COMMODITY PRICE RISK HEDGING PRACTICES IN FINNISH MANUFACTURING INDUSTRIES

Examining the role of commodity derivatives

Lappeenranta–Lahti University of Technology LUT
Master's programme in Supply Management
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ABSTRACT

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Commodity price risk hedging practices in Finnish manufacturing industries – Examining the role of commodity derivatives

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The global commodity markets are a complex structure of physical flow of goods and financial tools designed to work as the backbone of society and provide the necessities we each consume daily. This research aims to add to the relatively scarce literature on commodity derivative use for financial hedging of commodity price risk in Finnish manufacturing industries. By examining five case companies from three different manufacturing industries, this research focuses on the state of financial hedging in the case companies and the way these companies have organized financial hedging decision making.

The findings of the research are threefold. Firstly, it is found that in these case companies the decision making on financial hedging is often dispersed between business functions and done in cross-functional teams. Secondly, it shows that both the food and the agricultural companies seem to use commodity derivatives for financial hedging whereas the forest industry as a heavily vertically integrated system seems not to have the same need for financial derivatives. Finally, regarding the available commodity derivatives it seems like whereas there are applicable products on the markets for the case companies, the geographical differences between their physical flow of goods and the location of the commodity exchanges poses challenges.

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Globaalit raaka-ainemarkkinat ovat monimutkainen järjestelmä fyysisiä tavaravirtoja ja rahoitustyökaluja, jotka luovat yhteiskunnan selkärangan ja tuottavat meille välttämättömiä tuotteita. Tämä pro gradu-tutkielma pyrkii lisäämään verrattain harvalukuista tutkimusaineistoa raaka-aineiden hintariskin hallinnasta hyödykejohdannaisilla suomalaisessa valmistavassa teollisuudessa. Tutkimalla viittä kohdeyritystä kolmelta eri toimialalta, tutkielma keskittyy kuvailemaan hyödykejohdannaisten käytön nykytilaa kohdeyrityksissa ja siihen, miten nämä yritykset ovat organisoineet päätöksenteon hintariskin suojaukseen liittyen.

Tutkielman tuloksia on kolme. Ensinnäkin, kohdeyritysten päätöksenteko raaka-aineden hintariskin suojauksesta tehdään pääosin liiketoimintojen välisissä yhteistyöryhmissä. Toisekseen, elintarvike- ja maataloussektoreilla hyödykejohdannaiset vaikuttavat olevan osa riskienhallintaa kun taas metsäteollisuuden vertikaalisesti integroitunut systeemi ei vaikuta yhtäläisesti tarvitsevan hyödykejohdannaisia. Kolmanneksi, markkinoilla tarjolla olevat hyödykejohdannaiset vaikuttavat olevan kelpoisia kohdeyrityksille, mutta maantieteelliset erot yritysten fyysisten tavaravirtojen ja hyödykepörssien välillä aiheuttavat haasteita.

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Antti Ahola 19.6.2023

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1 Introduction

In today's global business environment, manufacturing companies are forced to operate in commodity markets where prices of many commodities are formed by way of global supply and demand. Disruptive events such as the military attack to Ukraine by Russia further drives the synchronization of commodity prices (Ihle, Bar-Nahum, Nivievskyi and Rubin, 2022). Commodity prices are often outside of the control of any one entity because demand and supply forces usually transcend industries, technologies and countries (Zsidisin, Hartley, Gaudenzi and Kaufmann, 2016). Local markets can present occasional market disturbances compared to other markets but in the grand scale of things, many commodity markets tend to develop uniformly in an interconnected global system. This calls for specific attention and actions especially from the procurement professionals within manufacturing industries who are responsible for pricing of raw materials for production (Kouvelis, Li and Ding, 2013, Zsidisin et al., 2016). In simplistic terms, a dollar saved in purchasing price will directly improve a company's bottom line as well as result in lower inventory valuations and thus improve the return on assets (ROA) of the enterprise (Zsidisin et al., 2016).

Global markets and supply chains also expose companies to significantly higher risks. Environmental catastrophes, military conflicts and political unrest are just few of the factors that can have global effects on commodity prices. The deepening economic and political uncertainties have had a major impact on commodity markets beginning circa 2005-2006 (Krainer, 2019). A dry span during the growing season of soy in South America will push soy prices up all across the world due to the nature of the market and the importance of South American crops globally. Similarly we have seen that a military conflict in Ukraine impacted commodity prices, foremost grain and energy prices, not only in Europe but globally as well (Ahn, Kim and Steinbach, 2023).

Commodity markets are affected by various exogenous and endogenous phenomena which lead to volatility in their market prices. This volatility is the source of commodity price risk. Most obviously the commodity price risk affects any manufacturing company procuring commodities for raw materials to its production but in fact the risk is carried by the entire supply chain as higher input costs tend to trickle down the supply chain. For example, an increase of steel price on the global markets will increase the input costs of an auto parts manufacturer who will in turn attempt to increase their sales price towards their car manufacturing clients. This will eventually lead to an increase in the purchase price of a car

for a car dealership and finally to an increase in the consumer price as well. The pricing power of any entity within a supply chain affects their ability to force those higher input costs downward in the chain.

1.1 Background and motivation for the research

People have tried to standardize and trade commodities such as livestock since around 1500 B.C. with the aim of creating smooth and predictable trading for commodities. In China, the trading of rice futures dates back 2000 to 2500 years ago. The first modern commodity exchange began in Japan in the 1800s with the Dojima Rice Exchange in Osaka. Currently, the longest lasting commodity exchange in the world is the Chicago Board of Trade (CBOT), where agricultural commodities trading began in 1848. (Baker, 2018)

Commodity trading is either done directly with physical goods or indirectly via commodity derivatives. Baker (2018) claims that most of the commodity trading is done indirectly in the form of futures contracts, which are standardized commitments to either sell or buy a commodity by a stated date in the future. Owning contracts with sales commitments is called a short position whereas for purchase commitments the term is a long position. Market participants can choose to speculate on the future market development by positioning themselves short when they believe market prices will fall and long when they expect market prices to rise.

Understanding one's positioning in regard of purchasing raw materials is key when considering price risk. The more imbalanced the sales and purchasing volumes are, the higher is the price risk. On the other hand, if purchased volumes of raw materials equal the sales volume, any changes in market prices should not affect the company's sales profit. For a manufacturing company, the sensible thing might be to minimize their speculative positioning and focus on their core competence of production whereas investment funds specialized in commodity markets will base their business on speculating on the markets. Nevertheless, even refraining from speculation does not erase the need for hedging price risk. In fact, not applying any hedging practices at all is speculation by definition.

The effect of investment funds on commodity markets has been researched quite extensively and mostly the conclusion has been that they provide stability, liquidity and efficiency on the commodity markets. However, a purchasing professional of a market-traded commodity should keep in mind that this investment money works towards different

objectives on the commodity markets than participants in the actual physical commodity market. More of this research will be presented later on in the literature review.

The motivation for this research rises from the lack of perceived public and academic discussion on the importance of proper commodity trading expertise for procurement professionals in the Finnish manufacturing industries. As recent examples, the Covid-19 pandemic and the Russian attack on Ukraine have shown how volatile the commodity prices can become in the globalized commodity markets and it is a vital competence for a producing company to be able to manage their price risk. Publications related to commodity price risk hedging in Finnish context are mainly focused on energy and especially the electricity markets, although some other commodities have also been studied. Heljanko (2014) claims in his bachelor's thesis that the possibilities for farmers to hedge their price risk in grain markets are limited and lesser than for example in the United States. Makkonen (2014) found in her master's thesis that Finnish farmers mainly hedge against price risks by investing in storage space and storing their production and by shifting their production to grains with higher profit potential. Liu and Pietola (2005) estimate the optimal hedging ratios for a Finnish spring wheat producer. All of these studies were conducted from the perspective of the farmer, thus leaving a gap for further research from the perspective of manufacturing companies who process the grains. Furthermore, Lönnrot (2016) examined various hedging strategies for bitumen price risk, but the hedging strategies focused on over-the-counter (OTC) swaps instead of exchange traded commodity derivatives. Malaty, Toppinen and Viitanen (2007) performed analysis on the pine market price development in Finland between 1995 and 2005 but did not address the price risk management issues. They did however note that the price volatility in the Finnish roundwood markets had decreased after Finland joining the European Union in 1995 thus decreasing the price risks involved.

Krainer (2019) describes how companies tend to hire experts supporting their core operations such as production, sales or finance but argues that successfully managing commodity price risks requires different skills. Zsidisin et al. (2016) claim that organizations can attain a competitive advantage by understanding and effectively managing their commodity price risk. Yet, they also note that even companies with solid reasons to undertake financial hedging via commodity derivatives, do not do so due to lack of knowledge and experience. A depicting comment was made in 2020 by Sauli Järvenpää, then manager of UPM Pulp, in that they would be happy to learn commodity derivative trading together with their customers (Cord, 2020) which does not give the feeling that the

company has substantial expertise in commodity trading or sees it as an integral part of their own operation.

This research aims to shed light on the status of this kind of commodity trading expertise within Finland and should prove to be a valuable piece of information from a managerial perspective on potential challenges of implementing financial hedging processes as well as the importance of the topic for profitability in manufacturing industries. From an academic perspective this study will hopefully highlight potential needs for further research on the subject from the Finnish perspective, since the local market environment might pose specific requirements not discussed in the existing literature. There is a clear gap in the academic literature on analysis of commodity price risk in the Finnish markets and this research is an attempt address that.

1.2 Research problem and questions

To investigate the extent and sophistication of commodity hedging practices within Finnish manufacturing industries, this thesis will aim to answer the following primary research question:

1. What is the current status of commodity hedging by commodity derivatives in the examined Finnish manufacturing industries?

For supporting the primary research question, two sub-questions are formed as follows:

1. Is there enough expertise within the companies to develop a sufficient hedging strategy and in which business function is this expertise located?
2. Do the existing commodity derivatives cater to the hedging needs of Finnish manufacturing industries?

1.3 Scope and limitations of the research

The scope of the thesis is limited geographically to focus only on Finnish companies so as to find out the state of things within Finland and also investigate the potential challenges in commodity hedging that pertain specifically to Finnish companies. Some of the target companies might be in foreign ownership or public ownership, but their operations and manufacturing plants are located mainly in Finland. Furthermore, the thesis is limited to

cover only companies that purchase commodities to produce goods or services, excluding investment funds, commodity traders and others that do not operate on commodity markets due to their own production requirements.

As a further limitation, the results from the questionnaire do not portray the Finnish industrials sample-wise as they are only a set of companies chosen subjectively by the author. There were three general industries chosen for this thesis and they are agriculture, food and forest industry. The topic might be relevant for other industries as well, for example the metal industry.

As a qualitative study, this thesis has implicit limitations since the results are an interpretation of qualitative data gathered via a text-form questionnaire and interviews instead of quantitative data analysis on statistics and numerical data. Furthermore, the qualitative data gathered from chosen companies is anonymous and only covers a very limited amount of companies and industries. The questionnaire results should be taken as “some evidence” of the status quo and they provide mostly a base for discussion and reflection.

2 Theoretical framework

In this section, the existing literature on risk, supply chain risk management and commodity price risk is presented to give context for risk management in supply chains and how commodity price risk relates to the existing risk management theory. The section begins with a reflection on the definition of risk. Further on, the typology of supply chain risks by Rao and Goldsby (2009) is presented to give a holistic view of various risk factors affecting supply chains. Finally, this section focuses more specifically to commodity price risk by discussing the general terminology around the subject, the role of commodity exchanges in the entire commodity trading system and existing literature regarding commodity price risk hedging, hedging strategies and the role of financial investors on commodity markets.

2.1 Defining risk

To begin conceptualizing what is meant by the term ‘risk’, we can start by looking at the Risk Management Vocabulary developed by the International Organization for Standardization (ISO, 2009). ISO guide 73:2009 defines risk as “an effect of uncertainty on objectives”. This means that without an objective, i.e. an expectation of a result of specific actions, there is no risk. This also means that there needs to be something uncertain about the course of actions that are to be taken. Uncertainty is defined in the same vocabulary as a state of deficiency of information related to, understanding or knowledge of, an event, its consequence, or likelihood (ISO, 2009). These consequences refer to the ‘effects’ in the definition of risk and the word likelihood relates to the concept of probability, which constantly appears throughout the risk-focused literature (see for example Booth (2014), Cox (2017), Nason (2017), Moon (2020)). Uncertainty is one of the three elements that comprise the definition of risk according to Nason (2017). It is also included in Miller’s (1992) chosen definition of risk, that is “unpredictability in corporate outcome variables”.

The ISO 73:2009 continues to note that the effect is a deviation from the expected and can be either positive, negative or even both (ISO, 2009). In a business context, positive effects accelerate an organization’s achievement of goals whereas negative effects will hinder it (Moon, 2020). Rao and Goldsby (2009) find in their literature review that many authors refer to risk as a negative change with respect to performance but also that decision theorists emphasize the potential for positive deviation from the expectation. Nason (2017) promotes

this balanced view as well by emphasizing that an organization's risk management function should not only aim to minimize the downside (negative) effects of risk but to also focus on maximizing the upside (positive) effects. The existence of both positive and negative effects is another one of Nason's (2017) three elements of risk. Similarly, Cox (2017) states that risk is not to be avoided.

The third element proposed by Nason (2017) is that risk concerns explicitly the future. This is also present in Booth's (2014) wide definition of risk: "future randomness of all types". Booth also mentions that finance theory literature often equates risk with volatility but continues to then provide arguments against this equivalence.

Cox (2017) begins his risk definition by reminding that in business, every action is related to a consideration of risk and reward. Furthermore he connects risk into decision-making; risk can only occur when making a decision that affects the future. This ties into the earlier discussion about actions as well as Nason's (2017) 'future element' in risk definition. Rao and Goldsby (2009) define risk as "exposure to a premise, the outcome of which is uncertain". To conclude, defining risk involves terminology around uncertainty, expectations, the future, positive and negative effects, probability and action.

2.2 Risks in purchasing and supply chains

After the considerations of the previous section on the concept of risk, this section will examine supply and supply chain risk management more thoroughly. To conceptualize and categorize the different types of risks that supply chains face, the typology of supply chain risks constructed by Rao and Goldsby (2009) is incorporated into the theoretical base of the research. Of their proposed categories, commodity price risk is affected by environment, industry and organization factors which are therefore discussed in depth in the next three sections. The general structure of the typology is shown in figure 1 below.

