

# Risk management in feed costs

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*Development of a financial product to hedge the price changes of compound feed products for livestock farmers*



Master Thesis  
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## Foreword

As part of my master program, this thesis represents the final assignment for the master Financial Engineering and Management of the University of Twente. On behalf of ABN AMRO Bank N.V. I did research in the development of a new risk management product for intensive livestock farmers to reduce the price risk of compound feed. The proposed structure for this product is new to the agricultural sector and can be applied, if successful, to other types of risks products.

During this research, I was located at the department of Agricultural Companies of ABN AMRO. First, I would like to thank all members of this department and specially my supervisor Wilbert Hilkens in giving their support to my research. I thank the farmers and others that I have interviewed. They gave valuable external input to the research. I want to thank all other employees of ABN AMRO who assisted me in conducting my research.

Finally, I would like to thank Emad Imreizeeq and Berend Roorda, my supervisors from the University of Twente, for their quick assistance during my internship.

Gerlof Bergmans

Amsterdam, September 2008

## Management Summary

The increase in fluctuation in the feed prices for livestock farmers motivated ABN AMRO Bank N.V. to research the possibility to develop a new risk management tool. For the Farmers, feed costs represent 50% to 65% of the total costs. A new tool for compound feed will give the farmer the opportunity to hedge the risks of price changes. Several possibilities for a new product are researched, giving three concrete options.

(Original management summary excluded from public version)

# 1. Introduction: Scope and Outline of the Study

## 1.1. Preface

*'The farmer has to be an optimist or he wouldn't still be a farmer.'* [Rogers]

Every entrepreneur has to be aware of the risks (s)he takes. The cash flows of the company will reflect the consequences of taking certain risk positions. The agricultural sector is known for the many different risks farmers run (e.g. weather, seed costs, feed costs, sales prices, etc.). The research conducted in this study focuses on the risk livestock farmers have towards the price of compound feed products. This study is an initiative from ABN AMRO Bank N.V. (AAB) to reduce risks in the agricultural sector. The quote of Will Rogers gives a nice indication about the kind of entrepreneurs we are dealing with in this sector.

## 1.2. Motivation / Scope of Research

The increase in fluctuations in the price of compound feed products in 2007 made the management of risk in feed costs more important for livestock farmers. ABN AMRO recognizes an opportunity to help livestock farmers manage that risk by developing a new financial product.

Before developing a financial product, the market requires research. This research clarifies the requirements that potential clients have towards a financial product. These demands combined with the criteria of ABN AMRO give restrictions to the design.

Full understanding is required regarding the underlying. Compound feed products are not listed on an exchange. This makes the technical aspects of the new product and underlying a challenge. The technical challenge combined with the requirements from buyers and seller will determine whether it is possible to develop that financial product.

## 1.3. Objective

We formulate the objective of the research in two parts [Verschuren & Doorewaard, 1995].

*The development of an attractive, sellable financial product for livestock farmers  
by  
researching the demands of the market and ABN AMRO,  
and developing a model for the prices of compound feed products.*

This objective contains the core concepts of the research scope.

## 1.4. Research Questions

We define the problem in a central research question that contains the core concepts. The central question is similar to the research objective.

*How can we develop a financial product that:*  
*1) hedges the price of (frequently used) feed products*  
*2) meets demands of potential clients and*  
*3) is sellable by ABN AMRO?*

We divide the central question in four sub questions.

- What are the demands of potential clients and how do they affect the design of a financial product?
- What criteria does a product have to suffice before it can be sold and how does this affect the design?
- How can we model the price of feed products adequately?
- How can we turn the price model into a financial product that suffices all the criteria?

The research will be restricted to:

- the most important potential customers, pig farmers and poultry farmers in the Netherlands;
- developing a standardized product that will have to cover the price risk of most compound feed products.

The analytics in the report are mostly focussed on feed for fattening pigs or pig farmers. In these cases, conclusions can be generalized for other types of feed or farmers. To keep the report readable we only include these analyses.

## 1.5. Method

Figure 1 views the research model we use. The objective consists of four parts. The first two parts are concerned with acquiring the criteria the financial product has to fulfil. The third part researches the behaviour of the underlying; compound feed products. The last part contains the technical aspects that are required to model the price of compound feed products and designing the product.



