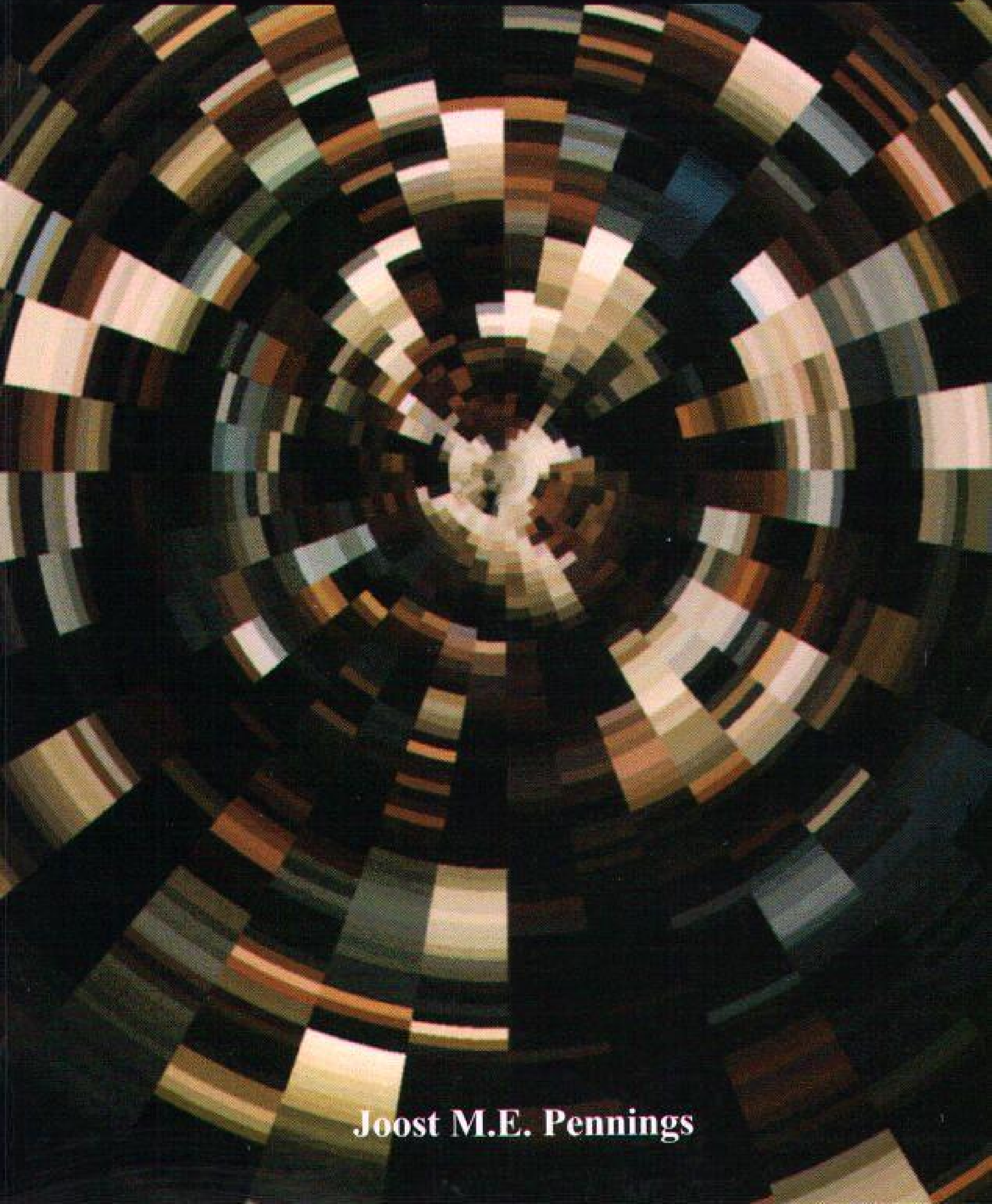
he Market for Hedging Services: A Marketing - Finance Approach

with special reference to rights futures contracts



Joost M.E. Pennings

STELLINGEN

Behorende bij het proefschrift

The Market for Hedging Services: A Marketing-Finance Approach

1. De verschillen in de wijze waarop de handel in termijncontracten plaatsvindt zijn terug te voeren op het verschil in de informatie die wordt gegenereerd.

2. Handelsvolume is een slechte maatstaf voor het vergelijken van het succes van termijncontracten.

3. Het is niet altijd mogelijk te zeggen dat termijnmarkt A meer liquide is dan termijnmarkt B, aangezien liquiditeit uit verscheidene dimensies bestaat. *Dit proefschrift*

4. Aan de huidige belangstelling voor de "ketenkunde" kan tegemoet gekomen worden met de reeds lang in de marketing aanwezige literatuur, in het bijzonder de *channel and distribution literature.*

5. Naarmate de hedging service van de termijnmarkt beter wordt afgestemd op de wensen van de gebruikers, zal de behoefte aan verticale integratie afnemen.

6. Het tijdstip van introductie van nieuwe termijncontracten is een belangrijke factor in het welslagen van het contract, vanwege de betekenis van het prijsniveau van het termijncontract in relatie tot de psychologische referentie prijs in de besluitvorming van de potentiële hedger. *Dit proefschrif*

7. De grootste concurrentie voor een termijnmarkt komt niet van die andere termijnmarkt maar van andere prijsrisico management instrumenten.

8. Voor de marketeer van een agrarische termijnmarkt is de moeilijkste opgave niet de landbouwer tot daadwerkelijke plaatsing van een order te bewegen, maar het instrument termijncontract geïncorporeerd te krijgen als wezenlijk element in de bedrijfsvoering van de landbouwer. Dit proefschrift

9. De makelaar op de termijnmarkt is het gezicht van de termijnmarkt en bepaalt daarmee voor een belangrijk gedeelte het succes van het termijncontract.

10. De onafhankelijkheid van de wetenschapper ten opzichte van het bedrijfsleven is in het grootste belang van het bedrijfsleven.

11. In het geval dat termijncontracten het aantal vrijheidsgraden van de landbouwer vergroten en daarmee de mogelijkheden tot zelfstandig ondernemerschap verruimen, wordt de attitude van de boer jegens de termijnhandel positiever (minder negatief). *Dit proefschrift*

12. Termijnmarkten hebben de neiging een overmatig belang te hechten aan de specificatie van het termijncontract, daarbij het belang van de *convenience needs* van de klanten onderschattend. *Dit proefschrift*

13. Een betere uitwisseling van ideeën en samenwerking tussen marketeers en financieel economen is een *low-risk/high-return investment* voor de bedrijfswetenschappen.

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Joost M.E. Pennings

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Conference), Chicago Board of Trade Research Symposiums and several other meetings and seminars. The comments made by participants on the papers I presented on these congresses and seminars have contributed to my PhD thesis.

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Contents

CHAPTER 1

Scope and Outline of the Study

1.1 Introduction

Entrepreneurs in the food and agribusiness run price risks on their stocks of inputs and outputs. To cover these price risks, several price risk management instruments are available, such as cash forward contracts, options and futures contracts. In this study we focus on the latter. Futures markets are characterized by well organized trading methods with a standardization of terms, resulting in widespread and low-cost access of buyers to sellers and great integrity of the contract.

Agricultural futures markets are and have been very important institutions in commodity pricing. These markets have been prominent in the United States for more than a century. Recent changes within the Common Agricultural Policy (CAP) of the European Union, as part of proposed reductions in financial support for agricultural products, have stimulated price volatility for agricultural raw materials, increasing price risks for both the primary agricultural producer and the agricultural industry. For a risk averse farmer or manager of an agribusiness company, an increased price volatility on the markets for agricultural raw materials will increase the need for price risk management instruments, such as futures markets.

Not only does a reduction of agricultural price support create a new dynamism in existing agricultural futures markets, it also advances the introduction of entirely new types of futures contracts. Furthermore, new market developments, such as the introduction of production rights, may stimulate the development of new futures contracts. The latter development will be analysed in more detail in this study. The European Union has introduced many different production rights, such as sugar rights, starch rights and of course the widely known milk rights. Only when a farmer possesses production rights, is he allowed to produce the underlying product. Next to production rights, an important role in agriculture seems now reserved for environmental rights as well. Trade volume for rights is not to be underestimated, with milk rights trade in the Netherlands and Great-Britain alone at an annual volume of two thousand million Dutch Guilders. A farmer holding no production rights, or striving to expand his business, will have to either purchase or lease them. The market for these rights is not transparent, causing the absence of any clear-cut reference price. Hence, large regional price differences and price fluctuations appear over time. This, too, exposes both farmers and agricultural industry to price risk.

The dynamics of futures exchanges is also stimulated by technological developments. Of increasing importance in this respect is the use of automatic computer-guided trading systems. There are several types of electronic trade systems, the differences between which can be reduced to differences in the type of information they generate. Information regarding high price, low price, last price, size of bid and ask, identification of executors, other markets and volume is relevant to the participants in the futures trade. Because an electronic trading system requires trades to be entered via the terminal, the trader's primary clearing member can monitor the risk position of its traders in real time. Trades executed on the electronic trading system are routed electronically to the exchange's clearing house for processing. Outtrades are virtually impossible. Moreover, an electronic market order book contains information on off the market bids and offers which may give the hedger some indication of his or her ability to unwind his or her position at low market depth costs. These developments in trading systems will increase the attractiveness of futures as price risk management instruments.

Also political developments advance the importance of futures markets in the EU. The influence of the changing CAP in this respect has been discussed already. Also the introduction of the single European currency may stimulate futures markets. It will give an extra impulse to futures contracts (on raw materials), since one of the difficulties with futures contract specification, standardization with respect to currency, will be eliminated, making national futures markets more attractive for hedgers and speculators from other European countries.

All these developments mentioned above, higher price volatility in the cash market for agricultural raw materials, the introduction of transferable production and environmental rights, the upsurge of computerized trade systems and the arrival of a single European currency, contribute to financial institutions' interest in agricultural futures markets. They have led several European futures markets, like the Amsterdam Exchanges, the London International Financial Futures & Options Exchange and the Marché à Terme International de France, to develop new agricultural futures contracts, e.g. for rapeseed and wheat.

While realising that the analysis of the market for hedging services has to be further elaborated, both from the marketing approach and the finance approach, it is our point of view that both approaches should be integrated by futures exchanges when developing and marketing hedging services. In this study we contribute to the understanding of futures markets by analysing hedging services both from the finance and the marketing perspective and by integrating both approaches.

1.2 Outline of the Book

The outline of the book is as follows. In the introductory Chapter 2 a conceptual framework for analysing futures markets is proposed. Subsequent chapters can be placed within this framework. The book consists of three parts, each of which has been subdivided into chapters that each cover a specific research topic.

Part I, taking the finance approach, deals with the problem of risks in futures markets. Part II, taking the marketing approach, analyses the price risk management behavior of entrepreneurs. Part III discusses the characteristics and feasibility of rights futures. The book closes with a chapter on the marketing-finance approach.

Part I starts with an outline in Chapter 3 of the risks a futures contract may carry. Yet, while much research has been done on the valuation of futures contracts, little is known about the risks of using futures contracts. Next, Chapter 4 studies the market depth of the futures market. In the final chapters of Part I, futures markets' hedging effectiveness is analysed thoroughly. First, in Chapter 5, a hedging effectiveness measure is developed which takes market depth risk into account when evaluating hedging effectiveness. Secondly, in Chapter 6, a concept of hedging efficiency and a measure of hedging efficiency are proposed. In contrast to the previous hedging effectiveness measures, this measure does not focus on the performance of a portfolio but on the hedging service of the futures contract.

Risk perception and risk attitude are important concepts concerning the hedging behavior of entrepreneurs. Therefore, in the first chapter of Part II, Chapter 7, two major approaches for measuring the risk attitude of small and medium-sized entrepreneurs in the domain of financial risk are investigated:

measures based on the expected utility model used in economics and measures based on marketing scales used in marketing research and psychology. It is endeavoured to test their applicability and use in futures markets research. Afterward the decision process of Small and Medium-Sized Enterprises (SMEs) for making use of hedging services is analysed in Chapter 8. In Chapter 9, the importance of promotion and distribution for the success or failure of futures contracts is demonstrated by analysing the information dissemination of new futures contracts.

Part III is devoted to rights futures contracts. First, in Chapter 10, we develop a theoretical framework for classifying rights. This enables a better understanding of the many rights existing today. In Chapters 11 and 12, we show that rights futures have some features that differ from those of traditional commodity futures. These features advance the usefulness of rights futures as a tool for managing price risk. The opportunities and constraints for a British and Dutch milk quota futures market and environmental rights futures market are discussed. In Chapter 13, the use of production rights futures for commodity spread hedging is investigated and illustrated for a dairy industry whose production is restricted by rights.

This book closes with Chapter 14 which offers a reflection on the research results of the forgone chapters, and focused in particular on the synthesis between the finance and the marketing approach in the analysis of futures markets, as advocated in the proposed framework of Chapter 2.

CHAPTER 2

Conceptual Framework of Analysing Futures markets

In this chapter we develop a framework for the different approaches to the analyses of futures exchanges. It is argued that futures markets research basically can be distinguished in either taking the marketing approach or the finance approach. A framework integrating the marketing and finance approach to the analysis of futures markets is developed. First, we present an overview of both approaches to the hedging services provided by futures exchanges. Both approaches are complementary. The finance approach furnishes relevant information about the technical feasibility of futures trading. The marketing approach, on the other hand, provides information about whether futures contracts meet the customer's needs. For this reason, we argue that an integration of both methods would lead to more insight into the functioning of futures markets and hence to better ways of optimizing futures contract trading volume.

Note that a futures market provides two different kinds of services: speculation services and hedging services. It does so by organizing a market where futures contracts are traded. The futures contract serves, as it is, as the medium through which the hedging and speculation service is provided. In this book, we focus on the hedging services provided by futures exchanges.

2.1 Finance Approach Towards Hedging Services

Financial management is concerned with the raising and allocation of financial funds (e.g. van Horne, 1986, p.2). Norms for efficient financial management can be derived once the financial environment and the functioning of financial instruments have been understood. This approach to financial services, such as the price risk management services of futures markets will create the necessary conditions for success. The financial approach to financial services is therefore a normative one: what necessary technical conditions have to be fulfilled for a financial service to be viable?

In the financial literature on futures contracts, the *commodity characteristics approach* and the *contract design approach* can be distinguished.

The *commodity characteristics approach* defines feasible commodities for futures trading, based on an extensive list of required commodity attributes, and, in so doing, focuses on *the technical aspects of the underlying commodity*. The following attributes were considered crucial for qualifying a commodity for futures trade: 1) the commodity should be durable and it should be possible to store it; 2) units must be homogeneous; 3) the commodity must be subject to frequent price fluctuations with wide amplitude; supply and demand must be large; 4) supply must flow naturally to market and there must be breakdowns in an existing pattern of forward contracting (Black 1986, Tashjian 1995). The first attribute has received a lot of attention from the field of (commodity) finance, since one of the economic functions often attributed to futures markets in commodity marketing is the temporal allocation of stocks. The uncertainty of the value of commodities in the portfolio causes problems for firms to make optimally economic efficient decisions. The futures market is an integral part of this *storage* scenario through provision of a hedge against price risk for the carrier of stocks. Since futures contracts are standardized contracts, this approach requires the underlying product to be *homogeneous,* so that the underlying commodity as defined in the futures contract corresponds with the commodity traded in the cash market. This makes possible to actually deliver in the futures market, which keeps basis risk at the lowest level possible. The *fluctuating price* attribute is of great importance, since a hedger will feel little incentive to insure himself against price risk if the possible price changes are small. The *broad cash market* criterion is important, because a large supply of the commodity will make it difficult for someone to establish dominance in the market place and a broad cash market will tend to provide for a continuous and orderly meeting of supply and demand forces. The last crucial attribute of this commodity approach indicates that cash market risk will have to be present in order that a futures market will come into existence; should all parties decide to eliminate each and every price fluctuation by using cash forward contracts, a futures market would not be interesting. This commodity approach has received a lot of attention and has increased our insight into the factors determining viable futures trade. However, the attributes considered to be necessary in this approach have proven themselves too strict to be used as criteria for futures market success. After all, different types of futures contracts have been developed (like the financial and other exotic futures) that do not have the attributes mentioned above, but are successful anyway.

The *contract design approach* views the contract specification (standardization process of the contract) as the critical factor determining the viability of a futures market and hence focuses on *the technical aspects of the contract.* Gray (1978) identified the importance of contract design. He argued that a contract must reflect the commercial movement of a commodity both closely and broadly enough, such that price distortions will not be a result of specifications in the contract. To warrant hedging, the contract must be as close a substitute for the cash commodity as possible (Thompson, Garcia and Dallafior 1994). Johnston and McConnell (1989) have shown that the hedging effectiveness is an important determinant in explaining the success of futures contracts and as a result considerable attention has been paid to the hedging effectiveness of futures contracts. Authors who have proposed measures of hedging effectiveness include Chang and Fang (1990), Ederington (1979) and Pennings and Meulenberg (see Chapters 5 and 6). However, high hedging effectiveness does not form any guarantee for success, since entrepreneurs may very well evaluate the hedging service provided by futures exchanges along other criteria than performance (that is hedging efficiency) alone, e.g. ease of use.

2.2 Marketing Approach Towards Hedging Services

The marketing approach tries to provide an answer to the question whether the hedging services provided by the futures exchange are able to satisfy the needs of potential customers. Often, alternative products or services will be available to meet the needs of the entrepreneur, which is why the marketing pays a lot of attention to the customer's decision making process. In this book we concentrate on the entrepreneur's decision making process regarding price risk management instruments. Knowing how the customer reaches a decision and why he or she decides the way he or she does, gives the marketer clues as to how to market the hedging service. Since needs constitute the starting point in marketing, we shall first elaborate on the needs for hedging.

The total set of customer needs with respect to a futures contract can be differentiated into instrumental needs and convenience needs (see Figure 1). The customer will choose that "service-product" (futures, options, cash forwards, etc.) which best satisfies his or her total set of needs, both instrumental and convenience, at an acceptable price.

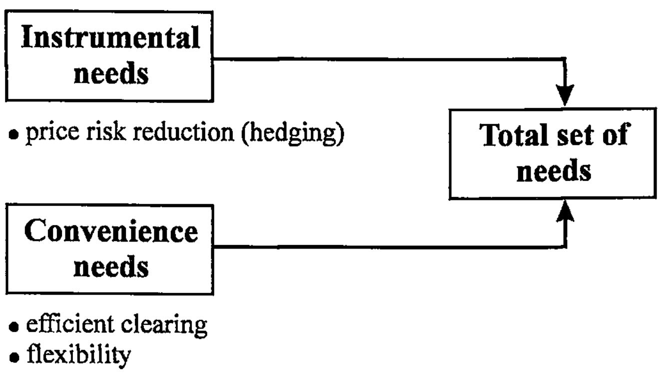

***Figure 1** Total set of needs*

Instrumental needs are the hedgers' needs for price risk reduction. Hedgers wish to reduce, or, if possible, eliminate portfolio risks at low cost. There are several different ways of managing price risks. The instrumental needs are related to the *core service* of the futures market, which consists of reducing price variability to the customer. These instrumental needs express themselves through hedgers, taking a hedge position in the futures market. An entrepreneur who is highly risk-averse may satisfy this need by hedging systematically, that is hedging all products that carry risk (therewith choosing a hedge ratio of 1). Not only do hedgers wish to reduce price risk, they also want things like flexibility in doing business and an efficient clearing system. These needs are called *convenience needs.* They reflect the customer's need to be able to use the core service provided by the exchange with relative ease. The extent to which the futures exchange is able to satisfy the convenience needs determines the *process quality* (Grönroos 1990). The service offering is not restricted to the core service, but has to be complemented by so-called peripheral services. The core plus peripheral services constitute the augmented service offering (Grönroos 1990; Kotler 1988; Ozment and Morash 1994). An example of a futures market's peripheral service is the efficient and correct conclusion of transactions.

Both types of needs can be met by the futures market. In order to indicate which futures market division mainly satisfies the instrumental needs and which the convenience needs, we will first review in a nutshell the business organization of the futures market. The futures market can be divided into two identities, namely: the "floor" and the "clearing house". The "floor" is where the actual transactions take place. The word "floor" has been put between quotation marks, because futures markets exist that literally do not have a floor anymore, the traditional trading place having been replaced with an electronic trading system. On the floor, the brokers execute customers' orders. Therefore, the floor can be seen as the place where mainly instrumental needs are being met. After all, the execution of an order means a hedge position has been taken in the futures market, which reduces the customer's price risk. After the execution has taken place, the clearing house takes care of the financial settlement and, in the case of actual delivery, makes sure that the commodities that are delivered meet the contract specifications. Therefore, the clearing house can be said to meet mainly convenience needs.

After having analyzed the customer's needs marketing will engage in designing the service and in developing the service delivery process. Both the *service design* and the *service delivery* process affect the nature of the customer's service experience (Rust and Oliver 1993; Rust, Zahorik and Keiningham 1996).

Discriminatory features of services as compared to commodities have a substantial impact on the *service design* process (de Brentani 1989; 1991). Intangibility presents a challenge to new service development, because it requires the management of the futures exchange to cooperate closely with customers and to stress the use of tangible cues to make the service more physical (Parasuraman, Zeithaml and Berry 1985). Tangible cues in the futures industry are the trading floor, the information provided by the trading system and the clearing system. Furthermore, intangibility may reduce the time needed to complete the new product development process for services. As a result, the futures industry may be able to respond more quickly and effectively to customers' needs. However, since services can be easily imitated ("me-too" products) there is a proliferation of similar services in the futures industry (de Brentani 1991; Easingwood 1986). Specific to futures as a financial service is the time between the placement of the order and the actual execution of the order, which determines the financial result of a service (Pennings et al. 1998).

In the services sector, the personal interaction between service provider and customer lies at the heart of most operations and therefore *service delivery* plays an important part. (Bitner and Booms 1996; Rust, Zahorik and Keiningham 1996). This interaction is sometimes referred to as the service encounter (Czepiel, Solomon, Surprenant and Gutman 1985) or "moment of truth" (Norman 1991). Simultaneous production and consumption entails that both customers and futures exchange interact closely at the time of the first service encounter and on subsequent service encounters in later stages of the relationship (Parasuraman, Zeithaml and Berry 1985; Shostack 1984). The interactions between the brokers of the exchange and customers influence the quality of the service delivery process in the futures industry (Pennings 1998).

In most cases, more than one instrument will be available to meet the entrepreneur's needs for price risk reduction. This makes it interesting to know *how* the entrepreneur chooses between these alternatives. In order to gain insight into this, the entrepreneur's choice behavior concerning price risk management instruments must be investigated. Insight into the choice process provides the marketer with clues about the characteristics a futures contract has to have in order to be preferred over the other alternatives. The entrepreneur compares the alternatives on the basis of different attributes or dimensions like e.g. the alternative's risk reduction capacity. The entrepreneur's choice for any particular alternative depends on the importance placed by the entrepreneur on these attributes as well as on how the alternatives differ with respect to these attributes in the entrepreneur's evaluation. Insight into these attributes and the variables influencing them, provide the management of the futures exchange with a framework for improving service design and service delivery. Moreover, insight into why the entrepreneur chooses the way he or she does provide valuable information in efficiently identifying certain target groups and customizing services. Because the entrepreneur is confronted with alternatives during the choice process, the choice process may well bring to the surface latent needs (often convenience needs). This, in turn, influences service design and service delivery, be it indirectly (see the left branch of Figure 3).

2.3 Marketing and Finance Approach Towards Hedging Services

We hold that an integration of both approaches, the marketing and finance approach, is necessary for a full understanding of the functioning of a futures market. The financial approach defines the necessary conditions which financial services have to meet. This approach focuses on the necessary technical characteristics of hedging which have to be fulfilled, in order to obtain a viable futures contract. In that sense it takes a normative approach. However, fulfilling these necessary conditions does not guarantee the market success of financial services. The success or failure of these services also depends on the extent to which financial services satisfy the needs of potential customers at competitive prices. It is a point of view familiar in marketing: products and services are determined on the basis of the customers' needs (Churchill and Peter 1995). Next, it is investigated which criteria and attributes underlie the decision process of the entrepreneur. These underlying dimensions provide the exchange with valuable information for adjusting service design and service delivery in such a way that the entrepreneur will prefer the service offered over the other alternatives.

A combination of the *marketing* approach, "which service is desirable from the customer point of view and what is the customer's choice behavior" and the *financial* approach, "which service is feasible from the technical point of view" seems a useful route when developing new hedging services. The type of information used is characteristic for both approaches and therefore crucial to understanding in what respect the financial approach differs from the marketing approach (see Figure 2). The financial approach makes use of *technical information.* Technical information consists of prices, rates of returns, volumes of transactions and historical data on all these items at different locations and on different markets.

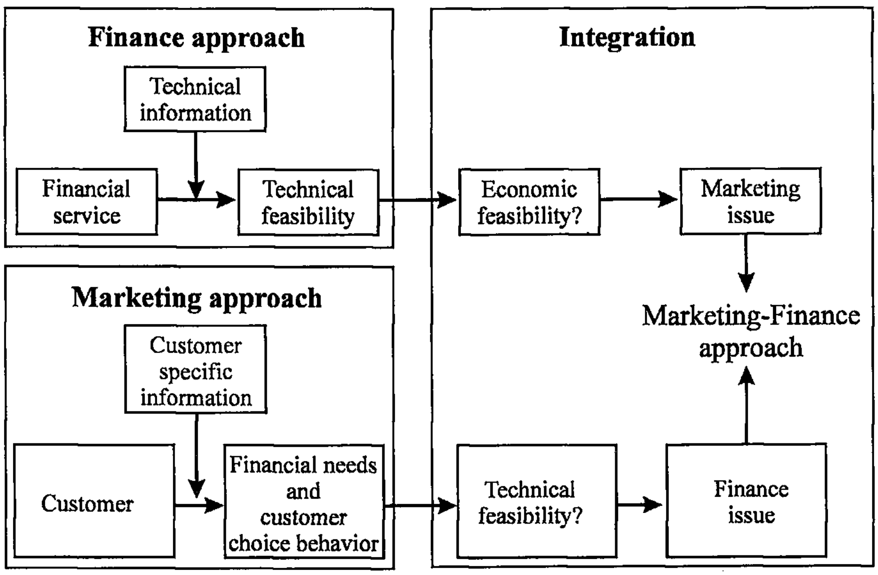

***Figure 2** The marketing-finance approach*

The marketing approach draws on *customer-specific information.* The latter type of information includes time preferences, choice criteria, investment opportunities, and the risk preferences of individual economic agents. Customer-specific information is essential for determining market needs and profit opportunities. A problem of financial institutions *vis-à-vis* customers may be information asymmetries, such as hidden information and hidden action, which might result in adverse selection and moral hazard (see Dietrich 1996). The cost of information asymmetry can be reduced by marketing research if the expected value of perfect information is positive (Dietrich 1996; Lovelock 1996). Customer-specific information is also useful in selecting target markets. Targeting market segments and designing effective positioning strategies require managers to have an insight into how the attributes of a service-product are valued by current and prospective customers. Customer-specific information can provide that insight (Lovelock 1996).

It is often difficult to derive from the marketing approach alone the successful functional and technical properties of financial services. On the other hand, it remains unclear whether the feasible properties of financial services as determined in the financial approach generate sufficient demand. It seems, therefore, that the financial and marketing approach to financial services, whether from the perspective of supply- or demand side, complement each other in the process of developing, producing and marketing financial services.

Figure 3 presents a conceptual framework that contains both approaches to help acquire a better understanding of the factors that contribute to the success of futures markets. It also shows the subjects that need deepening within both approaches.

In order to optimize futures exchanges policy, the financial and marketing approach will have to be integrated. Both approaches nourish each other with information, thus producing feedbacks from one approach to the other, as represented in Figure 3. Thus, the marketing approach will furnish information about the characteristics that the futures contract needs to be chosen by the entrepreneur, whereas the finance approach will determine the technical feasibility of such a contract and e.g. deduct the implications for the optimal hedge ratio and hedging effectiveness. This information, then, is important for service design and service delivery. Moreover, this information can indicate where and how the characteristics of a futures contract need adaptation on technical grounds.

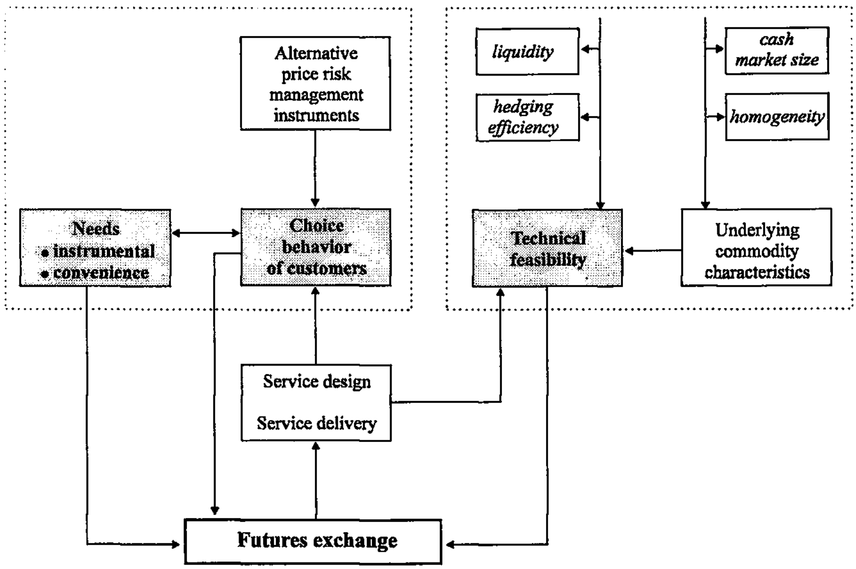

Figure 3 *A Synthesis of the financial marketing approach: a conceptual framework for hedging services*

Within the domain of these two partial approaches much research has to be done in order to improve our understanding of futures markets. In this book we consider three subject fields worth understanding in more detail: risks associated with futures (i.e. hedging efficiency), discussed in Part I, the decision making process of entrepreneurs regarding futures contracts, discussed in Part II and the characteristics and viability of an innovative futures contract, in our case rights futures, discussed in Part III.

PART I RISKS IN FUTURES MARKETS: A FINANCE APPROACH

There is a vast literature which takes the financial approach to futures markets. However, the fact that hedging not only lifts risks, but also may introduce risks has received limited attention yet. In fact, next to reducing risk, hedging on futures markets also introduces risks that cannot be covered. Therefore, in this part of the book we analyze the different sources of risk in hedging. Our research focuses on two aspects: the lack of market depth and measures of hedging effectiveness. Despite the fact that the finance literature has paid much attention to the bid-ask spread, it is the price path due to order imbalances which determines the costs a hedger incurs when trading in a market with a lack of market depth. The problem of market depth risk is particularly important for relatively small commodity futures markets. Due to their small scale, they often lack market depth, which results in relatively high hedging costs, inhibiting the growth of futures contract volume. Analysis of the price path due to order imbalances can provide us with information about the underlying dimensions of market depth. Insight into these dimensions can give the management clues to improve market depth.

The risks originating from trading at futures markets also influence the futures market's hedging effectiveness. However current measures do not take into account these risks, such as market depth risk. Therefore, we extend the existing hedging effectiveness measures by the market depth component, enabling the hedger to evaluate better the different futures markets along their over-all risk-reduction capacity. We propose a measure which looks at hedging effectiveness from a hedger's perspective. However, this measure holds relatively little information for a futures exchange management on how to improve hedging effectiveness. For this reason we also develop another hedging effectiveness measure taking the futures exchange management perspective. This measure is able to divide the distance between the perfect hedge and the actual hedge into a systematic part, which is controllable by the futures market, and a random part, which cannot be influenced by the futures exchange. The two hedging effectiveness measures developed are complementary. The first measure focuses on the performance of a portfolio, whereas the second measure is concerned with the quality of the hedging service provided by the futures exchange.

CHAPTER 3

Hedging Risk in Agricultural Futures Markets[1]

3.1 Abstract

Futures contracts are potential price-risk management instruments for hedgers. While much research has been done on the valuation of these instruments, little is known about the risks of using futures contracts. Hedgers must be aware of the risks associated with hedging which we analyze in this chapter. By analyzing the capacity of futures contracts for reducing risk, we provide the management of the futures exchange a better understanding of the pros and cons of futures contracts as instruments for price-risk reduction.

3.2 Introduction

There are two general sources of risk to hedgers[2], quantity risk and price risk. Quantity risk is a farm-specific phenomenon caused by a myriad of random factors such as disease and weather conditions. Price risk is a market phenomenon caused by random changes in the aggregate quantity of a good demanded or supplied (Dwight 1985). This chapter focuses on price risk. This type of risk has become more relevant to hedgers in both the United States (US) and the European Union (EU) because of the free-trade policy of

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[1] This chapter has been published as: Pennings, J.M.E. and M.T.G. Meulenberg (1997), "Hedging Risk in Agricultural Futures Markets", in: Wierenga, B., K. Grunert, J.B.E.M. Steenkamp and M. Wedel (eds), *Agricultural Marketing and Consumer Behavior in a Changing World.* Boston, Kluwer Academic Publishers pp. 125-140.

[2] Note that the words hedger and farmer are used interchangeably.

the GATT and the reforms of the common agricultural policy of the EU.

Because of increased fluctuations in agricultural prices, some exchanges are creating new futures contracts. Recently, the Marché à Terme International de France in Paris has introduced rapeseed futures contracts. On the one hand, price risk in the cash market can be decreased using futures, while on the other hand, futures generate additional risks. Understanding the capacity of futures to reduce overall risk is important. (Jolly 1983; Bosch and Johnson 1992). Actually, the lack of understanding by hedgers and firms, in general, about how to use futures has caused many failures in price-risk management (Figlewski, Landskroner and Silber 1991; Edwards and Canter 1995).

The contribution of this chapter on price-risk management by hedgers is twofold. First, in contrast to other studies, this chapter takes into account that futures not only reduce cash price risk but also introduce hedging risk[3]. This element of hedging efficiency has a great influence on the capacity of the futures contract to eliminate overall risk. Second, hedging risk is analyzed in all of its components. Furthermore, the influence of the interaction between those components on the hedging risk is examined.

This chapter is organized as follows. First, a general framework of hedging efficiency is proposed. Second, the risks introduced by futures are analyzed. In order to illustrate how large the hedging risk can be for hedgers using futures, the hedging risk for the potato futures contract traded on the Amsterdam Agricultural Futures Exchange is measured.

[3] Note that the words hedging risk and futures trading risk are used interchangeably.

3.3 Hedging Efficiency

Three hedging theories can be distinguished. First, traditional hedging theory emphasizes the potential of futures markets to avoid risk: cash positions are hedged by taking an equal but opposite position in the futures market. A second theory (Working 1962) suggests that hedgers operate like speculators, being primarily interested in relative prices rather than absolute ones. According to Working, holders of a long position in the cash market hedge if they expect the basis to fall, but not if a rise is expected. The latest and the most common theory nowadays is the portfolio approach. In this approach the risk of price changes is introduced into the hedging model by a variance function. Moreover, a frontier is traced, showing a relationship between variance and expected returns.

These measures are concerned with the minimization of the risk of the portfolio of the spot commodity and the futures contract or with finding some optimal balance between risk and return. All these measures implicitly assume that the futures contract is perfect, i.e., introduces no risks. However, futures contracts do introduce risks which have an impact on the variance of the hedger's returns. Furthermore, these risks have an impact on the success of a futures contract and are, therefore, of great interest both to the management of the futures exchange and the hedger.

A futures contract which is able to set a certain price without introducing other risks best fulfills the hedger's need for hedging. However, the hedger will not always use this particular futures contract, since the decision is also influenced by the cost involved in futures trading, i.e., commission costs and margin requirements. The hedger will weigh the costs involved in futures trading against the satisfaction he or she derives from the futures contract. Therefore, we propose to define hedging *efficiency* as the capacity of the futures contract to reduce the overall risk in relation to the cost involved in futures trading (because we include the costs we speak of hedging efficiency as opposed to hedging effectiveness which does not include the costs). For both the futures exchange and the hedger it is important to know how well the services provided by the futures contract meet the needs of the hedger. The proposed concept of hedging efficiency assesses how well the futures exchange is able to achieve this goal. Figure 1 illustrates our concept of hedging efficiency.

The capacity of the futures contract to reduce total risk in relation to the trading costs involved is the hedging service which the futures exchange provides. Two factors are important for the futures exchange: whether it meets the need of the hedgers with respect to overall risk reduction, and whether it can compete with competitive futures exchanges on that point. In this chapter, we elaborate on the futures trading risk, i.e. the upper-left part of Figure 1 denoted by the dotted line. In Chapter 6 we will derive a hedging efficiency measure, on the basis of the proposed concept of hedging efficiency.

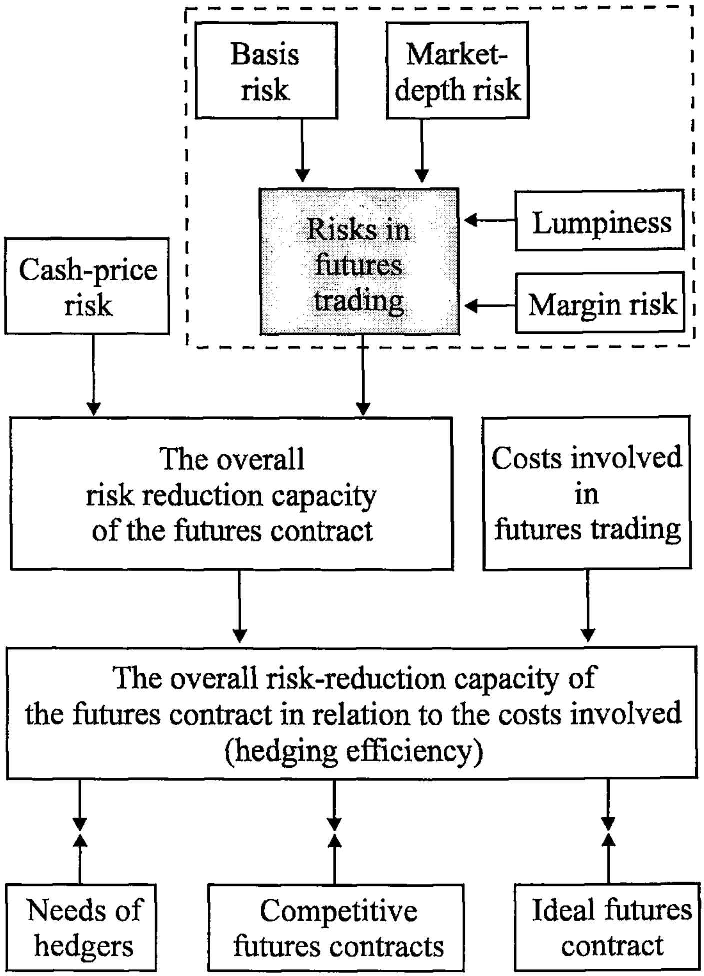

Figure 1 *Proposed concept of hedging efficiency*

3.4 Risks in Futures Trading

Because the futures market offers a price-risk-management service, this service preferably should not generate additional risk. When the futures market introduces no hedging risk, we refer to the futures contract as a perfect futures contract which generates a price for the short hedger in period $t + 1$ of:

$$ARP_{t+1} = CP_{t+1} + (PF_t - PF_{t+1} - TC) = PF_t - TC \quad (1)$$

where ARP is the actual realised price, CP the local cash price, PF the futures price, $PF_t - PF_{t+1}$ the liftings value and TC the roundturn brokerage costs[4].

However, in practice we observe that the actual price realized ARP_{t+1} is often not equal to the net futures price $PF_t - TC$ for which the hedger enters the futures market. Hence, the hedger is exposed to hedging risk, where hedging risk is defined as the distance between the price for which the hedger enters the futures market corrected for transaction costs, $PF_t - TC$, and the actual price after the hedger has liquidated the futures position, ARP_{t+1}, regardless of whether this distance is positive or negative.

Hedging risk can be broken down into the following elements: basis risk, lumpiness, market depth risk and margin risk (Pennings 1997). These elements are analyzed for hedging price risk for hedgers.

3.4.1 *Basis Risk*

It is generally recognized that futures markets can be used by hedgers to hedge the risks associated with price fluctuations in the underlying spot market (Grossman 1986). Any deviation in the cash-futures-price relationship at the settlement date will be

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[4] We could equally well have used a long hedger in this example, because a distinction is not essential for the derivation of the hedging risk.

eliminated. However, if the arbitrage transaction costs are high, the necessary convergence of the cash and futures prices will be countered, thereby introducing a risk to the hedger and negatively affecting participation in futures markets. The basis between a futures contract and its underlying commodity is an important measure of the cost of using the futures contract to hedge. In a cross-hedge, the relative size of the basis of alternative hedging vehicles often plays a decisive role in the selection of the optimal hedging vehicle (Castelino et al. 1991). Basis risk is attributed to location, quality and timing discrepancies between commodities traded in the cash market and those deliverable on futures (Paroush and Wolf 1989). In the case of futures indexes, unanticipated variation in dividends may involve basis risk (Figlewski 1984; Brennan and Schwartz 1990). The unpredictability of the basis presents hedgers with a risk that is unhedgable, as is outlined by Figlewski (1984) and Brennan and Schwartz (1990). Explanations for the variability in the basis include the marking-to-market requirement for futures contracts, the differential tax treatment of spot and futures, as well as the difficulties in arbitrating between large cash positions and futures. Kumar and Seppi (1994) find that arbitrage reduces basis volatility.

The existence of basis risk, which is specific to futures markets and does not exist in cash forward markets, introduces an element of speculation in the sense that hedgers are still exposed to this risk while hedging their physical commodity. In a recent article, Netz (1996) shows that basis risk not only affects the futures position but also the cash-market position for all hedging by risk-averse agents. Numerous articles provide statistical models for predicting the basis (Naik and Leuthold 1988; Trapp and Eilrich 1991; Liu et al. 1994), although researchers find it difficult to forecast.

3.4.2 *Lumpiness*

Hedgers can specify forward contracts which correspond with the quantity they have available for sale, in contrast to futures contracts which are traded in standard quantities. Therefore, a futures hedge may not exactly match the amount of the desired sale or purchase, and lumpiness causes a proportion of the cash position to remain exposed to uncertain changes in price. Note that if the quantity to be hedged increases, the relative importance of lumpiness declines and ultimately approaches zero.

3.4.3 *Market Depth Risk*

Market depth risk is the risk the hedger faces from a sudden price decrease or increase due to order imbalances; this risk seems important to systematic hedgers, particularly in thin markets. Kyle (1985) defines market depth as the volume of unanticipated order flows which move prices by one unit. Sudden price changes may occur in cases of both long and short hedges. If a relatively small market sell (buy) order arrives, the transaction price is the bid (ask) price. For a relatively large market sell (buy) order, several transaction prices are possible, at lower and lower (higher and higher) prices, depending on the size of the order and the number of traders available. If the sell order is large, the price should keep falling to attract additional traders to take the other side of the order. Given a constant equilibrium price in a deep market, relatively large market orders result in a smaller divergence in transaction prices from the underlying equilibrium price than in a thin market. The generally known factors which determine market depth, and in general liquidity, include: the amount of trading activity[5] or the time rate of transactions during the trading period; the ratio of trading activity by speculators and scalpers to overall trading activity; equilibrium price variability; the size of a market order (transaction); expiration-month effect; and market structure[6] (Black 1986; Thompson and Waller 1987; Christie and Schultz 1994; Chan and Lakonishok 1995; Christie and Schultz 1995). According to Lippman and McCall (1986) the deepness of the market for a commodity increases with the frequency of offers. Hasbrouck and Schwartz (1988) report a relation between market depth and trading strategies of market participants. Passive participants wait for the opposite side of their trade to arrive, but the active ones seek immediate transaction. Passive participants may avoid depth costs, whereas active ones generally incur depth costs. Some exchanges monitor temporary order imbalances, i.e., market depth risk, and slow down the trade process if these are present (Affleck-Graves, Hegde and Miller 1994). For example, an order-book official issues warning quotas when trading results in price changes that are larger than maximums allowed by the exchange and halts trading when order execution results in price changes that exceed exchange-mandated maximums (Lehmann and Modest 1994). In general, an individual hedger who manages a family farm needs only a few futures contracts to hedge his underlying cash position because of the large size of the futures contract relative to the cash position. For that reason the market depth costs are probably relatively small. However, for traders or cooperatives that wish to hedge price risks on behalf of a group of

[5] In the literature, trading activity is often used as an indicator for market liquidity. However, Park and Sarkar (1994) showed that, in the case of the S&P 500 index futures contract, changes in trading activity levels may be poor indicators of changes in market liquidity.

[6] This is not meant to be exhaustive.

hedgers, market depth costs may be large. Hedgers can eliminate market depth costs if they give orders with limit prices to a broker. However, if they use limit prices, hedgers may run the risk that their trade cannot be executed.

3.4.4 *Margin Risk*

The net cost arising from futures margin requirements consists of the opportunity costs of the initial margin requirement and the opportunity cost of marking to market (i.e., marking to market means that if futures prices fluctuate, those who hold losing positions must add to their margin accounts, while winners may withdraw their surpluses). Hedgers holding losing positions incur actual and opportunity interest costs. These income and cost flows compound over the span of the futures hedge. The margin cost is more significant if the time horizon of the hedge increases. Thus, futures in agricultural commodities with relatively long growth and storage periods, such as potatoes (time horizon of about one year), incur more margin costs than hogs, where there is no storage period and the growth period is short (time horizon of about three months).

3.5 Model

In order to gain insight into the consequences of hedging risk for the hedger, a microeconomic approach is adopted towards hedging. In this chapter, risk is measured by the variance. The variance is a measure of how much the outcomes vary or differ from one another. Note that in this chapter risk is represented by the variance of returns.

Consider a hedger who systematically hedges his output and intends to sell the output in period T on the cash market. The hedger can now use futures based on different strategies to manage price risk. The strategy of a hedger depends on whether the desired time period T equals the maturity of the futures M. If $T = M$, the hedger offsets his position and sells the commodity in the cash market or he holds the position and makes delivery[7]. Whether the hedger offsets his position or makes delivery depends on the standardization requirements, the search cost in the cash market, and the market depth cost in the futures markets. If $T \neq M$, the hedger can only liquidate his position by offsetting the original futures contract. Figure 2 depicts the decision tree of the hedger for hedging output with futures.

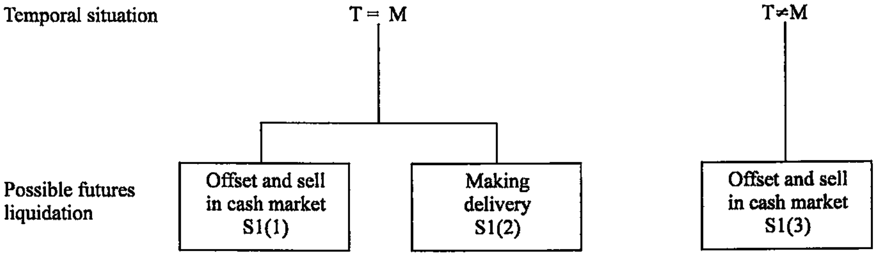

***Figure 2** Hedging strategies in the case of futures*

The revenue of a hedger who hedges his output when the delivery date for the commodity equals the maturity date of the futures can be expressed as:

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[7] Making delivery on a futures contract is only possible when the cash position of the hedger is equal to the underlying commodity of the futures contract, which is seldom the case.

$$\tilde{\Pi}_1 = n(PF_t - \tilde{CP}_T) + (q - n)\tilde{CP}_T + n\tilde{CP}_T + n\tilde{B}_T^{sq} - n\tilde{MDC} - nTC - I^{\epsilon} - n\tilde{I}^{mm} \tag{2}$$

where Π_1 is the revenue at the end of the period when the delivery date for the commodity equals the maturity of the futures, n is the futures quantity sold, q is the output produced, B_T^{sq} is the spatial and quality dimensions of the basis at the end of the period, MDC the market depth costs, I^{ϵ} is the initial margin costs and I^{mm} is the marking-to-market costs. A tilde (~) denotes a random variable. Lumpiness is expressed as $q - n$, i.e., the quantity which cannot be hedged because of the standardized units of the futures contract.

We assume that the hedger wishes to hedge his underlying cash position completely. It can be shown that a full hedge is not always optimal for the hedger. However, for simplification, we assume a full hedge, which does not affect our conclusions.

The revenue of a hedger who hedges his output when the delivery date of the commodity is unequal to the maturity date of the futures can be expressed as:

$$\tilde{\Pi}_2 = \tilde{\Pi}_1 + n\tilde{B}_T^{tem} \tag{3}$$

where Π_2 is the revenue at the end of the period when the delivery date for the commodity is unequal to the maturity date of the futures contract, and B_T^{tem} is the temporal dimension of the basis.

To determine the hedging risk, it is necessary to determine the covariance matrix of the stochastic variables contributing to the hedging risk. The covariance matrix can be represented by:

$$\Omega = \begin{pmatrix} \sigma^2_{CP} & \sigma_{CP,B^{sq}} & \sigma_{CP,B^{tem}} & \sigma_{CP,MDC} & \sigma_{CP,I^{mm}} \\ \sigma_{B^{sq},CP} & \sigma^2_{B^{sq}} & \sigma_{B^{sq},B^{tem}} & \sigma_{B^{sq},MDC} & \sigma_{B^{sq},I^{mm}} \\ \sigma_{B^{tem},CP} & \sigma_{B^{tem},B^{sq}} & \sigma^2_{B^{tem}} & \sigma_{B^{tem},MDC} & \sigma_{B^{tem},I^{mm}} \\ \sigma_{MDC,CP} & \sigma_{MDC,B^{sq}} & \sigma_{MDC,B^{tem}} & \sigma^2_{MDC} & \sigma_{MDC,I^{mm}} \\ \sigma_{I^{mm},CP} & \sigma_{I^{mm},B^{sq}} & \sigma_{I^{mm},B^{tem}} & \sigma_{I^{mm},MDC} & \sigma^2_{I^{mm}} \end{pmatrix}$$

where σ^2_x represents the variance of the random variable x, and $\sigma_{x,y}$ represents the covariance between the random variables x and y.

By letting $b' = (q - n, n, n, -n, -n)$, the variance of the revenue can be expressed as: $\sigma^2_{\Pi_2} = b'\Omega b$.