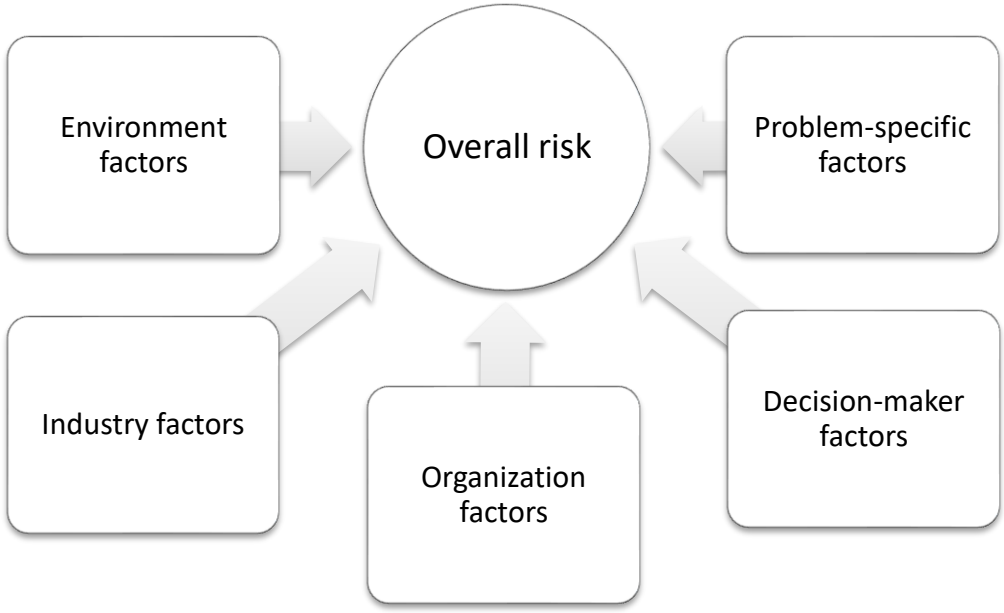

Figure 1 Risk factors in supply chains (Rao & Goldsby, 2009)

Rao and Goldsby (2009) argue that while supply chain risk management has increased its popularity in academic literature, more research on how to identify risks in supply chains in needed. Similar observations are given by Kouvelis, Chambers and Wang (2006). In order to identify the risks more effectively, Rao and Goldsby (2009) proposed the risk factor categories presented above. They focus mainly on the three factors labeled as “framework” factors, which are the environmental, industry and organizational factors. Similar categories are also presented by Miller (1992). The two other categories are problem-specific factors and decision-maker factors. The following subsections will examine these five risk categories more in depth.

2.2.1 Environment-based risks

Environment risks are ones that affect the overall business atmosphere across industries, according to Ritchie and Marshall (1993). These all-encompassing risk factors can of course present themselves differently towards different companies and industries, but in a general sense everyone will be affected by the changes in the general business environment (Miller, 1992, Kouvelis et al., 2006). In the typology by Rao and Goldsby (2009), the environment risk factors are divided into five subcategories presented below in figure 2. These are political, policy, macroeconomic, social and natural uncertainties. Miller (1992) describes

similar categories in his research. Rao and Goldsby (2009) state also that these five factors of environment risk are not independent of each other, although the magnitude of the relationships between the factors varies.

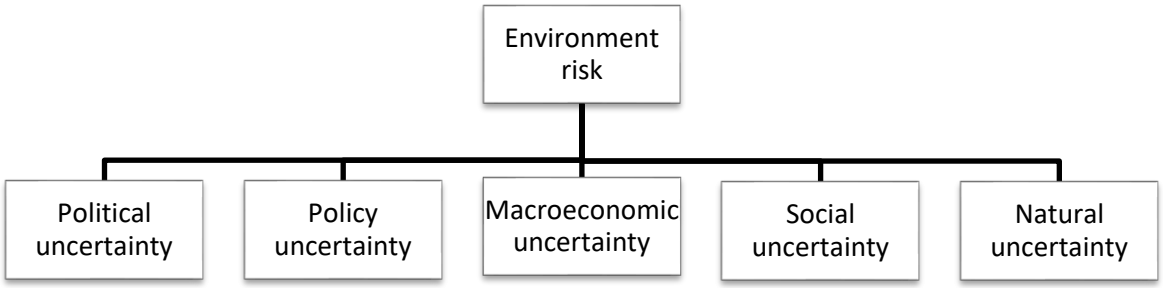

Figure 2 Environment risk factors (Rao & Goldsby, 2009)

Political uncertainty refers to any major changes in political systems that might affect a firm's supply chain (Shubik, 1983). Miller (1992) gives the following examples of political uncertainties: war, revolution, coup d'état and democratic changes in government. Hansen, Mena and Skipworth (2017) further describe the different facets of political risks in supply chains, which are: political instability, instability of socio-economic environment, macro-economic instability, policy predictability, institutional capacity limitations and legal unpredictability. Zsidisin et al. (2016) argue that today's global supply chains require increasing interactions with parties who are either heavily state-owned or significantly influenced by national policy agendas for example in countries such as Brazil, China or Russia. In a supply chain context, Cooke (2002) argues against ultimate supplier-base reduction exactly due to political risks in a single-supplier setting. As an example, the recent attack on Ukraine by Russia in early 2022 and the resulting events are an example of a realized political risk for any companies involved with trade to or from Russia and Ukraine. Charpin (2022) also investigates the seeming rise of nationalism during early 2020s and its influence to supply chains. He finds that two types of nationalism, economic nationalism and national animosity, support three types of supply chain uncertainties: demand, supply and operational uncertainty.

Both Miller (1992) and Rao and Goldsby (2009) separate policy uncertainty from political uncertainty. Whereas political uncertainty entails changes in the power structures of a state, policy uncertainty only refers to the potential changes in government policy that affect the

business environment (Ting, 1988). In an offshoring supply chain context, Charpin (2022) argues that multinational enterprises can face both supply and demand risks in foreign countries by way of trade barriers set by foreign governments. It could be argued though, that a realization of a political risk can also lead to the realization of a policy risk, although not necessarily. Furthermore, as Rao and Goldsby (2009) note, some researchers do not distinguish between political and policy risks. Some examples of potential policy factors that cause supply chain risk are monetary and fiscal reforms, price controls, minimum-wage legislation, nationalization of assets and trade restrictions (Miller, 1992; Rao and Goldsby, 2009). Whereas the war in Ukraine can be classified as a political risk, the resulting trade sanctions against Russia might also be viewed as policy risks. Thus, the line between political and policy risks can, at times, remain hazy and hard to define.

Macroeconomic uncertainty arises from fluctuations in economic activity and price levels at the macroeconomic scale (Oxelheim and Wihlborg, 1987). These fluctuations might come from factors such as currency exchange rates, commodity prices, cost of labor and interest rates (Miller, 1992), many of these are either drivers or effects of inflation. De Fauconval (2019) defines macroeconomic risk factors as factors that are linked to either inflation, GDP growth, current account balance and public debt. Rao and Goldsby (2009) point out an example of macroeconomic uncertainty, concerning companies who have outsourced their production to low-wage countries only to find out that the actual labor costs incurred have been much higher than anticipated.

Social uncertainty arises from the society in general, instead of policy or regulatory changes. Cunha et al. (2019) state that much of the existing risk management research focuses on the financial risks whereas social risks related to supply chains has received less recognition. Dunn (1983) attributes social uncertainty to the beliefs, values and attitudes found in society that are not reflected in existing policies. Especially with the growing popularity of social media, the voice of consumers has grown louder and the social pressure can affect businesses often much faster and more directly than political forces. Similarly, Miller (1992) states that societies are able to bypass existing government policy. According to Freeman (2010), social and political uncertainties address two different stakeholders (government and society), hence they should be viewed as being separate risks. However, there is possibly a connection between the two categories, as Miller (1992) proposes that social factors may be precursors to changes in government policies. Cunha et al. (2017) propose a taxonomy of social risks which includes risks in human rights (forced labor, child labor et cetera), labor practices (health and safety issues, low wages, working hours, access

to clean water et cetera) and the societal risks (relocation of indigenous people, exposure of communities, lack of ethics and transparency, expropriation et cetera). Furthermore, they propose a taxonomy on the potential consequences of social risks for companies, which are reputational, financial, operational, relationship, populational and legal consequences.

Finally, the fifth environment risk factor proposed by Miller (1992) and Rao and Goldsby (2009) is natural uncertainty. This category contains natural disasters such as hurricanes, floods, fires and earthquakes. Proper identification of and preparation for natural disasters can provide a valuable competitive advantage for businesses, as showcased by Wal-Mart's proficiency in providing aid to victims of hurricane Katrina (Dimiturk, 2005). Wal-Mart's preparedness and supply chain resiliency allowed for faster response to the catastrophe than the United Nations or the Red Cross were able to produce. Natural disasters are often disruptive in magnitude and as such, they propose a large threat to supply chains. However, the geographical context is an important factor when considering natural uncertainties as their probabilities differ regionally. This is depicted in the case study by Ramesh, Sarmah and Tarei (2020), where they state that the Indian supply chain decision makers they interviewed for their study gave little to no focus to natural phenomena which were considered both improbable and difficult to prepare to. De Fauconval (2017) describes these natural phenomena as event driven risks.

To conclude the literature about environment risks, they are universal events and influences whose consequences surpass country and industry borders. They can stem from politics, policies, the macroeconomy, society or the environment. An overlaying characteristic about them is that they are not under control of any business operator.

2.2.2 Industry-related risks

Contrary to the environment risks that are likely to affect businesses across sectors, industry risks are specific to the respective industry segments (Ritchie and Marshall, 1993). The typology of Rao and Goldsby (2009) divides these factors into three sub-categories shown below in figure 3. These categories are uncertainties either in input markets, product markets or competitiveness, following the work of Miller (1992). Contrary to environment risk factors, companies may have some control or at least influence over these factors.

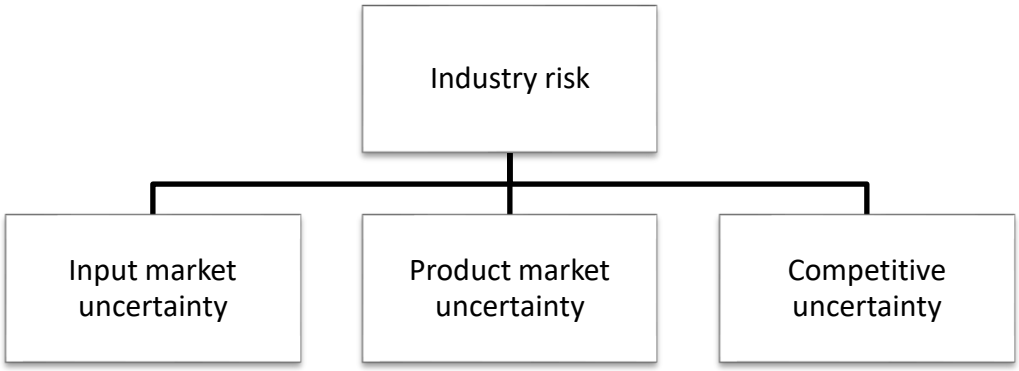

Figure 3 Industry risk factors (Rao & Goldsby, 2009)

The first subcategory of industry risk addresses uncertainties in input markets of a company. These refer to the acquisition of proper quality and quantity of inputs for a given production process (Rao and Goldsby, 2009), such as raw materials, components, labor, energy and production equipment. The risk may arise from changes in the upstream production operations or from changes in others' demand for a common input (Miller 1992). Sedarage, Fujiwara and Trung (1999) point out that risks in lead times of supply may lead to a choice of multiple supplier model which is in turn will weaken economies of scale in purchasing. According to Zsidisin, Ellram, Carter and Cavinato (2004), the majority of supply chain risks identified by companies deal with input uncertainties in one way or another. To combat input market uncertainty, Sutcliffe and Akbar (1998) find evidence of companies vertically integrating their supply chain. Ramesh et al. (2020) highlight in their case study of an electronics supply chain that the most significant input supply risk indicators are price margin, investment, on-time delivery, order fulfillment and design changes.

While input uncertainties deal with the upstream activities in a supply chain, product market uncertainties refer to risks in the downstream chain or as Miller (1992) puts it, to changes in the demand for a company's output. Examples of product market uncertainty offered by Rao and Goldsby (2009) include changes in consumers' tastes, availability of substitute products and availability of complementary products. They also note how environment risks can ultimately drive product market uncertainties as well, for example when social uncertainties affect consumer behavior. Changes in the product market might lead to extensive write offs in a company's inventory for example when goods in stock become obsolete due to changes in market demand (Ritchie and Brindley, 2004). Goldsby, Griffiths and Roath (2006) credit the understanding of both input and output risks for the birth of so-

called “leagile” supply chain strategies, i.e. lean and agile supply chains capable of adjustment, adaptation and dynamic changes.

The third and final category of industry-related risks is competitive uncertainty. These risks arise from the unpredictability and uncertainty concerning competitive businesses and rivals (Rao and Goldsby, 2009). According to Miller (1992), one such source of uncertainty is innovation that changes the product market. In a state of high competitive uncertainty, companies are often less likely to undertake plans of vertical integration or business acquisitions and more likely to focus on staying in business (Rao and Goldsby, 2009). Depending on the industry, the barriers of entry largely dictate the likelihood of competitive risks occurring.

In conclusion regarding industry risk factors, there are three categories proposed by Rao and Goldsby (2009): input market, output market and competitive uncertainty. A company’s position of power in their supply chain and affects the level of influence and control they might have over these factors and its adaptability dictates the impact these factors might have.

2.2.3 Organizational risks

Following the environment and industry risk categories, the third category of uncertainty focuses on firm-level uncertainties. These risks arise from within an organization and are specific to them. The factors of organizational risk are divided into four categories by Rao and Goldsby (2009); operating, credit, liability and agency uncertainty as presented in figure 4 below. Their labelling follows the work of Miller (1992) and Wu, Blackhurst and Chidambaram (2006). While these uncertainties do not consider the inward or outward supply chains of a company, they still provide considerable risk for the company’s internal supply chain.

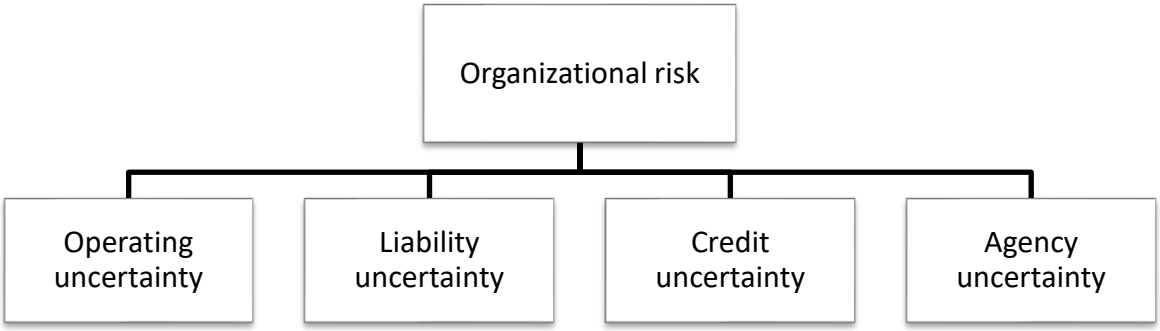

Figure 4 Organizational risk factors (Rao & Goldsby, 2009)

Operating uncertainties can occur in three different contexts: labor, firm-specific input supply and production uncertainty (Rao and Goldsby, 2009). They are similar factors to those discussed in the earlier sections but only focused on changes and uncertainties specific to a company. Labor uncertainty refers to any labor unrest or strikes that can affect productivity (Rao and Goldsby, 2009). To mitigate labor risks, companies might want to create safe and enjoyable work environments (Miller, 1992). Input supply uncertainty refers to any interruptions in the flow of firm-specific raw materials or other inputs (Rao and Goldsby, 2009). The distinction between these risks and the industry risk of input market uncertainty is the impact they have; an event only affecting one company belongs to the organizational risk category whereas input risks that affect multiple target companies are deemed industry risks (Miller, 1992). Finally, the third subcategory of operating uncertainties is production uncertainty. This includes potential failures in the production machinery and equipment of a company (Rao and Goldsby, 2009). In relation to production uncertainty, Craighead, Blackhurst, Rungtusanatham and Handfield (2007) argue that within a supply chain, the operators with the most responsibilities also pose the greatest risk potential.