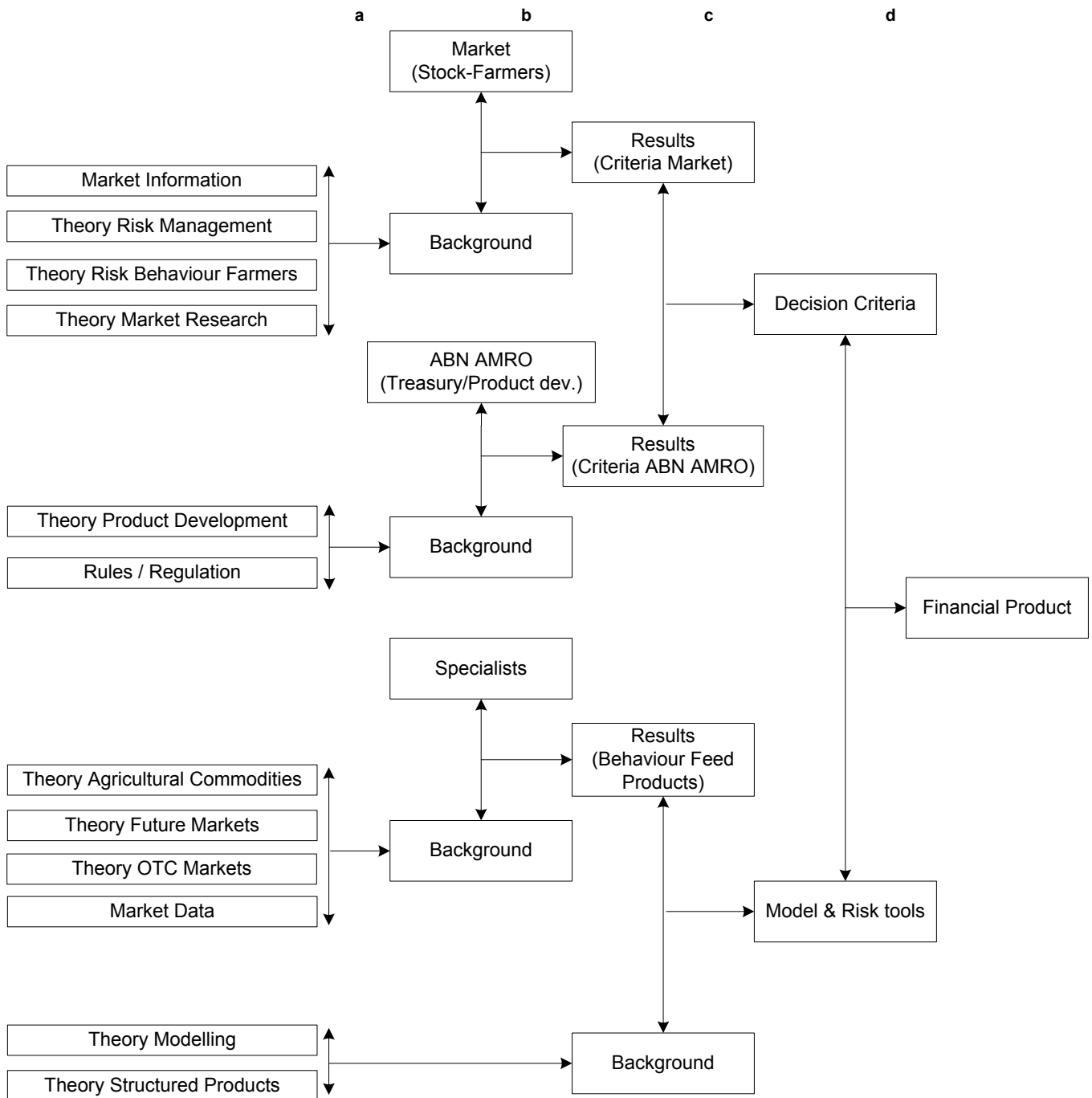


Figure 1: Research model

## 1.6. Reading Guide

When we look vertically at the research model, we can identify four stages (Figure 1). The first stage (a) is acquiring literature and information to form a background on the different topics (Chapter 2 & 3). In the second stage (b) the background is used in interviews with key actors like potential clients and players in the supply chain (Chapter 4). The third stage (c) contains the analyses of all the information to get decision criteria and a model (Chapter 4 to 7). The results are used in the fourth and final stage (d) for the development of the financial product (Chapter 7 and 8).

## 2. The Market

### 2.1. Preface

This chapter describes the market of compound feed. To give an overview of this market, Figure 2 displays the supply chain. First, we describe the backgrounds of the main actors. Then we discuss the characteristics of compound feed and in the last subsection we give an overview of the market of the most relevant soft commodities.

