipalities felt they deserved), unless the municipalities agreed to supply additional equity to their investments to a level where the trigger effect is reset, much like a margin call.

1.2.8. Ragnarok (November 2007)

As the turmoil of the financial crisis increased during the fall of 2007, new margin calls became more and more frequent in order to avoid a forced sale situation. The municipalities, now facing large potential losses, had no longer the capacity and willingness to meet these requirements and refuse further payments. Terra, realizing the scope of the situation, offered to put up NOK 69 million from their own equity account in order to avoid the force sale (Hofstad 2008).

The events culminated in November when Kredittilsynet decided to revoke Terra’s license after concluding that the financial intermediate had violated the code of business conduct towards the municipalities (Andersen 2009). The following day, Terra Group declared their subsidiary Terra Securities insolvent.

In the following months, the investments of Rana, Narvik, Hemnes and Hattfjelldal municipalities were either force sold or authorized to be sold. By the end of January 2008, the above mentioned municipalities had lost a total of NOK 565 million out of a NOK 726 million investment. The remaining four municipalities, Bremanger, Haugesund, Kvinesdal and Vik, had lost NOK 243 million out of their NOK 774 million investment. The overall loss for municipalities summed up to NOK 808 million on the NOK 1,500 million investments, or 53.39%. A summary of the investments is given in Table 1, while an in-depth description of the investments is provided in Appendix 3.

	Brem-anger	**Hatt-fjelldal**	*** **Hauge-sund**	**Hemnes**	**Kvines-dal**	**Narvik**	**Rana**	**Vik**
Restructure fee		**61.57** (2004)			**43.60** (2003)	**52.50** (2004)	**84.50** (2004)	
Restructure concession	**295.60** (2001)	**42.00** (2005)		**89.00** (2005)			**224.00** (2002)	**149.00** (2005)
Restructure tax	**54.40** (2005)					**190.00** (2005)		
Invested in low risk stocks	**54.40** (2005)				**10.00** (2003)		**224.00** (2002)	**51.13** (2007)
Invested in CLN	**295.60** (2001)	**103.57** (2004) & 2005)	**231.00** (2004)	**89.00** (2005)	**33.60** (2003)	**242.50** (2004)& (2005)	**308.50** (2004) & (2005)	**149.00** (2005)
Invested in CDO	**96.80** (2007)	**103.57** (2006)	**227.00** (2006)	**89.00** (2006)	**33.60** (2005)	**242.50** (2006)	**308.50** (2006)	**149.00** (2006)
Invested in CDO TOB	**170.00** (2007)	**103.57** (2007)		**89.00** (2007)	**43.60** (2007)	**242.50** (2007)	**** **213.00** (2007)	***** **38.50** (2007)
*Total invested (Including all costs)	** **350.00**	**103.00**	**231.00**	**89.00**	**43.60**	**242.50**	**308.50**	**149.00**
Total loss (2007)	**53.70**	**85.00**	**130.00**	**69.40**	**14.00**	**188.30**	**222.50**	**45.00**
Total loss % (2007)	**15.34 %**	**82.52 %**	**56.28 %**	**77.80 %**	**32.11 %**	**77.65 %**	**72.21 %**	**30.20 %**

Table 1 * All costs: Transaction cost, provision to Terra etc.

** NOK 35.2 still in BMA Kragerø, remaining NOK 48 (350-170-96.8-35.2) in Hjartdal og Gransherad Sparebank

*** Haugesund owned the hydropower. They used their annually dividend as capital and did not restructered as the seven other municipalities.

**** Remaining NOK 95.5 (308.5-213.00) still in CDO

***** Remaining NOK 59.37 (149.00-38.50-51.13) still in CDO

Part II - The decision to invest

The financial rationale behind the decision to invest is examined in this part. Reports from Sogn og Fjordane Revisjon (2008) and Albrethson (2008) show that the riskiness of the products increased with the introduction of each new investment. However, the reports show no risk comparison analysis between pre- and post-investing. An interesting question is thus to consider whether the change in risk was favorable as a result of investing. If support can be found for a risk increase by the introduction of the first credit linked note, it can be concluded that the risk increases for all sub-sequent investments as well.

Further, the reports and product prospects (Cloverie 2005, Libretto 1 2006, Libretto 2 2006, Starling 1 2007 and Starling 2 2007) show that the municipalities invested in products with similar terms and expected returns. Through these similarities it may be assumed that the results found for one municipality can be representative for the remaining seven.

Using the municipality of Hattfjelldal as an example, section 2.1. shows a timeline leading up to the first Credit Linked Note investment, section 2.2. presents a detailed description of the CLN and section 2.3. examines the change in risk by investing.

2.1 The timeline of Hattfjelldal Kommune

Hattfjelldal Kommune began its search for the possibility to restructure its concession fee and power in the late 2001 (Albrethson 2008). In 2002, Terra provided a 10 year swap-agreement with DNB NOR ASA to restructure the concession power. The swap-agreement was comprised of the following terms:

1. DNB NOR ASA agreeing to pay Hattfjelldal a onetime installment of 42 million NOK. The value of this transaction is known as the notional value.

2. Hattfjelldal agreeing to pay DNB NOR ASA quarterly cash flows of

a) Fixed amount equal to pre-agreed installments approximating quarterly expected income from the concession power.

b) Floating rate equal to NIBOR, plus 21 basis points compounded annually paid on the notional value (Haugesund 2013).

On June 30th 2004, the municipality decided to boost its return for the next 10 years by restructuring its revenue from concession fee as well (Albrethson 2008), as Terra had estimated that an additional annual income of NOK 574,000 could be obtained. Albrethson (2008) shows that the municipality in 2004 had invested NOK 61.6 million in Credit Linked Notes (Cloverie PLC 2005-61) [5] and NOK 42 million in safe bank loans bonds and obligations.

One year later, the residual NOK 42 million were also re-invested in Credit Linked Notes in order to increase the total returns. The total amount invested in the Credit Linked Notes on the 14th June 2005 amounted to NOK 103.6 million [6].

2.2 Credit Linked Notes – Cloverie PLC 2005-61

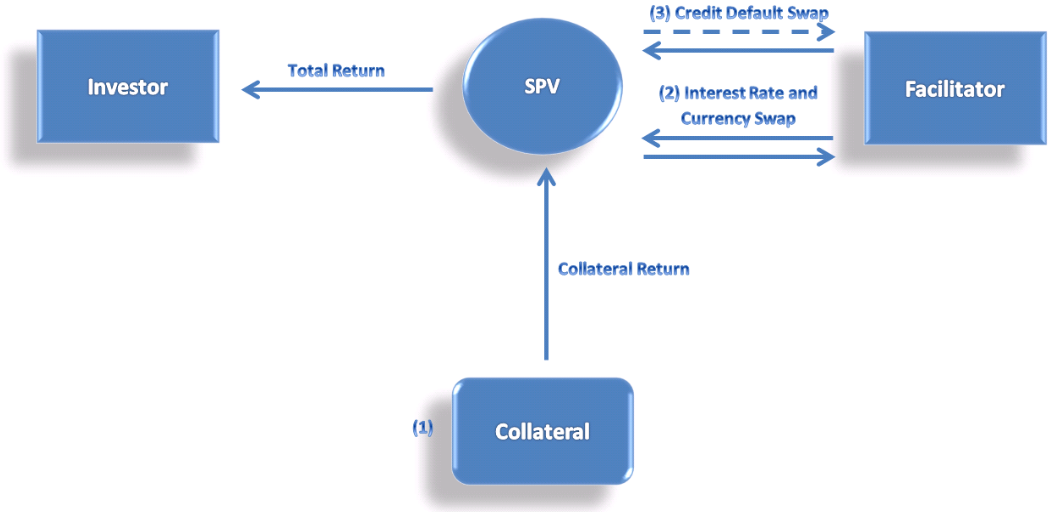
The Credit Linked Notes (Cloverie 2005) were issued by a Special Purpose Vehicle (SPV) owned by Citigroup. A SPV has the main purpose of being legally independent of the parent company[7].

The CLN has three main components:

1. The underlying assets (collateral)
2. An Interest Rate and Currency Swap Agreement
3. A Credit Default Swap

[5] ISIN number: XS022302035
[6] In reality Hattfjelldal had invested NOK 61.6 million in CLN Cloverie 2004-75 and NOK 42 million in CLN Cloverie 2005-61. Due to the problem of publicity, the prospect of Cloverie 2004-75 could not be obtained. For the simplicity of this paper it is assumed that they are the same, based on the similarities between them.

Figure 2 – Basic Credit Linked Note structure

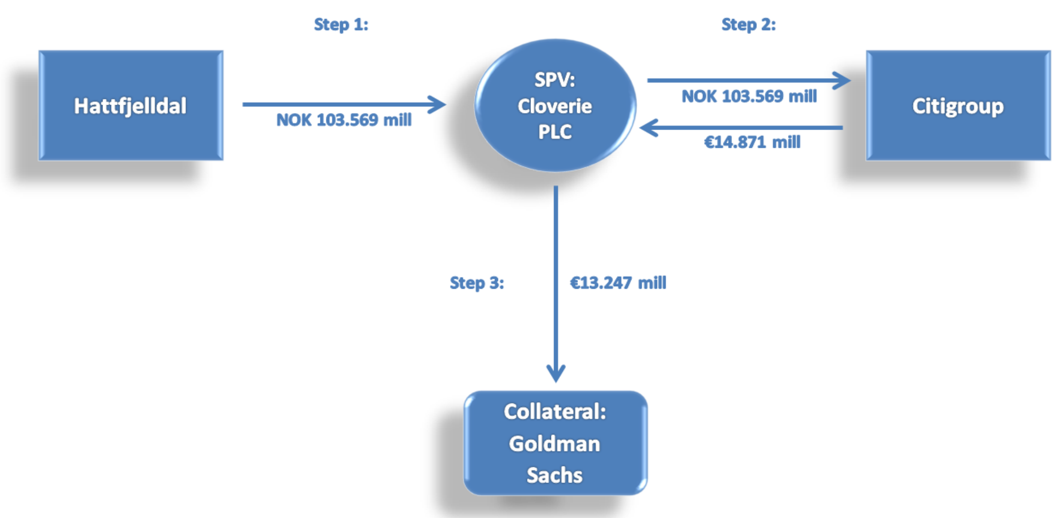


The collateral is the return yielding asset and consists of a Goldman Sachs debt portfolio[8]. This debt portfolio contains CDO`s, however the collateral is only linked to senior secured debt. The Interest Rate and Currency Swap Agreement has the main purpose of exchanging the return from the collateral from EUR to NOK and to exchange interest rates. The Credit Default Swap boosts the return by allowing the investor to sell protection against credit events to the facilitator.

2.2.1. The initial exchange

Figure 3 shows the initial cash flows when the investment was made. The CLN pays interest to the municipality on a quarterly basis, starting September 20th, while the collateral pays an annual interest starting April 24th the following year.

Figure 3 – Initial payment



[7] See Appendix 1, part 1.1
[8] ISIN number: XS0167154680

Step 1: Hattfjelldal transfers NOK 103.6 million to the SPV Cloverie PLC.

Step 2: In order to invest in the collateral, the Norwegian Kroner needs to be exchanged into Euros. This is where the Interest Rate and Currency Swap Agreement becomes important. Under the agreement, the SPV exchanges the initial payment equal to NOK 103.569 million with Citigroup, and in return receives a sum equal to EUR 14.871 million.

This transaction warrants further explanation. The agreement states an exchange rate of 7.81 NOK/EUR. At this rate, the amount transferred from the SPV to Citigroup equals EUR 13.247 million (notional value). However, the amount transferred from Citigroup to the SPV equals EUR 14.871 million. It is the assumption of the authors that the reason for why these amounts differ can be explained by the different payment dates of the CLN and the collateral. While the CLN promises to pay interest rate quarterly, starting September 20th 2005, the underlying asset only pays annually starting on the 24th of April 2006.

Because of this, the SPV will not be able to make its first 3 interest payments to Hattfjelldal unless it somehow is allowed credit to do so. This initial credit is granted via the swap agreement and equals the difference between the amount paid and the amount received – EUR 1.624 million.

Step 3: The amount of EUR 13.247 million is invested in the collateral, leaving EUR 1.624 million for the first 3 interest payment dates.

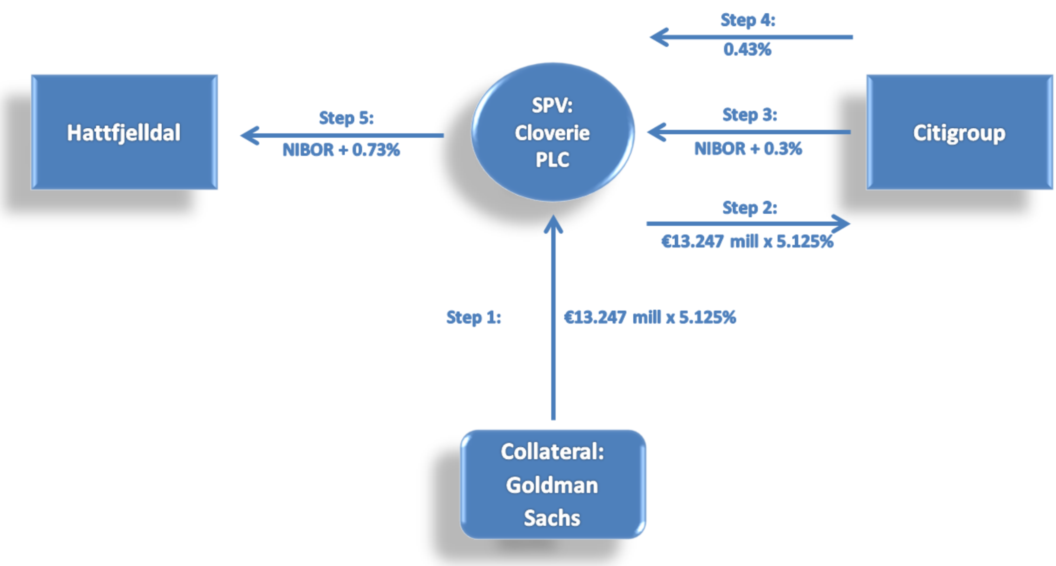
2.2.2. Cash flow to Hattfjelldal

Figure 4 presents the cash flow due to Hattfjelldal on each payment date.

Step 1: The collateral pays an annual interest equal to 5.125% on the notional value to the SPV.

Step 2: The SPV transfers the return from the collateral to Citigroup in order to exchange the return from Euro to Norwegian Kroner and repay its credit debt.

Figure 4 – Cash Flow



Step 3: The quarterly cash flow from Citigroup to the SPV equals the annual 3-month NIBOR plus an annual spread of 0.3% paid on the notional value in Norwegian Kroner.

The assumption of initial credit granted by Citigroup is repaid by the expectation that the annual 3-month NIBOR plus the annual spread will be lower than the 5.125% annual return generated by the collateral.

Step 4: In order to boost its returns, Hattfjelldal through the CLN, sells protection against credit events (such as defaults) to Citigroup. The agreement yields an additional return from Citigroup of 0.43% per annum paid on the notional value. In return, Hattfjelldal has to reimburse Citigroup for any losses on the collateral if a credit event occurs.

Step 5: The quarterly cash flow Hattfjelldal receives from the CLN investment equals the annual 3-month NIBOR plus an annual spread of 0.73%.

Summing up, it is noted that the general payments to Hattfjelldal depend on the 3-month NIBOR, the NOK/EUR exchange rate and the probability of default in the underlying assets.

A summary is given in Table 2.