Liability uncertainty includes potential harmful outcomes of producing or consuming a company's product (Rao and Goldsby, 2009). From a company's perspective, these outcomes would usually exhibit in legal or market actions against the producer. Walton, Handfield and Melnyk (1998) also point out that environmental requirements have created new challenges for supply chain management. This trend has only picked up speed during the new millennia and thus provided new liability risks for companies. For example Zhong, Lin and Yip (2022) state that of their recorded oil spills in the observed Chinese ports, the statutory compensations per incident ranged from about EUR 70 000 up to about EUR 2 400 000.

Credit uncertainty refers to risks related to collectibles and potential financial defaults within a supply chain (Rao and Goldsby, 2009). Kleindorfer and Saad (2005) argue that a primary supplier going bankrupt can severely impact the functioning of the entire supply chain. Finch (2004) states that companies who take part of supply chains with financially less stable counterparties in fact increase their own risk level by doing so. Dupré (2010) describes how marine oil (bunker fuel) sellers face enormous credit risks as the fuel is almost always sold with slim margins and on credit to shipowners without any security of payment. Moretto et al. (2019) argue that the traditional credit rating systems are not sophisticated enough to assess a supplier's holistic credit risk which is also affected by the way the supply chain or network is constructed. Moretto, Grassi, Caniato, Giorgino and Ronchi (2019) developed an integrated supplier rating system which incorporates both the traditional credit rating based on financial information as well as a more subjective vendor rating system based on operational information.

The final category of organizational risks is the agency uncertainty which includes uncertainties related to possible discrepancies between the company's (owners') interests and the employees' (acting as agents to owners) personal interests. Jensen and Meckling (2002) describe agency relationship as a contract under which someone engages another person (the agent) to perform a service on their behalf which also includes passing on some decision-making authority to the agent. They continue that managers of a company are often faced with incentives to increase their personal welfare at the expense of their employer. Rao and Goldsby (2009) argue that these agency risks do not only concern managerial positions within a company, but rather that sub-optimization and personal motives can happen at any organizational level.

In conclusion, organizational risk are ones arising from within a company. Thus, the level of control over these risks is higher compared to the earlier discussed environment and industry risk factors. Although organizational risk factors are ones within the limits of the company, they can still be influenced by external forces.

2.2.4 Problem specific and decision maker risk

Since commodity price risk arises from changes in external forces, problem specific and decision maker risks do not generally influence it. Thus, these two categories described by Rao and Goldsman (2009) are only briefly defined in this section.

Problem specific risks are similar to all the different uncertainties discussed in previous chapters, but only in a smaller scope. In a problem specific setting, risks are only considered when they directly affect the matter at hand. Bettis and Hall (1982) argue to the direction of there being, at least to some extent, endogenous risks to an organization and thus also some level of influence and control by the organization to manage their risks. One such method is outsourcing of business processes (Rao and Goldsby, 2009) which can also be viewed as a case of problem specific risk management. However, it has been argued by Kotabe et al. (2008) that while outsourcing might reduce some risks, it consequently creates some other uncertainties that were not present before the outsourcing decision. All in all, problem specific risk management can lead to suboptimal solutions in the organizational scope.

Finally, Rao and Goldsby (2009) briefly describe themes within the decision maker risk category. They are risks related to the decision maker or makers within an organization and could arise from things such as the decisions maker's personal knowledge, skill, experience and biases related to the decision.

2.3 Commodity price risk

Building upon the risk definition and supply chain risk section earlier, this section will focus more specifically to the commodity price risk. Commodity price risk arises from the volatility of commodity prices (Kouvelis et al., 2013). Furthermore, the imbalance between purchase and sales commitments is a key factor. With regards to the supply chain typology of Rao and Goldsby (2009), commodity price risk could be placed in the category of input market uncertainty under industry-related risk factors, although commodity prices are also closely connected to the environment uncertainties in the global commodity markets.

Zsidisin et al. (2016) state that while most firms are directly exposed to commodity volatility, just about all companies are exposed to commodity price risks at least indirectly. More importantly, an economic agent is only vulnerable to the risk when there is an imbalance between its upstream and downstream trade commitments. The balance between upstream (supply) and downstream (demand) commitments is often referred to as market position. A net long position refers to a situation where an operator has purchased more raw materials than it has sold. An opposite situation, where the quantity of goods sold exceeds the quantity of raw materials bought, is called a short position or 'being short'. A holder of long position

experiences positive price risk when the market price of the commodity in question increases as their purchase prices are fixed but their potential sales price increases. When the market price decreases, they experience negative price risk. For holders of short position, the logic works the other way around. Similar terminology is also used in trading of stocks and other financial instruments.

Krainer (2019) portrays the magnitude of commodity price risk with an example from the gold mining industry. He describes how the world's largest gold mining enterprise Barrick Gold posted a quarterly loss of USD 8,6 billion during a gold market crash from USD 1 700 per ounce to USD 1 200 per ounce in 2013. The company had not hedged their commitments in the supply side by consequently selling the same quantities either in physical markets or the futures markets and suffered from their long position in gold (Krainer 2019).

As another example from the agricultural markets, consider a farmer at the end of harvest season. They have invested in growing their crop throughout the growing season by purchasing seeds, fertilizers and pesticides as well as employing themselves or hired workers to cultivate, sow and harvest their fields. At this point, most of their upstream commitments are realized but if the farmer has not made any sales with fixed prices for their crop, they are subjected to the commodity price risk i.e. depending on the market development, they might not be able to secure enough revenue from their sales to cover their already fixed costs. Of course, risk operates in two ways and the farmer might also benefit from having no sales commitments if commodity prices soar. This view follows the risk definition by Nason (2017) where risk can also result in a positive deviation from the expected. The logic of commodity price risk for farmers works similarly in a manufacturing setting where a company commits to buying raw materials from its chosen suppliers and sells its end products to its customers.

2.3.1 Means of managing commodity price risk

As established, commodity price risk arises from imbalanced fixed price commitments between purchases and sales. Furthermore, lack of effective price risk management could also result in a company losing its competitive advantage in relation to their competition if their input costs rise, thus decreasing demand for their offering (Zsidisin et al., 2016). The simplest way to evade price risk for trade commitments is to secure both trade directions at

the same time for the same volumes. However, often this cannot be achieved due to a number of reasons such as fluctuating supply and demand conditions, discrepancy between the potential purchase and sales quantities of commodities or the general nature of the trade to name a few.

Zsidisin et al. (2016) propose eight approaches for managing commodity price volatility in direct purchasing of commodities, i.e. when a company sources commodities to transform themselves into a saleable product. In contrast, they also discuss managing commodity price risk in value chain purchases, where the initial sourcing of the commodity is made by a supplier (described above as direct purchasing) and where the observed company purchases components or subassemblies into which the commodities have already been transformed. However, here we focus on managing price risk for direct purchasing of commodities. The eight proposed approaches by Zsidisin et al. (2016) are:

1) building financial slack
2) forward buying
3) staggering contracts
4) switching suppliers
5) financial hedging
6) cross-hedging
7) improving product designs and production systems
8) developing substitution strategies

As the scope of this research is in financial hedging via commodity derivatives, items 1-4 and 7-8 are briefly described in this section and items 5 and 6 will be more thoroughly discussed in sections 2.3.3 and 2.3.4 later on.

Financial slack is a financial planning and budgeting method where a company may allocate funds in its balance sheet or purchasing budget as a safety measure for when input prices of their raw materials rise. Zsidisin et al. (2016) state that these measures are often the luxury of companies operating in high-margin industries or niche markets, low-margin industries are usually not able to account for such financial buffers without hindering their competitiveness.

Forward buying is a purchasing strategy where a company buys its input raw materials well in advance to fix their input costs and secure their supply for the chosen time period. Decisions to forward buy rely on competent market analysis and forecasts since it exposes

the company to price risks of long position, i.e. the company's competitiveness might suffer if the input market prices decrease rather than increase (Zsidisin et al., 2016). Zsidisin et al. (2016) also point out other disadvantages of forward buying: it requires capital to invest in increased inventories, it does not support lean supply chain practices, it increases chances of inventories damages or spoilage and it ties up capital. Forward buying is usually used for securing supply rather than speculating on the market price development and it is often applied when financial hedging or contract agreements are not viable for some reason (Zsidisin et al., 2016).

Staggering contracts is a purchasing tactic that leans on diversification over time. Essentially, a company makes fixed price forward contracts for a commodity in quantities less than 100% of its demand for different prices at different points in time (Zsidisin et al., 2016). This way the company will never fix their input costs at the highest market price levels nor will it liekly be able to secure all purchase prices at the cheapest levels either. Depending on the deployed tactic, 100% of the purchase volume of a commodity will be priced for example a month or a quarter before beginning of production (Zsidisin et al., 2016).

Switching suppliers is a self-explanatory purchasing tactic where a company might for example put out a purchasing tender to multiple potential suppliers to find the cheapest purchase price or by other means find lower price points for the same commodity by contacting alternative suppliers. Zsidisin et al. (2016) describe how at a strategic level, a purchasing company might have multiple contracts for the same commodity with flexible volumes towards different suppliers to accommodate for "shopping" of cheapest contract prices later on. They note that in some cases, purchasing companies tend to have these sorts of frame agreements with chosen pre-qualified long-term partners who are able to meet quality and execution needs. The ability to form these agreements with flexible quantities depends on the company's negotiation power and skill.

Improving product designs and production systems is a long-term method whereby a company aims to improve their products or production towards more efficient use and decreased demand of raw materials thus decreasing the effect that commodity price volatility has on the company's financial performance. It requires extensive collaboration both internally and with supply chain partners to create these more efficient production processes and product designs. This method will also require investments into research

and development as well as market research to ensure that potential new designs are accepted by the markets (Zsidisin et al., 2016.)

Finally, Zsidisin et al. (2016) describe how a substitution strategy might be an effective method to combat commodity price risk. They argue that preapproval of substituting raw materials would be ideal although substitutions are generally not technically or economically viable. As an example, they note that many coffee producers have learned to routinely switch between different varieties of coffee beans based on their respective market prices.

One form of commodity price risk management not proposed by Zsidisin et al. (2016) is index-based pricing mechanisms. Index-based pricing promotes a risk-sharing approach to trade contracts where the final fixed trade price of a commodity is determined at a different point in time than when the contract is formed and where the price is connected to a mutually (between seller and buyer) chosen publicly available index reference. Bolandifar and Chen (2020) give an example of such pricing mechanisms by describing the natural gas supply negotiations between Russia as the seller and China as the buyer. It is speculated that the pricing mechanism of the 30-year supply contract is an index-based model where the natural gas price is derived as a function of crude oil market prices. In a way, these sorts of agreements may utilize commodity exchanges indirectly.

In conclusion, there are multiple ways of hedging price risk of raw materials even without commodity derivatives. The methods range from financial and budgetary decisions to purchasing tactics, supplier selection and product design. Thus, there are multiple different business functions within a company, who may be subjected to price risk management decisions and measures. The scope of this research is in commodity derivatives and financial hedging and existing literature for them is presented next.

2.3.2 The function of commodity exchanges and derivatives

Commodity exchanges serve a vital role in the economy (Baker, 2018). This section briefly describes the general function of commodity exchanges, what commodity derivatives are and introduces some available commodity products and exchanges on the markets today. Focus is on exchanges relevant for the chosen case companies. A more extensive, although not exhaustive, listing with more exchanges and some interesting and potentially surprising tradable commodities can be found at the end of the paper in appendix 2.

Commodity exchanges, such as the Chicago Board of Trade established in 1848, were founded to create a centralized marketplace for buyers and sellers of commodities to formally trade in forward contracts of different commodities (Baker, 2018). Instead of the usual spot trading, market participants had grown a demand for securing their sale and purchase prices in advance to increase predictability and consequently manage their profitability better. As Johnson (1960) states: “the commodity exchange provides a central location where potential buyers and sellers make bids and offers for contracts covering delivery in various later months”. He continues to state that in most markets, only a minority of the contracts are actually delivered upon maturity. Instead, market participants generally liquidate their existing positions by offsetting transactions of the same contract. This way, public commodity exchanges and the commodity derivatives traded there offer liquidity for commodity markets. An operator is not required to find a counterparty to buy or sell physical goods to hedge their price risk when they are able to balance their physical market position by trading commodity derivatives and their price movement. And, as Working (1953) states, the most important function of the commodity futures and commodity exchanges is their contribution to the reduction of price fluctuation.

Commodity derivative trading is governed by the commodity exchanges or other financial institutions. Derivatives can generally be categorized into three classes:

Futures contracts

A futures contract is one that fixes a trade price in relation to a future settlement date (Baker, 2018). A futures contract is not to be confused with a forward contract, which is usually a normal trade agreement of physical goods but with a delivery date set in the future. The specifications of a futures contract are standardized by the governing commodity exchange and normally include terms relating for example to quantity, currency, price unit, delivery terms, minimum quality parameters and settlement terms. In fact, the only variable of these contracts is the price, which is formed by the trading occurring in the commodity exchanges (Zsidisin et al., 2016).

Settlement terms are terms dictating how a futures contract will ultimately be cleared. Depending on the futures contract specification, the settlement may either be done solely by cash or alternatively some contracts offer settlement by delivery as well. Most futures contracts are settled by cash, i.e. a holder of a short position (sales contract) will buy a long position (purchase contract) of similar quantity and vice versa. Only a small percentage of the contracts will lead to physical commodity flows (Johnson, 1960; Zsidisin et al., 2016).

This is often because of distinct quality specifications required by the buyers to which the standardized specifications of the commodity futures do not adhere to. For cash settlement, the difference between the purchase and sales prices will consequently be either debited or credited to the trader, depending on the price difference. (Baker, 2018)

As an example, the Euronext commodity exchange offers futures contracts of milling wheat for delivery in March, May, September and December. One futures contract equals 50 metric tons. Should a trader hold one short contract of December 2023 milling wheat upon maturity, which is on the 10th of December 2023, they would be obligated to deliver 50 metric tons of milling wheat according to the contract specifications set by the exchange. In this example, a delivery should be made in France at an approved silo in Dunkirk, La Pallice, Montoir, Nantes or Rouen by 31st of December 2023.

Options

A commodity option is a contract that allows the buyer *the right but not the obligation* to buy or sell the underlying asset (Baker, 2018). In commodity markets, options are connected with a futures contract (underlying asset), i.e. an option contract gives the buyer a right to either claim a long or a short futures contract at a specific price. In essence, a commodity option contract is a derivative of a derivative. Option contract terms are similarly governed by the commodity exchanges.

For a seller of an option contract, the price risk is substantial. A seller of an option has the obligation to either sell or buy the specified commodity at the specified price level (Baker, 2018). Selling of options is however not a hedging action but rather a tool for financial institutions to offer various investment products. A seller of an option might actually want to hedge their own price risk by taking a counterbalancing futures or options position.