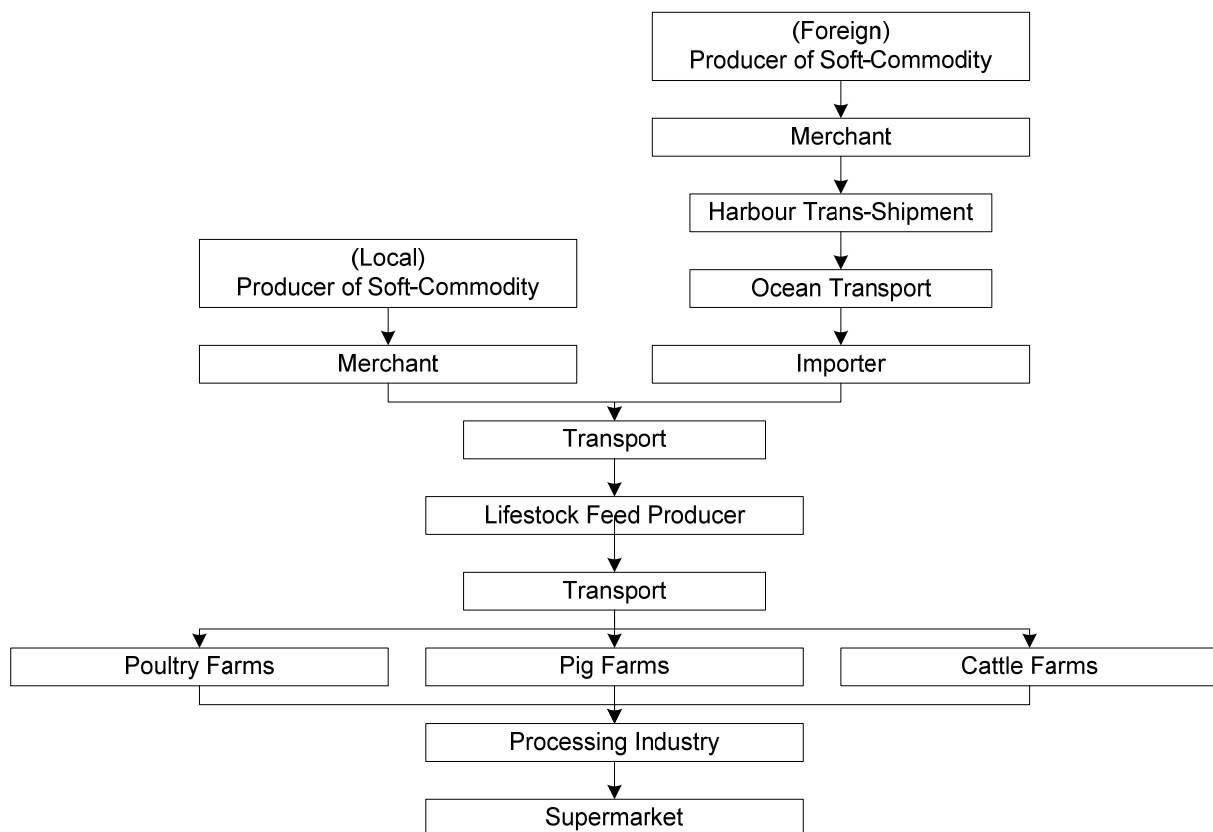


Figure 2: Supply chain

## 2.2. Relevant Actors

### 2.2.1. Compound Feed Manufacturers

In the Netherlands, there are around 130 producers of compound feed, where in 2004 only 10 manufacturers produced over 100,000 tons [Productschap Diervoeder, 2004]. In 2007, the total market size was 13.4 million tons. The five largest manufacturers in 2007 are De Heus, Cehave landbouwbelaag, Hendrix UTD (Nutreco), For Farmers and Agrifirm.

The industry is able to make higher profits despite of the high prices of ingredients [Horst, 2008]. This is due to takeovers and higher efficiency in production. They also benefited from fixing the prices of their raw materials. Competition is strong in the market. For the farmer this competition is positive, because it can deliver extra discounts from their current or new supplier [Horst, 2008].

### 2.2.2. Farmers

Over the last 10 years, the number of intensive stock farms decreased with 44% [CBS, 2008]. A decrease in pig farms is the main cause. The company size increased since the total number of held animals remained stable. Companies nowadays are higher financed, making them more dependent on cash flows and thereby market prices.

With a production value of EUR 2.2 billion in 2005, pig farms are an important economic sector in the Netherlands. In 2006, there were 4,000 specialised farms producing 75% of the national production. The other 25% is produced by another 5,000 companies [LEI, 2008]. Poultry farms are, with a total production value of EUR 800 million in 2005, a smaller sector. Poultry farms are diversified in laying hen farms and poultry for slaughter, broilers [LEI, 2008].