To Citigroup	To Hattfjelldal	Rate per annum	Currency	Based on
Fixed rate from underlying		5.125%	Euro	Notional value
Possible payment in case of credit event			Euro	Reduction of notional value
	Variable rate from Citigroup	NIBOR + 0.3%	Norwegian Kroner	Notional value
	Fixed rate from Citigroup (CDS)	0.43%	Norwegian Kroner	Notional value

Initial notional value invested	NOK 103,569,000
Amount insured by CDS	NOK 103,569,000

Table 2

2.3. Risk Profile

This section compares the risks between the investing and non-investing decision by estimating the future cash flows based on the information available at the time of decision. As the main goal of the municipality is to provide a steady stream of services to the public, low risk investments are preferred. Since the important factor for the municipality is the level of risk (Sogn og Fjordane Revisjon 2008), the change in riskiness should be investigated. Faced with the uncertainties of changes in interest rates, exchange rates and spot prices of electricity, it will be attempted to estimate the risks facing Hattfjelldal by simulating changes in these variables. According to Linsmeier (1999), the measurement of Cash Flow at Risk should be used instead of Value at Risk when focusing on hypothetical cash flow changes instead of hypothetical changes in mark-to-market portfolio values. Linsmeier also states that Value at Risk is normally calculated to give an estimation for the next *t days*, while CAR is used for *t quarters* or *t years*. Further, CAR simplifies the ability to coincide cash flows from different sources to the same time period. As a result, CAR is used in order to describing the risk evolution.

2.3.1. The portfolios

The alternatives of the municipality can be divided into two portfolios:

Portfolio 1: Investment in CLN

Portfolio 2: No investment in CLN

The first portfolio contains the risks of restructuring and investing in the Credit Linked Notes, while the second portfolio contains the risks if restructuring is not performed. The interesting question is whether Portfolio 1 is less, equally or more risky than Portfolio 2.

The non-investing profit comes from both the concession power, sold at the spot price, and the concession fees. As the concession fee is assumed to be fixed, the only risks to be considered in Portfolio 2 are the changes in spot price and the risk of production plants defaulting. Portfolio 1, however, includes the risks from changes in spot price (by cause of the restructuring), the 3-month NIBOR, the exchange rate as well as the risks of default in both the electricity market and the underlying assets.

With regard to the possibility of default, a discussion is needed. As mentioned, both Portfolio 1 and Portfolio 2 are exposed to the risk of default. The Norwegian Water Resources and Energy Directorate (NVE 2013) discusses this exposure and concludes that the risk of production plants defaulting is very low. For this reason, the risk of default in the electricity market will be ignored.

Further, due to the underlying assets in Portfolio 1, the risk of defaulting will be higher and the ability to measure the risk of default in the underlying assets proves to be difficult because of their complex nature. In order to overcome this problem, the risks in Portfolio 1 will be estimated without the risk of default in the underlying assets. The rationale is that if it can be concluded that Portfolio 1 is more risky than Portfolio 2 without the risk of default, it has to hold that Portfolio 1 is more risky than Portfolio 2 with the risk of default as well.

As a result, the following research question is derived:

Research Question 1:
"Portfolio 1 is considered to be more risky than Portfolio 2"

The risk exposures of the two portfolios are summarized in Table 3. Noticing that the spot price of electricity is present in both portfolios, it can be tempting to assume that the spot price of electricity cancel each other out. But, this is only true when the other variables are uncorrelated with each other. Obviously, this is a very strong assumption that cannot be assumed.

Portfolio 1 – Credit Linked Notes	**Portfolio 2 - No investment**
- Spot price of electricity - 3-month NIBOR - Exchange rate NOK/EUR	- Spot price of electricity

Table 3

2.3.2. Market development

This section explains how the markets have behaved in previous years. It further illustrates what *can* happen in the future and which models are *best* fit to describe the evolution. The following subsections cover the market development of electricity, NIBOR and the exchange rate between NOK and EUR.

2.3.2.1. Spot price of electricity

During the 11 years prior to 2003, the daily spot price has been extremely volatile. Shown in Figure 5, the highest spot price during that period was approximately 0.80 NOK/kWh (2002) while the lowest spot price traded close to 0.01 NOK (1992).

A closer look at the figure shows tendencies of seasonal effects, which can be explained by an increased need for electricity during the winter.

Figure 5 – Daily spot

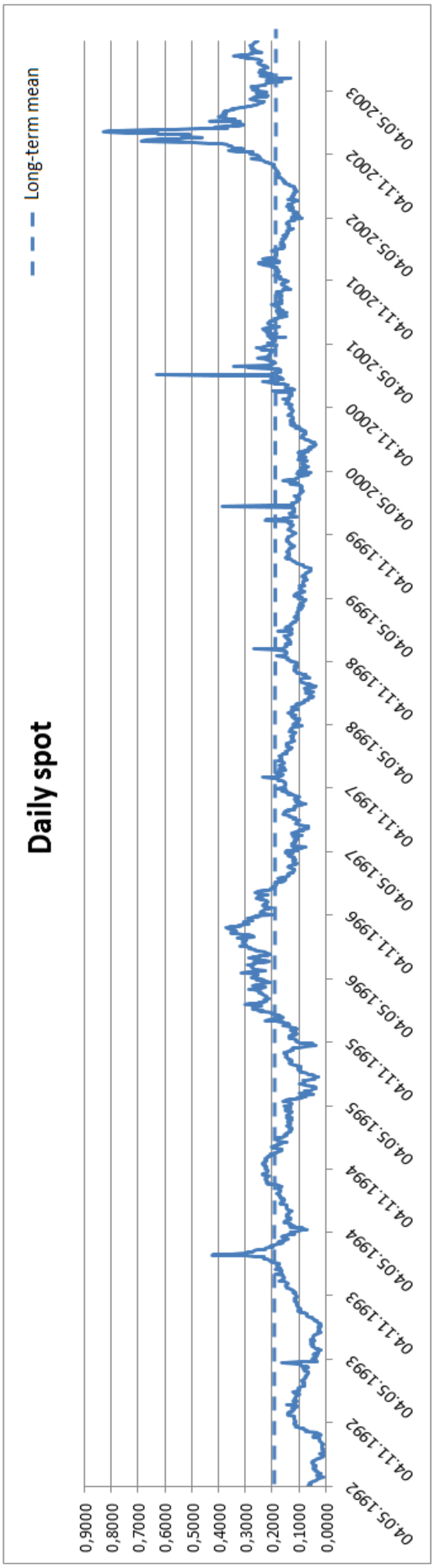
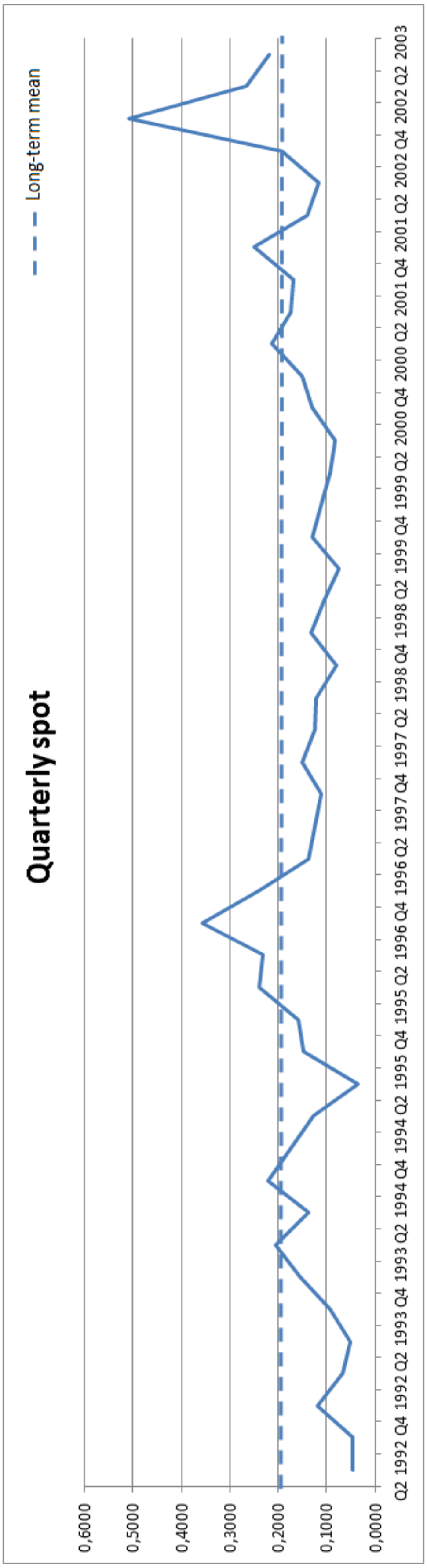


Figure 6 – Quarterly spot



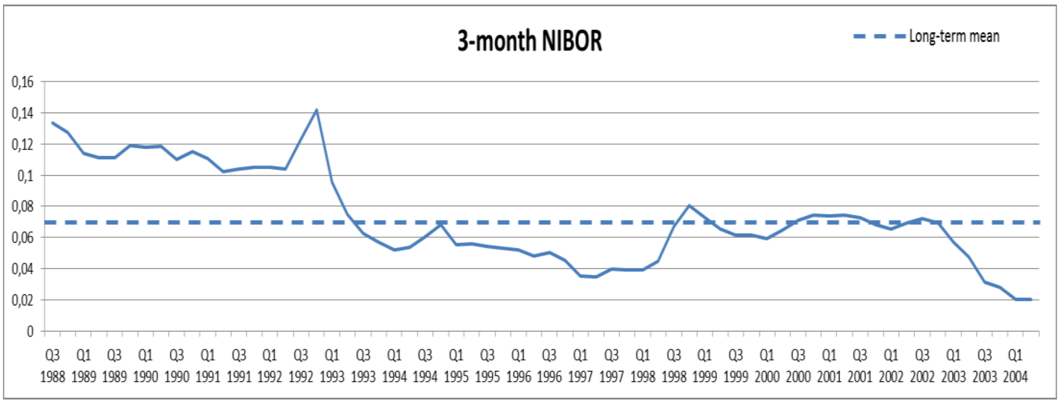
The prices tend to increase towards the end of the year, before decreasing towards the middle of the year. When prices move away from the mean, they tend to be pulled back towards the opposite direction. This is known as the mean-reverting effect (Cartea 2001). The long-term mean for these historical numbers lies just below 0.20 NOK/kWh.

In addition to mean reversion, extreme price increases can be noticed for short periods of time. Just as fast as they happen, they tend to return towards the mean. These extreme price in- and decreases are called *price spikes* and may be explained by events such as heat waves, plant outages, natural catastrophes or governmental constraints. Research conducted by Huisman and Mahieu (2003), Byström, (2005), Bourbonnais and Meritet, (2006), and Guthrie and Videbeck (2007) further validate the price spikes. Using quarterly prices instead, Figure 6 shows that the mean-reverting effect and the long-term mean of 0.20 NOK/kWh still can be observed. However, the spikes are no longer observable to such an extreme degree. This can be explained by the large speed of adjustment the price spikes often have.

2.3.2.2. The 3-month NIBOR

The 3-month NIBOR is shown in Figure 7. It shows that the interest rate does not experience the same mean reversion as the spot price of electricity. Displaying a downward trend, the 3-month rate is relatively low compared to its historical mean of approximately 7%. The figure further shows no short-term spikes as was seen with the price of electricity, implying no unanticipated events.

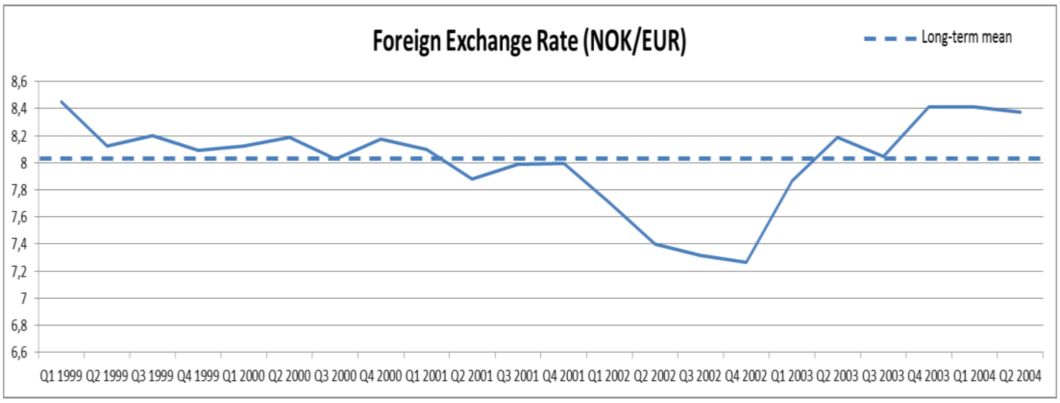
Figure 7 – 3-month NIBOR



2.3.2.3. Foreign exchange (NOK/EUR)

Figure 8 shows the development of the NOK/EUR exchange rate since the introduction of the Euro. Observed in the figure, the exchange rate seems to revert back to its long run mean of 8 NOK/EUR and displays low fluctuations and no spikes. However, the short trading period of the currency has to be taken into consideration. It is farfetched to assume that the development of the currency will stay the same during the next 10, 20 or 30 years into the future.

Figure 8 – Foreign exchange



2.3.3. The models

Simulating future price paths depends on the models being able to describe price behavior. An economic assumption is that stock prices today are determined by the last closing price plus some random walk. The same is assumed for all traded assets, such as interest rates, exchange rates and commodity prices. This assumption is an underlying factor for the models presented in the following sections.

2.3.3.1. The Geometrical Brownian Motion Model (GBM)

The Brownian Motion, or wiener process, is known as a stochastic continuous time process (Rigobon 2009) that makes it possible to simulate a particular random price movement tomorrow based on today's closing price. The model has no *memory*, and assumes constant mean and volatility. Having no *memory* means that each simulated price movement is independent of the prior simulated price movements.

The Brownian Drift model is given by:

Price Change Process = Drift effect (Non-random) + Volatility effect (Random)

where the Drift effect equals the last day closing price, and the Volatility effect is a random walk, also known as wiener process.

However, the Brownian Motion introduces a problem because of its ability to simulate positive as well as negative changes of more than 100 percent over time. A negative return of more than 100 percent would imply negative prices. Such developments are impossible for commodities and foreign exchange rates, and are highly unlikely for interest rates. For this reason modification to the model is needed.

A modified version of the Brownian Motion Model is the Geometric Brownian Motion Model (Vose 2013). Compared to the Brownian Motion Model, the Geometrical Brownian Motion Model (GBM) is based on returns instead of prices. The introduction of returns allows the model to mathematically be derived on the basis of logarithmic returns, which, over short time intervals, will approximate the actual return.