Over-the-counter (OTC) instruments

Over-the-counter instruments are devised by financial institutions to offer hedging products for traders not willing to trade futures or option directly. Baker (2018) describes them as instruments that allow an investor to take exposure to a wide variety of commodities without having to deal with contracts on physical goods or manage their own futures positions. The financial institutions that offer these products will undertake the trading activities on the commodity exchanges as a service.

The prerequisite for commodity exchanges to effectively work for hedging a market position is that the development of commodity prices on a given exchange are positively correlated with the development of the physical prices of the same commodities (Zsidisin et al., 2016). If a commodity derivative price correlates negatively with the price of physical goods, the derivative is not suited for hedging. Partly due to this, there are commodity exchanges all around the world in order to cater to differing market prices between different parts of the world. A company looking to hedge their price risk on a commodity exchange has to undergo a process for finding out the exchanges and derivatives that best correlate with their physical market prices in order to reach their intended risk mitigation effects.

Regarding the formulation of commodity market prices, the theory of storage explains the difference between a spot price (lower) and a future contract price (higher) to arise from the foregone interest in storing a commodity, the warehousing costs and the convenience yield on inventory (Fama & French, 1987). Baker (2018) describes it as an extra cost premium for fixing a trade price into the future. These situations where the prices of nearby delivery are lower than deliveries later on is called contango. Depending on the market situation, the price difference between spot price and futures price can also be reverted, which is referred to as backwardation. For example in commodities with highly seasonal supply characteristics such as grains, the spot price may rise well above future prices during the end of the crop season before new harvests begin. Similarly, the prices can be in backwardation if a sudden event causes a demand spike due to increased uncertainty of the future, as happened after Russia's military attack into Ukraine. (Baker, 2018)

Due to the longstanding history of agricultural future trading (Zsidisin et al., 2016) there are dozens of commodity exchanges around the world that offer agricultural derivatives. Likewise there are many other commodity derivatives catering for the needs of the food industry, although both these industries also partly operate in the same commodity markets. The Chicago Board of Trade offers futures and options contracts for grains such as corn, rice, wheat and oats as well as different soy products (beans, meal and oil). In Europe, the Euronext commodity exchange offers futures and options for wheat, corn and rapeseed. Both of these exchanges offer settlements both by delivery and cash.

When it comes to the wood and forest commodities, the financial hedging market seems to be less developed. In February 1997, the Finnish Options Exchange (FOEX) was founded to offer trading of wood pulp derivatives (Lindeberg, 2017) but only two years later, the exchange operations ended (Metsä Group, 2022). Nowadays, pulp derivatives are offered

only at the Shanghai Futures Exchange and the specialized NOREXECO exchange (Cord, 2020). The main difference between the two is that Shanghai Futures Exchange accepts settlement by physical delivery whereas NOREXECO only allows cash settlements.

2.3.3 Theoretical framework on financial hedging of commodities

Zsidisin et al. (2016) define financial hedging as an activity which consists of acquiring futures, options or other derivatives to offset anticipated future commodity price increases. However, this definition does not address a situation where the hedger would need to cover their downside price risk, i.e. a situation where they have bought raw materials at a fixed price and in order to remain competitive when the price levels decrease, they would hedge by selling commodity derivatives. Johnson (1960) describes hedging as a sort of insurance against price risk for a dealer of physical commodities. An owner of any commodity would seek to sell the same commodity on a futures market to mitigate (or hedge) their risk of negative market price movement before selling the commodity. In this view, the hedger is primarily motivated by mitigating their price risk, similar to Zsidisin et al. (2016). Bolandifar and Chen (2020) define hedging as taking counterbalancing actions so that future value varies less over the possible states of nature. Zsidisin et al. (2016) define three conditions for when financial hedging or raw materials is applicable: significant spend, high risk exposure and high price volatility.

Working (1953) offers an opposing view on hedgers' motivation. He considers financial hedging activities to be primarily motivated by a sort of arbitrage that occurs between the price developments of spot prices and futures prices. The risk mitigating effect Working considers to be a secondary benefit. This profound idea turns the function of financial hedging completely around. Instead of fixing a profit margin from commodity-related activities, Working suggests that hedgers are actually seeking extra profits from their hedging activities.

In addition to financial hedging, Zsidisin et al. (2016) also describe a hedging approach called cross-hedging. This approach might be applicable if a hedging need arises for a commodity for which no commodity derivatives are available but another exchange traded commodity shows similar price movements. For an example they explain how diesel fuel was not offered by commodity exchanges prior to 2007 so operators in diesel markets turned to heating oil derivatives for financial hedging because they had noticed similar price

movements for these two different products. They propose substantial correlation and regression analyses of commodities before applying cross-hedging approaches.

To summarize, financial hedging involves taking decisions on the financial markets to counterbalance actions in the physical commodity markets. There are alternative views as to what the motivation of financial hedging are; are they only risk management-oriented or is there an element of arbitrage and extra profit creation as well? In addition to direct hedging of commodities, some situations can also benefit from cross-hedging where a commodity price risk is hedged by trading derivatives of another commodity with correlated price development.

2.3.4 Hedging policies and strategies for commodity price risk

The literature on various different approaches, strategies and models for commodity hedging is substantial. This research does not intend to add to this literature but for sake of context, this section briefly describes some literature on hedging policies and strategies.

According to Kouvelis et al. (2013), commodity price risk is typically hedged with commodity derivatives whereas consumption volume risk is hedged by physical inventories. They suggest that instead of hedging these risks in separate policies, a manufacturing company should implement an integrated hedging policy taking into account both the derivative and inventory hedging methods. They state that hedging with commodity derivatives controls the profit variance whereas the operational hedging (via inventory management) can be used to improve mean profit.

Myers and Thompson (1989) propose a generalized optimal hedge ratio estimation model for agricultural commodities (corn, soybeans, wheat). Their paper aims to provide a generalized model more sophisticated than a simple regression model to be used to determine an optimal hedge ratio, i.e. the proportion of physical commodity positions that should be covered by a counterbalancing position on the derivatives market. Their finding was that regression models based on commodity price levels were inappropriate whereas same regression models based on commodity price changes were relatively accurate models to determine an optimal hedge ratio. Paul and Bhardwaj (2016) present evidence on optimal hedge ratios for soybean trading and conclude that in an optimal hedge ratio regression model, a time-varying coefficient between independent variables and the

dependent variable outperforms a static coefficient. That is to say that optimal hedge ratios change over time as markets fluctuate.

Similarly to Paul and Bharwaj (2016), Ni, Chu, Wu, Sculli and Shi (2012) researched a multi-stage hedging strategy for managing commodity price risk of manufacturing raw materials. Their approach outperformed traditional one-stage and minimal-variance strategies due to predefined intermediate stages in the strategy at which the principal company's commodity future position was rebalanced according to up-to-date information. Thus, it implies that for companies undertaking financial hedging activities, the process should be one of continuous improvement and constant monitoring and analysis with adaptation to market development.

Due to oil's essentiality to society and the economy, the crude oil market is often considered as a driver for other commodity markets. For example Liu, Pan, Yuan and Chen (2019) examine the connection between crude oil futures prices and Chinese agricultural commodity futures and find that 11 of the 12 examined agricultural commodity futures have a positive correlation with crude oil futures. Tiwari, Khalfaoui, Solarin and Shahbaz (2018) report similar findings on most of the 21 commodity futures they examine in their research. The results are explained by oil being an essential input cost for most supply chains. Similarly, Cortazar and Eterovic (2010) find that both copper and silver prices correlate with crude oil futures prices. Thus, some elements of cross-hedging could potentially be implemented by using crude oil derivatives.

Buhl, Strauss and Wiesent (2011) analyze the connection between a production company's hedging activities and financing with the assumption that hedging reduces the company's risk levels and thus leads to more confidence for potential investors. They found profitable hedging strategies in polypolistic settings whereas for a monopolistic company, the return on their hedging strategy was very small. Similarly to Buhl et al. (2011), Smith and Stulz (1985) consider financial hedging as a part of the financial decisions of a company.

Kleindorfer and Yücesan (2013) discuss commodity hedging at a general level. They emphasize the importance of internal control schemes for any hedging activities in order to limit the exposure to losses arising from derivative trading. They propose "virtual hedging pilots" before engaging in the markets with real money. They also note that competitive purchasing of commodities requires the use of financial tools. Ultimately, they stress the importance of correlation between traded financial instruments and actual procurement items and state that responsiveness to market information is the key to success.

Fama and French (1987) investigated two alternative theories of commodity future prices. The theory of storage, which they label “not controversial”, explains the difference between a spot price and a future contract price to arise from the foregone interest in storing a commodity, the warehousing costs and the convenience yield on inventory. The alternative theory explains futures prices as a combination of expected risk premium and a forecast of future spot price. They find more evidence supporting the theory of storage while stating that support for the alternative theory was more difficult to find. Brooks, Prokopczuk and Wu (2013) build upon Fama and French (1987) in their research. They find more evidence supporting the theory of storage as well as support for the forecast power of futures prices on spot prices at maturity. In contrast, their findings on risk premiums included in futures prices ends up inconclusive.

2.3.5 Role of financial investors on commodity derivative markets

In addition to the commodity producers, commodity traders and manufacturers who partake in the physical commodity markets, the derivatives market is also attended by speculative financial investors who generally do not take any part in the physical trade of commodities but rather seek to gain financial profits from trading the commodity derivatives (Zsidisin et al., 2016). For these financial investors, commodities provide diversification benefits and inflation coverage (Miffre and Brooks, 2013). The effects of investment funds on commodity markets has been researched quite extensively and mostly the conclusion has been that they provide stability, liquidity and efficiency on the commodity markets. Miffre and Brooks (2013) show in their analysis that long-short speculators do not cause changes in volatility. However, a purchasing professional of a market-traded commodity should keep in mind that this investment money works towards different objectives on the commodity markets than participants in the actual physical commodity market.

Alquist and Gervais (2013) define speculation (in the context of oil markets) as holding a long or short net position of oil by a firm with no commercial use of oil. Although at face value this seems like a disruptive force in the markets, Bohl and Sulewski (2019) find evidence that long-short speculators actually reduce volatility in commodity markets or at the very least their effect on the volatility is non-existent, although their research only covered five commodities traded in the US markets so further research is needed to conclude anything absolute. Reduced volatility would generally be a favorable condition for market participants taking part in the physical trade as it would lead to reduced market price

risk for the commodities and thus the attendance of long-short speculators could be beneficial. The same notion is stated by Miffre and Brooks (2013), Kim (2015), Manera, Nicolini and Vignati (2016) as well as Brunetti, Büyüksahin and Harris (2016) who state that hedge funds are a valuable source of liquidity for commodity markets and can act as a stabilizing force. Alquist and Gervais (2013) determine the role of speculators to have been "modest at best" in reference to the increase in oil prices between 2003 and 2008 which is also supported by Büyüksahin and Harris (2011) and Manera, Nicolini and Vignati (2013).

In contrast to long-short speculators whose goal is to beat the market by correctly timed trading, the market is attended also by commodity index traders (CIT), who typically invest long in the nearby commodity futures positions and have a predefined roll-over plan in place (Bohl and Sulewski, 2019). Due to their increased activity in commodity markets pre-financial crisis 2008, CITs were widely criticized for increasing volatility and pushing commodity futures prices higher. This theory has been labelled as the 'Masters Hypothesis' (Irwin & Sanders, 2011a). However, Sanders and Irwin (2011a, 2011b) do not find evidence of such effect occurring from CIT activity. They also fail to determine any stabilizing effect on market volatility by CITs which is in contrast to the evidence on long-short speculators discussed above. Hamilton and Wu (2015) examine if CIT market positions can be used to predict excess returns in agricultural commodity futures markets but are unable to show any supporting evidence thus also supporting the notion that financial investors do not cause any measurable effect on futures prices and are not driving futures prices.

2.4 Summary of the reviewed literature

In summary of chapter 2, we first began by examining different definitions of risk. The common characteristics of these definitions revolved around uncertainty, the future, probabilities and negative and positive deviations from expected results of actions. Thereafter the focus was on supply chain risks in general. The main supply chain risk categories were: environment, industry, organization, decision maker and problem specific risks. Moving on to the scope of this particular research, the commodity price risk concluded the chapter. General price risk hedging approaches were discussed first. Then a more specific focus was taken on commodity exchanges and commodity derivatives. Three main classes of derivatives were examined: futures, options and over-the-counter products. Finally, we concluded by examining literature on financial hedging, policies and strategies as well as the role of speculators in commodity markets.

3 Methodology and data collection

This chapter will describe the chosen research and data collection and analysis methods for this study. First, it will describe why this research was conducted as a qualitative case study. Secondly, the choice of case companies is explained and finally, the data collection and analysis is described with the aim of validating the choices.

3.1 Research method

This research is a qualitative one. Given the lack of previous research around the chosen subject, a qualitative research approach supports exploration of the subject in a more unstructured way and is more flexible to receiving unexpected responses, as described by Eriksson and Kovalainen (2008). As described earlier in the paper, there is a clear gap in commodity price risk management research in the Finnish context and thus, a qualitative research approach works well as a first phase study which can thereafter be continued as a quantitative one (Eriksson and Kovalainen, 2008). Furthermore, the aim of this research is to gather evidence to create a description of business processes, organization of work and sentiment towards the subject, further emphasizing the need for a qualitative approach.

In order to receive and analyze information from actual subjects of the chosen topic, a case study approach was chosen. A case study provides an opportunity to gain a holistic understanding of the research topic in the chosen context and allows for diversity and complexity in the empirical data and its analysis (Eriksson and Kovalainen, 2008). Similarly, Halinen and Törnroos (2005) argue that a case study approach is viable in revealing the complexities and dynamics inherent in business markets. Furthermore, since the aim of this research was also to examine potential differences between companies and industries, the study was conducted as a multiple case study. Although, as Eriksson and Kovalainen (2008) note, some definitions of a case study withhold multiple sources of information in general whereas some differentiate between a single and multiple case study. In addition to being a multiple case study, this research is also an intensive case study research defined by Eriksson and Kovalainen (2008) as one that aims to understand a unique case from the inside by providing a holistic and contextualized description.

3.2 Selection of the case companies

The case companies were subjectively selected for this study based on insights from the examined literature. As the literature suggests that financial hedging approach is primarily beneficial for high-volume purchases, the focus was to choose companies with operations large enough to warrant such actions. Furthermore, the case companies were required to have manufacturing operations within the borders of Finland to support the research aim. In addition, the literature showed that agricultural commodities have a long history and established culture of commodity derivative trading, thus providing a promise that interesting findings can be found in the food and agricultural industries. For comparison, the forest industry did not seem to have similar traditions in financial hedging although it has been a major industry in Finland for a long time. Thus, the choice of the third industry to be examined was directed at forest industry.

3.3 Data collection

Both primary and secondary data was collected for this research. The primary data was collected via semi-structured interviews when possible and otherwise via a questionnaire. The questionnaire also acted as the structure when interviewing subjects. The secondary data was collected from public corporate reports of the case companies.

A set of companies from different industries was chosen for data gathering based on their potential need and capability to hedge their commodity positions. The three factors considered when choosing the companies to contact were presence in international markets, the size of the companies in terms of personnel and annual revenue and the likeliness that they are purchasing commodities for which there are commodity derivatives available.

