

Financial hedging practices and processes as a part of oil refining company's supply chain Case: Neste Oil

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ABSTRACT

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Objectives of the Study

For oil industry the volatile markets and the complex and global supply chain are one of the main characters. These characters also create a great number of risks for oil companies and especially market risks have gained importance to oil companies' profitability during the past few decades. To be able to cope with increased market risks oil companies have started to get more involved in risk management and especially hedging.

The study aims to explore what are the hedging processes and practices in oil supply chain. Also a target is to shed light why hedging is an important part of oil supply chain and furthermore what are the challenges in oil supply chain regarding hedging. Further the thesis aims to increase understanding how hedging is positioned in oil supply chain i.e. in which parts of the oil chain there are risk exposures that require hedging. In addition a central purpose is to study how these two functions interact and why hedging can't be implemented in isolation and why intensive information sharing is actually required between supply chain and hedging processes.

The purpose of the theoretical part of the thesis was to study existing literature of financial risk management and supply chain functions especially in oil industry environment. Further the aim was to study what are the interactions between financial risk management and company supply chain. In the empirical part the aim was to study in which parts of its supply chain Neste Oil hedges its risk exposures and how supply chain is dependent on hedging.

Methodology

The empirical part of the study was conducted as a single case study within Neste Oil Oyj. The data was gathered through conducting semi-structured interviews with Neste Oil's employees from operational management, sales and trading, and treasury departments.

Findings and conclusions

Based on the literature review and interviews it was found out that oil company is exposed to market price risks or currency rate risks in each part of its supply chain. In addition in several parts of the supply chain decision making is dependent on hedging possibilities. As the complex oil supply chain makes it challenging to get the hedges to match the exposures, close interaction between functions is highly important and need to be secured.

Keywords

Financial risk management, supply chain, hedging, case study, price risk, currency risk, oil industry

Total number of pages: 126

ABSTRAKTI

Suojaamisen toimenpiteet ja prosessit osana öljynjalostajan toimitusketjua Case: Neste Oil

Tutkielman tavoitteet

Volatiilit markkinat sekä globaali ja monimutkainen toimitusketju ovat ominaisia piirteitä öljyalalle. Toisaalta nämä piirteet myös altistavat öljy-yhtiöt useille riskeille, joista erityisesti markkinariskit ovat nousseet entistä merkittävämpään asemaan viimeisen kahden vuosikymmenen aikana. Tämän vuoksi öljy-yhtiöt ovatkin alkaneet kehittää entistä enemmän riskienhallinnan ja erityisesti suojaamisen prosessejaan.

Tutkielman tavoitteena on tutkia suojaamista ja suojausprosesseja ja toimenpiteitä öljyn toimitusketjussa. Tarkoituksena on lisäksi selvittää, miksi suojaaminen on öljy-yhtiöiden toimitusketjuissa tärkeää ja mitä haasteita toimitusketju asettaa suojaamiselle. Lisäksi tutkielma pyrkii lisäämään tietoa siitä, miten suojaaminen on positioitunut toimitusketjussa eli missä kohdissa toimitusketjua on riskejä, jotka vaativat suojaamista. Lisäksi tärkeänä tavoitteena on tutkia kuinka nämä kaksi funktiota ovat vuorovaikutuksessa keskenään, minkä vuoksi suojaamista ei voi toteuttaa erillään toimitusketjun prosesseista vaan tiivis kommunikointi on välttämätöntä.

Teoreettisen osuuden tarkoituksena on tutkia erityisesti öljyn alan riskienhallinnasta ja toimitusketjusta jo olemassa olevaa kirjallisuutta. Lisäksi tavoitteena oli tutkia kirjallisuutta näiden kahden aspektin vuorovaikutuksista ja yhteneväisyyksistä. Empiirinen osuus tähtäsi selvittämään, missä kohdissa Neste Oilin toimitusketjussa suojattavia riskejä esiintyy ja toisaalta kuinka toimitusketjun toiminta riippuu suojausmahdollisuuksista.

Metodologia

Empiirinen osio toteutettiin case tutkimuksena, johon oli valittu Neste Oil Oyj. Tutkimus toteutettiin käyttämällä semistrukturoitua haastattelumenetelmää. Haastateltavat olivat Neste Oilin työntekijöitä kolmelta osastolta, jotka ovat tiiviisti osana toimitusketjua tai suojaamista.

Tulokset ja päätelmät

Kirjallisuuden ja haastattelujen pohjalta pystyttiin toteamaan, että jokainen osa öljy-yhtiön toimitusketjua altistuu joko markkina- tai valuuttariskeille. Lisäksi lähes jokaisessa toimitusketjun osassa toimitusketjuun vaikuttavat erilaiset suojausmahdollisuudet. Kuitenkin öljyn toimitusketjun monimutkaisuus luo isoja haasteita saada suojaukset vastaaman alkuperäistä riskiä, mikä tekee sujuvasta ja läheisestä kommunikaatiosta eri osastojen välillä äärimmäisen tärkeää. Siksi hyvin toimiva informaationkulku on tärkeä varmistaa.

Avainsanat

Riskienhallinta, toimitusketju, suojaaminen, case tutkimus, hintariski, valuuttariski, öljyalalla
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GLOSSARY

Crude oil: Is mostly produced through oil drilling and refined to broad range of different kinds of oil derivatives. Brent is the best known crude oil grade and is produced in North Sea. Oil production from Europe, Africa and Middle Eastern tends often to be priced on Brent basis. (www.wikipedia.com, 26.1.2012)

Commodity hedging: Protecting physical assets value from price fluctuations (Okochi, 2008)

Exchanges: Official market place for financial instrument's trade where buyers and sellers are able to find each other. Exchanges are regulated by broad range of rules and are monitored closely. In addition exchanges have only their own standardized instruments available for buyers and sellers. In oil industry ICE and NYMEX are the main exchanges. (Fusaro, 1998)

Forward contract: Financial instrument. Similar to futures but tailored on OTC-market (Mas and Sad-Requejo, 1995)

Futures contract: Financial instrument used whether to hedge or to speculate. Futures are standardized contracts with fixed delivery in future but price is agreed today. Traded through exchanges. (Mas and Sad-Requejo, 1995)

Hedging: Hedging can be divided to financial hedging and operational hedging. In this study Yakup and Sli's (2010) definition "an attempt to reduce the risk of an underlying transaction by concluding an adverse transaction in order to offset the risks" is used.

ICE Brent: Price quotation of crude oil futures traded on ICE exchange and is based on Brent crude oil's physical price. ICE Brent is the most used instrument to hedge crude oil price movements. (Fusaro, 1998)

Inventory hedging: Strategy of commodity hedging. Protecting the value of assets over their stocking period. (Gaur and Seshadri, 2005).

Operational hedging: Operational action that aims to reduce e.g. exchange rate exposure by delaying or reallocating capacity commitments (Ding et al., 2007).

Option contract: Financial hedging instrument. Buying an option instead of obligation to buy or sell in the future. (Mas and Sad-Requejo, 1995)

OTC: Over the counter- trade. Unregulated exchange place that coexists with official exchanges and provides a possibility to tailor instruments (Fusaro, 1998).

Platt's Brent dated: Daily spot price for physical crude oil from North Sea, which is called Brent. The most common price quotation of physical crude oil. (www.wikipedia.com, 26.1.2012)

Price risk (market risk): Adverse movement in interest rates, currency exchange rates, commodity prices, or equity prices (Ameer, 2010).

Risk: Remenyi and Haefield (1996) define risk as "the possibility that the actual input and the outcomes may vary from those originally estimated". However there are plenty of different concepts and definitions of risk. Risk can be considered as a natural part of the business environment (Kasanen et al., 1996, p 27).

Risk management: Is defined as "changing the distribution and probability of outcomes" (Kasanen et al., 1996, p. 73). Leads to avoiding, reducing, transferring, sharing or taking the risk (Jansson and Norrman, 2004).

Speculation: In a speculative position financial instruments are used in order to benefit from market movements without having a physical position to hedge (Fusaro, 1998).

Supply chain: Supply chain is defined as a "collection of activities a company uses to plan, source, make, and deliver a product or service" (Varma et al., 2007). In the oil industry supply chain includes all the activities from producing crude oil to the distributing refined oil products to petrochemical plants and retailers (Neiro and Pinto, 2004).

Swap: Financial instrument that is mainly traded on OTC-markets. Usually tailored to hedge a physical position and not usually used for speculation purposes. Swaps are used e.g. to hedge commodity prices, interest rates, and currency rates. (Fusaro, 1998)

1. INTRODUCTION

This chapter begins with the background information to the study. Subsequently, in addition to discussing about the purpose of the study, the second subchapter presents the research questions of the thesis. The third subchapter discusses shortly about the selected research method. Finally, the scope and the structure of the thesis are presented. The aim of the first chapter is to present the main ideas and targets of the study and represent how the thesis is constructed.

1.1 Background

In the present day the economic environment in which most firms operate is highly volatile and uncertain. This is much related to internationalization of business environments. Companies have benefitted of internationalization in many ways as the most countries have become more open due to reductions in trading barriers (Hutson and Stevenson, 2010). These benefits to companies include the possibility to broaden their customer base and to better optimize the cost structure of their operations (Hutson and Stevenson, 2010). On the other hand Hutson and Stevenson (2010) point out that thanks to the lower barriers, companies face increasingly competitive pressures from international companies. Also the management of supply chain has become more complex and challenging (ibid.). Additionally companies are more under an exposure to external economic risk (ibid.). This leads companies to be exposed to a wide variety risks such as exchange rate risk and commodity price risk which again have a great impact to companies' value. To protect themselves against the exposures to these risks many companies have established risk management programs (Kasanen et al., 1996). In addition risk management is gaining more attention due to several incidences like the bankruptcy of Enron. Furthermore, the importance of risk management is difficult to be understated. Companies can gain huge competitive advantage by conducting efficient risk management processes and practices and even companies' survival might depend on how or if they are involved in risk management.

During past few decades risk management and risk management tools and instrument have developed to a great extent. Risk management is a process which makes possible to influence these exposures of risks that affect to firm value. Risk management controls risk exposures

through hedging, and has therefore a possibility to increase firm value and thus shareholders' wealth. (Abid and Mseddi, 2010)

Worldwide reduction of trade barriers has developed regional, multi-country, and even global economic zones (Cohen and Mallik, 1997). And thus for instance from oil industry point of view, the whole North West Europe is one single trade zone. Another issue strongly affecting to today's trade is increased volatility in financial and currency markets (Cohen and Mallik (1997). Due to these and other massive developments Cohen and Mallik (1997) call global companies to adopt a new competitive strategy in order to survive in today's demanding business environment. In their article they also discuss about the high risks of adopting a global supply chain strategy (ibid.). In addition Cohen and Mallik (1997) note that more research regarding global supply chain problems is required. They also recognize major sources of difficulties in a global supply chain which include the complexity of physical movements, multiple sources of uncertainty, and different types of risks that must be taken into account like fluctuating price and demand, foreign exchange rates, development of technology, competitors' actions, and need for consistency between operational and financial hedging policies (ibid.).

Oil is the biggest and most important commodity in the world. Furthermore oil industry is one of the industries that is highly dependent on risk management in its volatile business environment. Until the beginning of 1970's the price of oil was very stable and fluctuated only between 5 and 15 U.S. dollars per barrel. However, after the oil crisis in 70's the crude oil price raised to the level of 10-40 U.S. dollar per barrel (Krichene, 2002). Furthermore the oil price fluctuations have increased dramatically recently and crude oil price has fluctuated even 100 U.S. dollars within one year. The year 2008 was a good example of this when crude oil price first increased from 90 U.S. dollars to 140 and then dropped below 40 dollars per barrel within just few months. From oil refining company point of view during the current period of high oil price volatility, risk management has become an essential element of company operations. Furthermore, it's not probably surprise that there're nowadays well-developed financial markets for oil derivatives that were developed to meet oil companies' financial risk management and hedging needs.

In addition to volatile markets oil companies face challenges also due to their complex supply chains. Oil supply chain is global and is characterised by long lead times and several sources

of possible unexpected changes. Further, both volumes and value of product in oil supply chain are massive. The complexity of supply chain, liquid nature of oil, and unexpected events in supply chain make hedging in oil supply chain highly challenging.

However, too often financial risk management activities are considered as an isolated part of actual core business processes and the interactions with core business processes are forgotten. For instance hedging is naturally connected to company's supply chain activities, especially in oil supply chain, but most of the hedging literature ignores the important connection to supply chain. This is the case even though financial risk management and hedging are widely studied subjects. In addition many studies have raised the importance of supply chain management to companies' success and therefore it is a field that has gained plenty of attention in literature over the past decades. However, also in supply chain management literature hedging is mostly left without attention. Furthermore due to high price volatility in oil markets which require oil companies to be involved in hedging and highly challenging oil supply chain, these two functions and their interactions require more attention and understanding. Increasing this understanding is the main objective of this thesis which is discussed more in detail in next subchapter.

1.2 Purpose and research questions

The purpose of the thesis at hand is to analyse and explore how financial risk management processes relate to oil company's supply chain. The aim of this study is to bring financial hedging closer to physical supply chain as even though there is plenty of literature of supply chains and hedging, the existing studies have discussed largely about these as isolated processes. Accordingly, little if any research has been conducted how financial risk management or hedging interacts with functions in a supply chain. However, there are some quite recent studies that discuss about the linkage between financial risk management and operational management. Hence, existence of the linkage is taken as an assumption to this study.

The objective of the research is to increase understanding how financial risk management is an integrated part of company's supply chain and how companies should take into account their standing in financial risk management when making decisions in supply chain processes. Furthermore, the key idea in this research is to recognize how and in which parts

of an oil supply chain hedging processes and practices are influenced by actions in a company's supply chain and in turn how supply chain is affected by hedging processes. In addition the thesis targets to shed light why hedging is an important part of oil supply chain and furthermore what are the challenges in oil supply chain regarding hedging. Especially the information flows and the point of interactions between these two functions are objects of interest in this study. The purpose isn't to study what are the sources of risks or why risk management is necessary, but to concentrate on how the practices and processes are affected by and affect to company's supply chain.

Given the above the key research questions of this study are:

- a) What are financial hedging processes and practices in an oil company's supply chain**
- b) How hedging is positioned in oil supply chain i.e. in which parts of the oil chain these two functions interact**
- c) How in different parts of oil supply chain hedging affects to decision making**

From an academic perspective, the objective of this study fill the gap in the literature that exists regarding hedging risk exposures in different parts of oil supply chain. In addition an academic objective is also to highlight a need for more research about the strong connection between hedging and oil supply chain. From a practical point of view the study aims to highlight the importance of information flow between functions involved in hedging and oil supply chain processes. The next subchapter discusses how the thesis aims to answer these research questions and fulfill these objectives.

1.3 Research method

This study is based on a literature review and qualitative case study including five semi-structured interviews. In literature review existing literature of risk management, concentrating mainly on financial risk management and hedging literature, and supply chain management are studied. These two fields are first studied in general and subsequently more in detail in oil industry environment. The main target of the literature review is present the main concepts of the study and explore what kind of literature already exists regarding hedging and supply chains in oil industry. Especially regarding financial risk management and hedging have been studied widely. However hedging in oil industry is much less studied issue especially in practical level. Oil supply chain has also gained some attention in

literature especially in logistics. In addition in literature review studies that discuss about connections between hedging and supply chain management are presented.

The empirical part aims explore hedging practices and processes in an oil refining company and find out how hedging and supply chain activities are connected in different parts of supply chain. A qualitative research method was chosen as the topic is relatively little studied phenomenon. In addition due to the nature of the research questions quantitative research method wasn't found to be applicable. Furthermore, the study is close to exploratory research. More in detail the research method is a single case study. A case study method is chosen to ensure an insightful and deep understanding of company's processes and practices in order to find if and what kind of interactions risk management department has with operational management and other parts of oil supply chain. The case company is a Finnish oil refining company Neste Oil. Further, semi-structured interviews were used as a primary method for collecting data for this study. Semi-structured interview method provides flexibility but still makes sure that the interviewees stay in the topic. To interviews the aim was to get comprehensive variety of people working in different departments involved whether in hedging processes or in supply chain activities. Neste Oil was found to be a suitable company for a case study as it has well established financial risk management processes and it uses financial hedging in an extensive way against price and exchange rate risks to which the company is highly exposed to. The research method used and the research process will be described more in-depth in the Research method chapter (chapter four) of the thesis. The next subchapter discusses about the scope of the study and presents the structure of the thesis.

1.4 Scope and structure of the study

Risk management is a broad field and there is a large variety of definitions of the concept of risk management. In order to keep the study manageable the study concentrates only on financial risk management. Also concentrating solely on financial risk management is judicious as operational risks are managed in a very different way and through different processes and practices. In addition operational risk management and supply chain management are relatively well studied areas already, whereas financial risk management in relation to supply chain management haven't raised much attention.

Also there are several financial risk groups that are left outside the study. The study concentrates only on financial risk management that involves financial hedging and therefore does not cover other literature of financial risk management as interest rate risk, liquidity risk or counterparty risk.

This study is divided into eight chapters. Followed by the introduction chapter the second chapter of the study concentrates on previous literature of financial risk management and supply chain management. Furthermore, the second chapter also aims to present the main concepts related to financial risk management and the tools that are used for hedging. In addition one target of the second chapter is to provide an overview of financial risk management and supply chain management in oil industry environment. The following chapter discusses about the relations and linkages between the concepts of supply chain management and financial hedging. The fourth chapter presents the research method and discusses how the research was implemented. In addition the limitations of research design are presented in the fourth chapter. The subsequent chapter presents the case company and basic concepts regarding Neste Oil's hedging practices. The empirical part and the findings from semi-structured interviews are presented in the sixth chapter. In the seventh chapter the findings from empirical part are discussed about and reflected to literature review. The last chapter provides conclusion of the study and presents the managerial implications and recommendations for further research.

2. LITERATURE REVIEW

This chapter provides a literature review of the main concepts of the study. First subchapter gives an overview of the concepts of risk and risk management according to previous literature of these subjects. Second subchapter concentrates more on financial risk management and its implementation and hedging. As this chapter aims to give more practical view to financial risk management, objectives and practices of hedging are described after representing the main concepts. Furthermore, commodity and currency hedging are discussed about in the end of second subchapter. The subsequent chapter discusses about the financial hedging processes in oil industry setting. In addition goals, practices, participants in hedging are presented. Finally the last subchapter concentrates on supply chain management concepts and practices in oil industry and illustrates the challenges in oil supply chain. The objective of the chapter is to give good understanding of concepts and phenomenon of the study.

Risk is a challenging concept to define as it has such broad variety of meanings and definitions. Thus it is common in risk literature that it is divided into different categories. In addition risk management is a relatively broad concept and in order to keep this study manageable the study concentrates on financial risks management and hedging that is a common practise as a part of financial risk management. Of financial risks only commodity risk, interest rate risk and exchange rate risk can be hedged of which this study concentrates on commodity risk and exchange rate risk and the practices and tools which are used to hedge these, namely swaps, options, futures, forwards.

Oil industry has several special characters which make hedging crucial for market participants. Oil industry is characterized by great price volatilities that expose oil companies to a massive commodity price risk. In addition the oil supply chain includes a lot of challenges due to globalization, long lead times and nature of oil. To meet industry participants' hedging needs there's well-developed financial markets and wide variety of instruments available. Hence in oil industry swaps, futures, options, and forwards are used extensively to hedge oil companies' exposures to commodity price risk and exchange rate risk exposures.

2.1 Concept of risk and risk management

This subchapter discusses about the definition of risks and studies different aspects and categorizations of the concept of risk. Furthermore the concept of risk management is presented and the risk management process is introduced. The aim is to present the basic concepts of which the main concepts used in this study are derived.

Risk is a challenging concept to define, comprehend, and in due course to manage. The origin of the challenge is that the term risk usually means different things in different situations and contexts. In addition, as Remenyi and Haefield (1996) point out, risk has different meanings to different people. Furthermore there is an enormous quantity of different definitions to the concept of risk. For instance Kuusela and Ollikainen (1998, p 18) define risk in their study as “a situation when negative outcome is unforeseen and inestimable”. However according to Remenyi and Haefield (1996) risk is defined as “the possibility that the actual input variables and the outcomes may vary from those originally estimated”. In their definition Remenyi and Haefield (1996) take into account that the outcome of a risk can actually be either positive or negative which is lacking in the definition that Kuusela and Ollikainen are using. Also the definition by Remenyi and Haefield (1996) points out that the magnitude of the risk is the possible difference between the expected value and the actual outcome. As in business environment risk means fluctuations (usually for instance prices or demand can whether increase or decrease) and therefore the definition used by Remenyi and Haefield (1996) is found to be more suitable in this study.

Also Kasanen et al. (1996, p. 55) note that a relevant element of the concept of risk is that risk doesn't always mean negative consequences as risk has as well a positive upside. Therefore when risk is eliminated by hedging or by other manners companies also eliminate the possibility to get the benefit if the situation changes in a positive way (Kasanen et al. 1996, p. 55). For instance when oil companies hedge their selling margins they usually lock the margin so that in the cases that price level increases the hedges prevent companies to benefit of this.

Risk is a natural part of business environment (Kasanen et al., 1996, p 27). Also Remenyi and Haefield (1996) point out that business risk is a risk that arises from the nature of the business undertaking itself. And as Kasanen et al. (1996) note companies face an extreme variety of

risks. Changes in demand and supply, price development, changes in legislation, and fires in addition to other possible damage make future of the business environment unknown (Kasanen et al., 1996, p 27). Furthermore only some of the risks are related prices (such as interest rates, exchange rates and commodity prices) as business risks include risks related to operations and products as well. The categorization of business risks is presented in Figure 1.



Figure 1: The categorization of business risks (Kasanen et al., 1996)

Ekwall (2010) defines business risk as “the likelihood of a negative incident combined with the economic impact of that incident” in his research paper. However Remenyi and Haefield (1996) use broader concept of risk when discussing about companies’ risks. They talk about organization risk which only includes business risk as a part of broader range of risks (ibid.). They see organization risk as a sum of business risk, financial risk, culture risk, structure risk, technology risk, and human risk (ibid.).

It’s important that companies recognize the sources of risks and find proactive ways to handle uncertainty (Kasanen et al., 1996, p 48). Likewise with the concept of risk there are many definitions mentioned in the literature that aim to define the concept of risk management (Remenyi & Haefield, 1996). Risk management is defined by Kasanen et al. (1996, p. 73) as changing the distribution and probability of outcomes. Furthermore in their view risk management doesn’t aim to eliminate all the risk but alters the probability and the directions of risks to match company’s own benefit. An example of this is that company buys or sells financial hedges so that changes in price actually benefit or neutralize its initial risk position. However Ekwall (2010) has relatively narrow view to risk management, he finds risk management as the risk handling process. Jansson and Norrman (2004) define risk

management as the process whereby decisions are made to accept a known or anticipated risk and/or the implementation of actions to reduce the effects or likelihoods of those risks. Furthermore in Jansson and Norrman's (2004) view risk management leads to avoiding, reducing, transferring, sharing or taking the risk. Also it is good to notice that risk management is a very broad term due to the wide range of risks and thus there are several categories of risk management as financial risk management (Panos et al., 2009), operational risk management, supply chain risk management (e.g. Jansson and Norrman, 2004).

Jansson and Norrman (2004) define risk management process as focusing on understanding the risks, and minimizing their impact. Kuusela and Ollikainen (1998, p 135) describe the risk management process as below:

1. Risk identification
2. Measurement and analysing
3. Controlling and finance
4. Evaluation
5. Cost calculations

In addition to Kuusela and Ollikainen (1998) also Jansson and Norrman (2004) emphasize the importance of risk identification and analysis. This is also mentioned by Kasanen et al. (1996). According to them it's important for companies to recognize the sources of risks and find proactive ways to handle uncertainty (Kasanen et al., 1996, p 48). According to Jansson and Norrman (2004) implementing actions to reduce risks probabilities or influences is an important part of risk management process.

This introduction has discussed the basic ideas and concepts of risk and risk management which are the basic concepts of the chapters. As the risk is such a broad concept the basic categorization of business risks was presented in this subchapter to narrow down the risks considered in this study. Moreover this subchapter discussed how in risk management literature the importance of risk exposure identification has been emphasized. Also as discussed in this subchapter the term risk is a very wide concept and thus this study concentrates only on financial risks and therefore the following subchapter concentrates on financial risk management as well as hedging and hedging practices and instruments.

2.2 Financial risk management and hedging

This subchapter concentrates on financial risk management and hedging. First the concept and categorization of financial risks and risk management is provided. Subsequently objectives and reasons of hedging are discussed about. Furthermore hedging instrument and practices are presented. This subchapter ends with a discussion regarding commodity hedging and exchange rate hedging. This subchapter aims to give insightful view what financial hedging is, and why and how it's been implemented.

2.2.1 Financial risks and financial risk management

Financial risks is only one category of a broad field of risks. Furthermore financial risks can be classified into three subclasses: credit risk, liquidity risk, and price risk. Yet, price risk can be classified into four broad classes: foreign currency, interest rate, commodity, and equity risk. Figure 2 illustrates the classifications of financial risks.

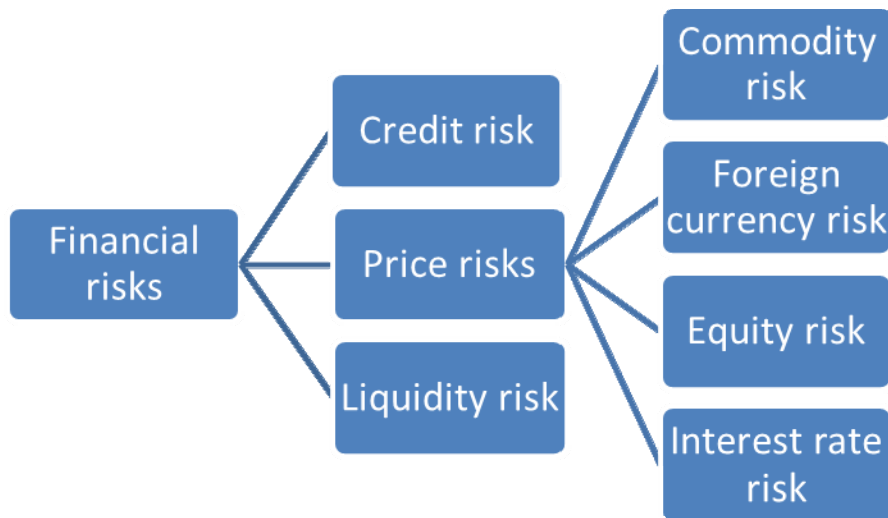


Figure 2: The classification of financial risks (Kasanen et al., 1996)

Credit risks are risk that companies face due to uncertainty of receiving all the payments of their sold products (Kasanen et al., 1996, p 30). Kasanen et al. (1996, p 30) define liquidity risk as a risk that company has no capability to settle its commitments when they are due. Price risks are risk related to interest rates, foreign currencies, or prices of commodities or equities (Kasanen et al., 1996, p 30). This study concentrates solely on price risks that can be hedged and thus only commodity and foreign currency risks are under the scope.