Figure 3 publishes an overview of the consumers of compounded feed. The main users are pig farms, poultry farms and cattle farms. A total of 5.9 million tons are used by pig farms in 2007 and 3.7 million ton by poultry farms [Fefac, 2008]. For cattle farms, compound feed is not the only source of feed. They produce grass for the livestock themselves, which reduces the impact of price changes in compound feed.

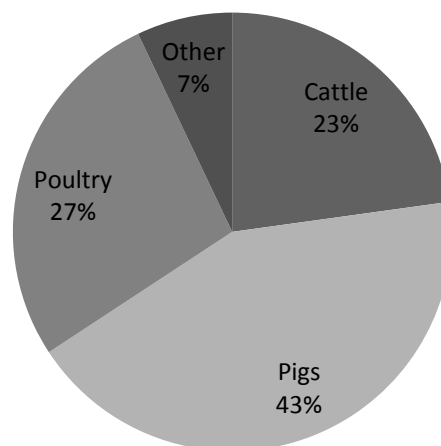


Figure 3: Compound feed users

Poultry farmers are the most dependent on the prices; 65% of their production costs are feed cost. A change in price of compound feed has large effect on the profits. Pig farmers spend 50% of their production cost on feed. For pig farmers the price of feed has increased with 33%<sup>1</sup> in 2007 [LEI, 2008].

<sup>1</sup> Average increase in price in 2007 of feed for bearing sows, sows in lactation, baby piglets, young fattening pigs and fattening pigs.

### 2.2.3. ABN AMRO Bank N.V.

This part contains a description of ABN AMRO N.V. and their position in the market of livestock farmers.

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## 2.3. Compound Feed Products

To meet the demands of the market, feed manufacturers produce dozens of different compound feed products. Through increased efficiency, livestock farmers use specific compound feed products that help their livestock grow or produce optimally (e.g. production of meat, milk, eggs). Every animal and every growing phase needs different basis ingredients, nutrients and additives.

The main elements of compound feed are energy, proteins, vitamins and minerals. Grains are the main ingredient for the energy component and soymeal for proteins. A compound feed product is established by blending several ingredients (e.g. wheat, soymeal and corn) in such a way that the blend contains the quoted nutrients of the product. Since several ingredients contain overlapping nutrients, the mix can vary. Manufacturers are flexible in changing this mix to produce the mix at the lowest price. By dynamic programming, the optimal combination is calculated without harming the content, taste and texture. This optimization problem is known as the blending problem.

LEI, the Agricultural Economic Institute, publishes every month the average price of more than 30 compound feed products. LEI is an independent organisation and part of Wageningen University. The feed prices are established by taking a weighted average of quoted prices of feed manufacturers. Figure 4 displays the increase in price of the most used products.

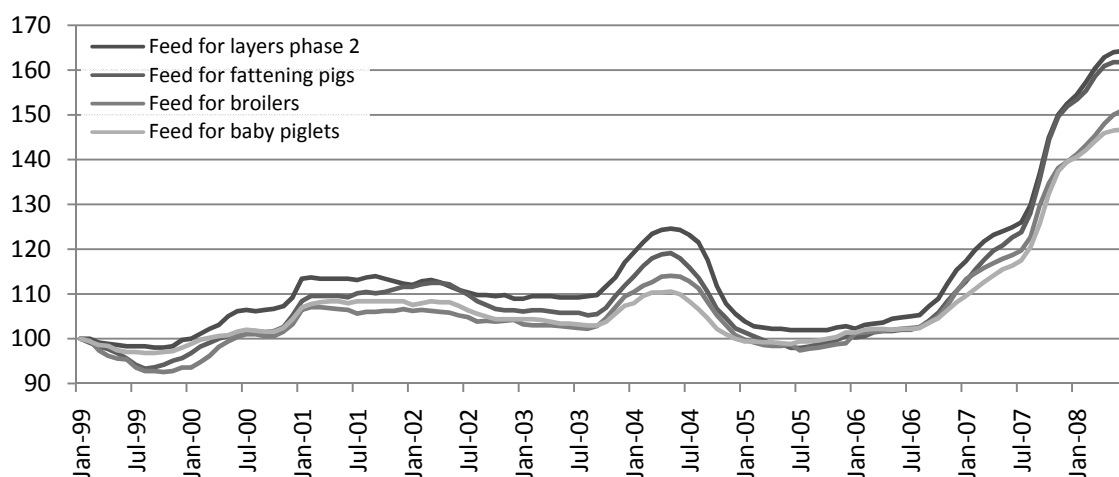


Figure 4: Monthly prices index of common compound feed products (Jan-99 = 100)

The cost of the ingredients is the main factor that determines the price. Since the soft-commodities grains and oilseeds form the largest part of the ingredients, they have the largest influence. Transportation costs are also an important factor, including transportation from the harbour to the factory as well as transportation to the farmer. Third and last factor are production costs of compound feed.