The covariance matrix provides insight into the underlying structure of hedging risk. If there is no lumpiness, i.e., n equals q, the influence of cash-price uncertainty can be entirely eliminated. Thus, for large hedgers (i.e. farmers) and cooperatives which represent a group of farmers, the lumpiness will not be large. However, if a large farmer or cooperative enters the market with many contracts, in contrast to a small farmer who enters the futures market with only a few futures contracts, they may face market depth-cost risk. Knowing the characteristics of the underlying structure of market depth cost is helpful in order to reduce this risk (see Chapter 4).

The interaction between the components of the hedging risk are represented by the covariances. For the hedger it is important to understand the interactions between the hedging risk components. For example, from a theoretical point of view, it is expected that the covariance between the basis (both the temporal dimension and spatial and quality dimension) and the market depth influence the variance of the revenue when the futures market is relatively thin and the underlying commodity of the futures contract is not exactly equal to the cash position of the hedger. An example makes this clear. Suppose a potato producer goes short the April 1996 contract traded on the Amsterdam Agricultural Futures Exchange at 30 Dutch Guilders. Now, suppose that in April 1996 when he enters the market to lift his hedge, the current basis is 0.5 Dutch Guilders. He buys to cover his short position, and because of a lack of market depth, the transaction pushes the price upward, so that the actual basis is 0.1 Dutch Guilders. Thus, the market depth risk has actually decreased the hedging risk and, hence, improved the hedging effectiveness (Pennings and Meulenberg 1997).

The covariance matrix not only provides information for hedgers but also for the management of the futures exchange. The futures exchange has tools, such as the futures contract specification and the trading system, which may affect the elements of the covariance matrix thereby affecting the hedging efficiency (Pennings and Meulenberg 1997). For example, the basis may, to some extent, be managed by the futures exchange. A futures contract specification which resembles the cash position reduces basis risk. The futures exchange can also reduce market depth risk by using a mechanism to slow down the trading process if order imbalances occur and to attract market depth by reporting these (cfr earlier this chapter). Also, order book information may be improved; one mechanism that allows potential participants to view real-time limit orders, by displaying the desired prices and quantities at which participants would like to trade, affects market depth because participants can now observe how many contracts can be traded at the quoted price. We may conclude that insight into the covariance matrix provides the hedger with information about the risk he is facing when using futures and provides the management of the futures exchange with insight into their hedging services. To determine the hedging risk for potato growers, a simulation was conducted by applying our model to data from the Amsterdam Agricultural Futures Exchange.

3.6 Illustration

The hedging risk is measured using data on the potato futures contract traded at the Amsterdam Agricultural Futures Exchange (ATA). The potato futures contract is a relatively successful futures contract. In fact, the volume generated is large relative to competitive potato futures contracts in Europe. With the aid of transaction-specific data, it was possible to measure the hedging risk run by trading potato futures contract for delivery April 1996. Because only transaction-specific data for period February 1995 to June 1995 were available, the time horizon of the simulation was limited. Thus, no distinction could be made between the temporal basis and the spatial and quality basis. The period captured the preharvest period for potato growth and the marketing cycle. This implied that the basis between the cash prices for February to June 1995 and the price of futures for April 1996 included the full storage costs for the harvest period of September 1995 to April 1996. Therefore, changes in the basis in the sample period are not due to changes in storage costs. It is assumed that the estimated variance of the cash price and the variance of the basis in the sample were constant over time, because these are characteristics of the market.

The covariance matrix Ω was calculated using the Rotterdam potato cash prices, the closing prices for potato futures and on the basis of transaction-specific data collected by the clearing corporation. The market depth costs for an order selling imbalance were calculated as the area between the downward-sloping price path and the price for which the hedger enters the futures market,

$$MDC = PF^1 \cdot N - \sum_{i=1}^{N} (PF^i) \qquad (4)$$

where PF^1 is the futures price for which the hedger enters the market and N the total order flow.

The market depth costs for an order buying imbalance were calculated as the area between the upward-sloping price path and the price for which the hedger enters the futures market,

$$MDC = \sum_{i=1}^{N} (PF^i) - PF^1 \cdot N \qquad (5)$$

From the data, it was impossible to infer the exact split between an increasing and decreasing price path, since prices are constant for several contracts in the local minimum or maximum. Therefore, we followed the following procedure: for an odd number of intersecting contracts we used the middle contract, whereas for an even number of constant contracts a random assignment with equal probabilities was used to determine the split. Subsequently, all order-specific market depth costs were converted into daily market depth costs per futures contract. The margin costs depend on the price of the futures contracts sold. The margin costs were calculated for several prices on the basis of a debit interest rate of 5% and a credit interest rate of 4%.

The amount of output which the farmer wishes to hedge q the output produced n and the price which the farmer has locked in the futures market PF were specified ex ante (see Table 1).

Four combinations of *n* and *q* were examined to investigate the sensitivity of the results for lumpiness. For every combination of *n* and *q* eventeen different futures price levels for which the farmer enters the futures market were looked at. Table 1 summarizes the combinations of *n*, and *PF* ed in the analysis.

***Table 1** Research design for calculating the variance of returns in case of price risk management by futures for different values of the futures position n, cash position q and futures price PF*

n	q	PF
$n_1 = 1$	$q_1 = 1$	PF_i = 23, 24, 25 26, 27, 29, 31, 33, 35, 40, 45, 50, 55, 60, 65, 70, 75
$n_2 = 1$	$q_2 = 1.5$	PF_i idem
$n_3 = 10$	$q_3 = 10$	PF_i idem
$n_4 = 10$	$q_4 = 10.5$	PF_i idem

3.7 Results

The variance per futures contract is given in Figure 3.

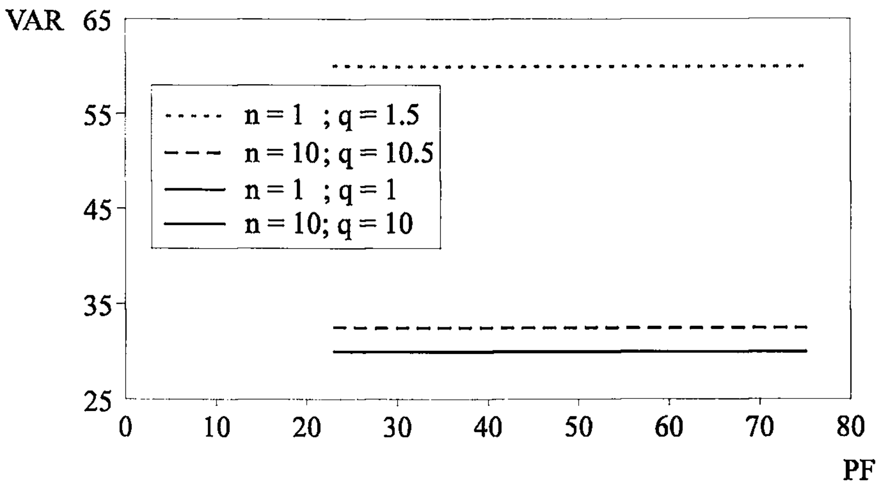

***Figure 3** Variance of revenues (see Equations 2 and 3) introduced by the potato futures contract traded at the Amsterdam Agricultural Futures Exchange*

The results of our simulation suggest that the effect of lumpiness on the hedging risk of the potato futures contract decreases when the output that a farmer wishes to hedge increases. Furthermore, the hedging risk does not significantly depend on the price at which farmers enter the futures market. Thus, the market depth risk in the potato futures market is relatively low compared with the cash-price risk and basis risk. This result is in accordance with previous research where it was concluded that the potato market is relatively deep with respect to other futures contracts, such as hogs futures, which are also being traded on the ATA (see Chapter 4). The covariance matrices suggest that the variance introduced by the potato futures can be attributed mainly to the basis.

From the empirical results, we conclude that futures introduce risk, which must be taken into account by farmers who manage price risks. Farmers can reduce those risks, especially risks due to lumpiness, by not hedging their cash position individually, but by jointly hedging their cash positions. An agricultural cooperative could do so by trading futures for a group of farmers.

Although the benefits associated with risk reductions are important factors in motivating the farmers to engage in futures trading, we are aware that potential users may also be heavily influenced by their subjective assessments of the performance and reliability of a futures market (see Chapter 8).

3.8 Conclusions

As agricultural markets become freer, price volatility will increase, and thus, the need for hedging will also increase. The increased opportunities for farmers to manage risk by using futures require a better understanding of the risks involved. In contrast to earlier research, we examined the decrease in price risk through hedging as well as risks that futures introduce. Hedging with futures may lead to temporal basis risk, spatial and quality basis risk, market depth risk, marking-to-market risk and lumpiness. These risks are particularly important to farmers hedging their output on new and small futures exchanges. The empirical results show that the hedging risk in the potato futures market in Amsterdam decreases when more futures are used. Hence, farmers who cooperate in hedging their potatoes bear less risk than farmers who trade separately. The price for which the farmers enter the market has almost no effect on hedging risk, i.e., marking-to-market risk was relatively low. Further research which includes other price-risk-management instruments is clearly called for in order to deepen the understanding of the risks introduced by those instruments and, hence, to provide insight into the optimal price-risk management strategies for farmers. Research taking subjective performance into account is in progress.

3.9 Acknowledgments

We are indebted to the Amsterdam Agricultural Futures Exchange (ATA) and the Clearing Corporation (NLKKAS), especially to Rolf Wevers, for invaluable data and to J.A. Bijkerk from the Department of Marketing and Marketing Research for computational assistance. Furthermore, we are indebted to the board of directors of the ATA for helpful comments on an earlier draft.

CHAPTER 4

The Price Path Due to Order Imbalances: Evidence from the Amsterdam Agricultural Futures Exchange[1]

4.1 Abstract

The lack of sufficient market depth, particularly in many newly initiated futures markets, results in relatively high hedging costs, and this inhibits the growth of futures contract volume. In this chapter the price path due to order imbalances is analyzed and a two-dimensional market depth measure is derived. Understanding the underlying structure of futures market depth provides the management of the futures exchange with a framework for improving their market depth and gives hedgers a better understanding of market depth risk. The managerial implications of our findings are demonstrated empirically, using data from the Amsterdam Agricultural Futures Exchange.

4.2 Introduction

A key aspect of futures market performance is the degree of liquidity in the market (Cuny 1993). The relationship between market depth and futures contract success has been thoroughly investigated in the literature (Black 1986). A futures market is considered liquid if traders and participants can buy or sell futures contracts quickly with little price effect resulting from their

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[1] This chapter has been published as: Pennings, J.M.E., W.E. Kuiper, F. ter Hofstede and M.T.G. Meulenberg (1998), "The Price Path Due to Order Imbalances: Evidence from the Amsterdam Agricultural Futures Exchange", *European Financial Management*, 4 (1), 27-44.

transactions. However, in thin markets, the transactions of individual hedgers may have significant price effects and result in substantial 'transaction costs' (Thompson et al. 1993).

These transaction costs are the premiums that traders are forced to pay or the discounts they are forced to accept in order to establish or close out futures positions (Ward and Behr 1983). Although, to some extent, hedgers can take positions that offset each other, a futures market, if it is to be successful, should normally create more market depth in the form of attracting additional traders.

In the literature, liquidity is often synonymous with width, represented by the bid-ask spread for a given number of futures. The bid-ask spread as a measure of liquidity has some limitations. The price may change between the moment the market maker buys and sells, and the trader can earn much more or much less than the spread quoted at the time of the first transaction suggests. Hence, the trader faces costs due to changes in the bid-ask spread. Yet these costs are the essence of market liquidity (Grossman and Miller 1988). The concept of market depth (the number of securities that can be traded at given bid and ask quotas), an aspect of market liquidity, does not suffer from the limitations of the bid-ask spread, however (Berkman 1993; Harris 1990; Kyle 1985). Therefore, we turn to an examination of market depth as a measure of liquidity.

The objective of our study is to improve insights into market depth and the effect it may have on the performance of futures contracts and, in consequence, on the success of futures exchanges (Pennings and Meulenberg 1997). In the literature, measures of market depth have not explicitly considered the price path produced by temporary order imbalances. Often there is an implicit assumption of linearity and they allow only a limited understanding of the costs associated with lack of market depth. Thus the management of the exchange gets only a limited insight into how the problem of a lack of market depth should be dealt with. In this chapter, we propose and parameterize a model that pays explicit attention to the price path caused by temporary order imbalances. When we have more information about these price paths, we will be able to distinguish two dimensions of market depth that can be related to the toolbox of the futures exchange (the trading system and trading rules). Evaluating different (competing) futures contracts and futures exchanges along these dimensions can shed light on the performance of the futures contract as a price-risk management instrument. In addition, different trading systems and different trading rules can be evaluated along these dimensions. By doing so we can gain some insight into the performance of trading systems and trading rules.

This chapter is organized as follows. In Section 4.3 the measures of liquidity - and in particular the measures of market depth - are examined and Section 4.4 presents a hypothesis of the underlying structure of market depth from which a market depth price path model is then derived. The remainder of the chapter is concerned with the application of our model. Section 4.5 describes the dataset and gives some data transformations. Section 4.6 presents an analysis of market depth for three selected futures contracts. In Section 4.7 the managerial implications for the management of the futures exchange are discussed and the results and main conclusions are summarized in Section 4.8.

4.3 Measures of Liquidity, Particularly Market Depth

Previous research developed measures of *liquidity* on the basis of indices usually represented by some weighting of trading activity (Working 1960; Larson 1961; Powers 1979; Ward and Behr 1974; Ward and Dasse 1977). An important element in these measures is the proportion of hedging to speculative trading volumes. Several researchers (Roll 1984; Gloston and Milgrom 1985; Thompson and Waller 1987; Stoll 1989; Smith and Whaley 1994) propose methods for an indirect estimation of liquidity costs. A liquidity cost proxy based on the estimated covariance of prices has been introduced by Roll (1984). Another accepted proxy for the bid-ask spread has been proposed by Thompson and Waller (1988), who argue that the average absolute value of price changes is a direct measure of the average execution cost of trading in a contract. Smith and Whaley (1994) use a method of moments estimator to determine the bid-ask spread. This estimator uses all successive price change data, and assumes that observed futures transaction prices are equally likely to occur at bid and ask.

Market depth measures are rather scarce. Brorsen (1989) uses the standard deviation of the log price changes as a proxy for market depth. Lehmann and Modest (1994) study market depth by examining the adjustment of quotas to trades and the utilization of the chui kehai trading mechanism on the Tokyo Stock Exchange, where the chui kehai are warning quotas when a portion of the trade is executed at different prices. Utilizing the chui kehai trading mechanism can give an indication of market depth, but cannot be used to measure it. Other researchers such as Bessembinder and Seguin (1993) use both price volatility and open interest as a proxy for market depth. Common to all these market depth measures is the fact that they are based on transaction price variability (Huang and Stoll 1994, 1996) and implicitly assume that the price path due to temporary order imbalances is linear (see, for example, Kyle 1985). Presumably, the price path will not be linear and particularly so where large orders are concerned. Therefore, we propose a non-linear function which relates the futures price to successive trades.

In the literature there are no measures that reflect the shape of the price path due to order imbalances, while it is this shape that provides insight into the underlying structure of market depth. The underlying structure of market depth is especially relevant to new commodity exchanges in Western and Eastern Europe because of the smaller scale of these exchanges (Kilcollin and Frankel 1993). Furthermore, the underlying structure of market depth is an important issue for the clearing houses with respect to the system of margining (Gemmill 1994; Goldberg and Hachey 1992). Insight into the underlying structure of market depth in combination with improvements in computer and telecommunications technology will lead to improvements in the structure of futures markets and financial institutions in general (Merton 1995).

4.4 A Market Depth Model

4.4.1 *Conceptual Model*

Market depth is usually analyzed by determining the slope $\frac{\mathrm{d}PF}{\mathrm{d}Q}$, where PF is the futures price and Q is the quantity traded. As outlined in the previous section, current market depth measures are based on transaction price variability and implicitly assume the price path due to order imbalances to be linear. In this section we hypothesize that the price path arising from order imbalances can be characterized by an S-shaped curve. During the occurrence of such an S-curve, the equilibrium price change is assumed to be constant.[2] The price path is downward-sloping in the case of a sell order imbalance and upward-sloping in the case of a buy order imbalance (Working 1977; Kyle 1985; Admati and Pfleiderer 1988; Bessembinder and Seguin 1993).

We conjecture that the market depth price path consists of four sequential phases, namely I) a sustainable phase, II) a lag-adjustment phase, III) a restoring phase, and IV) a recovery phase. Although we assume this four phase structure to hold for both upward- and downward-sloping price paths, we confine our discussion to a downward-sloping price path.

Figure 1 depicts the price path of a sell order. On the vertical axis the futures price per contract traded is given. On the horizontal axis the successive contracts traded are given, where the serial number of the futures contract is denoted by i. $i = 1$ is the first contract traded, $i = 2$ is the second contract traded and so on.

In the *sustainable phase* (Phase I) the first contracts are sold at or near the bid price because of outstanding bids in the brokers' order books. In this phase the already existing bids are almost or completely equal to the first bid price. For that reason, the initial price decline due to order imbalances is very moderate. However,

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[2] There is a large volume of research in the literature (for example, French and Roll 1986; Fama 1991; Stein 1991; Foster and Viswanathan 1993; Holden and Subrahmanyam 1994; Oliver and Verrechia 1994; Hiraki et al. 1995) on information, market efficiency and market liquidity. In these articles, information refers to information relating to fundamental economic factors (supply and demand factors of the underlying 'commodity' of the futures contract traded). Theoretically, we can split price changes into changes due to fundamental economic factors and changes due to the fact that there is a temporary order imbalance. In this study, we concentrate on the latter.

after these bids have been 'used', the price must fall in order to match the next bid in the order book: this point will be called the 'breaking point'. If the price path depicted in Figure 1 is denoted by $PF(i)$, then the breaking point is located where the curvature $(\frac{d^2PF}{di^2}(i))$ is maximized over i, where $i = 1$ is the first contract traded, $i = 2$ is the second contract traded and so on.

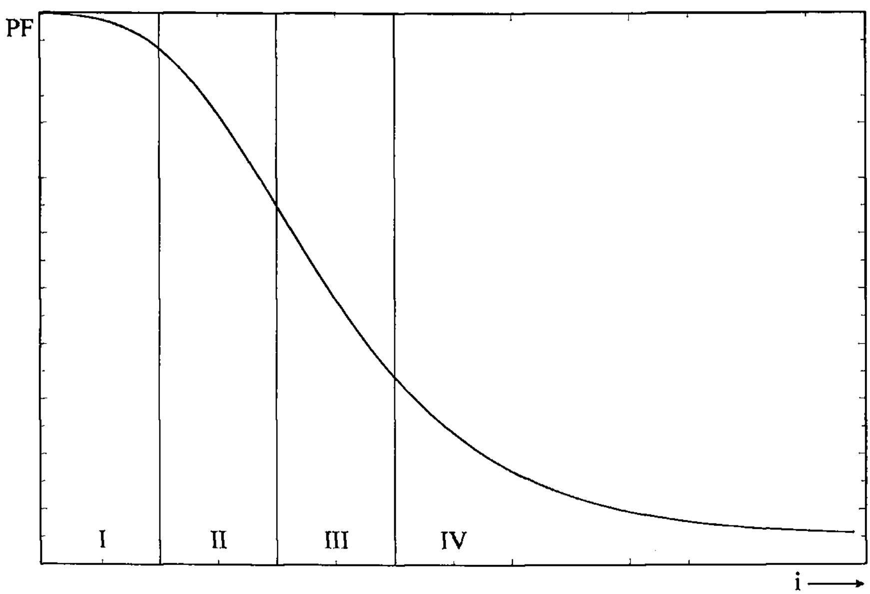

***Figure 1** Price pattern of a sell order in a thin market*

In the *lag-adjustment phase* (Phase II) it is not possible to find enough market depth at a justifiable price. The price falls because bids that have been in the order book for some time (and thus relatively low price bids) are now matched. This gives rise to substantial (compared with Phase I) opportunity costs, gains forgone, because the hedger cannot execute the order at the first bid price (Wagner and Edwards 1993). Important for the length of this interval and the scale of the price fall is the information provided by the trading system (Keim and Madhavan 1995). The lag adjustment phase is situated in between the breaking point and the point of inflexion, the latter being located where the slope $(\frac{\mathrm{d}PF}{\mathrm{d}i}(i))$ is maximized over *i*.

During the 'lag-adjustment phase' the traders process the price decrease information. They will gradually enter the market after the price has fallen sufficiently (Grossman 1992). At that moment the *restoring phase* (Phase III) begins. In this phase the prices fall further, but at a decreasing rate. Phase III is situated in between the point of inflexion and the point where the curvature is minimized over *i*.

In the *recovery phase* (Phase IV) the rate of price decrease slows down fast because more opposite orders enter the market as a consequence of information acquired by the participants. The recovery phase starts at the point where the curvature is minimized over *i*. It ends where the price reaches the resistance price level.[3] Because the rate of price decrease is slowing down and the price gets close to the resistance price level, the participants gradually recognize that fundamental economic factors (supply and demand factors of the underlying commodity of the futures contract) cannot be causing the price change. This leads them to conclude that the price change is caused by order imbalances. In this phase participants tend to expect that the price will not fall any further or at least expect that the price will not decrease by more than the minimum tick size (Chordia and Subrahmanyam 1995). After the resistance price level has been reached, the price will not decrease further because the orders are now balanced.

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[3] The resistance price level marks the upper and lower boundary between which the price fluctuates according to the participants if the equilibrium price is constant. The equilibrium price is determined by fundamental economic factors.

The market depth price path is caused by frictions in the market structure which includes the trading system and the rules of the exchange. The quality of the market information generated by the trading system regarding high price, low price, last price, size of last trade etc., is crucial for such frictions and hence, for the market depth price path (see Domowitz (1993a,b) for a description of trading systems and their impact on market depth).

The S-shaped price path can only be identified ex post. Recognized market efficiency theory would suggest that the price would not adjust in a predictable way (Fama 1991). However, at the moment the price changes, the participants are not able to identify whether the price movement is due to fundamental economic factors causing a change in the equilibrium price or whether it is due to a lack of market depth generated by market frictions caused by the trading system itself.

A priori we do not assume that the downward-sloping S-shaped price path is exactly the reverse of the upward-sloping price path. It is possible, for example, that there are many stop-loss buy orders and hardly any stop-loss sell ones and vice versa, thus causing dissimilarity between upward-sloping and downward-sloping price paths (Chan and Lakonishok 1993). Nor do we assume the length of the four phases to be equal. In a market that is unable to absorb orders near the equilibrium price, for example, the sustainable phase will become rudimentary.

4.4.2 *Mathematical Specification of the Model*

In the mathematical model showing the conceptual model of market depth portrayed in Section 4.4.1, both sell and buy orders (downward- and upward-sloping price paths) are taken into account. An upward-sloping S-shaped path may well be approximated by a Gompertz curve, since this curve has a non-symmetrical S-shape and thus, does not impose restrictions on the length of the different phases. The Gompertz model is a growth curve and can therefore only be used to describe an upward-sloping price path. However, subtracting a downward-sloping price path from an appropriate constant may establish an upward-sloping price path which will cover the four phases. Consequently, after transforming the data, the price path will always be upward-sloping. We can describe the transformed price series using the Gompertz model given by

$$TPF_i = \alpha \exp(-\beta \exp(-\delta i)) \quad (1)$$

where TPF_i is the transformed price of futures contract i $(i = 0,1,2,\ldots,n)$ and α, β and δ are positive parameters. Since the price path is restricted to start in the minimum tick size, TPF_0 is equal to the minimum tick size. The parameter β is determined by both α and TPF_0: $\beta = \ln\left(\frac{\alpha}{TPF_0}\right)$. The parameters α and δ of the Gompertz model capture two dimensions of market depth. The first dimension, represented by α minus the minimum tick size, indicates how far the price rises (falls) as a consequence of a lack of market depth. The second dimension, presented by δ, has a one-to-one relation with the rate of adjustment, which, as we will show below, is equal to $[1 - \exp(-\delta)]$, see Chow (1967) and Franses (1994a,b). This rate of adjustment may be translated into costs in terms of price risk; the futures price may change before actual order execution.

Taking natural logarithms of (1) yields

$$\ln(TPF_i) = \ln\alpha - \beta\exp(-\delta i) \tag{2}$$

A convenient representation of the Gompertz process is obtained by subtracting $\ln(TPF_{i-1})$ from (2) which after some rewriting using (1), gives

$$D\ln(TPF_i) = [1 - \exp(-\delta)][\ln\alpha - \ln(TPF_{i-1})] \tag{3}$$

where D is the first order differencing filter defined by $Dz_i = z_i - z_{i-1}$. Equation (3) is of particular interest because it can be interpreted as a partial price adjustment model. In order to see this, note that $0 < [1 - \exp(-\delta)] < 1$. As a consequence, although α will always exceed TPF_i, $\ln(TPF_i)$ is rising toward $\ln\alpha$ at a constant rate of adjustment $[1 - \exp(-\delta)]$. For instance, if $[1 - \exp(-\delta)] = 0.1$, it will take many more contracts to achieve a particular price rise than in the situation where $[1 - \exp(-\delta)] = 0.5$, *ceteris paribus*. Similarly, if $\ln\alpha$ exceeds $\ln(TPF_i)$ by one per cent of $\ln(TPF_i)$, then $\ln(TPF_i)$ will increase by $[1 - \exp(-\delta)] \times 100$ per cent. In addition, $\exp(-\delta)$ is the elasticity of TPF_i with respect to TPF_{i-1}.

In terms of the parameters of our model representing two dimensions, this means that an increase (decrease) of both α and δ implies a decrease (increase) of the market depth. Where α and δ have opposite signs we have two counter acting forces. If the order is relatively large the first dimension α is particularly relevant as far as incurring execution costs are concerned. For relatively small orders the second dimension δ is relevant. Table 1 summarizes the effects of changes in the two dimensions on market depth.

Table 1 Effects of changes in the two dimensions on market depth

	α increases	δ increases	α increases and δ decreases	α increases and δ decreases
Lack of market depth (in terms of execution costs)	increases	increases	depending on magnitude order flow	depending on magnitude order flow

The model in (3) may be extended on three fronts. First, Equation (3) is an approximation to the transformed price series. Hence, we add a disturbance term u_i to (3) under the assumption that $u_i \sim \text{IID}(0, \sigma^2 \text{I}_n)$. Second, notice that the transaction-specific price observations cannot be described by a single curve such as the curve depicted in Figure 1, but by a sequence of such curves where an upward-sloping curve is always succeeded by a downward-sloping one and the other way round. As a consequence, the data series on the transformed price consists of a panel (not restricted to being balanced) of upward-sloping curves in chronological order. Third, as discussed in section 3.4.1, to allow upward- and actually downward-sloping curves to have dissimilar shapes, (3) is extended to:

$$\text{D} \ln (TPF_{ci}) = \pi_s - \tau_s \ln (TPF_{c,i-1}) + u_{ci} \tag{4}$$

$$\text{s.t. } u \sim \text{IID}(0, \sigma^2 \text{I}_N)$$

where $\pi_s = [1 - \exp(-\delta_s)] \ln \alpha_s$, $\tau_s = [1 - \exp(-\delta_s)]$, $i = 1, \ldots, n_c$ with $c = 1, \ldots, H$ and s is an index for actually upward- $(s = 1)$

and downward-sloping ($s = 2$) curves. H denotes the number of curves. Notice that our dataset on TPF_{ci} consists of $N = \sum_{c=1}^{H} n_c$ observations (i.e., traded contracts), where n_c is the number of contracts per curve c. In the next section more details are given on how we obtain these observations.

4.4.3 *Estimation of the Model*

In our theoretical model we assume that during the occurrence of an S-shaped price path, the equilibrium price is constant and, therefore, the S-shaped price path is attributed solely to temporary order imbalances. However, actual price changes in the futures market result from both temporary order imbalances and from supply and demand factors of the underlying commodity of the futures contract. Consequently, estimation of the model on the basis of real futures market data might invalidate the assumption of a constant equilibrium price during every separate S-shaped price path. However, S-shaped price paths due to temporary imbalances occur in a very short period of time, say within a matter of minutes. Since the effect of fundamental economic factors occurs over a much longer period of time than a few minutes, we might expect that during such a downward-sloping or upward-sloping price path the price change due to fundamental economic factors, i.e. the change of the equilibrium price, is negligible compared to the price change due to order imbalances.

After identifying the individual price paths, we subtract the observations of each downward-sloping price path from the price at which the price path started, such that all curves become upward sloping.[4] In order to eliminate the general price level effect, we shift the curves downward, such that each curve starts at the minimum tick size. Thus, each S-curve, after being transformed to become upward sloping, is shifted downward to the minimum tick size. In doing so we correct for differences in equilibrium price between S-curves. Using the resulting data series, estimates of the dimensions of market depth α and δ are obtained by the following procedure. First, maximum likelihood estimates of π_s and τ_s are obtained by applying ordinary least squares to (4). The maximum likelihood estimates of the relevant parameters α_s and δ_s are computed by $\alpha_s = \exp(\frac{\pi_s}{\tau_s})$ and $\delta_s = -\ln(1 - \tau_s)$. Second, the standard errors of α_s and δ_s are computed by the square root of the diagonal elements of $\mathrm{var}(\eta) = [\frac{\partial\eta'}{\partial\theta}]\,\mathrm{var}(\theta)[\frac{\partial\eta'}{\partial\theta}]'$ (see Cramer 1986), where $\eta = (\alpha_1\ \alpha_2\ \delta_1\ \delta_2)'$ and $\theta = (\pi_1\ \pi_2\ \tau_1\ \tau_2)'$ are four-dimensional parameter vectors. Since the maximum likelihood estimators have asymptotic normal distributions, *t*-values may be used to test if the parameters are significantly different from zero. To see whether one single market depth price path for both upward- and downward-sloping curves suffices, i.e. whether or not the upward-sloping price path is exactly the reverse of the downward-sloping price path, we test the hypothesis H_0: $\{\alpha_1 = \alpha_2 = \alpha$ and $\delta_1 = \delta_2 = \delta\}$. In terms of Equation (4) this implies testing

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[4] From the data it is not clear where the exact split between an increasing and decreasing price path should be imposed when two or more contracts in between are traded at the same price. Therefore, to determine the split we apply the following procedure: for an odd number of contracts traded at the same price we use the middle contract, and for an even number of constant contracts we employ a random assignment with equal probabilities.

H_0: $\{\pi_1 = \pi_2 = \pi$ and $\tau_1 = \tau_2 = \tau\}$. Since the restrictions are linear we use an F-test of which the test statistic has an $F(2, N - 4)$ distribution, under H_0.

4.5 Data

In order to illustrate the contributions of the model presented above, we apply it to data from the Amsterdam Agricultural Futures Exchange (ATA). This exchange is one of the largest agricultural futures exchanges in Europe. The trading system employed by the ATA is the open outcry system. There are no scalpers on the trading floor and all orders enter the trading floor via brokers. Brokers are only allowed to trade by order of a customer. There is no central order book on the ATA. The broker only has insight into his/her own order book. The customer (hedger or speculator) has no information on outstanding orders.

Potatoes and hogs are traded on the ATA. The potato futures contract is a relatively successful one in the sense that the volume generated (about 200,000 contracts annually) is large relative to competitive potato contracts elsewhere in Europe (such as the potato futures traded on the London Commodity Exchange and on the Marché à Terme International de France). The annual volume is small, however, when compared with agricultural futures traded in the United States. Hog futures are not successful as far as their volume (about 30,000 contracts annually) is concerned. The minimum tick size for the potato and hog futures contracts equals 0.10 Dutch Guilders and 0.005 Dutch Guilders, respectively.

We use real-time transaction-specific data for three futures contracts: potato contract delivery April 1996, and hog contract deliveries August and September 1995.[5] Descriptive statistics for both the potato and hog futures price and volume series are presented in Table 2. The average number of contracts per trading day is relatively large for the potato market compared with the hog markets. The latter market faces severe problems of market depth which inhibits its contract growth.

***Table 2** Descriptive statistics of the real-time transaction-specific futures prices*

	Futures Contracts		
	Potato delivery April 1996	Hog delivery August 1995	Hog delivery September 1995
Number of observations (i.e. contracts traded)	46791 (April '95 - August '95)	2742 (February '95 - August '95)	2317 (February '95 - August '95)
Average number of contracts per trading day	503	24	22
Average price per contract*	43.4	2.330	2.265
Standard deviation of the price	18.0	0.150	0.120
Minimum price	21.7	2.065	2.060
Maximum price	79.0	2.655	2.650

* *The futures price for potatoes is quoted in Dutch Guilders per 100 kilogram whereas the hogs are quoted in Dutch Guilders per kilogram live weight.*

[5] The reason that we investigate these three futures contracts is a practical one. In order to estimate the model we had to obtain transaction-specific data. These data were gathered by the exchange on our request. Normally the exchange only saves the daily close price, high price, low price and traded volume. We were able to receive transaction-specific prices only for the three futures contracts investigated in the chapter.

4.6 Empirical Results

In this section we apply ordinary least squares to (4) and express the estimates of π and τ in those of α and δ.

In Table 3 the estimation results for the potato futures contract, delivery April 1996, are displayed.

Table 3 *Estimates of the parameters describing the underlying dimensions of market depth of the potato futures contract, delivery April 1996*

Contract			Parameter estimates Gompertz curve*	
			α	δ
Potatoes futures contracts, delivery April 1996		downward sloping	1.374	0.053
			(0.057)	(0.002)
		upward sloping	1.013	0.060
			(0.053)	(0.002)
Number of observations	46790			
R^2	0.099	Probability of $F(3, 46786)$		< 0.001
$F(3, 46786)$	638	Durbin - Watson statistic		1.914
$F(2, 46786)$ for H_0: $\{\alpha_1 = \alpha_2 = \alpha$ and $\delta_1 = \delta_2 = \delta\}$			7.760	
Probability of $F(2, 46786)$			< 0.001	

* *standard errors in parentheses.*

It can easily be seen that all parameter estimates are significantly greater than zero when using a one-sided t-test and a 0.05 level of significance. The Durbin-Watson statistic does not indicate any mis-specification. In spite of its low value, the R^2 is significantly greater than zero, as indicated by the $F(3, 46786)$

statistic. The hypothesis H_0: $\{\alpha_1 = \alpha_2 = \alpha \text{ and } \delta_1 = \delta_2 = \delta\}$ is rejected. Therefore, the market depth for the potato futures contracts, delivery April 1996, significantly differs between periods of price rise and price fall.

Table 4 presents the estimation results for the hog futures contract, delivery August 1995. Since the hypothesis H_0 cannot be rejected, we conclude that the market depth for this contract is characterized by a single Gompertz curve. So, the upward sloping price path is the reverse of the downward sloping price path. Compared with Table 3, the statistics in Table 4 lead to similar conclusions with respect to the performance of the regression.

***Table 4** Estimates of the parameters describing the underlying dimensions of market depth of the hog futures contract, delivery August 1995*

Contract			Parameter estimates Gompertz curve*	
			α	δ
Hog futures contracts, delivery August 1995			0.039 (0.016)	0.159 (0.009)
Number of observations	2741			
R^2	0.249	Probability of $F(1, 2739)$		< 0.001
$F(1, 2739)$	348	Durbin - Watson statistic		1.811
$F(2, 2739)$ for H_0: $\{\alpha_1 = \alpha_2 = \alpha \text{ and } \delta_1 = \delta_2 = \delta\}$			0.217	
Probability of $F(2, 2739)$			0.805	

* *standard errors in parentheses.*

Table 5 shows the estimation results for the hog futures contracts, delivery September 1995. The results are quite similar to those in Table 4. Again, we cannot reject H_0.

***Table 5** Estimates of the parameters describing the underlying dimensions of market depth of the hog futures contract, delivery September 1995*

Contract				Parameter estimates Gompertz curve*	
				α	δ
Hog futures contracts, delivery September 1995				0.044 (0.022)	0.115 (0.008)
Number of observations	2314				
R^2	0.200	Probability of $F(1, 2312)$			< 0.001
$F(1, 2312)$	348	Durbin - Watson statistic			1.855
$F(2, 2312)$ for H_0: $\{\alpha_1 = \alpha_2 = \alpha$ and $\delta_1 = \delta_2 = \delta\}$				0.136	
Probability of $F(2, 2312)$				0.873	

* *standard errors in parentheses.*

4.7 Discussion

We will now discuss how the management of the exchange can use our empirical results to improve the performance of the futures exchange with regard to its market depth. For this purpose, we draw the Gompertz curves for the upward-sloping and downward-sloping potato futures price path (see Figure 2) and for the hog futures price paths (see Figure 3), using the parameter estimates in Tables 3, 4 and 5.

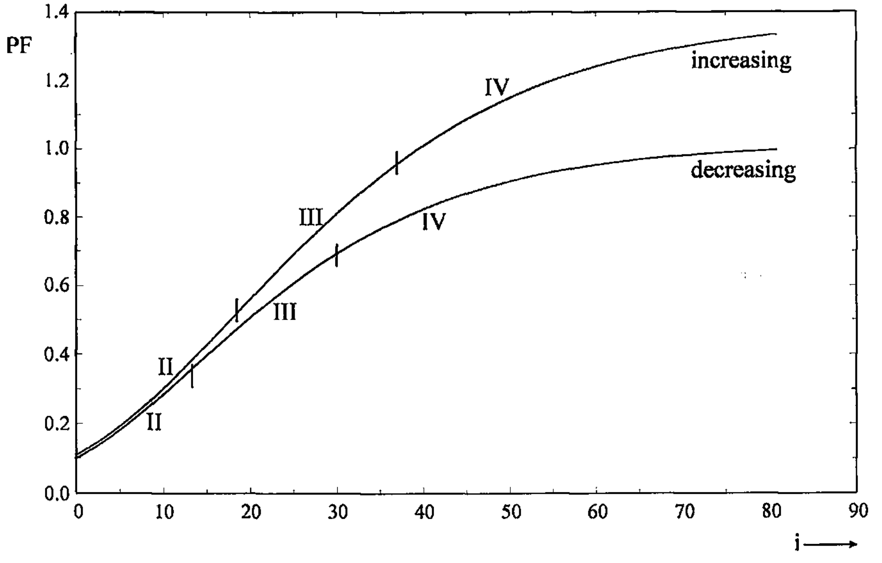

***Figure 2** The Gompertz curves for the potato futures contract delivery April*

The figure depicts the Gompertz curves for increasing and decreasing price paths. On the vertical axis the futures price per contract traded is given. On the horizontal axis the prices of successive contracts traded are given, where the serial number of the futures contract is denoted by i. $i = 1$ is the first contract traded, $i = 2$ is the second contract traded and so on.

In each of the two figures both dimensions of market depth are visualized simultaneously. Note that since the upward-sloping price paths for both deliveries of hog are the reverse of the downward-sloping price paths, we only depict the upward-sloping price paths for both hog series in Figure 3.

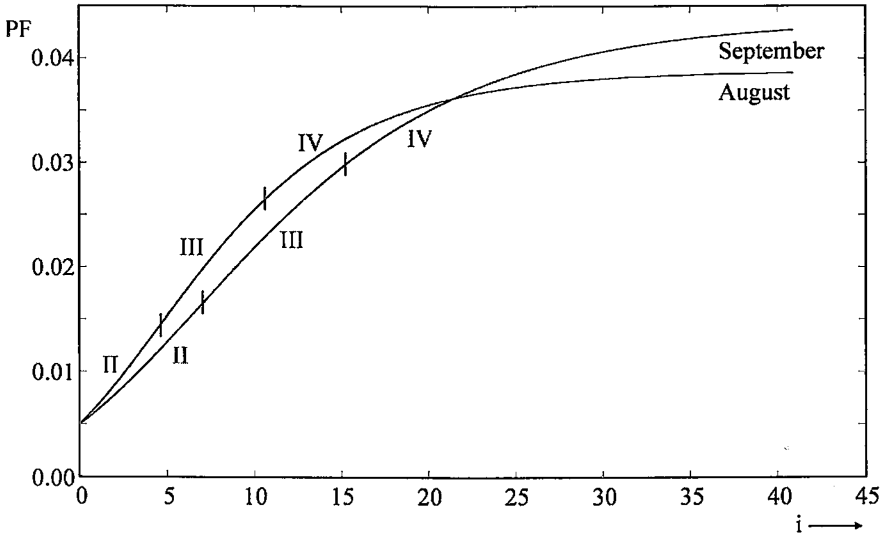

***Figure 3** The Gompertz curves for hog futures contracts deliveries August and September*

The figure depicts the Gompertz curves for hog delivery August and hog delivery September. No distinction is made between upward- and downward-sloping price paths, because the upward sloping price path is exactly the reverse of the downward sloping price path. On the vertical axis the futures price per contract traded is given. On the horizontal axis the successive contracts traded are given, where the serial number of the futures contract is denoted by i. $i = 1$ is the first contract traded, $i = 2$ is the second contract traded and so on.

The upward- and downward-sloping Gompertz curves for *potato* futures have dissimilar shapes. The first dimension - indicating how far the price falls or rises due to order imbalances - is quite large compared with the general price level. This might be due to the absence of scalpers. In order to improve the absorption capacity, the ATA might consider allowing scalpers on the floor. The second dimension - the rate of price change - is higher for the upward-sloping price path than for the downward-sloping price path. This can be explained by the fact that there are differences between the number of stop-loss buy and stop-loss sell orders. The difference between the numbers of stop-loss buy and stop-loss sell orders can be explained by the fact that participants in the potato futures market consist of relatively large firms (potato processing industry) who are the net buyers of potato futures contracts on the one hand and relatively small firms (potato farmers and small potato traders) who are net sellers of potato futures contracts on the other. The former participants often use stop-loss buy orders especially because they normally make cash forward contracts with retailers regarding potato products (such as chips and French fries). When the price rises we observe a trigger effect: a considerable number of stop-loss buy orders are executed which push the price upwards and thereby reinforce the stop-loss buy order effect which causes an acceleration of the price of futures. The potato farmers and small traders usually do not use stop-loss sell orders, but wait until the price is satisfactory and then enter the futures market.[6]

Since the curves in Figure 2 do not intersect, we may conclude that the futures market is deeper in the case of a sell order imbalance than in the case of a buy order imbalance. The problem of the high rate of (adverse) price changes at the ATA might be solved by implementing a mechanism for slowing down the trade process if order imbalances do occur and to improve market depth by reporting these. Also the order book information can be improved. At the ATA, the order books of the different brokers are not linked and the customer has no information with regard to outstanding orders. An order book mechanism that allows potential participants to view real-time limit orders, displaying the desired

[6] We acknowledge the information we received on this subject from the brokers at the Amsterdam Agricultural Futures Exchange.

prices and quantities at which participants would like to trade, will improve the rate of adjustment and the distance between the lower and upper bounds.

The upward- and downward-sloping price paths are similar for both *hog* deliveries. In the hog futures market we observe a symmetry between stop-loss buy and stop-loss sell orders in contrast to the potato futures market.[7] Tables 4 and 5 show that α is smaller for delivery August than for delivery September indicating that the delivery August performs better on the first dimension. However, on the second dimension delivery September performs better than delivery August (i.e, δ for delivery September is smaller than for delivery August). Consequently we observe in Figure 3 that the price paths intersect, indicating that for relatively small orders September delivery is deeper than August, whereas for large orders August delivery is deeper (see also Table 1).

4.8 Conclusions and Further Research

In contrast to the existing market depth measures, we conjecture that the market price depth path has an S-shape in which four phases can be distinguished: the sustainable price phase, the lag-adjustment phase, the restoring phase and the recovery phase. This S-shaped price path may well be approximated by the Gompertz curve, which allows for a non-symmetrical S-shape and hence, does not impose certain restrictions on the length of the different phases. The two parameters of our model represent two dimensions of market depth. The first dimension represents the

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[7] We acknowledge the information we received on this subject from the brokers at the Amsterdam Agricultural Futures Exchange.

distance between the upper and lower bounds, i.e. indicates how far the price falls (rises) due to a lack of market depth. The second dimension indicates the rate at which price falls or rises. Our market depth measure has convenient characteristics. First, it provides insights into the underlying structure of market depth and gives guidelines for improving market depth. Second, our measure can be used to compare competitive futures contracts. Third, the market depth model is estimated with simple regression techniques. Furthermore, since our measure can be presented in a graphical way, it is relatively easy to interpret.

We applied the model to the potato and hog futures traded on the Amsterdam Agricultural Futures Exchange. We found that both the distance between the upper and lower bounds of the price path and the rate of the price change is high, indicating a lack of market depth. The current trading system - no scalpers and no central order book information - contributes to this situation. Redesigning the trading system in order to lower the distance between the upper and lower bounds of the price path and the rate of the price change is recommended.

When interpreting the results, it is important to be aware of the following points. First, as we have indicated, our model requires transaction-specific data. Transaction-specific data enable us to identify individual downward-sloping price paths and individual upward-sloping price paths by assuming that each of these price paths ends when the traders expect that price will not change by more than the minimum tick size, and that during each price path, which takes place over the space of a few minutes, price change due to fundamental economic factors will be negligible compared to the price change due to order imbalances, i.e. we may expect that over such a short period of time the equilibrium price does not change.

Second, our research is restricted to one futures trading system. In order to draw conclusions with respect to the relation between the two distinguished market depth dimensions and the futures market structure, other futures trading systems should be incorporated into the analysis. Measuring the market depth dimensions for different kinds of trading systems provides more information as far as the relationships between the market depth dimensions and the different elements of trading systems are concerned. Research addressing these two points should be an interesting avenue to explore in the future.

4.9 Acknowledgments

The authors wish to thank the Amsterdam Exchanges (AEX Agricultural Futures Exchange) for its financial support. We are indebted to the Clearing Corporation (NLKKAS), especially to Rolf Wevers, for invaluable data and the brokers of the Amsterdam Agricultural Futures Exchange for providing information on the potato and hog futures markets. Furthermore, we would like to thank the Board of Directors of the ATA, the management of the European Options Exchange, the participants of the European Association of Agricultural Economists 1996 Seminar: Agricultural Marketing and Consumer Behavior in a Changing World, the participants of Chicago Board of Trade 1996 Ninth Annual European Futures Research Symposium, especially Paul Dawson of the City University Business School, and an anonymous reviewer of the *European Financial Management* for their helpful comments on an earlier draft of this chapter.

CHAPTER 5

The Hedging Performance in New Agricultural Futures Markets[1]

5.1 Abstract

Agribusiness companies and farmers must cope with the risk of price changes when buying or selling agricultural commodities. Hedging price risk with agricultural commodity futures offers a way of minimizing this risk. Information is needed on the hedging effectiveness of these futures. Since many new agricultural futures markets, especially those in Europe, are thin markets, hedgers face liquidity risks which have to be taken into account when evaluating hedging effectiveness. Contrary to the next chapter which introduces a new hedging efficiency measure by taking a futures exchange management perspective, this chapter will adopt a hedger's perspective (cfr. Chapter 6, Table 3).

5.2 Introduction

Price risk has become a more immediate issue for both farmers and agribusiness companies in the United States (US) and European Union (EU) due to GATT free trade policies and the agricultural policy reforms made by the EU. Owing to increased agricultural price fluctuations, some exchanges in Europe such as the Amsterdam Agricultural Futures Exchange, the London Commodity Exchange, the Warenterminbörse in Hannover and the Warsaw Board of Trade, are planning to introduce new agricultural

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[1] This chapter has been published as: Pennings, J.M.E. and M.T.G. Meulenberg (1997), "The Hedging Performance in New Agricultural Futures markets: A Note", *Agribusiness: An International Journal,* 13(3), 295-300.

futures contracts. These new futures markets are thin, meaning that the size of the transaction of an individual hedger may have a significant effect on the price and may therefore result in substantial 'transaction costs'.

In recent articles Conley (1994) and Ennew et. al. (1992) draw conclusions about the hedging performance of a futures market without recognizing this price effect. This chapter proposes a new method to measure hedging effectiveness which also considers how the taking and unwinding of a large position may affect the futures price in thin futures markets. Therefore, the proposed measure is particularly appropriate for thin markets, such as some of the European agricultural futures markets. The proposed measure also includes basis risk and trading costs. These have been discussed in previous research.

5.3 Literature Review

Recently proposed measures of hedging effectiveness express the usefulness of trading a futures contract, based on the results of a combined cash-futures portfolio relative to the cash position alone (e.g. Ederington 1979, Franckle 1980, Hill and Schneeweis 1982, Wilson 1984, Howard and D'Antonio 1984, Chang and Shanker 1986, Overdahl and Starleaf 1986, Lindahl 1989, Chang and Fang 1990, Gjerde 1987, Pirrong, Kormendi and Meguire 1994, Hsin, Kuo and Lee 1994). The researchers' conclusions about the hedging performance of futures markets depend on the method used to measure the hedging effectiveness.

Ederington (1979) and Hill and Schneeweis (1982) measured hedging effectiveness as the percentage reduction in the variance of returns achieved by an optimally hedged position as opposed to an unhedged position. Their hedging effectiveness measures assume a hedging strategy to minimize price variance. The objective of these effectiveness measures is to measure hedging effectiveness for a risk-minimizing hedge which can be represented by the minimum risk hedging ratio.

The hedging performance measures frequently cited do not explicitly take into consideration the liquidity risk involved in trading futures. However, thin agricultural futures markets do introduce liquidity risk which will have an impact on the variance of returns. For a detailed description of liquidity see Chapters 3 and 4 of this book.

5.4 A New Measure of Hedging Effectiveness

Following the method of Ederington (1979) let R represent the return on a portfolio which includes both spot market holdings, X_s, and futures market holding, X_f, where X_s and X_f have opposite signs. A hedger who uses the futures market to manage his/her price risk and is aware of the basis and liquidity cost will take this into account. The expected return on a portfolio can now be written as:

$$E(R) = X_s E[P_s^2 - P_s^1] + X_f E[P_f^2 - P_f^1] - X_f E[LC] - K(X_f) \quad (1)$$

The variance of the return is given by:

$$\text{var}(R) = X_s^2\sigma_s^2 + X_f^2\sigma_f^2 + X_f^2\sigma_{LC}^2 + 2X_sX_f\sigma_{sf} - 2X_sX_f\sigma_{sLC} - 2X_f^2\sigma_{fLC} \quad (2)$$

where $E(R)$ is the expected return on a portfolio, $[P_s^2 - P_s^1]$ is the gain or loss on a spot position, $[P_f^2 - P_f^1]$ is the gain or loss on the futures position, LC are the liquidity costs, $K(X_f)$ are the brokerage costs and the cost of providing margin. σ_s^2, σ_f^2, σ_{sf}, σ_{fLC} and σ_{sLC} represent the subjective variances and the covariances of the possible price and liquidity cost changes from Time 1 to Time 2.