Price risks are also referred to as market risks. Ameer (2010) defines market risk as the risk of arising losses from adverse changes of prices and rates in the market. Adverse changes can include negative movements in interest rates, currency exchange rates, commodity prices, or equity prices.

For financial risk management there are many different kinds of definitions. Some researchers define it whether very broadly or narrowly which leads that there is no globally accepted definition of financial risk management (Yakup and Asli, 2010). However financial risk is such a complex and extensive concept that financial risk-management practitioners need often specialize themselves only to certain part of financial risk management as for instance foreign exchange risk.

Yakup and Asli (2010) point out in their study that over the last decade the business environment has become more and more global, which has not only enabled companies to gain access to new customers and to additional resource but also forced companies to cope with increased level of international competition and a growing diversity of international business risks as risks of fluctuating currencies, commodity prices and interest rates. This also raises the importance of risk management, financial risk management, and hedging (Yakup and Asli, 2010). However as Ameer (2010) points out that even though risk management has gained a lot of attention since mid-1970's most of the earlier studies of financial risk management have mostly concentrated on companies' foreign currency risk and only recently market risks such as commodity risk has gained more of attention.

According to Marshall et al. (1996) risk management should be one of the biggest concerns of CFOs. They list several of reasons why managers should pay more attention to risk management (ibid.). Especially they highlight the impacts of accelerating technological change, more volatile markets, globalization, and deregulation which all have led to increased uncertainty regarding risk exposures (ibid.). Also these changes don't affect only to financial forms but also to non-financial. Thus Triantis (2000) mentions several reasons why companies should manage their risks. According to his study financial risk management:

- Increases debt capacity and maximizes value of debt tax shields
- Helps to avoid costly external financing
- Lowers underinvestment costs associated in investment opportunities when financial constraints are present

- Decreases incidence of making value-decreasing investment decisions
- Lowers the cost of risk-compensation to employees
- Enables to get better contract terms with suppliers, customers, and employees
- Hedges the risk on behalf of shareholders that risk is not well-diversified
- Supports in meeting earnings targets
- Aids in meeting the industry and peer benchmarks

Kasanen et al. (1996, p 48) also point out that it's important that companies recognize the sources of risks and find proactive ways to handle uncertainty. According to them the length and method of bid and offering, the choice of supply and sell currencies and company's position in the market affect to its risk position (ibid.). Also, it's important to take into account that a company might end up having a risk position whether it is active at financial market or not (ibid.).

2.2.2 Objectives of hedging

Yakup and Asli (2010) define hedging in their research as “an attempt to reduce the risk of an underlying transaction by concluding an adverse transaction in order to offset the risks”.

According to Yakup and Asli (2010) increased risk exposures and increased hedging activity are consequences of internalization in of business environments. Also Yakup and Asli (2010) point out companies that have foreign sales, foreign income, and foreign assets are exposed to exchange rate risk (due to more of foreign currencies) and interest rate risk (due to higher leverage and lower quick ratios). These companies are also more likely to be exposed to commodity price risk as their market prices become more volatile (Yakup and Asli, 2010) Thus changing company's strategy to more international one means that the company faces an increased need to protect itself more against exposures to risks. Also Kasanen et al. (1996, p.17) recognize the impact of internationalization as according to them today's fluctuating exchange rates and interest rates make business planning even more difficult and those risks can have an significant impact to company's survival, whether negatively or positively. Usually the risk is whether transferred to a party that is capable to bear the risk or to a party that is hedging its own exposure in which case the risk exposure is being neutralized for both parties (Triantis, 2000).

Even though companies are facing increased number of financial risks Kasanen et al. (1996, p. 17) emphasize that companies are still able to affect to those impacts themselves, at least to magnitude of them. Nonfinancial firms might decide that that their core business risks is all they want expose to and they therefore want to mitigate market risk or ideally eliminate it altogether. Derivatives and hedges aren't only tools used by financial institutions such as banks and insurance companies, but also non-financial firms are using them to hedge their risks too (Yakup and Asli, 2010). For instance multinational industrial companies usually hedge at least their exposure to foreign exchange risk (Nathan, 2000). This is due to the fact that to companies that are involved in exports and imports, in particular, the changes in the exchange rates create a major risk (Ameer, 2010).

In addition, it is good to notice that usually companies can't be successful without accepting to take at least some risks. According to classical financial theory under perfect and complete markets companies shouldn't hedge their idiosyncratic risk on behalf of well-diversified shareholders and systematic risk should be priced in the market (Triantis, 2000; Boyabatli and Toktay, 2004). In this case corporate risk management programs or hedging wouldn't add any value to shareholders. Also according to Abid and Mseddi (2010) hedging can't reduce cost of capital as shareholders have access to same capital markets, to same information, and risk management tools as companies do. According to them shareholders should be able to manage all risks by themselves and therefore hedging doesn't create value. However, financial economists have brought up several explanations why corporate hedging is still rational or value creative. Most often market imperfection is used to explain the reasoning behind companies' hedging activity (Abid and Mseddi, 2010). Also Boyabatli and Toktay (2004) state in their research that market imperfections do exist which makes managing volatilities by implementing company level risk management programs rational. Practically due to market imperfections shareholders cannot diversify the risk themselves and the risk management can be only done efficiently by companies themselves.

Triantis (2000) finds financial methods to manage risk the most appropriate. According to Triantis (2000) using financial instruments provides significant benefits to companies such as corporate tax benefits, steady stream of cash flows which enables investing in a timely and profitable manner in future projects, and decreased probability of incurring bankruptcy or reorganization costs. Information asymmetry, taxes and transaction costs are the reasons which justify companies exercising risk management on behalf of individual company's

shareholders (Fan and Wang, 2011). Also Smith and Stulz (1985) argue that hedging can affect firm value, as hedging can affect tax liabilities, stakeholder contracting costs, and relationship between financial policy and future real investment decisions. Furthermore also Ameer (2010) mentions that hedging can increase a company's value by reducing external liabilities such as taxes paid to government and both direct and indirect bankruptcy costs. Hedging also reduces agency costs as it aligns managerial interests with the interests of capital suppliers (Ameer, 2010). Geczy et al. (1997) note that companies use hedging to reduce cash flow variations which could otherwise prevent companies to invest in different growth prospects. However the main reason why companies implement hedging is the motivation to reduce the variability of cash flows (Triantis, 2000). An alternative to hedging would be simply to reduce the amount of leverage the firm takes on but this could mean reducing its business operations (Triantis, 2000). As a conclusion it can be stated that due to several reasons mentioned above hedging risk can contribute to maximizing company's value. Boyabatli and Toktay (2004) state that increasing shareholder value by enhancing firm value through the management of risk exposures is the main objective of risk management programs. Therefore Ameer (2010) also points out that hedging should be an integral part of firms' risk management policy. Also Smith and Stulz (1985) suggest that hedging should be considered as part of companies' overall financing policy firms in order to maximize their value to shareholder. However considering hedging as an integral part of financing policy or risk management is probably not enough broad view because as discussed later hedging interacts with many other functions as well.

Hedging isn't always very simple and therefore improper management of processes can lead to even greater risk. In addition, risk management can be considered as managing the trade-offs between return and risks, so that value is created to stakeholders (Marshall et al., 1996). The main objective for firms to use derivatives is to reduce risk, especially the down side risk of markets. Generally when company hedges its exposure to risks it gets protected against downside risk but at the same time it also loses its upside potential (Huchzermeier and Morris, 1996).

2.2.3 Hedging practices and instruments

The first phase in financial risk management and hedging process is to identify and evaluate the risk exposure, which can be a difficult task (Okochi, 2008). Identifying the risks is challenging as companies are exposed to a portfolio of risks which contains both company specific risks and risks that are common to all firms in the economy (market risks) (Boyabatli and Toktay, 2004). When financial risks which exposure is meant to be hedged are under analysis, company must identify those risks that are subject to asset prices such as interest rates, exchange rates and commodity prices. After the pool risks are identified company needs to determine the correct hedging instruments to take onto use in managing their exposures. Thanks to the developed financial markets there are plenty of risk management tools and instruments available. Company can buy or sell financial derivatives as forwards, futures, options, swaps. Furthermore Boyabatli and Toktay (2004) mention that companies can take position in large cash balance or change its financial policy (Tufano, 1996) or hold debt in foreign currency (Geczy et al., 1997).

Derivatives are financial assets that derive their value from other assets. On the other words derivatives are financial instruments which change their market value depending on the price of actual variable like exchange rate, stock price or price of commodity (Yakup and Asli, 2010). When the price of oil increases because of e.g. decreased supply, the prices of oil derivatives increase as well. In particular, there are financial derivatives that are tailored contracts written over asset prices such as interest rates, exchange rates and commodity prices (Boyabatli and Toktay, 2004). Derivatives are used neither financing nor investing but to transferring price risk associated with asset price fluctuations (Mas and Sad-Requejo, 1995). Derivatives enable companies to reduce and transfer risk (Mas and Sad-Requejo, 1995). Economists mostly regard derivatives as a positive mechanism as they enable more precise pricing of financial risk and better risk management. And as companies are able to manage their exposures better, they are also able to plan their processes better and focus on their primary business (Okochi, 2008). Also as Mas and Sad-Requejo (1995) mention derivatives increase understanding and enable better measurement of risks.

Companies use hedging instruments as derivatives in order to handle and reduce the risks they must face in their business. Advances in financial theory have created wide variety of hedging instruments such as derivatives and made them easily available for market

participants. The derivative markets were developed in order to enable price detection and to facilitate risk pricing and hedging. As the markets for financial derivatives have developed well to meet the companies' needs, financial derivatives markets provide an efficient mechanism to transfer risk (Triantis, 2000). Furthermore as companies are nowadays more under exposure of risks, they are getting more involved in new financial instruments and thus in derivatives trading (Yakup and Asli, 2010). Also according to Triantis (2000) during the past few decades the usage of derivatives as an instrument to manage exposures to financial risks has grown massively. However as Boyabatli and Toktay (2004) point out financial markets have already existed for a relatively long time.

Also it is good to keep in mind that in addition to hedge risks derivatives can be used for trading and speculative purposes (Yakup and Asli, 2010). In financial markets there are several instruments developed to meet the participants' needs to hedge their exposures to foreign exchange rates, interest rates, and commodity prices or to their interest to speculate:

Futures contracts is financial derivative which means trading of deliveries that are in the future but the price is agreed already today. Like other derivatives, futures contract is an agreement to do something in the future, no goods or assets are exchanged today. However even though a physical delivery is possible, normally there's is no physical delivery and the delivery is settled so that only the price difference between positions is paid. Movements in commodities spot market prices affect to the value of bought or sold futures contract so that the rise in the spot price of the commodity benefits the party that has bought the futures and vice versa for the one that was on the selling side. For most commodities as metals, energy products, and grains have their own futures contracts. In addition futures contracts are available for most currencies. (Mas and Sad-Requejo, 1995)

Forwards are very similar to futures contracts. The main difference is that futures are mostly traded in exchanges as forwards are tailored and mostly traded in OTC markets, which are explained a bit later in this study. Also the cash flow mechanism is slightly different to futures. (Mas and Sad-Requejo, 1995)

Swap contracts are common financial instruments that mostly used for hedging instead of speculating. Swaps can be used e.g. to hedge commodity prices, interest rates and currency rates. As with other derivatives physical delivery is not usually the aim of a swap contract.

As companies aim to hedge their individual positions, swaps are usually made as OTC-trades where it's possible to tailor contracts. The participants make swap contracts as they have opposite views of future price development. Buying or selling a swap contract locks the price of opposite physical sale or purchase. Thus swaps are done to fix profit margins. The buyer of a swap benefits if the price increases whereas the seller gains if the prices decrease. (Fusaro, 1998)

And according to Okochi (2008) swap turned out to be the most successful of the financial hedging tools. Currency swaps have become to a three trillion U.S. dollar market. (Okochi, 2008)

Options are financial instruments which are used to buy a right, compared to an obligation which is a case with swaps and futures, to buy or sell the commodity or currency in an agreed price. Options are used to hedge both price and exchange rate risks. (Mas and Sad-Requejo, 1995)

Real options are not financial instruments. Real options are operational actions such as postponing assembly, delaying capacity commitments, reallocating capacity, or switching production locations that are also used to reduce company's exposure to price and other risks. Real options can be used together with financial hedges (Ding et al., 2007). However in this study real options are disregarded as the focus is in financial hedges.

OTC (over- the-counter) markets are unregulated markets compared to exchanges in which companies can make contracts to meet their own individual needs as long as they are able to find a counterparty that is willing to enter to a contract with them. Brokers are commonly used to find a counterparty. Most of the swap and option contacts are done on OTC markets as official exchanges can't meet companies' hedging needs with their standardized contracts. (Fusaro, 1998)

Exchanges are official market places for financial instruments. Exchanges have certain rules and even though exchanges usually have great amount of different kinds of instruments available they only have standardized contracts available. The main exchanges in oil industry are NYMEX and ICE. (Fusaro, 1998)

Whether companies use swaps, options or futures depends largely whether they are hedging long term debt or operational short-term transactions. Forwards and futures are relatively low cost instruments and are suitable to hedge frequent exposures and uncertain transactions. However, there is a basis risk when using forwards for the exposures of operating transactions which is caused by the differences between characteristics of the original transaction and the hedging contract such as maturity and payoff date. However the basis risk for operating transactions is fairly limited as the transactions are usually only for short term. In contrast customized swaps are more cost efficient for the risks related to long term debt contrast as they can be customized to match with the original exposure. Furthermore as each financial instrument includes costs, the cost of customizing one contract is usually lower than managing a portfolio of un- customized contracts. (Geczy et al., 1997)

However, when designing financial risk management strategy should also the costs associated with different instruments be taken into consideration. Geczy et al. (1997) mention costs related to the usage of financial instruments like liquidity costs, transactions costs, costs of customization, costs associated to basis risk and counterparty risk. They note when using customized and long term contracts liquidity, counterparty and counterparty costs increase whereas basis risk decreases.

2.2.4 Commodity hedging

It's characteristic for all business environments that feedstock must be purchased and paid before the final product is sold to customers (Kuusela and Ollikainen, 1998, p 202). This period between purchasing the feedstock and selling the product puts a company under an exposure of a price fluctuation which is the reasoning behind commodity hedging (Okochi, 2008)

Panos et al. (2009) highlight in their study that commodity risks have become more evident than before. For instance rapidly developing economies like China and India has driven up the global demand and prices. Also as Fusaro (1998) points out that companies face fluctuating markets caused by political, environmental and economic factors. As the risk exposures have increased the companies are aiming to manage their exposures better and hence avoiding increased costs or earning volatility (Panos et al., 2009). However, the development of commodity exchanges and emergence of wide availability of forwards and

other derivatives allows companies to meet these targets (Panos et al., 2009). Through the developed markets companies are able to hedge the price and demand uncertainties by using financial contracts as forwards, futures, swaps, and options as discussed earlier. Many commodities like agricultural products (corn, wheat, soybeans), energy products (crude oil, petroleum products), metals (aluminium, gold, copper) and softs (coffee, sugar, cocoa) have their own hedging instruments (Mas and Sad-Requejo, 1995).

The sale of an asset is hedged by purchase of put option or swap. The payoffs of these two offset each other and hence market price exposure is reduced. On the other words hedging reduces profit variances as physical commodity's price movement are offset by the commodity hedge's price movement. In addition it's been stated that hedging is more beneficial when the price of underlying asset is more volatile and the product has longer lead time. (Gaur and Seshadri, 2005)

Even though same hedging instruments and techniques can be applied to all interest rate, currency exchange and commodity price risk, the instruments used for commodity hedging differ from currency and interest rate hedging instruments in two ways. Firstly, commodity hedging is usually implemented by the purchasing manager than the corporate treasurer. Secondly, the instruments available to the commodity hedging can typically be traded maximum only one year forward whereas interest rate bonds for instance can be done for 30 years. (Okochi, 2008)

Also it's important to understand that hedging against risk exposures is not a same thing as speculative trading in which the aim is to make profit at the market. In addition it's not always worthwhile to hedge the commodity price exposures entirely as companies might also want to keep the some of the risk in order to benefit of possible favourable movements.

Inventory hedging is hedging the price risk of commodities during their inventory. It has been studied for instance by Gaur and Seshadri (2005). The main benefits of inventory hedging is that it reduces profit variance and increases expected utility. In addition hedging makes keeping bigger inventory levels profitable and thus increases the optimal inventory level. Furthermore, it's been stated that net inventory investment is decreased as the cash flows from hedges off set the financial investment in building the base inventory. Furthermore it's been found out that dynamic hedging decreases risk even when the initial inventory

commitment cannot be changed. According to these findings financial hedging is very suitable for hedging oil inventory's price risk. (Gaur and Seshadri, 2005)

Okochi (2008) points out that commodity hedging isn't always very straight forward and has often several challenges. Even defining the commodity price risk exposure which can be considered as a starting point of commodity hedging can be problematic (Okochi, 2008). After the exposures are defined and measured companies need to start analysis whether it is possible or reasonable to hedge the exposure. With commodities finding the appropriate instrument that actually hedges the exposure in the way company prefers isn't always that straightforward (Okochi, 2008). However, the efficiency of hedging strategy depends highly on the existence of a strong and stable correlation between commodity's spot and futures prices. With commodities there's a risk that company starts to use hedging instrument that actually isn't correlated entirely with the original exposure and therefore hedges just increases firm's risk exposure e.g. exposure to price volatilities (Okochi, 2008). In commodity hedging the financial instrument such as swap is meant to level out the changes in commodity's price movements but with a wrong instrument company might lose money from both hedging and actual commodity. Thus when designing risk management and hedging strategies correlation and volatility between commodity prices and hedging instruments are the most important factors to consider (Okochi, 2008). The efficiency of hedging strategy depends highly on the existence of a strong and stable correlation between commodity's spot and futures prices. If the correlation doesn't hold persistently or the level of correlation changes over time hedging loses its effectiveness. However, commodities futures contracts generally correlate very well with underlying commodity's spot prices (Gaur and Seshadri, 2005). For instance crude oil futures correlate excellently with crude oil spot prices as shown later in this work.

2.2.5 Currency hedging

Hutson and Stevenson (2010) point out that thanks to the lower barriers and business environments becoming more global companies are increasingly exposure to different kinds of market risks. Of these risks exposure to exchange rate fluctuations has become one of the key external risks (Hutson and Stevenson, 2010). Companies that have their operations in various countries and thus incomes and expenses in multiple currencies are exposed to foreign exchange fluctuations (Aytekin and Birge, 2004). In general all the exchange rates

and their fluctuations in a supply chain affect to the value of manufacturing supply chain. And as exchange rate fluctuations can be significant (1% in a day or 20% in a year) exchange rate fluctuations can have substantial impact on global companies' profitability (Ding et al., 2007). Furthermore, according to Aytekin and Birge (2004) fluctuations in relative value of currencies can have significant impact to company's value. In addition Huchzermeier and Morris (1996) mention that in real applications unpredictable and fluctuating foreign currency rates are often the most significant elements of short run changes in profitability and material flows. In addition exchange rate fluctuations can create unstable cash flows and even lead to a bankruptcy (Aytekin and Birge, 2004). Thus foreign exchange movements are often one of the primary concerns in global operations management. However in order to be able manage the currency exposures there are financial instruments such as futures and options available at well-developed financial markets (Aytekin and Birge, 2004). Currency futures exist for on all major currencies (Mas and Sad-Requejo, 1995). However according to Ding et al. (2007) currency options are the most used financial instrument for hedging currency exposures. Financial hedging contracts fix future cash flows in denominated foreign currency into the desired or domestic currency at the current spot exchange rate (Huchzermeier and Morris, 1996). Hence firms that use financial hedges are less affected by exchange-rate volatilities as the risk related to the exchange rate is reduced considerably through the hedges (Ding et al., 2007). In addition to eliminating fluctuations of an exchange rate, risk adverse companies pursue to utilize financial hedging contracts to reduce the volatility of cash flows and to stabilize net earnings (Huchzermeier and Morris, 1996). In addition to these financial instruments companies can also implement operational risk management such as building foreign production capacity (Aytekin and Birge, 2004). The exposure to an exchange risk begins when a company enters to an agreement and it lasts until the time that the final transaction is actually done (Huchzermeier and Morris, 1996). In oil business this can be considerable long time thanks to the long distance between supplier and customer.

Huchzermeier and Morris (1996) point out that hedging and protecting against risk also generates disadvantages. For instance if company's sales are weaker than expected and exchange rates move unfavourably can company face significant financial losses. Also Huchzermeier and Morris (1996) state that hedging makes firm's cost structure too predictable and can therefore increase the risk of foreign market entry. In addition if the company is not exporting or importing itself it is still impacted by currency movements as it can lose or gain competitive advantage compared to foreign competitors.

Companies aim to construct hedging portfolios that balance the marginal impact on expected profit and the total variance of the profit. In the cases when the foreign market demand is not dependent on changes in currency exchange rate, financial hedging reduces operations profit variance caused by the exchange rate fluctuations. Usually the aim of hedging the exchange rate risk is to decrease operations profit's exposure to currency fluctuation and thus balance the cash flow fluctuations from operations transactions and hence reduce the total variance of the profit, not to gain profit from financial markets. (Ding et al., 2007)

According to Mas and Sad-Requejo (1995) there are three types of foreign exposures; transaction exposure, translation exposure, and operating or economic exposure. Transaction exposure arises from a foreign exchange position that hasn't been settled yet (e.g. import/export commitments, receivables and payables, and foreign currency loans) (ibid.). Without hedging exchange rate changes between the time of commitment and settlement will affect the home-currency value of the transaction (ibid.). Translation exposure means an open foreign exchange position in a corporation's balance sheet (e.g. foreign currency assets and liabilities) (ibid.). Operating or economic exposure arises from unexpected movements in exchange rates affecting to company's value (Mas and Sad-Requejo, 1995). For instance a company might lose competitive value in foreign markets due to exchange rate movement. Hence the source or exchange-rate exposure affects what kind of derivative company ends up to use (Geczy et al., 1997). Transaction exposure companies to numerous frequent transactions like receivables of sales or payments of purchases (ibid.). In contrast a debt exposure is usually a single or only a small number of transactions with a known timing (ibid.). As companies know the length of the exposure when entering a foreign debt contract they are able hedge in long term strategy with relatively low basis risk (ibid.). This is a contrast to operating exposure which requires dynamic management in order to minimize the costs associated with basis risk (ibid.).

This subchapter discussed about the subjects regarding financial risk management and hedging. In addition to introducing the definitions and concepts of financial risk and risk management the growing importance of these was discussed about. The main reason to the growing importance is the increased risk exposures caused by the globalization of business environments. In addition financial risk management includes several benefits. Next the objectives of hedging were discussed. The increased cash flow uncertainty due increased price and currency rate fluctuations are seen as the main drivers behind hedging. Later on the

instruments and practices to implement hedging were presented. Hedging is usually implemented by buying or selling a derivative (swaps, options, futures and forwards) that is opposite to physical or initial cash flow position. The subchapter ended with introduction of commodity hedging and currency hedging which both have gained greatly more importance since the internationalization of industries. Commodity hedging is important due to high price fluctuations whereas currency hedging can be crucial to company's survival due to increasing part of business done in foreign currencies. After the main terms and concepts are introduced the next subchapter will concentrate financial hedging objectives, benefits, and practices in oil industry.

2.3 Financial hedging in oil industry

This subchapter concentrates on financial hedging in oil industry. First reasoning and importance of financial hedging is discussed about. Later the hedging practices as instruments their usage and market places are presented. Finally the different participants and their motives in oil market are discussed about. The aim of this subchapter is to give an overview of financial hedging and how it is used in oil industry. In addition different market participants' motives on oil markets are described. The target of this subchapter is to give insightful overview of who is doing what and why in oil financial markets.

2.3.1 The aim of hedging in oil industry

High price volatilities are characteristic for oil industry (Verleger, 1993). Even though some of the volatility can be predicted (such as seasonal trends in demand and changes in OPEC's supply policy), some of the volatility is difficult or impossible to predict (for instance a war in one of the supply countries (ibid.)). In addition price volatility is also increased by some big participants' actions in the market (ibid.). These big players have significant power in the market compared to vast majority which actions have no pricing power (ibid.). Ferderer (ibid.) study concentrates on oil price volatilities and he for instance concludes that crude oil price volatility has increased dramatically. For instance the standard deviation of the real crude oil Producer Price Index growth rate in the post 1980 period was approximately three times bigger than the standard deviation pre 1980 period (Ferderer, 1996). Also Fusaro (1998) notes that the Gulf War in 1991 confirmed that price volatilities and supply uncertainties will stay as a component of oil business environment.

The Figure 3 illustrates the volatility in oil prices between 2008 and 2011 and as can be seen from a picture the price has fluctuated as much as 100 U.S. dollars/bbl in a year in 2008. Furthermore it seems that price fluctuations are here to stay as the oil demand has increased and especially in developing countries and as the industry environment has become even more unstable of which the unrests going on in North-Africa are a good example. In addition at the moment there's no indicator of volatilities to decrease. This raises the importance of proper risk management systems.