Feed manufacturers take positions in futures (delivery) contracts for their ingredients. These positions dampen price movements of compound feed products. Interviews with manufacturers gave insights in their positions. In a business neutral model, all manufacturers take the same purchasing positions. Large cooperative manufacturers are leading, given that they have to return their results back to their clients. The purchasing positions reduce volatility of compound feed products in comparison with the ingredients with a factor 5<sup>2</sup>.

## 2.4. Soft-commodities

Soft-commodities are produced and traded all over the world. The most important types for compound feed are grains (wheat, barley, corn) and oilseeds (soybeans, rapeseeds). The world grain production in 2007 is 1.66 billion tons [International Grains Council, 2008]. Largest producer are USA and China. Largest exporters are the USA and Argentina.

Due to high oil prices, bio-fuels have increasing impact on the production of soft-commodities in the world. Corn is one of the crops used for ethanol. The production of ethanol in the USA is expected to increase rapidly due to new factories, to 114 billion litres in 2020 [Matt, 2008]. In 2007, 25 billion litres are produced requiring 86 million tons of corn. This is 25% of the production of corn in the USA, 11% of the production worldwide [RFA, 2007] [EIU, 2007]. Globally, 50 billion litres of ethanol is produced using also sugar canes as crop.

The stocks of grains in the world have decreased over the last years through poor harvests and increase in use of crops for bio-fuels. For the first time since 1977, the EU expected to have no grain safety stocks in the beginning of 2008 [DCA, 2008]. This shortage changed the market from supply orientated to demand orientated. Consequences of this change are the higher fluctuations in price of the soft-commodities. When safety stocks increase, the market will be again supply orientated.

Figure 5 plots this increase of prices over the last 8 years.

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<sup>2</sup> Volatility feed for fattening pigs in period 2003 to 2007 3.3% and from (Dutch) wheat 15.7%.

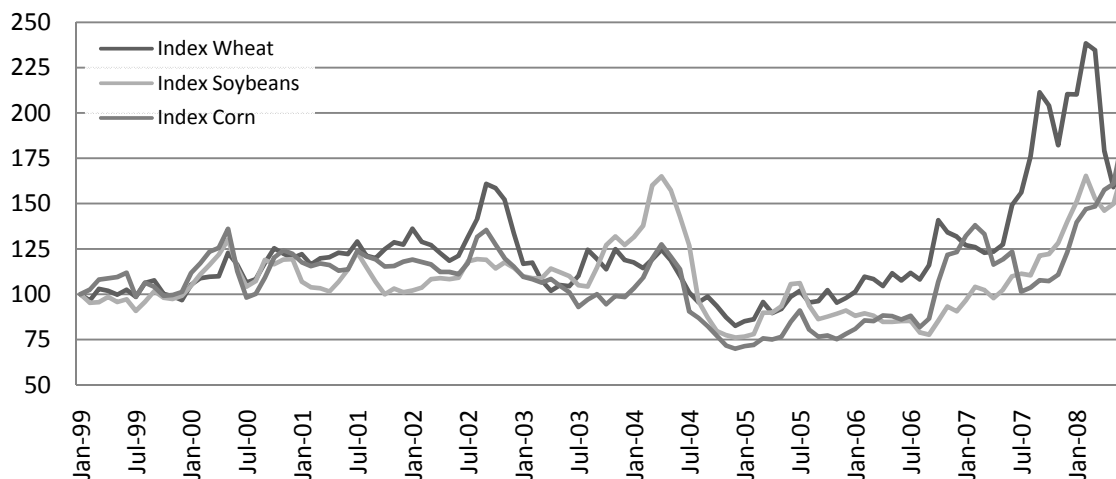


Figure 5: Monthly price index of corn, soybeans and wheat during the last 8 years (Jan-99 = 100)<sup>3</sup>

Soft-commodities are traded on numerous local markets. There are a few larger exchanges, with the Chicago Board of Trade (CBOT) being the most liquid futures market. In Europe, Euronext has a futures market in London (LIFFE), which includes the former exchange in Paris (MATIF). Hannover (RMX) is the largest exchange on the mainland. The RMX has on average a volume of 10 trades per security per day, making it illiquid for larger trades. A big disadvantage of these futures exchanges is that the settlement is often based on physical delivery.