The survey itself included 12 questions. The first two were used to categorize the responding companies by revenue and industry. Questions three to eight were intended to investigate the status of the companies' hedging activities at the time of answering. Questions nine to eleven asked for the respondent's opinion on their company's hedging activities and the available hedging possibilities via commodity derivatives. And the final question concerned speculative commodity trading. The entire survey can be found in appendix 1 at the end of the paper.

Data analysis was done primarily via the structured survey which had clear multiple choice questions. Comparative analysis of the received data was done by visualization as portrayed in the next chapter.

4 Data description and empirical findings

This section will describe the gathered data from the target companies and share the initial findings and results of the survey. Some of the survey results were received by online submission from the target companies but for the ones where the data was gathered during an interview, there is further qualitative data than shown in the survey results and when relevant, they are presented and discussed later in section 5. These include comments and quotes made by the interviewees.

For initial characterization of the examined companies, the 2021 total revenue was either received from the respondents or from published financial statements. There were four categories created in order to create some separation between the respondents. The literature examined earlier would indicate that smaller organizations might not have sufficient resources to invest in expertise required for financial hedging of commodity price risk. Therefore the survey was directed towards larger companies. Of the respondents, only one might be considered a small or medium sized enterprise (SME) according to the definition of Statistics Finland (2023), which limits the annual turnover at EUR 50 million for SMEs. Other than this one company, the annual turnover for the focus group ranged from EUR 100 million to over EUR 1 billion euros, presented below in figure 5.

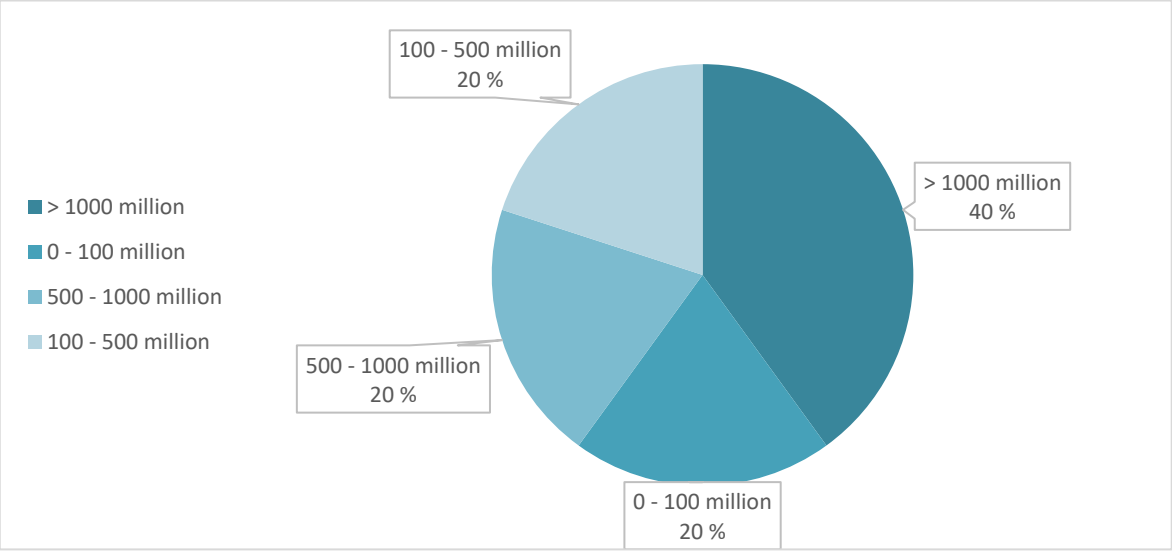

Figure 5 Focus group company revenues in 2021

The second basic characterization of the companies was done by their primary industries. As discussed earlier, there are varying histories between different industries when it comes to financial hedging and therefore it was the objective from the start to examine differences in methods and organizations across industries. The respondents were from agricultural, food and forest industries. Each industry is characterized by different supply chains and market dynamics as well as different characteristics regarding the commodities that they procure. As described earlier in the study, there is a long history of commodity derivative trading in the agricultural sector whereas similar culture and tradition does not appear in the forest industry.

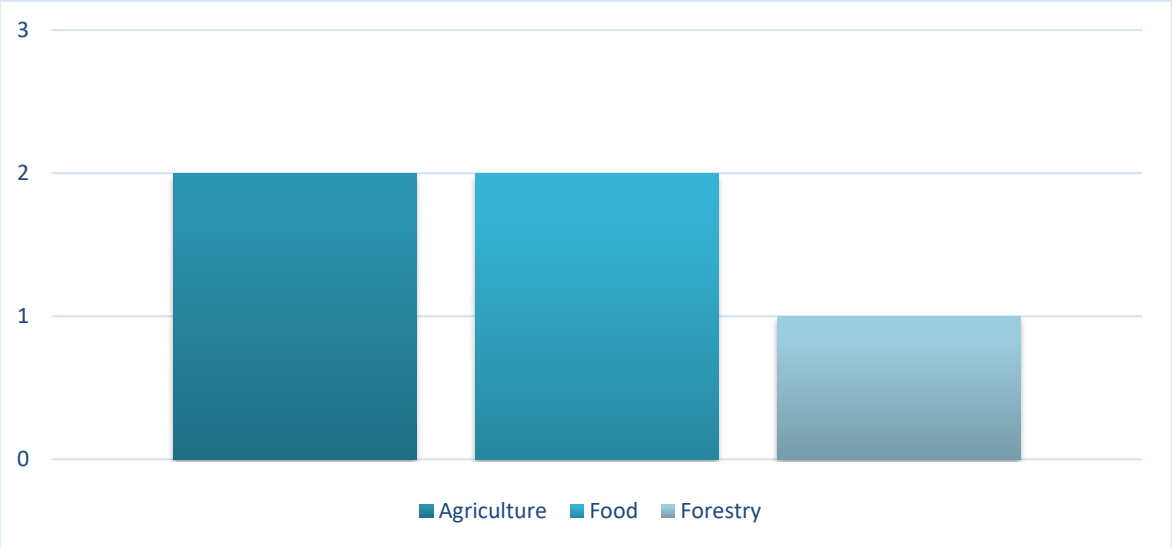

Figure 6 Case companies by primary industry

Moving on from the base categorization of the examined companies, the first question pertaining the topic of this research was simple: does the company use commodity derivatives to hedge their raw material commodity price risk? Of the two agricultural companies interviewed, one answered yes and the other no. For both of the food producers interviewed, the answer was yes. The company producing wood-based products did not take part in the financial hedging markets for their raw materials. This was commented by the interviewee that there is not a tradition of financial hedging of raw materials in the Finnish forest industry and that heavy vertical integration in the sector partly erases the need for financial hedging. The results are summarized below in figure 7.

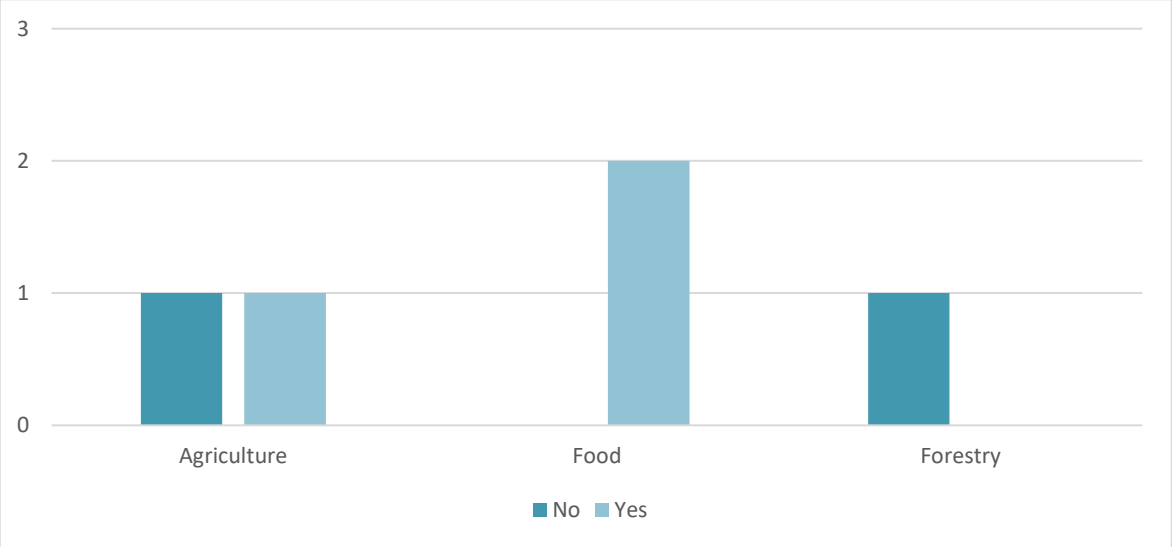

Figure 7 Survey question 3: Does your company use commodity derivatives to hedge raw material commodity price risk? Categorized by industry.

Next question was aimed to find out more about the market dynamics that the companies operated in. Depending on how their upstream and downstream trade is construed, the need for financial hedging of raw material price risk might focus either around the company's purchasing operations or their sales operations. For three of the four companies partaking in financial hedging by commodity derivatives, they had a holistic approach to price risk management where both their sales and purchase commitments were included in decision making of financial hedging activities. Only one company had a single trade direction included in financial hedging decision making where they were only concerned about their purchases. This is an interesting finding since, as discussed earlier, the commodity price

risk is created by the imbalance between purchase and sales commitments and therefore both aspects would ideally be needed when considering financial hedging. Figure 8 portrays the division of answers to this question.

Figure 8 Survey question 4: If yes [company uses derivatives to hedge], do you hedge sales or purchases?

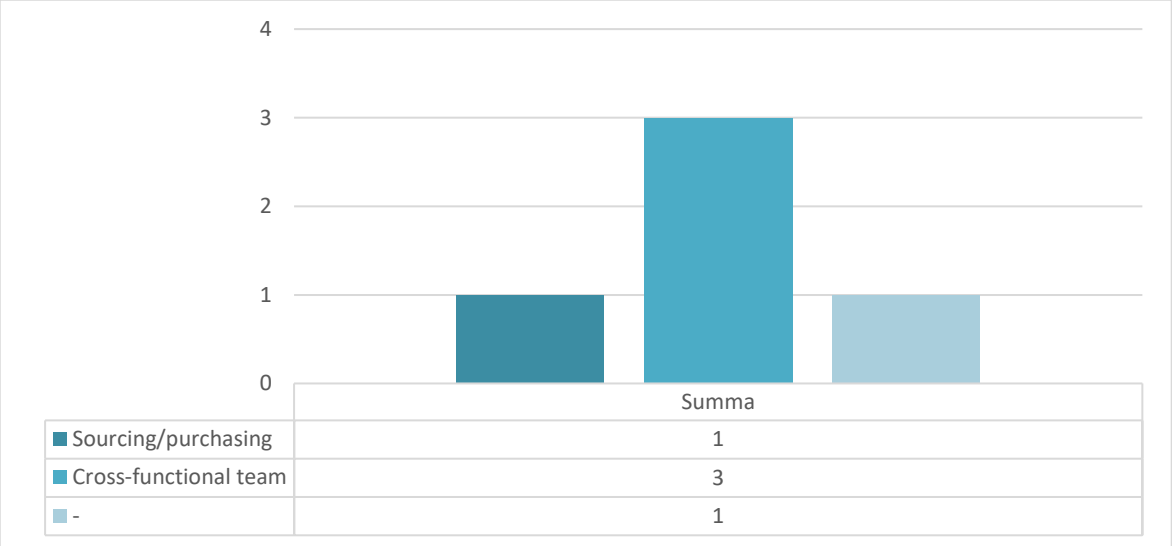

Figure 9 Survey question 5: Which business function is responsible for creating and executing your company's commodity derivative trading strategy?

Question 5 of the survey and its received answers are shown in figure 9 above. The question was aimed to find out which business functions were given responsibility of commodity price risk management. The results should provide some evidence to the research question of

where the potential financial hedging expertise is located in these industries in Finland. The most common response to the question was that a company had a group or a team with experts from different business functions to create and execute their commodity derivative trading strategy. This was the case for three of the four companies doing financial hedging and in the case of the fourth one, it was their sourcing/purchasing function who had primary responsibility of commodity trading.

The next question was continuation for the research on financial hedging expertise and looked to reveal the number of professionals involved with financial hedging at the companies. The base assumption would be that companies with larger turnover would also be susceptible to larger price risks and might therefore want to invest more heavily in risk management expertise. Of the three companies who disclosed this information, it can be seen in figure 10 that the number of employees involved with commodity price risk management increases correspondingly with company turnover. This of course does not provide a quantitatively solid argument but rather a snapshot of the target companies. Nevertheless, there were more than one employee in each company responsible for financial hedging.

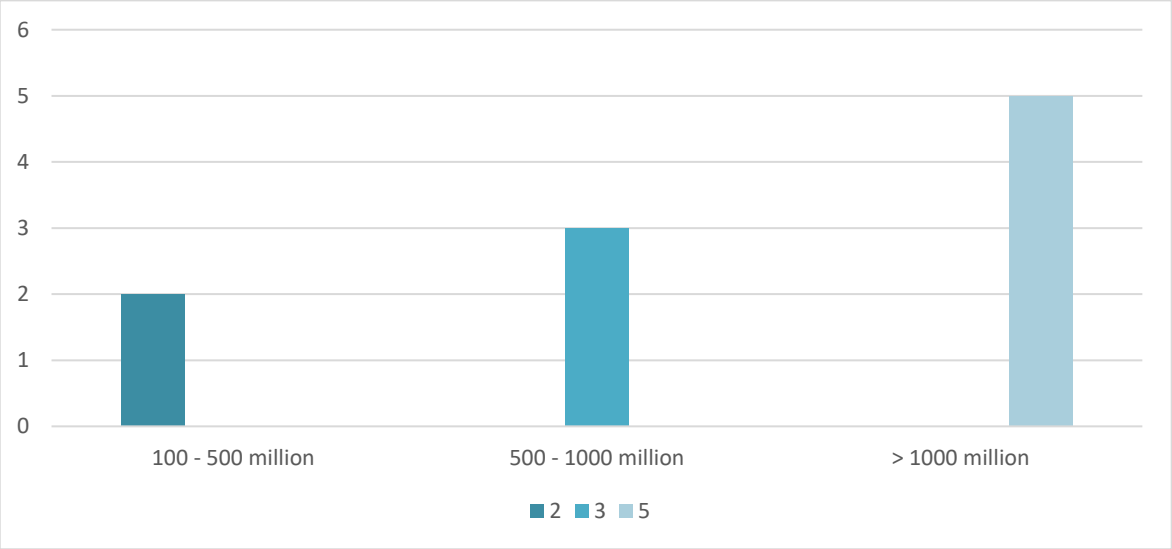

Figure 10 Survey question 6: How many people are responsible for creating and executing your company's trading strategy? Categorized by company revenue.

In addition to the research on price risk management of raw materials, the survey included also one question concerning supportive commodities for production such as energy and fuel as well as a question of currency exchange rate hedging which applies for companies operating in international markets and foreign currency. Both of the agricultural companies

were hedging energy input costs by derivatives and one of them also hedged foreign exchange rates. Neither had hedged fuel costs. For the food industry, currency exchange rates were hedged by both companies whereas fuel and energy inputs were both only hedged by one of the two. For the forestry company, they partook in hedging energy and fuel risks. As we are examining production companies, it is not a surprise to see energy costs being hedged quite broadly across industries. Summary of these results is below in table 1.