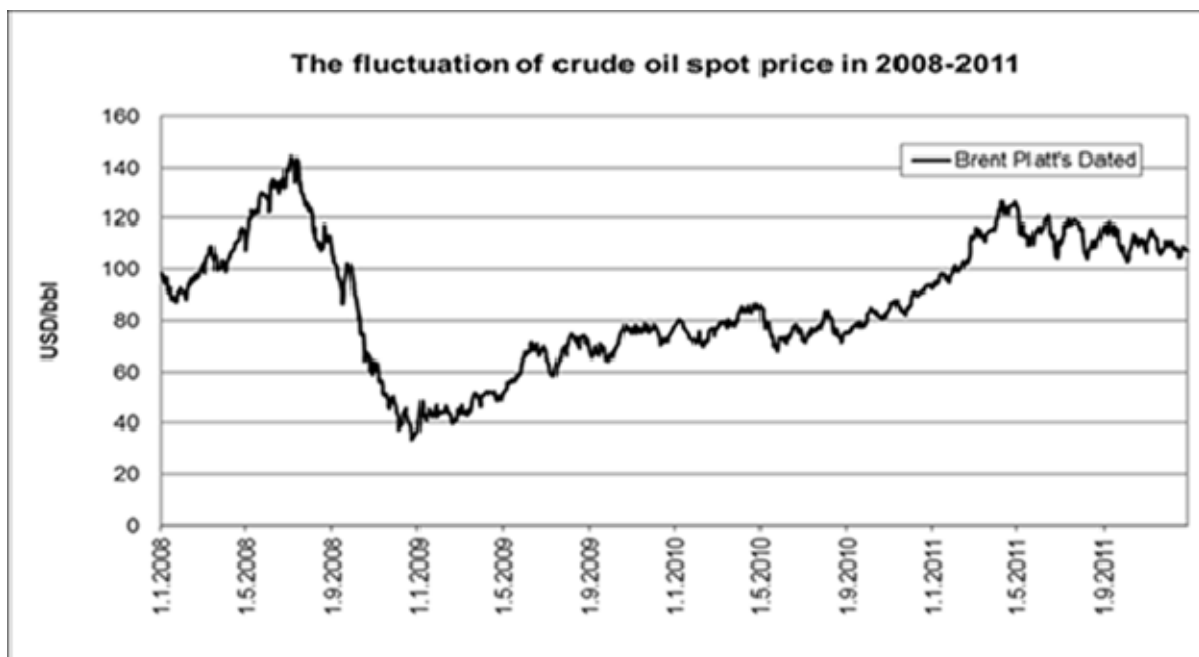


Figure 3: Crude oil price volatility (source EIA)

Due to the high volatility participants in the oil market have started to search for methods to hedge their exposure to it which started the development of forward markets to coexist with spot markets (Verleger, 1993). In oil companies perspective financial markets provide a mechanism to protect themselves against the price fluctuations that could have unwanted affect to their costs or profits. Also according to Fusaro (1998) financial instruments are necessary tools of the energy trade in today's uncertain and volatile energy markets. Thus according to Fusaro (1998) due to the high volatilities it is unacceptable for energy companies not to hedge. Also it's worthwhile to notice that financial tools aren't new in oil markets, however the applications of tools and technologies have developed (ibid.). Furthermore already in the beginning of 90's 75% of oil refiners were using currency derivatives (Geczy et al., 1997)

2.3.2 The hedging practices in oil industry

In oil industry oil is traded through various different types of markets and contracts. Thus the oil market consists of following four markets and two exchange possibilities:

- Spot-markets
- OTC-markets/ exchanges
- Forward markets
- Futures markets
- Option and swap markets

Spot market means markets of physical crude oil and refined products in which physical oil is sold and bought to be delivered in relatively near future. Crude oil is usually sold close to the point of its production on FOB-bases. Furthermore crude oil price is typically determined of spot prices quoted right after loading the cargo. However as the price is formed close to its production while the delivery time can be long, might the oil price have fluctuated significantly before it reaches the refinery. The difference between spot and forward markets is the delivery of the product. In forward markets the physical delivery is not the aim of the trade even though it is possible as well. In addition in forward markets trades are done even years in the future whereas on spot markets the delivery is usually latest within next a couple of months. (Verleger, 1993; Fusaro, 1998)

In both physical spot markets and financial derivatives markets there are four major grades (WTI, Brent, Dubai and Tapis) which are also reflecting the most important crude oil supply areas (Chang et al., 2010). There are two major exchanges of financial oil contracts; the New York Mercantile Exchange (NYMEX) and IntercontinentalExchange (ICE) (Campbell et al., 2006). The most traded crude oil futures contracts are West Texas Intermediate (WTI) which is traded in NYMEX and Brent that is a European grade traded in ICE (Campbell et al., 2006). The financial markets for oil are well-developed and have very good liquidity. These exchanges offer a possibility to trade and hedge oil price for years in the future (on ICE there were contracts available for December 2019) (www.theice.com). In addition the entry barriers to the market are low and credit risks can be mitigated. Actually dollar volume of market turnover is higher in oil markets than in any other commodity futures market. However the oil exchanges seem a lot less liquid compared to other commodities when measured by turnover relative to production (and contracts with long delivery dates are even less liquid). However, as Campbell et al. (2006) state in their article oil financial markets aren't complete.

For instance there are several crude oil grades that don't have their own contract. Also there are contracts available only for relatively short-term (Campbell et al., 2006).

In their article Campbell et al. (2006) aim to explain why the liquidity in oil exchanges is relatively bad compared to the production volumes. First of all oil producers might avoid hedging as they can't hedge the price of their imports (ibid.). Second conclusion they made was that state-owned producers are more concerned about the benefit of upward price movements than what they are worried about downward movements (ibid.). In addition oil companies do not want to take a risk of under-pricing their national asset (Campbell et al., 2006).

OTC (over-the-counter) markets, that developed and gained liquidity during 90's and early 2000, are used to make swaps and options contracts that aren't available through exchanges (Campbell et al., 2006). The exchanges have only very standardized contracts available while usually oil derivative swaps and options are more used for hedging purposes than to take speculative positions and usually help until their maturity (Campbell et al., 2006). Thus exchanges aren't able to meet the need of individually tailored contracts that participants in the oil markets usually need to hedge their company specific risks and positions. As OTC trades are done directly (or through a broker) between counterparties and therefore they are able to construct any kind of contracts they want. Furthermore according to Campbell et al. (2006) most (or even as much as 90%) of the swaps and option contracts are OTC deals. Thus OTC markets are an important source of liquidity on financial oil markets. However, usually even OTC contracts do not extend many years to the future (Campbell et al., 2006).

Claessens and Varangis (1994) point out that futures and other oil-derivative markets are the best indicators of future prices. Futures oil prices are prices of specified quantity of specified quality and grade of oil delivered at a specified time to a specified location (Claessens and Varangis, 1994). This way the futures contracts can be standardized. Futures contract is a commitment to sell or buy an agreed quantity of a standardized commodity at specified time in the future at an agreed price that is decided when making the futures contract. Futures on exchanges are standard (for 1,000 barrels of certain quality delivered on contract month and year). A futures contract is a financial derivative of the commodity on which it is based. E.g. ICE Brent futures are based on Brent crude oil spot price.

As discussed earlier in this work it is highly important the instrument used to hedge the commodity must correlate with commodity's actual spot prices. Futures contracts can be considered to represent spot-prices very well. Figure 4 illustrates how the price of hedging instrument (ICE Brent 1st line) correlates with the commodity spot price (Brent crude oil).

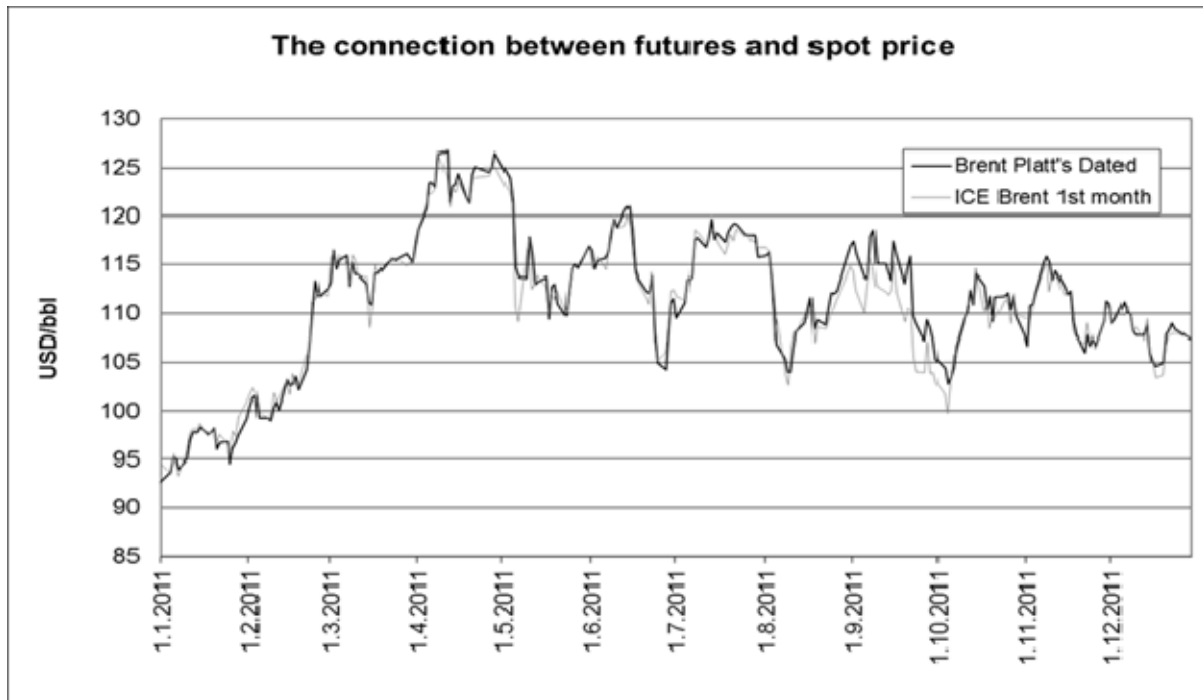


Figure 4: Crude spot price and futures correlation (source EIA)

As the Figure 4 above illustrates the correlation between Brent crude oil spot price and ICE Brent 1st line is greatly strong. Therefore ICE Brent is the most used instrument to hedge crude oil price movements. In addition when the daily movement isn't identical, it's at least to the same direction. Although the prices between spot and futures are correlated, correlation changes over time which is very difficult to avoid.

Claessens and Varangis (1994) state that due to fat tails in the oil price distribution it is more efficient to use financial hedging instruments instead of holding low-yielding assets as reserves in order to hedge risk exposures. Option is a good instrument to hedge against spikes or sharp drops in spot prices. Oil producer can buy a put option and pay premium of a right to sell the option if the price level drops (Campbell et al., 2006). An oil consumer would hedge its oil purchase by buying a call option. However as options can be tailored to meet the individual requirements they have many means of usage (Campbell et al., 2006). In addition to options, oil producers use swaps as an easy way to hedge future incomes (Campbell et al.,

2006). An oil producer that is selling physical oil uses swaps to lock in the price by selling a swap and thus receive a fixed price and while paying the floating spot price in return (Campbell et al., 2006). If the swap and physical delivery are pricing at the same time they eliminate together the impact of price fluctuations as while the physical delivery is pricing in and the swap is pricing out (Campbell et al., 2006). On the contrary, an oil consumer could want to lock in the price of its oil purchase and buy a swap (Campbell et al., 2006). However if it turns out that the physical delivery and the swap do not price simultaneously is the company's exposure to price fluctuations only increased. It's also worthwhile to notice that as the liquidity for oil futures, options and swaps is currently very good, is there a good ground for them to develop further. (Fusaro, 1998)

As the oil industry is developing for instance due to the emerged market for bio and renewable fuels, is there are need for r risk management to develop as well. For instance new instruments to hedge these new products and feedstock are emerging to the markets. Even though the liquidity in financial markets is good there's problem with a lack of reliable data for instance regarding oil reserves. The lack of reliable data is worrying as relevant data is often crucial in developing confidence and therefore liquidity in any financial market. Data affecting to financial oil markets is data regarding e.g. oil reserves, oil consumption, and trading. In their research Campbell et al. (2006) mention that countries and oil companies might over estimate reserves in order to affect their production quotas or share prices. Similarly, sometimes it is difficult to get reliable data of oil producers' and countries' inventories or production quantities. Even though hedging is widely used in oil industry Campbell et al. (2006) state that the most of future oil production will still not be hedged. However, in their study they didn't find any failures in forwards markets that would explain the low involvement in hedging markets (ibid.). And as discussed earlier oil forward markets are actually very well developed and more liquid than many other commodity futures markets. In their article Campbell et al. (2006) also suggest that low hedging activity might affect increasingly to forward prices and even restrict future oil supply.

2.3.3 The hedging participants in oil industry

Nowadays there are plenty of participants using financial oil derivative instruments. Campbell et al. (2006) recognize many participants in their article for instance oil companies, oil producers, oil consumers (e.g. airlines) hedge funds, and trading companies. According to

Campbell et al. (2006) all these participants at the market have distinctive objectives and practices in the market. For instance oil producing companies are involved in the market at different degrees, and often as both buyers and sellers. Oil producers gain informational advantage in many trades due to their insightful knowledge of oil production. According to Campbell et al. (2006) oil producers do not generally hedge their future production. The reason for this is that their oil companies' shareholders wish oil producers to keep exposure to price movements and thus benefit from upward price movements i.e. having shares of oil producer would be taking a speculative position. However oil producers manage their cash flows by hedging around their delivery schedules. Therefore national oil producers for instance in Middle Eastern and South American countries are involved in OTC markets, but only to a limited extent. In addition Campbell et al. (2006) found out in their study that countries do not significantly hedge their oil consumption needs but they might hold strategic oil stocks.

According to Campbell et al. (2006) smaller independent oil producers or exploration companies are more involved in hedging than large oil producers as they want to ensure steady incomes in order to satisfy their financiers. Also smaller oil companies' profit might more dependent on oil price and thus they tend to hedge more of their production. In their study Campbell et al. (2006) give an example of an UK-based oil producer that stated to hedge 20% of its production. However oil refiners that are in the middle of oil supply chain are willing to use hedges as for them it is possible to hedge both purchase of crude oil and other feedstock and the refined products and thus transfer the changes in price down the supply chain. Some of the major global oil consumers like airlines are participating in oil derivatives markets and use oil futures, options and swap to hedge their exposure to increasing oil price (Campbell et al., 2006). However they are relatively small players compared to the major investment banks and oil companies. In addition Campbell et al. (2006) are sceptical regarding their usage of markets to hedge their longer-term exposure to the future oil price. According to Campbell et al. (2006) for instance airlines are not willing to hedge for several years forward even though hedging would reduce cost volatility. The main reason for this is that there is no forward market for airline tickets and therefore if oil price goes down they are stuck with expensive hedges and aren't able to transfer the cost to ticket prices without becoming too expensive compared to competitors. However some big investment banks are involved in oil derivative markets both as dealers and as taking exposure to price risk themselves (mostly only in cases when they haven't found a second

counterparty to a deal in which they are as a dealer). Also hedge funds are increasing their participation in oil derivatives markets. They usually take positions only on the most liquid segments and products. As the oil derivatives market provides numerous opportunities for hedge funds and other traders to take views and find arbitrages and thus the hedge funds and banks have started to increase their positions which has increased the speculative nature of oil markets. In addition specialist oil trading firms, pension funds, and asset managers participate to oil derivatives markets.

Oil producers need forward markets to ensure the value of the investment. There's always a risk that after investing in oil production capacity the oil prices fall and thus making the investment unprofitable. The risk of falling oil prices might limit companies' interest to make investments in their production capacity. The risk in capacity investment is significant in oil industry where it takes considerably long time before the oil well is in commercial production while the price volatilities are very high. In addition there's no alternative usage for oil production facilities and investments are huge. Oil derivatives markets provide oil company a possibility to sell futures contract and thus lock the price of its future production and consequently ensure its investments profitability. However as Campbell et al. (2006) note in their study, oil producers do not seem hedge their future production. An evidence of this is that in the end of 2005 in ICE and NYMEX combined there were outstanding futures contracts equivalent only 4% of that year's global oil production volume. Secondly most of the Oil futures contracts exist only 15-18 months to the future which is relatively short time compared to other commodities futures and which isn't long time enough for oil producers to hedge their whole future production, at least through an exchange, as an oil well can produce oil for n decades (Chen et al., 1987).

In addition for instance in early 1990's Venezuela always had its next five month's export volumes hedged by options. Furthermore in 70's and 80's a big part of Venezuela's economic management was focusing on how to accommodate the changes in the global oil prices. Big part of Venezuela's tax income was coming from oil producers and refiners. And in 1992 80% of government revenues were coming from oil related activities. It is easy to see that fluctuations in oil price had huge impact on government's budget and investments. For Venezuela implementing financial hedging was crucial in order to reduce the impact of price fluctuations. (Claessens and Varangis, 1994)

This subchapter started with a discussion what is the main incentive for oil companies to hedge. Basically the increasing and very unpredictable price volatilities encourage oil companies to hedge their oil sales and purchases. Next the hedging practices were described i.e. the exchange types and used financial instruments are presented. The subchapter ended with discussion of different market participants such as oil producers, refiners, customer (e.g. airlines and shipping companies), and hedge funds. This far the study has concentrated on risks and financial hedging, thus the next subchapter concentrates on other main concept of the study, namely supply chains in oil industry. Especially the chapter concentrates on special characteristics of oil industry supply chain which again increase importance of hedging in oil supply chain.

2.4 Supply chain in oil industry

The last subchapter reviews oil industry supply chain. First the structure and logistics of the supply chain is studied which assists to understand the challenges and uncertainties in the supply chain which are studied next. The subchapter continues with discussion of oil price volatilities. The goal of this subchapter is to explain how the oil flows from crude oil production to end customers and what are the special characters in the chain causing great uncertainties.

2.4.1 The structure of oil supply chain

The supply chain council defines a supply chain as “a collection of activities a company uses to plan, source, make and deliver a product or service” (Varma et al., 2007). According to Manuj and Mentzer (2008) global supply chains face more risks than domestic supply chains since global chains usually are great networks that involve many companies connected to each other. Furthermore, these linkages are exposed to disruptions, macroeconomical and political changes, breakdowns and so forth, which gain lead to higher risks and make risk management more challenging.

Demand for oil and its derivatives is global since they are an essential source of energy and raw material for a large number of other industries (Hussain et al., 2006). In addition the demand for oil is global and in developing countries oil and its derivatives demand is increasing vastly all the time (Hussain et al., 2006). In addition the barriers for global oil derivative markets have basically vanished (Hussain et al., 2006). These two elements enable oil producers and refiners to globalize their markets and increase their market share and profitability (Hussain et al., 2006). Thus crude oil and its derivatives’ supply chain usually involves different continents (Hussain et al., 2006). Neiro and Pinto (2004) define oil supply chain as chain of global companies that connect crude oil production facilities to refineries and from refineries from which refined oil is distributed to petrochemical plants and up to end product markets like retailers. Oil supply chain includes all activities related to oil production and processing, in addition to storage and transportation to demand sources (Al-Othman et al., 2008). Furthermore Hussain et al. (2006) highlight that the supply chain of the oil industry is extremely complex when compared to the supply chain of many other industries. Due to the global nature and numerous players and activities involved, oil supply chain can also be seen as a network (Neiro and Pinto, 2004).

Hussain et al. (2006) divide petroleum's supply chain into two major segments, the upstream and downstream supply chains, which are nevertheless closely related. The downstream supply chain includes all the processes starting from the refinery onwards whereas the upstream supply chain consists of the processes before product reaches the refinery (Hussain et al., 2006). The refinery is the place where the crude oil is manufactured into end products (diesel, gasoline etc.) or components for other refineries (Hussain et al., 2006). The upstream supply chain includes the acquisition of crude oil which is the main raw material of petroleum products (Hussain et al., 2006). In general upstream process consists of exploration, forecasting, production, logistics management and delivering crude oil from distant oil wells to refineries (Hussain et al., 2006). The downstream supply chain includes forecasting, production, logistics and delivering the petroleum products to customers around the world. Both supply chain segments include various challenges, especially in the logistics area, which is much more challenging in petroleum industry compared to many other industries (Hussain et al., 2006).

On its supply chain oil passes through all necessary logistics such as warehouses, pipelines and carriers (Neiro and Pinto, 2004). Commodities like oil, gas, and petrochemicals require specific modes of transportation due to their special character and oil is traditionally transported by ships, trucks, pipelines, or railroads (Hussain et al., 2006). Neiro and Pinto (2004) and Al-Othman et al. (2008) describe oil supply chain more in detail in their studies. According to Neiro and Pinto (2004) the actual starting point of the supply chain is the crude oil production facilities which locate in numerous locations around the globe (Al-Othman et al., 2008). Produced crude may be categorized into different grades, and each grade has specific processing requirements and markets as each refinery has its own special crude and other feedstock mix requirement (Al-Othman et al., 2008). The vast major of crude oil is transported by oil tankers or pipelines from production facilities to refineries' terminals located around the world whereas the small quantity will go to local terminals (Al-Othman et al., 2008; Neiro and Pinto, 2004). From terminals crude oil is transferred by pipe to the refinery's storage (Neiro & Pinto, 2004). At refinery crude oil and other feedstock are processed to petroleum products (Neiro & Pinto, 2004). After refining, the products are whether sold locally, sold to petrochemical plants as a feedstock, or sold to global markets (Al-Othman et al., 2008).

Obviously, markets for different refined products are distinct, and conditions and locations vary between these different markets (Al-Othman et al., 2008). For oil companies it is typical to sell the product before it is produced and thus let the sales department to optimize the product mix (Al-Othman et al., 2008). Other option is to make a monthly plan before selling the product (Al-Othman et al., 2008). After refining the most common transportation methods are vessels, pipelines, trains, or trucks (Neiro and Pinto, 2004). Figures 5 and 6 illustrate oil supply chain as described above.

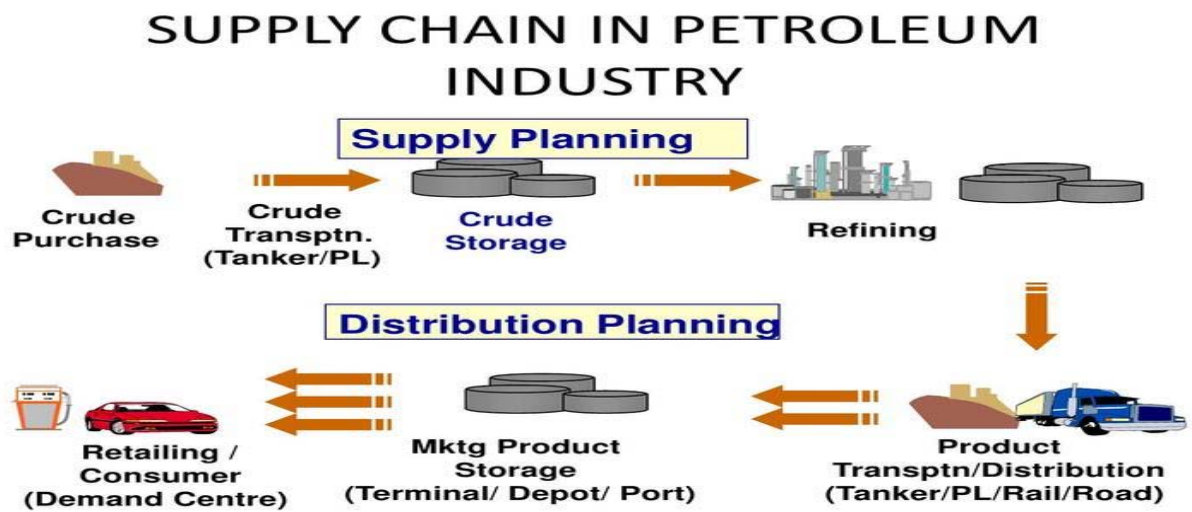


Figure 5: Supply chain in oil industry (Vaghasiya & Yadav, 2010)



Figure 6: Simplified supply chain in oil industry (Vaghasiya & Yadav, 2010)

2.4.2 Challenges and uncertainties in oil supply chain

Oil is distributed long distances by pipelines, vessels or tankers, and railroad as crude oil and gases are found and produced only in specific and limited areas of the world but are however demanded all over the globe. The distances between supply chain partners are vast and transporting oil is slow no matter which mode is being used. Therefore a lead time of several weeks from the shipping point to the final customers' location is very common in oil industry. Also due to great distances and special requirements of transportation mode

transporting oil is expensive. The great distances between supply chain partners also create a high variability of transportation times. As production capabilities are often very limited and transportation takes significantly long time and requires special modes of transportation is the logistics in an oil supply chain very inflexible. Also long lead times and supply chain's inflexibility require high safety stocks which naturally increases costs. Furthermore due to these reasons and global business environment the oil supply chain has several challenges which again raises the importance of information flow from operational management for risk management as otherwise the timing of hedging processes is challenging to get right. (Hussain et al., 2006)

However Hussain et al. (2006) state that even though the supply chain management is highly important due to the high and even growing complexity of the supply chains, the management of supply chain in oil industry is still need for a lot of development. Due to the long lead time, limited manufacturing capacity, limited means of transportation (special tankers are needed to ship oil) oil supply chain is very inflexible and difficult to adjust (Hussain et al., 2006). Also there are lots of variables in oil supply chain that are difficult to predict. Inflexibility in the supply chain is the constraints involved along the chain, such as long lead-times, manufacturing capacity, and limited means of transportation, that are hard to change (Hussain et al., 2006). For instance at the starting point of the supply chain at crude oil production site changing weather conditions, delays in loading or discharging operations, vessels' queuing problems, can create problems. Also crude availability and quality create great amount of uncertainty (Neiro & Pinto, 2004). For instance in crude oil production interruptions are common for instance in Middle East, which is the largest oil producing region, where political unrests make sustainable oil supply highly unpredictable (Hussain et al., 2006). This was seen also in 2011 as in Libya oil supply was stopped during the civil war. Due to supply chain inflexibility and unpredictability oil and petrochemicals companies are required to maintain high safety stocks and be alert to be able to search for alternative sources of supplies. Also Jenkins and Wright (1998) note that refining capacity is difficult to adjust quickly if the market changes. These factors raise the unique aspect of high degree of uncertainty that is very characteristic oil supply chain systems. Uncertainty flows through the supply chain network from the supply side, to processing and production facilities and finally to the refined products' market prices and demand (Neiro & Pinto, 2004). As oil supply chain includes so much uncertainty is hedging processes difficult to implement without getting up to date information from production planning. Also Hussain et al., (2006) point out in their

study that even though oil and petroleum industry play very important role in our society and oil supply chain is significant for part of the industry, it has gained very little attention in operations and supply chain management literature.