Following Vose (2013), the Geometric Brownian Motion Model is derived the following way:

$$S_{t+1} = S_t + Normal(\mu, \sigma) \quad [1]$$

where S_{t+1} is the stock price the next day, S_t is the stock price today and the variables change with one unit of time by an amount that is normal distributed with mean μ and variance σ^2.

$$S_{t+2} = S_{t+1} + Normal(\mu, \sigma)$$

$$S_{t+2} = [S_{t+} + Normal(\mu, \sigma)] + Normal(\mu, \sigma)$$

$$S_{t+2} = S_t + Normal\,(2\mu, \sqrt{2\sigma}) \quad [2]$$

Generalizing equation [2] over time T for continuous time form gives:

$$\delta S = Normal(\mu\delta t, \sigma\sqrt{\delta t}) \qquad [3]$$

$$S_{t+T} = S_t + Normal(\mu T, \sigma\sqrt{T}) \qquad [4]$$

The Stochastic Differential Equation (SDE) is given by:

$$\delta S = \mu\delta t + \sigma\delta z \qquad [5]$$

where $\delta z = \varepsilon_t\sqrt{\delta t}$ is called the generalized Wiener Process and ε is Normal(0,1). Modeling equation [5] over returns yields:

$$\frac{\delta S_{t+T}}{S_t} = \mu\delta t + \sigma\delta z \qquad [6]$$

or

$$\delta S_{t+T} = \mu S_t\delta t + \sigma S_t\delta z \qquad [7]$$

Using Itô's Lemma:

$$\delta F = \frac{\delta F}{\delta X}\delta X + \frac{1}{2}\frac{\delta^2 F}{\delta X^2}\delta t \qquad [8]$$

it is possible to integrate over time T in order to find the relationship between S_t and S_{t+T}.

The result is the exponential GBM shown in equation [9]:

$$S_{t+T} = S_t * e^{\left[(\mu - \frac{\sigma^2}{2}\delta t + \sigma\varepsilon_{t+T}\sqrt{\delta t}\right]} \qquad [9]$$

where

$$S_{t+T} = price\ at\ time\ t+T$$
$$S_t = price\ at\ time\ t$$
$$\mu = expected\ continuously\ compunded\ return$$
$$\sigma = annualized\ standard\ deviation\ of\ returns$$
$$\delta t = time\ step\ in\ years$$
$$\varepsilon_{t+T} = random\ shock\ in\ time\ t+T\ which\ is\ N(0,1)$$

The exponential term in equation [9] means that S > 0, avoiding the problem of negative prices (or rates) (Vose 2013). However, one important limitation must be considered: When increasing the number of simulated steps towards infinity, the paths will increase or decrease exponentially - resulting in drifting returns.

2.3.3.2. The Geometrical Brownian Motion Mean Reverting Model (Ornstein-Uhlenbeck)

The problem of exponential drift can be accounted for by introducing a new term to the GBM model, which forces the drift to return to a mean level. A model that includes such a mean reverting component is the Geometrical Brownian Motion Mean Reverting Model, or more popularly known as the Ornstein-Uhlenbeck process. Contrary to the GBM model, the adding of a mean reverting component no longer allows the paths to be changed completely independent (Blanco 2001).

Starting at [5] $\delta S = \mu\delta t + \sigma\delta z$

the mean reverting model is modified as follows:

[10] $$\delta S_{t+T} = \alpha(\lambda - S_t)\delta t + \sigma\delta z$$

where $\alpha > 0$. Modeling in terms of returns, r_t, gives:

[11] $$\delta r_{t+T} = \alpha(\lambda - r_t)\delta t + \sigma\delta z$$

Equation [11] is known as the Ornstein-Uhlenbeck process. Integrating equation [11] gives:

[12] $$r_{t+T} = r_t * e^{-\alpha\delta t} + \lambda(1 - e^{-\alpha\delta t})\varepsilon_t\sigma\sqrt{\frac{1-e^{-2\alpha\delta t}}{2\alpha}}$$

where

$$r_{t+T} = return\ at\ time\ t + T$$
$$r_t = return\ at\ time\ t$$
$$\alpha = speed\ of\ adjustment\ given\ in\ absolute\ terms$$
$$\lambda = long\ run\ mean$$

The mean reversion component in equation [12] consists of the speed of adjustment, α, and the long run mean level λ. If the value at time t is below the long run mean level, the mean reversion component will be positive and have a positive effect on the value in time t + T. Contrary, if the value at time t is above the long run mean level, the mean reversion will have a negative effect on value at time t + T. As a result, this component will in the long run make sure that the future simulated paths will not drift too far away from the long run mean. Problems do however arise when trying to estimate and justify a *correct* long run mean. The model also falsely assumes a constant mean reversion rate, which in reality is never constant.

2.3.3.3. Explanatory power of the models:

Estimating price (or rate) movements depends on being able to predict future volatilities. They can either be estimated from historical data or by using implied volatilities - which will function as a markets best guess. Regardless of the choice, biases such as over- and under-estimation of the true volatility will occur. Another problem with the explanatory power of the models is contributed by the assumption of constant volatility and mean reversion rate. Obviously, this cannot be a realistic assumption. Further, if the standard deviation is very high, the drift will dominate the price (or rate) evolution sample and create a large band between the maximum and minimum value. A last problem to mention is that the models assume no correlation between all simulated variables. This is a not realistic, as interest rates and exchange rates are assumed to be correlated.

In the following sub-sections the models fit to the variables is discussed. Table 4 provides a summary of the model choice.

Simulate	**Model to use**
Spot price of electricity	Ornstein-Uhlenbeck process
Interest rate	Geometric Brownian Motion
Exchange rate	Ornstein-Uhlenbeck process

Table 4

2.3.3.3.1. Electricity spot prices:

Previous research points to several problems and pitfalls when using the GBM to simulate spot prices for the electricity market. Blanco (2001) shows that the spot price of electricity does not follow lognormal distributions, thus modifications to the model is required.

Considering the mean reversion and price spikes observed in Figure 5 (section 2.3.2.1.), a mean reverting model including the ability to simulate jumps could be used. However, such a model has better explanatory power when the time interval is short as with daily or hourly prices. Since the payment dates of the CLN are quarterly, prices will be simulated on a quarterly basis and a model including jumps will over-estimate the prices. For this reason the Ornstein-Uhlenbeck process should be a better approach to explain the price evolution.

2.3.3.3.2. Interest rates:

Hull (2003) suggests using the Ornstein-Uhlenbeck model in order to simulate interest rates. According to Hull, this model is usually used to simulate short-term interest rates. Since the investment period is ten years, a simulation of the interest rate for the next ten years is required. As the short-term model is based on short term historical values, a simulation based on historically low interest rates will underestimate the long term mean assuming the rates converge to previous levels. Bearing in mind the low rate levels, it can be assumed that they will increase over the next decade. One way of estimating the interest rate is to use a higher long-term mean reversion level. However, guessing the *correct* long-term rate may prove to be difficult. A solution to this problem can be to run simulations using the GBM in order to have drifting long-term rates. For this reason the GBM model should give a more realistic representation of the interest rate level in the long-term as the model does not assume a fixed, random long-term level.

2.3.3.3.3. Exchange rates:

As mentioned in section 2.3.1.3., the Euro has been traded for a short time period. This makes it difficult to estimate the future evolution of the exchange rate based on past data. Nevertheless, according to the Purchasing Power Parity theory (PPP), foreign exchange rate should be mean reverting. Spikes and drifts, if any, are small and revert to their mean over time. Taylor et. all (2001) supports this view. Based on the theory of PPP, the foreign exchange rate is assumed to follow a mean reverting motion.

2.3.4. The data

The data has been found through Thompson Reuters Datastream and collected by requesting contracts and documents from the eight municipalities, banks, *Fylkesmannen* and accounting firms. Table 5 summarizes the information previously discussed.

	Amount/Annual Rate
Net present value of concession power	NOK 61.569 million
Net present value of concession fee	NOK 42 million
Expected profit of fee	NOK 574,000
Bank loan	NIBOR + 21 basis points
Production cost	90 NOK/MWh
Interest Rate and Currency Swap	NIBOR + 43 basis points
Credit Default Swap	30 basis points

Table 5

In order to estimate the future cash flows, additional data about the expected profits from the two portfolios is required and covered in the following three sub-sections.

2.3.4.1. Concession power and fee

Section 2.2.1 explains that the CLN pays interest every quarter. The option to sell concession power is exercised on daily basis while the concession fee is received once every year. In order to have consistent cash flows, both concession fee and power are assumed to be paid quarterly as the CLN.

The annual cash flow from concession fee is found in Albrethson (2008) and equals NOK 7 million, or NOK 1.75 million per quarter. The amount of concession power received is not mentioned by any reports. Nevertheless, knowing that the net present value from the concession fee equals NOK 61.569 million, calculations[9] show an annual discount rate of 0.6414%. Using this discount rate, the quarterly income from concession power is NOK 1.194 million based on the net present value of the concession power (NOK 42 million).

Further, the amount of concession power is needed to estimate the cash flows based on spot price changes. Dividing the quarterly income of NOK 1.194 million by the production cost of 90 NOK/MWh yields a quarterly amount of 13,264.256 MWh.

2.3.4.2. The restructure agreement with DNB NOR

None of the documents collected mention the specifics of the restructuring agreement with DNB NOR. Nevertheless, Haugesund (2013) shows the restructuring agreement Haugesund Munipality had with its bank. Because of the similarity between the investments, and the benefits the municipalities have in the credit market, it is assumed that the same conditions apply for Hattfjelldal[10].

2.3.4.3. Expected cash flows of the portfolios

The expected profits from concession power and fee are based on information in Albrethson (2008). Found in Table 5, the expected additional annual profit from investing the concession fee is estimated to NOK 574,000. Dividing by the total amount invested (NOK 61.569 million) yields a rate of return of 0.932%. As the concession fee and power are invested in the same product, the expected additional return from the concession power also equals 0.932%, or NOK 391,560[11].

[9] See *Hattfjelldal concession fee and power discount.xlsx*
[10] See *CF calculations.xlsx* – worksheet "CF Bank loan"
[11] NOK 42 million x 0.00932 = NOK 391,560

Transforming NOK 574,000 and NOK 391,560 into quarterly values, the expected profits of Portfolio 1 and 2 add up to NOK 3,185,173[12] and NOK 2,943,783[13], respectively.

2.3.5. Methodology

The methodology is based on the similar approach used by Financial Engineering Associates (Blanco 2001). The future cash flows in the portfolios will be estimated by simulation. The risk levels between them will then be compared by the measure of Cash Flow at Risk (CAR).

The Ornstein-Uhlenbeck process will be used to simulate price paths for the electricity spot and exchange rates. The model is given by (from equation [12]):

$$r_{t+T} = r_t * e^{-\alpha\delta t} + \lambda(1 - e^{-\alpha\delta t})\varepsilon_t\sigma\sqrt{\frac{1 - e^{-2\alpha\delta t}}{2\alpha}}$$

where λ is the long run mean and α the speed of adjustment in absolute terms. The speed of adjustment can be estimated by regressing the absolute price change on the (lagged by 1) price levels. Dividing the intercept by the slope yields the long run mean, and dividing the standard error by the long run mean results in the volatility (Blanco 2001).

Simulations of the interest rates follow the exponential Geometric Brownian Motion Model (from equation [9]):

$$S_{t+T} = S_t * e^{\left[(\mu - \frac{\sigma^2}{2}\delta t + \sigma\varepsilon_{t+T}\sqrt{\delta t}\right]}$$

where μ is the expected continuously compounded return, σ is the annualized standard deviation of returns, δt is the time step in years and ε_{t+T} is a N(0,1) random shock in time t + T. μ and σ are estimated on the historical values.

Using Monte Carlo simulation, the quarterly price (or rate) paths for the next 10 years are simulated 10,000 times. These price or rate paths are used to create

[12] NOK 1,750,000 (concession fee) + NOK 1,193,783 (concession power) + NOK 143,500 + NOK 97,890 = NOK 3,185,173
[13] NOK 1,750,000 (concession fee) + NOK 1,193,783 (concession power) = NOK 2,943,783

10,000 scenarios for the cash flow received from the two portfolios.

The CAR is calculated at the one percent level by subtracting the simulated cash flow from the expected profit at each point in time. Next, it is compared between the two portfolios.

As a final step it is investigated whether the same conclusions can be drawn when modeling without the installments due to DNB NOR ASA through the swap-agreement. This is done in order test whether the fixed installments that Hattfjelldal has to repay significantly impact the CAR in Portfolio 1.

2.3.6. Results

Table 6 shows the parameters μ, σ, α and λ for all calculations

	Spot Price	**3-month NIBOR**	**Foreign Exchange**
μ		-0.0623	
σ	0.3948	0.2216	0.0278
α	1.0330		0.2325
λ	0.2775		0.1254

Table 6

The first 20 simulations for the spot price, interest rate and foreign exchange rate can be seen in Figure 9-11[14]. A summary of the 40 quarters CAR and standard deviation of the CAR for both Portfolio 1 and 2 are given in the tables 7 - 10[15].

If the difference between the expected profit and simulated cash flow is positive, a loss is incurred. The reverse holds for a negative cash flow. Graphically, a cumulative distributed representation will show losses on the right side and gains on the left side. The standard deviation of the CAR shows the variation of the simulated cash flow at risk, and a higher the standard deviation is associated with higher risk of the CAR.