Table 1 Hedging activities of supporting commodities in the case companies

INDUSTRY	COMPANY	ENERGY	CURRENCY	FUEL
AGRICULTURE	A	Yes	No	No
AGRICULTURE	B	Yes	Yes	No
FOOD	C	Yes	Yes	No
FORESTRY	D	Yes	No	Yes
FOOD	E	Yes	Yes	Yes

Question 8 concerned the different derivative classes. The case companies were asked which of the three presented derivative types they use for their hedging purposes. The recorded answers are below in table 2. Only one of the food industry respondents used option contracts for hedging in addition to using futures contracts while none of the other case companies did so.

Table 2 Hedging instruments used by the case companies

INDUSTRY	COMPANY	FUTURES	OPTIONS	OTC PRODUCTS
AGRICULTURE	A	No	No	No
AGRICULTURE	B	Yes	No	Yes
FOOD	C	Yes	No	Yes
FORESTRY	D	No	No	Yes
FOOD	E	Yes	Yes	No

Questions 9 and 10 addressed the currently available commodity derivatives and their suitability for financial hedging of raw materials in these case companies. The respondents were asked the same question from two different perspectives; in terms of the product specification (quality, commodity) and in terms of geographical locations of commodity exchanges and potential locations of settlement by delivery.

In terms of the quality specifications of available commodity derivatives, the opinions were generally favorable for the available derivatives. On a scale of 1 to 5, the agricultural

company answered 4 and the two food industry companies answered 3 and 4. The agricultural company stated though, that they are using most of the different crops produced in Finland (wheat, barley, oats, peas) and the only available commodity derivatives are milling wheat futures and options. They do however feel that they are a good enough tool for their raw material financial hedging in a cross-hedging approach. Figure 11 shows how the companies responded to this question.

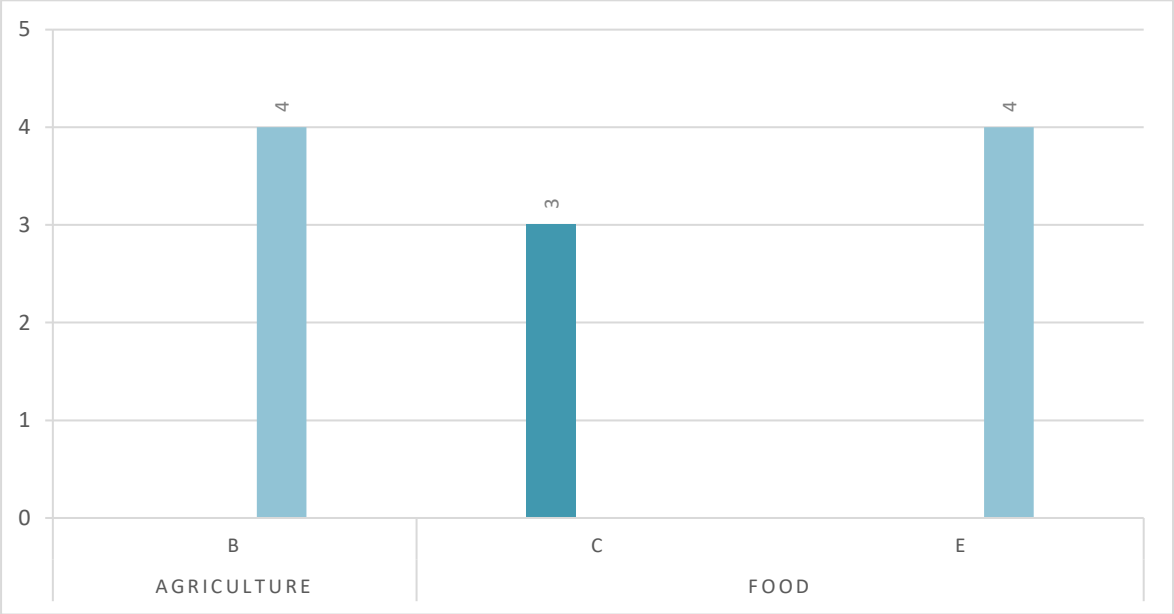

Figure 11 Respondents' assessment from 1 (worst) to 5 (best) of how well available commodity derivatives apply to their needs in terms of product specification, categorized by industry and company.

As seen in figure 12 below, the geographical differences between the case companies' markets and the commodity exchanges and potential delivery settlement locations are seen as a challenge. Both the food industry respondents evaluated the geographical component at a 3 out of 5 while the agricultural company only gave a 2 out 5 assessment. As mentioned earlier, both these industries are operating partly with the same supply chains and commodities, however the difference in the assessment might arise from the fact that the agricultural company's production involves raw materials other than grains, for which the geographically closest commodity derivatives are not found in Europe as they stated in the interview as well.

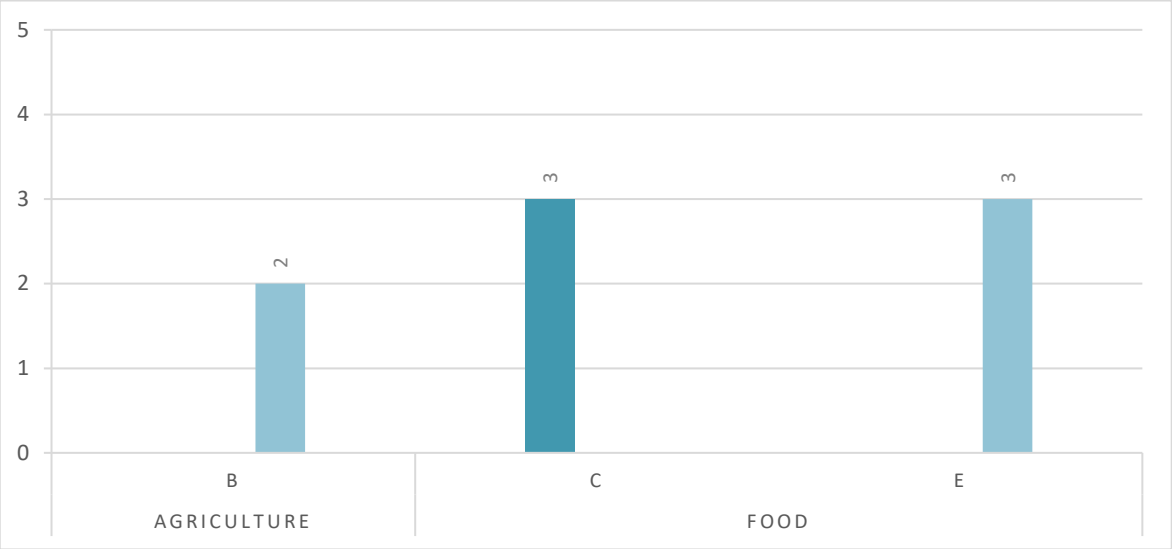

Figure 12 Respondents' assessment from 1 (worst) to 5 (best) of how well available commodity derivatives apply to their needs in terms of geographical location, categorized by industry and company.

Question 11 was aimed to assess the satisfaction and sentiment that the case companies had towards their respective commodity trading strategies and execution. Case company E seemed most satisfied with their current hedging operations at an assessment of 4, followed by company B in agricultural sector at 3 and company C at an assessment of 2. The results show that for each company, they feel like they could benefit from developing more sophisticated financial hedging systems. These results are seen in figure 13.

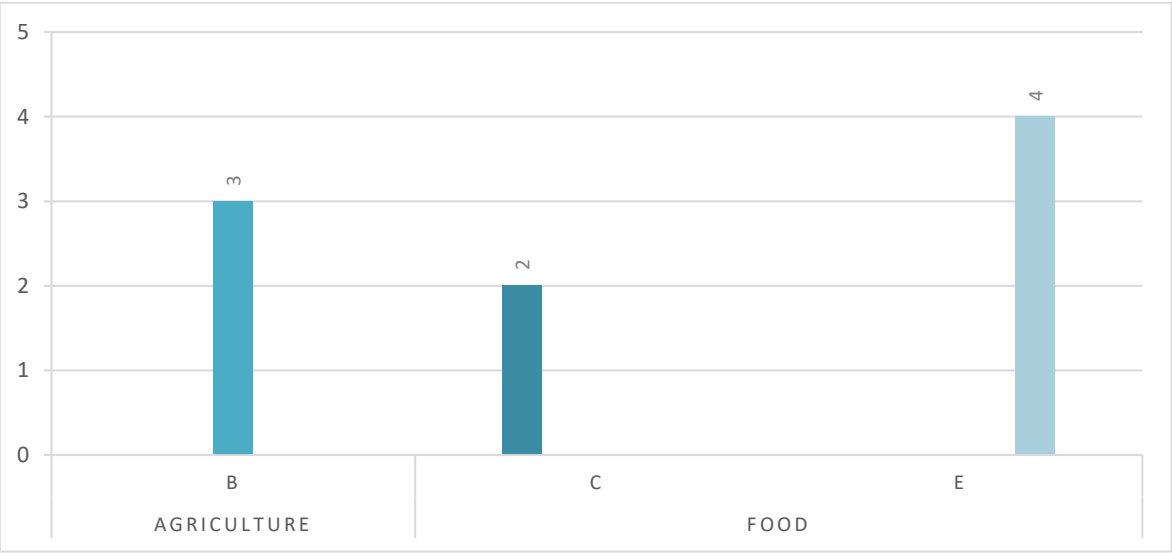

Figure 13 Respondents' assessment of the state of their commodity derivative trading strategy and execution.

The final question of the survey was directed at speculative trading of commodities. A company trading in physical commodities should be aware of their relevant commodity markets which could in turn give them the expertise and opportunities to exploit their market knowledge in speculative positioning as well. Of the five case companies, one of the agricultural companies and one of the food producing companies confirmed that they also trade derivatives with speculative profit-seeking objectives, as seen in figure 14.

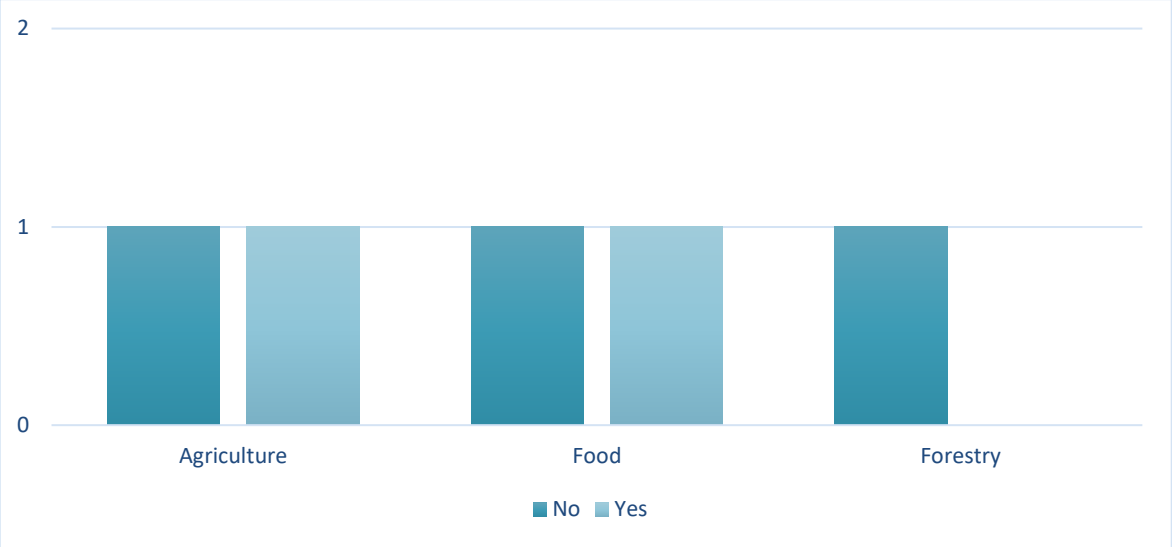

Figure 14 Answers to question 12: do the case companies use commodity derivatives for speculative commodity trading?

In conclusion, this chapter described the data gathered from the case companies. Clear distinctions were made in approaches to financial hedging of raw materials between industries, as the case company in forest industry did not hedge their raw material price risk at all (although they do hedge supportive commodities of production) while three of the four companies in the agricultural and food sectors did. All companies hedged their energy demand for production with derivatives, and most also hedged either their currency or fuel needs. The most common working method for financial hedging decision making was cross-functional teams as three of the four companies that disclosed this information stated that to be their method. The primary instruments used by the companies were commodity futures and OTC instruments, only one company was directly trading commodity options for hedging. In terms of the available commodity derivatives, the companies generally felt that the commodity specifications are quite appropriate but the geographical discrepancy to their own markets poses some challenges. In terms of sentiment towards the case companies' financial hedging strategies, there were clear differences between the companies and none were entirely satisfied with the current status. Finally, it was recorded that two of the five

case companies undertake in speculative commodity trading in addition to their raw material hedging. These findings are further discussed with relation to the previously discussed literature next in chapter 5.

5 Discussion

This chapter will discuss the findings of the empirical data collected with relation to the relevant literature presented earlier in chapter 2. The discussion will begin with discussion on the findings for the given industries after which their differences are examined and finally some general findings about the study will be discussed.

For the agricultural sector, the financial hedging and futures trading have a long history and tradition (Baker, 2018) which is only natural as agrarian practices are one cornerstone of how modern civilizations began to form from the earlier hunter-gatherer era. The seasonality and relatively standardized commodity environment with specific species of grains and cereals dominating most of the farming area (Baker, 2018) have shaped the agricultural markets to grow both the need and the possibility of efficient financial hedging of agricultural commodities.

Thus, it was a surprising finding to see that one of the agricultural companies focused on in this study did not hedge their raw material price risk with commodity derivatives. Although, as well pointed out by Zsidisin et al. (2016), there are many other ways of hedging commodity price risk which were out of the scope of this study and might be implemented at the company. For example, if they are able to secure back-to-back trades of purchasing raw materials and selling their end products, the need for financial hedging ceases to exist. It could be as well, that the company does not possess the necessary resources or expertise to partake in financial hedging markets as it requires different skills than their normal business operations as also noted by Zsidisin et al. (2016). Although, the company did hedge their price risk for the energy used in production, so at least a primitive understanding of financial hedging is possessed.

For the other examined case company in the agricultural sector, financial hedging of raw materials was seen as a strategic need especially now after the rising volatility in the agricultural commodities resulting from the war in Ukraine (Ahn et al., 2023). They have correctly determined that the increased volatility also requires increased attention to price risk management as backed by Kouvelis et al. (2013). In addition to their raw materials, they also hedged supporting commodities in the form of energy and currency; energy for their production process' demand and currency for their export and import business conducted in foreign currency.

Regarding the available commodity derivatives, the agricultural company concluded that the available commodity derivatives were relatively good for their financial hedging needs in terms of the product specifications. Although they stated that some cross-hedging approaches were needed to accommodate for hedging of goods that had no derivatives offered in commodity exchanges. This approach was also presented in the theoretical section as explained by Zsidisin et al. (2016). Furthermore, the company stated the need for pricing mechanisms based on product quality that could not be found in the standardized commodity trading system of commodity exchanges. As Baker (2018) states, commodities of the same type are subject to varying degrees of quality and these quality parameters are addressed only in the trading of physical commodities as the commodity derivatives only offer standardized qualities as defined by the exchanges.