2.4.3 Price fluctuations in oil supply chain

Before the 1970s price shocks caused by major supply disruptions oil industry was highly concentrated and vertically integrated as some big players dominated most components in oil supply chain. Companies were able to use linear optimization and refinery yield maximization to make decent profits. Stability also kept prices low and fluctuations relatively moderate (as mentioned earlier before 70's the crude oil price fluctuated between 5-15U.S.dollars/barrel). However the 70's brought several changes to the industry which altered the oil industry structure and fundamentals and made the majors to lose the control of crude prices; OPEC was formed, margins dropped due to decreased gasoline demand, more developed technology started to play a role, and hedging and more advanced trading techniques emerged. All these changes triggered a great increase in price volatility and the price ranged between 10-40 U.S. dollars/barrel which meant high increase in companies' oil price exposures. (Kafoglis, 1999; Kirschene, 2002)

Oil price is an important macroeconomic issue which reflects current situation in global economy like the worries of development of conflicts in far-east or the situation with European financial crisis (Campbell et al., 2006). The oil market price fluctuates according to supply and demand of both crude oil and refined products (Campbell et al., 2006). Oil prices are also affected by trading consideration, political stability, OPEC's production decisions and terrorism (Varma et al., 2007). In addition trader's speculations can have huge impact both to crude oil and consumable products' prices (Varma et al., 2007). Also the oil price fluctuates nowadays enormously and its development is highly difficult to predict (Campbell et al., 2006). For instance in 2003 crude oil was about 30 U.S. dollar and increased \$60 by year 2006 (Campbell et al.,2006) and was in the end of 2011 around 110U.S. dollars/bbl.

There are several global main spot markets which use standard trade terms regarding for instance quantity and quality in order to offer an efficient way for seller s and buyers to find each other in this global market (Verleger, 1993). In spot markets the participants are buyers (consumers as oil companies and air lines and refiners) and sellers (oil refiners and oil producers) (Verleger, 1993). In oil industry the prices of physical deliveries are based on

price quotations that are published in a determined pricing window. Usually pricing window is linked to the loading date which can be estimated but not known for sure at the time when contract is done as the schedules of vessels and loading operations can't be predicted with total certainty. Therefore at the time when the contract about oil trade is done both the pricing window and price are still unknown. Also the pricing dates can be quite distant in the future thanks to the long supply chain which exposes oil company to a great market risk. Thanks to the pricing structure in oil industry it is obvious that companies need to hedge their exposures to market price fluctuations. However, it is important to note how exposures that need to be hedged are vastly linked to the physical deliveries.

As Schwartz (2000) points out it takes five weeks for an oil tanker to sail from Persian Gulf to United States. And as the price of oil is highly volatile can the value of a cargo be significantly higher or lower when it arrives to its buyer compared to the price that it had in origin. Also oil market price level can change greatly during processing and delivery which also take up to three weeks (Schwartz, 2000). Furthermore according to Jenkins and Wright (1998) it takes nine months from purchasing crude oil before the oil derivative is sold to final retail customer. Refiners like Neste Oil encounter numerous risks associated with the volatility of the international oil prices. These continuous changes in the crude oil and product prices create uncertainty in various parts of the oil chain and have thus a significant impact on the profitability of the business (Neste Oil Annual Report, 2010). The refining margin (= premium of refined products compared to the cost of feedstock) is the most important determinant of the refiner revenues and therefore forms a significant economic oil price risk (Neste Oil Annual Report, 2010).

This chapter reviewed the main concepts and phenomenon of this study. The chapter started with introducing risk and risk management and then concentrated on financial risks, which are the reason to conduct financial risk management. Furthermore after reviewing the concept of financial risk management hedging, which is a practise a part of financial risk management, was discussed about; first discussing about the objectives of hedging after which the hedging instruments and practices were studied. Next the chapter concentrated on commodity hedging and currency exchange hedging. Going forward, the chapter concentrated on hedging in oil industry and its aims, practices, and participants. The chapter concluded with describing supply chain in oil industry context.

The aim of the chapter was to give an overview of what is hedging what are the concepts of which it's derived from. In addition the chapter aimed to explain why companies are involved in hedging and what are the tools that are available for hedging. Especially the chapter aimed to illustrate hedging in oil industry context. Furthermore the goal of the chapter was to discuss about oil industry supply chain and study what are its special characters which create challenges in hedging and at the same time make hedging so important for oil companies.

However, as in this chapter these two phenomenon were reviewed distinctly the next chapter concentrates on the interactions between these two. The aim of the following chapter is to illustrate how these two concepts, financial risk management and supply chain, are connected and thus information sharing between these two functions is crucial. Furthermore the chapter aims to illustrate how these two functions affect to each other. In addition the subsequent chapter presents the theoretical framework of this study.

3. FINANCIAL HEDGING AS A PART OF SUPPLY CHAIN

This chapter aims to integrate financial hedging and supply chain literature. The chapter starts with a literature review regarding the importance of financial hedging in supply chains what are the benefits of hedging in supply chain management. Next the importance of information sharing between these two functions is reviewed. Further the chapter discusses about how financial hedging can influence to processes in supply chain and respectively how supply chain affects to hedging processes. The main target is to increase understanding of the interactions and influences within hedging and supply chain. Furthermore the goal of the chapter is to present theoretical background to the framework of the empirical study. Thus concepts discussed in previous chapter are synthesized to form a theoretical framework.

Companies are becoming more and more international. In addition those companies that aren't internationalizing their activities and supply chains themselves still are affected by the internationalization of their business environments. More international business environment exposes companies increasingly to exchange rate and price fluctuations. Thus hedging offers several benefits to an internationally operating company. However hedging can't be done without being up to date what is happening in supply chain in order to get the hedging to match the actual exposure. Thus there are several researchers that highlight the importance of information sharing between hedging department and supply chain.

As companies have exposures to several risks they are using hedging in extensive ways to protect processes in their supply chain and thus benefit in many ways of hedging. Thus companies supply chains get affected depending company's hedging. It's also been stated that financial hedging has a great impact to company's operational strategy, both in quantitative and qualitative ways. According to several studies, companies that use hedging are able to increase their inventory levels as they don't have to worry of the price fluctuations decreasing the value of their assets in inventory. In addition to improved inventory decision making companies are able to make better commodity procurement decisions. Also it's been found out that financial hedging strategy can have an impact on global company's supply chain structure and thus to location and number of production facilities. In addition companies are able to make business in fluctuating currencies if there are currency hedging

instruments available. In addition processes in supply chain naturally affect hedging. First stage in hedging is to understand what is the exposure and without receiving information what is happening in supply also hedging can't be implemented right. Thus the hedging department needs actual and timely information of flows in supply chain. However the special characters of oil supply chain make this information sharing even more important. The theoretical framework in the end of chapter aims to illustrate how and in which parts of a supply chain hedging and oil supply chain processes interact.

3.1 Importance of financial hedging in supply chains

This first subchapter discusses why financial hedging is beneficial for supply chains. The subchapter discusses about the increased risks in supply chains and how financial hedging are able to help companies to reduce these risks. In addition the benefits of financial hedging are discussed about. The aim of this subchapter is to increase understanding why financial hedging is important from supply chain point of view.

In their research Norrman and Jansson (2004) emphasize increasing risks in supply chains. According to them especially supply chains that are long or have uncertain demand and supply should pay special attention to risk management. In addition Ding et al. (2007) note that as companies expand their supply chain activities all over the world, and products move to different countries, companies are more exposed to uncertainties and complexities of the global business environment. In the study of Manuj and Mentzer (2008) supply chain managers mentioned currency, transit time variability, forecasts, quality, safety, business disruption, survival, culture, dependency and opportunism, events affecting to suppliers and customers, and inventory ownership as the main risks in a to global supply chains. Consequently in order to able to cope in a complex and challenging business environment companies have developed risk management programs (Ding et al., 2007). According to them the aim of these risk management programs is to reduce companies' exposure to exchange rate and price uncertainties that they face in their supply chains (ibid.). Furthermore they also note that the typical way to implement these programs and hedge against risk exposures is to use instruments available at financial markets (ibid.). Ding et al. (2007) show in their study how financial hedging policy affects to company's supply chain structure. For instance, according to their study company changes its preference between domestic and foreign location and the number of its production facilities (ibid).

Global firms that sell their products or services to various countries face fluctuations in demand and increased uncertainty of currency exchange rates which thus create great amount of challenges in their supply chains (Ding et al. 2007). As discussed earlier in this study fluctuations in exchange rates can have a great impact for instance to company's production and sourcing costs, sales pricing, and sales volume. From operations perspective companies can use capacity allocation options and wait for definite information in order to avoid unfavourable surprises from market regarding demand, market prices or currency rates (Ding et al. 2007). However it's not always possible or wise to use operational instruments in order to avoid uncertainties. Therefore financial instruments are widespread and for instance option contracts are used in the currency exchange market to hedge the exchange rate uncertainty (ibid.). The advantage of using financial instruments is that company is able to hedge its risk exposures before they get more information from the markets (ibid.). Also using financial instruments advantage is that company is not forced to adjust its operations as it be very challenging (ibid.). However they highlight that hedging doesn't only affect to variance of profit but actually has a great impact on company's optimal capacity decision, expected profit, and profit variance (ibid.). In their study they also conclude that the firms that are using financial hedging are less sensitive to volatilities and risk attitude compared to companies that aren't involved in financial hedging (ibid.).

This subchapter has discussed about why supply chains benefit of financial hedging and why in supply chain management the advantages of financial hedging should be considered. Supply chains are becoming more complex and international and thus are exposed to several risks. For instance fluctuations in exchange rates have a strong impact to production and sourcing costs, sales pricing and volume. Furthermore it's not surprising that supply chain managers mentioned currency and inventory ownership as one of the main risks in global supply chains. Hence the companies are widely using management programs and hedging to reduce their exposures to exchange rate and price uncertainties. Moreover companies also benefit of hedging as they do not need to amend their operations in order to reduce risks and thus they are able to optimize their capacity better. The next subchapter concentrates on the importance of information sharing between hedging department and supply chain.

3.2 Information sharing between hedging department and supply chain management

The second subchapter concentrates on the importance of information sharing between the department implementing hedging and supply chain management and processes subchapter. The subchapter presents several studies that have concluded that good information flow between these two functions is vital. In addition then importance of information flow is justified. The aim of this subchapter is to increase understanding why information sharing is essential in order to make hedging perform well.

Kasanen et al. (1996 p, 49) emphasize that it is crucial that risk management function and business function cooperate closely. According to them, for instance, risk management function is unable to manage exchange risk if business units don't provide information about their sales and purchasing volumes and currencies. In addition Kasanen et al. (1996) underline that risk management must understand the core business in order to be able to match their hedging strategy with core business environment. On the other hand Kasanen et al. (1996) stress that business units must also understand what risk management does and how risk management's processes and practices affect. If company's risk management that is usually responsible of hedging operations fails collaborate with business unit, company might end up to hedge itself against risk that it's not exposed to. Also Fisher and Kumar (2010) point out that there's always a risk that hedging in commodities actually destroys more value than was originally at risk if it's not done properly. Okochi (2008) also recognizes that the department responsible for physical trades might be resistant to share information with treasury and see this is as a big challenge.

According to Okochi (2008) coordination and communication is needed between the department responsible for physical purchases and hedging department in order to the ones responsible of hedging are able to understand the core commodity risk. This is due to the reason for instance that the business environment of core commodities' is often complex and erratic (Okochi, 2008). Also Claessens and Varangis (1994) recognize the importance of close communication between departments in oil industry. If the entity implementing the hedges isn't closely communicating with the entity that handles the physical trade it could miss important information regarding production, delivery dates, long-term plans regarding supply and exports, and developments in the world oil market (Claessens and Varangis,

1994). All of these are important information when implementing hedges or planning hedging strategies (Claessens and Varangis, 1994). Furthermore Fisher and Kumar (2010) present a case in their study in which a chemical company kept hedging its natural gas costs even though it wasn't actually exposure to the risk as the price fluctuations were already passed to a customer in sale contracts.

Fisher and Kumar (2010) emphasize that companies should only hedge exposures that actually threaten their financial position or strategic plans. It is still relatively common that companies hedge risks to which they have no exposure to and create little or no value for shareholders (ibid). To prevent this hedging should be implemented in close collaboration with business units. On the other hand also individual business units might hedge irrelevant exposures if they aren't well familiar with risk management (ibid.). Also to prevent company to do hedges against risks that company is no longer exposed to due to e.g. changed business environment, collaboration between risk management and business is essential. Changes in business environment or in processes might change, create new or eliminate risks that company has exposure to. For instance Fisher and Kumar (2010) present an example of an aluminium company that hedged its exposure to crude oil and natural gas, and only years later it was figured out these impacts on overall margin was very limited.

This subchapter started with a discussion why it is crucial for hedging department to receive information from supply chains and what are the risks if no information is received or the information is wrong. Firstly hedging can't be done without receiving information from supply chain as otherwise companies can't know what the exposures they should be hedging are as the hedges should match with the original exposure. Wrong information might lead companies to hedge exposures they actually don't have or hedge by using a wrong instrument. Also without proper communication hedging department might not receive the information regarding changes in business environment and business practices. In addition business units must understand what's been hedged. The next chapter will concentrate on what kinds of impact financial hedging can have to supply chain processes.

3.3 Impacts of financial hedging to supply chain management

This subchapter discusses how financial hedging has an impact on supply chain management. Several researchers mention many effects that hedging has to supply chain processes. First the impacts on inventory levels are discussed. In addition the influence to capacity decisions and operational strategy are reviewed. Next the subchapter discusses why financial hedging can't be replaced with operational hedging. This chapter aims to raise understanding how financial hedging is connected to supply chains.

Furthermore Panos et al. (2009) emphasize in their study that in order to achieve better management of cash flow volatility, companies should integrate hedging with their sourcing and inventory management decisions. Also Panos et al. (2009) stress that cross-functional decision coordination and information sharing between operations and financial managers is needed to implement the integration. According to their study this would also improve commodity procurement and inventory decisions (ibid.). In their study they also conclude that for instance the decision regarding the optimal base stock inventory levels requires awareness company's commitments to financial hedges (ibid.). According to Panos et al. (2009) when deciding about base inventory level operations should know what kind of hedge contracts they have for cash flow volatility. In addition Gaur and Seshadri (2005) also agree that hedging makes keeping bigger inventory levels profitable and thus increases the optimal inventory level. Without hedges stock levels are usually decreased to avoid the exposure to spot market price fluctuations. In their study Panos et al. (2009) also find significant evidence of the benefits of integrated commodity risk management. They also conclude in their study that by increasing cash flow volatility financial hedges enable higher inventory levels and thus better customer service level (ibid.). Furthermore they find that decreased cash flow volatility enables better profit maximizing policies (ibid.).

Ding et al. (2007) also note in their study that company's operational strategies should affect to financial hedging contracts and that these two are related. Furthermore they conclude that financial hedging increases company value by enabling them to optimize their operational policy (ibid.). They also list as a one of the benefits of using financial hedges that hedges enable companies to better optimize the capacities of their foreign and domestic manufacturing facilities (ibid.). An example of this is a case when company has production both in home country and abroad as for instance the company that has a possibility to

postpone its production needs only a forward contract to manage its exchange risk whereas a company without postponement possibility would need two contracts (call and put options). In addition in cases when demand is dependent on currency exchange rate movements, the relation between operational decisions and financial hedging becomes stronger. In addition Ding et al. (2007) conclude that the optimal financial hedging strategy is related to correlation between demand and exchange.

In their study Ding et al. (2007) found proves that financial hedging has a great impact to company's operational strategy and those two are closely tied to each other. Interesting was that Ding et al. (2007) state that financial hedging can have both quantitative and qualitative impact on an operational strategy. Also they found out that financial hedging strategy can have an impact on global company's supply chain structure and thus to location and number of production facilities (ibid.). Financial hedging impacts also capacity decisions (ibid.). In their research they find connection between using operational and financial hedges, and conclude for instance that companies that use only financial hedges and no allocation options tend to increase capacity in the foreign market (ibid.).

In addition to financial hedging there are several commercial and operational tactics which can be used to decrease exposure to price risks. These tactics include passing risk to a counterparty, vertical integration, revising product specifications, shutting down production facilities, or holding additional cash reserves (Fisher and Kumar, 2010). These tactics can also be combined with financial hedging. Also Chen et al. (1987) represent some alternatives to financial hedging as revising the pricing process and long-term contracting between producers, refiners and consumers. Also Ding et al. (2007) point out that globally operating companies use allocation as an instrument to improve their profits. Furthermore according to Ding et al. (2007) there are two ways how a global company can decrease its exposure to currency exchange rate risk; companies can whether delay capacity allocation to different markets and wait until uncertainties regarding demand and currency have disappeared or use financial hedges according to the decided capacity allocation. Cohen and Mallik (1997) state that in global supply chains operational risk management strategies can be more effective than pure financial risk management practices. This might be true with some supply chains and with some products, however, on the other hand adjusting operations to hedge the risk isn't always possible which also seems to be a case in oil industry as prices and exchange rates fluctuate globally and continuously but the oil supply chain is very inflexible as

discussed earlier. And as Cohen and Mallik (1997) note the decisions in a global supply chain are relatively limited e.g. production switching but on the other hand they can be done relatively frequently. On the other hand it is very common to use both operational and financial hedging at the same time. However Ding et al. (2007) also recognize that even though both financial hedging and operational hedging has been studied greatly current literature really lacks studies that manage effectively to integrate financial and operational hedging strategies. However according to Ding et al. (2007) in international finance literature the need for combining financial and operational hedging to decrease the exposure to exchange rate movements is clearly recognized.

As mentioned earlier the aim of this study is to emphasize the need for study that brings financial hedging closer to physical supply chain. Ding et al. (2007) also argue that in literature there should be more studies that take into consideration how production and operational hedging decisions might be affected by the scale and variance cash flows. In their study they found out that deploying a real option is dependent on price and market demand scenarios (ibid.). If capacity is fixed, financial hedging always reduces the profit variance and thus creates incentives for a company to invest more in capacity (ibid.). However if the financial hedge in place is not suitable to a risk that is supposed to be hedged (wrong instrument, wrong timing or quantity), hedging can increase profit variance. In their article (Ding et al., 2007) also conclude that companies that use financial hedges always invest more than the companies without financial hedges. Also Ding et al. (2007), argue that financial hedging doesn't impact to company's profitability directly, thus hedging should increase profits indirectly by reducing profit variance. Furthermore reduced profit variance increases capacity investments which usually lead to higher profits. Thus they state their article that companies that use financial hedges always invest more in expanding capacity than the companies without financial hedges (ibid.). Also financial hedging increases the optimal capacity.

Many risk managers underestimate the true cost of hedging, typically focusing only on the direct transactional costs, such as bid-ask spreads and broker fees (Fisher and Kumar, 2010). This again calls for better cooperation between risk management and business.

This subchapter concentrated on how financial hedging influences processes and decision making in supply chains. Financial hedging for instance assists in commodity procurement.

Furthermore financial hedging affects to optimal inventory levels and enables companies to optimize the capacities of their foreign and domestic productions. Thus it can be stated that financial hedging has an impact on company's supply chain structure. In addition it's been argued that using financial hedging is more beneficial than using only operational hedging. Further in this subchapter it was concluded that financial hedging enables companies to invest more in capacity and thus financial hedging increases optimal capacity. The next subchapter discusses how the interaction between these functions works in other direction i.e. how supply chain affects to hedging.

3.4 Effects of supply chain processes to financial hedging

This subchapter discusses how financial hedging is dependent on the events in supply chains. First the importance of recognizing the risk exposure in supply chain that commences hedging process is discussed. Furthermore this chapter discusses which actions in supply chains risk exposures are and furthermore in which parts of the supply chain risk exposures appear i.e. in which parts supply chain hedging is needed. This chapter aims to rise understanding how processes and actions in supply chain impact to hedging processes.

As Kasanen et al. (1996, p 48) state companies need to recognize the sources of risks in order to be able to implement risk management. In addition Okochi (2008) and Triantis (2000) highlight that the first step in implementing hedging is to identify and evaluate the risk exposure. Companies that have their operations in various countries and thus incomes and expenses in multiple currencies are exposed to foreign exchange fluctuations (Aytekin and Birge, 2004). The exposure to an exchange risk begins when a company enters to an agreement and it lasts until the time that the final transaction is actually done (Huchzermeier and Morris, 1996). Furthermore, since sales, incomes, and assets in foreign currencies exposes a company to exchange rate risk (Yakup and Asli, 2010) when hedging currency exposure information regarding those is needed. As this is also referred to as transaction risk in currency hedging, information regarding transactions i.e. sales and purchases in foreign currency is essential.

The risk exposure in commodity hedging point of view starts when feedstock is purchased and lasts until the product is sold (Okochi, 2008). In oil industry the supply chains are inflexible and include a lot of uncertainty for instance due to long lead times (Hussain et al.,

2006). In addition in oil supply chain the final quantity, timing of loading and thus pricing are typically known only after loading the cargo (Verleger, 1993) and as the financial hedges are supposed to match with the physical delivery (Campbell et al., 2006) it can be concluded that for hedging information regarding physical delivery is needed i.e. what is the actual risk exposure to be hedged.

This subchapter concentrated on how events and actions in supply chains affect financial hedging processes and activities. As hedging is supposed to match to the original exposure, it's important to recognize which actions in supply chains create risk exposures. Furthermore, it's as valuable to get information how big is the exposure and when the exposure is. For instance as the exchange rate exposure starts when a company enters to an agreement the hedging department needs to get information of this agreement in order to be able to implement hedging. Furthermore the commodity price risk exposure starts when feedstock is purchased. However in oil industry the actual exposure is usually only known after the loading of oil. The next subchapter synthesizes different theories presented in this and previous chapter and presents the theoretical frame work of the study.

3.5 Theoretical framework

The last subchapter presents the theoretical framework of this study. In the framework findings from literature review are combined and connected to the oil supply chain. The framework aims to illustrate, in which parts of a supply chain there are market risks that could be hedged and what kinds of connections past literature recognizes between supply chain and hedging.

In previous chapters two and three, past literature regarding risks, hedging, and hedging processes were reviewed. In addition oil supply chain and its special characters have been studied in past chapters of this study. Furthermore, in literature review studies that aim to connect supply chain management and hedging were explored. The framework is constructed by combining these studies. However, as there wasn't found studies regarding positioning of hedging in oil supply chain, were the findings in literature linked to the oil supply chain illustrated by Vaghasiya and Yadav (2010). The theoretical framework is presented on Figure 7.

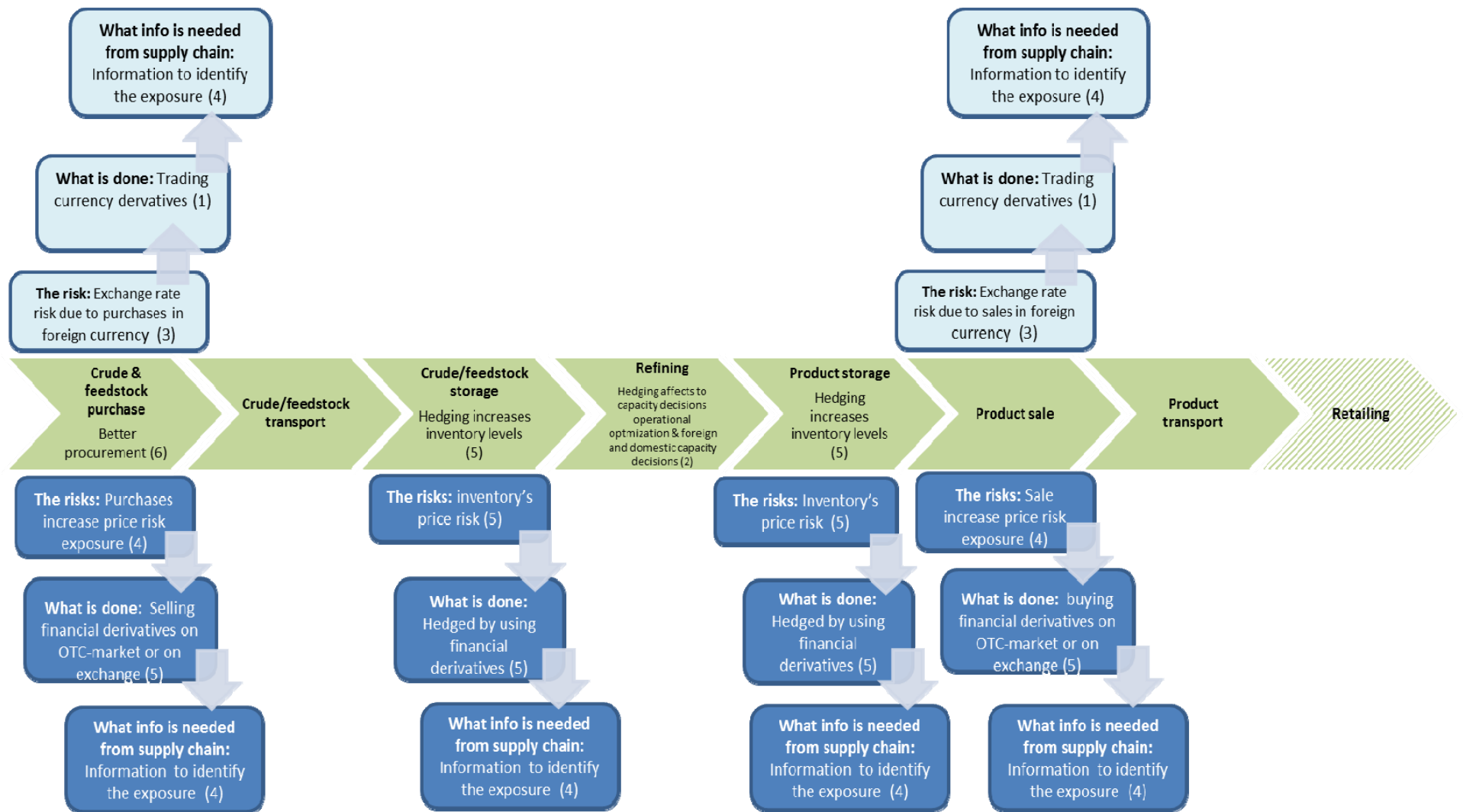


Figure 7: Theoretical framework: Connections between oil supply chain and financial hedging. Modified from: Ayetekin and Birge, 2004 (1); Ding et al., (2007) (2); Yakupe and Asli, 2010 (3); Kuusela and Ollikainen, 1998 (4); Gaur and Seshadri, 2005 (5); Panos et al. (2009) (6); Vaghasiya and Yadav, (2010).