Let $b = -\frac{X_f}{X_s}$ represent the proportion of the spot position hedged. Since in a hedge X_s and X_f have opposite signs, b is usually positive. The variance can now be expressed as:

$$\text{var}(R) = X_s^2[\sigma_s^2 + b^2\sigma_f^2 + b^2\sigma_{LC}^2 - 2b\sigma_{sf} + 2b\sigma_{sLC} - 2b^2\sigma_{fLC}] \quad (3)$$

Holding X_s constant, let us consider the effect of a change in b, the proportion hedged, on the expected return and variance of the return R.

$$\frac{\partial\, \text{var}(R)}{\partial b} = X_s^2[2b\sigma_f^2 + 2b\sigma_{LC}^2 - 2\sigma_{sf} + 2\sigma_{sLC} - 4b\sigma_{fLC}] \quad (4)$$

So the risk minimizing b, b^* is

$$b^* = \frac{\sigma_{sf} - \sigma_{sLC}}{\sigma_f^2 + \sigma_{LC}^2 - 2\sigma_{fLC}} \quad (5)$$

Substituting (5) in (3) yields:

$$\text{var}(R^*) = X_s^2 b^{*2}(\sigma_f^2 + \sigma_{LC}^2 - 2\sigma_{fLC}) + X_s^2 b^*(-2\sigma_{sf} + 2\sigma_{sLC}) + X_s^2\sigma_s^2 \quad (6)$$

where $\text{var}(R^*)$ denotes the minimum variance on a portfolio containing futures.

Let U represent the return on an unhedged position,

$$E(U) = X_s E[P_s^2 - P_s^1] \quad (7)$$

$$\text{var}(U) = X_s^2\sigma_s^2 \quad (8)$$

In line with Ederington (1979) our measure of hedging effectiveness is the percentage reduction in the variance of the return on the portfolio and can be given by:

$$HE = 1 - \frac{\text{var}(R^*)}{\text{var}(U)} \quad (9)$$

Consequently,

$$HE = -\frac{b^{*2}(\sigma_f^2 + \sigma_{LC}^2 - 2\sigma_{fLC}) + b^*(-2\sigma_{sf} + 2\sigma_{sLC})}{\sigma_s^2} \quad (10)$$

It can easily be shown that in liquid markets, i.e. markets with no liquidity risk, the proposed measure *HE* equals the Ederington measure.

Our measure will be a particularly valuable tool in evaluating the hedging effectiveness of new agricultural futures which will, initially, be traded in thin markets. In order to illustrate the usefulness of the proposed measure and the difference between this measure and the Ederington measure (the latter is widely used by practitioners and researchers), we have applied both hedging effectiveness measures to data from the Amsterdam Agricultural Futures Exchange.

5.5 Data

The Ederington measure and the proposed measure are calculated using data on the potato futures contract traded at the Amsterdam Agricultural Futures Exchange. The annual volume (200,000 contracts in 1995) is small compared with agricultural futures traded in the United States. The sample covers the period from September 1995 up to April 1996. This period equals one potato storage year, i.e. potatoes harvested in 1995. The transaction-specific futures contracts data were obtained from the Clearing Corporation (NLKKAS) of the Amsterdam Agricultural Futures Exchange. The cash price data were obtained from the Rotterdam potato cash market. This is the central spot market for potatoes in the Netherlands.

The transaction-specific data consist of the price quoted of every futures contract traded in chronological order. Liquidity costs can be calculated using these data. In the case of an order selling imbalance liquidity costs were calculated as the area between the downward-sloping price path and the price for which the hedger enters the futures market, hence

$$LC = PF^1 \cdot N - \sum_{i=1}^{N} (PF^i) \tag{11}$$

where PF^1 is the futures price for which the hedger enters the market, PF^i is the price of the *i*-th futures contract and *N* the total order flow.

The liquidity costs in the case of an order buying imbalance were calculated as the area between the upward-sloping price path and the price for which the hedger enters the futures market, hence

$$LC = \sum_{i=1}^{N} (PF^i) - PF^1 \cdot N \tag{12}$$

Having determined the liquidity costs, the spot prices and the closing prices of the futures contract, the proposed measure can be calculated according to Equation (10). In this chapter we test the hedging performance of hedges held over one week, hence $P_s^2 - P_s^1$ in Equation (1) covers one week.

We hypothesize that the proposed measure shows a relative less effective hedge than the Ederington measure because the latter does not include liquidity risk.

5.6 Results

Table 1 tabulates the value of the hedging performance measured by the Ederington measure and the value of the proposed measure.

Table 1 Hedging performance of potato futures contract delivery April 1996.

Ederington measure	Proposed measure
0.94	0.89
$b^* = 0.47$	$b^* = 0.44$

Note that both measures range from 0 to 1, indicating the reduction in the variance of the return. From Table 1 it appears that the hedging effectiveness of the potato futures contract is higher according to the Ederington measure than according to the proposed measure, which corresponds with our expectations. This result is due to the fact that the proposed measure takes basis risk and liquidity risk into account, whereas the Ederington measure only takes basis risk into account.

To see whether the hedging effectiveness using the Ederington measure is statistically different from the proposed measure, we test the hypothesis H_0: $\{\text{var}(R^*) = \text{var}(R^*)^e\}$ where $\text{var}(R^*)$ and $\text{var}(R^*)^e$ denote the minimum variance on a portfolio containing futures based on the proposed measure and the Ederington measure respectively. We expect that $\text{var}(R^*) > \text{var}(R^*)^e$ because, in our approach, we take liquidity risk into consideration. To make this test we calculate $F = \text{var}(R^*)/\text{var}(R^*)^e = 1.83$ with 116 *df.* Under H_0 the 5% level is $F_{0.05} = 1.36$. Hence, H_0 is rejected ($p = 0.00063$), meaning that the minimum variance on a portfolio containing futures is significantly greater for our approach than the Ederington approach. Therefore, the inclusion of liquidity risk makes our measure of hedging effectiveness statistically significantly different from the Ederington measure.

Table 1 shows that the Ederington measure recommends hedging 47% ($b^* = 0.47$) of the spot position whereas the proposed measure recommends hedging 44%. Our empirical application illustrates that in thin markets, the Ederington measure may overestimate hedging effectiveness and therefore recommends hedging more than in the case that liquidity risk is taken into account. Therefore, we propose using the hedging effectiveness measure as it is given in Equation (10), if we suspect a thin futures market.

5.7 Conclusions

Unlike other studies on the measurement of futures contract performance we emphasize that futures markets not only introduce basis risk but also liquidity risk. This is particularly relevant in thin markets such as the present European agricultural futures markets. We propose a more comprehensive measure than the Ederington measure by including liquidity risk. If there is no liquidity risk our measure equals the Ederington measure. So, whenever we suspect that the futures market might be thin because, for example, the volume traded is small or there are no scalpers on the floor to absorb temporary order imbalances, we recommend using the proposed hedging effectiveness measure. The application of this measure requires transaction-specific data and cash market data. Because of the evolution of information technology these data become easy to obtain. Therefore, it seems that our measure can be useful in managing the futures exchange and to assist agribusiness companies in evaluating the performance of futures contracts in order to minimize risk.

5.8 Acknowledgments

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CHAPTER 6

Hedging Efficiency: A Futures Exchange Management Approach[1]

6.1 Abstract

In studies of futures markets much attention has been paid to the hedging effectiveness of futures contracts because it is an important determinant in explaining the success of futures contracts (Tashjian and McConnell 1989). The authors who have proposed measures of this effectiveness include Chang and Fang (1990), Ederington (1979), Gjerde (1987), Hsin, Kuo, and Lee (1994), Lasser (1987) and Nelson and Collins (1985). All these measures have in common that they try to indicate to what extent hedgers are able to reduce cash price risk by using futures contracts. In these studies hedging effectiveness refers to returns on portfolios. A particular futures contract can have different values with respect to hedging effectiveness, depending on which measure is used and on the hedger's utility function. Futures contracts, themselves, introduce risks for hedgers. Therefore, the extent to which a futures contract offers a reduction in overall risk is an important criterion for the management of the futures exchange to evaluate the hedging performance. Actually, the smaller the basis and market depth risks of a futures contract, the greater the risk reduction. The preference for one hedging vehicle over another is given after considering both the risk and the cost of the alternative hedges (Castelino, Francis and Wolf 1991).

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6.2 Introduction

This chapter introduces a new concept of hedging efficiency and a measure of this efficiency, indicating the quality of the hedging service provided by the futures contract (including both the risks and the costs of the hedge). The proposed measure is an extension and a supplement to existent measures, and has a different purpose, a different interpretation and a different target group. It assesses futures contracts from the perspective of the management of the futures exchange. The futures market is assumed to be predisposed towards creating a superior value for customers (Narver and Slater 1990), thereby generating a high trading volume. The chapter's goal is to provide a measure which is able to give the management of the futures exchange insight into the performance of the exchange. The proposed hedging efficiency measure appraises the distance between the actual hedge and the perfect hedge. This distance can be divided into a systematic part, which can be managed by the futures exchange, and a random part which is beyond its control. Hence, the measure is a useful tool for the management of the futures exchange, because it allows for a quality evaluation of the actual hedge.

This chapter is organized as follows. After having reviewed frequently used measures of hedging performance, that is hedging effectiveness, the conceptual aspects of hedging efficiency are discussed, and a new measure is presented. An empirical application of the proposed hedging efficiency measure reveals its usefulness for the management of the futures exchange. The final section summarizes the findings.

6.3 Measures of Hedging Effectiveness: a Brief Review

The latest and the most common hedging theory nowadays is the portfolio approach. In this approach the risk of price changes is introduced into the hedging model in a variance function. Moreover, a frontier is traced, showing a relationship between variance and expected returns.

***Table 1** Mathematical formulas of measures of hedging effectiveness currently in use**

Measures	
Ederington (1979)	$e = \frac{\sigma_{sf}^2}{\sigma_s^2 \sigma_f^2} = \rho^2$ where σ_s^2, σ_f^2 and σ_{sf} represent the subjective variances and covariance of the possible price change from time 1 to time 2. ρ^2 is the population coefficient of determination between the change in the cash price and the change in the futures price.
Howard and D'Antonio (1984)	$HE = \frac{\theta}{(\bar{r}_s - i)/\sigma_s}$ where θ is the excess return per unit of risk, $\bar{r}_s$ the expected one period return for the spot position, *i* the risk free return and σ_s the standard deviation of one period return for the spot position.
Hsin, Kuo and Lee (1994)	$HE = r_H^{ce} - r_S^{ce}$ where r_H^{ce} and r_S^{ce} denote the certainty equivalent returns of the hedged position *H* and the spot position *S*, respectively.

* *This list does not pretend to be exhaustive.*

The recently proposed measures of hedging effectiveness are based on this hedging approach. Several studies (e.g.

Ederington 1979, Franckle 1980, Hill and Schneeweis 1982, Wilson 1984, Howard and D'Antonio 1984, Chang and Shanker 1986, Overdahl and Starleaf 1986, Lindahl 1989, Chang and Fang 1990, Gjerde 1987, Pirrong, Kormendi and Meguire 1994, Hsin, Kuo and Lee 1994) express the usefulness of trading a futures contract, after comparing the results of a combined cash-futures portfolio and the cash position only. Table 1 summarizes the mathematical formulas of the different measures of hedging effectiveness currently in use.

Ederington (1979) defines hedging effectiveness as the reduction in variance. The objective of a hedge is to minimize the risk of a given position. This risk is presented by the variance of returns. Howard and D'Antonio (1984) define hedging effectiveness as the ratio of the excess return per unit of risk of the optimal portfolio of the spot commodity and the futures instrument to the excess return per unit of risk of the portfolio containing the spot position alone (e.g. Chang and Shanker 1986; Lien 1993). Hsin, Kuo and Lee (1994) measure hedging effectiveness by the difference of the certainty equivalent returns between the hedged position and spot position. This approach considers both risk and returns in hedging. They argue that the advantages of their measure are that it considers both risk and expected returns and that it is a consistent measure regardless of the empirically expected changes in spot prices.

The measures reviewed are concerned with optimizing the payoff of the portfolio, under the condition that the variance in returns is minimized or that some optimal balance is found between risk and return. All these measures implicitly assume that the futures contract is perfect, i.e. introduces no risks. However, futures contracts do introduce risks, which will have an impact on the variance of the hedger's returns. These risks have an impact on the success of a futures contract and are therefore of great interest to the management of the futures exchange. Table 2 summarizes and classifies the hedging performance of the measures described above, including the proposed measure.

***Table 2** Hedging effectiveness measures and their characteristics**

Measure	Based on minimum variance hedge	Based on risk-return	Including cost involved in futures trading[2]	Including basis risk and liquidity risk
Ederington	yes	no	no	no
Howard and D'Antonio	no	yes	no	no
Hsin, Kuo and Lee	no	yes	no	no
Proposed measure	yes	no	yes	yes

* *This list does not pretend to be exhaustive.*

In the next section a concept and a measure of hedging efficiency are proposed.

6.4 Conceptual Aspects of Measuring Hedging Efficiency

A hedger who wants to manage price risk will weigh the futures trading risk, as outlined in Chapter 3, against the need to eliminate the cash price risk. In this section these two components will be integrated into a concept of hedging efficiency from which a

[2] Brokerage costs and margin requirements.

measure of hedging efficiency is derived. The assessment has been made from the perspective of the management of the futures exchange, that is interested in the quality of the hedging service.

The proposed measure informs the management of the futures exchange about the efficiency of a specific futures contract by confronting the ideal hedge (where all risk, cash price risk and futures trading risk, is eliminated) with the actual hedge (see Figure 1). The proposed measure assesses the distance between the actual hedge and the perfect hedge. Furthermore, the proposed measure is able to divide the variance of a hedge into a systematic part, which can be controlled by the management of the exchange, and a random part, which is beyond its control.

Hence, the proposed measure is a complement rather than an alternative to the existing measures. A futures contract that is able to set a certain price without introducing other risks will best fulfill the hedger's need for hedging. In this case the hedger will not always use that particular futures contract, because the decision will also be influenced by the cost involved in futures trading, i.e. commission costs and margin requirements. The hedger will weigh the cost involved in futures trading against the satisfaction derived from the futures contract. Therefore, the concept of hedging efficiency is defined as the capacity of the futures contract to reduce the overall risk (basis risk, cash price risk and market depth risk) in relation to the cost involved in futures trading. For the futures exchange it is important to know how well the services provided by the futures contract meet the needs of the hedgers. The proposed concept of hedging efficiency assesses how well the futures exchange is able to achieve this goal. Figure 1 illustrates this concept of hedging efficiency.

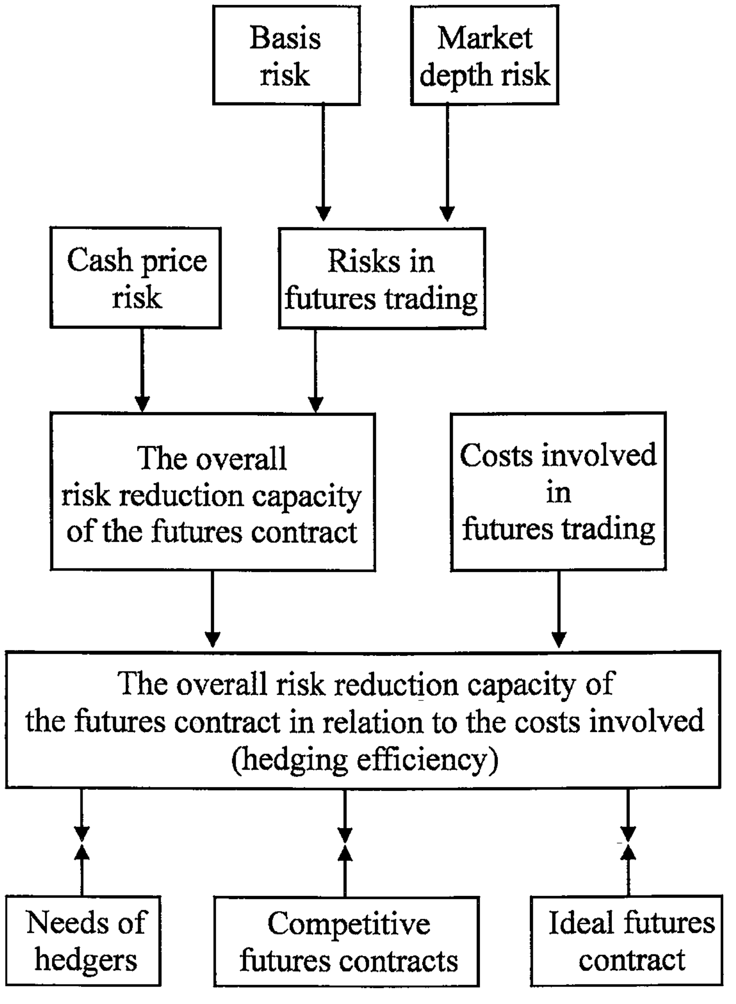

***Figure 1** Concept of hedging efficiency*

This overall risk reduction capacity of the futures contract in relation to the trading costs involved is the hedging service which the futures exchange provides. Two factors are important for the futures exchange: whether it meets the need of the hedgers with respect to overall risk reduction, and whether it can compete on that point with competitive futures exchanges.

Table 3 shows the conceptual difference between the measure of hedging effectiveness reviewed and the proposed one.

***Table 3** Conceptual differences between the measures of hedging effectiveness reviewed and the proposed measure*

	Measures of Hedging Effectiveness Reviewed	Proposed Measure of Hedging Efficiency
Related to:	hedgers	futures contract
Focus on:	cash market risk	cash market risk and futures trading risk
Concerned with:	performance of portfolio	hedging service of futures contract
Way of measurement:	measuring reduction in variance in portfolios	measuring distance between actual and perfect hedging services
Instrumental variables:	means and variances Sharpe index	variances divided into a systematic part and random part
Information for:	hedgers	management of futures exchange

6.5 Measure of Hedging Efficiency

In this section a measure of hedging efficiency will be derived that is in accordance with the proposed concept of hedging efficiency. Each step will be described, in order to understand the components which are combined in the measure (see Figure 1).

Because the futures market offers a risk management service, this service preferably should not introduce additional risk itself. For an ideal futures contract, two conditions have to be satisfied. The first is that when the futures contract matures that there is no basis.[3] The second that there is no market depth risk. The basis can be measured by the difference between the cash price and the futures price, whereas the market depth can be measured by the price difference between the prices at which hedgers enter the market PF^1 and the prices of successive contracts traded, PF^k, as is shown in Equation (1).

$$DC_j = \sum_{k=1}^{K} \frac{V_k \cdot (PF^1 - PF^k)}{V}, \tag{1}$$

where DC_j is the market depth costs of futures contract j, PF^k the price of the k-th futures contract with k the number of changes in transaction prices with $k = 1 \ldots K$, K the total number of transaction prices, V_k the volume of futures contracts sold at PF^k and V the total volume. The proposed depth measure assesses the average depth costs per futures contract.

If the futures market introduces no additional risk, the futures contract is a perfect or ideal one. Let IPR_{t+1} be the price the hedger would realize for time $t + 1$ if an ideal futures contract is used, P_{t+1} the commodity price in the cash market at maturity and PF_{t+1} the futures price at maturity. If the futures contract is a perfect one, a short hedger will realize a price of:[4]

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[3] The hedging efficiency measure is also applicable to the situation where the futures position is offset before maturity.

[4] Because it is not essential for the derivation of the measure of hedging efficiency, a long hedger could well have been used in this example.

$$IPR_{t+1} = PF_t, \tag{2}$$

which implies that $PF_{t+1} = P_{t+1}$.

The price actually realized will differ from Equation (2) because of the basis, market depth cost and trading costs (i.e. commission) and can be expressed as [5]

$$ARP_{t+1} = PF_t^1 - B_{t+1} - DC_{t+1} - C, \tag{3}$$

where PF_t^1 is the futures price at the moment of entrance, ARP_{t+1} is the actual price realized, B_{t+1} the basis of the futures contract and DC_{t+1} the market depth cost when initiating the futures position and offsetting the futures position. The service of risk reduction by futures contracts is not free; the hedger has to pay for it. Therefore C is the cost involved in futures trading per futures contract, represented by the commission.

ARP_{t+1} is a stochastic variable because of the stochastic nature of the basis and the market depth costs. The expected value and the variance of ARP_{t+1} can be expressed as: $\mu_A = E(ARP_{t+1}) = PF_t^1 - C - E(B_{t+1} + DC_{t+1})$ respectively $\sigma_A^2 = E(ARP_{t+1} - \mu_A)^2$. Defining $FTR = B_{t+1} + DC_{t+1}$ and $\mu = E(B_{t+1} + DC_{t+1})$ the variance of ARP_{t+1} can now be written as:

[5] Note that the basis and liquidity cost should not be a problem for the price the hedger wants to realize, if the hedger is able to internalize this basis and liquidity cost.

$$\sigma_A^2 = E(FTR - \mu)^2 = E(FTR^2 - \mu^2), \tag{4}$$

subsequently $E(FTR^2) = \sigma_A^2 + \mu^2$.

To interpret the measure of futures trading risk μ^2 can be looked upon as the systematic deviation of a futures contract at time period $t + 1$ from the ideal futures contract and σ_A^2 the random deviation. Knowledge of the systematic part is very important to the futures exchange because this part of the total deviation is caused by contract specification and futures exchange structure (trading system, kinds of traders allowed etc.) and, therefore, can be managed by the futures exchange. For example, a hedger in Jacksonville will know that (s)he has to discount the transportation costs if the futures contract specifies delivery in Chicago and that because of those costs the price set by a hedge will deviate from the price locked into with the help of a Chicago exchange, i.e., the systematic deviation. The exchange in Chicago could reduce this systematic deviation by allowing delivery in Jacksonville (see Pirrong, Kormendi and Meguire 1994). The random deviation is dependent on factors that are beyond the control of the futures exchange.

Similar to the coefficient of variation[6], the futures trading risk measure (*FTRM*) is measured as the square root of the futures trading risk $E(FTR_{t+1}^2)$ relative to the net price for the hedger if an ideal futures contract is used:

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[6] The standard deviation is expressed as a fraction of the mean. For data from different sources, the mean and standard deviations often tend to change together, so that the coefficient of variation is relatively stable. Furthermore, being dimensionless the coefficient of variation is easy to remember (Snedecor and Cochran 1994).

$$FTRM = \frac{\sqrt{E(FTR_{t+1})^2}}{PF_t^1 - C} \tag{5}$$

where the net price is the futures contract price minus the cost of commission, $PF_t^1 - C$.

6.5.1 *Hedging Efficiency*

Risk in futures trading does not indicate, per se, how well a futures contract will meet the hedger's need. The hedger's need to reduce, if not to eliminate, cash market risk without introducing futures trading risk implies that both the risks of futures contracts and of the cash market have to be included in a measure of hedging efficiency.

Analogous to the measure of futures trading risk, the measure of cash price risk is defined as:

$$CPRM = \frac{\sigma_{CP}}{E_t(CP)} = \frac{\sqrt{E(CP_t - \overline{CP})^2}}{\overline{CP}} \tag{6}$$

where $\overline{CP}$ is the mean of the cash price over the period from initiating the futures position to the time of liquidation of the futures position.

A hedger will tend to use a futures contract if the value of the futures trading risk measure (5) is low compared with that of the measure of cash price risk (6). In that case the hedger is exchanging high risk in the cash market for low risk in the futures market. For this reason the following measure of hedging efficiency is proposed:

$$E = \frac{FTRM}{CPRM} \tag{7}$$

where $E \geq 0$.

The value of the proposed measure ranges from zero to infinity. If the proposed measure is smaller than 1, hedgers will reduce their risks, because they exchange a larger cash price risk for a smaller futures trading risk. Note that if the value of the proposed measure increases, the hedging efficiency decreases.

Equation (7) can be rewritten as:

$$E = \frac{\sqrt{E(FTR_{t+1})^2}\,\overline{CP}}{(PF_t^1 - C)\sqrt{E(CP_t - \overline{CP})^2}} = \frac{(\sqrt{\sigma_A^2 + \mu^2})\overline{CP}}{(PF_t^1 - C)\sqrt{E(CP_t - \overline{CP})^2}} \tag{8}$$

where $\sqrt{\sigma_A^2 + \mu^2}$ represents the distance between the actual hedging service and the perfect service, divided into a systematic and a random part.

The intuition behind Equation (8) is the following: if the futures trading risk increases compared with the cash price risk, the hedging efficiency decreases. Furthermore, if the commission costs increase, the hedging efficiency decreases.

6.6 Empirical Test of the Ederington Measure and the Proposed Measure

Because the Ederington measure is still the most used measure in practice as well as in research, the Ederington measure will be compared with the proposed measure of hedging efficiency.

However, as has been outlined before, these measures are in no way substitutes, because they serve different purposes.

6.6.1 *Data and Methodology*

The Ederington measure and the proposed measure are calculated with the use of data on the potato futures contract traded at the Amsterdam Agricultural Futures Exchange (ATA). The annual volume (200,000 contracts in 1995) is small compared with agricultural futures traded in the United States. The sample covers the period from September 1995 up to April 1996. This period equals one potato storage year, i.e. potatoes harvested in 1995. The data on transaction-specific futures contract are obtained from the Clearing Corporation (NLKKAS) of the ATA. The cash price data are obtained from the Rotterdam potato cash market, being the central spot market for potatoes in the Netherlands.

The transaction-specific data consist of the price quoted of every futures contract traded in a chronological order. With these data the market depth costs can be calculated. The market depth costs in the case of an order selling imbalance were calculated as the area between the downward-sloping price path and the price for which the hedger enters the futures market. The market depth costs in the case of an order buying imbalance were calculated as the area between the upward-sloping price path and the price for which the hedger enters the futures market. Having determined the market depth costs, the spot prices and the closing prices of the futures contract, the proposed measure can be calculated according to Equation (8).

Because the time series data are limited, this study can only test the hedging performance of hedges held over two short periods: 1) one-day period and 2) one-week period. This type of hedging, offsetting the contract within one day or one week seems more relevant to a speculative transaction than a systematic hedging transaction, because the period of harvesting and storing the potatoes covers about one year. Therefore, this empirical analysis must be viewed as illustrative only.

It is well known that the hedging effectiveness tends to increase as the investment horizon increases (Castelino 1992; Geppert 1995). Therefore, it can be expected that both measures indicate that situation 2 is more effective than situation 1. Furthermore, it is expected that the proposed measure shows a relatively lower efficiency than the Ederington measure because the latter does not include market depth costs and commission costs. The empirical analyses will also reveal the managerial implications of the proposed measure, i.e. providing information about what part of the hedging inefficiency can be managed by the exchange.

6.6.2 *Results*

Table 4 tabulates the value of the hedging performance measured by the Ederington measure and the proposed measure for the two different periods of hedges, one day and one week respectively. Furthermore, Table 4 presents the systematic deviation, μ^2, and the random deviation, σ_A^2. Both measures indicate that the hedging performance increases (the proposed measure decreases and the Ederington measure increases) as the period of hedges held increases.[7] This result confirms the results of previous research (Castelino 1992; Geppert 1995).

[7] Note that a low value of the Ederington measure indicates a low hedging effectiveness, whereas a low value of the proposed measure indicates a high hedging efficiency.

***Table 4** Hedging performance of potato futures contract April 1996 measured by the proposed hedging Efficiency Measure (E) and the Ederington Measure (EM)*

Day Hedging		Week hedging	
E = 1.3800	EM = 0.92405	E = 1.28916	EM = 0.94006
μ^2 = 63.303		μ^2 = 63.620	
σ_A^2 = 65.398		σ_A^2 = 59.359	

From Table 4 it also appears that the hedging effectiveness for both hedge periods is high according to the Ederington measure. This in contrast to the proposed measure, which indicates that the hedging efficiency is relatively low, i.e. the futures trading risk measure exceeds the cash price risk measure. This different result between both measures is due to the fact that the proposed measure takes basis risk, market depth costs and commission costs into account, whereas the Ederington measure only takes the basis risk into account.

One can derive from the proposed measure that for both the one-day hedge and the one-week hedge the systematic deviation μ^2 accounts for about 50% of the total distance between the perfect and the actual hedges.

The data indicate that both the basis and the market depth risk contribute to the relatively inefficient hedging possibilities of the potato futures contract.

6.7 Summary and Conclusions

In this chapter a concept of overall risk reduction and a measure of hedging efficiency have been described. In contrast to the existing measures, this one does not focus on the performance of a portfolio but on the hedging service of the futures contract. Therefore, unlike other researchers measuring futures contract performance, this measure takes into account that futures contracts not only reduce cash price risk, but also introduce additional futures trading risk, consisting of basis risk and market depth risk. Furthermore, the proposed measure takes commission costs into account. The measure expresses the distance between the hedging service provided by the exchange and the perfect hedge. This distance is divided into a systematic part, which can be managed by the futures exchange, since this is caused by futures contract specification and structure of the futures exchange, and a random part, which is dependent on factors beyond the influence of the futures exchange. The hedging efficiency measure provides the hedger with a tool for comparing the competitive strength of alternative futures contracts. Not only the characteristics of the futures contract are incorporated in the measure of hedging efficiency, but also those of the cash market risks, because both the quality of hedging service and the need for this service (i.e. the price risk in the cash market) are relevant to the success of the hedging service rendered by the futures exchange. The futures trading risk component of the measure indicates the hedging quality of the futures contract. The cash price risk component emphasizes the potential need for the futures contract. The empirical results indicate the usefulness of the measure for the futures exchange management. Further research, in which the proposed measure is applied to different futures markets, is clearly called for.

6.8 Acknowledgments

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PART II ENTREPRENEURS' CHOICE FOR HEDGING SERVICES: A MARKETING APPROACH

In Chapter 2 we have stressed the importance of a marketing approach to the development and sales of hedging services. It has been argued that the basic need of an entrepreneur, who is using futures, is the reduction of price risks. In fact, an entrepreneur who perceives price risk will feel the need to reduce it and therewith make use of the hedging services only when he is risk-averse. Therefore risk attitude is an important concept in the entrepreneurs' decision making behavior concerning price risk management instruments. Much research has to be done on the measurement of risk attitude and its influence upon the choice of a risk management instrument. This part of our study will be devoted to this topic. It starts with methodological research into measuring risk attitude of entrepreneurs in the financial domain. We analyze two major approaches used in the past for measuring the risk attitude of entrepreneurs of small and medium-sized enterprises in the domain of financial risk. Measures based on the expected utility model, used in economics, and measures based on marketing scales, used in marketing research and psychology. Specifically, we are interested in their convergent validity, whether the measures developed within either discipline have common elements, that is whether the investigated risk attitude measures are measurements of the same construct *risk attitude*. Moreover, we are interested in the nomological validity of these measures.

After having gained insight into the risk attitude construct, we model the choice behavior of entrepreneurs (in our empirical study hog farmers) regarding futures. Insight is gained into how hog farmers decide and why they decide the way they do. Based on this decision model, aspects related to service design and service delivery by futures exchanges will be discussed.

Due to the nature of a futures market's organization, the information dissemination process of futures contract innovations is of great influence on the success of a futures contract. For this reason it is interesting to investigate which tools available to the futures exchange might accelerate this process.

CHAPTER 7

Measuring the Risk Attitude of Entrepreneurs in the Domain of Financial Risk[1]

7.1 Abstract

Two major approaches of measuring the risk attitude of entrepreneurs are compared with respect to nomological validity and convergent validity. One set of risk attitude measures is based on the expected utility model, dominant in economics, and is derived from responses to lotteries. Another stems from the psychometric approach, dominant in marketing, and is based on Likert statements. We study the strengths and weaknesses of both approaches and their use in marketing and management science. The empirical context concerns the use of price risk management tools, i.e. futures contracts. Data from 346 entrepreneurs were obtained in computer-assisted interviews. The intrinsic risk attitude was measured by means of the certainty equivalence and rating technique. A unidimensional psychometric risk attitude scale was developed by performing CFA on a set of statements selected from the literature. Behavioral data concerned the use of futures contracts, the frequency of trading in the risky market, and the choice of the marketing channel (risky vs. safe). The risk attitude based on lotteries was found to predict actual market behavior much better than the psychometric risk attitude scale. In contrast, the psychometric scale showed more coherence with self-report measures of innovativeness, market orientation, the intention to secure profit margin and the intention to reduce income fluctuations. When interested in actual (market)

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[1] This chapter is based on: Pennings, J.M.E. and A. Smidts (1998), "Measuring Risk Attitude of Entrepreneurs in the Domain of Financial Risk" Working Paper, Wageningen Agricultural University, Department of Marketing and Marketing Research.

behavior and given the apparently higher predictive validity of the intrinsic risk attitude, we recommend making use of revealed preference methods concerning decision making under risk, such as lotteries in marketing and management science.

7.2 Introduction

The markets in which entrepreneurs operate are often turbulent. The unpredictability of e.g. the market price exposes entrepreneurs to (price) risk. The way in which entrepreneurs handle these risks depend largely on the entrepreneur's risk attitude (Robison and Barry 1986). Thus, in many models, rooted in economics, finance and marketing, risk attitude plays an important role in understanding decision making behavior (Kahl 1983; Smidts 1990; Tversky and Kahneman 1981). In empirical studies two major approaches towards risk attitude measurement can be differentiated: measures derived from the expected utility framework, dominant in economics and finance (Fishburn 1988; Savage 1954; Schoemaker 1982; Stone and Mason 1995; von Neumann and Morgenstern 1947; von Winterfeldt and Edwards 1986), and measures derived from psychometrics, dominant in marketing and psychology (Miller, Kets de Vries and Toulouse 1982; Stone and Mason 1995). Since we may anticipate that the way in which risk attitude is conceptualized and measured affects our understanding of decision making under risk, it is of the utmost importance to gain insight into the construct validity of the different risk attitude measures derived from both approaches. Research into the construct validity of risk attitude is still lacking. One aspect of construct validity is convergent validity (Churchill 1995): if the risk attitude measures from both approaches are indeed measuring risk attitude then the different measures should highly correlate. A second aspect of construct validity is nomological validity (Churchill 1995): if the different risk attitude measures actually measure risk attitude, they will have to be related to variables to which risk attitude is theoretically related, such as the attitude towards innovation. In this study we are particularly interested in the relationship between the different risk attitude measures and actual market behavior. In other words: what can be said about the predictive validity of the risk attitude measures derived from both approaches concerning actual market behavior?

The expected utility model has been used for many years for the analysis of behavior under risk. Von Neumann and Morgenstern (1947) are the major contributors to a large body of work that forms the justification for the use of the expected utility model by a rational decision maker. The expected utility model views decision making under risk as a choice between alternatives. Decision makers are assumed to have a preference ordering defined over the probability distributions. For this preference ordering a number of axioms hold (Fishburn 1983). Risky alternatives can be evaluated under these assumptions using the utility preference function, $u(x)$. The curvature of the utility function is a measure of risk attitude (Keeney and Raiffa 1976). The utility function and hence the risk attitude measure is assessed by means of lotteries. The well-known Pratt-Arrow coefficient of risk aversion then provides a local measure of risk attitude. Within the expected utility approach, a number of researchers suggest to correct the utility function obtained by lotteries for the strength of preference (Bell and Raiffa 1982; Dyer and Sarin 1982; Sinn 1983; Currim and Sarin 1983). The strength of preference refers to the intensity of a decision maker's preference for an alternative. These researchers argue that the outcomes in a lottery are transformed into subjective values under certainty by the strength of preference function (see Dyer and Sarin 1982 and Smidts 1997). For this reason, they suggest to transform the utility function $u(x)$ by means of the strength of preference function $v(x)$, that is $u(x) = f(v(x))$. According to these researchers, the difference between the utility and the strength of preference function can be attributed to the influence of risk preference. The difference is therefore the true risk attitude, also denoted as the intrinsic risk attitude or relative risk attitude, since it is defined relative to the strength of preference function (Bell and Raiffa 1982; Dyer and Sarin 1982; Schoemaker 1980). Thus, one may expect the intrinsic risk attitude to perform better on nomological validity than the risk attitude obtained by lotteries only.

Within the psychometric approach, constructs such as risk attitude are measured by means of scales which consist of a number of statements (multi-item measurement). The respondent has to indicate the extent to which he/she agrees with a particular statement (Nunnally and Bernstein 1994). Several researchers have developed risk attitude scales (Childers 1986; Harnett an Cummings 1980; Jaworski and Kohli 1993; Miller, Kets de Vries and Toulouse 1982; Raju 1980). The different risk attitude scales all pertain to a specific domain. Hence, risk attitude here is rather seen as a state variable (i.e. context-specific variable) than as a trait (personality characteristic). For example, Jaworski and Kohli (1993) developed a risk attitude scale measuring top-management risk aversion. The risk aversion scale was composed of six items (e.g. top managers in the business unit like to "play it safe"), and tapped top managers' disposition toward risk and uncertainty.

In this study we thus investigate the construct validity of risk attitude by differentiating three measures: two measures are derived from the expected utility framework, risk attitude based on the curvature of the utility function $u(x)$ and the intrinsic risk attitude, and one measure is derived from psychometrics. We concentrate on risk attitude measures in the domain of financial risk faced by entrepreneurs, specifically price risk when selling output. A personal computer-guided interview conducted with 346 entrepreneurs of SME's enabled us to study the individual decision behavior of entrepreneurs of SME's.

Within the expected utility framework we use lotteries to obtain the utility function $u(x)$ on the basis of which we derive the Pratt-Arrow risk attitude measure. The strength of preference function $v(x)$ is measured using the rating technique. By relating the utility function $u(x)$ to the strength of preference function $v(x)$ we are able to deduce the intrinsic risk attitude. Based on the risk attitude measures already present in the literature, we develop within the psychometric framework a one-dimensional risk attitude scale. The risk attitude measures are tested for convergent validity by investigating the correlation between the risk attitude measures. In order to test for nomological validity we relate the risk attitude measures to: the entrepreneur's attitude towards innovation, the entrepreneur's attitude towards market orientation, the entrepreneur's intention to reduce fluctuations in his/her income, and the entrepreneur's intention to secure his/her profit margin. Apart from these attitude and intention measures, we relate the risk attitude measures to behavioral variables. We gathered behavioral data on: the entrepreneurs' use of futures contracts (being *the* most relevant price risk management instrument for the entrepreneurs in our empirical study), the frequency of trading in the risky market and the marketing channel chosen (risky versus safe). By using both attitude or intention variables and revealed preference data, the nomological validity can be assessed in its broadest sense.

The chapter is organized as follows. In Section 7.3 we present a framework for testing construct validity. We formulate hypotheses about the relationship between risk attitude and variables to which it is theoretically related. The research method of the study is described in Section 7.4, whereas in Section 7.5 findings are given with respect to the risk attitude measures. Within the expected utility framework we present the results of the certainty equivalence technique and the rating technique. We measure the intrinsic risk attitude by relating the certainty equivalence technique with the rating technique. The utility curve, the strength of preference function and the relationship between them (i.e. the intrinsic risk attitude) is tested for exponential and power functions. Within the psychometric framework, we test the scale developed for reliability and validity using confirmatory factor analysis. In Section 7.6, the risk attitude measures developed are tested for construct validity by testing for convergent validity and nomological validity. We conclude by discussing our results and making suggestions for further research in Section 7.7.

7.3 Framework for Testing Construct Validity

The construct validity of the different risk attitude measures is investigated by testing for convergent and nomological validity. The convergent validity, defined by Churchill (1995) as the confirmation of a relationship by independent measurement procedures, will be tested by investigating whether the risk attitude measures show a positive significant correlation (cf. also Figure 1). If the different measures actually measure risk attitude, we may expect a correlation between them. Moreover, we expect the strength of preference, measured with the rating technique, not to correlate too much with the risk attitude measures (the strength of preference, after all, measures the intensity of a decision maker's preference for an alternative, not his/her risk attitude), which would provide the discriminant validity of the risk attitude measures.

In order to gain insight into the nomological validity of the risk attitude measures, we investigate how these measures are related to the variables to which risk attitude is theoretically related. In the nomological net, variables have been included which are on the attitude and intention level, along with variables which reflect the entrepreneur's actual market behavior (see Figure 1). In the empirical study, the variables on the attitude and intention level have been measured by self-report measures, whereas the variables which reflect the entrepreneur's actual behavior have been measured by registering past behavior.

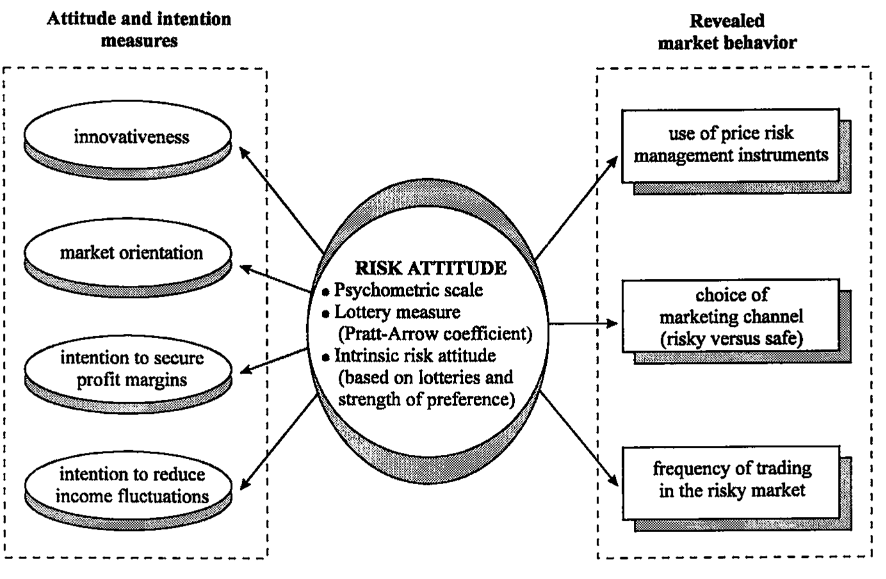

***Figure 1** Nomological net of risk attitude*

Based on literature we formulate several hypotheses reflected in the nomological net of Figure 1. First, we present the hypotheses which relate risk attitude to variables which describe the entrepreneur's attitude towards innovation, market orientation and intention to reduce risk. Then, we present the hypotheses which relate risk attitude to actual market behavior. Note that we define risk attitude to be "positive" for risk-averse decision makers and "negative" for risk prone decision makers when formulating the hypotheses.

7.3.1 *Attitude and Intention Variables*

Innovativeness. The attitude towards innovation refers to the extent to which entrepreneurs are open to new experiences and novel stimuli, possess the ability to transform information about new concepts, ideas, products or services for their own use, and have a low threshold for recognizing the potential application of new ideas (Leavitt and Walton 1975, 1985). Innovators, compared to other members in the system, are relatively quick to adopt innovations. Adoption of products, services or ideas that are not generally adopted, implies risk-taking behavior (Bhoovaraghavan, Vasudevan and Chandran 1996). Because innovators adopt innovations earlier and hence expose themselves to a degree of uncertainty, we expect to find a risk-averse decision-maker to be less innovative. O'Reilly (1989) surveyed several hundred managers in diverse industries, concluding that taking risk is a key value in promoting innovation. Similarly, Goldhar, Bragaw and Schwartz (1976) identify taking risk as an characteristic of innovating firms. Nakata and Sivakumar (1996) argue that low levels of uncertainty avoidance facilitate the initiation phase of new product developments through risk-taking and minimal planning and controls. We therefore hypothesize that:

HYPOTHESIS 1a. *The entrepreneur's risk attitude is negatively related to the entrepreneur's attitude towards innovation.*

Market orientation. Following Narver and Slater (1990) a market oriented business continuously examines the alternative sources of sustainable competitive advantage to see how it can be most effective in creating sustainable superior value for its present and future target market. Market orientation consists in their study of three behavioral components: customer orientation, competitor orientation and interfunctional coordination. The organization's market orientation is shaped by its managers' attitude towards market orientation. Kohli and Jaworski (1990) argued that the greater the risk aversion of top managers, the lower the organization's market orientation. Indeed, they found that if top managers are risk-averse and intolerant of failures, subordinates will, for example, be less likely to be responsive to changes in customer needs. In another study Jaworski and Kohli (1993) found that responding to market developments entails some amount of risk. Thus we hypothesize that risk-averse entrepreneurs will be less market oriented than risk-seeking entrepreneurs. More formally:

HYPOTHESIS 1b. *The entrepreneur's risk attitude is negatively related to the entrepreneur's attitude towards market orientation.*

The entrepreneur's intention to secure his/her profit margin. We may expect risk-averse entrepreneurs to feel an incentive to secure their profits and to eliminate exposure to profit risk, while risk-seeking entrepreneurs will not feel an incentive to secure their profit margin, for example by means of cash forward contracts for both inputs and outputs. Thus, we hypothesize that:

HYPOTHESIS 1c. *The entrepreneur's risk attitude is positively related to the entrepreneur's intention to secure his/her profit margin.*

The entrepreneur's intention to reduce his/her income fluctuations. We may expect risk-averse entrepreneurs to feel an incentive to reduce income fluctuations, for example by means of income insurance, whereas risk-seeking entrepreneurs will not feel this incentive. Therefore we hypothesize that:

HYPOTHESIS 1d. *The entrepreneur's risk attitude is positively related to the entrepreneur's intention to reduce his/her income fluctuations.*

7.3.2 *Revealed Market Behavior Variables*

We may expect risk attitude to be an important determinant of the entrepreneur's market behavior. A risk-averse entrepreneur will feel a need to reduce risk in the case of price risk (Stoll and Whaley 1993). The entrepreneur can meet this need by using price risk management instruments such as futures and options, when available. Of course, the entrepreneur would not only have to be risk averse, he/she would also have to perceive a substantial price risk in order to feel the need to use price risk management instruments. We therefore hypothesize that:

HYPOTHESIS 2a. *The entrepreneur's risk attitude is positively related to the incidence of using price risk management instruments.*

Usually, an entrepreneur will have the opportunity to sell his/her output via different market channels, such as the trader, the wholesaler, the retailer, or directly sell to the final customer. These market channels may differ as to the price risk they generate (spot price versus average price over certain period). When selling his/her output, we propose that a risk-averse entrepreneur will choose the marketing channel that fits his/her risk profile. We hypothesize that:

HYPOTHESIS 2b. *Entrepreneurs who are more risk averse will choose a marketing channel which exposes them to a lesser amount of risk.*

A decision maker can spread his/her risk by frequently trading his/her output in a risk-bearing market. By trading in the market frequently and over a period of time, it will yield an average price. This strategy is attractive for a risk-averse entrepreneur, since it allows him to reduce his/her price risk. The more market risk he/she perceives, the more often he/she will enter the market. On the other hand, a less risk-averse entrepreneur will attempt to trade less frequently in the market, because he/she is prepared to take more risk in particular if such a decision maker perceives low market risk. We therefore expect an interaction effect between risk attitude and risk perception and the number of trades in the risky market. We hypothesize that:

HYPOTHESIS 2c. *A risk-averse entrepreneur will trade more frequently. The more risk he/she perceives, the more frequent this trading behavior will be.*

7.4 Research Method

7.4.1 *Decision Context*

The subjects of the study are entrepreneurs of medium-sized and large hog farms in The Netherlands. The Dutch hog industry is among the largest exporters of slaughter hogs in the European Union and accounts for an important part of Dutch export. Contrary to practice with other agricultural products, the market for slaughter hogs in the European Union does not know any government intervention. Therefore, slaughter hog prices show heavy fluctuations. A hog farm is a specialized company with hog-farming accounting for about 85% of the entrepreneur's total income. Its production process is pretty simple. The entrepreneur buys piglets and feed and raises the piglets to slaughter hogs within three months. Often, the entrepreneur has a number of so-called "rounds" within the company, each "round" representing a group of hogs of the same age. When buying the piglets and the feed, the entrepreneur runs a risk on that particular "round" (i.e. the slaughter hogs), since the price of slaughter hogs three months from the moment of purchase (when the piglets will have been raised to slaughter hogs) is largely unknown.

From depth interviews with 40 entrepreneurs it became clear that futures contracts were the most relevant price risk management instrument.

7.4.2 *Data Collection*

A questionnaire was developed on the basis of literature and 40 test interviews to make sure that the questions would be interpreted correctly. The survey consisted of face-to-face interviews. The personal interview was computerized and care was taken to build a user-friendly interface. The software written for this interview was extensively tested and 15 test interviews were conducted to ensure that the interface was being understood by the entrepreneurs and perceived as "very user-friendly". The large-scale personal interview took place in the second half of 1996 at the entrepreneur's enterprise. Prior to the interview an appointment was made over the telephone. There was a high response rate: 60% of the entrepreneurs approached were prepared to be interviewed. A net total of 346 entrepreneurs were interviewed. All the interviewers had prior interviewing experience and had followed an extensive training program for the assessment procedures. Moreover, the training program ensured that the interviewers understood the questions posed to the entrepreneurs. The personal computer-assisted interview lasted for about 35 minutes. The sampling frame was stratified according to the variables 'region' and 'size of enterprise'.

7.4.3 *Measurement of Risk Attitude*

7.4.3.1 *Assessment of the Utility Function: The Lottery Technique*

In the certainty equivalence method, the researcher asks the respondent to compare a lottery (x_l, p, x_h) with a certain outcome, where (x_l, p, x_h) is the two-outcome lottery that assigns probability p to outcome x_l and probability $1 - p$ to outcome x_h with $x_l < x_h$. The researcher then varies the certain outcome until the respondent reveals indifference between the certain outcome denoted by CE(p). Through application of the von Neumann-Morgenstern utility u we obtain:

$$u(\mathrm{CE}(p)) = pu(x_l) + (1 - p)u(x_h).$$

When eliciting utilities, first, two outcomes are fixed such that the range of outcomes between them includes all outcomes of interest. Secondly, one may set $u(x_L) = 0$ and $u(x_H) = 1$ where x_L and x_H denote the upper and lower bound respectively of the outcome range. The certainty equivalence method used in this study concerns a bisection framework that only uses probability 0.5. First, the outcome CE(0.5) with utility 0.5 is found as above. Then the outcome CE(0.25) is obtained with utility 0.25 through an indifference $\mathrm{CE}(0.25) \sim (x_i, 0.5, \mathrm{CE}(0.5))$. An indifference $\mathrm{CE}(0.75) \sim (\mathrm{CE}(0.5), 0.5, x_h)$ is used to obtain the outcome CE(0.75), with utility 0.75. So, former responses to lotteries are used in the assessment of subsequent responses. Subsequently, one can find a large number of CEs after a sufficient number of questions in which every question involves a bisection of a particular interval (Smidts 1997).