Although the product specifications of the derivatives were quite relevant to their needs, the geographical layer portrayed some challenges to the case company in the agricultural industry. The need for the buyer or the seller to accept or make a delivery in a location specified by the commodity exchange constrains the geographical reach of a commodity exchange (Laulajainen, 1995) which is clearly manifested in the relation between the case company and the closest agricultural commodity exchange Euronext, which presents delivery points only in France. This discrepancy between delivery points of the physical goods results in hidden discounts and premiums against the exchange price and thus decreases the price transparency (Laulajainen, 2005). The same was confirmed by the case company, who stated that while they use commodity derivatives in financial hedging, the actual pricing of physical commodities differs from those traded on the futures markets. In this kind of situation, the correlation analysis has to be made to ensure that changes in the exchange market price are also recorded in the physical commodity markets (Baker, 2018).

In terms of their sentiment on the financial hedging strategy, this agricultural company gave a clear signal of wanting a more systematic approach to be taken. Drawing from the literature reviewed for this study, the company could benefit from theories such as optimal hedging ratio (Myers and Thompson, 1989; Paul and Bhardwaj, 2016) or a multi-stage hedging process such as presented by Ni et al. (2012). In any case, the process of formulating a systematic financial hedging strategy has to begin with an assessment of the hedging applicability of different commodity derivatives by way of correlation and regression analyses (Zsidisin et al., 2016). All these approaches do require knowledge and skills that a company either needs to develop from within or acquire from outside either by hiring professionals or acquiring professional consulting services.

In both of the examined food industry companies, financial hedging was implemented to address their raw material price risk. Between the examined food producing companies, all three classes of commodity derivatives were reportedly used. As already mentioned earlier, the food industry and the agricultural industry operate partly in the same value and supply chains. More specifically, the examined food producers were involved with the grain supply chains which could explain the results of the survey as agricultural commodity derivatives are quite popularly traded. The food industry has a lot of diversity in business operations and financial hedging likely will not suit for all of the sector and results with different case companies are likely to differ.

As the evaluation of hedging strategies themselves was not in the scope of this research, it cannot be concluded if company E from the food industry has implemented some of the financial hedging theory presented in chapter 2 but their assessment of their hedging strategy status was a 4 out of 5. However for company C with an assessment of 2 out of 5, the same suggestions as for company B in the agricultural sector could prove useful regarding optimal hedge ratio models and multi-stage hedging strategies.

Similarly to the agricultural companies, the food producing companies financially hedged their energy purchasing for production. The finding that generally all the case companies hedged their energy needs suits the fact that there are also academic studies done directly regarding e.g. electricity hedging in the Finnish context (see for example: Junttila, Myllymäki and Raatikainen, 2018; Sihvonen, 2015). Furthermore, the energy demand in industrial manufacturing includes the three factors calling for financial hedging as described by Zsidisin et al. (2016): significant spend, high risk exposure and high price volatility.

With regard to the only case company in the forest industry, the empirical findings were quite scarce as they were only hedging their supporting commodities and not their raw materials. However, a very interesting remark was made by the interviewee in that the forest industry commodity hedging is underdeveloped due to high vertical integration in the supply chains and thus a lesser exposure to price risk. This is in line with Sutcliffe and Akbar (1998) who found evidence of companies vertically integrating to combat input market uncertainties. Similarly, Xue, Wang, Liu and Chang (2022) conclude their research in oil and gas markets stating that vertical integration both decreases the efficiency of hedging and can mitigate price volatility risk. As mentioned earlier, there are a couple of commodity exchanges providing pulp derivatives but as the Shanghai Futures Exchange was the only

one with deliverable futures, the case company would likely have to have some trade relations to Eastern Asia in order to make efficient use of these derivatives.

Three of the four answers to the decision making responsibility of commodity trading in the case companies pointed towards a cross-functional team approach. However, the research did not examine the reasons for such arrangements so the reasons remain speculative. From the literature, it appears that companies tend to hire skills that contribute to their normal business operations (Krainer, 2019) and if no emphasis on raw material price risk management by financial hedging is given at the executive level, it is unlikely that appropriate skills are searched for either. However, for a manufacturing company the price fluctuation of raw materials directly impacts its end product price (Moheb-Alizadeh, Handfield, 2018) and as such, the management of raw material price risk is an essential part of a manufacturing company's core competence, as also noted by Zsidisin et al. (2016). Further on the subject, Tufano (1996) proposes that managerial risk aversion may affect corporate risk management policy. Croci, del Giudice and Jankensgård (2017) find some evidence that the age of an organization's CEO may affect the risk management policy but contrary to Tufano's (1996) proposal, they find no evidence of managerial risk aversion having effects. Their remark supports the idea that the executive level is in a key position to address how a company manages its commodity price risk.

In addition to their hedging practices, two of the five companies partook in commodity derivative markets with speculative motives. This is a clear distinction between the case companies and can stem from two strategic objectives. A company not involved in speculative trading is likely choosing to focus on its core competence in manufacturing and thus only participates in the derivative markets for financial hedging purposes as defined by Johnson (1960). Alternatively, a company with speculative motives may possess skills and insights that allow for such additional profit making operation. Thus being able to utilize its resources and skills more effectively and adding to the profitability of the company. As Zsidisin et al. (2016) state, this can be a source of competitive advantage for a company.

Returning back to the research questions given at the beginning of the paper. The two sub-questions were:

1. Is there enough expertise within the companies to develop a sufficient hedging strategy and in which business function is this expertise located?
2. Do the existing commodity derivatives cater to the hedging needs of Finnish manufacturing industries?

From this research we may conclude that the commodity hedging expertise of the case companies is generally dispersed between the different business functions. We recorded one outlier where the purchasing organization had the hedging responsibility. Generally, the purchasing organization withholds a relatively holistic view of a company's operations and can thus be given this hedging responsibility. A cross-functional team can benefit from diverse points of view and a holistic approach in decision making, however it might hinder the development of specified expertise on the subject of financial hedging.

Regarding the available commodity derivatives, we may conclude that in the food and agricultural sectors there are generally applicable commodity derivatives on the markets. However, specific attention has to be given to the different quality attributes of commodities in the physical trading and the quality differences between the commodity derivative contracts and the contracts on physical goods. It can also be proposed that the geographical layer is the foremost challenge in financial hedging for Finnish manufacturing companies. The nearest applicable commodity exchange is located in Central Europe, even that only for agricultural commodities, and thus the available commodity exchanges might not correlate to the actual physical flow of goods that Finnish manufacturing companies are part of.

The primary research question was:

1. What is the current status of commodity hedging by commodity derivatives in different Finnish manufacturing industries?

This multiple case study depicts of course only a snapshot of the situation and perhaps pinpoints some challenges and issues to be further researched. However, it can be concluded that commodity hedging is definitely a focus in the agricultural and food sectors. For the forest industry, raw material price risk hedging by derivatives is perhaps not as important at least for the case company or even more generally due to the industry characteristics. A general conclusion can be made that energy price risk hedging is quite broadly used in the Finnish manufacturing industries. Also some speculative commodity derivative trading is happening in the Finnish manufacturing industry which gives a promising outlook in that there are appropriate skills and executive encouragement to partake in the global commodity derivative markets as active participants.

6 Conclusion

The developments in logistics and information technology give rise to more opportunities but also more risks in supply chains than ever before. As supply chains become more complex and commodity markets more global, the risk management practices at companies become equally more important to secure reliable and competitive supply of raw materials. For manufacturing companies, the price risk of raw materials is a key issue to address for competitiveness in dynamic market situations and profitability in the long run. In this research, the focus has been to examine the readiness and expertise that Finnish manufacturing companies have when facing the challenges that global commodity markets pose.

By looking at five Finnish manufacturing companies in three different industries, this research showcases some of the ways that these companies organize their raw material price risk management and some of the challenges they face with financial hedging operations. The expertise and skills required for financial hedging are different compared to the core manufacturing processes and thus it is important to gauge where and at what level are these resources present as well as in what ways could the situation be improved to gain a more comprehensive and efficient hedging practice. From the research it seems like financial hedging expertise is generally quite dispersed in different business functions but the reasons remain unclear. Within the case companies, the sentiment seemed to be that financial hedging strategies have room to develop. Perhaps the future will see Finnish manufacturing companies taking a more proactive and comprehensive approach to commodity trading by way of specialized commodity organizations focused solely on commodity market analysis and derivative trading.

The study also examined the sentiment among Finnish industries on the available commodity derivatives. While the products themselves were found to be adequate, a clear challenge seems to lie in geographical differences between the physical commodity markets and the commodity derivative markets. Coming from a small market area, Finnish companies are bound to operate in much larger commodity markets and thus need to find ways of adjusting their operations to fit better into the greater international markets to benefit from the risk mitigation opportunities available in the global commodity markets.

As a multiple case study, this research offers only indicative evidence on the subject. The limitations are both geographical and industry-related. Some major industries such as the

metal industry were not focused on in this study although similar matters are relevant for them as well. Furthermore, this research only covers supply chain operators who source and transform commodities in their own production operations, leaving out primary producers of raw materials, trading businesses without production operations and speculators.

This study also offers room for much further research. On the qualitative research area, similar studies could be undertaken with a wider scope, covering more industries, companies and types of supply chain operators. The applied decision making processes, responsibilities and commodity trading strategies could also be further examined. In the quantitative research area, there is room to research different financial hedging approaches specifically regarding commodities produced and sourced in Finland. Likewise, research of available commodity derivatives and their applicability to Finnish manufacturing companies' hedging needs has not been extensively studied.

References

Ahn, S., Kim, D. & Steinbach, S., 2023. The impact of the Russian invasion of Ukraine on grain and oilseed trade. *Agribusiness,* 39(1), pp. 291-299.

Alquist, R. & Gervais, O., 2013. The role of rinancial speculation in driving the price of crude oil: Financial speculation in the oil markets and the determinansts of the price of oil. *The energy journal,* 34(3), pp. 35-54.

Baker, K. H., 2018. *Commodities: markets, performance, and strategies.* New York, NY: Oxford University Press.

Bettis, R. A. & Hall, W. K., 1982. Diversification strategy, accounting determined risk, and accounting determined return. *Academy of management journal,* 25(2), pp. 254-264.

Bohl, M. T. & Sulewski, C., 2019. The impact of long-short speculators on the volatility of agricultural commodity futures prices. *Journal of commodity markets,* Volume 16, p. 100085.

Bolandifar, E. & Chen, Z., 2020. Hedging through index-based price contracts in commodity-based supply chains. *Omega,* Volume 90, p. 101976.

Booth, J., 2014. What is risk?. In: *Emerging markets in an upside down world.* United Kingdom: John Wiley & Sons, Incorporated, pp. 95-118.

Brooks, C., Prokopczuk, M. & Wu, Y., 2013. Commodity futures prices: More evidence on forecast power, risk premia and the theory of storage. *The quarterly review of economics and finance,* 53(1), pp. 73-85.

Brunetti, C., Büyüksahin, B. & Harris, J. H., 2016. Speculators, prices, and market volatility. *Journal of financial and quantitative analysis,* 51(5), pp. 1545-1574.

Buhl, H. U., Strauss, S. & Wiesent, J., 2011. The impact of commodity price risk management on the profits of a company. *Resources policy,* 36(4), pp. 346-353.

Büyüksahin, B. & Harris, J. H., 2011. Do speculators drive crude oil futures prices?. *The energy journal,* 32(2), pp. 167-202.

Charpin, R., 2022. The resurgence of nationalism and its implications for supply chain risk management. *International journal of physical distribution & logistics management,* 52(1), pp. 4-28.

Cooke, J. A., 2002. Brave new world. *Logistics management and distribution report,* 41(1), p. 31.

Cord, D., 2020. *Hedging your bets with wood pulp.* [Online] Available at: https://www.upmpulp.com/articles/pulp/20/hedging-with-wood-pulp/ [Accessed 15 June 2023].

Cortazar, G. & Eterovic, F., 2010. Can oil prices help estimate commodity futures prices? The cases of copper and silver. *Resources policy,* Volume 35, pp. 283-291.

Cox, D., 2017. What is risk?. In: *Enterprise risk management in a nutshell.* New York: Business Expert Press, pp. 1-4.

Craighead, C. W., Blackhurst, J., Rungtusanatham, M. J. & Handfield, R. B., 2007. The severity of supply chain disruptions: design characteristics and mitigation capabilities. *Decision sciences,* 38(1), pp. 131-156.

Croci, E., del Giudice, A. & Jankensgård, H., 2017. CEO age, risk incentives, and hedging strategy. *Financial management,* 46(3), pp. 687-716.

Cunha, L., Ceryno, P. & Leiras, A., 2019. Social supply chain risk management: A taxonomy, a framework and a research agenda. *Journal of cleaner production,* Volume 220, pp. 1101-1110.

de Fauconval, L., 2019. Climate change and country risk. *The RMA journal,* 101(7), pp. 54-63.

Dimiturk, P. A., 2005. Three keys to supply chain management in times of disaster. *Healthcare purchasing news,* 29(12), p. 64.

Dunn, J., 1983. Country risk: social and cultural aspects. In: R. J. Herring, ed. *Managing international risk.* New York, NY: Cambridge University Press.

Dupré, A., 2010. *Introduction to bunker credit risk.* Oxfordshire: Petrospot.

Eriksson, P. & Kovalainen, A., 2008. *Qualitative methods in business research.* Los Angeles, CA: SAGE.

Fama, E. F. & French, K. R., 1987. Commodity futures prices: Some evidence on forecast power, premiums, and the theory of storage. *The journal of business,* 60(1), pp. 55-73.

Finch, P., 2004. Supply chain risk management. *Supply chain management,* 9(2), pp. 183-196.

Freeman, R. E., 2010. *Strategic management: A stakeholder approach.* Cambridge: Cambridge University Press.

Goldsby, T. J., Griffis, S. E. & Roath, A. S., 2006. Modeling lean, agile, and leagile supply chain strategies. *Journal of business logistics,* 27(1), pp. 57-80.

Halinen, A. & Törnroos, J.-Å., 2005. Using case methods in the study of contemporary business networks. *Journal of business research,* Volume 58, pp. 1285-1297.

Hamilton, J. D. & Wu, J. C., 2015. Effects of index-fund investing on commodity ftures prices. *International economic review,* 56(1), pp. 187-205.

Hansen, C., Mena, C. & Skipworth, H., 2017. Exploring political risk in offshoring engagements. *International journal of production research,* 55(7), pp. 2051-2067.

Heljanko, E., 2014. *Viljan hintariskiä vastaan suojautuminen Suomessa,* Lappeenranta: Lappeenranta University of Technology.

Ihle, R., Bar-Nahum, Z., Nivievskyi, O. & Rubin, O. D., 2022. Russia's invasion of Ukraine increased the synchronisation of global commodity prices. *The Australian journal of agricultural and resource economics,* 66(4), pp. 775-796.

ISO/TC 262, 2009. *ISO Guide 73:2009 Risk management: Vocabulary,* s.l.: The International Organization for Standardization.