[14] See Simulations.xlsx

Figure 9 – 20 El-price simulations

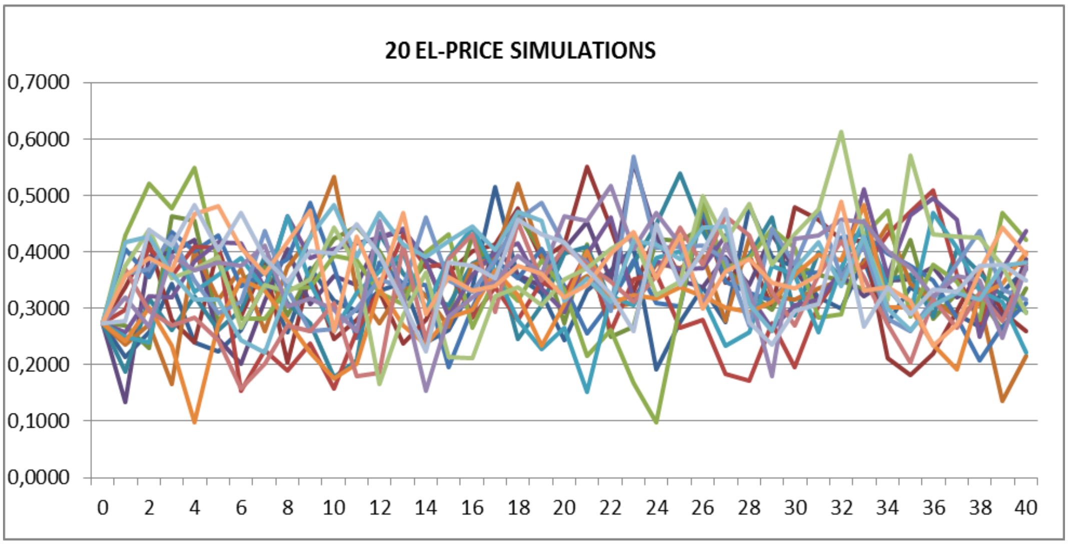


Figure 10 – 20 NIBOR simulations

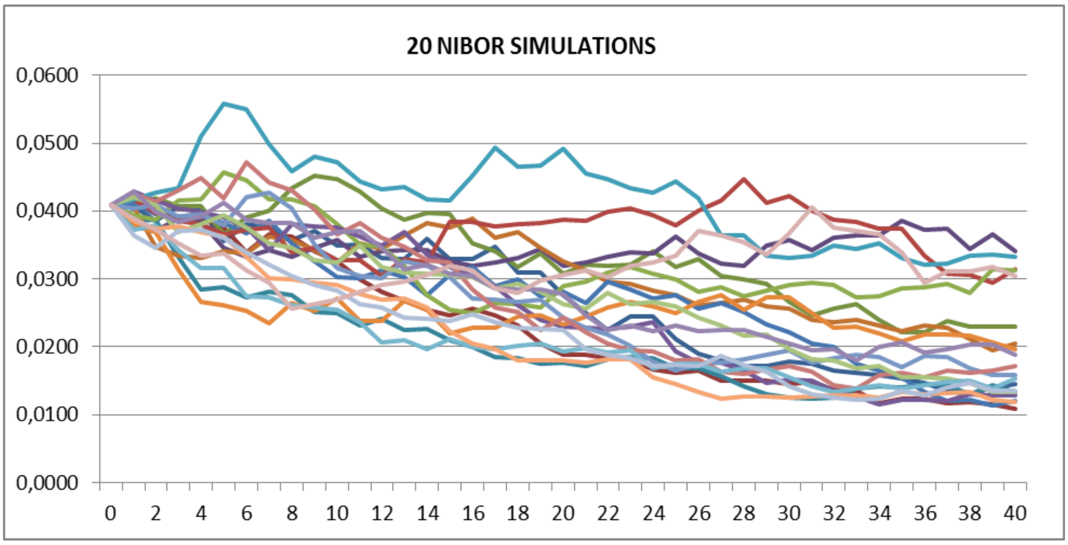
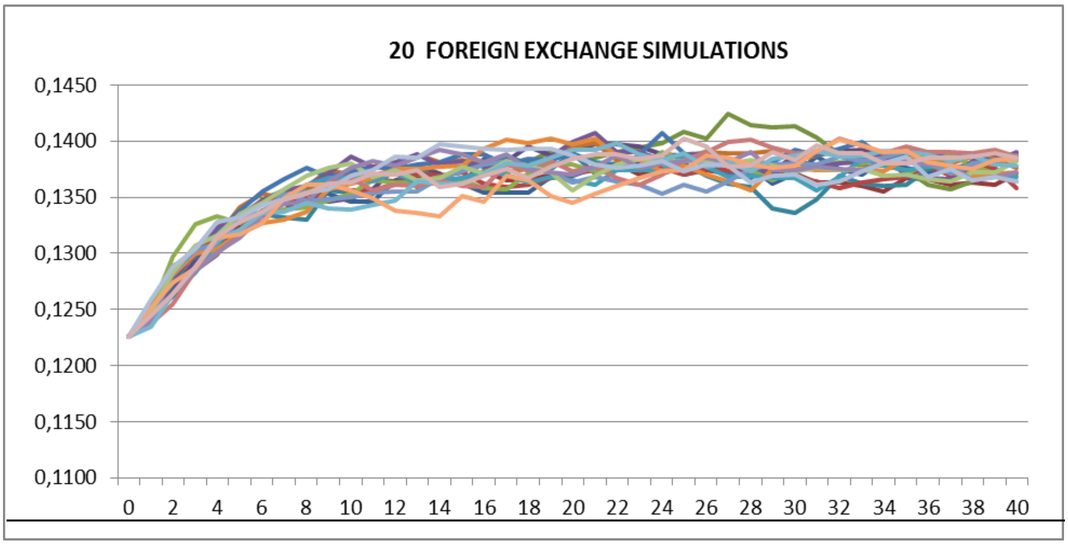


Figure 11 – 20 Foreign exchange simulations



[15] See CAR Q1-Q40 (values+graphs).xlxs

CAR			
Quarter	Portfolio 1	Portfolio 2	Difference
Q1	1 250 032	199 974	1 050 058
Q2	1 178 220	128 531	1 049 689
Q3	1 262 444	149 817	1 112 627
Q4	1 235 042	141 672	1 093 370
Q5	1 255 949	213 281	1 042 667
Q6	1 316 645	226 053	1 090 591
Q7	1 203 989	128 336	1 075 653
Q8	1 307 260	191 148	1 116 112
Q9	1 194 872	110 189	1 084 684
Q10	1 204 001	108 977	1 095 024
Q11	1 260 197	155 296	1 104 901
Q12	1 250 807	165 540	1 085 266
Q13	1 232 356	140 633	1 091 724
Q14	1 221 491	122 662	1 098 828
Q15	1 203 983	87 656	1 116 327
Q16	1 278 905	214 216	1 064 689
Q17	1 251 606	178 902	1 072 704
Q18	1 179 214	108 119	1 071 095
Q19	1 304 665	203 194	1 101 471
Q20	1 211 018	119 643	1 091 374
Q21	1 214 002	114 889	1 099 113
Q22	1 202 412	111 744	1 090 668
Q23	1 252 018	175 495	1 076 523
Q24	1 256 240	168 004	1 088 237
Q25	1 183 247	76 050	1 107 197
Q26	1 220 436	159 643	1 060 793
Q27	1 261 535	211 129	1 050 406
Q28	1 127 622	127 753	999 868
Q29	1 222 047	203 476	1 018 572
Q30	1 178 610	125 505	1 053 105
Q31	1 173 016	115 620	1 057 396
Q32	1 201 865	131 662	1 070 203
Q33	1 172 791	98 773	1 074 017
Q34	1 158 224	136 494	1 021 730
Q35	1 138 674	147 045	991 628
Q36	1 095 734	75 522	1 020 212
Q37	634 871	134 793	500 078
Q38	689 371	147 524	541 847
Q39	658 145	159 473	498 672
Q40	623 326	96 743	526 583

Table 7

CAR without installments			
Quarter	Portfolio 1	Portfolio 2	Difference
Q1	732 394	199 974	532 420
Q2	668 314	128 531	539 783
Q3	760 234	149 817	610 417
Q4	740 204	141 672	598 533
Q5	768 436	213 281	555 155
Q6	831 852	226 053	605 799
Q7	727 259	128 336	598 923
Q8	840 135	191 148	648 987
Q9	738 198	110 189	628 009
Q10	744 227	108 977	635 250
Q11	815 681	155 296	660 385
Q12	812 065	165 540	646 525
Q13	799 822	140 633	659 189
Q14	804 613	122 662	681 950
Q15	776 291	87 656	688 635
Q16	876 741	214 216	662 525
Q17	849 285	178 902	670 383
Q18	773 792	108 119	665 674
Q19	900 573	203 194	697 379
Q20	820 812	119 643	701 169
Q21	830 148	114 889	715 260
Q22	826 019	111 744	714 275
Q23	886 259	175 495	710 764
Q24	901 894	168 004	733 890
Q25	813 740	76 050	737 690
Q26	847 091	159 643	687 448
Q27	890 569	211 129	679 439
Q28	758 358	127 753	630 605
Q29	871 747	203 476	668 272
Q30	835 726	125 505	710 221
Q31	832 267	115 620	716 647
Q32	853 154	131 662	721 492
Q33	823 805	98 773	725 031
Q34	825 441	136 494	688 947
Q35	811 460	147 045	664 414
Q36	779 706	75 522	704 184
Q37	835 839	134 793	701 046
Q38	881 190	147 524	733 666
Q39	862 456	159 473	702 983
Q40	809 889	96 743	713 146

Table 8

Standard Deviation of CAR			
Quarter	**Portfolio 1**	**Portfolio 2**	**Difference**
Q1	973 780	970 415	3 366
Q2	1 007 123	1 000 361	6 762
Q3	1 020 945	1 009 588	11 357
Q4	1 034 434	1 020 257	14 178
Q5	1 043 692	1 033 186	10 506
Q6	1 052 135	1 039 492	12 643
Q7	1 030 584	1 014 458	16 126
Q8	1 050 432	1 031 051	19 381
Q9	1 038 926	1 021 706	17 220
Q10	1 055 045	1 036 084	18 961
Q11	1 055 476	1 032 329	23 147
Q12	1 065 934	1 041 835	24 100
Q13	1 065 285	1 042 225	23 060
Q14	1 053 322	1 027 900	25 422
Q15	1 040 593	1 016 973	23 620
Q16	1 049 601	1 026 874	22 727
Q17	1 049 588	1 021 717	27 871
Q18	1 049 979	1 024 249	25 731
Q19	1 060 479	1 035 704	24 775
Q20	1 056 155	1 033 132	23 022
Q21	1 049 860	1 022 298	27 562
Q22	1 053 424	1 024 202	29 222
Q23	1 053 342	1 026 217	27 125
Q24	1 047 102	1 025 408	21 694
Q25	1 056 488	1 028 069	28 420
Q26	1 063 105	1 038 435	24 670
Q27	1 054 710	1 030 538	24 173
Q28	1 048 457	1 024 659	23 798
Q29	1 046 533	1 022 305	24 228
Q30	1 039 021	1 014 212	24 809
Q31	1 056 423	1 032 686	23 737
Q32	1 050 147	1 024 638	25 509
Q33	1 052 182	1 023 918	28 264
Q34	1 061 323	1 036 051	25 272
Q35	1 049 025	1 026 720	22 305
Q36	1 051 001	1 030 393	20 608
Q37	1 047 400	1 023 803	23 598
Q38	1 063 373	1 038 424	24 949
Q39	1 055 992	1 030 204	25 788
Q40	1 039 918	1 017 988	21 930

Table 9

Standard Deviation of CAR without installments			
Quarter	**Portfolio 1**	**Portfolio 2**	**Difference**
Q1	973 780	970 415	3 366
Q2	1 007 147	1 000 361	6 787
Q3	1 021 028	1 009 588	11 440
Q4	1 034 609	1 020 257	14 352
Q5	1 043 929	1 033 186	10 744
Q6	1 052 452	1 039 492	12 960
Q7	1 031 025	1 014 458	16 567
Q8	1 051 028	1 031 051	19 977
Q9	1 039 634	1 021 706	17 928
Q10	1 055 939	1 036 084	19 854
Q11	1 056 520	1 032 329	24 192
Q12	1 067 242	1 041 835	25 407
Q13	1 066 670	1 042 225	24 445
Q14	1 054 791	1 027 900	26 891
Q15	1 042 312	1 016 973	25 338
Q16	1 051 472	1 026 874	24 598
Q17	1 051 638	1 021 717	29 922
Q18	1 052 201	1 024 249	27 952
Q19	1 062 826	1 035 704	27 122
Q20	1 058 586	1 033 132	25 454
Q21	1 052 582	1 022 298	30 284
Q22	1 056 474	1 024 202	32 272
Q23	1 056 644	1 026 217	30 427
Q24	1 050 178	1 025 408	24 770
Q25	1 059 516	1 028 069	31 447
Q26	1 066 334	1 038 435	27 899
Q27	1 058 071	1 030 538	27 533
Q28	1 051 870	1 024 659	27 211
Q29	1 050 017	1 022 305	27 712
Q30	1 043 095	1 014 212	28 883
Q31	1 060 411	1 032 686	27 725
Q32	1 054 206	1 024 638	29 568
Q33	1 056 630	1 023 918	32 712
Q34	1 065 708	1 036 051	29 657
Q35	1 053 247	1 026 720	26 527
Q36	1 055 373	1 030 393	24 980
Q37	1 051 959	1 023 803	28 156
Q38	1 067 697	1 038 424	29 274
Q39	1 060 815	1 030 204	30 611
Q40	1 044 097	1 017 988	26 109

Table 10

Figures 12 and 13 display the cumulative distribution for the first quarter[16].

Figure 12 – Q1 Portfolio 1

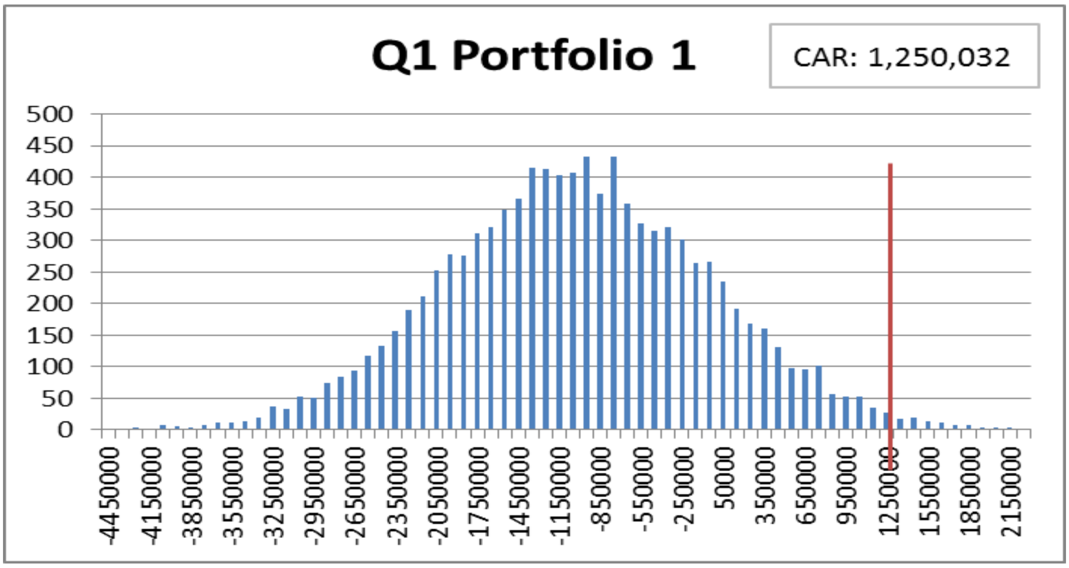
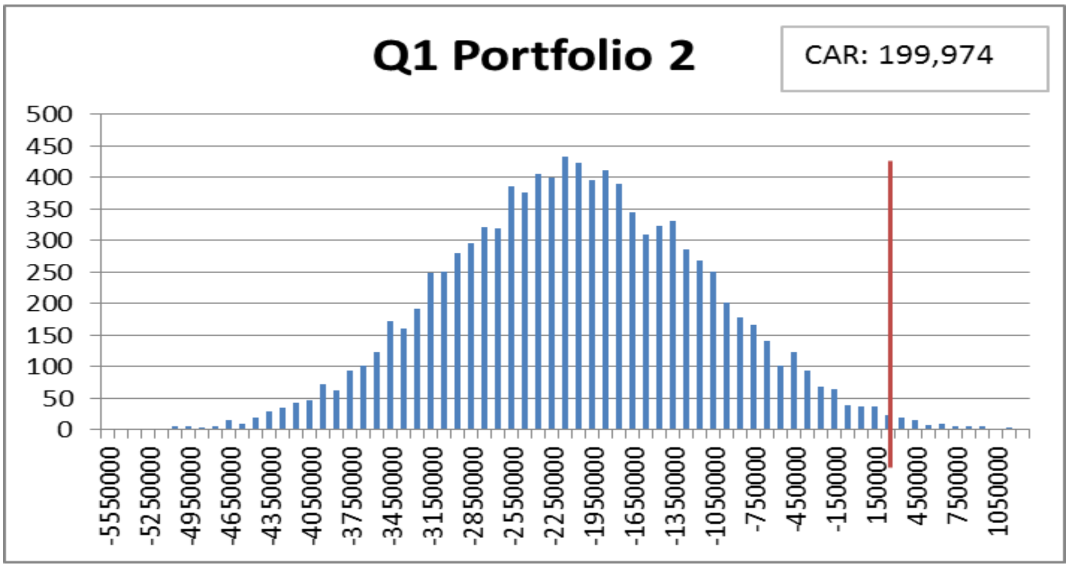


Figure 13 – Q1 Portfolio 2



A closer look at the first quarter reveals that the cash flow at risk is significantly larger for Portfolio 1 (Figure 12) than for Portfolio 2 (Figure 13). The figures show a CAR of NOK 1,250,032 and NOK 199,974 for Portfolio 1 and 2, and the red lines represent the cash flow at risk at the 99% confidence level. This indicates with 99% certainty that Portfolio 1 will not lose more than NOK 1,250,032. Similarly, Portfolio 2 will with 99% certainty not lose more than

[16] See Excel file CAR Q1-Q40 (values+graph).xlxs for the remaining 39 quarterly simulated cash flows.