In the empirical study the lottery technique was computerized. The respondents were asked to imagine themselves selling their hogs. They were given a choice between three alternatives. Alternative A (the lottery) entailed receiving a relatively high price or a relatively low price with a 50/50 chance, Alternative B meant receiving a fixed price, while Alternative C represented indifference to alternatives A and B. The scenario was perceived by the respondents as very realistic, since the decision-making problem thus presented is representative of the sales decision they have to make on a regular basis. Respondents saw the three alternatives depicted in rectangles on the computer screen. Alternative A consisted of a 50/50 lottery where the initial upper and lower bounds were set by the researchers. Alternative B consisted of a fixed price where the initial fixed price was randomly generated by the computer within the initial upper and lower bounds. Alternative C consisted of the statement that it did not matter to receive alternative A or B. The lotteries' outcomes were denoted in Dutch Guilders pro kilogram live weight of hogs. The first lottery presented to the respondents concerned a 50/50 lottery with outcomes of 2.34 Dutch Guilder and 4.29 Dutch Guilder. These boundaries were chosen since we know the minimum and maximum price of hogs to lie between 2.34 and 4.29 Dutch Guilders, based on historical prices. For each lottery the entrepreneur had to assess the fixed price (i.e. the certainty equivalent) by choosing A or B and again choosing A or B up to the point where the respondent chooses C, after which a new lottery started. The assessment of the certainty equivalent was an iterative process. If the respondent chose Alternative A, the computer generated a higher fixed price (Alternative B) than the previous fixed price, hence making Alternative B more attractive. If the respondent chose Alternative B the computer generated a lower fixed price (Alternative B) than the previous fixed price, hence making Alternative A more attractive. At some point, the respondent indicated that it did not matter to receive Alternative A or B, and chose Alternative C. The next measurement (the next lottery) started after the respondent chose C. With this method, nine points of the utility curve were assessed, including two points to check the consistency of the measurements. The lottery task took about 20 minutes. Based on the assessed utility curve, we are able to derive the Pratt-Arrow coefficient as a measure of risk attitude. The exponential function and the power function are used to specify the utility function. After scaling the boundaries of the functions, the estimation of only one parameter suffices to characterize a decision maker's risk attitude. Since it is the certainty equivalents, not the utility levels, which are measured with error, the inverse function is estimated (see for a detailed description of the estimation functions Appendix A).

7.4.3.2 *Assessment of the Strength of Preference Function: The Rating Technique*

In order to assess the strength of preference function, we use the rating technique. The strength of preference function is assessed by asking the respondent to express the strength of preference towards a price level through assigning a value to it. The respondents had to value nine price levels on a scale of 1 up to and including 10. Apart from using round scale numbers, the respondent could specify the fractions 0.25, 0.50 and 0.75, analogous to the performance rating system used in Dutch schools. Before the respondent started the task, the price range from which the price levels were drawn were shown. The price levels were drawn between the same range as the lotteries, hence the respondents were asked to value price levels which lay between 2.34 and 4.29 Dutch Guilders. This task took only a few minutes. As was the case by the lotteries the exponential function and the power function are used to specify the strength of preference function (see for a detailed description of the estimation functions Appendix A).

7.4.3.3 *Psychometric Risk Attitude Scale*

Several researchers have developed risk attitude scales. Raju (1980) developed a risk-taker scale with respect to restaurants, products, and brands. The scale was a nine-item, seven-point scale measuring the degree to which a person reports to be willing to take risk by trying unfamiliar restaurants, products and brands. Harnett and Cummings (1980) measured the risk attitude of 550 managers from Europe and the U.S. with "yes" and "no" answers to items like: "Do you like to invest money in a promising invention?". Miller, Kets de Vries and Toulouse (1982) measured risk-taking by two items. The respondents were asked to indicate the extent to which there is a proclivity toward high-risk projects or low-risk projects and the extent to which it is best to explore by timid behavior or bold wide-range acts. Childers (1986) developed a risk aversion scale with respect to product usage. The scale measures a person's fear of doing something with a product that he/she has not tried before. Jaworski and Kohli (1993) developed a risk attitude scale measuring top management risk aversion. The risk aversion scale was composed of six items (e.g. top managers in the business unit like to "play it safe"), and tapped top managers' disposition toward risk and uncertainty. Items for each scale were scored on a five-point scale, ranging from "strongly disagree" to "strongly agree". Risk attitude scales for the domain of financial risks faced by entrepreneurs of SMEs were not available in the literature. Therefore, the first step entailed the development of a new risk attitude scale, in which we used items from previous risk attitude scales. The following iterative procedure was adopted for that purpose. First, based on literature a large pool of items was generated. Care was taken to tap the domain of the risk attitude construct as closely as possible. Next, the items were tested for clarity and appropriateness in personally administered pretests with 40 entrepreneurs. The respondents were asked to complete a questionnaire and indicate any ambiguity or other difficulty they experienced in responding to the items, as well as for any suggestions they deemed appropriate. Based on the feedback received from the respondents, some items were eliminated, others were modified, and additional items were developed. The final scale was composed of three items showing a close relationship with the Jaworski and Kohli scale (1993).

7.4.4 *Measurement of Variables Included in the Nomological Net*

7.4.4.1 *Operationalization of Attitude and Intention Variables*

The measures of the constructs on the attitude and intention level were developed from scales as used in studies in marketing, psychology, and management. An extensive list of the items included in each of the measures is provided in Appendix B.

The Open Processing Scale (OPS) measure, first developed by Leavitt and Walton (1975, 1985), was utilized to measure innovativeness. The OPS is a psychometrically stable measure of behavioral tendencies (Goldsmith 1984, 1991; Joseph and Vyas 1984). See Appendix B for a detailed description of the psychometric properties of the scale.

We utilized items of Narver and Slater (1990) in order to construct the market orientation measure and adapted those to the context of this study. The measure is composed of items measuring consumer orientation and cash market tracing. As the interfunctional coordination component of market orientation in the Narver and Slater (1990) scale is not relevant, since the entrepreneur unites all the functions in himself/herself, these items were left out in the measurement. See Appendix B for a detailed description of the psychometric properties of the scale.

The entrepreneur's intention to secure his/her profit margin is operationalized by asking the entrepreneur to indicate on a nine point scale ranging from -4 ("I strongly disagree") to 4 ("I strongly agree") the extent to which he/she agrees with the postulate that he/she wants to secure his/her profit.

The entrepreneur intention to reduce his/her income fluctuations is operationalized by asking the entrepreneur to indicate on a nine point scale ranging from -4 ("I strongly disagree") to 4 ("I strongly agree") the extent to which he/she agrees with the postulate that he/she wants to reduce income fluctuations.

7.4.4.2 *Operationalization of the Revealed Market Behavior Variables*

The frequency of trading in the risky market is measured by registering the number of times per year the entrepreneur usually enters the market to sell his/her hogs. From the depth interviews it is known that the number of market entries lies between a maximum of once a week and a minimum of four times per year. This minimum is imposed by the nature of the production process since raising of piglets into hogs takes three months. A hog farmer with only one "round" at a time in his/her company would thus still have to enter the risky market four times per year.

Whether or not the entrepreneur was using futures contracts as a price risk management instrument was measured by registering whether or not the entrepreneur had used futures as a hedging tool in recent years.

The choice of marketing channel was measured by registering the marketing channel the entrepreneur uses when he/she sells his/her output. We were able to distinguish three marketing channels: 1) selling to the trader 2) selling to the slaughterhouse and 3) selling to a cooperative. When selling to the trader or directly to the slaughterhouse, the hog farmer receives the spot price and hence finds himself exposed to cash market risk. Hence, selling to a trader or slaughterhouse can be seen as choosing for a relatively risky marketing channel. When the hog farmer sells the hogs to the cooperative he/she receives an "average price" and consequently reduces his/her cash price risk. The word average has been put between brackets because the price the hog farmer receives from the cooperative is the spot price plus an amount of money, in proportion to the hog farmer's sales, that corresponds to the profit that the cooperative made. Moreover, the cooperative has a relatively low credit risk. Therefore, this is considered a relatively safe marketing channel.

The entrepreneur's risk perception is measured by asking the entrepreneur to indicate on a nine point scale ranging from 1 (very risky) to 9 (not risky at all) the extent to which he/she perceives the market for hogs as risky.

For descriptive purposes, some background variables were measured, such as the age of the entrepreneur and the size of the company (the number of slaughter hogs being raised).

7.5 Results of Measurements

7.5.1 *Risk Perception and Trading Behavior*

During the interview, the entrepreneur was asked to indicate on a scale from 1 ("I do not know what the price will be") to 9 ("I know exactly what the price will be") the extent to which he/she felt that he/she could tell what the price level would be three months later, the time span between purchasing piglets and selling them as slaughter hogs. An average score of 1.84 and a standard deviation of 1.49 suggest that the entrepreneur feels that price fluctuations are hard to predict. Moreover, a question about the amount of risk in the hog market produced an average score of 7.5 on a scale of 1 (very risky) to 9 (not risky at all) with a standard deviation of 2.1. This suggests that the entrepreneurs perceive the market in which they operate as risky. However, the entrepreneurs' perception of market risk does not lead to a frequent use of price risk management instruments. A mere 13% of the entrepreneurs interviewed used futures contracts and 3% used cash forward contracts to cover their price risk. This indicates that entrepreneurs are willing to incur risk in the sale of slaughter hogs, or, as one entrepreneur put it during one of the in-depth interviews: "we value markets with high price volatility, because they provide opportunities to gain". Also the fact that sixty-four percent of all hog farmers sell to traders or directly to slaughterhouses, where they receive the spot price and hence are exposed to price risk, suggests risk taking behavior. Twenty-three percent of the respondents supply exclusively to a cooperative where they get an average price, thus spreading their risk. The remaining 13% sell their slaughter hogs through a combination of marketing channels, trader, slaughterhouse and cooperative.

7.5.2 *Results of Lottery Measurement*

In Table 1, some descriptive statistics are shown concerning the certainty equivalents assessed. The results in Table 1 are ordered by level of expected utility of the lotteries. The order in which the lotteries were presented to the respondent is indicated by the number in the first column of Table 1. The second column shows the outcomes used in each lottery. With the exception of the first lottery, in which the outcomes are 2.34 and 4.29 Dutch Guilder for all respondents, the outcomes of the lotteries depend upon the answers respondents have provided in former lotteries. As a consequence, the expected value of the lottery and range of the lottery for each level of expected utility vary between respondents.

***Table 1** Results of the assessment of the certainty equivalence technique (in Dutch Guilders/kg)*

Measurement	Lottery		Expected utility		Certainty Equivalent		Response E(x_i)-x_i (%)		
x_i	x_l	x_h	E(u(x))	Mean	Median	st.dev.	A	RN	S
4	2.34	x_2	0.125	2.74	2.61	0.42	27	7	66
2	2.34	x_1	0.250	2.95	2.88	0.45	22	4	74
5	x_2	x_1	0.375	3.14	3.15	0.45	21	23	56
1	2.34	4.29	0.5	3.35	3.34	0.44	42	0	58
8	x_2	x_3	0.5	3.36	3.40	0.48	23	13	64
6	x_1	x_3	0.625	3.48	3.50	0.45	24	25	51
9	x_5	x_7	0.625	3.55	3.60	0.43	25	11	64
3	x_1	4.29	0.75	3.64	3.70	0.45	55	3	42
7	x_3	4.29	0.875	3.88	4.00	0.28	42	17	41

where x_l is the relatively low price in the lottery, x_h the relatively high price in the lottery, E(x) the expected value of the lottery, CE the assessed certainty equivalent, A is risk-averse, RN is risk-neutral and S is risk-seeking.

In Table 1 the measurements are classified for each level of expected utility into risk-averse, risk-neutral and risk-seeking responses by taking the difference between the lottery's expected value $E(x)$ and the certainty equivalent CE. A positive difference indicates risk-averse behavior, while a negative difference points to risk-seeking behavior. On average, the entrepreneurs show risk-seeking behavior in lotteries with relatively low utility. When expected utility is relatively high, ($u(x) = 0.75$ and $u(x) = 0.875$), we observe risk-averse behavior. We had two measurements at $u(x) = 0.5$ and two measurements at $u(x) = 0.625$ in order to test the internal consistency of the assessments. If entrepreneurs respond in accordance with the expected utility theory, the same certainty equivalents should result aside from random response error. When tested, the differences between the assessed certainty equivalents for the same utility levels are not significant ($p > 0.99$ (pairwise test) for both consistency measurements). It is therefore concluded that respondents assessed certainty equivalents in an internally consistent manner.

The power function and the exponential function are applied in the utility assessment because of their theoretical properties regarding absolute and proportional risk aversion. Moreover, after having scaled the boundaries of the functions, the estimation of only one parameter suffices to characterize an entrepreneur's risk attitude. In Table 2, the descriptive statistics of the parameter estimates are presented. The average mean squared error (MSE) for $u(x)$ was 0.0256 for the exponential and 0.0268 for the power function. This difference in fit is significant ($t_{345} = 2.21$, $p = 0.028$; pairwise test). The average mean absolute error (MAE) for $u(x)$ was 0.1060 for the exponential and 0.1072 for the power function. This difference in fit is not significant ($t_{345} = 1.43$, $p = 0.152$; pairwise test). In conclusion, the exponential function fits the data slightly better than the power function.

Table 2 shows that, on average, the entrepreneurs are risk-seeking decision makers, corresponding with the entrepreneur's revealed trading behavior.

Table 2 Results of estimating the risk attitude and strength of preference per individual for the exponential function and the power function (sample statistics, N = 346)

	Lottery		Rating	
	exponential	power	exponential	power
Parameter[a]	*c*	*d*	*e*	*g*
Mean	-0.497	1.769	0.334	0.852
Median	-0.266	1.222	0.368	0.800
st.dev.	1.569	1.808	0.491	0.262
Fit indices[b]				
Mean MSE	0.026	0.027	0.012	0.011
Median MSE	0.019	0.019	0.008	0.007
Mean MAE	0.106	0.107	0.069	0.069
Median MAE	0.102	0.101	0.064	0.060
Mean R^2	0.891	0.892	0.908	0.908
Median R^2	0.922	0.923	0.939	0.941
Percentiles parameter				
20th	-1.322	2.338	-0.083	1.043
40th	-0.492	1.427	0.245	0.854
60th	-0.049	1.064	0.460	0.745
80th	0.595	0.676	0.700	0.644
Classification of respondents on the basis of the parameter value[c]				
Concave function	36%	38%	78%	77%
Convex function	64%	62%	22%	23%
Classification of respondents on the basis of the t-value[d]				
Concave function	35%	33%	74%	73%
Linear function	4%	5%	4%	6%
Convex function	61%	62%	22%	21%

[a] See for the function specifications Tables A1 and A2 in Appendix A.
[b] MSE = Mean Squared Error; MAE = Mean Absolute Error; R^2 is calculated by squaring the Pearson correlation between actual values and the values predicted from the model.
[c] If $c > 0$ the respondent is said to be risk averse and if $c < 0$ the respondent is said to be risk seeking.
[d] A respondent is classified as risk neutral when the parameter is not significantly different from zero at the $p = 0.1$ level. Note that to test whether the parameter is significantly different from zero (risk neutral), we had to assume that the residuals are independently and identically distributed per individual and that the non-linear-squares estimator is distributed approximately normally. Since it is questionable whether the residuals per individual fit the assumptions, the analysis performed here shall serve illustrative purposes only.

7.5.3 *Results of Strength of Preference Measurement*

From the rating technique it becomes clear that, on average, the entrepreneurs show decreasing marginal value (i.e. the strength of preference function $v(x)$ is concave), that is, an entrepreneur values an increase from x Dutch Guilders in a relatively low price range more than the same increase in a relatively high price range (see Table 2). The MSE for $v(x)$ was 0.0113 for the power and 0.0116 for the exponential function. This difference in fit is significant ($t_{345} = 2.76$, $p = 0.006$; pairwise test). The MAE for $v(x)$ was 0.0685 for the power function and 0.0689 for the exponential function. This difference in fit is not significant ($t_{345} = 0.92$, $p = 0.357$; pairwise test). This leads us to the conclusion that the power function fits the data slightly better than the exponential function.

7.5.4 *Results of Intrinsic Risk Attitude*

Regarding the intrinsic risk attitude, both functions fit the data equally well (see Table 3). The average mean squared error (MSE) for $u(x)$ was 0.0124 for the exponential and 0.0122 for the power function. This difference in fit is not significant ($t_{345} = 0.74$, $p = 0.457$; pairwise test). The average mean absolute error (MAE) for $u(x)$ was 0.0648 for the exponential function and 0.0639 for the power function. This difference in fit is also not significant ($t_{345} = 1.91$, $p = 0.057$; pairwise test).

***Table 3** Results of estimating the intrinsic risk attitude per individual for the exponential function and the power function (sample statistics, N = 346)*

	exponential	power
Parameter[a]	q	k
Mean	-1.724	2.231
Median	-1.251	1.620
st.dev.	3.660	3.093
Fit indices		
Mean MSE	0.012	0.012
Median MSE	0.007	0.006
Mean MAE	0.065	0.064
Median MAE	0.055	0.055
Mean R^2	0.909	0.911
Median R^2	0.945	0.946
Percentiles parameter		
20th	-3.281	2.876
40th	-1.782	1.867
60th	-0.751	1.335
80th	0.447	0.894
Classification of respondents on the basis of the parameter value		
Risk-averse	27%	26%
Risk-seeking	73%	74%
Classification of respondents on the basis of the t-value		
Intrinsically risk-averse	26%	25%
Intrinsically risk-neutral	1%	3%
Intrinsically risk-seeking	73%	72%

[a] See for the function specifications Table A3 in Appendix A.

Note: in order to compare the parameter estimates of Table 2 with the parameter estimates presented in this Table the latter estimates have to be divided by 1.95 (which is the range of the price levels, that is x_h-x_l).

Table 3 shows that the sample averages of both functions imply that the average respondent exhibits intrinsically risk-seeking behavior which corresponds to the findings of Smidts (1997). In order to test whether the group of respondents is significantly different from intrinsically risk-neutral, it is tested whether the parameter is zero is rejected. The t-test was rejected (for the exponential function $t = -7.74$, $p < 0.001$ and for the power function $t = -6.60$, $p < 0.001$). This result indicates once more that there is no linear relationship between *u(x)* and *v(x)*, which is in line with previous studies (Krzysztofowicz 1983 and Smidts 1997). This confirms the proposition that $u(x)$ and $v(x)$ are different constructs, with only $u(x)$ telling us something about risk. Figure 2 provides further insight into the magnitude of the differences between entrepreneurs in risk attitude and strength of preference.

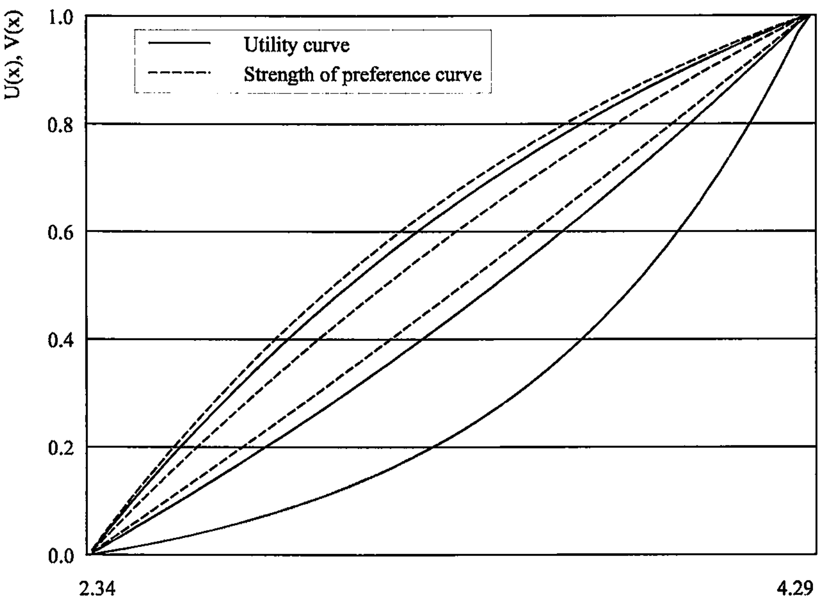

***Figure 2** Utility and strength of preference curves corresponding to the 80th, 50th and 20th percentile.*

7.5.5 *Results of Psychometric Risk Attitude Scale*

We used the item-total correlation and exploratory factor analysis for purification of the initial scale of nine items. After that, the number of items was further reduced by selecting only high loading items following the procedure as described in Steenkamp and van Trijp (1991). A unidimensional risk attitude scale, labeled RiskAtt Scale, was composed of three items showing a close relationship with the items from the Jaworski and Kohli scale (1993). (See Appendix B for the psychometric properties of the scale.) Respondents were asked to indicate the extent to which they agreed with the given statements on a scale ranging from -4 ("I strongly disagree") to 4 ("I strongly agree"). We then conducted confirmatory factor analysis to assess the measurement quality of the RiskAtt Scale. All factor loadings were significant (minimum t-value was 4.60, $p < 0.001$) and greater than 0.4. These findings support the convergent validity of the scale (Anderson and Gerbing 1988). The composite reliability for the RiskAtt Scale was 0.72, which indicates reliable construct measurement. Note that we used the sum scores of the items included in the RiskAtt Scale in the correlation analysis.

7.6 Construct Validity of Risk Attitude

7.6.1 *Convergent Validity*

Table 4 shows the correlation matrix for the different measurement methods. We find that all measurement methods for risk attitude show a significant positive correlation, implying convergent validity. Table 4 also stresses the discriminant validity of our measures. While the RiskAtt Scale does correlate significantly with the risk attitude obtained from the lotteries ($r = 0.1567$, $p = 0.003$) and the intrinsic risk attitude ($r = 0.1344$, $p = 0.012$), it does not correlate significantly with the strength of preference function ($r = 0.0539$, $p = 0.299$). Moreover, the correlation between lottery and the rating is lower than between the lottery and the RiskAtt Scale. After all, the strength of preference function does not measure risk attitude whereas the risk attitude obtained from the lotteries, the intrinsic risk attitude and RiskAtt Scale do.

***Table 4** Correlation matrix between the measurement method*

	RiskAtt Scale	Lotery	Intrinsic risk attitude	Rating
RiskAtt	1.000			
Lottery	**0.1567** $p = 0.003$	1.000		
Intrinsic risk attitude	**0.1344** $p = 0.012$	**0.7602** $p = 0.00$	1.000	
Rating	0.0539 $p = 0.299$	0.0934 $p = 0.072$	**0.1331** $p = 0.01$	1.000

A correlation in bold indicates that the correlation is significant at p < 0.05 (two-tailed)

7.6.2 *Nomological Validity*

Nomological validity is assessed by testing the hypotheses as formulated in Section 7.3. The hypotheses which contain variables on the attitude and intention level (see Figure 1, left branch) are measured with self-report measures. These variables are latent variables and each such variable, or rather, construct, is measured by a set of observable indicator variables (i.e. items). Observable variables may be assumed to be measured with error. Structural equation models permit the explicit modeling and estimation of errors in measurement (Baumgartner and Homburg 1996; Bagozzi and Yi 1994 and Steenkamp and van Trijp 1991). Thus, the coefficients in the structural equation model represent theoretical cause and effect relationships among the attitude and intention variables and risk attitude, and as such they are the parameters of our interest (Baumgartner and Homburg 1996; Bagozzi and Yi 1994; Steenkamp and van Trijp 1991; Fornell And Bookstein 1982). Therefore structural equation modeling was conducted in order to test the hypotheses regarding the entrepreneur's characteristics. The model has been estimated using LISREL 8. The input for the analysis consisted of covariance matrices based on N = 346. Table 5 summarizes the results.

Table 5 *Results of structural equation models (using LISREL 8, N = 346)*

Construct	RiskAtt Scale	Intrinsic Risk Attitude	Lottery	H(+/-)
Innovativeness				
β =	-0.445	-0.037	-0.064	H(-)
t =	**-5.593**	-0.597	-1.043	
χ^2 /df =	2.467	2.376	2.267	
p =	0.002	0.036	0.045	
RMSEA =	0.065	0.063	0.061	
GFI =	0.974	0.987	0.988	
AGFI =	0.944	0.962	0.964	
CFI =	0.966	0.978	0.980	
TLI =	0.946	0.964	0.960	
Market orientation				
β =	-0.178	0.053	-0.099	H(-)
t =	**-2.429**	0.863	-1.612	
χ^2/df =	1.018	2.113	1.286	
p =	0.429	0.061	0.267	
RMSEA =	0.007	0.056	0.028	
GFI =	0.989	0.998	0.993	
AGFI =	0.977	0.964	0.979	
CFI =	0.999	0.976	0.994	
TLI =	0.971	0.956	0.987	
Intention to secure profit margin				
β =	0.255	0.096	0.164	H(+)
t =	**3.925**	1.782	**3.085**	
χ^2/df =	7.854	*	*	
p =	0.003	*	*	
RMSEA =	0.141	*	*	
GFI =	0.977	*	*	
AGFI =	0.886	*	*	
CFI =	0.940	*	*	
TLI =	0.933	*	*	
Intention to reduce income fluctuations				
β =	0.184	0.065	0.090	(H+)
t =	**2.872**	1.213	1.676	
χ^2 /df =	3.346	*	*	
p =	0.035	*	*	
RMSEA =	0.082	*	*	
GFI =	0.990	*	*	
AGFI =	0.952	*	*	
CFI =	0.978	*	*	
TLI =	0.969	*	*	

where H(+/-) indicated the expected sign of β which is the standardized regression coefficient which shows the relation between the risk attitude and the latent constructs.
A bold t-value indicates that the t-value is significant at the 5% level.
* the model is saturated, therefore leading to a perfect fit

The estimation results for the intrinsic risk attitude and the risk attitude obtained from the lotteries, presented in Table 5, are based on the exponential function. Conducting the same analysis for the power function shows very similar results. From Table 5 the following conclusions may be drawn.

Table 5 shows that the RiskAtt Scale is significantly related to the attitude and intention variables. Hence, the corresponding hypotheses, 1a to 1d (see Figure 1, left branch), have been confirmed (t-values of β's are significant and model fit is good). The intrinsic risk attitude showed no significant relationship with the attitude and intention variables. Risk attitude, measured by lotteries, showed a significant relationship only with the entrepreneur's intention to secure his/her profit margin. Based on these results, we conclude that the RiskAtt Scale outperforms the measures derived within the expected utility framework regarding nomological validity based on the selected attitude and intention measures.

Now we will turn to test the nomological validity of the risk attitude measures for actual, revealed, market behavior.

In Hypothesis 2a we expected that the entrepreneurs' risk attitude is positively related to the incidence of using futures contracts. Since the choice to use or not to use futures contracts is a binary variable, we use logistic regression (Hosmer and Lemeshow 1989) to model the probability of this choice. The model chi-square values resulting from the logistic regression are displayed in Table 6. The model, in which risk attitude was obtained by the lottery and the intrinsic risk attitude, significantly improve the fit when compared to the null model with only an intercept ($p < 0.03$) thereby confirming Hypothesis 2a. Moreover, the validity of the models is supported by the proportion of correctly classified choices. These proportions significantly exceed the proportion of choices correctly classified by chance as derived from Huberty's test ($p < 0.05$). The model developed with the RiskAtt Scale has a very bad fit. Therefore, for this scale Hypothesis 2a is rejected, which indicates that the RiskAtt Scale is a bad instrument to predict the use of futures contracts.

In order to gain more insight into the selling behavior of the respondents and the elicited risk attitude measures, we split the respondents in two groups. The first group sold slaughter hogs on the free market (i.e. directly to the slaughterhouse or the trader), the second group sold slaughter hogs to a cooperative, at an average price. The split shows the entrepreneur's preference for either a price risk-bearing market channel or a risk-reducing market channel. As expected, using the lottery and the intrinsic risk attitude (both the power and the exponential function), a significant difference in risk attitude was found between entrepreneurs who sell directly onto the free market and entrepreneurs who supply cooperatives, the latter being less risk-seeking ($p < 0.025$). This confirms Hypothesis 2a once more. For the RiskAtt Scale no significant difference in risk attitude was found between entrepreneurs who sell directly onto the free market and entrepreneurs who supply cooperatives.

***Table 6** Results of logistic regression in which risk attitude predicts behavior*

	RiskAtt Scale	Intrinsic Risk Attitude	Lottery
Uses futures markets to cover risk: Yes (= 1) or No (= 0)			
B	0.0615	0.320	0.567
Wald Statistic	1.8133	6.870	7.105
significance	0.1781	**0.009**	**0.007**
R	0.0000	0.186	0.190
χ^2-improvement	1.902	8.115	8.022
Significance	0.168	**0.004**	**0.005**
Marketing Channel Choice: sell to a trader or directly to a slaughterhouse (= 1) versus sell to a cooperative (= 0)			
B	0.023	0.080	0.192
Wald Statistic	1.388	3.927	6.116
significance	0.238	**0.047**	**0.013**
R	0.000	0.064	0.093
χ^2-improvement	1.392	4.822	6.667
Significance	0.238	**0.028**	**0.010**

In Hypothesis 2b we expected that entrepreneurs who are more risk averse will choose selling to a cooperative (where he or she gets an average price) over selling to a trader or slaughterhouse (where he or she receives the spot price). Since the choice to sell to a trader/slaughterhouse or to a cooperative (i.e. risky vs. safe) is a binary variable, we use logistic regression (Hosmer and Lemeshow 1989) to model the probability of this choice. The model chi-square values resulting from the logistic regression are displayed in Table 6. The model, in which risk attitude was obtained by the lottery and the intrinsic risk attitude, significantly improve the fit when compared to the null model with only an intercept ($p < 0.03$) thereby confirming Hypothesis 2b. Moreover, the validity of the model is supported by the proportion of correctly classified choices. These proportions significantly exceed the proportion of choices correctly classified by chance as derived from Huberty's test ($p < 0.05$). The model developed with the RiskAtt Scale has a very bad fit. Therefore, for this scale Hypothesis 2b is rejected, which indicates that the RiskAtt Scale is a bad instrument to predict the choice of the marketing channel (risky versus safe).

In Hypothesis 2c we predict that a risk-averse entrepreneur will attempt to trade more frequently, that is, enter the market more often with a "round" of hogs, thereby spreading his/her risk. This behavior will be more prominent, the more risk he/she perceives. To investigate the relationship between the frequency of trading in the risky market and risk attitude, we have developed a model which includes a interaction between risk perception and risk attitude. Besides 'risk attitude' and 'risk perception' we included in the model 'size of enterprise'. Because of the technical aspects of the production process and the near-impossibility of transporting large numbers of slaughter hogs from the company to the purchaser at the same time, we expect in general a larger company to have more rounds.

***Table 7** Results of multiple regression in which risk attitude predicts behavior*

Frequency of trading in the risky market				
	β	Standard error	*t*-value	*p*-value
Size of company	0.144	0.000	2.75	0.006
Risk perception (RP)	0.159	0.026	3.01	0.002
Intrinsic risk attitude (IRA)	-0.067	0.153	1.22	0.220
Interaction[1] (IRA*RP)	0.018	0.009	1.91	0.057

Degrees of freedom 341 from 346 observations

R^2 =	0.07
Adjusted R^2 =	0.06
$F(4,341) = 6.15$	Probability of $F(4,341) = 0.00$

[1]The variables risk perception and intrinsic risk attitude are centered prior to forming the multiplicative term (Cronbach 1987; Jaccard et al. 1990).

Table 7 shows the regression results for the intrinsic risk attitude. As expected, the size of company shows a positive significant relationship with the frequency of trading in the market. In the regression, the interaction between risk perception and intrinsic risk attitude is significant. The positive sign of the interaction term can be interpreted clearly (see Figure 3). The interpretation of the interaction term is visualized in Figure 3 on the basis of the results of the multiple regression analysis as displayed in Table 7. In Figure 3, a split is made between intrinsically risk averse and intrinsically risk seeking subjects.

A risk-averse entrepreneur will in general trade in the risky market relatively more often, in order to spread his/her risk than a risk-seeking entrepreneur. When he/she perceives much risk, this behavior will be more prominently present. So, for a risk-averse entrepreneur, high risk perception will lead to more trades, that is, taking relatively little price risk. In contrast, a risk-seeking entrepreneur will react to the same situation by trading less often and thus exposing himself to more price risk. When he/she perceives little risk, that behavior will not be present this prominently. So, for a risk-seeking entrepreneur, high risk perception will lead to an even lower frequency of trades in the market.

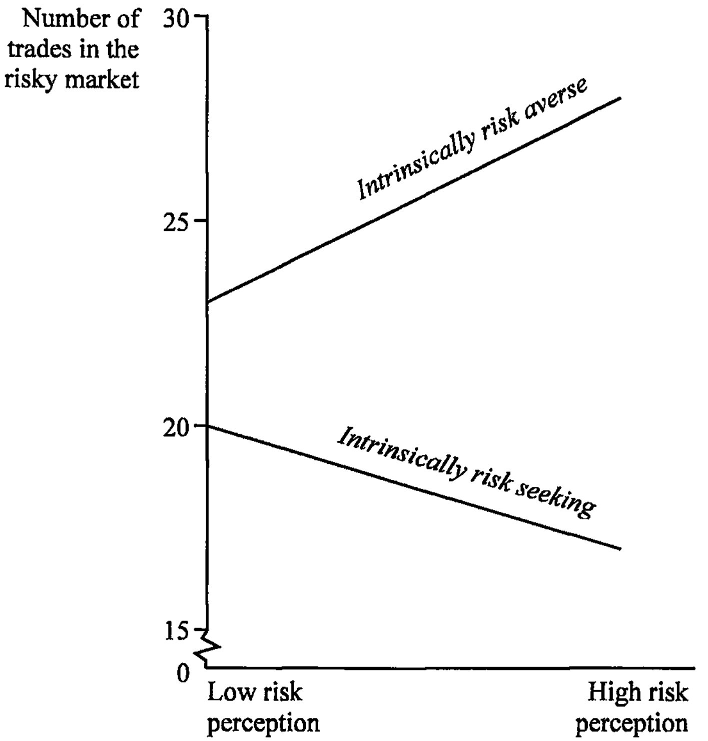

Figure 3 *Visualization of the interaction effect for risk attitude and risk perception on the number of trades in the risky market for risk seeking and risk averse subjects*

We estimated this model also for the RiskAtt Scale and the risk attitude obtained from the lotteries. In both cases this did not produce significant results for the risk attitude measure and/or the interaction term.

Our findings show a striking pattern for nomological validity. The risk attitude measure derived from the psychometric framework shows a clear relationship with the attitude and intention variables. The nomological validity of this set of variables (the left branch of Figure 1) is supported. However, we do not find any relationship between the risk attitude scale and variables which describe actual behavior (see right branch of Figure 1). Thus, the nomological validity of this set of variables is not supported. When we look at the risk attitude measures derived from the expected utility framework, however, we see the reverse pattern. These risk measures show a significant relationship with actual market behavior, but, for the most part, lack correlation with the attitude-intention variables in the nomological net. Within the expected utility framework, the intrinsic risk attitude performs slightly better than the risk attitude obtained from lotteries. In particular, the interaction between intrinsic risk attitude and risk perception is significantly related to the frequency of trading in the risky market. In conclusion, we may say that, pertaining to actual market behavior, the measures derived from the expected utility framework have a higher predictive validity. Moreover, we investigated the correlation between the attitude-intention variables (self-report measures) and actual behavior. In other words, we checked for correlation between the variables in the left and right branch of Figure 1. Like the risk attitude scale, the self-report variables do not correlate with actual behavior either.

7.7 Conclusions

Risk attitude plays an important role in understanding decision making behavior. In empirical studies, risk attitude is conceptualized and measured in completely different ways. We may expect that the specific risk attitude measure used may influence the results and consequently our understanding of decision making under risk. For this reason, it is of great importance to gain insight into the construct validity of the different risk attitude measures. In this chapter, the construct validity of risk attitude measures, derived from the expected utility model, rooted in economics, and measures derived from psychometrics, rooted in marketing and psychology, have been tested.

Within the expected utility model, the risk attitude was assessed by means of lotteries. The consistency checks show that the respondents have assessed the certainty equivalents in an internally consistent manner. The intrinsic risk attitude was assessed by measuring the strength of preference by means of the rating technique. Both the exponential function and the power function fit the data equally well. We find that there is no correlation between strength of preference and risk attitude, as measured by the certainty equivalence technique and the rating technique respectively. This confirms the theory claiming strength of preference and risk attitude to be two different constructs (Dyer and Sarin 1982; Smidts 1997). Thus the intrinsic risk attitude is a separate indicator of the risk taking behavior of a decision maker. Within the psychometric framework we developed a unidimensional risk attitude scale based on a number of Likert statements with good psychometric properties.

The three different risk attitude measures correlate significantly and positively, indicating convergent validity. They also show discriminant validity. Whereas the RiskAtt Scale does correlate significantly with the risk attitude scale obtained from the lotteries and the intrinsic risk attitude, it does not correlate with the strength of preference function, as the strength of preference function does not measure risk attitude.

The tests on the nomological validity of the measures produce interesting results. Our nomological net contains self-report measures which describe the attitude towards innovation and market orientation and the intention to reduce risk, and revealed preference data about market behavior. The psychometric risk scale performs especially well with respect to these self-report measures, contrary to the risk attitude measure obtained from the lotteries and the intrinsic risk attitude. The RiskAtt Scale showed coherence with innovativeness, market orientation, the entrepreneur's intention to reduce fluctuations in his/her income and the entrepreneur's intention to secure his/her profit margin. The intrinsic risk attitude showed no coherence with the constructs listed above, the risk attitude obtained from the lotteries showed coherence only with the entrepreneur's intention to secure his/her profit margin.

In contrast, the lottery measure and the intrinsic risk attitude greatly outperform the psychometric scale when the relationship with actual behavior is concerned. The measures derived from the expected utility model showed themselves powerful predictors of the entrepreneur's choice of market channel (risky channel versus safe channel), the incidence of using futures contracts and the number of trades in the risky market (i.e. the number of times the entrepreneur was exposed to price risk).

These findings presented above may be explained by the fact that the task of responding to lotteries elicits a mental set which closely resembles actual behavior, i.e. this task has "behavioral" characteristics. After all in this task, the respondents made choices which resemble their daily decision making behavior very closely. The choice between receiving a relatively high price or a relatively low price with a 50/50 chance or receiving a fixed price shows many similarities with the choices these same entrepreneurs make in daily life: that is, to sell on the cash market and thus be exposed to price risks (the reader will perceive the analogy with the element of the 50/50 chance in the lottery) or to sell the forward in the futures market and hence fix the price in advance (the reader will perceive the analogy with the element of the fixed price in the lottery). Therefore the lottery task may be seen as a simulation of actual behavior. By correcting for strength of preference, intrinsic risk attitude slightly outperforms the lottery measurement. The risk attitude measures derived within the expected utility theory already incorporate the behavioral element, i.e. revealed preferences, making them much better predictors of actual behavior than the risk attitude scale.

The psychometric scale performs better in the nomological net as far as the self-report scales are concerned. This may be explained by the fact that both the self-report scale measuring entrepreneurs' attitudes and intentions and the risk attitude scale are on the "opinion" level, i.e. the "I think that" or "I feel that" level. The good performance of the risk attitude scale may also be attributed to self-consistency inherent to the use of scales, that is, the respondent's urge to score according to patterns considered logical. Several studies in psychology show this tendency (see Sherman 1980, McFadden 1986, Feldman and Lynch 1988, Lance, Lapointe and Fisicaro 1994). Note that a self-report measure can be valid in itself, e.g. someone may truly consider himself a risk taker. However, his/her behavior (as compared to that of others) may show that he/she is not an exceptionally risk-taking person. In such a case, the attitude-behavior relationship will be relatively weak. It appears that the lottery task and rating task are much better suited at eliciting that mental state which occurs during a real decision to use futures contracts or about which marketing channel to choose. Hence, one behavior predicts the other.

In marketing and management research, we are often interested in actual behavior. In that case we advise to make use of revealed preference methods instead of self-report measures. When specifically investigating decision making behavior under uncertainty, it is advisable to use lotteries as a revealed preference method. Unfortunately, this task is relatively time-consuming and can only be performed in (expensive) face-to-face interviews. A technical advantage of psychometric scales is that they can be completed relatively quickly.

A researcher will have to weigh these disadvantages of the lottery technique against the advantage of probably higher predictive validity. In this study, intrinsic risk attitude appeared to perform slightly better on predictive validity than the risk attitude measures solely derived from lotteries. In order to deduct the intrinsic risk attitude, the lottery task alone is insufficient, we need the rating task as well. The latter task however, does not take much time. Therefore, if one decides to use lotteries, it seems wise to include the rating task in an empirical study as well.

Our findings suggest several directions for further research. First, the nomological net used in this study could be broadened. Second, our research could be replicated across different domains, thereby testing for domain influences particularly regarding market behavior. Moreover, our research can be tested for other revealed preference methods, such as the tradeoff method for eliciting $u(x)$ recently developed by Wakker and Deneffe (1996) and the perceived risk attitude concept by Weber and Milliman (1997). The current revealed preference method (CE-technique) has to its disadvantage that it takes relatively much of the respondent's time. Developing faster and therewith cheaper revealed preference methods might be an interesting avenue to explore in the future.

7.8 Acknowledgments

The authors are very grateful to the 346 entrepreneurs for their generous participation in the personal interviews. Research support provided by the Amsterdam Exchanges (AEX) is gratefully acknowledged. The authors would also like to thank J.A. Bijkerk for building a user friendly interface for the personal computer-assisted interview. The authors express special thanks to M.T.G. Meulenberg and the participants of the 1997 Agrarökonomisches Kolloquium University of Kiel (Germany) who provided helpful comments on the research project and preliminary versions of this chapter.

Appendix A

Estimating risk attitude based on the lottery technique and the intrinsic risk attitude based on both the lotteries and the rating technique

The exponential function and the power function are used to specify the utility function and the strength of preference function derived from the lottery technique and rating technique respectively. After scaling the boundaries of the functions, the estimation of only one parameter suffices to characterize a decision maker's risk attitude. Because the certainty equivalents are measured with error and not the utility levels, the inverse function is estimated. In the rating technique the order of price levels presented to the respondent is random and therefore these measurements can be viewed as independent, which is why we do not need to estimate the inverse function. Tables A1-A3 present the mathematical representation of the different function specifications for the different methods. Since it is not possible to measure intrinsic risk attitude directly, the following procedure has been adopted. First, both the utility $u(x)$ and strength of preference $v(x)$ are measured for the price stimulus x. Secondly, $u(x)$ and $v(x)$ are related statistically (see Smidts 1997).

***Table A1** Function specifications of the utility function obtained by lotteries*

Certainty equivalence technique	
Exponential function	Power function
Function	
$u(x)=\dfrac{1-e^{-c(x-x_L)}}{1-e^{-c(x_H-x_L)}}$	$u(x)=\dfrac{(x-x_L)^d}{(x_H-x_L)^d}$
Estimation function	
$x_i=\dfrac{\ln(0.5(e^{-cx_l}+e^{-cx_h}))}{-c}+e_i$	$x_i=(x_H-x_L)(0.5((\dfrac{x_l-x_L}{x_H-x_L})^d+(\dfrac{x_h-x_L}{x_H-x_L})^d)^{\frac{1}{d}})+x_L+e_i$

where x_l and x_h represent the low and high outcomes of the 50/50 lottery respectively and x_i stands for the assessed certainty equivalent. The respondent assesses x_i for n lotteries, with varying outcomes x_l and x_h. The exponential function implies a constant absolute risk attitude and an increasing proportional risk attitude, whereas the power function implies a decreasing absolute risk attitude and a constant proportional risk attitude.

Table A2 *Function specifications of the strength of preference function obtained by the rating technique*

Rating technique	
Exponential function	Power function
Function and *estimation function*	
$v(x) = \frac{1 - e^{-e(x-x_L)}}{1 - e^{-e(x_H-x_L)}}$	$v(x) = \frac{(x - x_L)^g}{(x_H - x_L)^g}$

where x is the price level which the respondent had to value (by given it a rate), x_H and x_L are the highest and lowest price level given to the respondent respectively.

Table A3 *Specification of the functional relationship between strength of preference and utility function*

Intrinsic risk attitude	
Exponential function	Power function
Function and *estimation function*	
$u(x) = \frac{1 - e^{-qv(x)}}{1 - e^{-c}}$	$u(x) = v(x)^k$

The parameters in the formulas as displayed in Tables 2-4 are estimated using routine ZXMIN from the IMSL-library of FORTRAN programs. In ZXMIN the least squares estimate is obtained by Fletcher's Quasi-Newton Method. We followed Smidts (1990) in our estimation of the parameters.

Appendix B

Confirmatory Factor Analysis for the Measures

To examine the measurement quality of the constructs, confirmatory factor analysis has been performed using LISREL 8 (Steenkamp and van Trijp 1991). The input for the analysis consisted of covariance matrices based on $N = 346$.

RiskAtt Scale

1) I am willing to take higher financial risks in order to realize higher average yields
2) I like taking big financial risks
3) I am willing to take higher financial risks when selling my hogs, in order to realize higher average yields

Entrepreneurs were asked to indicate their agreement with each item through a nine point scale ranging from "strongly disagree" to "strongly agree". Construct reliability = 0.72; model is saturated

Innovativeness

1) I buy new products before my colleagues (competitors) buy them
2) I like experimenting with new ways of doing things
3) I take more chances than others
4) I generally like trying out new ideas in my enterprise

Entrepreneurs were asked to indicate how well the statements fit their own views through a five point scale. Construct reliability = 0.76; $\chi^2 = 8.37$ ($df = 2$, $p = 0.01$); RMSEA = 0.09; GFI = 0.99; AGFI = 0.95; CFI = 0.98

Market orientation

1) I think it is important to understand the wishes of my customers
2) I think it is important to know how my customers evaluate my product
3) I adapt to changes in the market
4) I think it is important to know a lot of the end-users

Entrepreneurs were asked to indicate their agreement with each item through a nine point scale ranging from "strongly disagree" to "strongly agree". Construct reliability = 0.72; $\chi^2 = 4.54$ ($df = 2$, $p = 0.08$); RMSEA = 0.06; GFI = 0.99; AGFI = 0.97; CFI = 0.99

CHAPTER 8

Modeling Choices of Small and Medium Sized Enterprises for the Hedging Service Provided by Futures Exchanges[1]

8.1 Abstract

We propose a model that explains the choice behavior of small and medium sized enterprises (SMEs) with respect to price risk management instruments, one of them being futures contracts. We relate the key components of the model to characteristics of SMEs, in this way explaining differences between the decision units' evaluations of the financial services provided by futures exchanges. The model is tested on data collected from 467 entrepreneurs of small and medium sized enterprises by means of computer-assisted personal interviews. We find that the difference between the futures price and the entrepreneur's reference price, and the components ease of use, performance and entrepreneurship are the key components in the entrepreneur's choice process with respect to financial services. These key components turn out to be related to the SMEs' characteristics innovativeness, market orientation and level of understanding of price risk management instruments. We discuss how these key components can be influenced through the marketing policy of futures exchanges and how our findings can improve the effective design of futures.

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[1] This chapter is based on: Pennings, J.M.E. and M.J.J.M. Candel (1997), "Modeling Choises of Small and Medium Sized Enterprises for Financial Services", Marketing Science Conference in Berkeley CA, USA, 21-24 March 1997.

8.2 Introduction

The financial services industry is one of the fastest growing industries. In the case of financial derivatives markets, futures and options provide important services. The last decade has shown an almost exponential growth of both futures and options. In order to assure survival, futures exchanges show a rapid product innovation (Carlton 1984; Miller 1990). However, for futures contracts the risk of failure is considerable (Davey and Maguire 1996; Tashjian 1995). Futures contracts are traded on futures exchanges and make it possible for those who want to manage price risk, hedgers, to transfer risk (hedging service of the exchange) to those who are willing to accept it, the speculators (speculation service of the exchange). In this chapter we investigate the decision process of entrepreneurs towards hedging services. This chapter corresponds to the marketing approach as outlined in Chapter 2. To get some insight into the failure and success of futures contracts we want to examine how choices between different financial services are made by entrepreneurs of SMEs, and what criteria are used in the evaluation of these financial services. In particular, we examine SMEs' choices between competitive financial services, one of which is futures contracts. To deepen our understanding of the choices between financial services, several hypotheses are formulated concerning characteristics of SMEs that may be related to the evaluation of these financial services. Knowledge about this makes it possible to introduce futures contracts successfully.

Although the functioning of Price Risk Management Instruments (PRMIs) such as futures contracts and options, has been the subject of extensive academic research in the financial literature, the issue of identifying who uses these markets and for what reasons has received little attention. Neither do relatively recent studies (e.g. Boot and Thakor 1993; Makus et al. 1990; Merton 1995; Tashjian 1995) explain why potential hedgers act as they act, nor do they reveal the underlying (psychological) constructs explaining their buying behavior. Moreover, previous research on financial services focuses on consumers or managers of large companies, whereas the buying behavior of SMEs for financial services is particular relevant for the financial derivatives industry. Therefore, we propose a new model that explains the choice behavior of entrepreneurs of SMEs for financial services. Insight in the choice process will reveal the necessary information for the financial institution to improve the design of financial products. We relate our findings to the effective design of financial products.

The chapter is organized as follows. First, we introduce a model which links beliefs and evaluations of SMEs concerning PRMIs to the choices among PRMIs. Second, the relations between the key components of the model and SME's characteristics are specified in order to deepen our insight into SME's choice behavior. After the presentation of the research method and the operationalization of the model, our hypotheses are tested with structural equation modeling. Data obtained from 467 entrepreneurs of small and medium sized agricultural enterprises by means of computer-assisted personal interviews constitute the input for this part of the research. We conclude with an evaluation of the study and discuss several managerial implications of the study.