Jensen, M. C. & Meckling, W. H., 2002. Theory of the firm: managerial behavior, agency costs, and ownership structure. In: D. A. Wittman, ed. *Economic analysis of the law.* Chichester: John Wiley and Sons, Incorporated, pp. 162-176.

Johnson, L. L., 1960. The theory of hedging and speculation in commodity futures. *The review of economic studies,* June, 27(3), pp. 139-151.

Junttila, J., Myllymäki, V. & Raatikainen, J., 2018. Pricing of electricity futures based on locational price differences: The case of Finland. *Energy economics,* Volume 71, pp. 222-237.

Kim, A., 2015. Does futures speculation destabilize commodity markets?. *The journal of futures markets,* 35(8), pp. 696-714.

Kleindorfer, P. R. & Saad, G. H., 2005. Managing disruption risks in supply chains. *Production and operations management,* 14(1), pp. 53-68.

Kleindorfer, P. & Yücesan, E., 2013. Managing commodity procurement risk through hedging. *2013 Winter simulations conference (WSC),* pp. 136-146.

Kotabe, M. et al., 2008. *International marketing.* Brisbane: Wiley.

Kouvelis, P., Chambers, C. & Wang, H., 2006. Supply chain management research and production and operations management: Review, trends, and opportunities. *Production and operations management,* 15(3), pp. 449-469.

Kouvelis, P., Li, R. & Ding, Q., 2013. Managing storable commodity risks: The role of inventory and financial hedge. *Manufacturing and service operations management,* 15(3), pp. 507-521.

Krainer, A., 2019. Commodity price risk, profits, and value creation. *The journal of corporate accounting and finance,* Volume 30, pp. 83-89.

Laulajainen, R., 1995. The geographical reach of a commodity exchange: The London metal exchange and beyond. *Resources policy,* 21(2), pp. 133-141.

Lindeberg, A., 1997. Price risk management for pulp and paper - a dream come true. *Pulp and paper international,* 39(9), pp. 21-23.

Liu, X.-D., Pan, F., Yuan, L. & Chen, Y.-W., 2019. The dependence structure between crude oil futures prices and Chinese agricultural commodity futures prices: Measurement based on Markov-switching GRG copula. *Energy,* Volume 182, pp. 999-1012.

Liu, X. & Pietola, K., 2005. Forward hedging under price and production risk of wheat. *Agricultural and food science,* Volume 14, pp. 123-133.

Lönnrot, M., 2016. *Derivative hedging strategies for bitumen price risk,* Lappeenranta: Lappeenranta University of Technology.

Makkonen, P., 2014. *Hintariskeiltä suojautuminen viljakaupassa - viljatermiinit ja niiden käyttö Suomessa,* Lappeenranta: Lappeenranta University of Technology.

Malaty, R., Toppinen, A. & Viitanen, J., 2007. Modelling and forecasting Finnish pine sawlog stumpage prices using alternative time-series methods. *Canadian journal of forest research,* Volume 37, pp. 178-187.

Manera, M., Nicolini, M. & Vignati, I., 2013. Financial specnlation in energy and agriculture futures markets: A multivariate GARCH approach. *The energy journal,* 34(3), pp. 55-81.

Manera, M., Nicolini, M. & Vignati, I., 2016. Modelling futures price volatility in energy markets: Is there a role for financial speculation?. *Energy economics,* Volume 53, pp. 220-229.

Metsä Group, 2022. *Finnish pulp has a bright future.* [Online] Available at: https://www.metsagroup.com/metsafibre/news-and-publications/news-and-releases/stories/2022/finnish-pulp-has-a-bright-future/ [Accessed 15 June 2023].

Miffre, J. & Brooks, C., 2013. Do long-short speculators destabilize commodity futures markets?. *International review of financial analysis,* Volume 30, pp. 230-240.

Miller, K. D., 1992. A framework for integrated risk management in international business. *Journal of international business studies,* 23(2), pp. 311-331.

Moon, J., 2020. So, what is risk?. In: *Foundations of quality risk management.* Milwaukee, WI: ASQ Quality Press, pp. 10-12.

Moretto, A. ym., 2019. Supply chain finance: From traditional to supply chain credit rating. *Journal of purchasing and supply management,* 25(2), pp. 197-217.

Myers, R. J. & Thompson, S. R., 1989. Generalized optimal hedge ratio estimation. *American journal of agricultural economics,* 71(4), pp. 858-868.

Nason, R., 2017. What is risk?. In: *Rethinking risk management.* United States: Business Expert Press, pp. 1-12.

Ni, J. et al., 2012. A multi-stage financial hedging approach for the procurement of manufacturing materials. *European journal of operational research,* 221(2), pp. 424-431.

Oxelheim, L. & Wihlborg, G. C., 1987. *Macroeconomic uncertainty: International risks and opportunities for the corporation.* New York, NY: John Wiley & Sons.

Paul, R. K. & Bhardwaj, S. P., 2016. Econometric modeling for optimal hedging in commodity futures: An empirical study of soybean trading. *Econometric affairs (Calcutta),* 61(3), pp. 447-453.

Ramesh, K. T., Sarmah, S. P. & Tarei, P. K., 2020. An integrated framework for the assessment of inbound supply risk and prioritization of the risk drivers: A real-life case

on electronics supply chain. *Benchmarking: an international journal,* 27(3), pp. 1261-1286.

Rao, S. & Goldsby, T. J., 2009. Supply chain risks: a review and typology. *The international journal of logistics management,* 20(1), pp. 97-123.

Ritchie, B. & Marshall, D., 1993. *Business risk management.* New York: Chapman & Hall.

Ritchie, R. L. & Brindley, C. S., 2004. Risk characteristics of the supply chain – a contingency framework. In: C. S. Brindley, ed. *Supply chain risk.* London: Routledge.

Sanders, D. R. & Irwin, S. H., 2011. New evidence on the impact of index funds in U.S. grain futures markets. *Canadian journal of agricultural economics,* 59(4), pp. 519-532.

Sanders, D. R. & Irwin, S. H., 2011. The impact of index funds in commodity futures markets: A systems approach. *The journal of alternative investments,* 14(1), pp. 40-49.

Sedarage, D., Fujiwara, O. & Trung Luong, H., 1999. Determining optimal order splitting and reorder level for N-supplier inventory systems. *European journal of operational research,* 116(2), pp. 389-404.

Shubik, M., 1983. Political risk: analysis process, and purpose. In: R. J. Herring, ed. *Managing international risk.* New York, NY: Cambridge University Press.

Sihvonen, T., 2015. *Sähkönmyyntiyhtiöiden riskienhallinnan haasteet ja kehittäminen,* Lappeenranta: Lappeenranta University of Technology.

Smith, C. W. & Stulz, R. M., 1985. The determinants of firms' hedging policies. *Journal of financial and quantitative analysis,* 20(4), pp. 391-405.

Statistics Finland, 2023. *Concepts - SME.* [Online] Available at: https://www.stat.fi/meta/kas/pk_yritys_en.html [Accessed 12th June 2023].

Sutcliffe, K. M. & Zaheer, A., 1998. Uncertainty in the transaction environment: an empirical test. *Strategic management journal,* 19(1), pp. 1-23.

Ting, W., 1988. *Multinational risk assessment and management.* Westport, CT: Greenwood.

Tiwari, A. K., Khalfaoui, R., Solarin, S. A. & Shahbaz, M., 2018. Analyzing the time-frequency lead–lag relationship between oil and agricultural commodities. *Energy economics,* Volume 76, pp. 470-494.

Tufano, P., 1996. Who manages risk? An empirical examination of risk management practices in the gold mining industry. *The journal of finance,* 51(4), pp. 1097-1137.

Walton, S. V., Handfield, R. B. & Melnyk, S. A., 1998. The green supply chain: integrating suppliers into environmental management processes. *The journal of supply chain management,* 34(2), pp. 2-11.

Working, H., 1953. Futures trading and hedging. *The American economic review,* 43(3), pp. 314-343.

Wu, T., Blackhurst, J. & Chidambaram, V., 2006. A model for inbound supply risk. *Computers in industry,* 57(4), pp. 350-365.

Xue, Q., Wang, Z., Liu, S. & Chang, P., 2022. Hedging, vertical integration and firm value: Evidence from the oil and gas industry. *Fuel (Guildford),* Volume 310, p. 122349.

Zhong, H., Lin, Y. & Yip, T. L., 2022. A quantitative liability risk assessment of oil spills in oil ports: the case of the Guangdong-Hong Kong-Macao Greater Bay Area. *Maritime policy and management,* 49(7), pp. 971-989.

Zsidisin, G. A., Ellram, L. M., Carter, J. R. & Cavinato, J. L., 2004. An analysis of supply risk assessment techniques. *Internatinoal journal of physical distribution and logistics management,* 34(5), pp. 397-413.

Zsidisin, G. A., Hartley, J. L., Gaudenzi, B. & Kaufmann, L., 2016. *Managing commodity price risk: A supply chain perspective.* 2nd ed. New York, NY: Business Expert Press.

Appendix 1. Research questionnaire

Company revenue in EUR (2021) *

Yhtiön liikevaihto euroissa (2021)

- ◯ 0 - 100 million / miljoonaa
- ◯ 100 - 500 million / miljoonaa
- ◯ 500 - 1000 million / miljoonaa
- ◯ > 1000 million / miljoonaa

Primary industry *

Pääasiallinen toimiala

- ☐ Food / Elintarvikkeet
- ☐ Agriculture / Maatalous
- ☐ Metal / Metalliteollisuus
- ☐ Forestry / Metsäteollisuus
- ☐ Muu: _____

Does your company use commodity derivatives to hedge market risk? *

Käyttääkö yhtiönne hyödykejohdannaisia markkinariskiltä suojautumiseen?

- ◯ Yes / Kyllä
- ◯ No / Ei

If yes, do you hedge sales or purchases?

Jos kyllä, suojaatteko myyntejä vai ostoja?

- ◯ Sales / Myynti
- ◯ Purchases / Osto
- ◯ Both / Molemmat

Appendix 1. Research questionnaire

Which business function is responsible for creating and executing your company's commodity derivative trading strategy?

Mikä liiketoiminto on vastuussa yhtiönne hyödykejohdannaisten treidausstrategian luomisesta ja toimeenpanosta?

- [ ] Top management / Ylin johto
- [ ] Finance / Talous
- [ ] Specific commodity derivative team / Erillinen hyödykejohdannaistiimi
- [ ] Cross-functional team / Toimintojen välinen yhteistyöryhmä
- [ ] Sourcing/purchasing / Hankinta/ostotoiminto
- [ ] Sales / Myynti
- [ ] Muu: _____

How many people are responsible for creating and executing your company's trading strategy?

Kuinka monta vastuuhenkilöä yhtiönne treidausstrategian luomisella ja toimeenpanolla on?

- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ More than 5 / Yli 5

Appendix 1. Research questionnaire

Besides your company's main area of production, does your company hedge other supporting commodities such as fuel, energy or currency with derivatives?

Yhtiönne päätuotantosuunnan lisäksi suojaako yhtiönne johdannaisilla muita hyödykkeitä kuten esimerkiksi polttoaineet, energia tai valuutta?

- [ ] Fuel / Polttoaineet
- [ ] Energy / Energia
- [ ] Currency / Valuutta
- [ ] None / Ei mitään
- [ ] Muu:

Which instruments does your company utilize for hedging purposes?

Mitä johdannaisinstrumentteja yhtiönne käyttää suojaustarkoitukseen?

- [ ] Futures / Futuurit
- [ ] Options / Optiot
- [ ] Customized over-the-counter (OTC) products / Muokatut erikoistuotteet (OTC)
- [ ] Muu:

How well do currently available commodity derivatives apply to your company's hedging needs in terms of the derivatives' product specification? (1 = very poorly, 5 = very well)

Kuinka hyvin nykyisin saatavilla olevat hyödykejohdannaiset soveltuvat yhtiönne suojaustarpeisiin johdannaisten tuotemääritelmien osalta? (1 = todella heikosti, 5 = todella hyvin)

1	2	3	4	5
○	○	○	○	○

Appendix 1. Research questionnaire

How well do currently available commodity derivatives apply to your company's hedging needs in terms of the marketplaces' geographical location? (1 = very poorly, 5 = very well)

Kuinka hyvin nykyisin saatavilla olevat hyödykejohdannaiset soveltuvat yhtiönne suojaustarpeisiin markkinapaikkojen maantieteellisten sijaintien osalta? (1 = todella heikosti, 5 = todella hyvin)

1	2	3	4	5
○	○	○	○	○

In your opinion, how well formulated is your company's commodity derivative trading strategy and execution? (1 = very poorly, 5 = very well)

Kuinka selkeästi yhtiönne hyödykejohdannaisten treidausstrategia ja strategian toimeenpano yhtiössänne on mielestänne järjestetty? (1 = todella heikosti, 5 = todella hyvin)

1	2	3	4	5
○	○	○	○	○

Does your company use commodity derivatives for speculation on the markets? *

Käyttääkö yhtiönne hyödykejohdannaisia markkinaspekulaatioon?

- ○ Yes / Kyllä
- ○ No / Ei

Appendix 2. A selection of commodity exchanges and derivatives

EXCHANGE	CATEGORY	DERIVATIVE PRODUCTS
Chicago Mercantile Exchange (CME)	agriculture / food	corn, wheat, soybean, soybean meal, soybean oil, oats, rice, live cattle, lean hog, feeder cattle, pork, milk, whey, butter, cheese, urea
	energy	crude oil, gasoline, natural gas, carbon credits
	metals	gold, silver, platinum, palladium, aluminum, copper, zinc, lead, steel, iron ore, steel scrap
	woods	lumber
EURONEXT	agriculture	corn, wheat, rapeseed
Japan Exchange Group (JPX)	agriculture	corn, soybean, red bean, rubber
	energy	crude oil, gasoline, kerosene, gas oil, electricity, natural gas
	metals	gold, silver, platinum, palladium
London Metal Exchange (LME)	metals	aluminum, copper, zinc, lead, nickel, tin, steel, steel scrap, lithium, cobalt, molybdenum, platinum, palladium
Intercontinental Exchange (ICE)	agriculture / food	canola, cocoa, coffee, cotton, sugar, orange juice
	energy	crude oil, gas oil, natural gas, coal, electricity, ethane, carbon credits, butane, gasoline, heating oil, propane
	metals	gold, silver
Johannesburg Stock Exchange (JSE)	agriculture	corn, wheat, soybean, sorghum
	energy	crude oil, diesel,
	metals	gold, silver, copper, platinum
Shanghai Futures Exchange (SHFE)	metals	copper, aluminum, steel, gold
	energy	crude oil, fuel oil, bitumen
	agriculture	rubber
	woods	woodpulp
B3 (Brazil)	agriculture / food	corn, soybean, live cattle, sugar, coffee

Appendix 2. A selection of commodity exchanges and derivatives

	metals	gold
	energy	ethanol
Dalian Commodity Exchange (DCE)	agriculture / food	corn, corn starch, soybean, soybean meal, soybean oil, palm oil, eggs, rice, live hog
	energy	coke, coal, liquid petroleum gas
	metals	iron ore
	woods	fiberboard, blockboard
	industrials	PVC, ethylene glycol, ethenylbenzene
European Energy Exchange (EEX)	agriculture / food	potato, butter, milk, milk powder, whey
	energy	natural gas, carbon credits, power