NOK 199,974. This means that by changing from Portfolio 2 to Portfolio 1, the cash flow at risk increases with NOK 1,050,058. Further, the standard deviation in Table 9 shows that the risk of the CAR is higher for Portfolio 1.

The same results are found for all the successive quarters up until Quarter 37 (Figure 14 and 15). At Quarter 37, the CAR differences have been significantly reduced.

Figure 14 – Q37 Portfolio 1

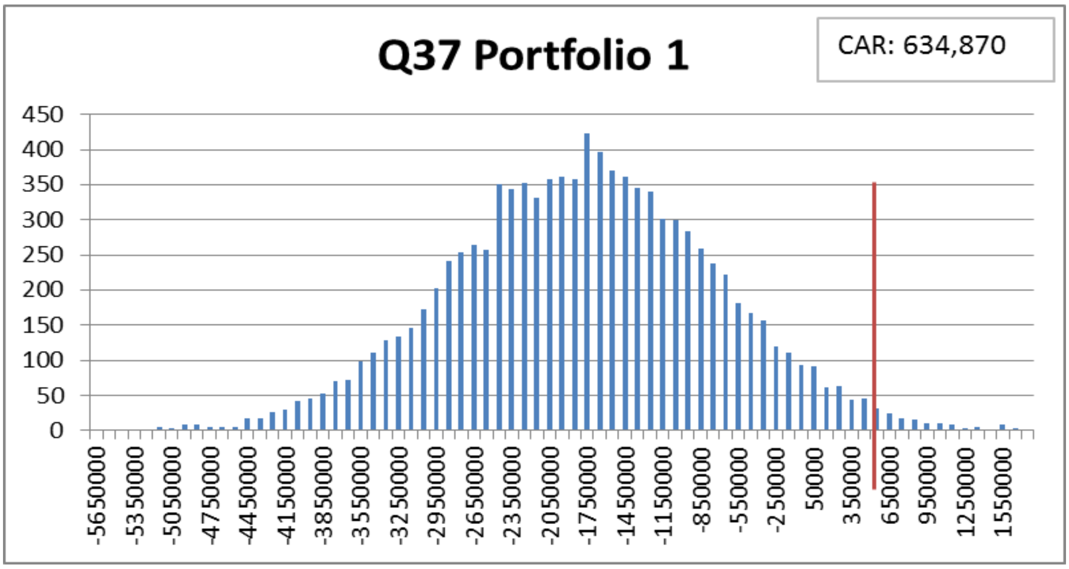
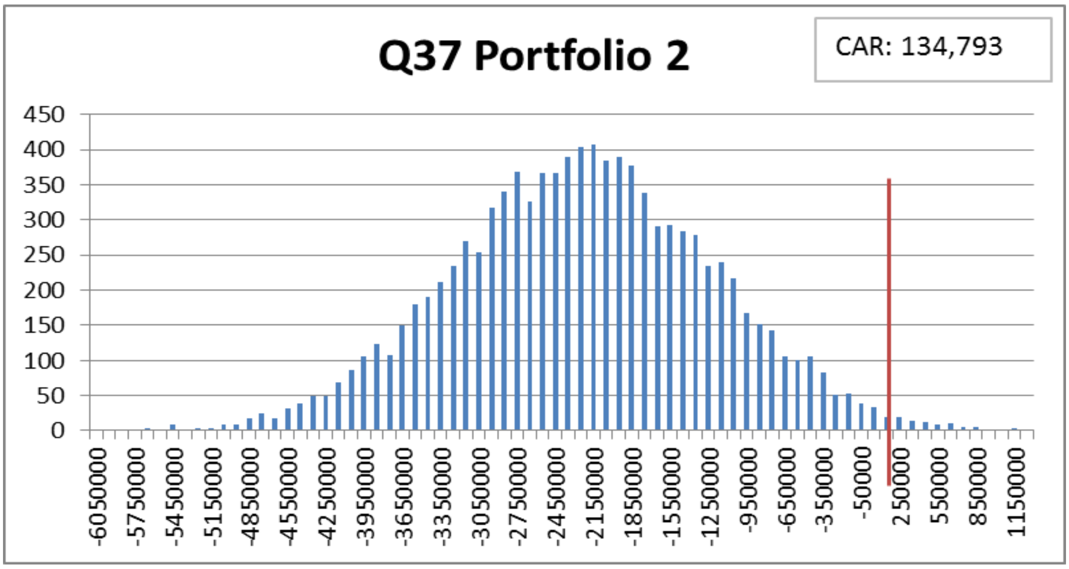


Figure 15 – Q37 Portfolio 2



An estimation of the CARs and standard deviations ignoring the installments is shown in tables 8 and 10[17]. The tables show that, even though the cash flows are

[17] See Excel file CF calculations without installments.xlxs and CAR Q1-Q40 without installments.xlxs

corrected for installments, the CAR and standard deviation is significantly higher in Portfolio 1 than in Portfolio 2.

2.3.7. Discussion

The results show that Portfolio 1 experiences a higher cash flow at risk in all quarters. This is further supported by a higher standard deviation of the CAR, and indicates that the risk increases substantially when the municipality enters the restructuring in order to invest. From just being exposed to the risk in spot price changes, it is now additionally exposed to the changes in the 3-month NIBOR and the exchange rates.

Next, the sudden drop in CAR for Portfolio 1 observed in Table 7 needs to be addressed. Found in the agreement of restructuring, the drop is explained by the absence of installments during the last four quarters. In order to exclude that the higher CAR of Portfolio 1 is caused by the installments, Table 8 shows the CARs modeled without the installments. As seen, even when the effects of installments are removed, the CAR is still larger for Portfolio 1 than for Portfolio 2. The same holds for the standard deviation. This indicates that the risks added by investing in the credit linked notes, such as the change in interest rate and foreign exchange, may explain the higher CAR in Portfolio 1.

However, problems regarding the results have to be vented. The models simulating the future price paths, which again are used to derive the cash flows, rely heavily on the assumptions of normality. The assumption of normality does not hold in the real world as extreme scenarios occur more frequently than predicted by the theory.

In addition, the mean reversion model assumes constant mean reverting rates. The speed at which the values revert to their mean does in reality depend on non-constant factors. Factors such as seasonal effects can be a reason, but also plant outages, natural catastrophes and/or increased demand other than seasonality could force the mean reversion rate to be different. As a result, this biases the estimated cash flows and thus the CAR.

Further, the random number generation by Monte Carlo simulation, with mean zero and standard deviation equal to one, are completely independent of each other. This means that the models assume that the future path movements between the spot price, NIBOR and exchange rate are uncorrelated. The assumption is unrealistic as the three variables most likely are correlated. Considering Purchase Power Parity, especially the 3-month NIBOR and the foreign exchange rate should be highly correlated. This results in over- and underestimation of the cash flows.

Notwithstanding the above, the results show an increase in risk. Even without considering the risk of default in Portfolio 1, Hattfjelldal`s risk indeed increased by changing from Portfolio 2 to Portfolio 1. This supports Research Question 1, stating that Portfolio 1 is considered to be more risky than Portfolio 2. Following this, all successive investments have to represent higher risky alternatives for the municipality - especially when adding the risks of default.

As all of the eight municipalities faced similar conditions, even though they did not all restructure the same future cash flows, or restructured at the same time, they all faced the same risky variables when investing. Since the products were so similar, and the equity invested faced the same underlying risks across all municipalities, it is possible to generalize the findings and derive the conclusion of an increase in risk for the eight municipalities.

Part III – Conclusion

By creating two portfolios it was possible to compare the decision to invest contrary to not investing. Portfolio 1 consisted of the alternative to sell electricity at spot price and to leverage in order to finance an investment in Credit Linked Notes (CLN). Portfolio 2 consisted of the continuation of selling electricity at spot price.

The results show that the cash flow at risk and the standard deviation of CAR was substantially higher for Portfolio 1 than for Portfolio 2 for all quarters of the investment period; even when ignoring the default rate. Further simulations of the cash flow at risk done on the two portfolios excluding installments gave the same results. This indicates that the additional risk in Portfolio 1 can be explained by other factors in the CLN, such as the change in interest rate and foreign exchange, rather than the volume of the installments.

Even without considering the risk of default in Portfolio 1, the risk of Hattfjelldal Kommune did indeed increase by changing from Portfolio 2 to Portfolio 1. This supports Research Question 1. Following this, all successive investments have to represent an even higher risk for the municipal - especially when adding the risks of default. As a result of similar terms of restructuring and products, these findings can be generalized across the municipalities.

Answering the research question it is concluded that the risk profile of the eight Norwegian municipals did change to the worse - exposing them to additional risks.

Appendix 1 - Fundamentals of the financial products

1.1. The Special Purpose Vehicle (SPV)

The main aspects of Special Purpose Vehicles is to transfer legal liabilities and to reduce risk in underlying assets of a parent company by transferring (selling) the assets to the SPV (Lucas 2006). They are new entities created for specific purposes and products. As a result they are not affected by previous decisions made by the parent company, nor can they affect the parent if defaulted.

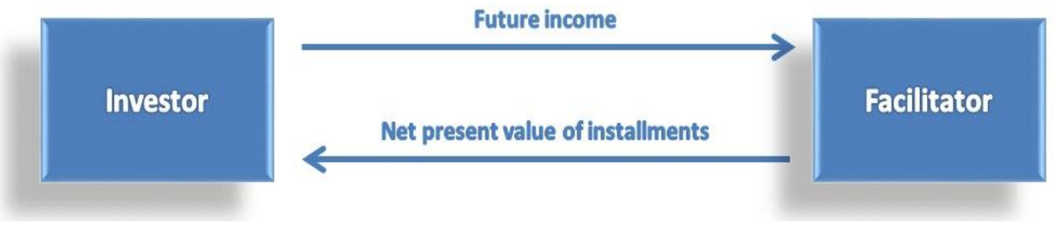
1.2. Interest Rate Swap (IRS)

An interest rate swap is an agreement between two parties to swap floating for fixed interest rates and vice-versa. The fixed rate can, either at the time of contract signing or at maturity, be paid as a lump sum based on it's future cash flow. At this point, the IRS functions as a loan and equals either a reversed zero coupon swap or zero coupon swap (Plaintiff Court London 2009).

1.3. Reversed Zero Coupon Swap (Reversed ZCS):

A reversed Zero Coupon Swap is an agreement where one party swaps its future income for a one time installment at initiation, calculated as the net present value, with a second party.

Figure 1 – Reversed ZCS



1.4. Credit Default Swap (CDS):

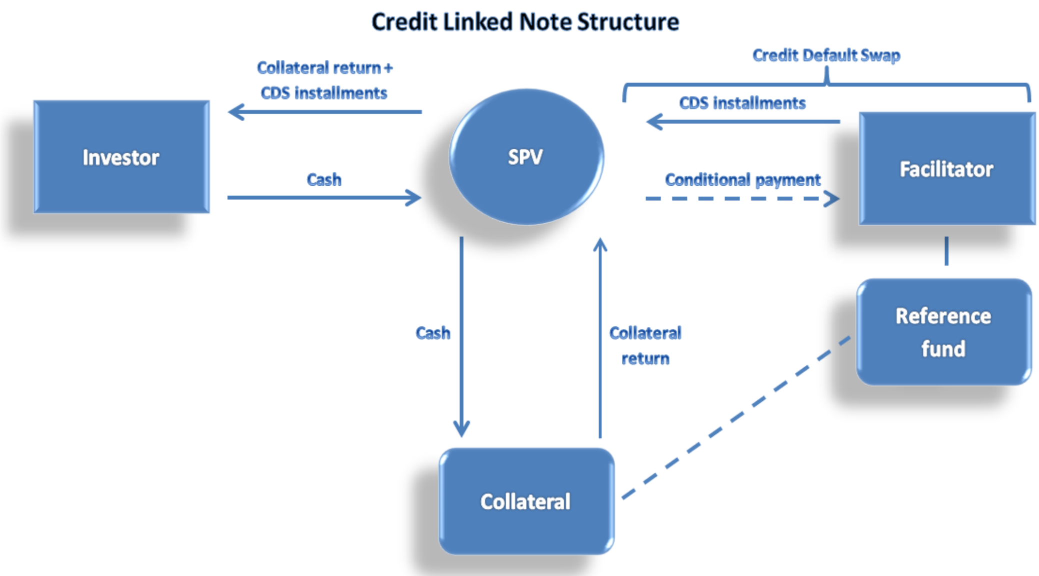
The principle of a Credit Default Swap is to give the buyer credit protection. The buyer of the contract pays periodic fees (CDS spread), for example monthly, to the seller and in return receives a conditional payment (notional payment) if a credit event occurs. Such credit events can be defaults or a pre-determined loss of a certain amount or percentage.

Figure 2 - CDS

1.5. Credit Linked Note (CLN):

A Credit Linked Note is a security that includes a CDS. The CDS yields investors a higher return than directly investing in public traded debt. The investor buying the note is paid a periodic payment consisting of a collateral return plus the CDS spread. The total return equals the premiums plus at least the recovery rate. Figure 3 illustrates a general Credit Linked Note Structure.

Figure 3 - CLN



The facilitator owns a portfolio of risky securities (reference fund) and wants to insure it. The facilitator creates a SPV, which sells a CDS to the facilitator. For this the facilitator pays the SPV an insurance spread. At the same time, the SPV issues a Credit Linked Note which it sells to an investor. The CDS within the CLN boosts the return and gives investors an incentive to buy the CLN notes rather than to invest in public traded debt directly. The value of the CLN is determined by the value of the reference fund. The income from the CLN sale is placed in a collateral portfolio consisting of low risk assets, such as T-bills and/or other debt. It is important to notice that in order for the CDS to have an effect for the facilitator, the collateral and the reference fund have to be positively correlated. The periodic payment to the investor will consist of the return from the collateral fund plus the CDS spread. At maturity, the investor will at least be returned a predetermined recovery rate if a credit event occurs and at max the total collateral fund.

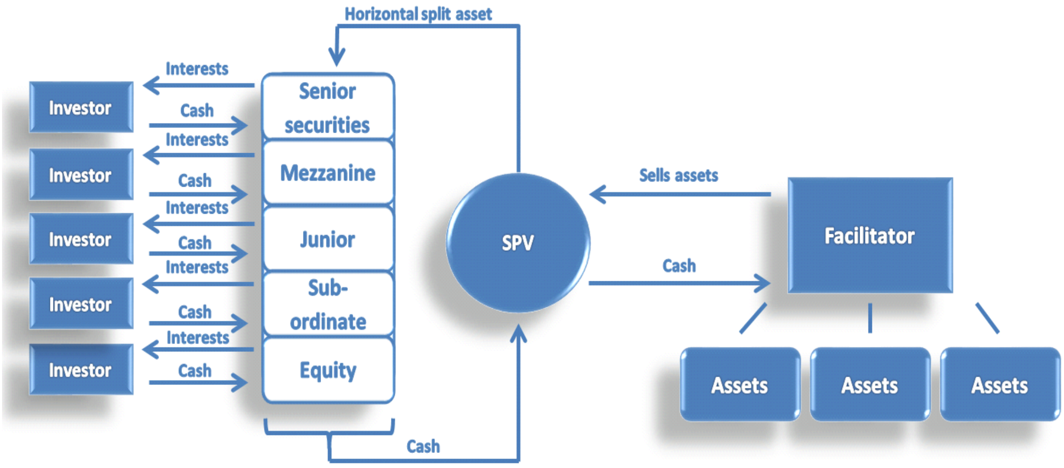
1.6. Collateralized Debt Obligation (CDO):

An illustrative example of a CDO is given before the fundamentals are explained in depth.