8.3 Modeling Choice Behavior

Fern and Brown (1984) and Bunn (1993) showed that the buying behavior of entrepreneurs can not be classified exclusively into either industrial or consumer buying behavior. In this study we primarily use consumer research to model the buying behavior of entrepreneurs. By taking the effect of the decision unit of the entrepreneur into account, a typical element of the industrial buying behavior is also incorporated.

Within consumer research, cognitive psychology and attitudinal research are available as tools for modeling choice behavior. Cognitive psychology offers the information-processing paradigm as a tool for building choice models. Attitudinal research offers multi-attribute models that focus on the links between cognitive, affective and conative components. Dabholkar (1994) proposed to model choice by integrating these two approaches. As argued by Dabholkar: "*Consumer choice models that integrate the contribution of information-processing and attitudinal research should promote greater understanding of how consumers make choices and of the processes underlying these choices*" (p.101). In formulating a choice model for SMEs' choices between financial services we elaborate upon this integrated framework.

One of the pillars of the choice model proposed is *multi-attribute attitude theory* (Fishbein and Ajzen 1975; Ajzen and Fishbein 1980; Bagozzi 1981). In the classical version of this theory, attitude is assumed to be decomposable as a sum of belief-evaluation products, with the products being weighted equally. The beliefs pertain to the degree to which an object may have particular consequences and the evaluations reflect the importance of these consequences. The equal weighting of belief-evaluation products however has been challenged by Shimp and Kavas (1984). They argue that cognitive elements regarding the consequences of behavior may be qualitatively different and are therefore likely to be organized into different schema or categories. The different categories may have different weights attached, and, consequently, may have separate influences on attitude. A way of modeling this in a multi-attribute approach is the formulation of expectancy-value components: similar beliefs are grouped into components and the evaluations of these components are allowed to influence the attitude differently.

The *information-processing* paradigm provides the second pillar of the choice model. It assumes that choice alternatives can be described by cognitive representations of object attributes. These representations are assumed to underlie consumers' choices (Bettman and Sujan 1987; Corfman 1991; Johnson 1984). When this rationale is extended to the attitudinal framework, it is likely that decision makers use cognitive representations about behavioral consequences as the basis for choice. The so-called Expectancy-Value Components (EVCs) can be seen as corresponding to these cognitive representations. An important issue is how subjects compare choice alternatives in order to reach a choice. Corfman (1991) argued that value and utility are more important than more objective features and functions of choice alternatives. Therefore, the comparison in our choice model is assumed to take place on the EVC level since the expectancy-value components are on the value and utility level. To choose between PRMIs, the SME will map concrete features of the instrument into a component such as price risk reduction capacity or ease of use and will evaluate the instrument on this component. Furthermore, the attitude towards PRMIs is formulated as a higher-order affective state produced by the combination of the EVCs corresponding to different components (Bagozzi and Van Loo 1991).

The model for SMEs' choices postulates a sequential process. In line with the Expectancy-Value Comparison model of Dabholkar (1994) SMEs are assumed to group beliefs first according to dimensions and to form expectancy-value components for the choice alternatives under consideration. SMEs categorize beliefs into dimensions to facilitate the comparison across alternatives. For example, an entrepreneur might evaluate the ease of using a futures contract. This evaluation may be based on attributes such as the complexity of the hedging service provided by futures exchanges and the accessibility of the trading floor. Exploratory factor analysis on beliefs can be employed to reveal these dimensions. Components such as "ease of use" or "degree of risk reduction performance" may result. It is assumed that along each of these more abstract components the PRMIs are evaluated. This is the formation of Expectancy-Value Components (EVCs). As formulated by Dabholkar (1994), expectancy-value components may be thought of as valenced belief clusters that hang together in the entrepreneur's mind in schematic or categorical representations.

Let EVC_{ij} be the expectancy-value component for alternative i and component j. Let b_{ik} be the belief that alternative i leads to consequence k and let e_k be the evaluation of this consequence. The expectancy-value component for alternative i along component j is now defined as

$$\text{EVC}_{ij} = \sum_{k \in K_j} b_{ik} e_k \tag{1}$$

where the summation is across all consequences that belong to this component.

After having formed expectancy-value components for each alternative under consideration, the entrepreneur will compare these across alternatives. Dabholkar (1994) provided evidence that comparison at the level of expectancy-value components may occur when there are a few alternatives, when some of the alternatives are somewhat unfamiliar, when the choices are rather important and when there seems to be some natural grouping of the beliefs. The use of futures contracts is somewhat unfamiliar to most of the entrepreneurs in our empirical study. Moreover, the choices concern financial matters and will therefore be considered important. These conditions justify that the alternatives are compared from the EVC level onwards. There are different ways of comparing the EVCs across alternatives. As shown by Dabholkar (1994), the comparison among the EVCs turned out not to be very sensitive to the way the comparison was modeled. In the psychological literature however there are some indications that, when there are only two choice alternatives, the choice process seems to be based on value differences between alternatives along each of a number of evaluative dimensions (Albert, Aschenbrenner and Schmalhofer 1989; Böckenholt and Kroeger 1993; Busemeyer and Townsend 1993). In the present chapter, we will consider only two choice alternatives, say *i* and *h*, and therefore consider the following comparison across alternatives for a particular expectancy value component:

$$REVC_{ij} = EVC_{ij} - EVC_{hj} \qquad (2)$$

These differences are called relative expectancy value components. A central assumption of the model is that expectancy-value components are compared and that from this level onwards relative constructs are considered (Dabholkar 1994). This means that the entrepreneur combines the relative expectancy-value components to form a relative attitude towards an alternative. The relative attitude towards an alternative is the attitude towards an alternative, when compared to the attitudes towards the other choice alternatives. A study by Van den Putte et al. (1996) empirically demonstrates that relative measurements of constructs such as attitude are superior when they are obtained as direct comparisons of the alternative with other competing alternatives. Therefore, in this chapter, from the attitude level onwards, also direct comparative measurements will be assumed.

Let RAT_i be the relative attitude of alternative *i*. As already stated, this relative construct is assumed to be determined by the comparison of the alternative to the other alternatives on different affective components of the attitude, as expressed by the relative expectancy-value components. If the number of expectancy-value components is *J*, we assume that:

$$RAT_i = \sum_{j=1}^{J} \beta_j REVC_{ij} \qquad (3)$$

Note that, since the relative attitude is measured directly in this chapter, no aggregation of the attitudes across alternatives has to take place.

Based on the relative attitude the entrepreneur forms an intention to choose one of the alternatives when compared to the other choice alternatives under consideration. This is the relative intention. Traditionally, theories of consumer behavior concentrate on the choice process and the choice structure is not under discussion, that is, the individual consumer is assumed to be the decision maker. Since, in this chapter, we focus on the entrepreneurs of SMEs, the present model also includes the entrepreneur's perception of the extent to which significant others (such as advisors surrounding the SME) think that one should engage in one of the alternatives. This is the subjective norm. Also here we assume that the relative subjective norm is a determinant of the relative intention. That is, the degree to which the respondent thinks that relevant others expect him/her to make use of the hedging service of futures contracts, when compared to other alternatives, is assumed to influence the choice for futures contracts. The relative subjective norm is denoted as RSN_i. In line with various other studies in this domain, the attitude and subjective norm are assumed to be correlated (see e.g. Ajzen & Madden 1986; Ryan 1982). The relative intention towards alternative *i*, RIN_i is now assumed to be determined by the relative attitude and the relative subjective norm according to the following formula:

$$\mathrm{RIN}_i = \beta_1 \mathrm{RAT}_i + \beta_2 \mathrm{RSN}_i \qquad (4)$$

Finally, the relative intention towards the alternative will influence the choice for this particular alternative. We will assume a linear dependency between the intention and the choice variable, which in this chapter is binary: did the entrepreneur choose a futures contract or did the entrepreneur choose one of the other alternatives? Consider Figure 1 for a graphical representation of the choice model proposed. In the sequel the model will be further implemented for the context of SMEs' having to make choices among PRMIs, one of which is futures contracts.

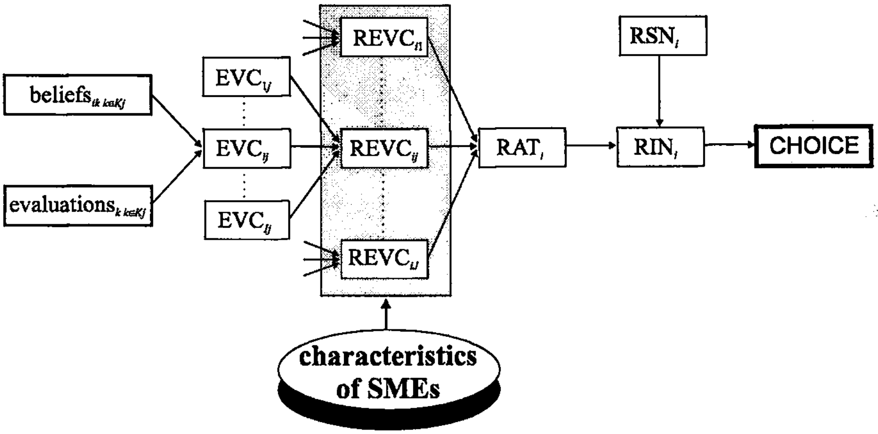


Figure 1 *The choice model*

In this figure k denotes consequence k ($k = 1 \ldots k$), K_j denote all consequences that belong to expectancy-value component j, EVC_{ij} the expectancy-value component for alternative i and component j ($i = 1 \ldots I$ and ($j = 1 \ldots J$), $REVC_{ij}$ the relative expectancy-value component for alternative i and component j, RAT_i the relative attitude towards alternative i, RIN_i the relative intention to buy alternative i, and RSN_i is the relative subjective norm for alternative i.

8.4 Implementing the Choice Model for the Hedging Service Provided by Futures Exchanges

In addition to testing the choice model, we want to deepen our insight into why SMEs evaluate the underlying dimensions, which they use in their decision, the way they do. In our model the relative expectancy-value components are used by the entrepreneur to form his/her relative attitude towards futures and ultimately determine the choice of the entrepreneur. The entrepreneur's choice for any particular alternative depends on the importance placed by the entrepreneur on the different expectancy-value components, as well as on how the alternatives differ on these expectancy-value components in the entrepreneur's evaluation. Hence, the relative-expectancy value components are the key components in our model.

In order to gain insight into why entrepreneurs choose as they choose, we have to investigate which variables are related to these relative expectancy-value components. Insight in the variables that influence these key components will provide the management of the futures exchange with a framework for improving their marketing policy and provides valuable information for the research and development department when designing new futures contracts.

8.4.1 *Qualitative Pre-Study*

Prior to the quantitative study, we conducted four group discussions with entrepreneurs about price risk management. The goal of the group discussions was to gain insight into the decision process of selling output using price risk management instruments. More specifically, we wanted to gain insight into the criteria entrepreneurs use when choosing between alternative price risk management instruments and what their evoked set consists of, that is, which price risk management instruments are perceived as alternatives in their industry. The groups consisted of ten entrepreneurs each. Care was taken to select some entrepreneurs who had, to some extent, been involved in futures trading and other entrepreneurs who had not been involved in futures trading at all. Having mixed groups with users and non-users stimulated the discussion why one should or should not use futures. Moreover, the decision criteria can be better traced when having mixed groups. The group discussions took place in an informal atmosphere and each session lasted for about two and a half hours.

The subjects of our study were entrepreneurs of medium and large sized hog farms in the Netherlands. In the Netherlands the hog industry is one of the most important industries. Because of heavy price fluctuations, the entrepreneurs face a price risk and consequently futures contracts might be an attractive price risk management instrument.

From the group discussions it became clear that the entrepreneurs had only two alternatives regarding selling hogs. The first alternative is to buy the piglets, raise them to hogs and then sell them on the cash market for a price that is unknown at the moment the piglets are bought. The second alternative is to sell the hogs forward by selling futures contracts at the moment the piglets are being bought and hence eliminate the price risk in the hog cash market. It became clear that a number of criteria are used in deciding whether or not to use futures contracts. Very prominent were: possibility of exercising entrepreneurial freedom, risk reduction performance, the possibility to plan the input and output of the production process and the ease of use. Furthermore, some entrepreneurs perceived futures contracts not as a price risk management instrument but as a pricing instrument. For these entrepreneurs a futures contract is interesting whenever it can be used to maximize the price that can be obtained for the underlying commodities. They indicated that if the futures price was high enough for them to make a profit, futures contracts became interesting. Some entrepreneurs indicated that the futures contracts currently traded have standardization characteristics that are difficult to fulfill. Especially the standardization towards time of delivery is perceived as problematic. These results may have important managerial implications for the management of the futures exchange.

Entrepreneurs who monitored the futures prices in newspapers and professional industry journals did not view the futures market as complex, whereas entrepreneurs who were not monitoring the futures prices perceived futures as a complex instrument that was not easy to use. Entrepreneurs who closely traced cash market prices of hogs were very clear in their opinion about the hedging service provided by futures exchanges. Those who did want "to play it safe" valued the price risk reduction capacity of futures whereas entrepreneurs who "valued markets with high price volatility, because they provide opportunities to gain" perceived the hedging service as not valuable.

The criteria the entrepreneurs said they used when choosing between the alternatives, served as a basis for the formulation of the beliefs in the large scale interview. Based on the qualitative pre-study we expect to find at least the following three dimensions underlying these beliefs: entrepreneurship, performance and ease of use. Hence, we expect that the key components in the choice process are represented by the relative expectancy-value components entrepreneurship, performance and ease of use. The relative expectancy-value component entrepreneurship (REVCE) is the extent to which an entrepreneur values using futures as a way to exploit his/her entrepreneurship compared to selling on the cash market (Kent, Sexton and Vesper 1982). The relative expectancy-value component performance (REVCP) is the extent to which an entrepreneur values the performance of futures in managing his/her price risk compared to selling on the cash market. Finally, the relative expectancy-value component ease of use (REVCU) is the extent to which the entrepreneur values the ease of use of futures compared to selling on the cash market. We can formulate several hypotheses as to *how* SMEs make choices regarding PRMIs. Based on desk research and the group discussions, we can additionally formulate several hypotheses as to *why* SMEs evaluate performance, ease of use and entrepreneurship the way they do. However, first we will consider the *how* of SMEs' choices.

8.4.2 *Hypotheses Related to the **How** of Choices*

Relative expectancy-value components: entrepreneurship, performance and ease of use. Our model hypothesizes that an entrepreneur groups beliefs into dimensions and transforms these dimensions into expectancy-value components for each alternative. After having formed expectancy-value components for each alternative on the dimensions entrepreneurship, performance and ease of use, the entrepreneur compares these across the alternatives (and thus forms relative expectancy-value components) which determine his or her relative attitude towards futures contracts. We hypothesize that the relative expectancy-value components entrepreneurship, performance and ease of use are the key components in the choice process of the entrepreneur.

H1: *The relative attitude of an entrepreneur towards futures contracts is influenced by the relative expectancy-value components entrepreneurship, performance and ease of use.*

Relative subjective norm. Although the entrepreneur of a SME ultimately makes the choice on his/her own, other highly-esteemed individuals may be involved in the decision process. These individuals may consist of advisors and trading partners. We may expect that the opinion of these individuals, who are important to the entrepreneur when futures are concerned, will influence the relative intention of the entrepreneur to use futures.

H2: *The SME's perception of the extent to which significant others (such as advisors surrounding the SME) think that one should use futures contracts as opposed to other alternatives is positively related to the relative intention to use futures contracts.*

Difference between the futures price and the reference price. When selling output the difference between the futures price and the reference price will play a role. The reference price is the price that determines the decision frame through which the entrepreneur views the futures price as a gain or loss. Following prospect theory (Kahneman and Tversky 1979, 1982; Tversky and Kahneman 1981) the entrepreneur evaluates the futures price as a gain or loss relative to the reference price. If the futures price level is above (below) the reference price, the entrepreneurs evaluate this price as a gain (loss) which in turn positively (negatively) influences the relative attitude toward futures.

H3: *The larger the difference between the futures price and the reference price, the higher the relative attitude towards futures will be.*

8.4.3 *Hypotheses Related to the **Why** of Choices*

Innovativeness. In line with Leavitt and Walton (1975, 1988) and Goldsmith (1984) innovators are defined in our study as individuals open to new experiences and novel stimuli, as possessing the ability to transform information about new concepts, ideas, products or services to their own use, and as having a low threshold for recognizing the potential application of new ideas. Innovators are the first ones to buy a new product or service, are more interested in the new product or service and are more exposed to information about the product or service. For the entrepreneurs in our study futures contracts are perceived as 'new products'. Although they have some sort of experience with risk reduction strategies, most of them are unfamiliar with futures contracts. The adoption of such a new instrument can therefore be seen as innovative (Goldsmith and Hofacker 1991). Innovative entrepreneurs like to use new instruments or methods with which they can exploit their entrepreneurial freedom of action. Because futures contracts increase the "degrees of freedom of action" in the market place, we hypothesize that innovative entrepreneurs will more strongly value using futures as a way to exploit their entrepreneurship (Brandstätter 1997).

H4: *Innovativeness is positively related to the relative expectancy-value component entrepreneurship.*

Market orientation: tracing the market. In line with the broader definition of market orientation proposed by Jaworski and Kohli (1993) we consider tracing the market, such as gathering information about prices and volume traded, and consumer orientation, to belong to the domain of market orientation. Note that the interfunctional coordination component of market orientation as included in the Narver and Slater (1990) scale is not relevant because SMEs often do not have different functional departments. All these departments are combined within the entrepreneur. Therefore, in this chapter, the concept of market orientation includes consumer orientation and tracing the market. In this research we are particularly interested in the latter aspect of market orientation.

If entrepreneurs are more market oriented in terms of tracing the market, then entrepreneurs will have a higher awareness of price fluctuations in the cash market and will hence be aware of the risks they face in the cash market (assuming the price is difficult to predict). So, if entrepreneurs are risk averse, then the more market oriented they are in terms of tracing the market, the more the hedging performance of futures will be valued.

H5: *For risk averse entrepreneurs tracing the market is positively related to the relative expectancy-value component performance.*

Level of understanding. The subjective assessment of the performance is heavily influenced by the information users have been exposed to with respect to the hedging service of futures. However, even if subjects have been exposed to the same amount of information, the subjects may differ in their understanding of these services. Futures contracts are often perceived as providing a complex financial service, which inhibits participation in futures trading. Understanding futures trading will reduce the psychological distance between the entrepreneur and the hedging service provided by the futures exchange. The level of understanding will influence how easy futures are considered as a PRMI and as a method of selling hogs. We can now formulate the following hypothesis.

H6: *The level of understanding of futures contracts is positively related to the relative expectancy-value component ease of use.*

Monitoring futures prices. By monitoring futures prices, entrepreneurs obtain some experience with futures trading. It is well known from the financial strain of literature, that the economic justification for futures markets is not only risk transfer but also price discovery (Stoll and Whaley 1993). When making price agreements, entrepreneurs can use the futures price as a benchmark. Entrepreneurs who develop a routine in processing this information in a meaningful way will perceive futures as less complex and difficult than entrepreneurs who do not have this routine. The extent to which entrepreneurs follow the futures prices will therefore have a positive relation with the evaluation of ease of use of futures contracts.

H7: *Monitoring futures prices is positively related to the relative expectancy-value component ease of use.*

We now show how we validated the model and the relations between the SME's characteristics and the relative expectancy-value components of the model as described by the hypotheses. The operational procedures (respondent sampling, measures and procedure) as well as the analytical procedures will be discussed in the next section.

8.5 Research Method

8.5.1 *Sample*

In 1996 personal interviews were administered to 467 entrepreneurs. These were obtained by a stratified sample, with stratification having taken place on the variables region and size of the enterprise. The interviews lasted for about 45 minutes each. All the interviewers had prior interviewing experience, and received an extensive training program in the assessment procedures. Moreover, the training program ensured that the interviewers understood the questions posed to the entrepreneurs.

The average age of the interviewed entrepreneurs was 43 years. Of the entrepreneurs 53% had received education at middle professional level, 33% at low professional level, 6% at high professional level and 8 % at university level. Of the 467 entrepreneurs, 387 (83%) sold their hogs at day-prices on the cash market whereas 14 entrepreneurs used cash forward contracts to sell their hogs (3%). The remaining 66 entrepreneurs (14%) used a combination of selling hogs on the cash market and selling hogs by means of futures contracts. Of the latter group 57.1% indicated they used futures solely for hedging, 24.5% used futures solely for speculation, while 18.4% used futures for both hedging and speculation.

8.5.2 *Procedure*

The entrepreneurs were contacted by the interviewer prior to the personal interview, to encourage participation and to ensure that the interview was conducted with the right person. The interview was computerized and care was taken to build a user friendly interface. The software written for this interview was extensively tested and 15 test-interviews were conducted to ensure that the interface was understood by the entrepreneurs and perceived as "very user-friendly". The interview consisted of several parts. After having been asked a few background questions (pertaining to for example the size of the enterprise, previous behavior regarding price risk management) the entrepreneurs were confronted with statements about selling hogs by means of futures contracts and selling hogs on the cash market. Care was taken to randomize the statements regarding the use of futures and selling on the cash market in order to avoid response biases.

We measured the variables in the model for a concrete choice situation, where a price level was given, and the entrepreneur had to make a choice. During this measurement respondents were instructed to "read the following situation carefully" and that "it is important to imagine yourself in the situation described". They were told that they had bought the piglets and that they had to choose between waiting until the hogs could be slaughtered and then sell the hogs on the cash market or selling the hogs now in the futures market and thereby fix the price in advance. We explicitly provided a price level of the futures contract. Five different price levels were randomly assigned to the entrepreneurs. The price levels chosen were based on price levels from previous years in the futures market and reflected the price distribution function. The scenario was perceived as being very realistic by the respondents. Entrepreneurs where asked to indicate their relative attitude, relative subjective norm and relative intention towards the two choice alternatives. Finally they had to make a choice between the two alternatives. The interview continued with items measuring the entrepreneur's market orientation, innovativeness and level of understanding. Finally, the entrepreneur's reference price was measured.

8.5.3 *Measures*

The beliefs and evaluations were measured on bipolar 9 point scales. For the beliefs the end-poles were labelled as "strongly disagree" to "strongly agree", whereas for the evaluations the the end-poles were labelled as "very negative" to "very positive". It has been argued by Ryan and Bonfield (1975) and Wochnowski (1995) that, when multiplying beliefs and evaluations, only the use of bipolar scales will result in a logical pattern of attitudes.

In this study the relative attitude was measured by asking the respondent to distribute 100 points across the two alternatives to indicate the extent of liking. The relative intention was measured by asking the respondent to distribute 100 points across the two alternatives to indicate the probability of using the alternative. In a similar way, the relative subjective norm was measured by asking the entrepreneur to indicate the extent to which significant persons surrounding him/her thought that he/she should use one of the alternatives by distributing 100 points across the two alternatives (Van den Putte et al. 1996). Finally, the entrepreneur had to make a choice between using futures contracts or selling the output on the cash market.

The measures of the constructs characterizing SMEs were developed from scales as introduced by studies in marketing, psychology, and management. An extensive list of the items included in each of the measures is provided in Appendix A. In developing the scales, the following iterative procedure was adopted. First, a large pool of items for each construct was generated. Care was taken to tap the domain of each construct as closely as possible. Next, items were tested for clarity and appropriateness in personally conducted pretests with 40 entrepreneurs. The entrepreneurs were asked to complete the questionnaire and indicate any ambiguity or other difficulty they experienced in responding to the items, as well as for any suggestions they deemed appropriate. Based on the feedback received from the entrepreneurs, some items were eliminated, others were modified, and additional items were developed.

Market orientation. We utilize items of the Narver and Slater (1990) measure of market orientation. The items were adapted to suit the purpose of our study. The measure is composed of two subscales, respectively measuring consumer orientation and tracing the market.

Innovativeness. The Open Processing Scale (OPS) as developed by Leavitt and Walton (1975, 1988), is utilized to measure innovativeness. The OPS measure provides a 'consumer friendly' instrument that is useful for studies on the utilization of new products of all kinds (Goldsmith 1984; Joseph and Vyas 1984). Leavitt and Walton (1988) show that the OPS measure is relatively independent of a scale measuring the desire for experience. This substantiates the psychometric quality of the OPS scale.

Level of understanding. We utilize items of the multi-item measure developed by Ennew et al. (1992) to measure the level of understanding. Respondents were asked to indicate their agreement with each statement on a nine point scale ranging from "strongly disagree" to "strongly agree".

Risk attitude. We used the intrinsic risk attitude as outlined in Chapter 7.

Difference between the futures price and the reference price (DRP). The reference price was identified by asking the entrepreneur to respond to the open-ended question: "if you sell your hogs you will receive different prices for your hogs depending on the market situation. Some prices will give you the feeling that you have made a loss and some prices will give you the feeling that you have made a gain. Suppose that you sold your hogs today, from which price level onwards would you perceive the price as a gain?"

Immediately after declaring the initial reference price, the respondent was confronted with the following sentence "so, if I understand you correctly, then a price below ------- Dutch Guilders is perceived as a loss" the respondent could answer this question with "yes" or "no". When the respondent answers the last question with "no", the first question was repeated, in order to give the respondent the opportunity to change the initial reference price. Whenever the respondent answered the latter question with a "yes", the assessment of the reference price had been accomplished (Puto 1987). The DRP variable was calculated as the difference between the price level of the futures contract and the reference price.

Monitoring the prices of futures. Monitoring the futures market was measured with a five point scale indicating how many times the entrepreneur had monitored the futures price in a certain time interval. On this scale 1 indicated that the futures price had never been monitored, 2 indicated that the futures price had been monitored several times per month, 3 indicated that the futures price had been monitored several times a week, 4 indicated that the futures price had been monitored once a day, and 5 indicated that the futures price had been followed several times a day.

8.5.4 *Measure Validation*

LISREL was used to assess the measurement quality of our constructs. All factor loadings were significant (minimum *t*-value was 4.60, $p < 0.001$) and greater than 0.4. These findings support the convergent validity of the items (Anderson and Gerbing 1988). The LISREL based composite reliabilities for the constructs ranged from 0.60 to 0.86, indicating reasonable reliabilities for the construct measurements. Details are given in Appendix A.

8.6 Results

The data obtained from the 467 entrepreneurs served as input for the validation of the model and the different hypotheses. The relations between relative expectancy-value components, relative attitudes, relative subjective norms, relative intentions, and choice behavior, as well as the relations with SME characteristics as specified in the previous section, are tested by structural equation modeling (Bagozzi 1994; Baumgartner and Homburg 1996; Dabholkar 1994; Steenkamp and van Trijp 1991). We used LISREL 8 for the structural equation modeling, with the covariance matrix as input (Jöreskog and Sörbom 1993). Prior to model estimation we screened the data on coding errors and the presence of outliers. We used PRELIS for screening and testing the univariate and multivariate normality of the observed variables. The coefficient of relative multivariate kurtosis was 1.11, indicating that the assumption of multivariate normality is tenable (Steenkamp and van Trijp 1991).

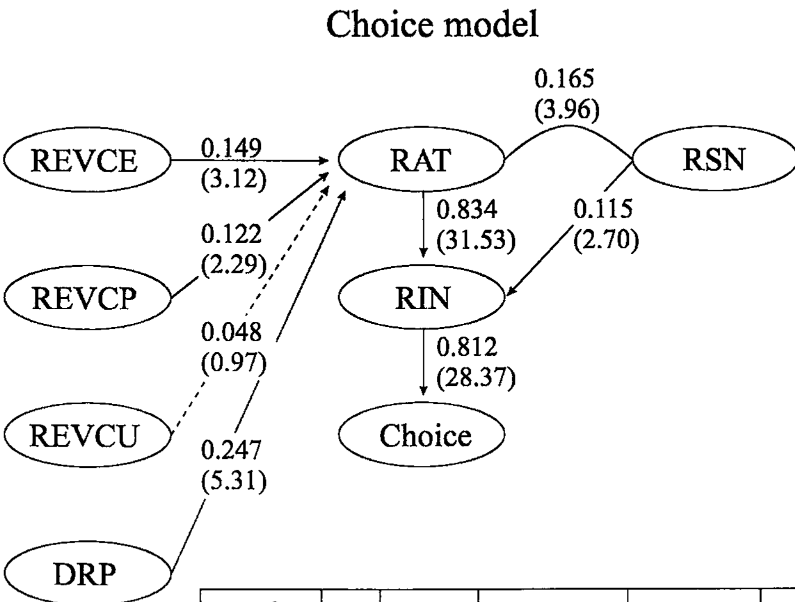
8.6.1 *Test of the Choice Model*

First, exploratory factor analysis was conducted on the beliefs. The results of the exploratory factor analysis showed that beliefs are grouped naturally into categories. We found that the beliefs could be grouped into three factors (components) which can be labeled as entrepreneurship, performance and ease of use. This confirms our findings of the group discussions. Hence, the entrepreneur may be expected to use these more abstract cognitive representations of futures contracts. Based on the results of the exploratory factor analysis we conducted a Confirmatory Factor Analysis (CFA) to test for the identified belief components. The

CFA model for entrepreneurship had a good fit, with a χ^2 of 14.55 ($df = 8$, $p = 0.07$), a root mean square error of approximation (RMSEA) of 0.04, a goodness-of-fit index (GFI) of 0.99, an adjusted goodness-of-fit index (AGFI) of 0.97, and a comparative fit index (CFI) of 0.98. The CFA model for performance had also a good fit, with a χ^2 of 14.55 ($df = 8$, $p = 0.02$), a RMSEA of 0.05, a GFI of 0.99, an AGFI of 0.97, and a CFI of 0.95. The fit for the CFA model for ease of use was not as good but acceptable, with a χ^2 of 36.47 ($df = 9$, $p = 0.0$), a RMSEA of 0.08, a GFI of 0.97, an AGFI of 0.94, and a CFI of 0.82. The details and results of the three CFA models are given in Appendix B.

Thus, three meaningful expectancy-value components - performance, entrepreneurship, and ease of use - were identified. The relative EVC's can now be calculated and are denoted as REVCP, REVCE and REVCU respectively. These three Relative Expectancy-Value components were used in our model. As noted earlier, in the actual choice situation, the futures price level, or, better stated, the difference between the futures price and the reference price, plays an important role in the decision process. Therefore this component was also included in our model.

The model (depicted in Figure 2) had an acceptable fit with a χ^2 of 29.55 ($df = 10$, $p = 0.001$), a RMSEA of 0.06, a GFI of 0.98, an AGFI of 0.94, and a CFI of 0.98. The test results show that the model provides an adequate description of the choice process of the entrepreneurs in our study. We will now consider the tests of our hypotheses related to the model.



χ^2	df	p	RMSEA	AGFI	CFI
29.55	10	0.00	0.06	0.94	0.98

***Figure 2** Choice model: structural parameter estimates and fit statistics*

8.6.2 *Test of Hypotheses Concerning the **How** of Choices*

The effect of the REVCs entrepreneurship, performance and ease of use on the relative attitude towards futures. The estimation results show that the relative attitude of an entrepreneur towards futures is significantly influenced by the relative expectancy-value components entrepreneurship ($\beta = 0.149$, $t = 3.12$, $p < 0.001$) and performance ($\beta = 0.112$, $t = 2.29$, $p = 0.01$), thereby (partly) supporting H1. The hypothesis regarding the effect of the relative expectancy-value component ease of use on the relative attitude toward futures was not supported ($\beta = 0.048$, $t = 0.97$, $p = 0.16$).

The effect of the relative subjective norm on the relative intention to use futures. The model showed that the entrepreneur's perception of the extent to which significant others think that one should use futures, when compared to the other alternative, significantly influenced the relative intention to use futures ($\beta = 0.115$, $t = 2.70$, $p = 0.004$), thereby supporting H2. The advisors surrounding the entrepreneur consisted of such persons as the account manager of the bank, the account manager of the slaughterhouse and the successor. These advisors apparently affect the SME's choice to use futures contracts via the relative intention.

The effect of the difference between the futures price and the reference price on the relative attitude towards futures. The difference between the futures price level and the reference price (DRP) had a significant influence on the relative attitude ($\beta = 0.247$, $t = 5.31$, $p = 0.00$), thereby supporting H3.

The relative expectancy-value component ease of use did not influence the relative attitude towards futures in the concrete choice situation. During the measurement of the model a scenario was presented to the respondents in which the futures price was included. In such concrete choice situation "ease of use" may not play an important role. Nevertheless, we may expect that "ease of use" influences whether futures become part of the business of conduct. Being part of the business of conduct seems important because before futures will be chosen by SMEs, it must be considered as a tool which belongs to the toolbox of the SME (McQuiston 1989; Posavac et al. 1997). In our case this is particularly important because the hedging service provided by futures exchanges is perceived as complex. Moreover, futures are an innovative instrument for the entrepreneurs in this study. In order to test the hypothesis that a high score on the ease of use component is positively related to becoming part of the business of conduct, we analyzed an adoption model describing how futures become part of the business of conduct. This model is the same as the proposed choice model except that the concrete choice situation (as described in the scenario) and the futures price level are not included. The model was operationalized by asking entrepreneurs to reveal their relative attitude, relative subjective norm and relative intention towards the two alternatives, measuring the extent to which futures would be accepted as being part of the business of conduct. This model had a good fit with a χ^2 of 2.45 ($df = 3$, $p = 0.47$), a RMSEA of 0.0, a GFI of 1, an AGFI of 0.99, and a CFI of 1. All the hypothesized causal relations were supported by significant *t*-values.

The adoption model shows that the REVCU plays an important role in the decision whether or not futures form part of the business of conduct ($\beta = 0.15$, $t = 3.39$, $p = 0.003$). After futures have been accepted as being part of the business of conduct, and are in the toolbox of the entrepreneur, REVCU does not play a major role any more in the concrete choice situation. The model fit of the adoption model was much better when compared to the fit of the choice model. This may be explained by the fact that choosing in a concrete choice situation is a much more complex phenomenon to explain than the process of futures becoming part of the business of conduct.

8.6.3 *Test of the Hypotheses Concerning the Why of Choices*

The effect of innovativeness on REVCE. Innovativeness had a significantly positive effect on the relative expectancy-value component entrepreneurship (REVCE) ($\beta = 0.130$, $t = 2.463$, $p = 0.007$), thereby supporting H4. The model fit was good with a χ^2 of 12.64 ($df = 5, p = 0.03$), a RMSEA of 0.05, a GFI of 0.99, an AGFI of 0.97, and a CFI of 0.98. Thus it appears that innovative entrepreneurs value more strongly the entrepreneurial opportunities that futures provide.

The effect of tracing the market on REVCP. Our hypothesis stated that risk attitude would have a moderating influence on the relation between tracing the market and the expectancy-value component performance. More specifically, we expected that risk averse entrepreneurs who trace the market would more strongly value the hedging service (i.e. the performance) of futures markets. Based on the risk attitude measure we divided the sample into risk averse entrepreneurs and risk seeking entrepreneurs. For the risk averse sample we estimated the relationship. Tracing the market had a significant, positive effect on the relative expectancy-value component performance (REVCP) ($\beta = 0.160$, $t = 2.089$, $p = 0.0184$), thereby supporting H5. The model fit was good with a χ^2 of 1.368 ($df = 5$, $p = 0.93$), a RMSEA of 0.0, a GFI of 0.99, an AGFI of 0.99, and a CFI of 1. For the risk seeking and risk neutral entrepreneurs no effect was found between tracing the market and REVCP. So, the relation between tracing the market and REVCP only exists for the risk averse group which shows that there is an interaction effect between risk attitude and tracing the market.

The effect of level of understanding on REVCU. The level of understanding had a significant, positive effect on the relative expectancy-value component ease of use (REVCU) ($\beta = 0.139$, $t = 3.033$, $p = 0.001$), thereby supporting H6. The model fit was acceptable with a χ^2 of 11.41 ($df = 5$, $p = 0.04$), a RMSEA of 0.05, a GFI of 0.99, an AGFI of 0.97, and a CFI of 0.97.

The effect of monitoring futures prices on REVCU. Monitoring the futures prices had a significant, positive effect on the relative expectancy-value component ease of use (REVCU)

($\beta = 0.153$, $t = 2.545$, $p = 0.006$), thereby supporting H7. The model was saturated, therefore leading to a perfect fit to the data.

8.7 Conclusions and Discussion

8.7.1 *Managerial Implications*

The results provide support for our model. The relative attitude towards futures has a strong predictive power for the choice behavior of entrepreneurs of SMEs. Below we discuss several managerial implications of these results.

Entrepreneurship. Whenever entrepreneurs had the feeling that by using futures they could exploit their entrepreneurial freedom to a larger degree, compared to selling in the market, they developed a positive relative attitude towards futures. It appeared that innovativeness is positively related to the relative expectancy-value component entrepreneurship. Futures are an attractive instrument whenever their use increases the degrees of freedom in the market place. The management of a futures exchange can use this information for its promotion of futures and can use this information when developing and redesigning futures contracts. Positioning futures as an extra tool for the entrepreneur by which his/her degree of freedom of acting in the market place increases seems valuable. Hence, providing information regarding the hedging strategies that can be employed with futures is an interesting promotion element. When designing futures contracts, the futures exchange can increase the compatibility of futures with other instruments available to the entrepreneur and thereby increase the expectancy-value component entrepreneurship of futures over other alternatives.

Ease of use. It was found that the expectancy-value component ease of use played a major role in whether or not futures become part of the business of conduct. During the group discussions it became clear that futures trading, and financial derivatives trading in general, is often perceived as complex and difficult to understand. The level of understanding and monitoring futures prices were positively related to the expectancy-value component ease of use. In order to reduce the psychological distance to futures contracts, the futures exchange might develop training programs for entrepreneurs and thus increase the understanding of futures trading.

Performance. The performance provided by futures is another critical attribute which influences the relative attitude. In the case of risk averse entrepreneurs, tracing the market is positively related to the relative expectancy-value component performance. Entrepreneurs monitoring the market know they face cash market risk and, in the case of risk aversion, they value the risk reduction service provided by futures exchanges. The performance of futures can be increased by using a more appealing standardization procedure of the underlying commodity. During the group discussions it became clear that standardization with regards to delivery date was perceived as limiting, causing logistic problems within the enterprise. Relaxing some of the standardizations may help to increase the performance of futures. Recently so-called flex-futures have been introduced for some commodities in the US. The standardization of these futures is less strict and therefore these futures are better able to fit the specific needs of buyers and sellers. In the financial strain of literature a lot of attention has been paid to the design process of futures. This strain of literature can contribute to the improvement of the performance and hence to the attractiveness of the instrument (Tashjian 1995).

Price level of futures in relation to the reference price. It appeared that the difference between the futures price and the reference price of the entrepreneur had a significant, positive effect on the relative attitude towards futures. Both the futures price and the reference price of the entrepreneur are beyond the scope of the marketing manager. The futures price is determined by fundamental economic factors (supply and demand factors of the underlying commodity of the futures contract). The reference price is determined by the entrepreneur's aspiration level with regard to making a profit. Although the futures exchange cannot influence these two prices, it can profit from them when introducing new futures contracts. Our model makes clear that, when introducing a new futures contract, the price level in the underlying market of the commodity is an important determinant in creating sufficient trading volume and hence liquidity. When introducing new futures at a point in time when the reference price is much higher than the futures price, the futures exchange may benefit from the positive relation between this difference and the resulting positive attitude towards futures which leads to a larger trading volume.

8.7.2 *Suggestions for Further Research*

Our findings suggest several directions for further research. First of all our study might be replicated within other financial services such as the speculation service and might be replicated for other financial derivatives such as options and swaps. Our sample consisted of entrepreneurs of SMEs who were somewhat unfamiliar with futures. An interesting thing to examine might be whether entrepreneurs familiar with futures and other price risk management instruments make the comparison of alternatives in a similar way. It would be interesting to see whether the same determinants also influence their choice. For the entrepreneurs in this study only two alternatives were relevant. Whether the choice process is the same for three or more alternatives should also be interesting to explore. In this chapter we examined the supply side of the market, that is, the sellers in the futures market. Obviously, to have futures trading, sellers and buyers are needed. So, to gain more insight into why futures succeed or fail also the buyers' side of the market, that is, the buyers in the futures market, should be taken into account which, in our case, are slaughterhouses and retailers.

Our study makes clear that the marketing point of view raises questions regarding the optimal design of financial services. The design of the financial service influences the performance component, and thus influences the choice of the entrepreneurs. The financial approach towards financial services focuses on the technical feasibility of financial services and in this way provides valuable information about the design and development of financial services. Both the marketing approach and the financial approach are complementary, which would make a multidisciplinary approach to research into financial services an interesting avenue to explore in the near future.

8.8 Acknowledgments

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Appendix A

Confirmatory Factor Analysis for the Measures

To examine the measurement quality of the constructs, confirmatory factor analysis has been performed using LISREL 8. The input for the analysis consisted of covariance matrices based on $N = 467$.

Innovativeness

1) I buy new products before my colleagues (competitors) buy them
2) I like to experiment with new ways of doing things
3) I take more chances than others
4) I generally like to try new ideas in my enterprise

Entrepreneurs were asked to indicate how well the statements fit their own views through a five point scale. Construct reliability = 0.78; $\chi^2 = 9.3$ ($df = 2$, $p = 0.01$); RMSEA = 0.09; GFI = 0.99; AGFI = 0.95; CFI = 0.98.

Market orientation: tracing the market

1) I think it is important to understand the wishes of my customers
2) I think it is important to know how my customers evaluate my product
3) I adapt to changes in the market
4) I track the market prices of the products I produce

Entrepreneurs were asked to indicate their agreement with each item through a nine point scale ranging from "strongly disagree" to "strongly agree". Construct reliability = 0.60; $\chi^2 = 2.3$ ($df = 2$, $p = 0.31$); RMSEA = 0.01; GFI = 0.99; AGFI = 0.99; CFI = 0.99.

Market orientation: consumer orientation

1) I want to know everything about the consumer who is buying pork
2) I think it is important to know a lot of the end-users
3) I think it is important to know the demands the consumer makes on pork

Entrepreneurs were asked to indicate their agreement with each item through a nine point scale ranging from "strongly disagree" to "strongly agree". Construct reliability = 0.86; model is saturated

Level of understanding

1) I know how the futures market is functioning
2) There is sufficient information on the functioning of futures markets
3) I understand the way I can hedge my risk on the futures market
4) I keep up with futures prices

Entrepreneurs were asked to indicate their agreement with each item through a nine point scale ranging from "strongly disagree" to "strongly agree". Construct reliability = 0.65; $\chi^2 = 6.36$ ($df = 2$, $p = 0.04$); RMSEA = 0.06; GFI = 0.99; AGFI = 0.97; CFI = 0.98

Appendix B

Confirmatory Factor Analysis On Beliefs About Futures Contracts and Using the Cash market

An exploratory factor analysis was conducted in order to find the underlying factor structure of the beliefs. A three factor model provided the best solution. Items loading relatively high on one of these factors (factor loading > 0.4) are included with the corresponding factors in a confirmatory factor analysis. The confirmatory factor analysis has been conducted using LISREL 8. The input for the analyses were covariance matrices based on $N = 467$.

Entrepreneurship

1) I think that by using futures contracts/cash markets I can fully exploit my spirit of free enterprise
2) I think that the use of futures contracts/cash markets gives me the opportunity to receive an extra high price
3) I think that using futures contracts/cash markets give me a large freedom regarding actions in the market place

$\chi^2 = 14.55$ ($df = 8$, $p = 0.07$); RMSEA = 0.04; AGFI = 0.97; GFI = 0.99; CFI = 0.98

Performance

1) I think that by selling my hogs by means of futures contracts/cash markets will enable me to reduce the fluctuations in my revenues
2) I think that a futures contract ensures the sale of my hogs
3) I think that using futures contracts will improve my relations with traders.

$\chi^2 = 17.27$ ($df = 8$, $p = 0.02$); RMSEA = 0.05; AGFI = 0.97; GFI = 0.99; CFI = 0.95

Ease of use

1) I think that using futures contracts/cash markets is an easy way of selling hogs
2) I think that using futures is a difficult matter
3) I think that by using futures I will not have to worry about finding buyers for my hogs

$\chi^2 = 36.47$ ($df = 9$, $p = 0.0$); RMSEA = 0.08; AGFI = 0.93; GFI = 0.97; CFI = 0.82

CHAPTER 9

The Information Dissemination Process of Futures Exchange Innovations[1]

9.1 Abstract

Much attention has been paid to theories which explain the success or failure of futures contracts. Previous literature explains the success or failure of futures contracts by the underlying characteristics of the futures contract (Black 1986; Tashjian 1995). From a marketing point of view these investigations implicitly focus on the product as an element of the marketing mix. In this chapter we focus on promotion and distribution as elements of the marketing mix of futures exchanges. More specifically we analyze the information dissemination process regarding new futures contracts as a two stage process from futures exchanges to brokers respectively from brokers to the potential customers.

9.2 Introduction

Futures markets make it possible for those who want to manage price risk - hedgers - to transfer that risk to those who are willing to accept it - speculators. Futures contracts can be seen as a hedging and speculation service provided by the futures market to hedgers and speculators. Futures markets also provide price information that the world looks to as a benchmark in determining the value of a particular commodity or financial instrument on a given day and time. These important benefits - risk transfer and

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[1] This chapter will be published as: Pennings, J.M.E. (1998), "The Information Dissemination Process of Futures Exchange Innovations: A Note" *Journal of Business Research*, forthcoming.

price discovery - reach every sector of the world where changing market conditions create economic risk, including such diverse areas as agricultural products, foreign exchange, imports and exports, financing, and investments. Futures exchanges provide a location for buyers and sellers to meet and, through an auction process, discover a price for specific futures contracts.

Exchanges are also responsible for disseminating these prices and guaranteeing fulfillment of traded contracts. This activity is centralized on the trading floor of each futures exchange. While all market participants have direct access to the floor through their brokers, only exchange members have the privilege of actually trading on the floor. Some traders known as floor brokers fill outside orders for different firms such as commission houses, commercial interests, financial institutions and portfolio managers. Others trade hedging or speculative accounts for the company they work for. Another group, known as locals, trade for their own account and speculate on future price movements. Futures exchanges are free markets where the many factors that influence supply and demand converge on the trading floor and through auction are translated to a price (Telser and Higinbotham 1977; Cornell 1981; Catania 1989). With a trade volume of 1.8 billion contracts in 1995, both futures and options, the futures industry can be classified as one of the world's fastest growing industries. The futures 'industry' is composed of competing firms (exchanges). Not only do futures exchanges compete with other futures exchanges, but also with cash forward markets. Moreover, competition with Over The Counter (OTC) markets has developed rapidly over the past decade. In order to assure survival, futures exchanges show a rapid product innovation (Carlton 1984; Miller 1990). The risk of failure is considerable for futures contracts (Carlton 1984; Tashjian and McConnel 1989; Tashjian 1995). In 1995 40 new futures contracts were launched throughout the world, only a few of which have proven to be successful in the first year (Davey and Maguire 1996).

In previous research the success of futures contracts has been explained by some well-known observable variables such as size of cash market and cash price volatility (Silber 1981; Black 1986; Ross 1989; Nothaft, Lekkas and Wang 1995; Brorsen and Fofana 1995). The two well-known approaches in futures contract innovation are the 'commodity characteristics' approach and the 'contract characteristics' approach as outlined in Chapter 2. The first approach defines feasible commodities for futures trading based on an extensive list of required commodity attributes and the second focuses on factors endogenous to the futures industry. Literature suggests that successful contracts will emerge where futures contracts satisfy a hedging need, where the futures price closely tracks the assets held by hedgers, and in markets where long and short participants are driven by different motives (Black 1986; Duffie and Jackson 1989; Tashijan 1995).

Although the benefits associated with risk reductions are important factors in motivating the decision makers to engage in futures trading, potential users are also heavily influenced by their subjective assessment of the performance and reliability of a futures market as has been outlined by Ennew et al. (1992). The subjective assessment of the performance is heavily influenced by the information potential users have been exposed to about the hedging service and speculation service of the futures contract. This is because of the relative complexity of the financial service provided by the futures contract.

A futures exchange can be seen as an institution that maximizes the common interest of its members. The rivalry theory (Kamien and Schwartz 1976) has been identified as being a key determinant in futures markets innovation. The rival theory finds that the rate of innovation activity, i.e. introduction of new futures contracts, increases with the intensity of rivalry (competition) in the futures industry. Most exchanges are not-for-profit membership associations. Membership in each exchange is limited to a specific number of individuals, although some exchanges permit the holding of multiple memberships by members. The members of futures exchanges are often brokerage houses who facilitate the auction process. The broker helps to bring individual buyers and sellers together. In the case of new futures contracts the broker plays an important role in providing information to potential customer. This information could lead to participation of the potential customers in the market of the new futures contract and hence enhance the success of the new futures contract. In this chapter we will elaborate on the information dissemination role of the brokers.

In order to set up an operational futures exchange, R&D and implementation should follow a structured procedure. Sandor (1973, 1991) divides the process of R&D and implementation by a futures exchange into two stages.

The first stage consists of a formal examination of certain established criteria to determine whether or not the commodity can be adapted to futures trading.

The second stage consists of marketing the new futures contract to potential customers. An important element of marketing new futures contracts is information dissemination of the new services provided by the new futures contract. Futures contracts are often perceived as a complex financial service, thereby inhibiting participation in futures trading. Information about the services futures contracts provide is thus a pre-requirement for successful futures trading.

Effective information dissemination regarding the service of a futures market will enhance the diffusion of futures contract innovations and hence the success of new futures contracts. Information dissemination of a new futures contract is an element of both promotion and distribution as an element of the marketing mix of a futures exchange. Promotion includes information regarding the new product or service and in the distribution process information is provided about the product or service. Information can reduce the psychological distance of a potential customer to a complex service, such as the hedging and speculative services provided by the futures exchange.

This information dissemination process seems particularly important to futures exchanges whose participants are relatively small companies, for instance, small commodity cash market traders who use the futures exchange to reduce their risk on their cash market position (Stoll and Whaley 1993). These small participants are not members of the futures exchange and are not able to generate information within their organization regarding such a complex financial service.