The number in the brackets refers to the source of information. This theoretical framework was also shown to the interviewees and thus functions as a base to the empirical framework presented later in this study.

The aim of the chapter was to integrate financial hedging and supply chain management and to represent what kind of interactions these two concepts have. Furthermore, the aim was to present why and what kinds of benefits it creates to take into account the connections between these two. In addition the chapter aimed to explain how hedging impacts to supply chain actions and on the other hand how hedging is dependent on activities in supply chain. Finally the chapter presented the theoretical framework of the study.

This chapter concluded the theoretical part of the study and thus the study concentrates next on the empirical research part. The following chapter discusses about the research method used, how the study was conducted, and what the limitations of the study. The target of the subsequent chapter is to give a comprehensive view how the research was done and what were the reasons for deciding the used method.

4. RESEARCH METHOD

In this chapter the research method related issues are described. In the first subchapter the choice of using case study method is justified followed by a discussion why Neste Oil was chosen as the case company. The following subchapter reviews the benefits of using interviewing as a data collecting method and why focused interview was chosen among different kinds of interviewing types. Issues related to research design together with the limitations of research design. The aim of the chapter is to present what were the research and data collection methods and what are their pros and cons to this study. In addition the aim is to describe how the study was implemented, and what kinds of limitations the research has.

The qualitative studies are usually used when the aim of the study is to understand relationships and linkages as this study at hand is aiming to do. Furthermore case studies are common when implementing qualitative study. Case study was found to be an appropriate research method as case studies are used to study complex connections. Interviewing was chosen to be used as data collection method due to its flexibility and ability to provide most insightful information about the relationships. Semi-structured interviewing was chosen to enable interviewees to speak as freely as possible but still making sure that they are in correct topic.

4.1 Case study method

This subchapter will shed light on a case study method as a research method. The subchapter first discusses shortly about qualitative studies. Then the subchapter concentrates on a case study method and its advantages in this study. The subchapter ends with a discussion of the case company. The aim of the chapter is to describe case study method and justify why it was chosen to be used. Furthermore the chapter aims to describe why Neste Oil was chosen as a case company.

There are five main methods that are used in qualitative research observation, interviewing, ethnographic fieldwork, discourse analysis, and textual analysis (Travers, 2001, p 2). The research was executed as a qualitative method as the purpose was to find linkages between risk management processes and company's value chain and to study how these interact. This kind of information can mostly be obtained by observing or through interviews. Qualitative

research method is often used when the aim is to understand complex interrelationships (Stake, 1995, p 37)

Case study method was chosen as the principal research method to this study due to several reasons. Case studies are a common way to do qualitative survey. Case studies are also certain kinds of field studies as researcher doesn't intervene to the phenomena (Fidel, 1984, 274). Case studies are appropriate to be used as a research method when the phenomena of the study 1) includes several relationships and factors, 2) no basic laws exist to determine the importance of the relationships and factors and 3) when factors and relationships can be directly observed (Fidel, 1984, p 273). In the study at hand all three points occur as the relationships and the importance of interactions between operation management and risk management are still unknown but they can be, however, observed and discovered. Also according to Yin (1994) single case studies are used to confirm or test an existing theory, or to represent a new theory. Furthermore as Eisenhardt (1989) mentions, case study is an appropriate method to use when new topic areas are being studied or when there's only a limited amount of information available about the topic. Even though there are plenty of studies of hedging and supply chains, there is very little literature available about their interrelations, especially in oil industry context, as most of the previous literature has illustrated these two functions in isolation. In addition academic literature is missing studies regarding the positioning of hedging in oil supply chain. Case studies also make detailed analysis possible as usually case studies are meant to concentrate on only a set of issues and thus allow research to concentrate to get a comprehensive understanding of the matter.

The case study is an effective method when the aim is to study and recognize dynamics present at single settings (Eisenhardt, 1989). Another benefit that Eisenhardt (1989) mentions is that case studies usually create novel, testable, and empirically valid theory. Also case studies aim to describe a complexity (Stake, 1995, p xi) of the case under the study. Furthermore case studies can aim whether to provide description, test existing theory, or generate new theory (Eisenhardt, 1989). This study at hand aims to provide description and also generate new theory. Case study can be seen to satisfy the three principles of the qualitative method: describing, understanding, and explaining (Bartam et al., 2011). Study can be whether qualitative or quantitative, or both (Eisenhardt, 1989). Case studies can consist of single or several cases and in this study only one case company is being studied in order to keep the scope controllable. This research method is called a single-case study.

There are several reasons why oil industry was chosen to be studied. Firstly oil industry has massive impact on world's economy and oil is probably the most important commodity of all which naturally makes oil industry very interesting to study. Secondly oil industry is volatile and faces several price risks and therefore has well-developed hedging markets. In addition the supply chains in oil industry are challenging and thus interesting to study. Furthermore there are a number of reasons why Neste Oil is considered as a suitable company to be studied as a case company. For instance Neste Oil was chosen to as a case company as it is in the middle of oil supply chain and therefore exposes to lot of financial risks. However it is also able to hedge against these risks and has well established risk management processes as can be seen in Neste Oil annual report. An important factor is also that the researcher is working at Neste Oil and has therefore profound interest to the company and its processes.

This subchapter discussed about the research method used in this study. The subchapter concentrated first on the benefits of qualitative research methods. The main benefit of the qualitative research is that complex connections can be explored, which is also the aim of this study. Next the subchapter discussed which are the reasons that make case study an appropriate method used in this research. The main benefit of case studies to this research is that in case studies new or little studied phenomenon can be studied. In addition case study is a good method when relationships are aimed to find out. In addition single case study was chosen as a research method as a case study enables to study complex processes. Oil industry was chosen to be studied due to its global importance and demanding industry environment that requires hedging. Neste Oil was studied as a case company due its profound involvement in hedging processes. Next subchapter concentrates on discussing about data collection method options and the interviewing method that was chosen to be used in this study.

4.2 Data collection

This subchapter presents the data collection method. The subchapter first discusses shortly what kinds of data collection methods are possible to be used in qualitative studies. In addition reasons for using interviewing are discussed. Then different types of interviewing methods are described including discussion of each type's adequacy to the study sat hand. The aim of the subchapter is to explain why semi-structured interviews were used as a data collection method and what are the benefits and drawbacks of this method.

The qualitative research methods are interviewing, observing, data collection, and experimenting. All of these are used in collecting data in case studies. In addition combining different methods is widely used (Tuominen and Sarajärvi, 2002). Especially in case studies several data collection methods are typically combined for instance all archives, interviews, questionnaires and observations can be used in one study. Interviewing is commonly used in case study researches (Bartam et al., 2011). Interviewing was chosen to be used as a data collection method as the purpose of the research is to study interactions and by observing the importance of different linkages could have stay vague. Experimenting isn't either found to be suitable due to the aim to study linkages between different departments. Using archives and observing documents would have been suitable at least in used together with interviews but most of the documents were confidential and therefore the method was abandoned.

Interviews are one of the most important sources of case study information. There are several reasons why interviewing was chose to be used a research method. First of all interviewing is a very flexible method to collect data which was considered to be important as the interviewees are from different departments and backgrounds. In addition interviewing is a good method when the purpose of the study is to study linkages and relationship (Bartam et al., 2011). Interviews also give better and deeper understanding of the case at hand than for instance observations (Travers, 2001, p 2). In interviews respondents can express their experiences and perceptions which might be difficult to detect in questionnaire or by observing (Bartam et al., 2011). And for instance in cases when the respondent doesn't understand the question is interviewer able to explain the topic further (Tuominen and Sarajärvi, 2002). Furthermore as in interviews the respondent is allowed to talk freely, can new issues around the research topic come up and thus give new insights to the researcher (ibid.). In addition interviewing is a good method to discover people's attitudes, believes, experiences, and reasons for certain behaviour (ibid.). The risk in interviews is, however, that the interviewer affects to respondents answers or isn't able to objective in analysing the answers (ibid.).

Furthermore, there are three types how interviews can be conducted: unstructured (open ended) interviews, semi-structured (focused) interviews, and structured interviews (questionnaires). In each interview type the interview is constructed differently in order to meet the purpose of the research at hand. For instance when the purpose of the study is to get insights to the issue or explore and understand new topics do open ended interviews usually

give the best results (Bartam et al., 2011). Tuominen and Sarajärvi (2002) represent different types of interviewing. Which type should be used in a research depends on the research type. Next different types are represented and their benefits and drawbacks in implementing the research are discussed.

Semi structured interview is a good method to find out people's perceptions and attitudes regarding the subject under the study. Semi structured interview is whether fairly structured and questions can be asked in varying order or in a certain order. Thus semi structured interview can be more similar to questionnaire or in-depth interview.

Semi structured interview was found to suitable to be used in this study as it is fairly structured but allows modifying the questions and their order (Tuominen and Sarajärvi, 2002). Bartam et al. (2011) also mention that semi structured interview being a middle ground between a structured interview with completely predetermined questions and their order and an unstructured interview. This is an important aspect in the study, as some additional questions or adjustments to the question might become necessary while making the study. Also compared to in depth interview it is good that finding enough information to the study isn't dependent on only one question. Also analysing results is easier.

In depth or open interview is the most unstructured and informal interview method. It is very close to conversation during which questions can change according to the answers of respondent. The in depth interview wasn't chosen to be used as interviewing method as there's a high risk that respondents don't answer to question at hand properly as they can speak too freely and thus next to the topic. In addition analysing the results is relatively challenging.

In addition Tuominen and Sarajärvi (2002) mention questionnaire and dialog as interviewing methods. In dialog the interviewer is partly answering to the questions by telling about his or her own experiences and opinions. This method wasn't found suitable for the study due to interviewers participation. Questionnaire is a structured method with predefined questions and thus the interviewer asks exactly the same questions in the same order. That kind of data collection wasn't found appropriate due to its inflexibility as the aim of the research is study interactions and find linkages.

All in all, in order to collect the most insightful data semi structured i.e. focused interview was chosen to be used as data collection method. It was chosen due its several benefits compared to other methods. The main benefits of semi structured interviews are flexibility it offers and a certain level of structure in order to get respondents to stay in a topic.

In case studies there are several data collecting possibilities. However interviewing was chosen to be used to collect data mainly due to the flexibility it offers. By interviewing profound understating can be attained as the respondents are able to explain for instance relationships and connections. There are plenty of interviewing types that can be used in case studies. However semi structured interviewing was chosen to be used as a research method as it offers the most suitable combination of flexibility and structure for this study.

4.3 Research design

This subchapter discusses about the research methodology and about design and practicalities of the research. The subchapter presents the phases of case studies and then explains how each phase was implemented. Further, the subchapter explains how the interviewees were chosen to this study. In addition the subchapter presents how the interviewing questions were formed and how framework was used in interviewing. The aim of the subchapter is to give good understanding about the implementation of the research and data collection.

The study was implemented by using the case study methodology from Yin (1994) and was implemented in four phases:

- 1) Design the case study,
- 2) Implement the case study,
- 3) Analyze the case study outcomes, and
- 4) Construct conclusions, recommendations, and implications.

The first phase was to design the case study. This included deciding the data collection method, choosing the interviewees and constructing the structure of questions. The interviewees within the case company were chosen to the study based on their position, job profile and experience. The purpose was to interview Neste Oil employees from all departments that are involved whether in hedging or in supply chain. Therefore the interviewee were from treasury department that is responsible for implementing hedges, from

sales and trading department which is responsible for implementing physical trades and from operational management department which is responsible for managing refinery input and output and inventory levels.

In appendices (Appendix 2) can be found a table presenting interviewees' departments, and positions, and the date when each interview was held. The questions were chosen so that special attention to information needs and information flows was paid in order to get an insightful view of connections between departments. Further the questions aimed to motivate interviewees to explain what kinds of issues regarding hedging/physical flow they need to take into consideration in decision making. The structure of questions can be found in the appendices (Appendix 1). However as the data collection method used was semi-structured interviewing, in each interview questions were slightly modified to match to the interviewees'

The second phase is to implement the case study and includes preparation for data collection, distribution of the questionnaire, and conducting interviews (Yin, 1994). Data was collected during January and February 2012. Further, the most of the interviews were recorded in order to allow the researcher to back to the answers later. To ensure all necessary topics and questions were covered in the interviews picture of the theoretical framework was shown to the interviewees. The framework was supposed to allow the interviews to have a natural flow, as different topics were discussed, but at the same time ensure that the interviewees were concentrating on topic at hand. Using the framework picture also allowed the interviewees to better comprehend the topic and the tailored questions to be used during the interviews. In addition the framework also allowed the interviewees to show connections and interactions between functions.

The third phase is the data analysis which includes of examining and recombining the evidence of the study so that an answer to the research problem can be constructed (Yin, 1994). In analyzing part the information from interviews is explored and combined with the studied literature. This is done in chapters 6 and 7 of this study. Further, the conclusions, recommendations and managerial implications are presented in the last chapter of the study. Several researchers have identified limitations in case studies. For instance according to Yin (1994) case study results are usually tied to a specific contexts and generalization of the results is limited. Also in Yin's (1994) view there should be several cases used in order to

reach scientific generalizability. Therefore the problem with this study is that only one case company is studied in one industry which limits the generalizability of the results. However, the limiting factor of the number of case companies was that as it was found important to explore hedging in oil industry, however, there is only one oil refiner in Finland which naturally caused problems to find more companies to the study. Also the experience and skills of the researcher can be questioned.

This chapter presented the research method and data collection methods used. First the chapter discussed about qualitative method as a research method and then concentrated on case study method. After describing the case study method the chapter discussed about the benefits the main concepts and phenomenon of this study. Further, the chapter discussed about different data collecting methods and their pros and cons to be used in this study. In addition the chapter presented how the research was implemented and what are the limitations of research design.

There are several reasons why qualitative method and more in detail case study method was chosen to be used. However the main reason was that case study method enables insightful research relationships and connections which haven't yet been studied much. Semi-structured interviewing was chosen to be used as a data collecting method due the certain degrees of flexibility and structure that the method provides. The research was conducted in 4 phases as suggested by Yin (1994). The phases construct of designing the study, conducting the study, implement the case study, analysing the results, and developing conclusions and implications. The main limitation of the study is that only one case company was studied which limits the generalizability of the results.

The next chapter concentrates on the case company Neste Oil. The following chapter aims to give a good overview of Neste Oil in general and then present the main hedging principles of the company using mainly Neste Oil's annual report as an information source. The target of the next chapter is to provide proper background information for the empirical part.

5. EMPIRICAL STUDY

This chapter concentrates on the case company Neste Oil. After presenting the basic information of the company the chapter discusses shortly about Neste Oil's market and currency risks. Further the chapter presents the main hedging principles of Neste Oil and how hedging responsibilities are divided within the company. In the end of chapter Neste Oil's hedging policies are described more in detail. First commodity hedging practices and processes are described after which the overview is given of foreign exchange hedging. The aim of the chapter is to give a good overview of the case company, its market risks and hedging procedures. This chapter serves as background information for following chapters.

5.1 Case company Neste Oil

Neste Oil is an oil refining company that is also involved in petroleum retailing in Finland, Baltic countries, Poland and Russia. It was established in 1948. The company produces a wide range of major petroleum products and the main usages of its products are transportation, heating, agriculture, and energy production. In addition to traditional fossil based products Neste Oil is also a supplier of renewable diesel. In 2010 the company's net sales were EUR 11.9 billion and it employed around 5,000 people. Neste Oil's share is listed on the NASDAQ OMX Helsinki. (www.nesteoil.com, 20.11.2011)

The oil refining industry, and therefore Neste Oil among other industry players, operates in a global business environment. Neste Oil has five refineries, two in Finland, one both in Singapore and in Rotterdam and one joint venture refinery in Bahrain. The main markets for Neste Oil are Finland, Sweden, Norway, Baltic countries, North-West Europe, and North-America. Neste Oil supplies its crude oil mainly from Russia and from North Sea. However crude oil, other feedstock and refined petroleum products have worldwide markets as transportation across continents can be done in a relatively cost efficiently by vessels or pipelines. (www.nesteoil.com, 20.11.2011)

As discussed earlier in this study, oil industry is highly challenging business environment. Firstly oil industry is characterized by high price volatilities (Kirschene, 2002). As crude oil is the main raw material of other oil products has crude oil's price fluctuations massive impact to refined products prices, which again has great impact to oil demand and oil

companies' margins. Furthermore fluctuations in international oil prices have an impact to the prices of several other products as many petrochemicals. Further, oil prices are affected by several factors including demand, crude oil availability, transportation capacity, refinery configurations and maintenances, and currency fluctuations. The cost of petroleum for the end consumer is also dependent on the national pricing policy, such as level of petroleum taxes or subsidization. In addition the supply of crude oil is critical issue for the countries with or without their own oil production (Federer, 1996). Therefore all the counties have their own crude oil reserves. In addition oil supply, demand, and federal reserves have significant impact to the world economy and political relations (Federer, 1996). Moreover it's been shown that there's a direct and considerable linkage between macro economical movements and the development of crude oil price (Federer, 1996). Also a new matter affecting on oil industry structure is the raise of renewable fuels. For instance EU-countries have mandates that 10% of petroleum production must be based on biological feedstock and components by year 2020. In addition the oil industry is also characterized by a global business environment and complex supply chain as discussed further in the chapter 2.4 in this study. All in all it can be concluded that oil industry is characterized by dynamic challenges which all mean plenty of risks to oil companies. Consequently in markets characterized by uncertainty and risk, price risk exposures can be and should be managed and controlled. Next subchapter discusses about different market risks, impacts of those risks and, and hedging at Neste Oil.

5.2 Market risks and hedging principles at Neste Oil

5.2.1 Hedging principles

Neste Oil has operations in 15 countries and as a global oil refining company Neste Oil exposures to several financial risks as fluctuations in commodity prices, currency rates, and in interest rates. The market risk in the oil industry is mainly from oil price and exchange rate fluctuations. Furthermore, Neste divides its oil price risk to two categories: refining margin risk, and refining inventory price risk. Exposures to these and to currency exchange risk have significant impacts to the profitability of Neste Oil. Therefore the aim of financial risk management at Neste Oil is to decrease the volatility of earnings, balance sheet, and cash flow as well as to secure effective and competitive financing for the whole company. Furthermore, Neste Oil uses broadly different kinds of financial risk management instruments in order to optimize its risk hedging processes. (Neste Oil Annual Report, 2010)

The magnitude of different exposures can be seen in the Figure 7 below.

+/- 10% change in EUR/USD exchange rate	-90/+110 Million EUR
10,00 USD/barrel change in crude oil price	-/+100 Million USD
1,00 USD/barrel change in refining margin	-/+110 Million USD

Figure 8: Market risk exposures' impacts to profitability (Neste Oil annual report 2010)

As discussed earlier crude oil price has fluctuated as much as 100 U.S. dollars in one year, therefore it is obvious that without risk management the business environment of Neste Oil would be unsustainably volatile. Also the oil price volatility is especially crucial for oil refiners who don't have their own crude oil production. Therefore, in order to protect its value to its shareholders Neste Oil has implemented hedging processes and practices. For hedging purposes there is a wide range of financial instruments including swaps, options and future contracts and forward agreements that are commonly used in the industry (Fan & Wang, 2011). In addition as the environment of oil industry is developing constantly, for instance new products are coming to the fuel market due to the changes in legislation that is creating renewable fuel market, also risk management practices and instruments need to develop. For instance new hedging instruments have emerged due to the new renewable fuel products.

According to Neste Oil the main factor affecting to its financial result is the price differential between prices of sold products (output) and the price of the crude oil and other feedstocks used in production (input). Both the prices of feedstock (input) and refined products (output) are mainly set by the markets which means that Neste Oil has very limited or non-existing possibility to affect price movements. Traditionally, in oil business, margins have been volatile and are very likely to remain so in the future as well. The volatility in refining margin has a great impact on Neste Oil's business, financial condition, results of operations, and future prospects. Therefore Neste Oil has focused on managing market risks related to the volatile commodity prices and foreign exchange markets. Neste Oil also decreases its exposure to foreign exchange risks by hedging its exchange exposure entirely. (Neste Oil Annual Report, 2010)

The Executive Board is responsible for determining Neste Oil's risk management principles as well as principles of credit and counterparty risk management principles. Whereas Neste Oil's Group Treasury that is part of Neste Oil's finance and accounting division is responsible for executing the hedging and risk management processes i.e. hedging refining margin and refinery inventory price risks, and managing foreign exchange, credit, counterparty, interest rate, liquidity, and refinancing risks as well as insurance management. In addition, treasury department manages and implements hedging of price risk associated to utilities and the emission allowances. Furthermore Group Treasury provides price hedging services to internal and external counterparties. (Neste Oil Annual Report, 2010)

To this study employees from three different departments were interviewed, more in detail from Group Treasury, Operational management and from Sales and trading. As mentioned above, Group Treasury, to which is hereafter referred as treasury, is responsible for implementing both commodity and currency hedges and developing strategies hedging to match risk exposures. Operational management is responsible of refineries' feed and production and thus defines what kinds of crude oils or other feedstock need to be purchased and on the other hand when and what will be produced. Further operational management decides about maintenance breaks and forecasts future production volumes. Traders that belong to sales and trading department execute the physical purchases and sales.

5.2.2 Commodity hedging at Neste Oil

The major elements affecting oil refineries' profit margins are the demand for and prices of petroleum products in relation to the supply and cost of crude oil and other feedstock. Also refinery's configuration, capacity and utilization rates affect to the profitability of refineries. Oil refining is primarily a margins-based business, in which both feedstock and petroleum products are commodities. Since operating expenses (when raw material costs aren't taken into account) are relatively fixed, Neste Oil's profit is very critically under an exposure to changes in commodity prices. As Neste Oil states in its annual report it aims to hedge its exposure to oil price volatilities. This is done by commodity price risk hedging, which is divided into refining margin hedging and refining inventory hedging. (Neste Oil Annual Report, 2010)

Margin hedging in Neste Oil

As discussed earlier it's very characteristic in oil industry that both input products and output products are subject to significant market price fluctuations. As Neste Oil's profit highly depends on the demand for and prices of refined oil products compared to the price level and supply of crude oil and other feedstock, price volatilities have great impact to its profits. Principally refining margin decreases if crude oil price increases or product prices decrease. Margin hedging is used in order to ensure a certain level of margin in this uncertain environment where price level can change significantly between the period that the crude oil is purchased and refined products are sold to customers. The aim of margin hedging is to ensure a certain profit of its production that is highly exposed to international market price fluctuations. (Neste Oil Annual Report, 2010)

Refining margin means the value that oil refining company gets when the costs of raw – material and production are reduced from the selling price of refined products. Refining margin indicates very well the profitability and cash flow of an oil refiner. As refining margin is an important determinant of Neste Oil's profits, its fluctuations (i.e. fluctuating price difference between selling and buying oil prices) generate a significant risk. Therefore Neste Oil aims to secure its margin per barrel and uses financial derivatives to hedge part of its refining margin. However Neste Oil only hedges a part if any of its refining margin whereas inventory price and foreign exchange risks are hedged entirely.

Inventory hedging

Inventory price risk means a risk that the value of products in the inventory fluctuates as the market prices changes. Managing inventory price risk is highly important to oil refiners as due to the nature of business, inventory levels tend to substantial but also fluctuate a lot due to volatile demand and demanding logistics. In practice as oil purchases and sales are always done to the market price level, there's a risk that in a case of decreased price levels, a refiner is in a situation in which it has inventories full of crude oil bought during a high price level and is now supposed to sell refined products at lower price. This could mean crucial losses to an unhedged refiner. Consequently, inventory hedging aims to reduce an exposure to price fluctuations. In practice in order to hedge this exposure oil companies seek to buy financial oil derivatives contracts when inventory decreases (and contracts are sold when in a reverse

situation). The idea behind this is that if the value of inventory decreases the value of futures increases and thus the physical and paper position offset each other.

Neste Oil's refining inventory, to which is referred as 'base inventory', consists of two components. The first component is the compulsory inventory which is a minimum inventory level that Neste Oil is required to maintain constantly by Finnish laws and regulations. The other component is the operational inventory which is a minimum level of products and feedstock which refinery requires to its operations without going below compulsory inventory level. The components are illustrated also in the Figure 8 below. In practice Neste Oil's inventory level fluctuates below and above base inventory level but is not allowed by law to go below compulsory inventory level. In practice the fluctuations below and above the base inventory level expose Neste Oil to price risk. Therefore Neste Oil's risk management policy is that hedging operations target only to those levels that excess or fall below of the 'base inventory'. If the whole inventory would be hedged the fluctuations in market prices would mean enormous fluctuations to the paper position's value (if inventory level were one million tons would 1 U.S. dollar/bbl increase in crude oil price mean over 7.5 Million U.S. dollar effect to the position's value (1bbl = 159litres)). And in this volatile price situation daily price movements of 5 U.S. dollars aren't uncommon. However, not hedging the entire inventory (both the compulsory and the operational inventories) is well justified as a big part of inventory remains stable (due to the law issues) and only fluctuating parts of these stocks create cash flow. (Neste Oil Annual Report, 2010)

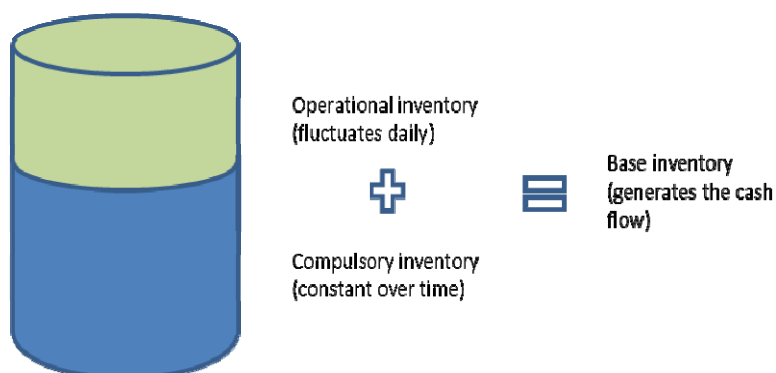


Figure 9: Neste Oil's refining inventory

Practically the refining inventory level depends on the relationships between feedstock purchases, refinery production and product sales which is a reason why refining inventory

price risk is also known as transaction risk. In addition it's worthwhile to notice inventory fluctuations expose Neste Oil's income statement and balance sheet to price risk too.