1.6.1. Illustrative example

Collateralized Debt Obligations are asset-backed-securities (Dodd-Frank 2013) and the cash flow to the security owners is distributed after priority (Figure 4). The process transfers credit risk from the facilitator to the holders of the CDO's and adds liquidity back to the balance.

Figure 4 - CDO



The facilitator pools its assets and sells them to an SPV. The SPV's main purpose is to securitize the pool and to sell these securities to investors, after horizontally splitting the assets by seniority reflecting each asset's riskiness. The securitization enables the SPV to fund the pooled assets.

The cash flow from the pooled loans are received by the SPV and paid to the security owners as coupons and principals according to priority. All tranches having a claim receive their coupon in subordinated order as long as the coverage tests hold (see section 1.6.2.4.). If a coverage test is violated, coupon payments are held back to fully pay of a senior tranche before paying subordinated tranches. However, loss of coupons is added to the subordinated tranches' par value.

1.6.2. Fundamental's of CDO's

There are four attributes to a CDO (Lucas 2006): assets, liabilities, purpose and a credit structure.

1.6.2.1. Assets (Cash Flow in)

The asset part of a CDO consists of the pooled assets bought from the facilitators. Typically, pools are made up from 20 - 500 loans or bonds (Khotari 2006). Assets may be high-yield loans, super senior/senior debt, mezzanine debt, capital notes, sub-prime mortgage, equity, asset-backed securities etc.

1.6.2.2. Liabilities (Cash Flow out)

The liabilities are ranked by seniority, also known as tranches. The tranches are in general categorized into senior, mezzanine and junior/equity tranches. Assets are horizontally split into tranches representing different risks for the investors. The riskiness and required return increases with the decrease in tranche rating (Rakkestad and Weme 2006). Coupons may be paid at floating or fixed rate. Notice that equity tranche and sponsors only receive cash flows when all other liabilities are covered.

A typical structure of a CDO can be seen in Table 1

Tranche	Percent of capital structure	Rating	Coupon
Senior Securities	92%	AAA	LIBOR + 26
Mezzanine Securities	3%	A	LIBOR + 75
Junior Tranche	1,5%	BBB	LIBOR + 180
Junior Tranche	1,5%	BB	LIBOR + 200
Subordinate Tranche	1,0%	Unrated	LIBOR + 480
Equity Tranche	1,0%	Unrated	Residual cash flow
Sponsor's Excess Spread	Not announced	Unrated	Residual cash flow

Table 1 - Example of CDO structure (Khotari 2006).

1.6.2.3. Distribution of cash flows

The cash flows are distributed according to the principles described the security's prospectus and by seniority. This distribution process is called the "waterfall":

Figure 5 – Waterfall process

1. Management and commission fees are covered before other liabilities are paid out.

2. Class AAA notes are paid before class A notes, which again are paid before class BBB notes etc. However, coverage tests are provided as protection to the liability holders. These are known as the *over-collateralization test* and *the interests coverage test* and will be explained in the next section.

3. Interests (Column 1 in Figure 5) are paid first according to seniority as long as coverage and interest test are not violated.

4. Principal (Column 2 in Figure 5) is paid second after the down payment of Column 1 in order of seniority.

5. Equity holders are paid last from residual income after the down payment of both columns.

If a test is violated:

a) On Class AAA, the remaining interest to the subordinated tranches is used to pay down the principal on Class AAA notes until the coverage tests are again met. If the remaining interest is not enough to cover the principal on Class AAA, cash flows from the equity tranche will be used until the coverage tests are met.

b) On Class A, the remaining interest to the subordinated tranches are used to pay down Class AAA, before beginning down payment of the principal to Class A until the coverage tests again are met. Similarly as above, if the remaining interest is not enough to cover the senior principals, cash flow from the equity tranche is used to satisfy the coverage tests.

1.6.2.4. Coverage tests

1.6.2.4.1. Over-collateralization test

The over-collateralization test gives the investors protection when the portfolio of their investments is deteriorated to a certain value. The over-collateralization ratio for a tranche can be calculated by:

$$\frac{Principal\ value\ (Par)\ of\ the\ collateralized\ liabilities}{Principal\ value\ (Par)\ of\ the\ tranche + all\ the\ tranches\ above}$$

The higher the ratio, the more protection the investor will receive. A minimum required ratio, also called the over-collateralization trigger, is specified in the prospectus guidelines. The test is passed if the over-collateralization ratio is equal to or above the minimum required ratio Figure 6 shows a CDO with all tranches passing the coverage test.

Figure 6 – Over-collateralization test

	Par Value	Minimum O/C	Present O/C
Class AAA	50	1,5	2,2000
Class A	30	1,2	1,3750
Class BBB	15	1,1	1,1579
Class B	15	NA	
Total of liabilities	110		
Principal value of the assets	110		

Figures 7 and 8 illustrate an example.

Figure 7 – Example of over-collateralization test

	Par Value	Minimum O/C	Present O/C	
Class AAA	50	1,5	2,0000	
Class A	30	1,2	1,2500	
Class BBB	15	1,1	1,0526	BREACH
Class B	15	NA		
Total of liabilities	110			
Principal value of the assets	100			

As can be seen in Figure 7, Class BBB is breached and the CDO has to be de-leveraged. The manager must pay off all the classes according to order until the OC test is re-stored.

Figure 8 – Example of over-collateralization test

	Par Value	Minimum O/C	Present O/C	
Class AAA	5	1,5	11,0000	
Class A	30	1,2	1,5714	
Class BBB	15	1,1	1,1000	PASS
Class B	15	NA		
Total of liabilities	65			
Reduce asset worth	45			
Value of the asset after default	55			

Figure 8 shows the final result after the down payment of Class AAA. The new par value of Class A and total value of asset after default are 35 and 100, respectively. By re-leveraging and payout par to class A, the CDO is re-stored and the new coverage test is passed.

1.6.2.4.2. Interest coverage test

The principal behind the interest coverage test is similar to the over-collateralization test. The test involves comparing the interest coverage ratio to the minimum required ratio.

The interest coverage ratio is calculated as

$$\frac{Coupon\ of\ the\ collateralized\ liabilities}{Coupon\ of\ the\ tranche + all\ the\ tranches\ above}$$

Appendix 2

2.1. The Tender Option Bond Program (TOB Program)

Investors can expose themselves to the TOB Program either by directly investing in the program by purchasing Residual Certificates or indirectly through an Interest Rate Swap.

The portfolio seeks attractive returns by employing hedged leverage in U.S municipal bonds through a Master Fund. The Master Fund applies the strategy of "purchasing a portfolio of long-dated tax-exempt municipal bonds, hedging the interest rate risk using minimum variance hedges, and leveraging a substantial portion of the municipal bond positions using a tender option bond program (TOB)" (Starling 1 2007).

The Master Fund leverages the initial investment and invests in a portfolio of long-term tax-exempt municipal bonds. The increase and decrease in leverage was achieved through a Tender Option Bond Program, a strategy existing since the middle of the 1990s. It works the following way (Figure 9):

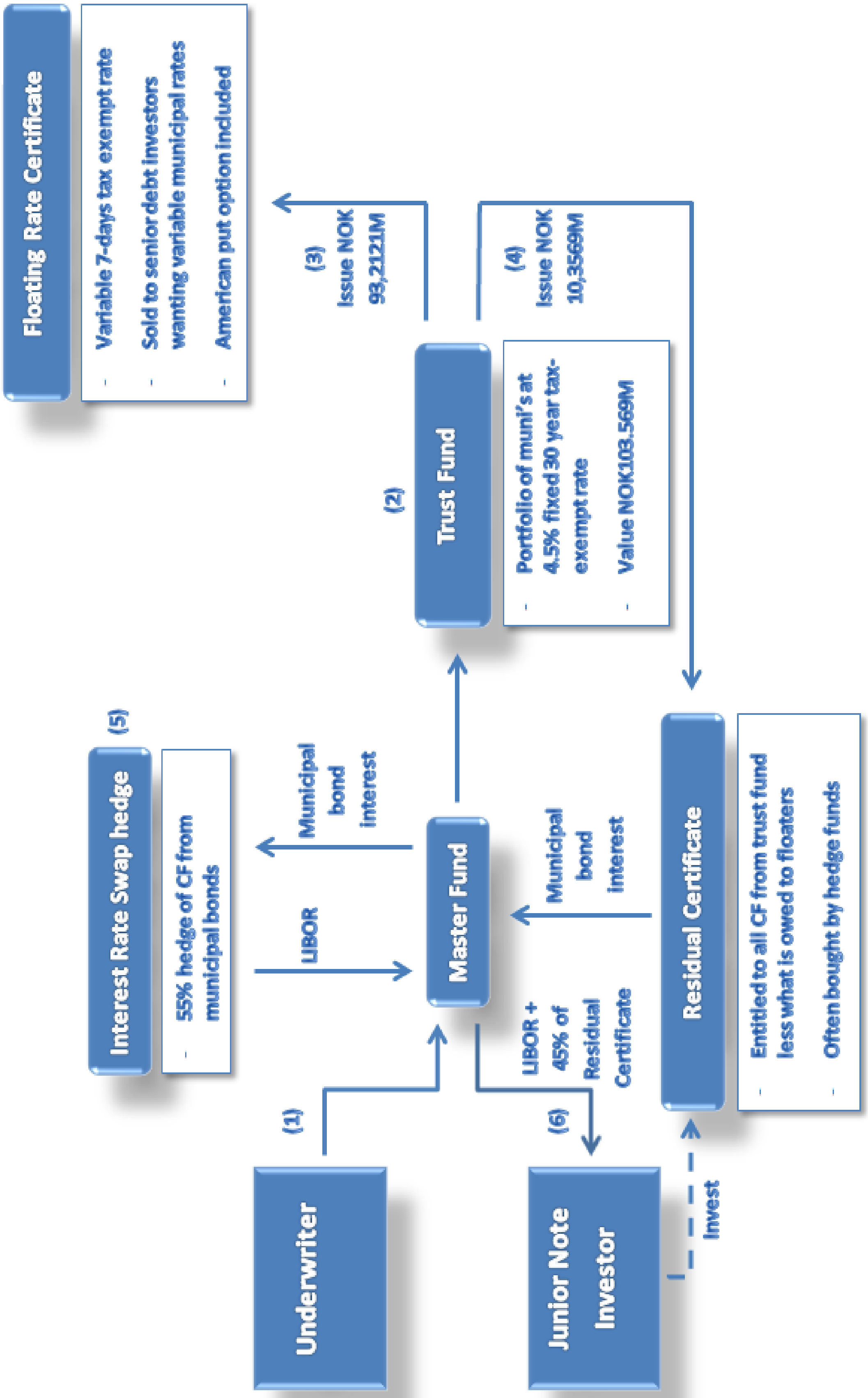
<u>Step 1:</u> Long-term tax-exempt municipal bonds are identified by the investment manager and added to a portfolio, bought with liquidity provided by an underwriter such as Citigroup. Based on that portfolio, the fund manager initiates a TOB program. In order to give an example of how this works, assume that the portfolio of consists of 30 years tax-exempt 4.5% fixed rate municipals (collateral) and that the portfolio value is $103.569 (collateral value).

<u>Step 2:</u> The portfolio of municipals are placed in a trust. This trust issues two types of certificates (i) Floating Rate Certificates and (ii) a Residual Certificate in order to repay the liquidity provided by the underwriter.

<u>Step 3:</u> By issuing the floating rate certificates (floaters), the fund manager essentially issues senior notes that include an American put option to other investors who want to swap fixed municipal rates for variable ones. These notes use the portfolio of municipals as collateral and will have the same maturity as the

municipals. The Floating Rate Certificates are entitled to receive interest on a short-term weekly rate, or 7 days tax-exempt variable notes, which is assumed to

Figure 9 – TOB Program



be lower than the fixed, long-term rate of 4.5%. The issuance amount is less than the value of the collateral, often 80-90% of the collateral value, leaving some residual value. For simplicity of the calculations, assume that the floating rate equals 3% and that the issuance value is $93.2121 in order to have a gearing effect of 9:1. The $93.2121 dollars are paid back to the underwriter.

Step 4: From the residual fund value, the fund manager issues Residual Certificates. These certificates are sold to junior note holders (TOB fund investors). The Residual Certificates are entitled to all the residual cash flow from the collateral, less the interest owed to the floaters plus the interest earned from the municipal bonds. They also have the right to buy back all the floaters if desired by the owners. The owners are now fully exposed to the leverage municipal portfolio. In the example, the fund manager sells Residual Certificates for a value of $10.3569, which is paid back to the underwriter. The liquidity provided by the underwriter has now been paid back in full. The ratio between the Floating Rate Certificates and the Residual Certificates is called the gearing effect.

Step 5: The Master Fund further applies an interest rate hedge. By entering into an interest swap agreement with an external swap counter-party, the fund exchanges 55% of the payment received on the Residual Certificates for a LIBOR[18]. As long as the LIBOR increases, the hedge will reduce the return from the Residual Certificates to the investors. However, when the interest rates decline, due to a lag in the spread between the tax-exempt rate and the non-tax-exempt rates, the hedge should earn additional return for the investors.

Step 6: The cash flow from the Master Fund to the investors equals LIBOR on 55% of the Residual Certificates and 45% of Residual Certificates return.

2.1.1. Example of returns with increasing interest rates

Assume a tax-exempt fixed and a floating rate of 4.5% and 3.0%. Further assume that the tax-exempt rates trade at 77.1% of the LIBOR, i.e. 18% above the theoretical trading rate of 65% (Citigroup 2013 p.10). Since the tax-exempt rates

[18] Based on Starling 1 (2007)

in theory are based on 65% of LIBOR, the Master Fund pays more (77.1%) through the IRS than it receives (65%).

1) Return from directly investing in municipal bonds:

Amount invested	Return
$10.3569	$10.3569 x 4.5% = 0.47

Table 2

2) Return from buying Residual Certificates:

	Amount	Calculations	Return
Municipal note	$103.569	$103.569 x 4.5%	4.66
Floating Certificate	$90.2121	$90.2121 x 3.0%	2.80
Residual Certificate	$10.3569	$10.3569 x 4.5%	0.47
Total Residual CF		4.66 - 2.80	1.86
CF to Master Fund		1.86 + 0.47	2.33
CF to IRS hedge	55% of 2.33	2.33 x 55%	1.28
CF from IRS hedge	Based on LIBOR	1.28 x (0.65/0.771)	1.08
Total CF to investors		2.33 - (1.28 - 1.08)	2.13

Table 3

From Table 3 it is shown that the leverage effect from the TOB program boosts the return of the investor compared to Table 2. The return increases from 0.47 to 2.33, but is reduced to 2.13 because of the hedging strategy.

2.1.2. Example of returns with decreasing interest rates

Consider now what happens when the interest rates decline. Assume rates of 4.2 and 2.9 percent for the fixed and floating rates respectively. Keep in mind that the tax-exempt rate now trades below the theoretical rate of 65%. Assuming that the proportional distance between the theoretical and actual rate is the same as in 2.1.1., the theoretical rate trades 18% above the actual rate.