In order to represent the effect of information on the diffusion process of new futures contracts, we propose, in accordance with Jones and Ritz (1991), a model of information dissemination which includes brokers and customers[2]. It is assumed that brokers act as intermediaries between the futures exchange and the (potential) customers. That is, the services that the futures contract provides flows from the futures exchange through the

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[2] Note that the information dissemination process is only one of the many variables explaining the success or failure of futures exchange innovations. We argue that the model presented in this chapter can contribute to a better understanding of the diffusion of futures contract innovations and hence to the success or failure of futures contracts.

brokers to the customers. The broker provides the information about the service of the futures contract to the customer. The assumed information dissemination process of a new futures contract is shown in Figure 1. Figure 1 shows that the size of the potential customer market is depending on the willingness of the brokers to provide information about the services which the futures exchange provides.

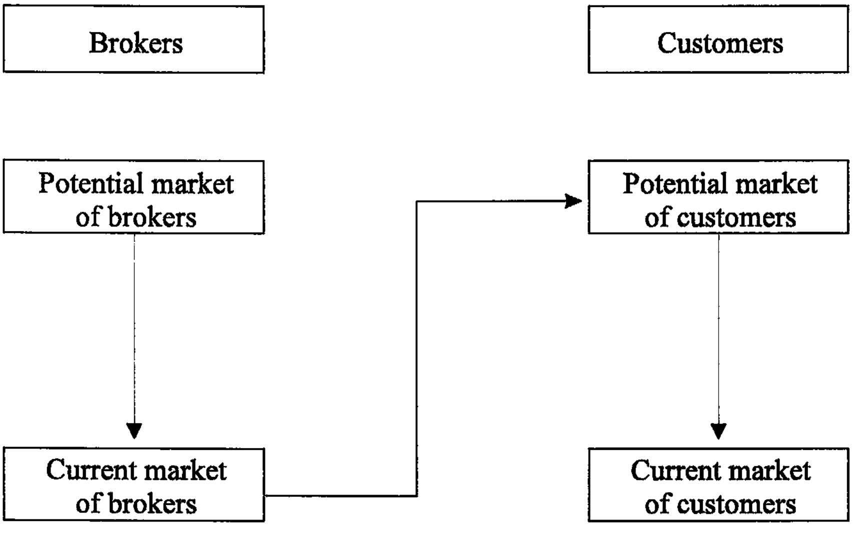

Figure 1 *The interaction between the information dissemination process of brokers and customers of new futures contracts*

9.3 Information Dissemination Model

Following Fourt and Woodlock (1960) and Jones and Ritz (1991) the information dissemination process regarding the new futures contract as hypothesized in Section 9.2 can be expressed by the differential equation:

$$\frac{\mathrm{d}B}{\mathrm{d}t} = \lambda(CI)[\overline{B}(CI) - B(t)] \qquad (1)$$

where $B(t)$ is the cumulative number of brokers who have disseminated the information of the new futures contract at time t, λ is the individual transfer rate and $\overline{B}(CI)$ is the maximum number of brokers who would disseminate information of the futures contract. Both the individual transfer rate and the maximum number of brokers are dependent on, i.e. can be influenced by, the controllable instruments (CI) of the futures exchange (see Table 1). Where the controllable instruments include the exchange seat policy, the rewarding policy and hedging efficiency. This implies that $\overline{B}$ is not an absolute maximum, since futures exchange might decide to increase or decrease the number of brokers admitted.

Equation (1) represents the speed of the brokers who disseminate information about the new futures contract. The individual transfer rate λ is the speed adjustment rate, it represents the fraction of brokers who have not yet started to disseminate information regarding the new futures contract in this period, but will disseminate the information in the next period. The futures exchange can use incentive measures, such as bonuses, in order to speed up the transfer rate.

For the customers, we assume a similar model:

$$\frac{\mathrm{d}C}{\mathrm{d}t} = \alpha(CI)[\overline{C}(CI, t) - C(t)] \qquad (2)$$

where $C(t)$ is the cumulative number of customers who have been exposed to the information regarding the new futures contract at time t, α is the individual transfer rate and $\overline{C}(CI, t)$ is the maximum number of customers who would be exposed to the information. Both the individual transfer rate and the maximum number of customers are dependent on, i.e. can be influenced by, the controllable instruments (CI) of the futures exchange (see Table 1).

Equation (2) represents the speed of the information exposure process to potential customers. It is assumed that the customer's exposure to information includes processing the information and subsequently using this information in deciding whether or not to engage in futures trading. The individual transfer rate α is the speed adjustment rate, it represents that part of the customers that have not yet been exposed to information regarding the new futures contract in this period, but will be exposed in the next period.

The maximum number of customers who would be exposed to the information is determined by the number of brokers who have disseminated the information regarding the new futures contract. Assume that each broker increases the maximum number of customers who would be exposed to the information by an additional ϕ customers, as expressed in equation (3),

$$\overline{C}(t) = \phi(CI)B(t) \tag{3}$$

where ϕ is the rate of transfer between brokers and customers that can be influenced by the controllable instruments of the exchange.

Using Equations (1), (2) and (3), the solution of the differential equation for the information dissemination process yields

$$C(t) = \phi(CI)\overline{B}(CI)(1 - e^{-\alpha(CI)t}) + \frac{\phi(CI)\alpha(CI)(\overline{B}(CI) - B_0)}{\alpha(CI) - \lambda(CI)}(e^{-\alpha(CI)t} - e^{-\lambda(CI)t}) \qquad (4)$$

where B_0 is the initial number of brokers that disseminated the information.

This model is able to provide insight into the information dissemination process and hence in the adoption process of the futures contract innovation and can therefore contribute to the explanation of the success or failure of new futures contracts. The model is an S-shaped curve (see Figure 2, the solid line). The futures exchange management will be interested to use their controllable instruments in such a way that the curve reaches the maximum within a short period. The model consists of two parts. The first part

$$\phi(CI)\overline{B}(CI)(1 - e^{-\alpha(CI)t})$$

shows the information dissemination process with all brokers spreading the information about the new contract from the moment of introduction. If this were the only component of Equation (4), the resulting evolution of information exposure to the potential customer would be an exponential curve, always increasing at a decreasing rate (See Figure 2, the dotted line). However, in the case of futures contracts, the brokers play an important role regarding the information dissemination process which is captured by the second part:

$$\frac{\phi(CI)\alpha(CI)(\bar{B}(CI) - B_0)}{\alpha(CI) - \lambda(CI)}(e^{-\alpha(CI)t} - e^{-\lambda(CI)t})$$

This part shows the influence of brokers on the information dissemination process. Thus, the second part of Equation (4) can be considered a transient term which diminishes what otherwise would be an exponential pattern of potential customers being exposed to information regarding the new futures contract (Jones and Ritz 1991).

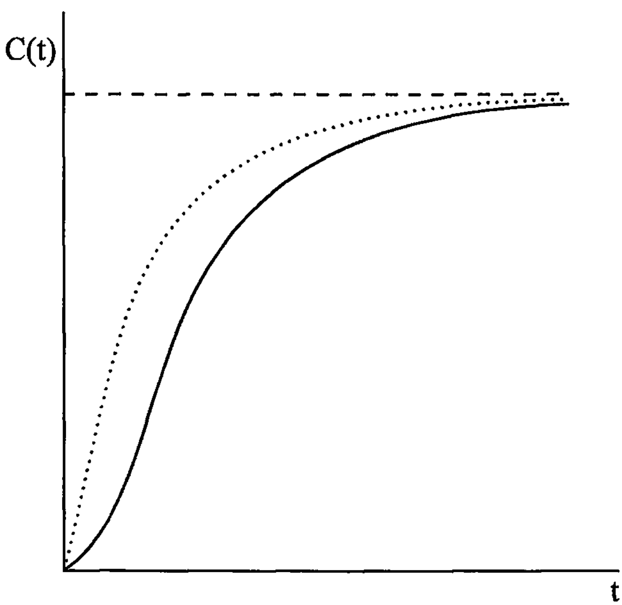

***Figure 2** The evolution of the customers who have been exposed to the information regarding the new futures contract*

In Figure 2 the solid line shows the evolutionary pattern of customer exposure to the information of the new futures contract. If all brokers spread the information right from the introduction of the futures contract, the evolutionary pattern of customer exposure to the information of the new futures contract would be reflected by the dotted line in Figure 2. For our model this implies that the second part in Equation (4) is not present.

Now the futures exchange management has five instruments, represented by the parameters of the model (as shown in Table 1), in order to maximize the model, i.e. to reach the maximum information dissemination within a short period. This means that the solid line in Figure 2 has to be reshaped towards an exponential curve such as the dotted line in Figure 2 which causes the maximum to be reached in the shortest possible time, i.e. the second part of Equation (4) will lose influence in favor of the first part.

***Table 1** Controllable instruments of the futures exchange*

Controllable instruments	Activities of the futures exchange
B	Seat policy of the exchange, only allowing the most motivated brokers on the floor, this will increase the number of brokers who are willing to disseminate high quality information to potential customers, hence increase $\bar{B}$
C	Increase of network of brokers.
α	Increase of promotion and increase of the quality of the service provided, for example, increase of hedging effectiveness and decrease of transaction costs, will increase the customers' individual transfer rate.
λ	Incentive measures for brokers, rewarding good performance, will increase brokers' individual transfer rate.
ϕ	Training of brokers regarding the benefits of the new futures contract will increase ϕ .

From Table 1 we can conclude that the information dissemination process of new futures and thus the diffusion of futures contract innovations is not only dependent on the variables thoroughly investigated in financial literature, but also on the marketing mix elements promotion and distribution, embodied in this chapter by the information dissemination process. This has been recognized by the Warenterminbörse Hannover (WTB) in Germany. In 1998, this exchange will launch new futures contracts for wheat and hogs. Because these contracts will be the first agricultural futures contracts in Germany, i.e. the potential customer is confronted with a relatively long (psychological) distance to the futures exchange, the futures exchange management puts a lot of effort into disseminating information about their new futures, using the activities as described in Table 1, in order to reach a large share of both motivated brokers and customers.

In this chapter we assumed for each broker to inform an equal number of customers about the new futures contract and for the futures market's management not to spread the information to the potential customers directly. Further research extending the model on these two points should be an interesting avenue to explore in the future.

9.4 Acknowledgments

I am indebted to the Board of Directors of the Amsterdam Agricultural Futures Exchange (ATA), an anonymous *Journal of Business Research* reviewer and William T. Hughes Jr. for their helpful comments on an earlier draft of this chapter.

PART III FUTURES EXCHANGE INNOVATIONS: RIGHTS FUTURES CONTRACTS

Innovation of products and services is presently a major marketing strategy of companies, also of futures exchanges. It can be pursued by new products for existing markets or by creating new products for new markets. We will focus in this part of the book on the latter strategy, more specifically on futures for production and environmental rights. Production and environmental rights play an important part in European agriculture. A farmer who does not possess production rights is not allowed to produce the product in question or will pay such a high levy that production would be uneconomical, for instance milk in the EU. The same reasoning holds for environmental rights: only the entrepreneur holding these rights is allowed to produce the pollutant, in proportion with the number of rights he or she owns. The rights that have been introduced in agriculture are tradable and, as a consequence, a lively trade has emerged in a number of member states of the European Union (specifically The Netherlands and United Kingdom). Price fluctuations are high on the cash market, which exposes the farmer to price risk. Therefore, a rights futures market seems an interesting option.

In comparison to goods, rights have a number of interesting characteristics which affect the hedging effectiveness of rights futures (should they be introduced) and, consequently, the success of such a futures market. We analyze the effect these characteristics have upon the optimal hedge ratio and on the viability of such a futures market. Moreover, we analyze the possibility of cross-hedging the profit capacity of the farm with the help of rights futures. This part chiefly draws from the finance approach (cfr. Figure 3, Chapter 2), in deriving the optimal hedge ratios and hedging effectiveness of rights futures. The marketing approach comes in when we propose futures contract specifications, which are based on the needs of the potential hedgers.

CHAPTER 10

The Dimensions of Rights: A Classification of Environmental Rights and Production Rights[1]

10.1 Abstract

The literature on rights has paid much attention to the description of rights and the performance of systems of rights. Less has been published on identifying the underlying dimensions of rights, even though such identification seems important for understanding the different types of rights and for classifying them so as to facilitate the process of development that occurs when introducing rights (Miller 1995). In this chapter a theoretical framework which sheds light on the structure of rights, is developed. After examining the characteristics of rights, a correspondence analysis is carried out on existing rights and on a hypothetical ideal right in order to find similarities between them and to identify their underlying structure.

10.2 Introduction

In the context of this chapter we define a right[2] as a permission from the government or public authority to take action which is otherwise prohibited by law. These rights are initiated by some government or supranational authority and are distributed to

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[1] This chapter has been published as: Pennings, J.M.E., W.J.M. Heijman and M.T.G. Meulenberg (1997), "The Dimensions of Rights: A Classificaton of Environmental Rights and Production Rights", *European Journal of Law and Economics*, 4, 55-71.

[2] The terms allowances, permits, quotas and rights will be used interchangeably in this paper to refer to the same phenomenon.

the affected firms. We will not consider privately initiated rights such as a buy option on a particular house, or intellectual property rights, nor will we consider public rights.

In the existing literature rights are often associated with environmental policy (Miller 1995), but they are also very common in agricultural production policy (Burrell 1990; Oskam 1989). In this chapter we develop a general theoretical framework for rights to enable the many rights in today's world to be classified and therefore better understood.

It is important to note the difference between credits and rights with respect to environmental policy. A credit is created by a source causing less pollution than its allowable limit. To obtain such a credit, a polluter is required to show that the actual emissions, plus or minus any traded credits, are less than the allowable limit. Subsequently the polluter is allowed to trade the credit or to bank it. In a credit program, the agency or authority responsible for it must certify the creation of credits and also record trades. In a rights system, however, trading in rights involves future pollution, the latter being illegal without approval. In the case of environmental rights, the environmental protection agency (EPA) has set an allowable limit for one source; the source can increase or reduce its allowable limit by trading rights.

The primary function of rights is to guide incentives to achieve internalization of externalities (Coase 1960; Demsetz 1976; Parisi 1995). At first sight this function is less obvious for production rights than for environmental rights. Low prices for producers such as farmers may be socially unacceptable to the government because this group of suppliers and related groups would generate an income that is below the accepted minimum standard of living. Furthermore, the increasing divergence between social classes, for example the low living standard of farmers and rural population compared with other groups, may be a more important consideration, which makes the option of low prices unacceptable to the government. To overcome this problem the government intervenes, by either buying the oversupply in the market or subsidizing, or both, to guarantee a price for farmers for their products. However, these subsidies may be a burden to the society at large and create a deadweight loss in welfare terms. Overproduction has become a negative externality; therefore production rights are used as a guide to achieve greater internalization of that externality.

The way in which rights are assigned, enforced, and transferred affects the allocation of resources and hence the amount and distribution of output (Hahn 1986b). Anderson and Hill (1975) argue that the social arrangements, laws, and customs which govern asset ownership are established on the basis of variables endogenous to the economic system. They address the question of how the rights structure is created (Anderson and Hill 1975; Nelson 1986; Nussbaum 1992). We propose to pay attention to the right itself, i.e. we will review its characteristics. By doing so we will be able to better understand, from both a business economic and policy perspective, how rights can be specified in order to be both attractive to the policymaker and the firms affected by the rights (Lewis and Sappington 1995; McCarthy, 1992). The characteristics which we will identify can be seen as controllable instruments of the policymaker. When specifying a right the policymaker implicitly uses these characteristics to design the right. Knowing and understanding the characteristics and their implications, the policymaker will be able to combine these characteristics in an optimal way, from both a business economic and policy perspective and hence design an optimal right.

First, the various types of policy instruments available to cope with environmental and production problems are discussed. Second, we deal with the characteristics of rights. Some existing rights will be classified on the basis of these characteristics. The classification will be analyzed through correspondence analysis in order to examine the underlying dimensions of those rights. The chapter concludes with an evaluation.

10.3 Mechanisms for Internalizing Externalities: Rights

Policymakers can choose from a variety of instruments for achieving specified objectives when implementing policies to solve environmental and production problems. Economists often distinguish between two broad categories of instruments. First, the command and control mechanisms, which are effective but not always efficient; firms have relatively little flexibility to achieve their goals. The second type, called incentive-based or market-based mechanisms, provides firms with incentives to look for more efficient ways to internalize (negative) externalities (Opschoor and Vos 1989; Tietenberg 1990). The incentive-based mechanisms ensure that firms automatically make control efforts in precisely the manner and degree which will result in the cost-effective allocation of the overall burden of control. Moreover, approaches involving economic incentives generally provide firms with incentives to find less expensive solutions. One important criterion when selecting policy instruments is to minimize the overall cost of achieving prescribed objectives.

Economic behaviour can be defined as the public at large being able to weigh up all of the costs and benefits of such behaviour (Pekelney 1993). Rights are one instrument that can supply the appropriate incentives, at least in theory (Hahn 1986a, 1994). Rights are rooted in the theory of externalities, which states that the public costs of certain economic behaviour (pollution, production) are largely external to the private costs the agent faces.

Hahn (1986a) distinguishes two broad categories of incentive-based policy instruments for environmental problems: pricing mechanisms and quantity mechanisms. This distinction also holds for problems of overproduction. In contrast to the quantity mechanism, the pricing mechanism is unable to predetermine the amount of environmental damage or of production, and is therefore less effective than a quantity mechanism. Subsidies and levies are examples of a pricing mechanism, they are widely used in environmental and production policy as an incentive for reaching the government's goal. A marketable rights scheme is an example of the quantity approach. Under such a system the overall tolerated level of externality is established and then allotted to firms in the form of rights. Firms that keep externality levels below the allotted level may sell or lease their surplus rights to other firms, or use them to offset excess externalities in other parts of their own enterprise. Examples of these rights are the SO_2 emission rights in the US and the milk production quotas in the European Union and Canada (Lord 1993; Pennings, Meulenberg and Heijman 1996; USEPA 1990, 1992a, 1992b; Tietenberg 1989a, 1989b).

Note that the right is efficient because it is transferable. If the authority does not allow any trade in rights, a rights system can still be effective but not efficient (Ledyard and Szakaly-Moore 1994; Selwyn 1993).

10.4 Characteristics of Rights

We will construct a classification for rights that is based on their basic characteristics.

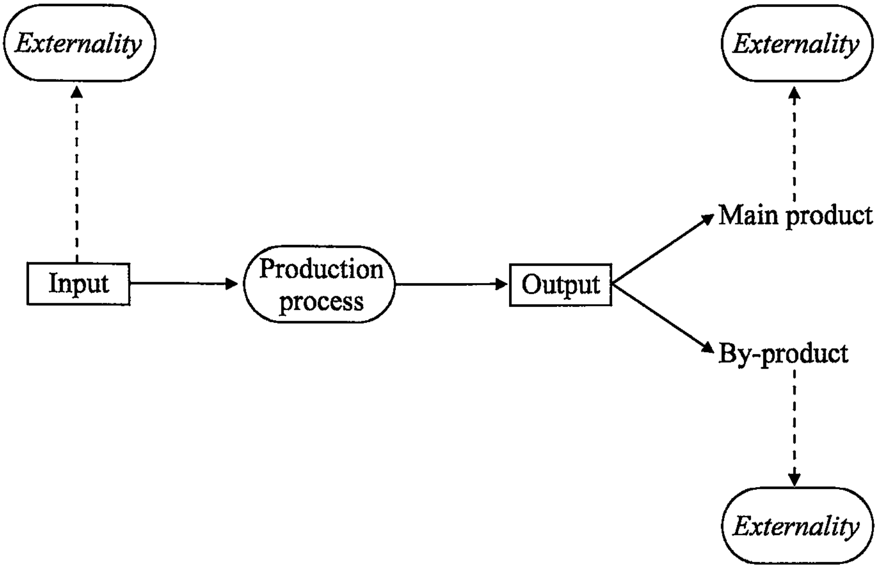

***Figure 1** Flows in the production process*

Basic characteristics of both environmental and production rights can be deduced from the related production process. Each production process can generate externalities (Figure 1), which can be internalized by rights. The rights linked to input are mostly resource rights, whereas those linked to output are environmental and/or production rights. The classes presented in Table 1 do not pretend to be mutually exclusive. Some resource rights, such as fishery rights, may be seen as environmental rights or as production rights, depending on the goal of the authority that initiated them. In this chapter, only rights related to output are examined.

***Table 1** The classes used for classifying rights by input and output*

INPUT	OUTPUT	
Rights with respect to resources	Environmental rights	Production rights

The input for and output of a production process can be described in terms of amount, quality, time, place and marketability (Naylor and Vernon 1969). Because rights are related to input or output, they can be described in an analogous way.

For rights the following types of characteristics can be distinguished: quality, temporal, spatial, property and transferability characteristics, which will all be specified and analyzed. They will be used as inputs for the correspondence analysis.

10.4.1 *Quality Characteristics*

Production and environmental rights interfere with the economic behaviour of the firm. Most rights affect the production side of the economy and, indirectly, the consumption side too. As far as production rights are concerned this is obvious. A production quota is assigned to an agent: it defines how much output is allowed in production during a specified period. Overproduction is illegal and will be penalized. In most cases environmental rights also interfere with production. Pollution rights will have an impact on the production level. Rights directly affecting the consumption side of the economy, for example, are rights to consume a maximum of 20 gallons of gasoline per month. In the European Union such rights exist for some chemical materials.

The quality characteristics of rights reflect the objectives of an institution which initiated the right. They specify what action the possessor of the right may take. In general, the right is defined as the amount of pollution or production per area per time period. Note that in this respect time means the time period for which the amount of pollution or production is defined. The duration of the rights scheme, i.e. the period the rights will last, will be discussed in subsection 10.4.2. In the case of environmental rights, not only the total quantity per enterprise, but sometimes also the quantity per output (i.e. the efficiency rate), is subject to the right; for example, the amount of SO_2 emission per kilowatt-hour energy, per time unit and per unit of area. In the case of production rights, such rights based on efficiency rate are rarely present.

10.4.2 *Temporal Characteristics*

The temporal characteristics of rights indicate the lifetime of the rights scheme and thereby the terms of the right. The rights scheme, i.e. the right, may be perpetual or tied to a certain period, after which it lapses. The right's duration is important for the right's marketability. If a rights scheme lasts only for a particular period, the government will have to redistribute rights in order to continue its policy. The time period during which the agent can exercise his or her right may be specified or not. In the latter case banking is allowed. The exercise period of the right can be specified precisely as a date or be tied to the occurrence of an event. One example of the former is the right to drive on Mondays and Wednesdays in a city having smog problems. An example of the latter - the occurrence of an uncertain event - is an agent who may exercise the right until the pollution reaches a specified limit.

10.4.3 *Spatial Characteristics*

The spatial characteristic indicates the geographic area in which the right can be exercised for environmental and production economic reasons. Except for global rights, such as those pertaining to chlorofluorcarbons rights[3], rights are almost always tied to a specific geographic area. The spatial characteristic of environmental rights is linked to air, water and ground pollution. It is extremely important in the case of pollution rights because pollutants are region-specific. In the European Union this characteristic of rights with respect to production rights is the subject of much discussion, because regional use of rights is connected with the distribution of the rights among the member states.

10.4.4 *Property Characteristics*

An environmental or production right is not necessarily a property right. Whether or not the government can limit, withdraw or otherwise modify the rights in the future without compensating the holders of rights is an important issue and is extremely important for the legal security of the agents affected by rights. If the right can be seen as an asset, then the government cannot reduce the rights which it has distributed, because it will encounter constitutional problems with respect to the right of property. In most cases the government indicates explicitly that the allocated right is not a property right. For example, the Acid Rain Program in the US refers to SO_2 emission rights, not to property rights (see ARP, Title IV of the Clean Air Act Amendments of 1990).

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[3] Note that, chlorofluorcarbon rights, although we describe them as global rights, affect only the partners of the Montreal Protocol.

10.4.5 *Transferability Characteristics*

One of the first tasks to be carried out by a regulatory agency is to allocate the rights to firms. The national government or a supranational government will have to distribute the rights among the different economic agents. The first option, auction of the rights, implies a financial burden to the economic agents involved. The government must indicate which economic agents can purchase the rights. The second option, distribution on the basis of administrative criteria (for example, grand-fathering), has been implemented in the European Union regarding production-rights (for example in the case of milk quotas). The basic distribution criterion was the historical production in a certain year, i.e. the reference year. In the case of pollution rights the above-mentioned distribution implies that environmentally unfriendly economic agents are rewarded for their behaviour by being given pollution rights. The regulatory agency will face substantial pressure to allocate rights in proportion to existing behaviour. This allocation, of course, favours existing firms which bear little risk or expenses when the program is created, and creates a bias against new firms which have to change their behaviour drastically (Dwyer 1992).

Whether a right can be transferred or not will influence the perception of the right by the affected firms. Transferable rights can, to some extent, be perceived as an asset, whereas a non-transferable right can be perceived as a privilege.

Transferability is attractive to policymakers, since it has several theoretical advantages over other methods, such as a regulated redistribution of rights. The market price of rights will reflect the cost of abating the externality and will provide a signal to other potential sources of externality. In theory, agents creating externalities will purchase rights or sell rights, depending on their initial abatement costs, up to the point at which the unit right price equals the marginal cost of externality control in the case of environmental rights (assuming no fixed costs). In the case of production rights, the agents will purchase or sell rights up to the net benefit (Varian 1990). Rights will therefore lead to business decisions based on externalities, too. If agents causing externalities with different cost and benefit functions are given the opportunity to trade rights, the total cost to society of reducing externalities is minimized. The trade system also lowers administration costs, since once the rights have been allocated, a market in rights can be expected to develop independently of the regulators. However, in this case it should be clear who is monitoring the policy, which is especially relevant in environmental policy. Most rights are transferable, because the government's rationale for introducing rights is to find an economically efficient solution for its problems, and the reason for the superior efficiency of rights compared with other policy instruments is that transferability causes the marginal cost of abatement to be equal throughout society in the equilibrium. This goal can only be achieved by a system of transferability. In a recent article Ledyard and Szakaly-Moore (1994) show that using markets for trading rights can be quite efficient. Participants were always better off under a market of rights than without such a market.

The trade in rights can be limited by different factors, some of which we will now discuss. The participants in the trade in rights may be restricted by the government in order to protect some groups. The question of who is allowed to participate in the trade is related to this issue. We can distinguish two kinds of participants: the affected and the unaffected agents. Agents who wish to enter a new market in which participants are affected by rights can only enter this market by buying rights.

The trade in rights can also be restricted by a government through approval procedures. A trade then has to be propounded to an authority, which will then use certain criteria to test the trade.

This kind of regulation can be an impediment to a liquid market in rights. The trade in rights may be linked to some item in such a way that trade is impossible without this item. This is a common phenomenon in the case of production rights. Trading milk quotas in the European Union must involve land, because milk quotas are linked to land; this influences the transferability of the milk right negatively. Not only the right itself but also market conditions can cause an illiquid market.

Transaction costs consist of two elements: finding a trading partner and, if necessary, obtaining approval from the authorities (Klaassen 1994). Searching for a seller is often a formidable task, because of the general scarcity of market information. However, some improvements have been made such as in the case of milk quotas in Canada, where, in a centralized market place, price information can be obtained (Tallard and Curtin 1991).

Other elements are costs and the length of the approval procedure. One advantage of trading rights over commodities is that they do not involve transport costs, grading costs, etc.

For rights there are different kinds of trading systems. We can distinguish between those in centralized trade and those in decentralized trade. Auctions are a well-known system in centralized trade. At sealed-bid auctions, rights are sold, starting with the highest bid and continuing until all rights have been sold or no bids are forthcoming. This is how the SO_2 emission rights in the US are traded. Electronic matching is another system, which involves all bids and offers being entered into a computer. At a particular price the volume of the right offered for sale will equal, or almost equal, the volume of the right being bid on. This unique price is referred to as the 'market clearing price'. The Ontario milkquota exchange is an example of this system. In contrast to decentralized trading systems, which are characterized by the employment of many middlemen, the centralized trade is very transparent.

The trading behaviour of agents affected by rights is not straightforward. Efficient firms will buy or sell their rights depending on the contents of those rights. Agents affected by environmental rights will be encouraged to clean up at relatively low cost to reduce their emissions, so that they are able to sell surplus rights to agents that do not have low cost clean-up options (Hahn 1994). Production rights will encourage firms to produce at relatively low cost, so that they are able to buy production rights from firms that are not so efficient. The agent's trading behaviour reflects the interaction between the quality characteristics and the transferability characteristics. Having described the characteristics of rights in detail, we will summarize them in the next paragraph.

10.4.6 *Overview of Rights Characteristics*

We have described the most important characteristics of rights, of which Table 2 gives an overview.

Table 2 Framework for describing rights

Characteristics	
Quality	Production or Pollution per Unit of Time per Unit of Space
Temporal	Permanent or Temporal
Spatial	Region Specific, National or Global
Property	Property Right or No Property Right
Transferability	Transferable or Non-Transferable, Linkage to Other Item or No Linkage

10.5 Environmental Rights and Production Rights: Commonalities and Differences

Characteristics of rights as described in Table 2 seem relevant to both environmental and production rights. However, their point of impact differs. In the case of environmental rights, the direct point of impact is the pollution and thereby indirectly the production of the main product, whereas in production rights the point of impact is directly the production of the main product (see Figure 1). This means that environmental rights can affect the use of production rights, if the environmental rights and production rights deal with the same production process, but not vice versa. The background of environmental and production rights and their features are analyzed below.

Certain characteristics of the type of pollutant have a crucial impact on the implementation of environmental rights. The pollutants may be divided into assimilative and accumulative pollutants, and into uniformly mixed and non-uniformly mixed pollutants. This division between pollutants is related to the quality characteristics. The capacity of the environment to absorb assimilative pollutants is sufficiently large relative to their rate of emission and in any year the pollution level is independent of the amount emitted in previous years. In the case of uniformly mixed pollutants, the ambient concentration depends on the total amount of emissions, but not on the distribution of these emissions among various sources (i.e. locations). This contrasts with spatial non-uniformly mixed pollutants (Tietenberg 1985, 1989a, 1992). Each of these characteristics (assimilation and degree of mixing) affects the quality characteristics of the right. Uniformly mixed assimilative pollution is a type of pollution that is relatively easy to fit into a rights trading system. For any geographic area this system allows ton-for-ton trades between all sources. In this case the spatial characteristic may be relaxed. Non-uniformly mixed assimilative pollutants involve a relationship between emissions and the pollution target, for which the location of the sources is crucial. For these pollutants the right is specified in terms of a ceiling on the permissible ambient concentration of that pollutant measured at specific locations: the spatial characteristic. The rights system for non-uniformly mixed assimilative pollutants involves a separate market in rights that is associated with each receptor; each source would have to procure sufficient rights in each (location-specific) market to legitimize its emission rate (ambient rights system). Uniformly mixed accumulative pollutants involve pollution which accumulates in the environment because the emission exceeds the assimilative capacity. The rights designed for this kind of pollution do not have a temporal characteristic; the holder is free to choose when to emit. These rights do not regulate emission rates, they limit total emissions. In this market the rights are an exhaustible resource, once used they are withdrawn from circulation. The rights system for non-uniformly assimilative pollution is complex because of the location specificity. It shows the interaction between the quality and spatial characteristics. Different approaches can be considered, such as zonal rights systems.

Similar to environmental rights, the characteristics of products have a crucial impact on the implementation of production rights. There are many characteristics of products such as perishability, seasonality etc. Therefore, these characteristics are not elaborated upon and we limit ourselves to describing the background of production rights. In many countries state intervention in production policy is a normal procedure. Ever since the earliest days of the Common Agricultural Policy of the European Union, agricultural production has increased more rapidly than demand. This has led to structural surpluses and low prices for farmers, which can only be eliminated through the increasing exercising of public intervention and storage measures, subsidized internal disposal schemes and of restitutions for an expanding volume of exports to the world market. These market support measures could only be sustained at an ever-increasing cost to the Union budget. In 1984 the European Commission concluded that it was no longer economically sensible nor financially possible to give producers a full price guarantee in the case of structural surpluses. The European Commission therefore decided that the principle of the guarantee threshold in the agricultural sector should be replaced by a quota system accompanied by a restrictive price policy. This principle forms the basis of the different kinds of quota systems in the European Union such as those for fishery, starch, sugar and milk. Also in many countries outside the European Union, governments introduce production rights to avoid overproduction. Most such rights are established within agriculture. The production right is defined in terms of the product volume per year which the producer in question is allowed to produce and for which in most cases (s)he obtains a guaranteed price. We can conclude that the differences between environmental rights and production rights are caused by the fact that the point of impact differs. Environmental rights indirectly affect the output of the firm whereas production rights directly effect the output. The commonality of environmental rights and production rights lies in the fact that the implementation of a rights scheme depends on the underlying product in the case of production rights or polluter in the case of environmental rights.

10.6 Classifying Existing Rights

We will use the characteristics of rights to classify some well-known rights. We use as an example of environmental rights: lead rights, SO_2 emission rights, chlorofluorcarbon rights in the US and manure rights in the Netherlands. As an example of production rights we use: milk rights and fishery rights in the European Union. Note that we selected rights schemes which are mature, i.e. rights schemes which have proven to last for some years. Many rights schemes are not stable, meaning that the specification and the rules which apply to them change very often. However, our methodological approach can also be applied to other rights, such as the Swiss highway Vignette, German Trucking Highway tax and the Power Plant quota in Denmark.[4]

The characteristics described are defined dichotomously. The codes of these characteristics (in parentheses) are as follows:

[4] Note that although the stocks of agricultural products are almost depleted in the European Union nowadays, production rights are needed to counter oversupply and hence low prices for farmers.

<u>D1 = Quality Characteristics;</u>
C1 = based on efficiency rate (1) or not (0);
C2 = point of input; consumption side (1) or production side (0);

<u>D2 = Temporal Characteristics;</u>
C3 = the right may be perpetual (1) or not (0), i.e. the rights scheme has not or has an expiration date;
C4 = the period of exercising may be specified (1) or not (0) (banking is allowed);
C5 = the use of a right may be tied to a specific time or a specific event whose time of occurrence is known (1) or unknown (0);

<u>D3 = Spatial Characteristics;</u>
C6 = the right is restricted to a specific geographic area (1) or is global (0), for environmental or production economic reasons;

<u>D4 = Property Characteristics;</u>
C7 = withdrawal of the right may or may not have consequences for legal security, i.e. compensation in the case of withdrawal (1) or not (0);

<u>D5 = Transferability;</u>
C8 = geographic limits to trading (1) or no limits (0);
C9 = allocation by the grandfathering system (1) or auction (0);
C10 = the participants allowed to trade are solely affected agents (1) or include agents from outside (0);
C11 = trading is regulated by the government, permission is required from agency (1) or no such permission is required (0);
C12 = right is linked to some item (1) or is not linked (0);
C13 = trading system is centralized (1) or decentralized (0);

The figures in parentheses correspond with Table 3.

The design of this classification is objective in the sense that the scores can be assigned objectively. We have assigned the scores on the basis of information we have gathered from institutions and authorities involved in these rights. Note that the methodological approach could be applied to many more rights.

Before we start our analysis we will specify a 'full right', which is a hypothetical right that has optimal characteristics in the sense of efficiency, i.e. implementing a policy which is efficient for the affected firms as well as for society. This means that the goal of internalization of externalities is reached at low cost to both the individual firm and society. This full right is based on efficiency rate, is perpetual, has no restrictions on transferability, and is a property right. In our analysis this right can be seen as a benchmark with which existing rights can be compared.

The rights (including the full right) which we will examine are classified in Table 3.

Table 3 Classification of existing rights according to their characteristics

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
PRODUCTION RIGHTS													
Milk right	0	0	0	1	1	1	0	1	1	0	1	1	0
Sugar rights	0	0	0	1	1	1	0	1	1	1	1	1	0
Fishery rights	0	0	0	1	1	1	0	1	1	1	1	0	0
ENVIRONMENTAL RIGHTS													
Lead rights	1	0	0	0	1	0	0	1	1	1	1	0	0
Chlorofluor-carbon rights	0	0	0	1	1	0	0	0	1	1	1	0	0
SO_2 emission rights	0	0	1	0	1	0	0	0	1	0	0	0	0
Dutch manure rights	0	0	0	1	1	1	0	1	1	1	1	0	0
Full right	1	1\0	1	0	1	0	1	0	0	0	0	0	1

We carried out a correspondence analysis to identify the basic dimensions of rights. The primary purpose of correspondence analysis is data reduction and summarization. Broadly speaking, it addresses itself to the problem of analyzing the interrelationships among a large number of variables and then explaining these variables in terms of their common underlying dimensions. Correspondence analysis has several features that contribute to its usefulness in research. The multivariate nature of correspondence analysis can reveal relationships that would not be detected in a series of pairwise comparisons of variables. Correspondence analysis also helps to show how variables are related, not just that a relationship exists. The joint graphical display obtained from correspondence analysis can help in detecting structural relationships among the variable categories, in our case the rights and the characteristics.[5] The analysis was carried out using the CORAN correspondence analysis computer package (Bagozzi 1994; Carroll, Green and Schaffer 1986, 1987). The central objective of CORAN is to find a set of coordinates representing the rows of the two-way contingency table (such as Table 3), so that the Euclidean distances between the rows of the coordinates respond in a straightforward way to squared distances between rows.

Our primary aim was to identify: (1) the similarities and differences between rights with respect to the various characteristics; (2) the similarities and differences between the characteristics with respect to the rights; and (3) the interrelationship between the rights and the characteristics. We also wanted to ascertain (4) if these relationships could be represented graphically in a joint low-dimensional space. This means that two rights are close if they share similar characteristics, and two characteristics are close, if they occur in the same rights to the same degree. It also implies that a right is close to a characteristic if the right has that characteristic.

The histogram of the eigenvalues indicates that the fourteen characteristics can be explained by an underlying structure consisting of 6 dimensions.

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[5] For a detailed description of correspondence analysis the reader is referred to Hoffman and Franke (1986).

Tabel 4 Eigenvalues

Factor	Eigenvalue	Percentage	Cumulative percentage
1	0.6467	59.51	59.51
2	0.1846	16.99	76.50
3	0.1398	12.87	89.37
4	0.0716	6.59	95.95
5	0.0355	3.27	99.22
6	0.0084	0.78	100.00

The eigenvalue represents the amount of variance accounted for by a factor. Note that three factors explain about 89 %. Based on the well-known scree test criterion, the underlying structure of the data set can be represented by three factors (or dimensions).

In Figures 2 and 3 the rights are denoted by R1 for milk rights, R2 for sugar rights, R3 for fishery rights, R4 for lead rights, R5 for Chlorofluorcarbon rights, R6 for SO_2 emission rights, R7 for Dutch manure rights and R8 for the full right.

Figure 2 represents the configuration of the characteristics and rights formed by the first two principal axes. Each of the principal axes is associated with an eigenstructure which defines the projections on the axes, as well as the relative variance in the characteristics and rights explained by the axes. In this analysis the full right can be seen as the ideal point.

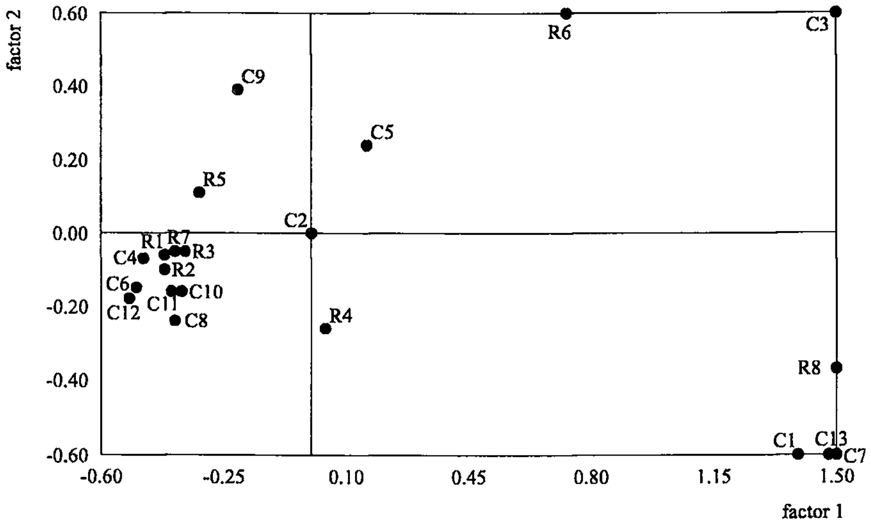

***Figure 2** Plot of the first dimension on the horizontal axes and the second dimension on the vertical axes*

Figure 2 shows that there is a striking similarity within the group of production rights, i.e. they are located close to each other. Within the group of environmental rights the similarity is less compared with the production rights. We can observe an interrelation between the production rights and the characteristics related to transferability (C8, C10, C11 and C12). Other rights and characteristics show no such interrelation.

From Figure 2 it can be concluded that the first dimension is able to discriminate between the full right and the existing rights, and the second dimension is able to discriminate between the existing rights. The first dimension describes the economic implications of the right from the point of view of both the affected firms and the society (dimension 1 has an absolute contribution of 77.6 to the full right, i.e. the full right is mainly stretched by this dimension). This dimension can be labeled as the efficiency dimension because characteristics 1 (based on efficiency rate), 3 (perpetual or not), 7 (compensation in the case of withdrawal) and 13 (trading system) load heavily on this dimension. The government can now evaluate the economic aspects of actual or proposed rights by using the first dimension as a benchmark. Rights which load relatively heavily on this dimension are preferred from a firm's point of view but also from a welfare perspective.

The second dimension is able, to some extent, to discriminate between environmental and production rights. The upper quadrant contains the rights associated with the environmental rights, whereas the production rights are in the bottomleft area of the plot. This dimension can be labeled as the content dimension, because characteristics 3 (right is perpetual or not), 9 (grandfathering or not) and 13 (trading system) load heavily on it.

Figure 2 shows that the distance between existing rights and the full right is large, indicating that much work needs to be done from an economic point of view on the process of designing rights.

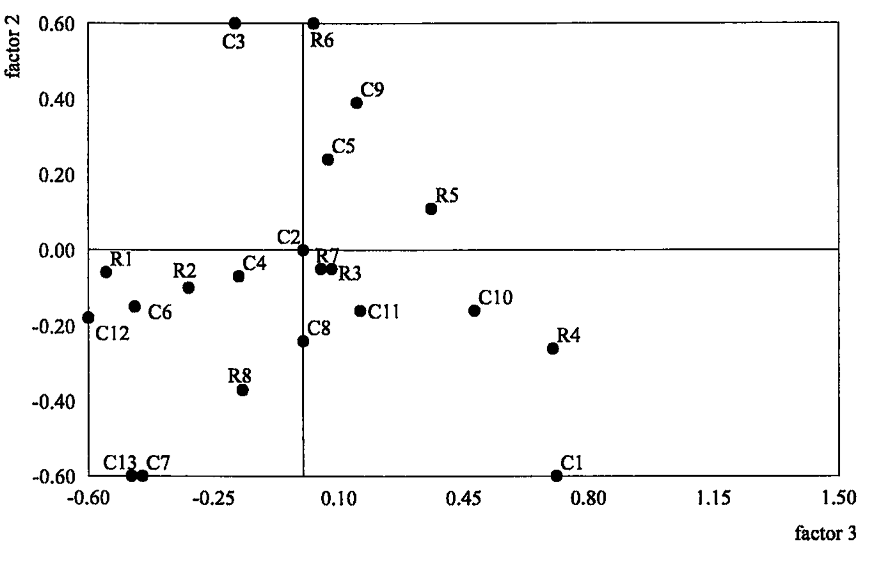

***Figure 3** Plot of the third dimension on the horizontal axes and the second dimension on the vertical axes*

From Figure 3 it can be concluded that the third dimension is able to discriminate between the rights with respect to transferability. This dimension can be labeled as the 'marketability' dimension because characteristics 10 (trade is only allowed with affected firms or not) and 12 (right is linked to an item or not) load heavily on this dimension. The full right is located near the center because this ideal right is stretched mainly by dimension 1. This plot gives us less information on similarities and interrelationships because the characteristics and rights are equally scattered in the plot; hence on the basis of the second and third dimensions, the rights and characteristics are not alike. This is not unexpected because this technique tries to condense all information into the space with the fewest dimensions (see Figure 2).

10.7 Summary and Conclusions

In this chapter a theoretical framework for rights has been developed. Both environmental rights and production rights have been considered. Both categories of rights are linked to the production process. The rights have been analyzed by characteristics deduced from the related production process. This theoretical framework makes it possible to classify existing rights and gives some insight into the many rights which are initiated in today's world. If applied to existing rights the underlying structure of rights can be determined empirically with the help of correspondence analysis. The benchmark in the correspondence analysis is a hypothetical right which has the optimal characteristics in the sense that such a right can contribute in the best way to reaching the goal of an authority and the affected firms in the sense of cost efficiency. The first of the three dimensions extracted, if using correspondence analysis, can be labeled as the 'efficiency' dimension because it is able to discriminate between the existing rights and the full right. The distance between the full, ideal, right and the existing rights is relatively large, indicating that from a business economic point of view much attention has to be paid to and research needs to be done on designing rights. The second dimension can be labeled as the 'content' dimension, because it is able to discriminate between environmental and production rights, whereas the third dimension can be labeled as the 'marketability dimension'. Our results should be interpreted with caution, because we used a small data set. We are continuing this line of research.

10.8 Acknowledgments

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CHAPTER 11

New Futures Markets in Agricultural Production Rights: Possibilities and Constraints for the British and Dutch Milk Quota Markets[1]

11.1 Abstract

Farms are increasingly being affected by policies that involve production rights. Because of fluctuations in the prices of these rights in the spot market, farmers face a price risk. Establishing a futures market might enable them to hedge against this price risk. Rights futures have some features that differ from those of traditional commodity futures. This makes them an effective and efficient tool for managing price risk. The implications of these findings will be illustrated for milk quotas in the United Kingdom and The Netherlands. Prior conditions which might make a futures market for milk quotas successful in both countries will be deduced.

11.2 Introduction

Between 1973 and 1983, milk production in the European Union (EU) rose by 30% while consumption rose by a mere 9% (Braatz 1992). This resulted in very large stocks of butter and milk powder and strong pressure on the EU budget because of the terms of the Common Agricultural Policy guarantee price system. As a

[1] This chapter will be published as: Pennings, J.M.E. and M.T.G. Meulenberg (1998), "New Futures Markets of Agricultural Production Rights: Possibilities and Constraints for the Dutch and British Milk Quota Markets", *Journal of Agricultural Economics*, 49, 50-66.

result a milk quota scheme was introduced on April 2th, 1984. All EU members had the right to produce a certain quantity of milk.[2] Individual states were free to implement this policy at their own discretion within the comparatively liberal framework the EU had provided. The EU has allowed the transfer of quotas within countries themselves. National governments must add their own rules to the framework of EU regulations (Burrell 1989; Oskam 1989). Despite the fact that these EU regulations require trade in milk quotas to be linked to land, farmers in both The Netherlands and the United Kingdom have found ways of circumventing this requirement.[3] The trade in milk quotas is increasing every year and most of this increase takes place in the United Kingdom and The Netherlands. The underlying value of the trade in these two countries was almost one billion ECUs in the milk year 1993/94 (Van Dijk and Pennings 1995). For this reason we have focused our attention on the United Kingdom and The Netherlands.

The motivation for this work originated from questions raised by dairy farmers and farmers' unions as well as from several futures exchanges. Farmers' unions were interested in finding out whether the use of futures on milk quotas would enable them to hedge effectively against price risks incurred in leasing and purchasing milk quotas. Futures exchanges wanted to find out about the viability of such a futures market. The chapter's research

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[2] For a detailed analysis of the producer response to the EEC milk super levy the reader is referred to Burrell (1990) and Williams (1993). The terms quotas and rights will be used interchangeably in this paper to refer to the same phenomenon.

[3] In most cases land is only transferred for one year. The purchasing farmer uses the land involved in the transaction for a year, taking care not to use it for dairy farming. After that year, the land loses its quota and is transferred back to the original owner whilst the quota remains with the purchasing farmer (Besseling 1991). This construction has proven an effective way of circumventing the attachment of quota to land, and is of particular help to smaller farmers who are unable to raise enough money to buy land as well.

design is as follows: first, the extent of volatility in the milk quota market is investigated both for leasing and purchasing; the market's price volatility is then compared to the volatility of commodities for which a successful futures trade has already been established; then follows a theoretical assessment of the effect that the special qualities of rights will have on the optimal hedging ratio, on hedging effectiveness as compared to traditional commodities and on the cross-hedge possibilities of rights. To provide insight into the variables that play a role in the viability of such a futures market, several simulations are included to show the conditions under which such a futures market might be successfully established.

11.3 Rationale for Hedging

11.3.1 *Spot Market of Milk Quotas*

In the United Kingdom most quotas transfers take place in England and Wales and, as can be seen from Figure 1, the total quantities transferred have grown continuously. After the abolition of regional boundaries in 1993, quota markets in the United Kingdom have shown considerable growth. These figures show not only that a large quantity is traded, but also that the number of participants (buyers and sellers, lessors and lessees) is considerable: 23,500 participants in 1994/1995.

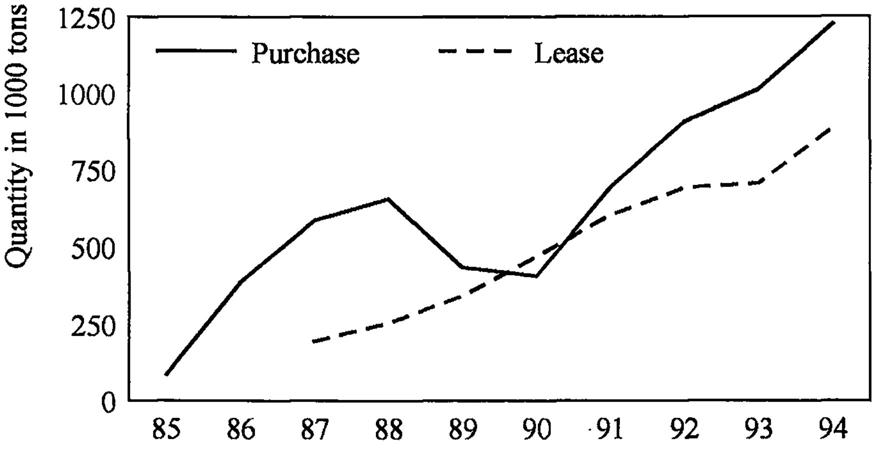

Figure 1 *Milk quota transferred in England and Wales (Source: National Dairy Council, 1995)*

The development of the milk quota market in The Netherlands received an additional impetus when leasing was introduced in 1989/90 and leasing is still gaining in popularity. In 1988/89, about 300,000 tons of quotas were transferred permanently between farms. In 1990, following the introduction of leasing, the total quantity transferred remained roughly the same. Only 180,000 tons, however, were transferred permanently. The remainder was offered for lease, indicating a shift towards temporary transfers. Figure 2 shows the rapid growth in leasing and a much slower growth in permanent transfers in succeeding years.