5.2.3 Foreign exchange risk at Neste Oil

Neste Oil reports in Euro whereas the pricing currency used in the oil industry is mainly U.S. dollar. Therefore Neste Oil is exposed to short-term transaction and longer-term economic currency risks. Thus, Neste Oil uses forward contracts and options in order to manage its net foreign currency exposure. To hedge its currency exposures Neste Oil hedges its contracted and forecasted cash flows and balance sheet exposures which are referred to as transaction exposure. In addition to this also the equity of non-euro zone subsidiaries (referred to as translation exposure) is hedged. Of its exposures the net working capital is the largest and most volatile which is common in the industries in which operational inventories are enormous by both size and value. Daily exposure of net working capital is hedged entirely as part of the balance sheet hedge in order to neutralize the effect of volatility in EUR/USD exchange rate. And for instance in 2010, the daily balance sheet exposure fluctuated between approximately EUR 335 million and EUR1,077 million. Hedging transactions are implemented by Group Treasury according to Business areas' forecasts of net foreign currency cash flows. For Neste Oil U.S. dollar is the most important currency to be hedged. However due to the increasing involvement in renewable fuel business, also other currencies, most importantly Malaysian ringgits, are gaining more importance. (Neste Oil Annual Report, 2010)

Since the most of Neste Oil's business transactions, product sales and crude oil and feedstock purchases are done in U.S. dollars but the fixed costs are mainly in Euros, EUR/USD exchange rate volatility is hedged entirely. In addition to this daily exposure of net working capital, Neste Oil's net foreign currency cash flows are forecasted and hedged for a 12-month period. In practice this means hedging Neste Oil's margin from fluctuation in EUR/USD rate. Otherwise as most of Neste Oil's sales are in U.S. dollars, would weakening Euro lead to significantly lower sales margins. Hedging is implemented on a rolling basis so that first six months are hedged entirely whereas only half of the following six months forecasted net volume is hedged. (Neste Oil Annual Report, 2010)

The aim of the chapter was to give an overview of the case company Neste Oil and about its hedging policies. Thus the purpose was to make it easier for the reader to follow and understand findings in following chapters. The chapter started with short summary of the company's basic information and short description of oil markets. Next the chapter discussed about Neste Oil's main market risk and presented shortly how these risks are hedged.

Whereas this chapter aimed to provide background information for empirical study, the next chapter presents the findings of the empirical research conducted. The subsequent chapter presents and discusses about the findings from the interviews and present the theoretical framework that was constructed based on findings from the interviews.

6. EMPIRICAL FINDINGS

This chapter presents the empirical finding discovered in interviews. In addition the chapter presents the empirical framework that is presented on next page. The chapter is organized to subchapters so that each part of oil supply chain and findings related to that part are discussed in a specific subchapter. Each subchapter first discusses how commodity hedging is done in that part of a supply chain and how events in a supply chain affect to hedging. Next the subchapter discusses how operational management and traders take into account hedging in that part of a supply chain in their decision making. In the end of each sub chapter currency hedging issues related to that part of the supply chain are presented. The order of subchapter is the same as in oil supply chain which is presented in the empirical framework next page. The aim of the chapter is to give a comprehensive perception about the findings from the interviews.

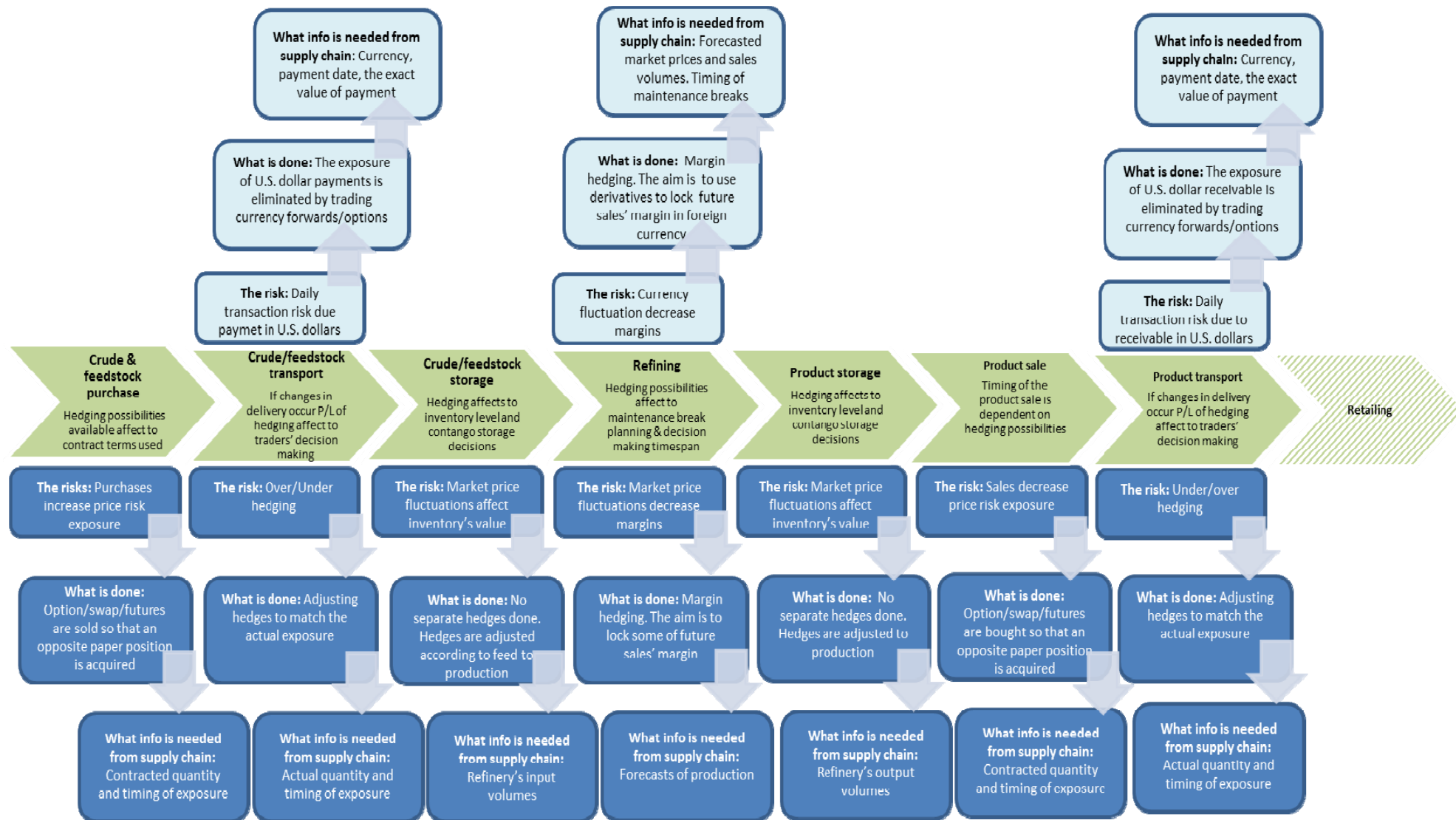


Figure 10: Empirical framework

6.1 Crude and feedstock purchase

As discussed earlier in the literature review and as suggested for instance by Okochi (2008) the most important step in commodity hedging is to identify the risk exposure. At Neste Oil, according to the interviewed risk analyst who works with commodity hedging, purchasing crude oil or other feedstock increases Neste Oil's exposure to market price risk. At Neste Oil this is considered as a starting point of a price risk exposure due to the price fluctuations that the products it buys and owns are exposed to. Further, according to the interviewee it can be considered that ownership is transferred evenly during the period that the product is pricing in. Therefore, it was noted by the interviewee that at Neste Oil price risk is not related to the actual payment date of the oil. Actually it can be argued that the market price risk exposure starts already at the point when decision regarding feedstock purchase is done. However the interviewee noted that as the buying decision flow is relatively steady, it can be stated that the market price risk exposure starts only when the cargo starts to price in (i.e. is exposed to market price fluctuations).

In oil industry most of the purchases are done on spot basis from different suppliers and loaded and delivered usually by a vessel within a delivery window negotiated by the supplier and the buyer. Furthermore as the purchases are mostly done on spot basis instead of regular term contracts the pricing formulas vary greatly. For instance, in interviews it was mentioned that most commonly crude oil pricing is linked to the loading date (usually referred to as a B/L date, bill of lading date) so that the price is determined as the average of spot prices of five subsequent days after B/L date. Other common quotations mentioned are a month average, fixed five day pricing window, three days after B/L date, and so on, but basically the buyer and seller can decide to use any kind of pricing formula and therefore there are very wide variety of formulas in use.

In oil industry there is usually no steady flow of crude oil coming to the refinery that could be easily forecasted and thus price risk exposure would be easily managed. There are some refineries that have a possibility to supply crude oil by pipe but for instance to the refineries of Neste Oil crude oil and feedstock is delivered only by vessels, trains, and in some seldom cases by truck. Furthermore due to for instance price development, product demand, crude and feedstock availability, changes in legislation, weather conditions, inventory optimization, and maintenance breaks, purchasing quantities vary greatly between different months.

Therefore it's not surprising that the interviewed risk analyst highlighted that several factors make it very difficult to forecast future price risk exposures.

The interviewed risk analyst responsible for commodity hedging emphasized that future purchases and thus risk exposures are very difficult to predict and therefore for commodity hedging it's essential to get information about new trades as otherwise it wouldn't be possible to identify the risk exposures. As discussed already in the literature review, also the risk analyst brought up that the idea of hedging is to reduce the initial physical exposure by making an opposite paper position. Therefore, at Neste Oil, when buying crude oil or feedstock that increases price risk exposure, this is offset by selling equivalent paper position. Naturally the derivatives used must correlate very well with the actual price fluctuations as otherwise hedging could only increase the initial risk exposure. Also as discussed earlier in this study it was also emphasized during interviews that the derivative instruments in oil financial markets correlate very well with the actual price fluctuations as there are instruments as futures, swaps, options and forwards available for different grades of crude oil (e.g. Brent, WTI, Urals), feedstock (e.g. high and low sulphur fuel oils), and refined products (e.g. different grades gasoline, diesel, jet). Furthermore most of these instruments are available for different delivery terms (e.g. CIF, FOB) and to different locations (e.g. CIF Rotterdam, CIF Mediterranean Sea, FOB Primorsk). As a conclusion, it was underlined that there are plenty of well correlating and easily tradable financial derivatives available. For instance when buying a crude oil cargo of 100 000 tons it's usually hedged by selling an equivalent quantity of ICE Brent futures with an exchange, or by buying a call option or selling a swap on OTC markets.

Due to availability of crude supply, schedule of the crude supplier, or the needs of the refinery there might be a situation that several crude oil cargoes are loading and thus increasing price risk exposure at the same time. Further this means that in these cases Neste Oil gets greatly exposed to that certain period's market situation. The interviewed trader stressed that this is usually an unfavourable situation as the price risk is usually aimed to be divided as evenly as possible. However if this situation can be foreseen, can the risk be divided more evenly by using CFD (contract for difference) swaps. CFDs are commonly used in the oil industry to distribute the price risk stemming from the timing of crude oil purchases. Further, it was mentioned by the trader that as some big players can have an impact on oil market prices, a CFD swap is a good instrument to avoid getting exposed to these manipulations too much.

It was also highlighted by the risk analyst that in order to get the hedge to match the initial exposure the information regarding timing, quantity, and quality of the trade is needed in commodity hedging. However, the actual exposure can only be known after loading the product so the hedges are usually done according to the best estimate. Furthermore, it was stressed by the risk analyst that the market price risk is transferred to the buyer already when the purchase is pricing in i.e. purchase is exposed to market price fluctuations, regardless if it physically locates in seller's tanks, in a vessel or in buyer's own storage. Also the risk analyst explained that some feedstock price in months before they are physically bought.

All in all, the findings in interviews seem to be very much in line with the past literature presented in chapters two and three. For instance Fusaro (1998) discusses a lot about the well-developed financial derivatives markets in oil industry. In addition, in interviews the information sharing regarding new exposures was highlighted by those responsible for implementing hedging. This is also much in line with for instance Okochi's (2008) view about the importance of information sharing.

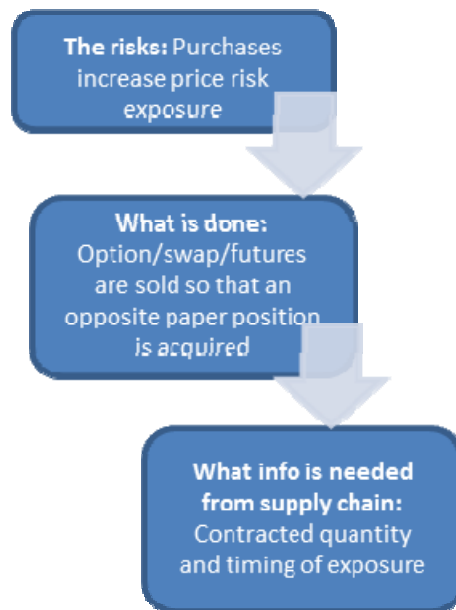


Figure 11: Connection of commodity hedging to crude oil and feedstock purchase

As one interviewee mentioned, the traders must be aware of hedging as they need to know who to inform about the trades. In addition traders need to know if there are hedges done in order to know how the price fluctuations will affect to the deal and its profitability. Furthermore crude oil and other feedstock purchasing traders and operational management

deciding of trades must take into account what kinds of hedging instruments and practices there are, as buying feedstock that can't be hedged should affect to purchasing decisions. Thus it was brought up by interviewed risk analyst that works in commodity hedging that hedging should be taken into consideration already before making the deal. For instance as the interviewed trader brought up, if hedging the purchase becomes too challenging are traders usually considering some other alternatives for instance regarding pricing. One good example of this which was mentioned by the interviewed trader regarding the pricing formula of Brent crude oil:

“Earlier it was very common in the industry to use pricing that was around the B/L date (more in detail usually pricing formula of two days before and after loading date and together with the actual loading date) but as the both buyers and sellers found the hedging of this kind of pricing formula too challenging the industry adopted the current formula. Nearly everyone use it nowadays.”

The current formula is the five days after the B/L pricing formula. This formula is currently the most common one even though there are other variations in use as well.

Further the trader explained how hedging affects to purchasing processes and purchasing decision making. According to the interviewee hedges affect to the situations when a feedstock is available at very low price level but due to fluctuating markets and long lead times the value of the cargo might be greatly higher when it finally is priced in and reaches the refinery. In addition the price level of the refined product might have decreased significantly or increased less in relation to the feedstock, so that the original purchase has become more or less unprofitable. These price differentials between feedstock or crude oil and refined products are called differentials or cracks. According to the interviews, if there's a risk that differential or crack decreases significantly before the feedstock or crude oil can be used in refining, operational management and traders aren't willing to buy cargoes unless the purchase can be hedged. In these kinds of situations the hedge is usually done by locking a price differential/crack between feedstock/crude oil and the refined product, which ensures a good economy of the purchase. As the interviewed trader said:

“Hedging makes purchasing crude oil much easier to manage. Also hedging enhances flexibility. Especially in situations that we have to buy something we need hedging to distribute risk. ”

The interviewed oil trader highlighted that hedges increase flexibility and manageability of purchasing cargoes especially in situations when the market situation is not very favourable but the cargo must be purchased anyway. Also it was mentioned that if hedging wouldn't be possible, purchases had to be divided as evenly as possible in order to avoid large exposures on a single period. However as mentioned earlier allocating purchases evenly is highly challenging.

The trader's comments are supporting the notions of Panos et al. (2009) who found hedging affecting positively to procurement. However, the linkage between hedging and pricing formulas seems to be very oil industry specific as it wasn't mentioned in previous literature. The importance of pricing formulas was, however, highlighted by the interviewees.

Furthermore, if hedges are done only after loading in cases that pricing is linked to the B/L date, the market prices affect to the loading schedule. In an interview it was noted for instance that if the market is in contango (prices are higher in the future) the cargo is tried to load as early as possible. Furthermore, according to the interviewee the market prices and market structure have strong impact on decision making regarding crude oil and feedstock purchases. As a conclusion, from interviews it can be concluded that market structure and hedging affect to the decision making.



Figure 12: Connection of supply chain decision making to hedging in crude oil and feedstock purchase

Purchasing crude oil or feedstock exposes an oil refiner to currency exchange risk. However as it with commodity hedging, also with exchange risk it can be argued what is the actual starting point of the exposure. Basically the starting point could be considered to be already

the point of purchase but according to the interviewed assistant manager, Neste Oil considers currency risk to start at the moment of the actual money transaction i.e. when the payment is done. In addition, usually there is quite long time between purchase and the payment of the crude oil or feedstock. Furthermore, it's very common that the payment date is connected to the B/L date. Due to these reasons currency risk i.e. daily exposure of net working capital is discussed in next subchapter even though the payment terms are negotiated when making the supply contact.

6.2 Crude and feedstock transport

Even though when a buying agreement is done for a certain quantity, due to oil's liquid nature and the loading equipment the exact purchased quantity is known only after loading or discharging. Basically the actual quantity is never exactly the same as the one agreed in a purchase contract as loading exactly e.g. 10 000 tons is extremely difficult and thus a couple ton difference is natural. In addition the agreements are often done so that there's certain a percentage range around the agreed quantity (often +/-10 % range is used) which allows depending on contract whether buyer or seller to optimize which end of range is used. In practice this means that if an agreement is done for 10 000 tons, but there's +/-10% range the actual quantity might be something between 11 000 and 9 000 tons. Furthermore there might be some unexpected problems in loading e.g. enough product is not available or supplier wishes to empty their storages and thus ask the buyer to load bigger quantity than originally agreed. In addition some deliveries can be cancelled in a very last minute (e.g. due to problems in quality or poor vessel availability during winter) or sold to another customer instead of buying it to themselves i.e. cargo is traded instead of bought to the refinery.

Another factor which is known only after loading is the loading date (usually referred to as B/L, bill of lading, date). And also as discussed earlier in this study for many cargoes the price is determined by price quotations that are usually connected to B/L date. As discussed in previous subchapter for instance for crude oil purchases' pricing formula of five pricing days subsequent to B/L date is very common in the industry.

These factors mentioned above naturally affect to the risk position and hedges. As a single delivery is usually worth of tens of millions U.S. dollars can small changes lead to significant

under/over position. Both interviewed risk analysts brought up that often hedges that are already done need to be adjusted accordingly. Also the risk analyst explained that:

“Futures definitely are the most practical instruments when you want to adjust the hedges you have done. Using swaps and options is much more difficult and requires much more work as they must be done on OTC-markets. “

Further it was explained that futures are often used as a hedging instrument as it very easy and convenient to buy back futures if the actual quantity ends up to smaller than anticipated and selling more if the actually quantity was bigger. Also it was noted by an interviewee that if the cargo gets cancelled or delayed must the hedges be cancelled as well.

All in all, it can be concluded that there are several challenges in hedging in transportation part that can be found to be very characteristic in oil industry environment. Further, this special but still very important issue was new, when compared to the theoretical framework or past literature.

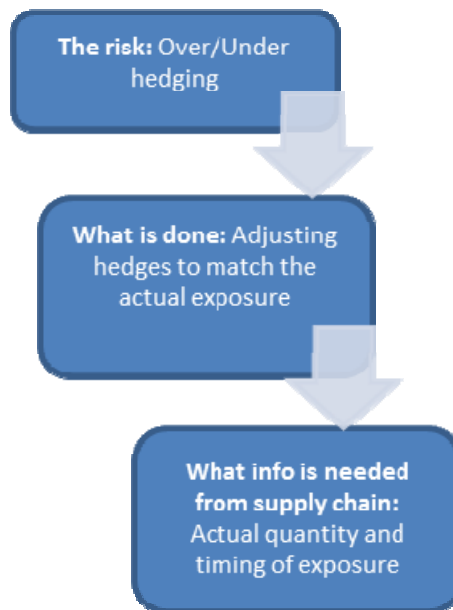


Figure 13: Connection of commodity hedging to crude oil and feedstock transport

According to the trader the hedging has an impact on crude oil and feedstock transport in cases that there are big changes in loaded quantities or some unexpected changes occur. For instance if the delivery gets cancelled which leads to cancelling or amending hedges more than normally the operational management and sales department need to know the profit or

loss that incurred from hedging. These profits or losses might affect to how the delivery is eventually handled or might be used in negotiations.

In appendix 3 two court cases are presented where hedges have played a massive role in a case that cargo was being cancelled and the buyer had encountered significant losses. However even though Neste Oil wasn't a counterparty in these court cases, there's a risk that Neste Oil faces same kind of situation and thus this must be taken into consideration.

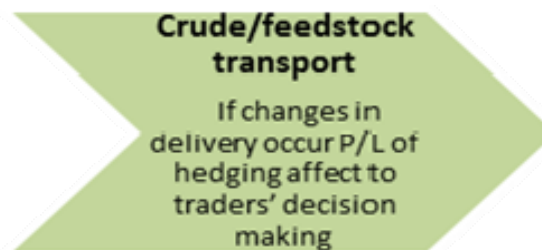


Figure 14: Connection of supply chain decision making to hedging in crude oil and feedstock transport

In addition to the most of Neste Oil's business transactions, also crude oil and feedstock purchases are done in U.S. dollars. However, as Neste Oil reports in Euros, purchases in U.S. dollars expose Neste Oil to transaction risk. Also it was noted by the interviewee that the value of a single payment is often tens of millions U.S. dollars, and as the stream of payments and receivables is unstable, the exposure is very volatile.

Usually the payment is done (and thus transaction risk takes place) only after the loading when the actual exact volume and the B/L date are known. This is due to the fact that as discussed earlier the agreed loading quantity is never the same as the actual volume and the payment date is usually linked to the B/L date, which as discussed tends to vary and be difficult to predict. However there are various possibilities for payment terms as well such as according to the delivery month or discharging date but in crude oil and feedstock purchases linking the payment date to B/L date is the most common. Thus treasury department responsible for the currency hedging need the exact information when the payment date actually is. In addition, there's a risk that the cargo gets cancelled due to diverse of reasons. Also some special cases may arise why the payment is delayed or done earlier than normally. For instance if there's something special issues with the delivery like the problems with quality or ambiguity regarding the loaded quantity, might the payment date be changed very

promptly. In addition there are some rather seldom special cases that payment is done before loading as prepayment and then only adjusted afterwards. All in all, the size of transaction risk is known exactly only after the loading (or discharging, depending if the purchase is done according to discharging volumes).

When the past literature and findings from interviews are compared, the unknown currency exposure seems to be disjunctive in oil industry. For instance in theoretical framework the transaction risk is connected to the purchase phase in the supply chain.

Furthermore as feedstock and crude oil purchases are so often done on spot basis, do the contract terms regarding payment terms vary as well and therefore it is important that treasury is well informed about the contract terms. In addition, the information flow from the trader making the purchase to treasury implementing currency hedges is important. However, according to the interviewee, as transaction risk takes place usually only several days after loading can information be shared through IT systems. According to the interviewee, proper and feasible IT-systems are important and the most important channel for information flows. Also the interviewee working with currency hedging didn't highlight the importance of information sharing as it was highlighted in commodity hedging. In addition as the exposure takes place only after the loading, there's usually no need for adjusting hedges separately after loading. Also it is good to notice that transaction risk might take place only after the purchased crude oil is already in Neste Oil's physical inventory or is already in a refining process.

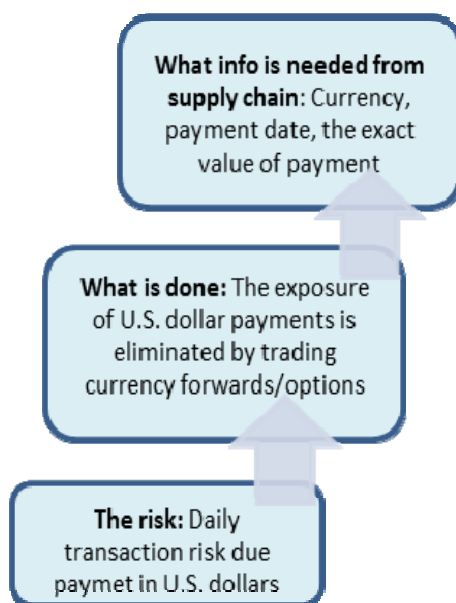


Figure 15: Connection of currency hedging to crude oil and feedstock transport

6.3 Crude and feedstock storage

The value of oil fluctuates during stocking period as the market prices fluctuate. However as discussed earlier in chapter 5.2, Neste Oil hedges its inventory price risk in order to remove the risk that falling market prices would also decrease the value of its assets. Practically when the value of crude oil and feedstock in inventory decreases, the value of hedges increases and thus these two positions offset each other. Further, as discussed in literature review it was also noted in interviews that the price fluctuations in oil markets can be dramatic. However as discussed in chapter 5.2 it was also brought up in interviews that there is no point to hedge the entire inventory as the most of the inventory is very stable for instance due to requirements in legislation. Therefore hedges are done only to the part of inventory that fluctuates above or below the base inventory level (the logic of base inventory level was described more in detail in chapter 5.2 of this study).

The risk analyst explained that in practice the volume in inventory is hedged when the purchases are hedged and thus no separate hedges are usually done solely during the inventory period. However the hedges (i.e. the short position) are kept over the stocking and refining periods and they aren't bought back as long as the crude oil, feedstock, or refined product is in inventory. Basically hedges that were sold when the crude oil was initially purchased are bought back only when refined product is sold. Also it was explained by the risk analyst, that regarding inventory price risk Neste Oil considers both crude oil and

feedstock and product inventories conjointly. However, hedges are adjusted according to feed to refinery and output from refining. This is due to as the loss (volume difference between input and output) generated in refining is not hedged and thus hedges are adjusted to match the actual exposure.