1) Returns from directly investing in municipal bonds:

Amount invested	**Return**
$10.3569	$10.3569 x 4.2% = 0.44

Table 4

2) Returns from buying Residual Certificates:

	Amount	**Calculations**	**Return**
Municipal note	$103.569	$103.569 x 4.2%	4.35
Floating Certificate	$90.2121	$90.2121 x 2.9%	2.62
Residual Certificate	$10.3569	$10.3569 x 4.2%	0.44
Total Residual CF		4.35 - 2.62	1.73
CF to Master Fund		1.73 + 0.44	2.17
CF to IRS hedge	55% of 2.17	2.17 x 55%	1.19
CF from IRS hedge	Based on LIBOR	1.19 x (0.771/0.65)	1.41
Total CF to investors		2.17 + (1.41 - 1.19)	2.39

Table 5

Table 5 shows that the return from the Residual Certificate has declined, as well as the total Residual cash flow. However, the cash flow back to the investors has increased with the amount earned through the interest rate swap hedge. As a result, the investors earn money even when the municipal rates decline as long as the correlations between the rates high.

Appendix 3

Hattfjelldal:

18.11.2004	Interest swap with DNB NOR:	NOK 62,000,000
18.11.2004	Purchase of CLN Cloverie 2004-61:	NOK 62,000,000
14.06.2005	Interest swap with DNB NOR	NOK 42,000,000
14.06.2005	Purchase of CLN Cloverie 2005-75	NOK 42,000,000
14.06.2005	Purchase CDO Libretto 2006-003	NOK 103,600,000
28.06.2007	Purchase of Starling TOB	NOK 103,600,000

Bremanger:

26.06.2001	Interest swap with DNB NOR:	NOK 295,600,000
26.06.2001	Purchase of CLN:	NOK 295,600,000
2005	Interest swap with Depfa Bank:	NOK 54,400,000
22.09.2005	Purchase of saving prod. BMA from Kragerø:	NOK 54,400,000
2007	Purchase of CDO:	NOK 96,800,000
2007	Purchase of saving product Hjartal Sparebank:	NOK 48,000,000
2007	Purchase of CDO TOB:	NOK 170,000,000

Hemnes:

02.12.2002	Interest Swap with DNB NOR:	NOK 89,000,000
14.06.2005	Purchase of CLN:	NOK 89,000,000
12.06.2006	Purchase of CDO:	NOK 89,000,000
21.06.2007	Purchase of CDO TOB:	NOK 89,000,000

Rana:

2002	Interest swap with DNB NOR:	NOK 224,000,000
2002	Purchase of low risk stocks:	NOK 224,000,000
18.10.2004	Interest swap with DNB NOR:	NOK 84,500,000
18.10.2004	Purchase of CLN Cloverie 2004-75:	NOK 84,500,000
2005	Purchase of CLN Cloverie 2005-61:	NOK 224,000,000
02.07. 2007	Purchase Starling PLC 2007-13 (CDO TOB):	NOK 203,000,000

Vik:

25.06.2002	Interest swap with DNB NOR:	NOK 69,000,000
2005	Purchase of CLN Signum Finance III:	NOK 69,000,000
2005	Interest swap with DNB NOR:	NOK 80,000,000
2005	Purchase of CDO Starling:	NOK 80,000,000
2006	Purchase of CDO Banque AIG TOB:	NOK 33,800,000
2007	Purchase of CDO Ocelot II:	NOK 38,000,000
2007	Purchase of saving product Hjartal Sparebank:	NOK 60,000,000
2007		NOK 51,000,000

Narvik:

01.07.2004	Interest swap with DNB NOR:	NOK 52,500,000
01.07.2004	Purchase of CLN PLC:	NOK 52,500,000
30.06.2005	Interest swap with Depfa Bank:	NOK 190,000,000
30.06.2005	Purchase of CLN Signum Finance III PLC:	NOK 190,000,000
07.07.2006	Purchase of CDO Ocelot:	NOK 190,000,000
07.07.2006	Purchase CDO Libretto Capiital:	NOK 52,100,000
27.06.2007	Purchase of Starling PLC 2007-13 (TOB):	NOK 48,200.,000

Kvinesdal (Lack of information, cannot justify the number below, but according to Hofstad 2008):

2003	Interest swap with DNB NOR:	NOK 43,600,000
2003	Purchase of CLN Cloverie:	NOK 33,000,000
2003	Purchase of saving product Helgeland S.bank:	NOK 10,000,000
2005	Purchase of CDO	NOK 33,000,000
2007	Purchase of CDO Banque AIG (TOB):	NOK 43,600,000

Appendix 4

Preliminary Master Thesis Report
at Handelshøyskolen BI

The study of municipalities' investment choices:

What can explain eight Norwegian municipalities' gamble on risky products during 2001 – 2007?

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Introduction to the research topic

This thesis will investigate the financial scandal that took place in Norway in 2007. During late 2007 it became known that several municipalities in Norway with the help of Terra Securities were leveraging and gambling future incomes in complicated high risk funds in the U.S. through Citigroup. They were advised by Terra to leverage their investments with security in future incomes in order to obtain higher profits (Hofstad 2008). This scandal later became known as “The Terra-scandal”.

The story was first revealed by Morten Hofstad, who at that time was a journalist employed by Finansavisen ASA. In 2008 he released the book “*Eventyret om TERRA og de åtte små kommunene som dro til Wall Street for å bli rike”* on the subject, and through his research won the “Skup-prize”.

The records show that eight so-called energy producing municipalities (Kraftkommuner) had heavily invested in products of Terra Securities and were affected by the scandal. These municipalities were Bremanger, Haugesund, Hattfjelldal, Hemnes, Kvinesdal, Narvik, Rana and Vik. Later research in 2010 (Forland, Pettersen and Røiseland 2011) showed that also Akershus Fylkeskommunale Pensjonskasse and the private investment company Langen Invest were among those affected.

There was a lack of knowledge and cooperation between CitiBank, Terra and the municipalities. Information from Terra about the different risks and products was not unveiled, and communication problems within the municipalities’ own financial advisers and the mayor lead to purchase of complicated products such as Credit Linked Notes (CLN) and Collateralized Debt Obligations (CDO). These were products the municipalities had very little to almost none knowledge about. Sold by CitiBank, these derivatives were backed by sub-prime mortgage loans. As soon as the financial crisis hit the U.S., these products decreased heavily in value.

Research problem reviewed

Ever since the story first became public in 2007, there has, to our knowledge, been no scientific research about it. The reason why these municipalities did agree to buy such products, and what kind of products they were offered is still a mystery to many. Our aim with this Master thesis is to unveil more information about this scandal, and to be the first research paper about this specific topic in Norway. There are currently ongoing lawsuits where the municipalities have taken legal actions against Citigroup, who they believe were issuing illegal loans in contradiction to the Municipality Act. For this reason information is difficult to obtain due to confidentiality clauses.

Our research question is as following:

“What can explain eight Norwegian municipalities’ gamble on risky financial products during 2001 – 2007?”

This thesis will be divided into three parts. In part one, we will provide the reader with the background information and explain what the products were. Kredittilsynet published an article about how they rarely have investigated such complex products (Haugen 2007). Understanding these products will be a key part of our research in order to be able to answer the research question. There has been some research about CDO’s in general, but not into the specific CDO’s that were purchased by the municipalities. As a start, we will get hold of the official presentation documents from Citibank and Kredittilsynet’s final report.

The risk profile of the municipalities with and without the products will be discussed in part two. We will check if entering into these products changes the risk profile to a more risky, less risky or to an unaffected one.

In the third part we will apply a statistical approach to test if there were any common denominators for the municipalities who invested in these products, contra those who did not. We will try to explain common denominators, if found, with theory from behavioral finance.

1. Background information

Reports from KPMG (Noreng 2008), PWC (Kvamme 2008) and SF Revisjon (Sogn og Fjordane revisjon 2008) on the different municipalities give a basic understanding of how the investments were marketed to the municipalities. The first investment happened on June 6th, 2001 by Vik Kommune.

The main goal of a municipality is to redistribute resources from the community to provide a steady stream of services to the community. The municipality of Vik, as the other seven, is an energy-producing municipality and has three main income sources from its production:

1. Energy fee (Konsesjonsavgift). This is the annual fee each municipality receives from the energy plant as compensation for the utilizing of its natural resources.

2. Property taxes (Eiendomsskatt). Energy producers are important sources for property taxes. This income is considered as yearly fixed income.

3. Energy power (Konsesjonskraft). This is energy the producer must make available for the municipality for their disposal. The amount will be determined based on the production volume. The energy is bought at production cost, which is more or less fixed at 0,09 kr/kWh (Sogn og Fjordane revisjon 2008).

After the millennium the municipalities experienced a couple of years with uncertain income streams from the power production because of a very volatile power market. A variable income stream is not a good foundation to be able to provide a steady stream of services. For this reason, the mayor of Vik Kommune at that time came up with an idea: Why not get a fixed price deal? The fixed price would generate certain income, which could be invested into interest carrying accounts or in the financial markets. He consulted the municipality's own bank, Vik Sparebank, to help him with the problem. They referred him to their financial partner, Terra Securities, who came up with a solution to the mayor's problem.

However, Terra Securities purposed an additional idea, a reversed zero coupon swap (ZCS): what if the municipality also borrowed money calculated against the net present value of future income and invested this amount in the financial markets for a higher return than the price of borrowing? This would according to Terra Securities yield Vik Kommune with an arbitrage opportunity.

The Municipality Law §50 (Kommuneloven, §50. Låneopptak) defines what products each municipality legally is allowed to invest in, and how this can be financed. According to this section, municipalities can borrow money to invest in property, plant and equipment. The idea is that the future income from the investment should be able to cover the interest payments and the installments. Borrowing to be able to invest in risky investments is not allowed since the expected return is combined with risk, which can reduce the ability to provide basic services.

A letter from the Ministry of Local Government and Regional development (KRD 2013) on the September 20th, 2002, concerning the legality of their proposed investment plan, concluded that Vik's plan to trade 10 years of future energy power revenue with a one time payment from DnB was not to be considered as a loan, and therefor the investment would not fall under §50. This means that Vik got the green light to reconstruct their energy power. However, the department based its conclusion on that there was no change in the risk profile and that the municipality would have to familiarize themselves with the increase in their risk exposure.

This so-called "Vik-letter" later became the loophole each of the Terra-municipalities used to justify their investments. Vik and Terra entered into an agreement to restructure the owner rights of the future energy power with the goal to increase the future profits. Terra became the financial advisor for Vik's investments, as well for the other seven municipalities later. All information and materials from Terra to Vik was never published due to their confidentiality agreement and this laid the foundation for all future affiliations between Terra and Vik.

Even though there may be different circumstances, the assumptions and incentives behind each investment and the main idea behind the products were the same for all municipalities. They all wanted to increase their returns from the energy power.

1.1 The Products

We first give an explanation of how the products in general work. After this we connect the products to the specific case of the municipalities and how their investments happened.

1.1.1. Zero Coupon Swap (ZCS)

The concept behind the zero-coupon swap is making it possible for an investor to sell the net present value of future income for a onetime payment.

1.1.2. Credit Default Swap (CDS)

This is a contract between two partners where the buyer of the contract pays the seller a fixed yearly premium in return for receiving a conditional payment in the case of a specific credit event, such as default or a loss of a before agreed upon amount or percentage of a financial instrument. The principle is the same as buying insurance from an insurance company for your financial instrument.

1.1.3. Total Return Swap (TRS)

A TRS is a swap agreement where the two parties agree to swap the total returns of an asset for a periodic payment (Gilleshammer et al. 2008). Why and how this works is as follows: There are times when investors cannot, for legal or practical reasons, invest in a product by selling an underlying asset. To be able to be exposed to the wished product, the investor can then agree to a TRS with a bank. Banks are often the second party in a TRS because the market for the underlying assets often is illiquid or non-existing. The bank, on behalf of the investor, will then invest the agreed amount in the product. To be able to invest, the bank borrows the value of the underlying asset in the money market with security in the underlying asset, plus an additional amount in either cash or liquid assets. For this the investor pays the banks borrowing costs plus an additional fee, which is the banks periodic payment (f.ex. LIBOR+0.7%). In return, the total return of the investment will be paid to the investor. In case of negative return, the investor has to compensate the bank for the loss.

1.1.4. Credit Linked Note (CLN)

CLN can be seen upon as an obligation build on highly rated (AAA) CDS'. By issuing a CLN, the issuer will be able to transfer the default risk over to the credit investors. The CLN is issued through a Special Purpose Vehicle (SPV) or trust. When investors buy securities from this trust, they received either a fixed or floating rate which is the premium paid by the CDS owners. At the end of the contract, the investors of the CLN will receive a par value depending on the status of the collateralized securities. In the case of no credit event, the investors will be returned their initial investment at par. In cases where CDS' have defaulted, investors will at minimum receive an amount equal to the recovery rate (less than par) (Andresen & Gjerdrup 2004).

1.1.5. Collateralized Debt Obligation (CDO)

Collateralized debt obligations are securities where you acquire an asset and return from a portfolio of debt securities. The owner of a CDO will therefore take on the risk for the underlying debt securities. The facilitator (the bank) that owns a portfolio of debt securities sells their portfolio to an SPV, which has a main purpose to reduce the risk for their clients. By doing this, the facilitator gets liquidity back in the balance. To be able to finance the purchase of the debt portfolio, the SPV issues a CDO at the value of the portfolio and sells the debt securities to CDO investors. The CDO is built up by different types of credit ratings, known as tranches. Tranches are different levels of security, where Senior has highest priority, Mezzanine second and Equity the lowest (Rakkestad and Weme 2006). The cash flow from the underlying asset is then directed to the investor by the SPV, less the commissions and transaction fees. The cash flow is then paid out after priority to the different tranches.

1.1.6. Synthetic CDO

A synthetic CDO is a more complex type of CDO. The main difference between these two is that the SPV does not have the juridical responsibility for the underlying. It works the following way:

A facilitator has a portfolio of securities and wants to reduce the risk. Instead of selling the portfolio right away (eliminating the risk), the facilitator wants to insure it against loss. To be able to do so, he creates an SPV which issues a CDS. This CDS will then be bought by the facilitator and acts as insurance in case the portfolio falls too much in value. The insurance will be paid if a predetermined loss level is reached. To be compensated for offering this insurance, the SPV expects a to be premium paid. However, the SPV will in most cases not have enough liquidity to cover a payout of a credit event. To be able to pay for this, the SPV issues CDO’s and sells them to investors. The value of the CDO’s issued will approximately equal the value of the CDS. The money from the investors buying the CDO’s is then used to invest in a safety portfolio, which is a low risk portfolio consisting government bonds etc. These risk free investments are meant to reduce the risk of the CDO investors since their returns will the first to be affected in case of a credit event. The idea can be compared to an insurance company that pays out insurance for a stolen cell phone versus having to pay out the total amount for a house that burned to the ground (defaulting). Reports of stolen cell phones occur much more often (and are cheaper to cover) than the ones of houses caught on fire.

In the case of no credit event, the cash flow to the CDO investor will consist of the periodical premium payments in addition to a smaller part of the return in the safety portfolio. In the case of a credit event, the investor will at max lose the value that the CDS is worth, but will keep the return from the security investment.

1.1.7. Tender Option Bonds (TOB) fund

Municipals (tender option bonds) are obligations with a coupon and a par value. The difference between these and regular bonds is that there is no marketplace for purchasing the municipals. Literature and research have shown (Fabozzi 2005) that the actual return is higher than the theoretical return, yielding an arbitrage opportunity. According to Green (1993), this arbitrage opportunity comes from a tax benefit municipals have compared to regular obligation. This arbitrage is what the TOB fund seeks through having a long position in municipals.