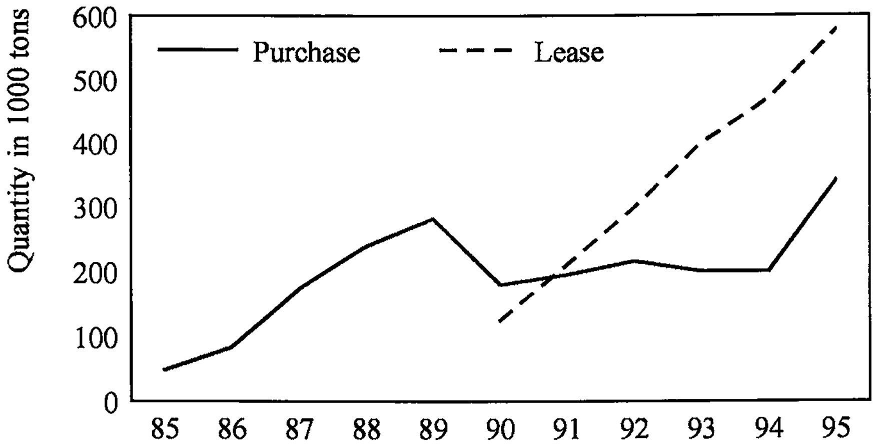

***Figure 2** Milk quota transferred in The Netherlands (Source: Productschap voor Zuivel, 1995)*

When transferring quotas, most farmers seek the assistance of agents, the mediators on the market. In the United Kingdom there are two main milk quota agents, Bruton Knowles and Quota Land Transfers (Dyfed). However, there are also smaller agents active in the market and the organization responsible for implementing the quota scheme is also involved in the process of mediation (Dairy Industry Newsletter 1993). In The Netherlands there are many mediators on the milk quota market. The large dairy cooperatives try to match demand and supply on the lease market, whereas on the buying and selling market real estate agencies and some of the large mixed-feed companies are active.

Spot markets for milk quotas have not been well structured or developed. Many agents are farm consultants trading small volumes. Cooperation between agents often remains at a very limited level, and there are no official bodies to facilitate communication between them. Thus, the price discovery process is not optimal, and farmers lack any clear-cut reference price.

Canada developed a centralized spot market in the 1980s and there have been centralized spot markets for milk quotas in Ontario since 1980 and in Quebec since 1985 (Oskam 1991). These centralized spot markets made the market for milk quotas transparent, though a more transparent spot market does not remove the risk farmers face when planning to lease or purchase milk quota. A transparent spot market does not enable one to predict future milk quota prices. However, the presence of a central spot market usually facilitates the institution of a futures market, in that it creates the possibility of offsetting a futures contract through cash settlement. With cash settlement, delivery of the underlying good does not actually take place. Instead, futures market positions are determined, using a model of calculation to be chosen by the futures exchange, often corresponding to prices on the central spot market. Canada, like the United Kingdom and The Netherlands, is investigating the feasibility of futures trade.

11.3.2 *Risks Faced by Dairy Farmers*

In The Netherlands and the United Kingdom agents normally charge a fixed mark-up commission, so the largest share of the price risk is borne by farmers. Both countries show considerable price differentials among regions and during different periods of time and this raises management problems for farmers. First of all, if the farmer intends to buy or sell milk quota, (s)he does not know what the price at the end of the milk price year will be, so (s)he faces a price risk. Secondly, dairy farmers who sell milk quota at the end of the milk price year have to sell dairy cows within a very short period, theoretically within an infinitely short period of time, because, having sold milk quota they will not be allowed to produce milk during the subsequent milk price year.

Thus, because farmers have to sell dairy cows immediately, they are not able to get the best price for their herd, i.e. farmers face execution costs. The same reasoning holds for farmers wanting to expand their farms.

In order to gain insight into the volatility of milk quota, month-end data were gathered on purchase and lease prices in the United Kingdom and for other farm products in which there is a long tradition of successful futures trading for the years 1987 to 1995 (source: Bruton Knowles, USDA National Agricultural Statistics Service, Rotterdam Potato Cash Market). Based on these data we have calculated the coefficient of variation, which is a stable and dimensionless expression of price volatility, as a proxy of market risk faced by farmers. It appeared that the coefficient of variation (CV) of milk quota prices, both lease (average CV is 0.13) and purchase (average CV is 0.11), is comparable to that of wheat (average CV is 0.10) and soy beans (average CV is 0.07) and, although to a lesser degree, of potatoes (average CV is 0.27). This suggests that from a "risk perspective" milk quota futures seem valuable. Note that a high degree of volatility does not necessarily mean that market risk will be higher than it would be with low volatility. Risk implies that prices cannot be predicted with any measure of certainty.

Besides providing a platform for hedging activities, futures markets also fulfil an information role. Without a futures market, informed agents use information about next period's price to make spot market purchases. Grossman (1989) argues that the trading activity of informed agents in the present spot markets makes the spot price a function of their information. When the spot price reveals all of the informed traders' information, both types of traders (informed and uninformed) will share the same beliefs about next period's price. In this case there will be no incentive to trade. In general, the spot price will not reveal all of the informed trader's information, since there are other factors ("noise") which determine the price along with the informed traders' information. This is particularly relevant for the milk quota market where price information on milk quota through magazines and personal, informal channels, is the main source of information. Substantial time lags and a lack of accuracy are common characteristics of these types of data. The information problem is most severe at the farm level, since individual farmers have rather limited information networks. This implies that, with only spot markets, informed and uninformed traders will have different beliefs about prices in the next period. It is this difference in beliefs which creates the incentive for futures trading in addition to the usual hedging incentive. When a futures market is introduced, the futures price as well as the spot price will transfer the information possessed by informed agents to uninformed agents.

On average, only 3% of the trade on the futures market is actually delivered (Catania 1989). In the case of a futures market of rights, actual delivery occurs more frequently when such a market is still in its early stages because the cash markets of most rights are not sufficiently liquid yet. Hedgers who fail to make a deal on the cash market will not offset their futures market position. As will be demonstrated in the next section, this higher frequency of delivery will not pose a problem in the situation where there is a futures market for rights.

11.4 Optimal Hedge Ratio and Hedging Effectiveness

The motivation behind hedging cash prices with offsetting futures contracts is to reduce, if not eliminate, cash price risk. Any deviation in the cash-futures price relationship at settlement date will be arbitraged away. However, if the arbitrage transaction costs are high, the necessary convergence of cash-futures price will not occur. This will introduce a risk for the hedger. This so-called basis risk will negatively affect participation in futures markets (Shafer 1993).[4] The basis between a futures contract and its underlying commodity is an important yardstick of the cost involved in using the futures contract to hedge. Basis risk can be divided into timing, spatial and quality discrepancies between the cash position of the farmer and commodities deliverable on futures (Paroush and Wolf 1989).

A right is a perfectly homogeneous 'commodity', i.e. the underlying commodity of a rights futures contract is identical to the commodity in the cash market. This implies that there will be no problems with respect to location of delivery, because delivery will take place by transferring book entries between accounts (Pirrong et al. 1994). Nor will there be any problems with respect to quality. Hence, there is no spatial and quality basis.[5] This characteristic is important for a farmer affected by rights who wishes to reduce his or her price risk.

A farmer might use a forward contract or a futures contract to manage price risk. The advantages of forward sellings/buyings over hedging in futures are quite clear. As with futures, the price

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[4] Where the basis is defined as the local cash price minus the futures price.

[5] If the maturity dates of a futures contract do not fit the hedger's horizon, the temporal basis will still play a role (Castelino 1992; Geppert 1995, Pennings and Meulenberg 1997).

level is fixed in advance of delivery, but unlike hedging in futures, there is no further adjustment of the firm's return as a result of any subsequent change in the basis. Moreover, the forward contract can be tailored more closely to meet the firm's needs with respect to quantity, quality, place and time of delivery as well as other terms. This is why forward contracts are still very important in agriculture. In the case of rights, the advantages of forward sellings/buyings over hedging in futures are not valid. In this case, the advantages of futures markets - the highly organized methods of trading with the extreme standardization of terms resulting in widespread and low cost access of buyers to sellers and great integrity of the contract - are not affected by the disadvantages of futures versus forward contracts mentioned above. This implies that rights futures are a more suitable price risk management tool for farmers than forward contracts.

Consider a farmer who can lock in the price risks regarding milk rights with the help of milk quotas futures. We will assume that the only production costs are the costs of acquiring milk quotas. Given that the farmer is risk averse and wishes to maximize the expected profit in the next time period adjusted for risk, where risk is measured by the variance in the expected profit margin, the objective function has been based on the expected value-variance (EV) model (Robison and Barry 1987). In the EV model, risk is measured by the variance in profits. The EV model is suited to determine relationships between variables and to show the direction of change in relevant variables.[6] Garcia, Adam and Hauser (1994) provide additional evidence of the usefulness of the EV model compared to the negative exponential and Cox-Rubinstein utility

[6] For the conditions that justify the use of the EV model and the discussion on the use of the EV model and the general expected utility model, the reader is referred to Bigelow (1993), Meyer and Rasche (1992), and Tew et al. (1991).

functions. In the EV model, the objective of the hedger is to maximize the objective function:

$$\Pi_{t+1}^{ce} = E_t(\Pi_{t+1}) - \lambda \operatorname{var}_t(\Pi_{t+1}) \tag{1}$$

where Π_{t+1}^{ce} is the certainty equivalent, $E_t(\Pi_{t+1})$ is the expected profit, given the information set at time t, and $\operatorname{var}_t(\Pi_{t+1})$ represents the variance in profit, while λ denotes the risk parameter which, for risk averse decision makers, is positive, thus providing compensation for risk bearing (Pratt 1964). At time t the farmer wishes to maximize the certainty equivalent for the next milk price year denoted as period $t + 1$, indicating that the hedging horizon is one year. Given that the cash positions (milk quotas) are predetermined, the expected profit at time $t + 1$ equals the revenue from selling the main product minus the cost of leasing the milk quotas in the cash and futures markets, corrected for the transaction costs. The expected profit per unit of output can now be written as:

$$E_t(\Pi_{t+1}) = E_t(p_{t+1}) - [\alpha(f_t - E_t(f_{t+1})) + E_t(CP_{t+1}) + |\alpha| \, TC] \tag{2}$$

where $E_t(p_{t+1})$ is the expected cash price of milk given the information set at time t, α the hedge ratio[7], f_t the futures price at which the contract is opened, $E_t(f_{t+1})$ the expected settlement futures price, given the information set at time t and $E_t(CP_{t+1})$ the expected cash price of the lease milk quotas, given the information set at time t and TC the transaction costs.

[7] The hedge ratio is the number of futures contracts per unit of the underlying cash position.

Because of the great importance of the basis on the hedging effectiveness, as outlined earlier, Equation (2) is rewritten in terms of the basis:

$$E_t(\Pi_{t+1}) = E_t(p_{t+1}) - [\alpha(f_t - E_t(f_{t+1})) + E_t(f_{t+1}) + E_t(b_{t+1}) + |\,\alpha\,|\,TC] \quad (3)$$

where $E_t(b_{t+1})$ is the expected basis at maturity, given the information set at time t, which equals $E_t(CP_{t+1}) - E_t(f_{t+1})$.

To determine the variance of the profit it is necessary to determine the covariance matrix of the stochastic variables contributing to the variance. Let $\text{var}_t(p_{t+1})$, $\text{var}_t(f_{t+1})$ and $\text{var}_t(b_{t+1})$ be the variance in the milk price, the variance in the settlement futures price and the variance in the basis, given the information set at time t respectively. Furthermore, let $\text{cov}_t(p_{t+1}, b_{t+1})$, $\text{cov}_t(f_{t+1}, p_{t+1})$ and $\text{cov}_t(f_{t+1}, b_{t+1})$ be the covariance between the milk price and the basis, the covariance between the futures price at maturity and the milk price and the covariance between the futures price and the basis respectively. The variance of the profit can be expressed as:

$$\text{var}_t(\Pi_{t+1}) = (\alpha - 1)^2\,\text{var}_t(f_{t+1}) + \text{var}_t(b_{t+1}) + \text{var}_t(p_{t+1})$$
$$-\,2(\alpha - 1)\,\text{cov}_t(f_{t+1}, b_{t+1}) + 2(\alpha - 1)\,\text{cov}_t(f_{t+1}, p_{t+1}) - 2\,\text{cov}_t(p_{t+1}, b_{t+1}) \quad (4)$$

The optimal hedge ratio can be derived by taking the first derivatives from Π^{ce}_{t+1} with respect to α. Hence, the optimal hedge ratio can be expressed as:

$$\alpha = \frac{-f_t + E_t(f_{t+1}) - TC}{2\lambda \, \mathrm{var}_t(f_{t+1})} + 1 - \rho_1 \frac{\sqrt{\mathrm{var}_t(p_{t+1})}}{\sqrt{\mathrm{var}_t(f_{t+1})}} + \rho_2 \frac{\sqrt{\mathrm{var}_t(b_{t+1})}}{\sqrt{\mathrm{var}_t(f_{t+1})}} \quad (5)$$

where ρ_1 is the correlation between the milk price and the futures price of the milk quota at maturity and ρ_2 is the correlation coefficient between the basis and the futures price of milk quota at maturity.

Equation (5) can be decomposed into both a speculative and pure hedge component. The first term of Equation (5) represents the speculative component and the second and third term represent the pure hedge component. When a farmer believes that the futures prices are unbiased (i.e. $E_t(f_{t+1}) = f_t$) and ρ_1 and ρ_2 are zero, the optimal hedge ratio is 1 (assuming that the transaction costs are negligible), i.e. the farmer will hedge the total cash position. Even when a hedger is extremely risk-averse, i.e. $\lambda \rightarrow \infty$ and both ρ_1 and ρ_2 are zero, the optimal hedge ratio equals 1. If there is a positive correlation between milk quotas (input) and milk (output) i.e. $\rho_1 > 0$ a "natural" hedge will appear in the system (see Equation (5)). As a result, the optimal strategy would be to hedge a smaller amount than one would have done had this correlation been absent (Tzang and Leuthold 1990; Fackler and McNew 1993). This is not surprising, because if price fluctuations in milk quotas are to some extent compensated by price fluctuations in milk, the fluctuations in expected profit will decline, and therefore the need for hedging will also be reduced.

Castelino (1992) showed that the correlation between the basis and the futures price, ρ_2, is usually a negative one. As a result, Equation (5) implies that, if the variance in the basis increases, less will be hedged. Because of the characteristics of rights, as explained at the beginning of this section, the variance in the basis will be small and at maturity zero. Thus, generally speaking, more will be hedged in the case of rights than would be the case when hedging traditional commodities, since the latter introduces spatial and quality basis risk. This means that the hedging effectiveness of rights futures is greater than that of traditional commodities. Tashjian and McConnell (1989) have demonstrated that hedging effectiveness is a very important determinant in explaining the success of futures contracts.

We are able to show that, relatively speaking, more will be hedged when trading rights, than would be the case when trading traditional commodities, *ceteris paribus* both by the optimal hedge ratio, and the minimum variance hedge ratio. The minimum variance hedge ratio is the optimal hedge ratio for an extremely risk averse hedger or one who believes futures are unbiased. Using Equation (5) (again assuming that the transaction costs are negligible) the minimum variance hedge ratio can be expressed as:

$$\alpha = 1 - \rho_1 \frac{\sqrt{\text{var}_t(p_{t+1})}}{\sqrt{\text{var}_t(f_{t+1})}} + \rho_2 \frac{\sqrt{\text{var}_t(b_{t+1})}}{\sqrt{\text{var}_t(f_{t+1})}} \tag{6}$$

$\text{var}_t(b_{t+1})$ is negligible because of the characteristics of rights. Theoretically, if basis risk is zero and assuming for the moment $\rho_1 = 0$, the minimum variance hedge ratio will be 1 and residual risk zero (Castelino 1992). However, we might expect that due to the natural hedge the minimum variance hedge ratio is smaller than 1.

In this respect, it is important to note that successful futures trading can only occur when the futures market is efficient. The ultimate consequence of a market's efficiency is the fact that 'prices always fully reflect all available information' (Fama 1991). In our hedging model this comes forward from our assumption that futures prices are unbiased (i.e. $E_t(f_{t+1}) = f_t$ in Equation (5)). If a futures market diverges too much from market efficiency, farmers will not trade and the market will collapse even though its potential trade volumes are high.

Not only is it interesting that rights themselves can be hedged effectively, it is also significant that rights futures lend themselves to cross-hedging the profit capacity of the farm. The term cross-hedging is used to describe situations in which futures contracts are used to hedge non-deliverable commodities (Stoll and Whaley 1993). Farmers affected by rights have an opportunity to cross-hedge the profit capacity of the farm. This will be demonstrated below.

Let us assume that the only barrier to entering the dairy industry is the necessity of milk quotas for production, i.e. the only limiting factor is the milk quota. This implies that the price of milk quotas can be seen as an economic rent. The economic rent generated in the production process is allocated to the milk quota. Whenever there is some fixed factor, in this case the milk quotas, that inhibits entry into the dairy industry, there will be an equilibrium rental rate for that factor. Hubbard (1992) has shown that milk quotas have replaced land as the fixed input in dairy farming and that they have become the ultimate repository of economic rent. Even with a fixed amount of allocated milk quotas, it will always be possible to enter the dairy industry by buying the position of a farm that is currently in the industry, i.e, buying milk quotas. The competition for milk quotas among potential entrants will force up prices to the point at which the net benefit of producing equals the price of milk quotas (Varian 1990). The value at industry level for lease milk quota can therefore be expressed as:

$$P_R R_0 = pR_0 - C(R_0) \tag{7}$$

where P_R is the price of milk quotas, R_0 is the total amount of rights allotted by the government, p is the price of milk and $C(R_0)$ is the cost of production excluding the cost of buying the milk quota. The cost concept used in Equation (7) is broad, i.e. these costs include factor costs, non-factor costs and capital depreciation.

In contrast to lease milk quota, the value of milk quota (buy/sell) is the discounted economic rent generated in the production process. The value of purchase milk quota at the industry level can therefore be expressed as:

$$P_R R_0 = \sum_{n=1}^{N} \frac{p_n R_0 - C_n(R_0)}{(1 + 1)^n} \tag{8}$$

where i is the annual interest rate and N the number of years the milk quota system will be in effect.

Equation (7) shows that the lease price of milk quota reflects the possibilities of marketing the milk and of the cost structure of the production process (excluding the cost of milk quotas) in a particular year. Hence, the lease price of milk quotas is a proxy for the current annual performance of the industry. If the price is high, this indicates that the industry is performing well and is therefore willing to pay a high price for the milk quota, and vice versa. Analogous to Equation (7), Equation (8) shows that the purchase price of milk quota reflects the discounted possibilities of marketing the milk and the cost structure of the production process (excluding the cost of milk quotas) during the period that the milk quota system is in effect.

Assuming that the profitability of individual farms is closely related to that of the dairy industry, the farmer now has the opportunity to use a single (milk quota) futures contract to hedge against adverse annual profit in the dairy industry in the case of a futures contract for lease quota and to hedge against adverse discounted revenue in the dairy industry in the case of milk quota futures (buy/sell). Regardless of the complexity of the production process, the farmer can use those futures to hedge against adverse fluctuations in the profit capacity of the production process, instead of using a complicated and perhaps non-existent futures contract spread. This cross-hedge possibility will affect the viability of a milk quota futures market in a positive way.

Having investigated the hedging effectiveness of milk quota futures contracts, major aspects of the feasibility of such a futures market will be discussed in the next section.

11.5 A Futures Market for Milk Quota: Requirements

New futures contracts have made a significant contribution to the growth of commodity trading. However, futures contracts carry a considerable risk of failure (Carlton 1984; Tashjian and McConnel 1989; Tashjian 1995). In 1995, world wide, 40 new futures contracts were launched. Only a few of these proved successful in the first year (Davey and Maguire 1996).

In order to successfully introduce a new futures contract, implementation should follow a structured procedure. Sandor (1973, 1991) discerns three stages in the process of research and development of a futures exchange.

The first stage consists of a formal examination of certain established criteria (embedded in different approaches to successful futures contract innovation) to determine whether or not the commodity can be adapted to futures trading. *The second stage* consists of specifying the contract and includes a viability study, while *the third stage* consists of post-introductory changes in specifications of the terms of the contract to broaden contract appeal. The first two stages are examined below.

In the *first stage*, two well-known approaches in successful futures contract innovation are commonly used: the 'commodity characteristics' approach and the 'contract characteristics' approach as outlined in Chapter 2.[8]

Following these approaches, there are three reasons why milk quota futures might have potential for futures trading. First of all, the future prices of milk quotas are uncertain at this time, creating an urge to hedge among risk averse farmers. Secondly, milk quotas satisfy all the criteria of the 'commodity characteristics' approach. An important question within the 'commodity characteristics' approach is whether or not the cash market size is large enough to justify a futures market. When comparing the underlying value of the trade in milk quota in both countries with the Dutch potato market, which has a long tradition of successful futures trading, we observe that the milk quota market in the United Kingdom (350 million ECUs in 1993/94) and the Netherlands (600 million ECUs in 1993/94) is larger than the Dutch potato market (300 million ECUs in 1993/94). This suggests that from a "cash market size" perspective milk quota futures look promising. The characteristics of rights, as has been outlined earlier, make milk quotas very suitable for futures trading according

[8] Another strand of literature explaining the success or failure of futures is literature on contract design. This literature suggests that successful contracts will emerge when the futures price closely tracks the cash market price and when buyers and sellers are driven by different motives (Duffie and Jackson 1989; Tashjian 1995).

to the 'contract specification approach'. Thirdly, the absence of an efficient cross-hedge for milk quotas will favourably influence the success of milk quota futures trading.[9] Furthermore, Tashjian and Weissman (1995) have found that futures contracts that attract participants who are risk averse and who have highly variable endowments produce high trading volumes. Both characteristics hold for farmers in The Netherlands and the United Kingdom (Smidts 1997; Van Dijk and Pennings 1995). Moreover, the fact that milk quota futures lend themselves to cross-hedging the profit capacity of the farm may well have a positive influence on the success of milk quota futures. However, as outlined above, the presence of a natural hedge will decrease the hedging need and thus negatively influence the success of milk quota futures.

The absence of monopoly power is an important factor in having a successful futures market. A monopoly situation may occur in the futures trade, when any single party (the monopolist to be) is ale to acquire a large portion of the existing contracts, thus undercutting the usual assumption that every trader is "small" in relation to the market. Another way could be for a party to simply decline to liquidate its position. Thus, at the very close of trading, a former small holding will have become large in relation to the open contracts. Manipulations of the futures market become manifest as squeezes, which are also known as corners. The adjustment to the risk of manipulation drives a wedge between the futures price and the anticipated price of the cash commodity. This gap makes the futures contract less valuable as a hedging tool. In the milk quota market, a relatively large number of parties each hold a relatively small proportion of the total national quota making it difficult to

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[9] Black and Silber (1986) found that the level of success of new futures contracts that qualify as pioneering products, which is certainly the case for milk quota, is significantly higher than the level of success of later "me-too" product designs.

manipulate the market. Even so, when establishing a milk quota futures market, measures to counter market manipulation will need to be taken. The best antidote for monopolization is information. An exchange can monitor holdings to ensure that even amounts under the limit will not become excessive in relation to the rest of the market (Easterbrook 1986).

In the *second stage* the viability of a futures market for milk quotas is analyzed. We propose two kinds of futures contract specifications. Futures Contract A is defined as the right to produce an amount of milk each milk year as long as EU milk policy continues. Futures Contract B is defined as the right to produce an amount of milk for a particular milk price year. The first contract is related to the milk quota buy/sell market, the latter to the lease market. Farmers who intend to stop dairy production or who want to expand their milk production in the long run, might use Contract A. Contract B is suited for temporary, short-time quota sales or acquisitions.

By definition, futures contract volume is a function of the size of the futures contract, size of the cash market, hedge ratio and velocity (Black 1986). The function relating the trading volume to these variables can be expressed as:

$$V = \frac{CS}{FCZ} \cdot HR \cdot VLCT \tag{9}$$

where V stands for the volume of the futures contract (number of contracts traded), CS for cash market size, FCZ for the size of the futures contract, HR for hedge ratio and $VLCT$ for velocity. Velocity is defined as the number of times the underlying product is traded on the futures market. A velocity of 1 means that market transactions take place between hedgers. Velocity frequently exceeds 1, with speculators being active on the futures market as well. Thus, it is common for a situation to occur in which a short hedger uses a futures contract to sell his or her underlying product to a speculator who, in turn, sells it to another speculator or a long hedger at some later date. For a long hedger, an analogous scenario might be applied.

Equation (9) can be used to determine the constraints and possibilities of the viability of a futures market for milk quota. The cash market size is a given, while the size of the futures contract has been fixed in the contract specification. Therefore a sensitivity analysis may be run by inputting alternative values for *HR* and *VLCT*. Note that, when using Equation (9) for a sensitivity study, we implicitly assume that all dairy farmers who trade milk quota participate to some extent in futures trading. How many futures contracts they trade in relation to their cash position depends on their hedging ratio.

The following assumption is made regarding the contract specification of milk quota futures: a futures contract represents 7000 kilogram of milk quota with a specific fat content. This amount equals the average annual production of a dairy cow in the United Kingdom and The Netherlands. Representatives of the Dutch farmers union and the dairy industry confirm that farmers tend to think in terms of number of cows when making decisions with respect to milk quotas. As a result the underlying value for Futures Contract A would be about 12,000 ECUs and for Futures Contract B 1000 ECUs, which is in line with the underlying value of other agricultural futures contracts traded in Europe.

Volumes for 1994 were calculated for different levels of velocity and hedge ratios, as shown in Figures 3, 4, 5 and 6.

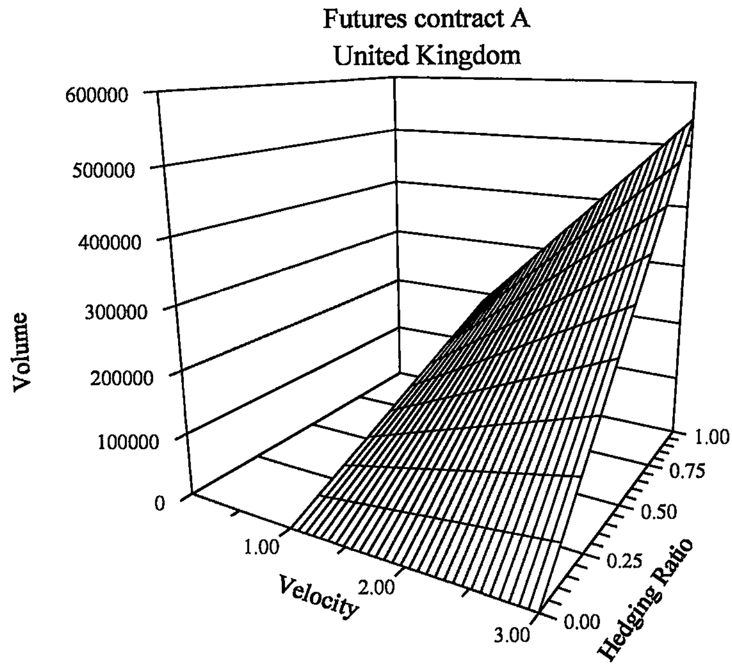

Figure 3 *Estimated volume of futures contract A in the United Kingdom for different levels of velocity and hedge ratios*

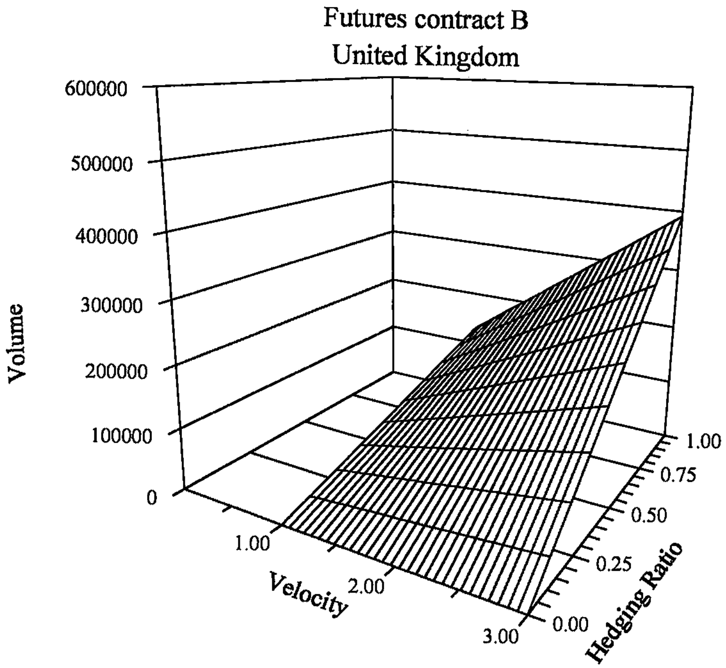

***Figure 4** Estimated volume of futures contract B in the United Kingdom for different levels of velocity and hedge ratios*

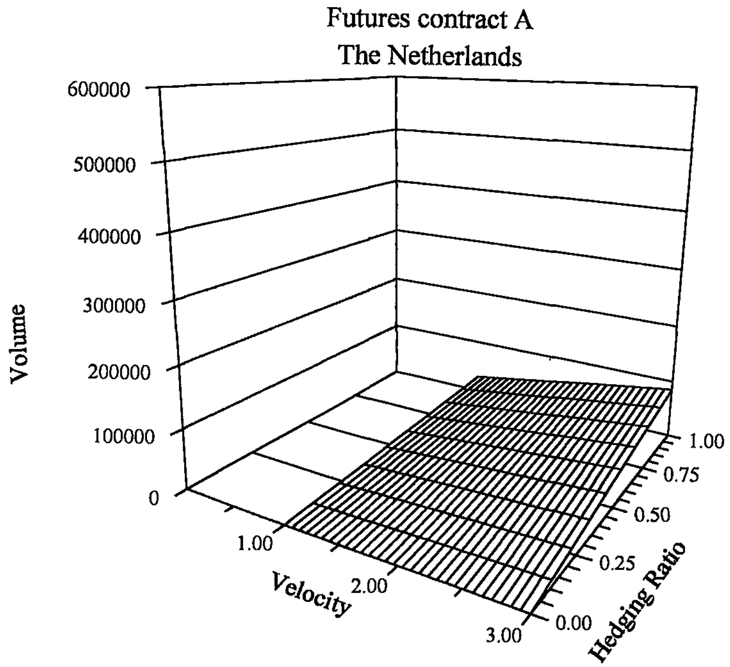

Figure 5 *Estimated volume of futures contract A in the Netherlands for different levels of velocity and hedge ratios*

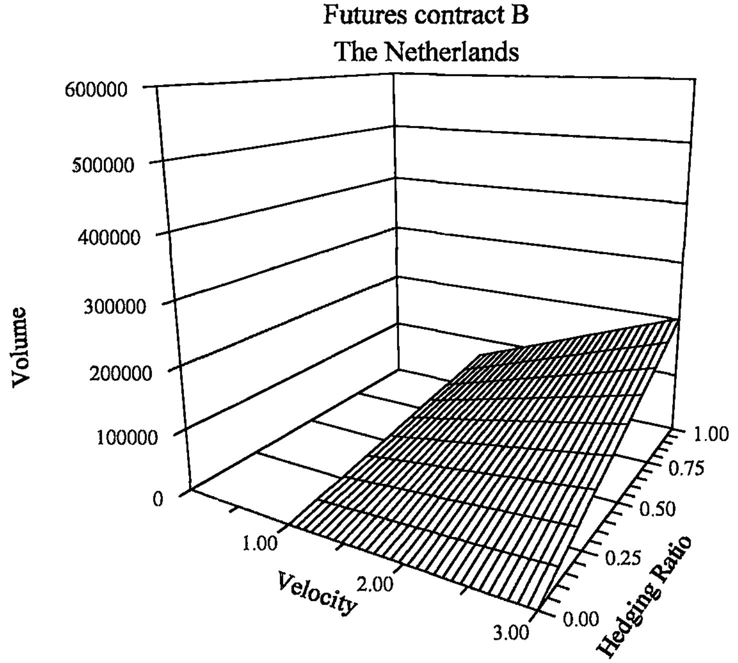

***Figure 6** Estimated volume of futures contract B in the Netherlands for different levels of velocity and hedge ratios*

Figures 3-6 show that an increase in velocity will increase the volume. However, a simultaneous decrease in the hedge ratio will partially offset this increase and vice versa. If both the hedge ratio and the velocity increase, volume will increase at a tremendous rate. It seems reasonable to expect that the velocity will be greater than 1, because we observed speculative trading in the cash market of milk quotas (Brasler 1994). Furthermore, we might expect the hedging ratio to be smaller than 1, making the values of

VLCT and *HR* in the south-east areas in Figures 3-6 more relevant. If we follow Silber's (1981) criteria for a viable futures market, this would suggest that there might be an opportunity for milk quota futures.

The market's velocity is determined by the number of speculators operating on the market. These speculators will assume the spot risk from the farmer and provide market liquidity, which will keep hedgers' execution costs (costs incurred by hedgers when executing an order in a non-liquid market) at a low level (Pennings and Kuiper et al. 1998). They are the ones who keep the market flowing. Therefore, to be successful a milk quota futures market will have to appeal to speculators as well.

The hedging ratio not only depends on the contract specification, which in its turn influences the basic risk as outlined in the previous section, but also on farmer attitudes towards futures trade. In Chapter 8 it has been shown that ease of use and performance of futures are important criteria in a farmer's decision for or against using the services of a futures market.

11.6 Conclusions and Further Research

Farmers face both a price risk and an execution cost risk with respect to their herd, because of the large price differentials of milk rights between regions and during different periods of time. A futures market would enable them to hedge against these risks. Rights futures have some features which make them different from those of traditional commodity futures and, at the same time, make them very suitable for futures trading. One such feature of rights futures is that, unlike traditional commodity futures, they have no residual risk at maturity. The underlying commodity is identical to the commodity in the cash market, which is seldom the case with traditional commodities. Nor is the place of delivery of importance since delivery takes place by book entry and hence will not adversely affect hedging effectiveness. If such a futures market were established, it would provide a price-risk management instrument for farmers with a great hedging effectiveness. If there is a positive correlation between rights (input) and milk (output) a "natural" hedge will appear in the system. As a result, the optimal strategy would be to hedge a smaller amount than one would were this correlation absent. Not only can futures serve as an interesting price-risk management instrument to reduce cash market risk, with the underlying commodity being a right, they also provide an opportunity for cross-hedging the performance of the industry.

To gain a further insight into the feasibility of such futures markets in the United Kingdom and The Netherlands, we have studied the effect hedging ratio and velocity will have on volume. A milk quota futures market seems viable when the hedging ratio approaches 1, which is not an unthinkable situation with respect to milk quotas, their hedging efficiency being relatively high. Furthermore, velocity would have to be bigger than 1, implying speculator presence. Hedging ratio is not just determined by the characteristics of the futures contract, it also shows that it is considerably influenced by the farmers' attitude towards futures markets as well. Further research must include an analysis of the willingness of farmers to use futures, in order to acquire a deeper understanding of the potential of a futures market for milk quota. Research in this area would be of considerable interest.

11.7 Acknowledgments

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CHAPTER 12

Environmental Rights on the Futures Markets: an Application to the Dutch Manure Market[1]

12.1 Abstract

A study was carried out to analyze futures markets for tradable rights after a cash market has been initiated. Furthermore, some indication was given as to the size of such a futures market to provide insight into its viability. Futures markets can play a role in solving environmental problems, by making the market for pollution rights (i.e. P_2O_5 rights) and agro rights (milk rights, sugar rights and P_2O_5 rights) more effective and transparent. Moreover, the market for tradable rights would be able to meet the users' need for hedging. This chapter investigates the possibility of introducing a futures markets of tradable P_2O_5 rights and the commodity manure. Because there already is a cash market for manure, although not well developed yet, and there will be a cash market for P_2O_5 rights, a futures market would be a logical sequel. The futures market can play a role in implementing agricultural policy efficiently and, with respect to manure and P_2O_5 rights, can be an economically efficient solution to environmental problems.

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12.2 Introduction

The market for transferable rights, such as SO_2 permits, is expanding. In the Netherlands, for example, problems with P_2O_5 emissions on account of intensive livestock production are tackled by the emission of P_2O_5 rights. In the U.S., a first start in developing a spot and futures market for permits (rights) was made by initiating the Acid Rain Program. The overall goal of the Acid Rain Program (ARP, established by Title IV of the Clean Air Act Amendments of 1990) was to obtain significant environmental benefits through reductions in emissions of sulfur dioxide and nitrogen oxides, which are the primary components causes of acid rain. To achieve this goal at the lowest possible cost to society, the program employs market-based approaches for controlling air pollution. In addition, it encourages energy efficiency and pollution prevention. The Program introduced a permit (not a property right) trading system that harnesses the incentives of the free market to reduce pollution (EPA 1993; Tietenberg 1989; Sandor 1991; Walsh 1992).

Despite the fact that the U.S. has taken the first steps in developing a spot market and a futures market, a centralized spot market for rights (i.e. milk rights) has run in Ontario since 1980, followed by Quebec in 1985. Since 1984 there has been a decentralized spot market for rights (i.e. milk rights) in the Netherlands and the United-Kingdom.

The possessor of (environmental) rights is bearing risks. Price fluctuations cause changing values of the right. Futures markets are a tool to deal with these price risks and hence will result in more efficient decisions. In this chapter, the possibilities and limitations of futures markets for environmental rights are discussed and an application to Dutch phosphorus rights, issued by the Dutch government, is presented.

In Section 12.3 some government policy options for abatement are discussed, which show that the introduction of a rights system is an efficient way for handling pollution problems. Sections 12.4 and 12.5 deal with the cash market for rights and the risk involved for users in general and for the Dutch P_2O_5 rights in particular. In Section 12.6 some models for futures markets for environmental rights are presented and applied to the Dutch P_2O_5 market. The viability of this futures market is discussed in Sections 12.7 and 12.8. This chapter ends with an conclusion.

12.3 Policy Options for Abatement in the Presence of Rights

In practice, many conditions of the model of perfect competition have not been satisfied. One broad class of violations are those occurring when an agent making a decision does not bear all the economic consequences of his or her action, the so-called externality. An externality is caused by the fact that the property rights structure is not exclusive. Externalities cause the market price to diverge from social costs and benefits. In general this brings about an inefficient allocation of resources and enhances government intervention in the market. The government has different tools to internalize externalities such as regulation, levies and the introduction of environmental rights (Bresser 1988; Huppes 1992).

Currently, a much suggested tool for internalizing externalities is the introduction of rights (cfr. Chapter 10). In the case of pollution rights we can make a distinction between a geographic transfer and a temporal transfer. A geographic transfer means a transfer of the right to another location. A temporal transfer means that the right can be used not only during the maturity but also during another time. In other words the right can be banked. As to a temporal transfer we can distinguish a permanent transfer or a temporary (lease) transfer (Peeters 1992; Tietenberg 1992).

Trading systems of rights can be characterized in terms of a number of important attributes, including scope of coverage, degree of government intervention, the technical basis for the trading, and its geographic limits (see Chapter 10). The geographic area in which trades are permitted is largely determined by the type of pollutant. If the pollutant spreads widely and has adverse effects even if the concentration is low, the geographic area is likely to be large. In other cases many pollutants have adverse effects primarily on a small local or regional area. An example is the manure problem in the Netherlands (Hahn 1984; Oskam 1991), which we will further investigate in this chapter.

Usually, when the efficiency of a system of tradable rights is involved, costs of the emission reduction are minimised under the constraint of minimum required reduction in the emission (Tietenberg 1985). However, in this case, the system of tradable manure rights is considered efficient if it ensures maximum profit w of a region's livestock farming sector as a whole and for each individual farm under the given constraint of a maximum allowed amount of manure M in the region.[2] Manure is in this context embedded to minerals.

It is assumed that there are n farms in the region considered. Total costs c_i of farm i including the cost of manure transportation

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[2] Of course, the amount of manure can be measured in several ways, for example in weights units P_2O_5, in M^3 sludge or otherwise.

and the costs of levies, excluding the costs to be paid for the manure right consisting of the price p_m times the right m_i, are assumed to be a rising function of production q_i, while the production manure ratio μ_i is assumed to be fixed for each farm *i*.[3] So:

$$c_i = c_i(q_i) \quad \frac{dc_i}{dq_i} > 0 \tag{1}$$

$$q_i = \mu_i m_i \tag{2}$$

From this it follows:

$$c_i = c_i(\mu_i m_i) = \mu_i c_i(m_i), \quad \frac{dc_i}{dm_i} > 0 \tag{3}$$

With a fixed price *p* of the final product and p_m for the price of the manure right m_i, total revenue r_i and profit w_i of farm *i* equal respectively:

$$r_i = pq_i = p\mu_i m_i \tag{4}$$

$$w_i = r_i - c_i = p\mu_i m_i - \mu_i c_i(m_i) - p_m m_i \tag{5}$$

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[3] A manure right is the right to produce a certain amount of manure during one period, and can be divided into standard contracts of specific amounts of manure.

It is assumed that farms strive for profit maximization. From the last equation it follows that farm *i's* profit is maximized if:

$$\frac{dw_i}{dm_i} = \mu_i \cdot p - \mu_i \cdot \frac{dc_i}{dm_i} - p_m = 0 \quad \text{or:} \quad \mu_i(p - \frac{dc_i}{dm_i}) = p_m.$$

The profit maximization problem for the sector as a whole may be formulated as follows:

$$\max W = \sum_{i=1}^{n} w_i = p\sum_{i=1}^{n} \mu_i m_i - \sum_{i=1}^{n} \mu_i c_i(m_i) - p_m \sum_{i=1}^{n} m_i \tag{6}$$

subject to $\sum_{i=1}^{n} m_i \leq M.$

Because it is assumed that the constraint of the allowed maximum amount of manure is restrictive, the "lesser than or equal to" sign can be replaced by an "equal" sign, hence we can apply the Lagrange procedure.[4] Thus:

$$\max L = p\sum_{i=1}^{n} \mu_i m_i - \sum_{i=1}^{n} \mu_i c_i(m_i) - p_m \sum_{i=1}^{n} m_i - \lambda(\sum_{i=1}^{n} m_i - M) \tag{7}$$

[4] If the "lesser than or equal to" sign should be maintained, the Kuhn Tucker conditions apply.

subject to: $\sum_{i=1}^{n} m_i = M.$

The first order conditions for a maximum are:

$$\frac{\partial L}{\partial m_i} = p\mu_i - \mu_i \frac{\mathrm{d}c_i}{\mathrm{d}m_i} - p_m - \lambda = 0 \quad (1 \leq i \leq n)$$

It follows, that in the maximum:

$$\begin{aligned} p_m &= \mu_1(p - \frac{\mathrm{d}c_1}{\mathrm{d}m_1}) = \mu_2(p - \frac{\mathrm{d}c_2}{\mathrm{d}m_2}) = \mu_3(p - \frac{\mathrm{d}c_3}{\mathrm{d}m_3}) = \\ &= \ldots = \mu_i(p - \frac{\mathrm{d}c_i}{\mathrm{d}m_i}) = \ldots = \mu_n(p - \frac{\mathrm{d}c_n}{\mathrm{d}m_n}) \end{aligned} \tag{8}$$

This means that, in equilibrium, the marginal revenue of the manure right equals marginal costs for all farms in the region. This result implies that, under the given constraint of the maximum amount of manure M and given price p, profits are maximised when all rights are sold at the equilibrium price p_m.

The equilibrium price may be found by way of an auction.[5] The auctioneer announces a price and considers how many permits are sold at this specific price. He continues doing so in a systematic way till he has reached a price at which all permits have virtually been sold. In this way, the equilibrium price is set and every farmer can buy the manure rights he wants at the equilibrium price. Of

[5] There may be different systems of selling the manure contracts. For example, it may be decided that each farmer has a certain amount of manure rights for free depending on the amount of land he owns in the region. Then only those manure rights that are not exploited by the owners (e.g. arable farmer) can be bought and sold at the auction.

course, this can only work properly with perfect competition at the demand side of the market.

A system that is based only on administrative regulations might not be as efficient, because, in practice, it is impossible to estimate the marginal productivity function of each farm. Besides, marginal productivity functions tend to change over time. The conclusion is that a system of tradeable manure rights may be more efficient than a system that consists only of administrative regulations.

Once the firm understands how the rights market functions and knows the price per right, it can start to formulate and evaluate alternative courses of action. The various actions to choose from (inexhaustive list):

- Purchase the necessary right each year for a specific period
- Purchase in year x all the necessary rights to cover the period of operation
- Install control equipment in year x
- Purchase the necessary rights in year x; install reduction methods, for example increase μ in our presented model by using different feed concentrate, at a future date and sell the rights previously purchased.
- Continue emissions without purchasing any rights and be penalized for violations

In practice it is impossible to estimate the future price per right, which causes uncertainty and as a consequence inefficient decisions. The futures market offers a tool to solve the above-mentioned problem. By making use of the futures markets of rights the firm can lock in the price and will be able to hedge against (adverse) price fluctuations. The futures market of rights is an economically efficient tool in planning ahead for users of rights.

12.4 Cash Markets of Rights: the Dutch P_2O_5 Rights Market

The cash market for rights shows some characteristic features. The amount of environmental rights is generally predetermined by the government. This implies that the total (aggregate) supply of rights is fixed, although some fine tuning regulations with respect to the trade of rights are possible. For example, trade may only be allowed in particular areas or a fixed percentage of reduction in the amount of rights may take place when trade occurs (which is the case on the Dutch cash market of P_2O_5 rights). The demand for rights is a demand derived from the means of production. The demand for rights will be an outcome of many factors like final product price, interest rate, etc. A right is a perfect homogeneous 'commodity', which implicates that the right is a very fungible 'commodity' on the cash market.

In the Netherlands livestock production has been expanding enormously in the past twenty years. Consequently, there is an overproduction of manure from the environmental point of view. This overproduction causes problems of minerals in the soil like eutrophic, nitrate loading of groundwater and acidification. These environmental problems made it necessary for the Dutch government to introduce a manure policy. Since 1987, when the Dutch government introduced a manure production right, the Duth government has had legislation on manure. By this policy instrument it tries to solve the problem. Another related instrument is the manure accountancy. Every producer of manure has to record how many minerals enter the production unit and how many are removed from the production unit. In this way every mineral can be traced (Baltussen 1992, 1993; Nentjes 1990).

In the 'Manure' Act it is arranged that a farm is principally not allowed to produce more manure than an equivalent of

125 kilograms of phosphorus per hectare of land. This land has to be the property of a farmer or in use on a tenancy basis. Farmers who recorded their livestock on 31 December 1986 have been allocated P_2O_5rights by the government. The amount may either exceed or remain within the 125 kilogram phosphorus limit.

If a farmer was granted an average P_2O_5 rights of more than 125 kilograms per hectare in 1986, he will be allowed to produce phosphorus up to his P_2O_5 rights. The phosphorus surplus, i.e. the amount of phosphorus exceeding the legal limits (this amount depends on which crop is grown on the land), will have to be removed from the farm. The farmer has to pay a levy because he produces more than 125 kilograms of phosphorus per hectare. Moreover he ought to have a manure record system. A farmer with a production of 125 kilograms of phosphorus per hectare or less does not have to pay a levy, doesn't need to have a manure record system and may increase his production up to 125 kilograms per hectare.

Since January 1994 it has been possible to buy P_2O_5 rights (the free transferable part of the rights, which was defined in the Act). Purchased rights will be added to existing P_2O_5 rights. A farmer who intends to produce more than 125 kilograms of phosphorus needs to buy P_2O_5 rights. If a farmer under the conditions of the new Act purchases more than 125 kilograms per hectare he must be able to remove the phosphorus surplus from his farm and prove that to the government.

A farmer with a phosphorus production of more than 125 kilograms per hectare who wants to increase his production has three possibilities under the new 'Removing Manure Production Act'.

1) To buy P_2O_5 rights; through this transaction his average production of phosphorus per hectare will exceed the 125 kilogram limit and he will have to pay a levy and bear the cost of removing the surplus phosphorus from his farm.

2) To buy land in order to produce manure up to 125 kilograms of phosphorus per hectare without paying a levy.

3) Combination of possibilities 1 and 2.

12.5 Risk Involved for Users of Rights (i.e. P_2O_5 rights)

When the spot market for P_2O_5 (phosphorus) rights is being established after the 'Removing Manure Production Act' has come into operation, there is a possibility for a futures market. With the creation of tradable rights, phosphorus rights markets involve price risk for the users (i.e. intensive livestock farmer). In order to comply with the new legislation, an intensive livestock farmer (a farmer who produces more than 125 kilograms of phosphorus per hectare) who wants to increase his production may either purchase phosphorus rights or reduce phosphorus production. Phosphorus production methods can be distinguished in reduction of phosphorus output per animal or reduction of the livestock. Reduction of phosphorus per animal involves making use of feed with low concentrate of minerals and breeding animals with a better feed conversion. The intensive livestock farmer will make this decision on the basis of the net profit involved in the above-mentioned possibilities. A farmer with relatively low marginal abatement costs (i.e. reduction in phosphorus production) will invest in phosphorus reduction measures. If his measures to reduce the phosphorus production are successful, he may be able to sell some P_2O_5 rights. A farmer with relatively high marginal abatement costs but with a relatively high processing margin (exclusive abatement measures) may decide to purchase P_2O_5 rights. Because prices of P_2O_5 rights, manure, abatement, meat etc. fluctuate, he runs a price risk (adverse price fluctuations in the cash market) the so-called processing margin risk. The intensive livestock farmer may make use of three markets to manage a part of his processing margin risk, namely 1) the market of phosphorus rights, 2) the market of hogs and 3) the market of manure, where the market of manure is the market where the livestock farmer has to sell the surplus manure he produces on his farm.