For instance Gaur and Seshadri (2005) discuss about inventory hedging in their study. According to the interviews the idea of inventory hedging in Neste Oil is very similar to theirs. However, in Neste Oil the hedges are often done before the oil reaches the inventory. Furthermore, another factor special for inventory hedging in Neste Oil compared to the past literature, is keeping a certain level of inventory that is not hedged due to its stability.

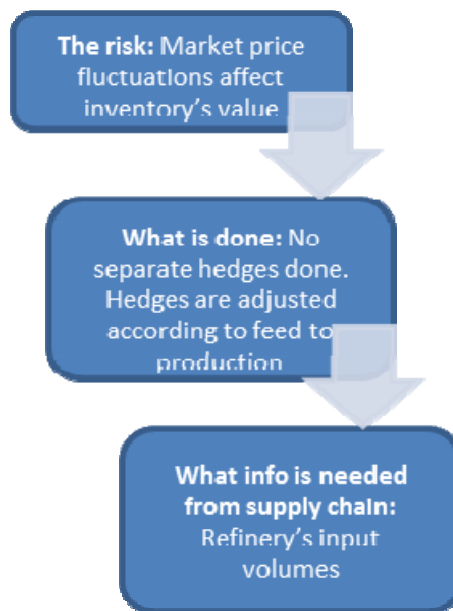


Figure 16: Connection of commodity hedging to crude oil and feedstock stocking

It was emphasized by the interviewed sales planner from operational management that from operational management point of view hedging affects to the optimization of inventory capacity which Neste oil has plenteously. According to the interviewee as inventories are being hedged the inventory levels and the inventory capacity can be exploited. In addition, as products are hedged over their inventory period, inventory level can be increased before good demand season or in cases when the market level for feedstock purchases is favourable.

The interviewee underlined the importance of hedging to inventory level planning:

“The hedges have great impact to our inventory level planning. Without hedging the inventory levels would be aimed to be kept as steady and flat as possible as all the fluctuations would expose us to a price risk. In practice our inventory levels fluctuate quite much as we aim to optimize the taxes and opportunities in the market”.

The interviewee also stressed that without hedges they wouldn't be able to exploit favourable market situations which would again have huge impact on company profits. Also the interviewee highlighted how hedging enables flexibility.

In addition, sometimes market situation encourages oil refiners to build so-called contango-inventories. Contango storage means that according to market forwards whether crude oil, feedstock or refined products are more expensive in the future which encourages refiners whether to buy crude oil or feedstock in advance and use it only when the market prices are higher or produce product and keep it in storage until price level has increased. Without hedging, it was mentioned by the sales planner that building contango storages would be too risky as the markets do not always develop as anticipated.

All in all, it can be concluded that very similar connections between physical inventory levels and hedging were mentioned in interviews than it has been found out in past literature. However, in interviews the flexibility to exploit market situations was found very important compared to the studies in literature review that mostly concentrated on optimizing inventory level. In addition contango storages weren't mentioned in literature review and weren't thus part of the theoretical framework either.

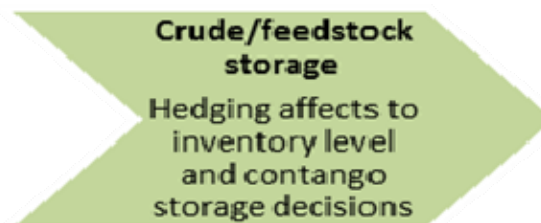


Figure 17: Connection of supply chain decision making to hedging in crude oil and feedstock stocking

According to the interviewee, no separate currency hedges are done during the inventory period. This is due to as Neste Oil considers transaction risk from cash-to-cash (i.e. from payment to payment) and hedges done during the payment are kept over the stocking and refining periods. In addition, the interviewee explained that hedges aren't adjusted during inventory period as is done with commodity hedging as the transaction exposure isn't affected by losses in refining etc. due to cash- to-cash exposure and as the value of sales are always more than the value of purchase (crude oil cheaper than refined product).

And as discussed in previous subchapter, physical crude oil or feedstock might be already in Neste Oil's physical inventory or in a case of very long payment period it can be already in a refining process when the transaction risk is hedged.

Also it was found from interviewing assistant manager responsible for currency hedging, that basically the whole inventory's value that is in U.S. dollars has been hedged. However, as discussed with commodity hedging, a significant part of total inventory is stable, and thus also in currency hedging there is no point to hedge the entire inventory. Therefore, it was told by the interviewee that in currency hedging there is also a inventory level below which there are no currency hedges done.

6.4 Refining

During interviews it became clear that refining is the most essential part of oil supply chain. It was highlighted in interviews that everything happening at the refinery affects strongly to hedging activities as refining regulates all the purchases, inventory levels, and sales. In addition, refining provides the forecasts at least in broader scope. Furthermore, in interviews it was also emphasized that close and quick communication is needed especially from refining to treasury. This was especially underlined by risks analyst responsible for commodity hedging. Again in this point it was highlighted that IT systems aren't able to replace close direct contacts when it comes to sharing information.

Neste Oil hedges its future refining margin in order to reduce its exposure to decreasing margins. The aim of refining margin is to lock some part of its future sales income and thus secure a certain degree of profit. Refining margin hedging is explained more in detail in the chapter 5.2 in this study. For instance 30% of year 2012 sales margins were already hedged in

the beginning of the year 2012 according to Neste Oil's interim financial report published on 3rd Feb 2012. According to the interviewed risk analyst, the refining margin hedges (in short, margin hedges) are based on forecasted sales and refinery production and are done relatively much before the actual sales. Therefore it was underlined that it is essential to have good communication with operational management regarding their production plans and future strategies. The main reason for this was mentioned to be that the hedges are done based on forecasted net sales volumes. Further, it was explained in Neste Oil's annual report (2010) net sales volumes means that from actual selling volumes the purchases that have the same price risk are reduced. Thus, interviewee continued that if there are changes in production prospects these must be communicated to those implementing margin hedges. For instance maintenance breaks at refineries have huge impacts on purchase and sales volumes and thus changes in maintenance break timings need to be communicated carefully to treasury department. Also, it was noted that, problems in production and unit breakdowns alter the product output and volumes. Therefore it was not stressed that without proper communication there's a risk as margin hedges are done months in advance that hedges do not match with the actual production.

“It can't be known in advance, at the point of hedging, what our production in the end is and how much each product will be produced. However, as our (refining) margin hedging ratios are relatively low, this doesn't mean problems for us. The situation would be different with higher hedging ratios.”

Interesting point that was brought up by the risk analyst was that in addition, maintenance breaks affect to the surrounding months as the refinery has to manage its inventory levels. Practically margin hedging is implemented by using financial derivatives contracts that aim to illustrate company's production. Also it was found important to notice by the interviewed risk analyst that as hedging also always fixes the margin and thus doesn't eliminate only the risk of decreasing margins but also the possibility to benefit if the margins increase. Therefore Neste Oil isn't aiming at very high hedging ratios as it wants to keep the upside potential, the interviewee noted as a conclusion.

Also regarding the connection between commodity hedging and supply chain the interviewed risk analyst noted that in addition to margin hedging the issues mentioned above as changes in maintenance break schedules also affect to feedstock and inventory hedging. It was found

important to notice that refining provides forecasts and production plans that need to be communicated carefully to treasury department. In addition, it was told by the risk analyst that as the loss generated in refining is not hedged it needs to be communicated for treasury department as well. Furthermore especially around maintenance breaks the loss might fluctuate plenty. Further, big unexpected events at the refinery can also lead to considerable under or over hedging situations. In addition it was noted by the risk analysts that changes in refining can cause massive changes to supply or sales programs. Further, all the planned changes in crude oil or feedstock supply or in product sales need to be communicated to treasury department as early as possible so that treasury is able to adjust its existing hedging strategies if needed.

Neste Oil's refining margin hedging is in line with the literature as also according to interviewees financial derivatives are used to lock some profits. However in the past literature there were no discussions about refiners locking their margins. Also it was highlighted during interviews that refinery is very important source of information.



Figure 18: Connection of commodity hedging to refining

The interviewed sales planner from operational management department emphasized that from refining point of view hedging has a massive role when bigger or smaller maintenance breaks are planned. According to him the main reason for this is that inventory levels need to be increased before any maintenance breaks. In order the refiner to be able to meet the demand during the time that that production is down high inventory levels are needed which

again would mean great price risk in case that hedges wouldn't exist. Also the interviewee noted that if the feedstock and product in inventory are hedged planning for instance maintenance breaks is easier as increasing inventory levels do not cause increased price risk exposure. It was also stated by an interviewee that without hedging the length and frequency of maintenance breaks was minimized which would lead to increased operational risk. Also it was mentioned that without hedging during maintenance breaks Neste Oil would have to rely more on purchasing cargoes from the market to meet its committed sales. Further in these cases, the sales planner noted that Neste Oil would be more dependent on the market situation and for instance in a case of tight supply Neste Oil would might to buy expensive cargoes from the market and thus be highly exposed to market price risk. Now thanks to hedging Neste Oil is able to produce to inventory enough products to meet the demand during its maintenance breaks.

Also, in cases that something goes wrong at the refinery, hedges are important to protect the value of the feedstock and crude oil that can't be refined and thus sold. It was noted during interviews that without hedges an unexpected production break would lead to an extensive exposure to market price risk as the value of feed stock inventory could meanwhile decrease significantly. There might be also committed purchases that can't be cancelled anymore.

Further it was mentioned that as operational decision making is highly based on forward prices from financial derivatives markets, without financial oil markets decision making and planning would be greatly more difficult. Without financial markets decision making regarding future production volumes would have to be based on current price level and own estimates. As the interviewed sales planner stated:

“Without hedging it would impossible to make long term decisions. All kind of planning would be much more difficult.”

He also mentioned as one of the important benefits of hedging is that there's a possibility to lock in some of the margin when planning production volumes. Also it's worthwhile to notice that in addition to forward prices also seasons (like the driving seasons), trends and market prices steer refining as it was noted by an interviewee.

Also it was underlined, that from operational management point of view hedging also enables long term planning. The sales planner found it very important that decision making timespan would be much shorter without hedging. According to him, currently profitable and favourable events in future wouldn't be able to possibly to exploit, an example of this is locking cracks and differential of future sales and purchases. In addition it was mentioned in interviews that without hedging Neste Oil would have to be much more in a lean mode, which would make Neste Oil more dependent on markets. Further in interviews it was highlighted that hedging enables flexibility. Flexibility again enables exploiting opportunities in the market.

The interviewed heavy product trader brought up how hedging also affects to refinery utilization. It was mentioned that for instance when refinery isn't otherwise making any profit for instance due to poor market situation but the high fixed costs do not encourage to reduce utilization rate and thus production margin hedges done might still make running the refinery at high utilization rate profitable. Therefore in practice margin hedges allow running the refinery at high utilization rate even when the market situation is unfavourable.

It was also mentioned in interviews that as hedging enables steady stream of cash flows hedging might also affect to the terms of loans as the investors might allow lower interest rates to a refiner that has locked at least some of its incomes. In addition investors might require a certain hedging ratio to be maintained as condition of a loan. Further, it was discussed that steady cash flow enables investments that would be otherwise difficult to finance during the times when margins are low.

All in all, hedging was found to be greatly important for decision making in refining. The interviewed sales planner found the most important impacts to be the decision making timespan and maintenance break planning. The past literature, however, has a lack of studies that would increase understanding about the impacts that hedging has to decision making.

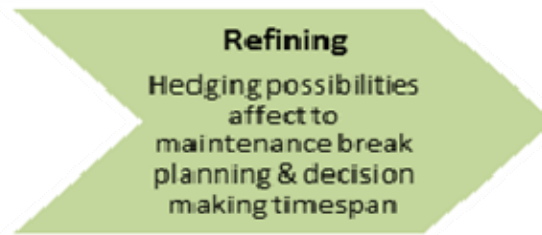


Figure 19: Connection of supply chain decision making to hedging in refining

In addition to commodity hedging refining provides forecasts for currency hedging as well and for instance the margin hedging is based on forecasts. The interviewed assistant manager explained that margin hedging means securing Neste Oil’s future sales margin from currency fluctuations as most of the sales are in U.S. dollars. Further, it was explained that there’s a risk that even though margins remain flat in U.S. dollars the profit might be much worse in Euros due to adverse currency rate development. Margin hedging is part of Neste Oil’s transaction risk and is explained more in detail in chapter 5.2. Exchange rate exposure is hedged mainly by using forward contracts and currency options. However as the margin exposure based on forecasts and hedges are done on rolling basis for 12 months for instance big changes such as changing the timing of maintenance break have impact on currency hedging. Also it was stressed by the assistant manager that in addition to volume changes, noteworthy changes in market price levels affect to currency hedging as well while in currency hedging the value of future margins are being hedged which is the quantity of volumes and prices. Again it’s important that if changes occur they need carefully be communicated to treasury.

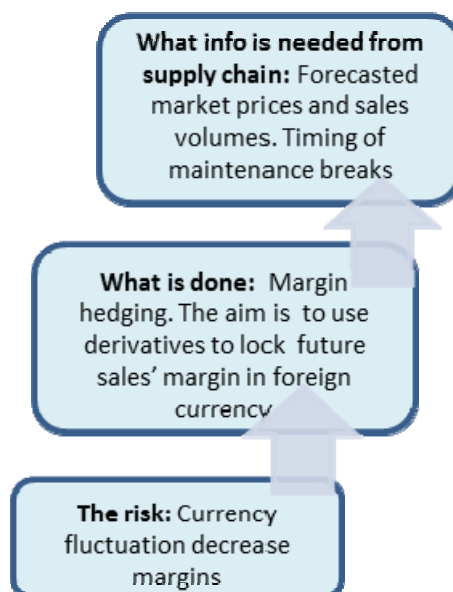


Figure 20: Connection of currency hedging to refining

6.5 Product storage

The refining output affects to product storage as it whether increases or decreases it. However as from commodity hedging point of view and explained in chapter 6.2, both crude oil and feedstock and refined product inventories are considered jointly, only the loss between the refinery input and output affects to the hedges during the inventory period. Therefore in interviews not much findings were related to this part from commodity hedging point of view. However, it was noted by the risk analyst that some products are bought straight to the inventory and are whether to other products but not refined or sold as such. However, it was also noted that from a supply chain point of view these products are considered as feedstock that only skip the feedstock inventory and refining parts.

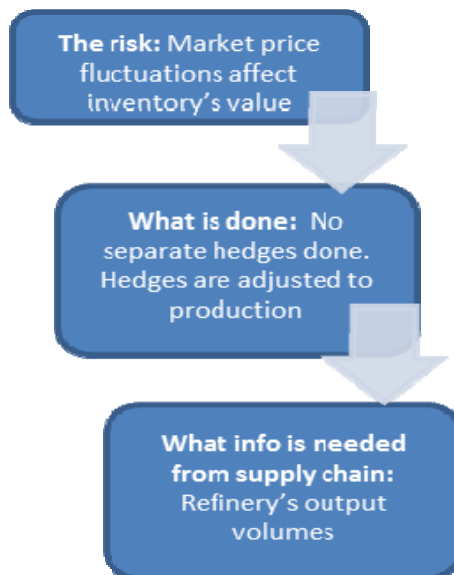


Figure 21: Connection of commodity hedging to product stocking

As discussed in chapter 6.2 hedging has great impact on inventory levels and inventory level optimization. As the interviewed sales planner stressed, before good demand season product inventory can be increased in order to have enough refined products available to be able to meet the increased demand or to exploit good market levels. For instance thanks to hedging if it is seen that demand will be high for instance during winter can product inventory levels be increased beforehand without the exposure to risk of lowering prices increasing. And as mentioned earlier in this study, increasing inventory levels would be too risky to do without hedging. Thus hedging enables flexibility that allows good service level for customers and enables exploiting good margins. Further as discussed in the subchapter 6.2, contango storages that are relatively common on product side as well wouldn't be possible without hedging.



Figure 22: Connection of supply chain decision making to hedging in product stocking

As during the crude oil and feedstock storage no separate currency hedges are done during product the inventory period. As discussed, hedges are only kept over the stocking and refining periods.

6.6 Product sale

As discussed earlier, Neste Oil considers market price fluctuations starting to affect its market exposure when the crude oil or feedstock is purchased. According to an interviewed risk analyst, Neste Oil considers the price risk being transferred to a customer when a refined product is sold to a customer. Therefore the hedges that were sold against the risk of price fluctuations affecting to product during the ownership of the oil are bought back. However both the interviewed risk analysts highlighted, that the selling contracts vary a lot and thus the price risk is transferred in different ways to a customer. One of the interviewees also shed explained about the complexity of refined product supply chain:

“There are also cases that a product is sold only after it’s been loaded to a vessel and it’s already sailing towards its destination country. Still, even though product is not in our physical inventory we consider it as part of our inventory position until it’s been finally sold.”

The reason for this kind of sales is the long lead times. According to an interviewee, it can be known that the product will be sold to North America due to good local price level and as it takes approximately three weeks to sail to U.S. or to Canada there is plenty of time to find a buyer that pays a best price.

About the hedging process, the risk analyst explained, that when hedges are bought back against a product sale, hedges are netouted together with possible product purchases that are

done in same time. It was explained that this is done in order to avoid situations that one should have to hedge separately crude oil purchases (increasing price risk exposure) and product sales (decreasing price risk exposure). In practice if these two exposures are considered together might input and output volumes net out each other and thus keep the price risk exposure stable. However due to the nature of the market these two usually aren't exchanging at parallel rate and thus price risk exposure fluctuates constantly and requires thorough hedging. Further, according to the risk analyst:

“In theory price risk exposures could balance each other. However, in practice this never happens and we always have to adjust our positions.”

Also the interviewed trader brought up that in product sales there is a much bigger variety of pricing formulas as with feedstock and crude purchases. Furthermore, in Neste Oil, sales are delivered a lot by truck that are small but relatively frequent deliveries but still create challenges to hedging. However, it was also brought up by the risk analyst responsible for commodity hedging that as product sales are delivered in smaller quantities which make the quantity of deliveries huge and again make hedging demanding. However as a seller Neste Oil is able to affect more to pricing formulas and is able to try to concentrate to pricing formulas that are easier to hedge.



Figure 23: Connection of commodity hedging to product sale

As discussed earlier, hedging affects to the timespan of decision making regarding product sales. However without hedging the decision making would be done regarding much shorter time span as otherwise decisions (e.g. regarding postponing sales) would exposure greatly to market price risks. Now hedging enables for instance selling volumes that are delivered in the future, even in months. Therefore hedging allows flexible, long term planning and thus exploiting the markets in the best possible way.

Also there are long term contracts that bind Neste Oil to sell the agreed quantity during the contract period that might be even 12 months long. In these cases it is actually so that the product is sold before the feedstock is purchased. This is however possible due to the margin hedges that secure a certain level of margin regardless market developments.

In addition hedges enable to exploit global markets and possible arbitrages that occur sometimes between continents. Without hedging long lead times would make sales to other continents too risky as the price level might change to significantly worse during the transportation. Therefore one of the interviewees mentioned that without hedging Neste Oil would concentrate on selling its products to much smaller geographical area. All in all, hedging enables flexibility for instance regarding delivery times as product can be held in an inventory longer which again means better service for the customer.

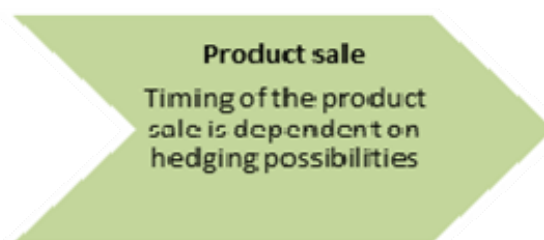


Figure 24: Connection of supply chain decision making to hedging in product sale

Due to the same reasons (payment is connected to the B/L date, the actual volume is known only loading etc.) as in subchapter 6.1 currency transaction risk in discussed further in product transport subchapter instead of Product sale.

However, it was mentioned by an interviewee that without hedging more would be aimed to be sold in domestic currency. However, as oil business is global, it was noted that preferring Euros as a sales currency would mean increased difficulty to find customers due to a

decreased customers, which again would have an impact to profits. Further, hedging can be seen increasing flexibility.

6.7 Product transport

With product transport the price risks are very similar to crude transport such as uncertain actual quantities, B/L dates, and a possibility to cancelling the trade, which again require adjusting hedges to match the actual exposure.

Interesting was also, that as told by the risk analyst, it's is characteristic for oil supply chain that products aren't always delivered straight to a customer but are delivered first to a storage that is located closer to potential end customers. Also it was stated that from price risk point of view Neste Oil carries the risk until the product is finally sold even though the product is delivered out of original storage. In addition the risk analyst responsible for commodity hedging, having oil storages in different countries and continents creates challenges to get the hedges done correctly. This character in a supply chain creates a risk to under or over hedging. Therefore, as it was underlined by the interviewee, tracking the exposure in different locations requires again close communication between departments as it can't be considered that a delivery from refinery automatically means reduced price risk exposure as the exposure is carried by Neste Oil until the final sale. It was also told by the risk analyst that in addition to putting product to storage, sometimes products are also loaded from one ship to another during product delivery which again makes it demanding to track the transfer of risk exposure.

In interviews it was also brought up that oil supply chain and oil trade are relatively dynamic and new kinds of pricing models are created every now and then. Further it was mentioned by the risk analyst that when negotiating about new pricing models should this also be communicated to treasury department so that possible new hedging strategies can be developed to match the risk exposure. Furthermore, if new foreign inventories are other changes to supply chain are taken into use should treasury department be carefully informed so that the hedgers are able to follow and identify the exposures. And due to the global nature of oil industry and volatile markets which might create new arbitrages making changes to product flow isn't peculiar. Once again close communication was highlighted to be essential between operational management, traders, and treasury department.

In oil supply chain there are huge variety of possibilities that might affect to the delivery of a cargo and thus cause unexpected changes; for instance cargo can't load to a bad weather or draft restriction, the counterparty is proven to be unable to pay for the cargo, or product quality is contaminated. Furthermore it's common that the changes are unexpected, sudden, practically impossible to predict, and require quick alternative evaluation and final decision making. Therefore it was explained by an interviewee that unexpected events in oil delivery might lead that the hedging was done incorrectly and the risk exposure is unwillingly increased. Further it was noted that if prices have developed to adverse direction there might be a massive impact to sale's overall profitability. Due to great possible financial impacts of incorrect hedging, in fast paced decision making it's important that treasury department is kept well up to date. As one of the interviewee mentioned in these kinds of situations close communication is highly important and relying solely on IT-systems would be impossible.

All in all it was highlighted in interviews that there are plenty of variations in oil supply chain especially in product sale and transport parts which create challenges to hedging. However, it was also noted by an interviewee that as individual delivery quantities are usually smaller on selling side than on purchase side, is the impact of one cargo to Neste Oil's risk exposure smaller on the sale side.



Figure 25: Connection of commodity hedging to product transport

From operational management and traders points of view hedging has a similar role as in crude oil and feedstock transport which was discussed in chapter 6.2. The hedging has mainly affect when something goes wrong with the delivery and hedging alterations create profits or losses. As discussed in chapter 6.2 there has been even court cases regarding the hedges profit and losses in cases that cargo was cancelled.

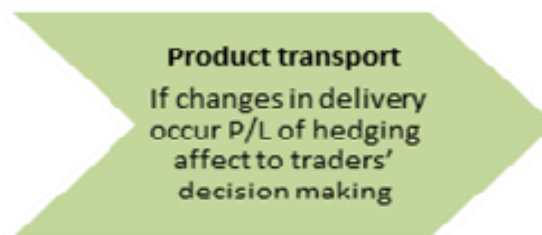


Figure 26: Connection of supply chain decision making to hedging product transport

According to the interviews, like it is with crude oil and feedstock purchases also most of the product sales are done in U.S. dollars. Further, it was explained that as big share of production is sold to Finland has Neste Oil also a significant portion of sale incomes in Euros as well. From transaction risk point of view product sale has a similar but a reverse impact compared to crude oil or feedstock purchase. Thus a sale in U.S. dollars decreases Neste Oil's transaction exposure.

Also on sales side the payment is received (and thus transaction risk is reduced) only after the loading when the actual exact volume and the B/L date are known. In addition also on product sale side there is a wide range of different kinds of payment terms. Actually on sale side there're even wider range of payments terms and different kinds of contacts as there are more modes of transport is use. However tracking the exposures and payments is relatively straightforward due to IT-systems. However, a big share of product sales are done on spot basis, which again requires that treasury gets well informed about the payment terms. Also currency hedges are usually sold after the product has left Neste Oil's inventories and depending on contract terms it might already be discharged to customer's tanks.

Also it was mentioned in interviews that transaction hedging is done as net basis which means that equal value of U.S. dollar purchases and sales keeps the transaction risk unchanged. Further, according to the interviewed assistant manager, when buying or selling currency hedges only the total change is taken into account. However, it was also noted by

the interviewee that in order Neste Oil to make profit should the sale incomes be bigger than the purchase expenses. Also it was mentioned that more sales are done in Euros than purchases as Finland is the big market for Neste Oil and basically no feedstock is bought in euros. Also an interesting point mentioned in an interview was that as the business is global and thus there's a global bank network involved in transferring money which leads to a risk that some receivable payments arrive late due to banks locating in different time zones. Late payments was said again to affect to the net calculations and can thus lead over/under hedging situation. However, it was mentioned that this is only a seldom occasion and thus doesn't cause massive risk.



Figure 27: Connection of currency hedging to product transport

6.8 Product retailing

This last part of the supply chain was left outside the scope of the study. Therefore Neste Oil's subsidiary Neste Markkinointi Oyj that takes care of the retailing wasn't included to the study. Price risk management in retailing companies and, for instance, in airlines has been studied to some extent. However, as the supply chain for oil retailer or for an airline is quite different than the one explored in this study it was left outside of the thesis's scope.



Figure 28: Retailing

This chapter aimed to present the findings from the interviews. In addition the chapter presented the empirical framework that was constructed according to findings acquired from the interviews. The chapter discussed about each part of oil supply chain and presented the finding from three points of views; commodity hedging, supply chain management, and currency hedging.

The following chapter includes discussion and further analysis regarding the findings presented in this chapter. The aim of the subsequent chapter is to summarize findings from the interviews and provide answers to the initial research questions.