Most markets of soft-commodities are illiquid, resulting in difficulties for traders. Parties that trade on these markets without the goal of physical settlement take increasing risks of settlement when their contract approaches maturity. This risk can lead to extra costs when contracts have to be sold instantly. For a new financial product, with soft-commodities as underlying, the characteristics of the market are important. First, the supplier of a new product, ABN AMRO, has no interest in physical delivery or illiquidity risks related to it. Second, the underlying of the futures contracts has to have a good fit with the characteristics of compound feed. Lastly, macro factors like politics can influence prices on foreign markets, resulting in a poor connection with local products.

<sup>3</sup> Plot made of the most liquid futures traded on CBOT. Corrected for currency and trading unit.

### 3. Risk

#### 3.1. Preface

This chapter discusses risk and risk management in the agricultural sector. First, we identify the different types of risks faced by a typical farmer. Then we explore the risk attitude and risk perception of farmers. In the last subsection, we describe the tools that are available for risk management which are interesting for the development of the new product.

#### 3.2. Types of Risk

Hardaker divides the risks in agricultural sector in six main groups [Hardaker et al, 1997].

- Production risk
- Price or market risk
- Institutional risk
- Human or personal risk
- Third-party risks
- Financial risks

Risks are assessed using two important aspects: the frequency of the occurrence of a risk and the risk impact. Depending on those aspects, a company can chose a risk management strategy (Table 1).

	<i>Frequency</i>	High	Low
<i>Impact</i>			
High		Avoid Risks	Transfer Risk
Low		Internal Risk Management	Unimportant

*Table 1: Risk strategies*

The risk on feed prices is qualified as a price or market risk. To assess the risk in feed, the main cash flows of a pig farmer are plotted in Figure 6. Feed seems not as risky as the meat prices or the prices of piglets. Prices were stable the last twenty years Commodity prices did not fluctuate heavily, because feed manufactures dampen the price with their purchasing positions. Still the increase in price of feed of the since 2006 had large effect on the income of pig farmers.

The frequency of the risk is hard to quantify. In the eighties, prices peaked as well. For the future, players in the supply chain expect more and extreme fluctuation, from which we conclude that the frequency is average to high. The impact is high, because feed costs are the main costs of a livestock farmer. As shown in Figure 7, the margin per pig place is decreased by EUR 20.00 from July 2007 due to feed<sup>4</sup>. According to Table 1 this risk should be avoided or, when frequency is lower, transferred.

<sup>4</sup> Figure 7 plots the gross margin for one fattening pig place when feed prices are variable and fixed from 2002.

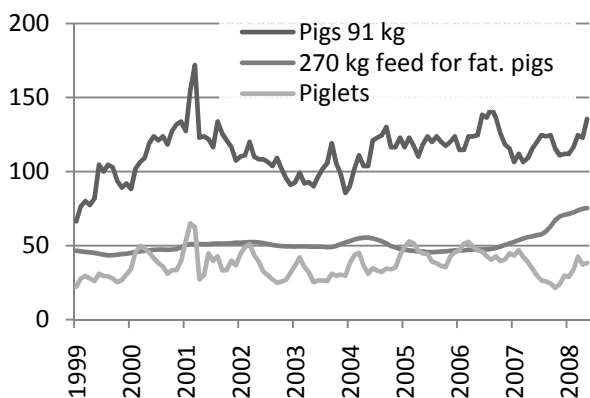


Figure 6: Prices per unit for a pig farmer in EUR [LEI, 2008]

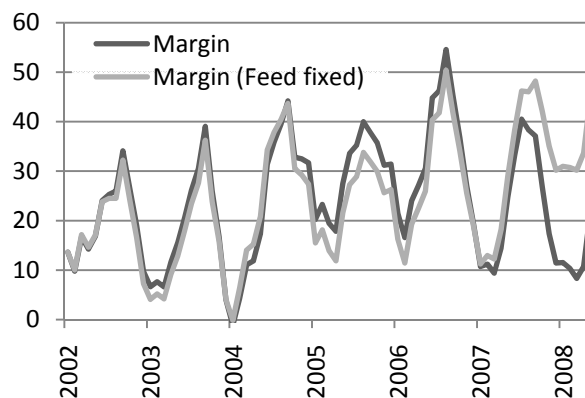


Figure 7: Margin per unit for a pig farmer in EUR

### 3.3. Risk Attitude

LEI does research on risk management by studying the risk behaviour of farmers and by examining the risk attitude and risk perceptions [Baltussen et al, 2006]. Risk attitude determines whether someone is risk seeking, risk neutral or risk averse. Pennings and Garcia concluded that the risk attitude of farmers influence their adaptation of risk management practices [Pennings & Garcia, 2001]. According to Baltussen et al, farmers are in general risk averse, meaning that they should be willingly to trade returns for less risk.