A TOB fund's intuition is to invest in municipals, and in addition hedge part of the portfolio with a swap that gives us a floating rate instead of a fixed. The rate from the municipals due to the tax benefit will be larger than the rate we have to pay for the swap. The floating rate we get from the swap is the LIBOR less taxes. This money will be invested in the money market, which again will give us a return of tax corrected LIBOR. The cash flow from the money market will therefore equal the cash flows from the swap and the arbitrage will come from the interest rate after tax in municipalities less the interest rate (fixed) paid on the swap.

1.2. Investment stages

There are 4-6 stages of investments (depending on if they reconstruct the property tax and energy fee), which the Terra municipalities have in common. Some municipalities reconstructed only energy power while others reconstructed their energy power, energy fee and property taxes. We can in general divide the investments into these following stages (KMPG Narvik Report 2008):

1.2.1. Reconstruction of energy power to fund investment or CLN

The general process for the Terra municipalities' reconstruction of the energy power is as following (Hofstad 2008): The municipality contacts an energy-company (for example Hafslund) to sell their energy power at a yearly fixed fee of 10 kr for 10 years. The total money received will be 100 kr over the 10 year period. Knowing this, the municipalities contact their bank to borrow an amount that yields a yearly repayment of interest and principal of 10 kr. We assume this gives them a loan of 95 kr. The 95 kr will then be invested in obligations and securities, where the expected yearly return is higher, for example 11 kr, than the cost of borrowing. This means that by the end of their investment they will receive a total of 110 kr, rather than 100 they would have received from the sale to Hafslund.

The main problem with this investment model is that it takes place in a static world. All variables such as the risks and investment value are fixed. As soon as the energy prices, interests or risk changes, the investment will no longer be profitable as previously predicted.

1.2.2. Reconstruction of energy fee to fund investments

This process will be the same as the reconstruction of the energy power. Municipalities contact a bank for a loan with the interest and principal payments each year equivalent to the energy fee received each year. The loan will be invested in obligations and securities such as in banks and other foreign bonds.

1.2.3. Reconstruction of property taxes to fund investments

Of the eight municipalities, Narvik and Bremanger reconstructed their property taxes. Narvik kommune decided in 2005 to make a zero coupon swap with DnB. This means that they will receive a onetime payment from DnB today for their future property tax income. The net present value of future tax income was calculated to be 190 mill kr. This amount was then invested in CLN obligations (While Bremanger invested in funds such as those mentioned above).

1.2.4. Fund investment to CLN

Municipalities sell their low risk investments in funds, in order to invest in CLN.

1.2.5. Reconstruction of CLN to CDO

In 2006, Terra called the municipalities' financial advisers informing them about a credit event that had occurred. The main reason was that the securities bought through CLN have had their credit-rating changed. No further information was given about why the credit event had occurred. According to Terra, reinvesting in

CDO would make it possible to reduce the amount of “badly rated securities”, while the risk of CDO is as low as, or even lower, than the CLN’s (Noreng 2008). Reports later revealed that the reconstruction in CDO was done without a credit-rating of the new investment products.

1.2.6. Reconstruction of CDO to CDO with linked to tender options fund (Municipal fund)

In 2007 the municipalities again were contacted by Terra. This time the municipalities were informed that Terra found new obligations that could increase their profit even more. They were recommended to sell their current CDO and purchase a customized CDO with the return linked to a municipality fund, in this case an American fund. The reports done by PWC, KPMG and SF Revisjon later showed that Terra withheld critical information. In Rana Kommune, 3 important pages about the “key risks” of Citybanks CDO-investment were left out when Terra translated them from English to Norwegian. Terra themselves also revealed to Kredittilsynet that the document “Funds Linked Repackaged Note” was attached after Hemnes Kommune decided to reconstruct their CLN. A “Funds Linked Repackaged Note”” is a document with information about the Citibank rights to terminate the contract in case of reduction in the investment (Fylkesmannen report Hemnes 2008).

1.3. Literature review

Mortgage based securities have played and will continue to play an important role in the capital market. This is due to the many risk benefits such as the opportunity for hedge fund managers to make strategic allocations in order to diversify their investments. All risk that investors must take into account stems from the various functions financial markets have in the global economy (Jaeger, 2008: 138). These economic functions give banks and insurance companies the opportunity to move the undesired risk to other partners and companies.

We understand that the misuse of mortgage backed securities such as CDO’s and CLN was the main reason for the financial crisis of 2008 (Jo, Hoje et al 2008:10). At the beginning, these securities were meant to help investors to hedge corporate bonds, especially because these swaps do not require the speculators to actually own the bonds (Adam and Guettler 2011: 2). As soon as people saw the advantage of the swaps, the market soon became flooded with these investments (Morgensen 2008). These kinds of derivatives are the same as the products the municipalities in Norway purchased during the 2001-2007 period.

The growing amount of new derivative products, coupled with the lack of customer service and support from the financial institutions, has left municipalities and small firms in a difficult position (Hance 2008). The biggest reasons for failure in the financial market was because of the lack of knowledge (Carlin 2008: 278–287) of the derivatives and to fully comprehend the legal risks associated with the instruments.

The lack of information leads to an increase in demand for independent and external expert help such as financial advisers. Studies have shown that people tend to think these advisers fail to de-bias their clients and often reinforce biases that are in their interests (Mullainathan, Noeth and Schoar 2012: 18). In reality, they are returns-chasing and encourage investors to invest in funds with high transaction fees. Many of the institutions that provided these products were not insured by the FDIC (Federal Deposit Insurance Corporation) and were later labeled as shadow banks (Krugman 2009). Because of such banks the market was flooded with Mortgage-backed securities, collateralized debt obligations and credit default swaps; and as soon as the market collapsed, a global financial crisis was unveiled.

2. Risk Profile

To show the risk profile of the municipalities' portfolio, we will use Vik Kommune's investments as an example.

The data for the risk profile will be of type daily time series. Data from the energy market are gathered from the Nordpool-Electricity Average Reference index in the time period 06.06.2001 to 01.12.2007 and will represent the volatility in the income stream for the municipalities, if they had not invested in any products. The investment period is divided into three parts.

As part one Vik invested into low risk funds (2001). In the second stage (part) the municipality invested in CLN products (2005). After 2006, the investment structure changed to link CDO's up to a TOB fund, which will be our third part. Therefore, we will need daily time series data on both the CLN investments and the later TOB exposure. The data will be collected through Thomson Reuters' Datastream, the financial information provider Markit and financial institutions.

One question is whether or not the entering in each of the investments actually would change the risk profile of the municipalities. From reports we know that Vik went from a volatile income stream to a static one where they were offered to sell the energy for 19-20 øre/kWh by Statkraft (Hofstad 2008), giving a guaranteed profit of more than 100% of the purchasing cost. Moving from a safe income stream to a uncertain one, will always be connected some amount of risk. The question is how the risk profile changed when comparing the volatility of the financial products to the volatility of the energy price movements. We believe that the risk increased.

3. *Research*

3.1. Data

The data will be collected from the municipalities who were offered and invested in products. We will be gathering information from all energy producing municipalities in Norway to check if they were contacted and offered products by Terra Securities. There are in total 160 energy-producing municipalities.

The primary data set used in the analysis will be gathered directly from the municipalities by first hand research. Since there is no database containing the information we need, it will all be gathered by surveys, interviews and research in public databases. Public databases used, in addition to the public databases registered and maintained by each of the municipalities them selves, will be the ones from Norwegian Social Science Data Services (NSD) and Ministry Of Local Government And Regional Development (KRD). We will identify and locate the employees and people responsible for the decisions during that time, in addition to those in the same positions today.

The data set will be comprised of the variables likelihood to invest, gender, age, education, financial related education, political party, size of decision board, tenure, majority of votes, location, time to re-election, marital status, children, financial literacy and experience in financial markets.

The information about the variables will be collected by a questionnaire sent out to the municipalities, first directed to the people who were involved in the processes during the time of the offers. Next, we will ask the people responsible for those kinds of decisions today in the municipalities to answer the questionnaire as well to find out if the over-all values of the variables have changed since the publicity of the scandal, especially with respect to financial literacy and financial work experience. We assume that the people in the municipalities who accepted the offers, now, years after the scandal, would be biased towards what we define as variables for general financial literacy and financial experience. This may be because those involved have been through public outings, investigations related to the case and are still involved in litigation's.

The questionnaire will be consisting of two parts. The first part will be structured as a basic survey for cross-sectional data. The cross-sectional data will be classified by discrete data with cardinal integers. The second part will contain a survey to measure financial literacy. We define financial literacy as the ability to understand financial theory and thinking. To be able to determine the level of financial literacy, we will create financial questions ranging from basic day-to-day knowledge to over-the-average knowledge about financial markets and simple financial products. The questions will include issues such as calculating basic interests, discounts, banking issues, diversification, liquidity, risk, investments in stocks, funds etc.

3.2. Hypothesis

The first hypothesis will build on the how the collected variables are influencing the decision to invest, contra not to invest. The question that remains is whether or not the eight municipalities who invested in the products had some kind of common denominator.

Hypothesis 1: *There are common denominators between the eight investing municipalities contra those who did not invest.*

We have reasons to believe that an offer to increase the income of the municipalities is a strong incentive to invest in the products. But the question of why some would invest in such complicated products with so little knowledge about them while others turned them down, still remains unsolved.

The second of our hypothesis' will be testing if whether or not the people who took part of the decision making in the municipalities who accepted the offers are biased towards financial literacy and financial experience. We believe that their participation and involvement in public outings, investigations and interviews by internal and external control organs, in addition to litigations, which today still are unsolved, will make them biased towards what we think the general knowledge base is. If this is true, then our research towards their knowledge at that time will not be correctly represented when questioned today. This is because we believe that people tend to try to learn from previous mistakes.

Hypothesis 2: *There is a bias of the level of knowledge between the representatives during the scandal and the average in said municipality today.*

If H2 holds, then we will have to try to correct for this bias in our main research question. If we assume that those who today occupy the positions do not have the same bias, one solution may be to use today's knowledge level as a benchmark for the financial literacy and financial experience instead of the data gathered from the accepting municipalities. We think that this will represent a more correct distribution of the knowledge at that time. Further, a little remark can be that because of the latest financial crisis, we could assume that people today will be more aware of financial products and finance in general than they were in the early 2000s.

3.2.1. The variables explained

- Likelihood to invest

  Based on the how many out of the 160 energy-producing municipalities where offered these products, this variable will state how high the investing percentage was. (8/160).
- Gender

  This variable will be of type dummy, coded as 0 for men and 1 for women. Research has shown that women are more risk averse than men (Eckel 2008: 1071) and we assume that the higher percentage of women on the decision board, the less likely it is that they would have invested. This variable should in our opinion have a negative effect on the likelihood to invest.
- Age

  Age will be a categorically variable with age intervals. We believe that the higher the average age is, the more experience they have and thus the more risk averse they will be to gamble on new products. Thus, the higher the age, the more negative effect it should have on the likelihood to invest.

- Education

The education variable will be of the same type as age. We assume that the higher the average education, the less likely they are to invest in the products offered. We again believe that the higher education, the more negative effect the variable will have. The assumption is that higher educated people are better trained within the understanding of probabilities and statistics.

- Financial related education

This will be a dummy variable, where 0 implies non-financial education whilst 1 implies a higher education (3-years or more) within the direction of finance. The assumption is the same as for the variable "education", however, we believe that this one will have a stronger negative influence than *"education"*.

- Political party

Will be a categorical variable. We have no beliefs about what political party the majority of the decision board belongs to will have any impact. However, we add it to make sure there is no correlation.

- Size of decision board

The report by SF Revisjon about Vik Kommune quoted "we never discussed the need for competence within the financial department, and there has never been any systematic rules for such either. [...] there was no one who raised their hand and said that this case had been to difficult for them. At the same time, neither did I." We assume that the larger the size of the decision board was, the more likely the individuals are to victims of peer-pressure and thus not state their insecurity (Milgram 1965:134).

- Tenure

Tenure measures how many terms the mayor has had. We believe that the more terms the mayor has been in office, the less pressure he/she will have to prove themselves, and thus be less willing to invest.

- Majority of votes

This is supposed to measure the percentage of support/votes the mayor has. The intuition is that the closer to losing the majority, the more likely the mayor would be to invest in order to be able to prove his/hers worthiness.

- Location

    Location will be a categorical variable. The reasoning behind this variable is that we do not want to miss out on any possibly cultural effect. Could there be any cultural reasons for being more risk prone than other places?

- Time to re-election

    The assumption is that the shorter time to re-election, the more incentive the board would have to invest to be able to show off their ability to generate income to the public, thus *buying voters*. We believe that it will positively influence the probability to invest the less time there is to next election.

- Marital status

    This variable is supposed to cover the participant's private status.

- Children

    We believe that people who have children tend to be more risk averse than others. Could this variable explain any differences between the municipalities? We assume that it will negatively influence the probability of investing.

- Financial literacy

    This variable is supposed to measure the level of financial literacy of the participants. We assume that the higher value this variable has, the lower the probability of entering into the products. It should therefore be a negative relationship between financial literacy and likelihood to invest.

- Financial experience

    We define financial experience as having practiced within the area for at least three years. We assume that the longer experience the average has, the less likely they are to invest in the products. Again, we assume a negative relationship.

Overall, we believe that the combination of the variables financial literacy, financial experience and financial related education will have the most weight with regard to not investing in these products.

3.3. Methodology

Our approach will start with a basic linear equation on the form

$$Y_t = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_t X_t + u_t,$$

where Y_t is the percentage of municipalities who invested in the products, given those who were presented with an offer; β_t is the percentage of a unit change in Y_t explained by the explanatory variables X_1, X_2,...,X_t.

Since the independent variables will be a combination of categorical and continuous variables the multivariate normality assumptions will not hold. This is because normal linear regression will have problems with variables that have values that are greater than 1 and smaller than 0. Falsely using classic OLS will thus give us estimates above 100%. The use of a logistic function will avoid this since it does not make any assumptions about the distribution of the independent variables (Brooks 2008).

The basic logistic regression equation is given by

$$\ln\left(\frac{p}{1-p}\right) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_t X_t,$$

where $\frac{p}{1-p}$ is defined as the odds of the function. The relationship between odds and probability is given by

$$p = \frac{1}{1+e^{-(\alpha+\beta_1 X_1+\beta_2 X_2+\ldots+\beta_t X_t)}}.$$

The relationship is here represented as a logistic curve that asymptotically approaches infinity as the independent variables X_1, X_2,...,X_t approach 1.

As the final approach, we will use the maximum likelihood estimator together with a stepwise selection procedure.

4. Progression plan

Stage 1:

- Contact municipalities about their connection with Terra communities: 15th Jan. 2009.
  - 60 answers out of 160 municipalities.
  - 27 confirmed contact with Terra.
  - 8 confirmed invested in the product.
- Contact PWC, KPMG, SF revisjon and "Fylkesmann" for additional information about each investment stages.
- Get hold of actual contract between each municipalities and Terra Securities.
- Gather data of indexes for risk portfolio analysis:
  - Contact CitiBank for CDO index.
  - Contact markit.com for itraxx index.

Stage 2:

- Gather information about each municipalities that have been contacted by Terra: Find information about each variables through:
  - Statistics Norway (SSB).
  - Norwegian Social Science Data Services (*NSD*).
  - Contact answered municipalities for further information.
- Full analysis of the products purchased.
  - Theoretical basis and how they in theory are supposed to produce surplus.
  - Linking the products parts with the municipalities investments (Especially the TOB fund)

Stage 3:

- Work on gathered data .
- Prepare the regressions.
- Final contact with municipalities and accounting firms for needed information.
- Run the regression.
- Analyze risk portfolio.

Stage 4:

- Analyze and discuss results.

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