7. DISCUSSION OF THE RESULTS

This chapter aims to concisely discuss about the results presented in the chapter six, and reflect the outcomes in the light of both the research questions and the theory from past academic research presented in chapters two and three. In addition the chapter aims to present what were the main differences between theoretical and empirical frameworks.

During the literature review and the case study it became evident that hedging has a significant role in oil industry. Market prices in the oil industry have become increasingly volatile, which increases the importance of risk management in the industry (e.g. Verleger, 1993). Based on interviews and previous research it was found out that hedges are used both to eliminate some market exposure and to lock some of the income or profits in beforehand and even in months before the actual sale. In addition it was found out during the literature review that there're several well developed market places for financial oil derivatives (Fusaro, 1998). In addition these derivatives are very liquid and there are plenty of participant on the markets (Fusaro, 1998). However according to past studies different market participants have very distinctive hedging activities (Campbell et al., 2006).

During the study it became evident that both exchange rate and market price exposures have great significance for Neste Oil. During the interviews it became evident that Neste Oil is greatly involved in hedging these risks. Even though there was only one case company studied in this research, it can be expected that other oil refiners are greatly involved in hedging as well while during the interviews the importance of hedging was emphasized in several occasions. In addition all the interviewees mentioned that they find the topic of the research very important, which can be considered to be a good indicator of topic's significance.

Neste Oil has four major market risk components that it hedges. The hedging practice's targets and short descriptions are gathered to the Figure 29 below. In Figure 29 the first two practices are part of commodity hedging and the last two belong to currency hedging.

	Target:	Explanation:	Connection points to supply chain:
Inventory hedging	Remove the oil's exposure to market price fluctuations between the periods that crude oil or feedstock is bought and refined product is sold.	Hedges regarding inventory are sold at the start of the price risk exposure and bought back when the risk is transferred to a customer. Hedges are adjusted to match the actual exposure and are thus highly dependent on events on supply chain.	All (exl. retailing)
Margin hedging	Secure/lock a certain degree of sales margin.	Hedges are done for several months to the future and thus very dependent on changes on production plan or unexpected events in production.	Refining
Daily transaction hedging	Reduce the oil's exposure to exchange rate fluctuations between the payments.	Hedges are done daily to match the foreign currency exposure from payables and receivables .The payment dates and values are dependent on B/L dates and quantities.	Crude oil & feedstock and product transports
Margin transaction hedging	Secure that margin in foreign currency doesn't lose its value when converted to Euros.	Hedges are done on rolling basis for next 12 months according to the sales forecasts. Dependent on changes in production plan and shifts in market price levels.	Refining

Figure 29: The summary of Neste Oil's hedging practices

In addition to above Neste Oil's hedging practices, crude oil traders use CFD-swaps to distribute crude oil price risk exposure more evenly.

The positioning of hedging processes in oil supply chain has gained very little attention in academic literature. Therefore one of the aims of the study was to connect hedging processes

to oil supply chain. During the study it was found out that hedging has part in every single point of the oil supply chain. Especially inventory hedging is highly affected by changes and events in supply chain. This can also be well seen in the Figure 10 presented in the beginning of the chapter 6.

In interviews it was found out that due to the nature of oil business forecasting exposures to exchange rate risk or to market price risk is not very straightforward. Usually exposures are linked to loading or discharging dates and quantities. Further, it was mentioned that as schedules are just forecasts, changes in delivery programs affect to exposures. Due to oil's liquid character, the loading system, and massive loading quantities it is basically impossible to know beforehand the precise loading quantity. Terminals are advised how much they are supposed to load but as the quantities are so huge there's always some difference in volumes. However, according to the interviews, the difference is taken into account in hedging and hedges are done or adjusted to match the actual exposure. Also, it was noted that some deliveries can be cancelled in a very last minute or sold to different customer instead of buying it to themselves. Therefore it was highlighted by interviewees that as single deliveries are worth of tens of millions U.S. dollars, can one day miscalculation lead to significant under/over hedging. If an exposure is calculated incorrectly the company exposes to exchange rate risk or market price risk even though the whole position is supposed to be hedged and no risk should be left.

For instance Okochi (2008) mentions that commodity hedging can be challenging and that for instance defining the starting point of the exposure in commodity hedging can be difficult. This was found to very true in oil industry context, where the exposures are connected to B/L dates and loading quantities. However, also Okochi's (2008) study is on general context and the challenges of commodity hedging in oil industry, which according to the interviews seem to have a big impact in oil industry, haven't gained attention in academic research.

Currency hedging has been studied greatly and for instance Ding et al. (2007) highlight the importance of exchange fluctuations to global companies' profitability. The exchange rate fluctuations are greatly important for Neste Oil as well, which can be concluded as for instance the daily transaction risk is hedged entirely. In addition, as it was found out from interviews that if transaction hedging wouldn't be possible, there would be impacts to Neste Oil's supply chain as more would be aimed to be sold to Finland and to other countries using

Euro, which would again have an impact to Neste Oil's competitive position due to smaller customer base.

Furthermore, from interviews it was found out that in oil supply chain currency hedging was seen actively affecting to three parts; crude oil and feedstock transport, refining, and product transport. However, it was also found out that the oil is hedged also during the inventorying and product sale periods. However as according to an interviewee, the events in supply chain such as increased loss in refining do not affect to currency hedging and thus currency hedges aren't usually adjusted. In the past literature there were no studies found that would have discussed about the position of currency hedging in oil supply chain. However, transaction risk is a basic theory of foreign exchange hedging, and thus there are plenty of comprehensive studies regarding the transaction risk. Also it was found out from the interviews that for a company, like Neste Oil, the exchange rate fluctuations have a great impact on sales margins. However this exposure can be hedged. Further, the only challenge regarding margin hedging are the possible changes in forecasts provided by traders.

Also in interviews it was highlighted that oil supply chain creates special challenges for hedging currency exposure. One interviewee compared oil industry to power and electricity industry in which invoicing is done once a month and prices are very predictable. In contrast to this in oil industry daily transaction exposure is very difficult to predict due to payments' connection to B/L dates and massive value of single payments or receivables. All in all, in currency hedging the main issues highlighted by the interviewed assistant manager were the volatility of the exposure and the importance of U.S. dollar to industry. In addition, information flow or identifying the exposure weren't seen as problems or causing challenges in currency hedging.

During the study it became evident that special characters of oil supply chain create special challenges for both commodity and currency hedging. Therefore during the interviews it became highly clear that hedging can't operate in isolation from operational management but there is a strong need for close and intensive communication and cooperation between functions. As importance of information sharing was highlighted by all the other interviewees besides the one responsible for currency hedging, it can be concluded that good information flow is especially evident for commodity hedging and more in detail for inventory hedging due to the fast changing exposures. Also it was found out in interviews the special characters

of oil supply chain discussed also in chapter 2.4 highly create plenty of sources of unexpected changes that often have an immediate impact to company's price risk exposure. For instance to changes in B/L dates or in loading quantities need often be reacted immediately in order to get the initial exposure and hedges to match, mainly, however, on commodity hedging side.

In hedging it is natural that there's a dependency between hedges and supply chain. However, it was found out from interviews, that in oil industry hedging is highly important in decision making in supply chain as well. This can be stated to be very characteristic especially for oil supply chain due to the massive market price risk and the magnitudes of both physical volumes and financial value. During interviews it was found out that hedges affect to traders' and operational management's decision making in each part of a supply chain as can be seen in the Figure 10 presented on the page 78.

According to the interviews, operational management found hedging highly important. Hedging affects to operational management's decision making in several parts of the oil supply chain. Further, it was highlighted by interviewees, especially by the sales planner, that hedging also affects to the supply chain in several ways. For instance, it was noted that without hedging more volumes would be aimed to be sold to domestic country and for instance intercontinental sales would be too risky due to long lead times.

During the study hedging was found out to provide several benefits to operational management. For instance, as it was noted by the interviewed sales planner that Neste Oil's great inventory capacity enables flexibility in oil supply chain and can thus be seen as one of Neste Oil's assets. However, without hedging Neste Oil wouldn't be able to exploit its inventory capacity as increasing inventory level would mean taking unbearable risk due to fluctuating market prices. The sales planner stressed this to be a crucial issue for oil companies. Furthermore, the interviewed sales planner underlined the importance of hedging to maintenance breaks and their planning. It was noted that without hedges, maintenance breaks would be implemented more seldom and kept shorter. The reason for this is that maintenance breaks require increasing inventory levels, which would cause a massive price risk.

Further it was noted by the sales planner that without hedging operational cycle would be aimed to be minimized so that oil would flow through the chain as fast as possible. This was also stressed to be a very critical issue. Without hedges, the shorter the operational cycle

causes that there is less time for the value of oil to decrease. Therefore shortening the operational cycle would reduce market price risk but would again restrict optimization or market exploitation possibilities, as it was underlined by the sales planner. Also it was found important that if Neste Oil wouldn't be involved in hedging the competitors would gain massive competitive advantage.

It was mentioned several times in interviews that without hedging the business and operational environments would be much more limited. Absence of hedging would also restrict operating and business possibilities. For instance, according to the interviewees, sales would be done more in domestic currency and thus domestic demand and sales (in this case Finland) would highly increase their importance. One option in the absence of currency hedging would be to change the whole company's operating and reporting currency to U.S. dollars.

Below is a summary of benefits of hedging from operational management point of view. According to the interviews hedging enables:

- Flexibility and agility in operations
- Long term decision making
- Frequent and proper maintenance breaks
- Exploiting global markets
- Exploiting favourable market situations
- Optimizing inventory level and exploiting inventory capacity
- Good customer service
- Building contango storages

Also as Ding et al. (2007) mentioned that financial hedging has great impact on company's operational strategy. This was supported highly by the interviewed Neste Oil employees as discussed above. In addition Ding et al. (2007) mentioned in their study that hedging has both qualitative and quantitative impacts, which was also supported by the interviewees as hedging was seen to impact for instance on customer service and inventory levels. The linkage between hedging and customer service was said to be that product can be stored longer and it is easier to get adjusted to costumers' request as it is possible to increase inventory levels without exposing to market price risk. However, especially as these benefits and impacts were found to be very significant, it is surprising how little there has been academic research about the impacts of hedging on decision making in supply chains. In the

past literature there has been several articles discussing how hedging enables higher inventory levels, however there's a lack of studies concentrating on what kinds of impacts higher inventory levels could have to oil companies' operations.

In addition in past literature there are several studies (e.g. Ameer, 2010; Geczky, 2010) that emphasize what kinds of financial benefits hedging can create. However, there were relatively few studies that aimed to find out what kinds of benefits hedging offers to the supply chain processes or supply chain planning. Furthermore, at knowledge of the author of this study there were no studies that aimed to explore what kinds of benefits or impacts hedging might have on oil supply chain. However, during the interviews several benefits such as exploiting market situations and inventory capacity were mentioned and the empirical framework created is taking a valuable step in studying the benefits of hedging.

As pointed out earlier in this study there are two major factors characteristic to oil industry; high price volatilities and complex and unpredictable supply chain. Furthermore it is recognized in several studies that department responsible for hedging needs close interaction with departments responsible for physical trades like procurement department. However even though for instance Okochi (2008) recognizes that a connection is needed between departments responsible of hedging and procurement, there's no discussion about the nature or importance of the interaction much further.

For instance Fisker and Kumar (2010) and Claessens and Varangis (1994) discuss about the importance of information sharing between those implanting the physical trades and the ones hedging. According to the past literature information sharing is needed in order recognize exposures and making strategies and plans. In addition according to Claessens and Varangis (1994) in oil industry information regarding production, delivery dates, long-term plans regarding supply and exports, is essential to be shared with the ones taking care of commodity hedging. During the interviews the same issues were highlighted several times, especially by the risk analysts taking care of commodity hedging.

During interviews it was highlighted several times by each interviewee that the IT-systems can't replace close and active communication between treasury department and operational management and traders. The information is often so prompt that relying solely on IT-systems would make it difficult for hedgers to hedge positions correctly. Thus a need for

close relationship between these departments was emphasized. Also the interviewed trader commented that *“price risk management should be located as close to traders as possible”*. This is very much in line with several studies presented in literature review chapters (e.g. Claessens and Varangis, 1994). However it can be argued that close communication between operational management and trading and treasury is even more important in oil industry context due to the special characters of oil supply chain. This view was also supported greatly by interviewees.

In commodity hedging i.e. inventory and margin hedging it was vastly highlighted by almost all the interviewees that good information flows are important and due to the special characters of supply chain (e.g. unexpected and prompt changes in vessel’s loading schedules) close relationships are needed in order to get the hedges to match volatile exposures. However, with currency hedging the proximity and continuing interaction wasn’t found to be that highly important. Naturally the information must be up to date and carefully communicated regarding currency exposures as well, but as currency exposure alters only when payments are transferred and for instance changes in B/L date or in loading quantities do not mean prompt changes to the exposure. Therefore, according to the interviews in currency hedging IT-systems are the best way to share information as IT systems enable accurate information flow regarding exact values. All in all, the need for information sharing was especially highlighted by the interviewed risk analysts that are responsible for commodity hedging. According to them information regarding changes and possible information gaps were mentioned as the biggest challenges. The currency trader on the other hand didn’t mention information flow to be any kind of problem.

In addition the close communication was found important due the dynamics of the industry. New exposures can emerge due to new kinds of pricing models or alterations in supply chain. Especially due to an increase of renewable fuels, new raw materials are explored which requires close communication between business and treasury in order treasury to be able to prepare new hedging processes and find most suitable instruments before the new exposures actually emerge.

When the theoretical and the empirical frameworks are compared it can be seen that several points were added to the empirical framework due to the findings in interviews. However it is worthwhile to notice that all the other points on the theoretical framework besides capacity

allocation between domestic and foreign locations were mentioned to affect Neste Oil's supply chain as well. Thus, there are plenty of same issues in both frameworks. In theoretical framework procurement was seen to improve due to hedging. According to the interviewed trader, this idea applies to oil industry and to Neste Oil as well, as it was noted that hedges, and more in detail CFD-contracts, improve managing crude oil purchases. However in past literature there was no discussion regarding the connection of hedges and contract term negotiations, which was, however, noted to be an important aspect in oil industry, especially regarding pricing formulas. In addition hedges can be used in negotiations in cases that something goes wrong with the delivery, which was also lacking from the theoretical framework. In theoretical framework it was recognized that hedging affects to inventory levels, however interviews increased understanding what kinds of impacts flexibility in inventory levels actually have. In addition in theoretical framework, capacity optimization was seen to be affected by hedging. This idea was also supported by the interviewed trader, according to whom an oil company that has hedged its margin is able to run its refinery at higher capacity during difficult market periods. Furthermore, in interviews it was emphasized, that hedging has great impact on maintenance break planning and decision making timespan. Neither of these were mentioned in literature review.

Further as currency hedging is widely studied issue, the main difference between empirical and theoretical frameworks in the terms of currency hedging was that daily transaction risk was connected in theoretical framework to transportation and not to sale or purchase parts as it was connected in empirical framework. In addition the literature review and thus the theoretical framework lacked the discussion of margin hedging as a part of transaction hedging. However, hedging the margin's currency exposure is important to a company that most of the sales are in foreign currency.

In commodity hedging the theoretical framework and the empirical framework had a lot of similarities. However the theoretical framework failed to recognize what kind of information is needed from the supply chain in order to identify the price risk exposures. In interviews it was stated that as most of the sales and purchases are done on spot basis and the price risk exposure is often connected to the B/L date, treasury needs to be informed about the volumes, pricing (i.e. timing) of the exposure, and contracted quantity. In addition in theoretical framework there was no discussion about adjusting hedges after loading the cargo, whereas in interviews adjusting hedges to match the actual exposure was said to be an important part of

hedging. Further, one of the main differences between frameworks was that no separate hedges were said to be done for inventory, but hedges were kept over the stocking and refining periods and only adjusted to match the loss from refining. In addition the in literature review or in theoretical framework refining margin hedging wasn't discussed, which was said in interviews to be an important part of Neste Oil's commodity hedging. All in all, it can be concluded that biggest difference between frameworks was the depth of topics, an interviews provided more insightful information regarding connections between oil supply chain and hedging compared to previous literature. One explaining factor is that so few studies specified in oil industry was found.

This study concentrated solely to Neste Oil's oil refining supply chain. However not all the Neste Oil's oil purchases and sales have this kind of long supply chain as Neste Oil also trades oil. Trading oil means that whether crude oil refined petroleum is bought from a seller and sold straight away or after keeping it in an inventory for a while to third party. Oil trading supply chain and price and currency risks related to it are left outside this research as the supply chain is quite different to the traditional oil supply chain and also risks and hedges are handled differently.

This chapter presented the discussion about the results presented in chapter six. Further the chapter provided conclusions to the initial research questions. Furthermore, the chapter targeted to provide summaries from the findings and discuss about the findings from the interviews reflected to the findings in the literature review.

This next chapter provides the conclusions of the research. The subsequent chapter, reviews shortly the objectives if the study and gives short overview how the study aimed to answer to these questions. Also the chapter discusses about the contribution of this study and provides managerial implications. In addition the next chapter presents the limitations of the study together with future research directions. Further, the following chapter concludes the thesis.

8. CONCLUSIONS

This chapter concludes the thesis. First the objectives and aims of the study are summarized. Next the chapter presents its main contributions to the academic research. In addition the chapter presents practical implications, limitations of the study, and finally ends with suggestions for further study.

The objective of the study was to increase knowledge of hedging in oil industry and to bring financial hedging closer to physical supply chain. From an academic perspective, the objective of this study fill the gap in the literature that exists regarding hedging risk exposures in different part of oil supply chain. Further from a practical point of view the study targeted to study the importance of information flows between functions involved in hedging and oil supply chain processes. The research questions that were stated in the beginning were a) what are financial hedging processes and practices in an oil company's supply chain, b) how hedging is positioned in oil supply chain i.e. in which parts of the oil chain these two functions interact, and c) how in different parts of oil supply chain hedging affects to decision making. To these questions has been answered by conducting comprehensive literature review of risk management and particularly of financial risk management and oil supply chain. The literature review presented literature of these subjects first in general but then focused on hedging and supply chain processes in oil industry. Furthermore in literature review studies that discussed about the importance of connections between hedging and supply were presented. After exploring the literature from previous studies an extensive case study was conducted in a Finnish oil refining company. During the case study six semi-structured interviews were conducted among case company employees.

The result of this study is a middle range theory and an empirical framework. The first theoretical implication of the study is the identification of the importance of information flow from supply chain to those implementing hedging. Although the past literature discusses about several aspects of hedging it falls short in identifying how the special characters of oil supply chain have a significant impact to hedging processes. However this study takes a step further in understanding the interactions and relationship between financial hedging and oil supply chain which opens future research directions which are presented later in this chapter.

As the oil companies are highly exposed to market price risks the second contribution of this research was to identify the parts in an oil supply chain that affect to market price exposures. As the special characteristics of oil supply chain (e.g. a linkage of price risk exposure and B/L date) often require adjusting hedges the hedging and supply chain interact in all parts of a supply chain. In addition the study explored how hedging affects to decision making in oil supply chain, which is also a very little studied topic.

It is surprising how little attention oil price risk hedging has gained in academic literature (excluding the studies regarding the hedging instruments) considering that oil is probably the most important commodity used extensively around the world. However one explaining factor might be that most of the studies regarding oil price risk are conducted by oil companies themselves or by private research institutes. In addition it was surprising how little attention the connection between oil supply chain and financial hedging has gained.

Further oil supply chain should have gained more devotion in academic research considering several issues that result oil supply chain to be complex and challenging. Especially the influence of hedging to oil supply chain should be studied more as it was found out in this research that hedging affects to supply chain decisions widely in several parts of an oil supply chain.

Practical result is that managers in oil refining companies must pay special attention to the information flows and communication between operational management, traders, and risk management. Also it would be important to examine if the processes are sufficient so that information flows without interrupts and both those implementing hedging operations and those working with physical deliveries and trades have all the information they need available. In addition the strong linkage between financial hedging and supply chain events should encourage managers to make sure that risk management department is located close to the traders and operational management and is not been isolated from other departments.

However there are several limitations in this study, especially regarding generalizability as only one case company study was conducted. Further as only five interviews were conducted the research could have been extended and made more valid, if more interviews would have been done. In addition using other sources of information together with interviews would have increased study's validity. However the chosen interviewees had different tasks and

were from three different departments, which enabled a broad and insightful view to the topic.

The results drawn from the interviews and the constructed framework should be tested also in other in other oil refining companies in order to prove generalizability. Further as to this study only one oil refining company was studied and it is possible that some other oil refiner views hedging in a different way and thus has very distinctive hedging practices. However during interviews it was mentioned that in oil industry the hedging principles are rather industry wide and Neste Oil has very similar hedging policy as many other refiners do. However, for instance, margin hedging ratios vary greatly between different oil refiners as some refiners hedge almost their entire volume and whereas some refiners do not want to lock any of their incomes.

For purposes of further research, as this study doesn't concentrate on quantitative aspects even though both the physical and financial volumes in oil supply chain and the market fluctuations are massive, should also quantitative aspect included to a similar kind of study. Moreover similar study to this could be conducted regarding renewable fuels. Renewable fuels' hedging instruments, supply chains, and markets are still relatively little studied. However renewable fuels and their hedging is gaining more and more importance as the countries are increasing their bio mandates and more companies are starting to produce renewable fuels. In addition renewable fuels supply chain are probably at least as complex as in traditional petroleum business and all the renewable fuel hedging instruments are new and more instruments are probably emerging as new raw materials (and thus creating new supply chains) are taken into use. In addition there's plenty of room for future research of oil price risk hedging as hedging in oil industry is dynamic and developing constantly as new instruments are taken in to use. For instance in December 2011 new ICE Bren future contract (ICE Brent NX) was launched that is meant to take over and replace the current main instrument (ICE Brent). As the ICE Brent is the main financial derivative in oil industry studying this conversion and its impacts would be important issue to study.

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APPENDICES

Appendix 1: Interview questions for the case company employees

1. In which department you work at and what is your position?
2. Which are the main departments that you work with?
3. Which department provides you the information that use in your work?
4. Which departments use the information that you produce?
5. How does a new physical trade affect to your work?
6. In which cases hedging has an impact to the decisions you make?
7. If something goes wrong in your job what are usually the main reasons that caused it?
8. How would you improve the process flow?
9. Can you list five biggest risks you recognize in the picture? How could these risks be prevented or how they are handled?
10. Can you identify in the picture in which parts there are situations that you need information from treasury/operational management/ sales & trading?

Appendix 2: Interviewees

Interviewee 1, Risk Analyst, Group Treasury, January, 2012

Interviewee 2, Risk Analyst, Group Treasury, February, 2012

Interviewee 3, Manager, Heavy Products trader, Sales and Trading, February, 2012

Interviewee 4, Sales planner, Operational Management, February, 2012

Interviewee 5, Assistant Manager, Group Treasury, February, 2012

Appendix 3: Hedging profit/loss impact in a case of cancelled cargo – cases in law

Shipping Bulletin February 2011 – Hedging sales contracts

Glencore v Transworld / Choil v Sahara

One issue that is receiving increasing attention from the courts is what effect a party's hedging arrangements should have on the amount of the losses it can claim. For example, if a party to a contract ('A') would (because of a breach by its contracting party, 'B') have lost, say, US\$5m, but because it sensibly hedged its position, its losses only in fact amounted to US\$2m, is A entitled to the full US\$5m from B, or are A's hedging arrangements taken into account, so as to reduce the losses claimable from B?

This question was recently considered in two cases, *Glencore Energy UK Ltd v Transworld Oil Ltd* and *Choil Trading SA v Sahara Energy Resources Ltd*. In the former, Glencore purchased 271,000 barrels of Crude from Transworld, and after Transworld failed to perform, Glencore claimed losses of US\$11,112,626, being the difference between (i) the contract price and (ii) the value of the oil on the date when it ought to have been delivered (the normal measure of damages in sale of goods cases).

However, Glencore had hedged its position by selling futures to protect its exposure to a drop in the physical sale price during the proposed voyage. Glencore's overall loss when the hedge was taken into account was US\$8,665,496.

Transworld argued that to measure damages without reference to the hedging gains would give Glencore a windfall of some US\$2.4m. They said it would be inappropriate not to take the hedge into account, since it would overcompensate Glencore.

Glencore replied that the hedges it had entered into were entirely separate transactions and, when assessing damages, should be seen as independent to the sales contract. Glencore argued that the court should consider the hedge in the same way as it would view an insurance policy in Glencore's favour. In other words, the hedging should be ignored altogether and should not operate to reduce the damages to which Glencore was entitled. The Court found in favour of Transworld on this issue.

In *Choil v Sahara*, the Claimant in fact suffered no loss on the physical sale, but lost money on their hedge due to delays brought about by the Defendants' breach of contract. The Court held that losses suffered on a hedge taken out/dealt with after and in response to the breach of contract by the Defendant were losses "attributable to a reasonable attempt in mitigation" and were therefore recoverable by the Claimant from the Defendant.

The above cases of course concern sale contracts and are of direct relevance to traders. However, these cases also have the potential to be highly relevant to ship owners and charterers. Following these decisions, it is likely that a court or tribunal will consider that (a) contemporaneous hedging transactions are part and parcel of a sales contract/trade, and (b) hedging activities post-breach can be considered to be acts of reasonable mitigation. Thus where a claim is brought by cargo interests against a carrier under a contract of carriage, for example in a delay claim, the carrier would be advised to investigate whether the cargo interest has profited from any hedging activities. If so, this may reduce the damages claim faced by the carrier.

Equally, however, if hedging is an integral part of the contract, this may in future prompt cargo interests to attempt to claim pure hedging losses from carriers. This could be on the basis that such losses were a consequence of breach of contract by the carrier, or (depending upon the timing) as expenses incurred in mitigation. In the former case, however, such losses are likely to be considered to be too remote and not within the reasonable contemplation of a carrier at the time of contracting (per *Trafigura v Mediterranean Shipping Company* - the "MSC Amsterdam"). However, this point may well be ripe for reconsideration, particularly in a tanker context.

Source: Holman Fenwick Willan – HFW / Shipping Bulletin February 2011

(Available: <http://www.hfw.com/publications/bulletins/shipping-bulletin-february-2011/shipping-bulletin-february-2011-hedging-sales-contracts>, read 28.02.2012)