Based on research of ABN AMRO, 62% of the pig farmers have attention for risk-management [ABN AMRO, 2008]. They made the conclusion based on the survey that pig farmers have large interest in hedging risk on feed costs. In another survey, half of the respondents find it interesting to have tools to hedge their price risk on feed (Table 2) [Agridirect, 2006]. From interviews with farmers we will develop a better view on the specific attitude towards risk in feed prices.

*Would you find it interesting for yourself to have the opportunity to protect the price that you pay for feeding products against price fluctuations?*

	Pigs 50-100 NGE		Pigs >100 NGE		Total	
	Number	%	Number	%	Number	%
Yes	22	46.0	28	51.9	50	49.2
No	23	48.0	22	40.4	45	43.9
Other	3	6.0	4	7.7	7	6.9
Total	47	100.0	55	100.0	102	100.0

Table 2: Survey Agridirect



### 3.4. Risk Perception

Risk perception is about the subjective feeling regarding risk. Every farmer has an individual feeling about the probability of losses. The way a person evaluates information influences the perception. How humans evaluate information is based on several heuristics [Kahneman et al, 1982]. These heuristics are important when developing a risk product.

- The Availability heuristic  
Events that can be more easily brought to mind or imagined are judged to be more likely than events that could not easily be imagined.
- The Anchoring heuristic  
People will often start with one piece of known information and then adjust it to create an estimate of an unknown risk. This adjustment will usually not be big enough.
- Asymmetry between gains and losses  
People are risk averse with respect to gains, but people will be risk-seeking about losses, preferring to hope for the chance of losing nothing rather than taking a sure, but smaller, loss (e.g. insurance).
- Threshold effects  
People prefer to move from uncertainty to certainty more than making a similar gain in certainty that does not lead to full certainty.

The threshold effect is the most important aspect for developing the financial product. Because price of feed is farm specific, the new product will never hedge the risk completely. Hence, the risk tool has a disadvantage regarding risk perception.

### 3.5. Risk Management

In this section we describe the tools that are available for risk management and which are interesting for the development of the new product.

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## 4. Market Research

Market research is the process of systematically gathering, recording and analyzing data about customers, competitors and other actors in the market [Pride et al, 1999]. In 2007 Bradley published the Marketing Research Mix (MRX), a framework to design marketing research [Bradley, 2007]. The structure of four P's is comparable with the Marketing Mix of Neil Borden [Borden, 1964], which is used to set a product in the marketplace. The four P's of the MRX stand for Purpose, Population, Procedure and Publication.

First, we will use the MRX to setup the market research and setup an interview. We analyse the interview and discuss the risk attitude and perception of farmers. Finally, the market information is transformed in product development criteria.

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## 5. Product Development

### 5.1. Preface

In this chapter, we focus on product development. First, we discuss how a new product can be structured. Then we examine the already developed products. The unsuccessful elements of the specific developed products are important input for our development. From the development process, the criteria of ABN AMRO are deducted.

### 5.2. Methods of Product Development

#### 5.2.1. Structuring Derivatives

The investment opportunities that can be created by structuring derivatives are almost unlimited. Derivatives are tools to manage exposure to a large variety of risks [Kat, 2001]. Existing derivatives, like futures contracts and options, can be used as building blocks to design a new product. This approach is called the 'Lego' approach and is much easier than designing a new product.

By combining derivatives, cash flows are combined. Cash flows are payments from one counterparty to another and characterized by the amount to be exchanged and the date of exchange. Kat describes a 5 step procedure to structure derivatives [Kat, 2001].

- Step 1: Identify the relevant payment dates and reference indices.
- Step 2: Link the cash flows on the payment dates to the reference indices in such way that the problem at hand is solved.
- Step 3: Add additional rights and/or restrictions if required.
- Step 4: Package everything into a single contract.
- Step 5: Ask a derivative firm to quote a price for the contract.

Hedging a product based on soft-commodities is easy. By having position in the individual building blocks, the futures contracts, the exposure of ABN AMRO towards farmers can be covered 100%. Some factors can differ between the developed contract and the building blocks. Size differences can lead to hedge errors. Liquidity can form a problem in trading the building blocks at accurate prices.

#### 5.2.2. Over-the-Counter

Over-the-Counter (OTC) contracts are transactions that are closed directly between two parties. In contrast with exchange trading there is no open listing for those contracts and no central party that facilitates the trade. Big advantages of OTC trading are the freedom in contract specifications and the lower transaction costs. All parties in the OTC market have to agree upon the contract specification (e.g. the reference, payout structure). Disadvantage is the extra risk in the trade (e.g. payments, delivery, bankruptcy). These risks of the counterparty are for the trading parties and not for a central party. Another potential disadvantage can be the anonymity of the parties. For OTC derivatives,

these trades are usually governed by an International Swaps and Derivatives Association agreement.

The price of an OTC contract dependent on the price a counterparty wants to offer. Prices are calculated based on risk models of the cash flows of the contract used by the counterparty. Dependent on the model and parameters that are used different prices can be offered by different counterparties. For hedging risks OTC, at least two counterparties are required. This way prices can be compared, choosing the best. For ABN AMRO pricing is not essential; they are bounded to the price offered by counterparties.

### **5.2.3. Exchange listed product**

An exchange-listed product is accessible by everybody with an investment account. This makes the risk tool independent of a financial institute, reaching buyers that have accounts at other banks, covering a bigger market. Before a product can be listed, it has to satisfy several requirements of the exchange. Such conditions can include minimum number of contracts outstanding, minimum total value and minimum trade volume.

## **5.3. Developed Structured Products**

### **5.3.1. Turbos**

The Turbo is a certificate developed by ABN AMRO and listed on Euronext. Turbo certificates are exchange listed investment products and issued on a great range of markets. They can be used to participate in rising markets (long) and falling markets (short). The main difference between Turbo certificates and ordinary futures contracts is the leverage feature, created by a finance level. Advantages of Turbos are that the buyer has no margin requirement, low capital outlay, protection by stop-loss level and easy to access.

For soft-commodities like soybeans and wheat, several Turbo certificates are available. The certificates are based on futures traded on the CBOT. Because the underlying is rolled over, the Turbos have no time constraint. The size of the underlying of a Turbo is only 10 bushels. This small size makes it accessible for smaller parties. On futures, Turbos also have a leverage feature. On this level of finance, 2% costs are calculated. Interest is not paid since this is settled in the forward price.

In theory, Turbos can be used to hedge the risk on feed. To take a position in Turbos Long of soft-commodities like soybeans and wheat, the biggest risk is covered. When feed is bought, Turbos are sold. There are two main disadvantages of using Turbos. First, the stop-loss element makes the lifetime uncertain. Second, rolling the futures makes the underlying unclear. Therefore, Turbos cannot be used for a price hedge.

### **5.3.2. Warrants**

Warrants are OTC derivatives that are comparable to options. Key difference is the issuing party. The company who issues them can only write a warrant. The lifetime is in general longer than options; years instead of months and they are not as standardised as all exchange-listed options are. ABN

AMRO does not issue warrants on soft-commodities. Société Générale for example has issued some wheat and soybean warrants.

Just like Turbos it is theoretical possible to use warrants for hedging. For compound feed, warrants based on futures of wheat and soybeans can be used, or by creating a warrant on a better underlying. For creating a Turbo or a Warrant, the underlying must be clear and tradable. When it is tradable, prices of the Turbo or Warrant will match the price of the underlying, since the market has tools to correct it to the real value.

To issue warrants large volumes are necessary. The issuing party needs to cover exposure by taking position in the underlying. This underlying must be a tradable asset like an index or a stock. Also high volumes are required to receive listing on an exchange.

### **5.3.3. *Specific Developed Products***

This paragraph describes three products that are specifically developed to hedge some sort of risk.

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## **5.4. Process**

This paragraph describes the process of product development.

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## **5.5. Criteria ABN AMRO**

We summarise the criteria of ABN AMRO towards a new financial product in this paragraph.

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## **6. Agricultural Markets**

In this chapter, we elaborate on the agricultural markets as already described briefly in chapter 3. LEI registers the agricultural prices every month. They do this for a great period, giving an useful overview of historical prices. We use these prices to examine the Dutch commodity market. Then we discuss the futures market and finally we elaborate further on compound feed.

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## **7. Risk Tools: Basket of Futures & OTC**

In this chapter, we structure the new risk product. When hedging risk the hedge instrument usually fails to match the exposure in terms of expire, underlying asset, or both [Sercu & Xueping, 2000]. We distinguish several reasons for this mismatch called basis risk.

Next, we develop three options to hedge the price of compound feed.

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## **8. Feasibility**

In chapter 7, three possible risk products are developed for hedging price risk in feed. We assess the feasibility of those options in this chapter.

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## **9. Conclusions and Recommendations**

In this report, we researched the possibility to develop a risk tool for livestock farmers to hedge their price of feed. In this chapter, we draw conclusions and give recommendations.

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## **Appendix**

(Excluded from public version)