Whether farmers are inclined to hedge rights depends on their risk attitude. We will illustrate this for a farmer who is risk averse, with a constant average risk attitude measure λ. We assume that this farmer is hedging only his rights by buying those rights in the futures market (i.e. long hedging). Furthermore it is assumed that production does not vary as a result of variation in weather conditions or unexpected diseases. The latter assumption seems reasonable for the production considered, pig raising and dairy farming. Following Robison and Barry (1987) we will demonstrate that the variance in price of rights in the spot market has a positive impact on hedging. It is assumed that the price of the right is the only factor of uncertainty in the profit maximisation problem. The objective of profit maximisation for a farmer, who is constantly absolutely risk averse with a constant average risk attitude measure λ, can be expressed as follows :

$$\Pi_{ce} = E(\pi) - \frac{\lambda}{2}\,\mathrm{var}(\pi) \qquad (9)$$

where Π_{ce} is the certainty equivalent, π is the profit and λ is the risk parameter which is positive, assuming the individual is risk adverse. If the only price uncertainty in determining the profit is the input price of the right, then the profit can be expressed as:

$$\pi = R - [(P + \varepsilon)(q - h) + P_f h] - C(q) - F \tag{10}$$

where R is the turnover (output times output price); $P + \varepsilon$ is the current spot price of the right with expected value P and variance σ_ε^2; q is the unhedged input of rights; h is the hedged input and P_f is the futures price of rights; it is assumed that there is no basis risk; $C(q)$ are variable costs and F are fixed costs.

The expected profit is:

$$E(\pi) = R - [P(q - h) + P_f h] - C(q) - F \tag{11}$$

Similarly, the variance of profits is:

$$\sigma_{(\pi)}^2 = (q - h)^2 \sigma_\varepsilon^2 \tag{12}$$

The certainty equivalent model can now be formulated as:

$$\pi_{ce} = E(\pi) - (\frac{\lambda}{2})\sigma_{(\pi)}^2 \tag{13}$$

where $\frac{\lambda}{2}$ is the trade-off at equilibrium between expected profit and variance of profit. By substituting (11) and (12) into (13), the objective function can be written in terms of the level of risk,

$$\max \pi_{ce} = R - [P(q - h) + P_f h] - C(q) - F - \frac{\lambda}{2}(q - h)^2 \sigma_\varepsilon^2 \tag{14}$$

To determine the optimal holdings of futures contracts, the objective function is differentiated with respect to h. After setting the first order condition equal to zero one obtains:

$$h = q - [\frac{-P + P_f}{\lambda \sigma_\varepsilon^2}] \tag{15}$$

This relationship indicates the condition required for a complete hedge. If the expected spot price P equals P_f, the total cash position will be hedged because a risk aversive farmer will always exchange an uncertain price for a certain one if the latter equals the expected value of the uncertain one. But the expected spot price P and the futures P_f price may not be equal. Very important to note is the fact that the expected spot price P of the right and the futures price of the right P_f are costs in respect to the objective function (i.e. are negative prices). Risk-averse firms will exchange a certain input price P_f for the uncertain spot input price of the right, i.e excluding input price risk, despite the fact that the certain input price of the right exceeds the uncertain spot input price. The more risk-averse the farmer and/or the more price fluctuations in the spot market of the right, the greater the level of hedging for a constant positive difference between P_f and P. Only when P, the expected spot input price of the right, exceeds the certain future price, will the risk-averse firm speculate, because the expected value of the difference between buying and subsequently selling (i.e long liftings value) is positive.

Differentiating h in Equation (15) with respect to σ_ε^2 yields the farmer's level of hedging response to an increase in the variance of the expected spot input price of the right,

$$\frac{\partial h}{\partial \sigma_\varepsilon^2} = \frac{(-P + P_f)}{(\lambda \sigma_\varepsilon^2)^2} \tag{16}$$

The response to an increase in the variance of the spot input price of the right is unambiguously positive as long as $P_f > P$.

12.6 A Proposal for Implementation of P_2O_5 Futures Contracts

The contract specification for manure futures is more difficult than for P_2O_5 rights futures since a manure futures is a legally binding agreement to make or accept delivery of a standardized quantity and quality of manure at a standardized time and place for a price agreed upon today, while manure is not a homogeneous product. First, four kinds of manure are distinguished: from hogs, cows, calves and poultry. Second, the manure can be distinguished by their contents of phosphorus and other minerals. Probably the best solution in this complex matter is to specify two manure contracts: hogs manure futures and poultry manure futures. The manure surplus problem in the Netherlands is mainly caused by hogs and poultry farming. It is expected that those kinds of manure will generate the most trade. The two contracts should also specify the phosphorus and moist contents.

Although manure from farms will seldom be exactly the same as specified in the two futures contracts, hedging is possible by cross-hedging. In Table 1 the special features of the proposed futures contracts are summarized.

Table 1 *Special features of P_2O_5 future contract and Hogs/Poultry futures contract*

	P_2O_5 Futures contracts	Hogs/Poultry manure futures
Unit of trading	the contract unit shall specify the right to produce a certain number of kg phosphorus	the contract unit shall specify a certain number of kg of hogs/poultry manure with specified moist and phosphorus content
Standards	phosphorus rights are those issued by the Dutch government and administered by 'Bureau Heffingen'. Deliverable phosphorus rights must be applicable to phosphorus production in the same year of the month of delivery	the contract is specified as to origin, delivery place and time, contents of moist and phosphorus
Months and years traded in	every month of every year	every month of every year
Price basis	all prices of phosphorus rights futures shall be multiples of one NLG per contract	all prices of hogs/poultry manure futures shall be multiples of one NLG per contract
Delivery	Delivery shall be made by book entry transfer between accounts in the book entry system of the government by cash settlement	delivery shall be made in cooperation with and by the rules of the clearing house or by cash settlement

12.7 Participants and Hedging Systems

Participants (hedgers and speculators) involved in the already existing hogs futures market could be interested in the P_2O_5 rights and manure futures. Other possible participants in the trading of manure futures are the manure processing industries. They could use the futures market to hedge against adverse price fluctuations of manure. By making use of the futures market they can plan ahead and so be able to use their capacity optimally. The government may be a participant in the rights futures as well. Through the futures market, the government is able to plan ahead and when starting programs it can hedge against adverse program costs. Environmental organizations can buy futures contracts on the futures market, thus achieving their goals in the same way as happened on the SO_2 rights market in the USA. In the Netherlands participation of farmers on the futures market is not as common as it is in the United States. In the case of the intensive livestock farmers it will be the (cooperative) meat processing industries and the (cooperative) mixed feed industries that will participate. In the Netherlands, the feed concentrate industries and meat processing industries have already worked closely together in the production chain to establish high quality meat (for example, Dumeco).

If the intensive livestock farmer purchases the P_2O_5 futures, he is obligated to remove the manure surplus, which means that he needs to hedge himself against adverse cost price fluctuations with the help of manure futures. In this way he can use both futures markets to hedge against adverse price fluctuation of both commodities. The intensive livestock farmer may also use the already existing hogs futures markets for his output to hedge against adverse price fluctuations.

The intensive livestock farmer can make a futures contract combination of the above-mentioned possibilities, buying the P_2O_5 rights futures and selling the hogs and manure futures. The farmer can use this hedge to protect his processing margin against adverse price fluctuations. This so called spread (the simultaneous purchase of one futures contract and the sale of a different futures contract) can be considered analogous to the soybean crush at the Chicago Board of Trade and could be called "the Meat Product Spread" (MPS). After making use of the MPS, the only factor of uncertainty in the processing margin is the feed price. Nevertheless, the farmer can also buy a futures contract such as corn on the futures markets of feed components.

Often a co-ordinated marketing operation through the marketing channel is needed in order to achieve competitive advantages over rivals. Chain marketing, established by the agribusiness industries, can be extended by their offering the intensive livestock farmer an MPS package. By introducing an MPS package, chain marketing can be strengthened. The farmer can establish a known processing margin without having to worry about the knowledge involved in futures trading (Table 2).

***Table 2** Meat product spread model*

Mixed feed industries (MFI)	Goes long in the feed concentrate components. For example corn and soybean meal at the CBOT.
Intensive livestock farmer	Makes use of MPS package
	MPS: long in P_2O_5 futures contract
	short in hogs manure futures contract [6]
	short in hogs futures contract
Meat processing industries (MPI)	Goes long in hogs future contract.

The MPS can be executed by trading each futures contract seperately or by trading the spread as a combined futures contract. If the spread is traded as one futures contract then in fact the processing margin from hogs is being traded. An MPS contract specification is a combination of the three contracts involved.

12.8 Viability of Futures Markets of Rights

Yet the cash market of rights has not been well-structured and developed. This primitive structure of the cash market will have an impact on the futures markets for rights. The purpose of futures markets is to provide hedging possibilities for participants, since actual delivery seldom occurs in a liquid futures market. On average, only 3% of the trade that is conducted is actually

[6] The value of manure is negative, so the price will be negative. To avoid a negative price quotation in the futures market we can define a dual manure futures contract. This contract could be defined as the service to remove a certain number of kilograms of manure with specified moist and phosphorus contents.

delivered. In the case of a futures market for rights, actual delivery will be higher in the early days of such a market, because the cash market will not be that liquid yet. Hedgers who do not succeed in making a deal on the cash market will not offset their futures markets position. As mentioned in section 11.4, this higher frequency of delivery will not pose a problem in the case of a rights futures market because of the homogeneity of rights.

In this section the viability of a futures market for manure futures contracts and P_2O_5 rights is evaluated by using data on the cash market in manure, contract success criteria and data on existing futures markets. The following assumptions were made:

(1) a manure futures contract is defined as 125 kilogram P_2O_5 embedded in hogs respectively poultry manure. The 125 kilogram P_2O_5 criterion was chosen because of the 125 kilograms of P_2O_5 per hectare criterion of the Dutch manure legislation.

(2) 90% of the amount of phosphorus that was processed and traded in 1991 was hedged on the futures market. This figure was expected to fluctuate because farmers, agri-distributors and processors can make contracts with each other on the cash market which would have their impact on this figure.

(3) the turnover on the futures market was two and a half. The argumentation with respect to the turnover was the following: a contract may be traded on the spot market between farmers A and C, the turnover of one contract being one. A contract may also be traded between farmer A and middleman B and between middleman B and farmer C, the turnover of one contract being two times. On the futures market speculators can trade with a farmer, a scalper or another speculator (in reality the clearing house will take the opposite position in those transactions). The above-mentioned ways of reaching a certain level of turnover makes an average turnover of two and a half acceptable.

In 1991, the supply of phosphorus was 88 million kilograms; 3 million kilograms P_2O_5 of which were processed, 3 million kilograms were exported and the rest distributed to phosphorus shortage areas within the Netherlands. From the distributed part of the manure 14 million kilograms were traded (Source: National Manure Office 1993). In total, 17 million kilograms were traded consisting of 3 million kilograms from the processing industry and 14 million kilograms from distribution industries. The volume of this futures market would be 306,000 futures contracts per year (17 million kilogram times 90% divided by 125 times 2.5). This volume is more than three times the actual volume of the potato futures contract in Amsterdam and indicates a successful futures contract according to Silber, Sandor and the Wall Street Journal.

In 1992, the supply of manure was 16 million tons; 616 thousand tons of which were processed, 378 thousand tons exported and the rest distributed to shortage areas within the Netherlands. Of the distributed part of the manure, 2.8 million tons were traded. (Source: National Manure Office 1993). A futures contract on hog manure could be defined as 25 tons of hogs manure with 5 kilograms of P_2O_5 per ton. A futures contract on poultry could be defined as 25 tons of poultry manure with 15 kilograms of P_2O_5 per ton. The 25-ton criterion was chosen because that was the average manure capacity per truck. The phosphorus criterion was based on the P_2O_5 content in manure of hogs, respectively poultry. The price risk involved on the manure cash market could be hedged on the hogs and/or poultry manure futures market. If 90% of the cash market was hedged and the turnover was two and half, the volume would be 252,000 contracts per year. Again the percentage of 90% is disputable. If the manure processing industries and the producers of manure make spot market contracts in advance, this percentage of 90% will be lower.

The statistics on manure traded are not complete yet for the Netherlands. What we do know is the amount of manure removed from intensive livestock farms to farms with a shortage. This manure shift is recorded by the so-called delivery proofs. The participants in the manure trade will likely want to hedge against adverse price fluctuations. In Table 3 an estimation is presented for this hypothetical futures market, where a contract is specified as 25 tons of manure (hogs or poultry).

***Table 3** Estimated volume (number) of manure futures contracts (not specified as to type of manure)*

	Amount of manure traded with delivery proofs in tons*	Corresponding contracts (90% of column 2 divided by 25)	Turnover	Volume of trade at hypothetical futures market
1990	2792000	100512	2.5	251280
1991	3241000	116676	2.5	291690

* *Source: LEI-DLO, own calculation, 1993*

The volume of contracts traded on the hypothetical futures market is high compared with the existing futures market in hogs and potatoes in Amsterdam. Important in the calculations made above is the supposition that on the cash market for manure, there is a cash market between every participant in the marketing channel of manure. Integration of manure producers with agri-distributors and processors could reduce the turnover.

***Table 4** Manure production in millions of tons and the equivalent in P_2O_5 in millions of kilograms of phosphorus*

	Production		Surplus	
	manure	P_2O_5	manure	P_2O_5
1994	83.3	223	17.2	84.3
1995	75.4	196	17.3	74.1
2000	64 - 71	172 - 184	22 - 26	86 - 93

Source: National Manure Office, 1993

Table 4 shows an estimate of the future Dutch manure problem. The manure surplus will be traded on the cash manure market. If there is a high price variability on that cash market, a futures market will be a logical consequence so that participants can hedge against adverse price fluctuations. The amount of surplus manure indicated in the above-mentioned contract specifications is huge.

***Table 5** Proposed solution for the Dutch manure surplus in millions of kilograms of phosphorus*

	1995	2000
Distribution	59	32
Process/export	12	54

Source: TNO-Arcadis and National Manure Office

If it is assumed that 90% of the manure to be distributed is hedged by the participants on the manure futures market and the turnover is two and a half, the volume of futures contracts will be one million in 1995 and 576,000 contracts in 2000, provided that one contract consists of 125 kilograms of phosphorus. Important to note, however, is that this number is partly influenced by the magnitude of the contract. In the calculation the 125-kilogram P_2O_5 criterion was used because of the 125 kilograms of P_2O_5 per hectare criterion of Dutch manure legislation. This criterion is disputable. Another and perhaps better criterion would be the value of the underlying commodity. The value of the manure futures contract must not be too high because that would have a negative impact on the attractiveness of the contract. On the other hand, the value of the underlying commodity (i.e. manure) must not be too low relative to the transaction costs involved in trading on the futures market. The 125-kilogram criterion might give the contract too low a contract value. Nevertheless, Tables 3 and 4 show that the manure surplus in the Netherlands is of such volume that a futures market will be successful according to the volume traded (under the assumptions made).

12.9 Conclusions

Introducing environmental rights is an economically efficient tool for implementing environmental policy. The users (i.e. polluters) of rights have to put up with adverse price fluctuations of the right, which cause different valuation of the right. This uncertainty of price estimate for the futures on rights causes problems for firms in making optimally efficient economic decisions. Futures markets for rights would be a perfect tool to solve the above-mentioned problem. With the help of such a market, users of rights can lock in the right price for the futures contract. A futures market for those rights is not available yet. An important barrier for developing such a futures market is the legislation involved with rights. Cooperation with the government in initiating a right, spot and futures market is required.

CHAPTER 13

Complex Spread Hedging where Production is Restricted by Rights[1]

13.1 Abstract

The specific characteristics of rights make them extremely suitable for futures trading in a commodity product spread context. The usefulness of production rights futures in the case of commodity product spread hedging is analyzed for the dairy industry where production is restricted by milk quota.

13.2 Introduction

Futures markets for tradable environmental and production rights[2] can help make the market for rights more effective and transparent. Moreover, a futures market for tradable rights would be able to meet the users' need for hedging.[3] In the USA, the Chicago Board of Trade (CBOT) and the Environmental Protection Agency (EPA) are trying to establish a futures market for SO_2 rights (Sandor 1991; Walsh 1993). Rights that lend themselves to trading on a futures market are also found in agriculture, examples being

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[1] This chapter is based on: Pennings, J.M.E. and M.T.G. Meulenberg (1996), "Complex Spread Hedging where Production is restricted by Rights" Working Paper, Wageningen Agricultural University, Department of Marketing and Marketing Research.

[2] Note that the words rights on one hand and environmental rights and production rights on the other hand are used interchangeably.

[3] The scope of this chapter does not include the question of how futures can be used as hedging vehicles because there is already an extensive literature on this subject. See, for example, Stoll and Whaley, 1993 and Pennings and Meulenberg, 1997b.

the water rights and phosphorus rights in the US and the milk rights (milk quotas) in Canada and the European Union (Pennings, Heijman and Meulenberg 1997).

In this chapter an attempt is made to determine the optimal hedging amount of output and input when production is restricted by environmental rights or production rights. It is assumed that the farmer can hedge both the volume of production and rights. First we analyze the general case of a farmer who hedges main products, inputs and by-products. This is done by maximizing the farmer's certainty equivalent. Having determined the optimal hedging amounts and hedging ratios in general terms, the model is extended by including rights futures contracts. The characteristic features of rights futures are discussed in the context of commodity product spread hedging. We then go on by applying the model to dairy complex spread hedging including milk quotas. Finally, the results and main conclusion are summarized.

13.3 Model

We begin by introducing a model of a farmer's hedging decision in the case of a commodity product spread.[4] Consider a farmer who can lock in the price risks with the help of three futures markets. This so-called commodity product spread - analogous to the Soy Bean Crush at the CBOT - enables a farmer to manage part of his or her processing margin risk. Given that the farmer wishes to maximize the expected processing margin in the next time period adjusted for risk, where risk is measured by the variance of the

[4] A commodity product spread refers to the simultaneous purchase and sale of two or more different futures contracts in order to hedge the farmer's production margin or profit.

processing margin, the objective function can be expressed on the basis of the expected value-variance (EV) model (Kahl 1983; Robison and Barry 1987). We have adopted the EV approach because we want to determine the relationship between the variables and to show the direction of change in relevant variables.[5]

$$\Pi_{ce} = E(\Pi) - \lambda \operatorname{var}(\Pi) \tag{1}$$

where $E(\Pi)$ is the expected processing margin and $\operatorname{var}(\Pi)$ represents the variance of the processing margin. The risk parameter λ for risk-averse decision makers is positive, thus providing compensation for risk bearing (Pratt 1964). At time t the farmer wishes to maximize the certainty equivalent for the next period $t+1$. Given that the cash positions are predetermined for the main product, by-product and input, the expected processing margin at time $t+1$ equals the revenue from selling the main product and by-product in the cash market and futures market minus the cost of buying the input in the cash markets and futures markets corrected by the transaction costs and the basis, where the basis is defined as the local cash price minus futures price. A farmer who uses the futures market to manage price risk is aware of the basis and will take account of it (Lapan and Moschini 1994). The expected processing margin can now be written as:

$$\begin{aligned} E_t\Pi_{t+1} = \sum_{k=1}^{3} [\alpha_k(PFk_t - E_tCVk_{t+1}) + \beta_k E_tCVk_{t+1} \\ - \alpha_k TCk + \alpha_k E_t Basis_{k,t+1}] \end{aligned} \tag{2}$$

[5] For the conditions that justify the use of the EV model and the discussion on the use of the EV model and the general expected utility model, the reader is referred to Bigelow (1993), Meyer and Rasche (1992), Robison and Hanson (1997) and Tew et al. (1991).

where $E_t\Pi_{t+1}$ is the expectation formed at time t of the processing margin at time $t+1$, E_tCVK_{t+1} is the expectation formed at time t of the cash price of commodity k at time $t+1$ (a positive sign denotes an output price and a negative sign denotes an input price); α_k is the amount of commodity k corresponding to futures contracts where $k = 1$ is the main product; $k = 2$ is the by-product and $k = 3$ is the input ($k = 1$, $k = 2$ corresponds to a short position and $k = 3$ corresponds to a long position, and the optimal hedging amount is denoted by α_k^o), PFk_t is the futures price at which the contract is opened (a positive sign denotes an output price and a negative sign denotes an input price); β_k is the amount of cash market position of commodity k; TCk is the transaction costs per futures contract k (transaction costs include brokerage costs and interest costs of margin requirements) and $E_tBasis_{k,t+1}$ is the expectation formed at time t of the basis of commodity k at time $t+1$.

For reasons of convenience, in the rest of this chapter E_tCVK_{t+1} and $E_tBasis_{k,t+1}$ are denoted as CVK_{t+1} and $Basis_k$ respectively.

In the case of a full hedge, the cash position equals the futures position ($\alpha_k = \beta_k$). If the futures position is larger than the cash position ($\alpha_k > \beta_k$), then there is speculation. Finally, if the futures position is smaller than the cash position ($\alpha_k < \beta_k$) then there is a partial hedge of the cash position.

Let σ^2_{CVk} and $\sigma^2_{Basis_k}$ be the variance of the cash price of commodity k and the variance of the basis of commodity k respectively. Also let R be the term which combines the covariances. The variance of the processing margin is now given by:

$$\text{var}(\Pi) = \sum_{k=1}^{3} [(\beta_k - \alpha_k)^2 \sigma_{CVk}^2 + \alpha_k^2 \sigma_{Basis_k}^2] + R \qquad (3)$$

where CVk_{t+1} has a constant variance conditional on the information available at time t given by: $\sigma_{CVk}^2 = E(CVk_{t+1} - E_t(CVk_{t+1}))^2$ and $\sigma_{Basis_k}^2$ has a constant variance conditional on the information available at time t given by: $\sigma_{Basis_k}^2 = E(Basis_{k,t+1} - E_t(Basis_{k,t+1}))^2$. See the Appendix for more details on the variance and on the content of R.

The optimal hedging amounts of the main product (α_1^o), by-product (α_2^o) and input (α_3^o) are derived by taking the first derivatives from Π_{ce} with respect to α_k. Hence, the optimal hedging amounts can be expressed as:

$$\alpha_1^o = OP_{\alpha_1}(\beta_1 - \frac{(CV1_{t+1} - PF1_t + TC1 - Basis_1)}{2\lambda\sigma_{CV1}^2} - \frac{(\beta_1\sigma_{12} + \alpha_2^o R1 + \beta_2 R2 + \beta_3 R3 + \alpha_3^o R4)}{\sigma_{CV1}^2}) \qquad (4)$$

$$\alpha_2^o = OP_{\alpha_2}(\beta_2 - \frac{(CV2_{t+1} - PF2_t + TC2 - Basis_2)}{2\lambda\sigma_{CV2}^2} - \frac{(\beta_2\sigma_{34} + \alpha_1^o R1 + \beta_1 R5 + \beta_3 R6 + \alpha_3^o R7)}{\sigma_{CV2}^2}) \qquad (5)$$

$$\alpha_3^o = OP_{\alpha_3}(\beta_3 - \frac{(CV3_{t+1} - PF3_t + TC3 - Basis_3)}{2\lambda\sigma^2_{CV3}} - \frac{(\beta_3\sigma_{56} + \alpha_1^o R4 + \beta_2 R8 + \beta_1 R9 + \alpha_2^o R7)}{\sigma^2_{CV3}}) \tag{6}$$

where $R1 \ldots R9$ are the covariances between the futures price, cash price and basis of the corresponding commodities (see the Appendix Equation A1); σ_{12} is the covariance between the cash price of the main product and the basis of the main product; σ_{34} is the covariance between the cash price of the by-product and the basis of the by-product; σ_{56} is the covariance between the cash price of the input and the basis of the input and OP_{α_k} is a multiplier which can be expressed as:

$$\frac{1}{1 + \frac{\sigma^2_{Basis_k}}{\sigma^2_{CVk}} - \frac{2\rho_{(B_k,C_k)}\sqrt{\sigma^2_{Basis_k}}}{\sqrt{\sigma^2_{CVk}}}} \tag{7}$$

where $\rho_{(B_k,C_k)}$ is the correlation between the basis and the futures price.

OP_{α_k} can be interpreted as a proxy for hedging effectiveness (Pennings and Meulenberg 1997a). If there is no basis risk, OP_{α_k} will be 1 (in this case $\sigma^2_{Basis_k} = \rho_{(B_k,C_k)} = 0$) and will indicate that the futures contract performance is perfect with respect to basis risk. If the basis risk tends to infinity the value of OP_{α_k} tends to be zero (in this case $\sigma^2_{Basis_k} \rightarrow \infty$ and $\rho_{(B_k,C_k)} = 0$) indicating that the risk reduction performance is minimal.

It is possible to express each of the α_k^o separately in terms of the exogenous variables and parameters (the system of Equations (4), (5) and (6) has an unique solution), but these expressions are so complex that they are worked out later, where some simplifications are made because of the specific characteristics of rights.

From Equations (4), (5), (6) and (7) it can be inferred that if prices in the three markets are not related i.e. $R1 \ldots R9$ are zero and if the variances of the cash price of the three products tend to infinity, the optimal hedging amounts will converge to the corresponding cash positions (i.e $\alpha_k = \beta_k$). Under this condition, the farmer will make a complete commodity product spread hedge.

Also it can be inferred from (4), (5) and (6) that if risk aversion λ increases, the hedging amount of the output and by-product will also increase, provided that $(CVk_{t+1} - PFk_t + TCk - Basis_k)$ for $k = 1, 2$ is positive. This condition will normally be met, because risk-averse farmers will exchange a certain revenue in the futures market for the uncertain cash price only if the expected spot price includes a risk premium. Note that risk aversion does not imply that individuals are unwilling to take risks but that individuals must be compensated for taking risks in the form of a premium over and above the return on a cast-iron investment.

If risk aversion increases, the hedging amount of the input will also increase if $(-CV3_{t+1} + PF3_t + TC3 - Basis_3)$ is positive, as is normally the case. Risk-averse farmers will wholly or partially exchange a certain input cost $(PF3_t + TC3 - Basis_3)$ for the uncertain input cost of the input, i.e. excluding input price risk, even though the input cost exceeds the expected input cost. It is important to note that the expected spot price of the input $CV3_{t+1}$ and the futures price of the input $PF3_t$ are considered to be costs in the objective function (2). Normally the markets we consider are related and the hedging amount is therefore affected by the covariance terms which represent the interaction of the futures.

The optimal hedging ratio $HR_k \equiv \frac{\alpha_k^o}{\beta_k}$ is an increasing function of the cash position under the condition that the farmer is risk-averse, i.e. $\lambda > 0$, and that there is no interaction between the futures in the spread, i.e. $R1 \ldots R9$ in Equations (4), (5) and (6) are zero. This property of the hedging ratio can easily be interpreted: if the cash position increases, the farmer's degree of risk will increase and in order to restore the optimal balance between risk and return the hedger must increase his or her hedging ratio. If, however, the futures in the spread are related, i.e. $R1 \ldots R9$ are not zero, then this property of the hedging ratio does not necessarily hold, since α_2^o and α_3^o will influence the optimal hedging ratio too. We will elaborate on this situation below in the case of rights.

13.4 Extension to Environmental Rights and Production Rights

The primary function of rights is to offer incentives for internalization of externalities, the environmental costs in the case of environmental rights and the financial burden to the tax payer in cases of agricultural price support (Coase 1960; Demsetz 1967; Parisi 1995).

Let us assume that the input in the commodity product spread is a production right, a permit from the government or public authority to perform actions which are prohibited by law unless approved by government or public authority.

We assume that the production right permits the production of a certain amount of the main product in a certain period. The cost of the right is the rental price of the right during a specific period and we assume that the right can be sold or leased. This situation corresponds with the current practice in European countries and Canada of leasing and buying milk quota in order to produce milk.

Unlike traditional commodity futures contracts, rights futures contracts have no residual risk at maturity. For a more detailed description the reader is referred to Chapter 11.

The absence of basis risk with rights futures has an impact on the hedging amount of rights and also on the hedging amount of the other commodities in the spread. The optimal hedging amount of rights increases, compared to the optimal hedging amount of an input that is not a right. In the case of traditional commodities the multiplier OP_{α_k} is smaller than 1 because, as shown by Castelino (1992), the correlation between the basis and the futures price i.e. $\rho_{(B_k,C_k)}$ is usually negative and as a result the multiplier has a decreasing influence on the optimal hedging amount. However, in the case of rights, the multiplier in (6) is 1 because there is no basis and hence has no decreasing influence upon the optimal hedging amount. This means that the farmer will hedge more input if the input considered is a right than when the input is not a right. This is caused by the special features of rights discussed in Chapters 10 and 11 and the conclusion will also hold in the case of a commodity spread.

13.5 Dairy Complex Spreading: the Case of Milk Quota in Canada and the European Union

In Canada and the European Union, milk production has expanded enormously, amongst others because of agricultural policies supporting product prices. Consequently there has been an overproduction of milk. The costs as a result of these price support policies became too high and made it necessary for national and supra-national governments to introduce a milk quota policy.[6] The trade in milk quota is large in Canada and in the member states of the EU. In the United Kingdom and the Netherlands the total quantities of milk quota transferred have grown continuously. In 1993/94 some 1.7 billion liters were traded (both lease and sales) in both countries. In the same period 1.6 million kilogram butterfat (unused market sharing quota sales) were traded in Canada on the Ontario exchange.

The prices on the Ontario exchange are very volatile. The coefficient of variation, based on month-end data for the period 1987/88-1993/94 was 0.27 for unused market sharing quota sales. This is almost equivalent to the potato market in the Netherlands (coefficient of variation of 0.28 for the same period) in which there is a long tradition of successful futures trading by farmers. Therefore, milk quota futures might be useful from a "risk perspective". Also, Gunjal and Legault (1995) found that the majority of dairy farmers in Quebec are risk averse. A dairy farmer could manage his or her processing margin risk by trading on three futures markets: selling milk futures (main product), selling livestock futures (by-product) and buying milk quota futures

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[6] Various details of Canada's dairy policy and EU's dairy policy can be found in Ewasechko and Horbulyk (1995), Burell (1989) and Oskam (1989).

(input), if such futures markets did exist.[7] Suppose that cash market prices of milk and livestock are not correlated, that the prices of milk quota and milk are very strongly positively correlated and that the price of milk quota is not correlated with the price of livestock, then in model $\rho_{(CV1,CV2)} = 0, \rho_{(CV1,CV3)} \approx 1$ and $\rho_{(CV2,CV3)} = 0$, where ρ is the correlation coefficient.

To some extent this case describes the current situation in Canada and the European Union. In these countries the cash market for livestock is weakly related to the cash markets for milk and milk quota. The cash price of milk quota is determined to a large extent by the price of milk. This relationship is positive: if the milk price increases the farmer is willing to pay more for the milk quota if there is a shortage of milk quota (from the farmer's point of view). The latter is actually the case in Canada and the EU. For reasons of convenience we assume that the milk and milk quota prices are exactly correlated.

The covariance terms in our model will be affected by these assumptions. Many covariances will be zero because the livestock market is not related to the other two markets and because of the characteristics of rights as outlined earlier in Chapters 10 and 11. The optimal hedging amounts can now be expressed as:

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[7] In October 1995, the US commodity futures trading commission approved Grade A milk futures for both New York's Coffee, Sugar and Cocoa Exchange (CSCE) and the Chicago Mercantile exchange (CME). The CSCE began trading its contract on December 12th, 1995, the CME on January 11th, 1996. In combination with the CSCE Cheddar cheese and non-fat dairy milk contracts that have been traded since June 1993, the milk contracts offer comprehensive trading opportunities in the dairy complex. The Amsterdam Agricultural Futures Exchange is currently investigating the possibility of a milk quota futures contract in the Netherlands.

$$\alpha_1^o = OP_{\alpha_1}(\beta_1 - \frac{(CV1_{t+1} - PF1_t + TC1 - Basis_1)}{2\lambda\sigma^2_{CV1_{t+1}}} - \frac{(\beta_1\sigma_{12} + \beta_3 R3 + \alpha_3^o\sigma_{15})}{\sigma^2_{CV1_{t+1}}}) \tag{8}$$

$$\alpha_2^o = OP_{\alpha_2}(\beta_2 - \frac{(CV2_{t+1} - PF2_t + TC2 - Basis_2)}{2\lambda\sigma^2_{CV2_{t+1}}} - \frac{(\beta_2\sigma_{34})}{\sigma^2_{CV2_{t+1}}}) \tag{9}$$

$$\alpha_3^o = (\beta_3 - \frac{(-CV3_{t+1} + PF3_t + TC3)}{2\lambda\sigma^2_{CV3_{t+1}}} - \frac{(\alpha_1^o\sigma_{15} - \beta_1\sigma_{15})}{\sigma^2_{CV3_{t+1}}}) \tag{10}$$

where σ_{15} is the covariance between the cash price of the main product and the cash price of milk quota.

From Equation (8), (9) and (10) we see that α_3^o, the optimal hedging amount of milk quota, is related to α_1^o, the optimal hedging amount of milk. This is not surprising because we assumed that in the cash market these commodities are related. The optimal hedging amount of livestock is not related to the optimal hedging amount of milk quota and milk. Also it can be inferred from (8), (9) and (10) that if the variance of the cash market prices of the commodities (including rights) in the spread reaches infinity, all optimal hedging amounts, α_k^o, can be determined separately and $\alpha_k = \beta_k$. In practice the cash market prices in agricultural markets have a finite variance, amongst others because of policy instruments and market structure.

On the basis of (8), (9) and (10) some conclusions can be drawn about the influence of crucial variables for the hedging amount of milk quota: the milk quota cash position β_3, the cash position of milk β_1 and the farmer's risk aversion λ.

In order to measure these influences on α_3^o, the optimal hedging amount is expressed in the exogenous variables, by substituting (8) into (10)

$$\alpha_3^o = \Gamma(\beta_3 - \mathrm{H} - \frac{\sigma_{15}}{\sigma^2_{CV3_t+1}}(OP_{\alpha_1}(\beta_1 - \mathrm{K} - \Omega) - \beta_1)) \quad (11)$$

where Γ, H, K and Ω are combinations of characteristics of the respective cash and futures markets as specified in (8) and (10) (see Appendix for the content).

The influence of *the milk quota cash position* β_3 on α_3^o, the optimal hedging amount of milk quota, can be derived from Equation (11) by taking the first derivative of α_3^o to β_3.

$$\frac{\partial\alpha_3^o}{\partial\beta_3^o} = \Gamma(1 + \frac{\sigma_{15}(\sigma_{25} - \sigma_{15})OP_{\alpha_1}}{\sigma^2_{CV3_{t+1}}\sigma^2_{CV1_{t+1}}}) \quad (12)$$

On the basis of (12) it can be concluded that the milk quota cash position β_3 has a positive influence on the optimal hedging amount of milk quota i.e. $\frac{\partial\alpha_3^o}{\partial\beta_3^o} > 0$ if $OP_{\alpha_1} < \frac{1}{\sigma^2_{15}}$ and

$\sigma_{25} > -\dfrac{\sigma^2_{CV3_{t+1}}\sigma^2_{CV1_{t+1}}}{OP_{\alpha_1}\sigma_{15}} + \sigma_{15}$ where σ_{25} is the covariance between the basis of the milk and the cash price of the milk quota, which, in general, will be close to zero. In other words, if the hedging effectiveness of milk is low and the cash price variances of the milk quota and the milk are high then the cash position of milk quota will have a positive influence on the optimal hedging amount of milk quota.

The influence of *the cash position of milk* β_1 on α_3^o, the optimal hedging amount of milk quota, has been derived from (11):

$$\frac{\partial \alpha_3^o}{\partial \beta_1} = \Gamma[\frac{\sigma_{15}}{\sigma^2_{CV3_{t+1}}}(1 - OP_{\alpha_1} + \frac{\sigma_{12}OP_{\alpha_1}}{\sigma^2_{CV1_{t+1}}})] \tag{13}$$

It appears from (13) that the hedging effectiveness of the milk, expressed in OP_{α_1}, is an important factor for the influence of β_1, the cash position of the milk, on α_3^o, the optimal hedging amount of milk quota. If OP_{α_1} is relatively small (not negative) compared to the variances, then the cash position of the milk has a positive influence on the optimal hedging amount of milk quota i.e. $\frac{\partial \alpha_3^o}{\partial \beta_1} > 0$. It follows that if the milk hedge becomes less effective and hence OP_{α_1} becomes smaller, then the hedger will increase his/her hedging amount of milk quota.

Equation (14) shows the influence of *risk aversion* λ on the optimal hedging amount of rights.

$$\frac{\partial \alpha_3^o}{\partial \lambda} = \Gamma(\beta_3 \text{H} - \frac{\sigma_{15}}{\sigma^2_{CV3_{t+1}}} (OP_{\alpha_1}\text{K})) \tag{14}$$

From Equation (14) it appears that risk aversion has a positive influence on the optimal hedging amount of milk quota under the condition that $\text{H} > \text{K}\sigma_{15}OP_{\alpha_1}\sigma^2_{CV3_{t+1}}$. Note that H and K will normally be positive (see Robison and Barry 1987). This condition is sooner met when the hedging effectiveness and the variance of milk prices are low.

Because we assumed that the prices of milk quota and milk are exactly correlated, the hedger has the possibility of using only one futures contract to hedge for both commodities. This so-called cross hedge is effective if the co-movement of cash and futures of the related commodities is reliable and consistent. The hedger will then use the futures contract that has relatively low liquidity cost and low residual cost, in our case, the rights futures contracts (Anderson and Danthine 1981; Black 1986; Ames et al. 1992). These characteristics of rights futures, high hedging effectiveness and the cross hedge possibilities, imply that rights futures are a very suitable tool for implementing production policy efficiently, both from the policy perspective and from the business economics perspective.

13.6 Summary

In this chapter we analyzed how futures contracts are related in a commodity product spread. We examined the relationships between the cash position, the cash price variance and the risk aversion in a commodity product spread and their influence on the optimal hedging amounts. Because farmers are increasingly affected by environmental rights and production rights, we extended the commodity product spread model to tradable rights. It was concluded that because of the nature of rights, the farmer will hedge more if a commodity is a right than if it is not a right. In our case we analyzed how the hedger will use different hedging strategies to manage his or her processing margin risk. We illustrated the usefulness of milk quota futures for the dairy complex and draw conclusions about the influence of the milk quota cash position, the cash position of milk and the farmer's risk attitude on the optimal hedging amount of milk quota futures in a dairy complex spread. If the co-movement of cash and futures prices of related commodities is reliable and consistent, the hedger will prefer a cross hedge by a futures contract with lower residual risk, in our case the rights futures contract. However, no such futures market is yet available. Further research on the viability of futures markets for rights is in progress.

13.7 Acknowledgments

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Appendix

The variance of the expected processing margin is given by:

$$\begin{aligned}\text{var}(\Pi) = {} & (\beta_1 - \alpha_1)^2\sigma_{CV1}^2 + \alpha_1^2\sigma_{Basis_1}^2 \\ & + (\beta_2 - \alpha_2)^2\sigma_{CV2}^2 + \alpha_2^2\sigma_{Basis_2}^2 \\ & + (\beta_3 - \alpha_3)^2\sigma_{CV3}^2 + \alpha_3^2\sigma_{Basis_3}^2 + R\end{aligned} \tag{A.1}$$

where

$$\begin{aligned}R = {} & +2(\beta_1 - \alpha_1)\alpha_1\sigma_{12} + 2(\beta_1 - \alpha_1)(\beta_2 - \alpha_2)\sigma_{13} \\ & +2(\beta_1 - \alpha_1)\alpha_2\sigma_{14} + 2(\beta_1 - \alpha_1)(\beta_3 - \alpha_3)\sigma_{15} \\ & +2(\beta_1 - \alpha_1)\alpha_3\sigma_{16} + 2\alpha_1(\beta_2 - \alpha_2)\sigma_{23} \\ & +2\alpha_2\alpha_2\sigma_{24} + 2\alpha_1(\beta_3 - \alpha_3)\sigma_{25} + 2\alpha_1\alpha_3\sigma_{26} \\ & +2(\beta_2 - \alpha_2)\alpha_2\sigma_{34} + 2(\beta_2 - \alpha_2)(\beta_3 - \alpha_4)\sigma_{35} \\ & +2(\beta_2 - \alpha_2)\alpha_3\sigma_{36} + 2\alpha_2(\beta_3 - \alpha_3)\sigma_{45} \\ & +2\alpha_2\alpha_2\sigma_{46} + 2(\beta_3 - \alpha_3)\alpha_3\sigma_{56}\end{aligned}$$

where σ_{xy} represents the covariance between the variables x and y with $x = 1 \ldots 6$ and $y = 1 \ldots 6$, where 1 denotes the cash price of the main product, 2 the basis of the main product, 3 the cash price of the by-product, 4 the basis of the by-product, 5 the cash price of the input (i.e. rights) and 6 the basis of the input.

Explanation of the terms

$R1 = \sigma_{13} + \sigma_{24} - \sigma_{14} - \sigma_{23};$

$R2 = \sigma_{23} - \sigma_{13};$

$R3 = \sigma_{25} - \sigma_{15};$

$R4 = \sigma_{15} + \sigma_{26} - \sigma_{25} - \sigma_{16};$

$R5 = \sigma_{14} - \sigma_{13};$

$R6 = \sigma_{45} - \sigma_{35};$

$R7 = \sigma_{35} + \sigma_{46} - \sigma_{36} - \sigma_{45};$

$R8 = \sigma_{36} - \sigma_{35};$

$R9 = \sigma_{16} - \sigma_{15};$

$K1 = \sigma_{15} - \sigma_{25};$

$K2 = \sigma_{35} - \sigma_{45};$

$K3 = -\sigma_{15};$

$$\Gamma = \frac{1}{1 - \dfrac{\sigma_{15}^2 OP_{\alpha_1}}{\sigma^2_{CV1_{t+1}}\sigma^2_{CV3_{t+1}}}};$$

$$\mathrm{H} = \frac{(-CV3_{t+1} + PF3_t + TC3)}{2\lambda\sigma^2_{CV3_{t+1}}};$$

$$\mathrm{K} = \frac{(CV1_{t+1} - PF1_t + TC1 + Basis_1)}{2\lambda\sigma^2_{CV1_{t+1}}};$$

$$\Omega = \frac{(\beta_1\sigma_{12} + \beta_3 R3)}{\sigma^2_{CV1_{t+1}}}.$$

CHAPTER 14

Towards A Marketing-Finance Approach: Final Remarks and Illustration[1]

14.1 Abstract

It has been argued in Chapter 2 that a synthesis between the finance and the marketing approach is useful for analyzing the possible success or failure of hedging services. It has also been shown that much research is yet to be done in the domain of both approaches separately. In this final chapter we discuss the additional value of the marketing-finance approach, using the results presented in the previous chapters. The usefulness of the marketing-finance approach is illustrated by an empirical study of the market potential of a new to the world futures contract which is yet to be introduced.

14.2 Marketing-Finance Approach

It has been argued in Chapter 2 that in studying the market potential of a hedging service provided by a futures market the integration of the marketing approach and the finance approach into a marketing-finance approach offers the best results. In order to profit optimally from such an integration, each separate approach will have to be elaborated further along the lines of research topics, as has been

[1] This chapter is an extended version of Pennings, J.M.E., M.G.M. Wetzels and M.T.G. Meulenberg (1997), "Synthesis of the Financial Approach and the Marketing Approach towards Financial Services: A Conceptual Model for the Futures Contracts Innovations" Working Paper, Wageningen Agricultural University, Department of Marketing and Marketing Research.

done in the previous chapters. Thus, the finance approach needs a shift of perspective from portfolios to futures exchange management, so that the measures developed within this approach will also provide the exchange management with valuable information on how to create successful markets. The elaboration of the marketing approach should focus in particular on a better understanding of the decision making process of entrepreneurs regarding the use of price risk management instruments. Especially a better understanding of the question "why do entrepreneurs decide the way they do" generates important information for the marketer. The different components that play a part in an entrepreneur's decision-making, e.g. risk attitude, deserve more attention, not only in making these constructs operational, but also in measuring their influence on actual behavior.

Integrating both approaches into a marketing-finance approach broadens our knowledge of the existing markets (why are some of them successful while others are not?), and for that reason is helpful in improving the development of hedging services. It reveals problems and opportunities alike. Examples from our research results can illustrate our point. Our research on hogs futures shows that 1) performance and entrepreneurial freedom come to the fore as very important components in the decision making of farmers regarding the use of hog futures. This is relevant information since it indicates that research has to be done on hedging effectiveness and compatibility with other price risk management instruments.
2) the farmers' survey demonstrates that standardization of date of delivery was perceived as problematic. This information indicates the need for research on the flexibility in the standardization for date of delivery, thus improving the performance - and implicitly the appeal - of the hog futures contract.

Our research into rights futures, a new to the world futures contract, in Part III shows that, 1) from a finance perspective, these futures contracts have some very convenient features which make them efficient instruments for hedging price risk, 2) from a marketing perspective, it is found that potential users perceive futures markets as complex. As a result, futures contracts are not always considered an alternative price risk management instrument. For the futures exchange management this means that, in order to secure a successful introduction of futures, they will in particular have to pay attention to the information which they disseminate among potential hedgers about the functioning of futures contracts.

The foregoing examples illustrate the merits of the marketing-finance approach. It appears that the results from the separate approaches are complementary in an analysis of the market potential of a futures contract. Clearly, both approaches can be used separately in order to analyze specific aspects of existing futures markets.

We will now illustrate the marketing-finance approach for a new to the world hedging service by analyzing the market potential of a whey powder futures contract, which does not exist yet. Recently, both the European Whey Products Association and the Amsterdam Exchanges came up with the idea of creating a whey powder futures contract. Since the data for this study were limited, the marketing-finance approach to a new whey powder futures contract cannot be elaborated in detail.

14.3 The Market Potential of a Whey Powder Futures Contract: an Illustration of the Marketing-Finance Approach to New Hedging services

Whey is a liquid product released in the manufacture of cheese and casein after the curd has been separated. It emerges from acids, rennet and/or physico-chemical processes. The sharp price fluctuations of whey powder harm both processors and end-users of whey powder. Both market parties have a considerable interest in reducing price risk. For this reason it is useful to investigate the idea of launching a whey powder futures contract.

14.3.1 *Research Design*

In order to investigate the necessary technical criteria for a whey powder futures contract, we gathered data on prices, trade volume and product specifications of whey powder in Europe. The data covered the period from January 1989 up to and including June 1996. Also, a questionnaire was mailed to the directors of sixteen whey powder producing enterprises in seven European countries. The companies were contacted by the EWPA (European Whey Products Association) before the mail questionnaire was sent, to encourage participation and to ensure that the questionnaire be sent to the correct individual. In order to understand the decision process of CEO's in the whey powder market and to make sure that the questionnaire would be interpreted correctly, the relevant literature was consulted and in-depth interviews were carried out with three senior executives. All respondents were senior managers involved in the marketing of whey powder. Eleven questionnaires were returned, i.e. a response rate of 69%. Note that the EWPA covers all companies involved in European whey powder production. Although our sample of eleven executives is small in absolute terms, it nevertheless covers 75% of the total European whey powder sector in terms of volume. Moreover, our respondents were key-subjects and well-informed.

From in-depth interviews with senior managers, it appeared that cash forward contracts (legal agreements between sellers and buyers in which the price is fixed for delivery in the future) and inventory control (which determines the price level in the total cash market between an upper and lower level predetermined by an inventory authority) are perceived as alternative instruments for futures. For that reason our survey includes questions about cash forward contracts and inventory control. We take into account the influence of competition between these alternatives, along the lines suggested by Laroche and Sadokierski (1994). Beliefs about the three alternative price risk management instruments were measured by using statements describing the characteristics of these alternatives. Respondents indicated on a scale ranging from 1 ("I strongly disagree") to 7 ("I strongly agree") the extent to which they agreed with the statements. Also, the respondents were asked to indicate on a scale from 1 ("I would definitely not intend to select") to 7 ("I would definitely intend to select") their intention to select one of the alternatives. The probability of actually using the price risk management instruments is measured relatively by asking the respondents to distribute 100 points among the alternatives to indicate the probability of using one of the three instruments (van den Putte et al., 1996)[2]. Furthermore, we measured some relevant aspects of futures contracts which were strongly related to instrumental needs and convenience needs. The aspects included in the survey were generated by the in-depth interviews conducted with a number of senior managers. The respondents were asked to indicate the importance of each aspect on a scale ranging from 0 ("No importance") to 10 ("Overwhelming importance").

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[2] Note that not using any price risk management instrument is not an alternative for whey powder producers. The heavy price fluctuations and relatively low profit margins make risk management necessary from a producer's point of view.

14.3.2 *Analysis and Results*

Finance approach

Criterion 1: *price volatility*. In order to conclude whether the volatility of whey powder prices justifies the introduction of a whey powder futures contract, the coefficient of variation of European whey powder prices is compared with that of soybeans in the United States, the latter commodity having a long tradition of successful futures trading. The coefficient of variation of whey powder, 0.23 (based on 78 monthly observations covering the period January 1989-June 1996) is relatively high compared with the coefficient of soybeans, 0.07 (based on 78 monthly observation covering the same period as for whey powder). Thus, from the price volatility point of view, a market for whey powder futures looks promising. Criterion 2: *size of cash market*. The underlying value of the cash market is about 1 billion US dollars; the underlying value of the cash market for potatoes (successfully traded at the Amsterdam Exchanges), by comparison, is worth 300 million US dollars. Criterion 3: *standardization possibilities*. Whey powder can easily be standardized (whey powder is a rather homogeneous product). Criterion 4: *number of participants*. The number of potential participants, on both supply and demand side, is rather small, which could lead to problems of squeezing the market (market manipulation). Hence, there could be high market-depth risk and, as a result, low hedging effectiveness. For this reason it is very important to attract speculators to the market.

Marketing approach

In order to gain insight into the opinions of senior managers about the whey powder market, the respondents were asked to indicate the extent to which they agree with a series of statements on the whey powder market, ranging from 1 ("I strongly disagree") to 7 ("I strongly agree"), Table 1 summarizes the opinions.

Table 1 *Statements on the whey powder market (1 = I strongly disagree; 7 = I strongly agree)*

Statement	Mean	Standard deviation	Range
I am able to predict the price of whey powder three months from now	2.55	1.57	4
I am able to predict the price of whey powder six month from now	1.82	1.17	3
I am able to predict the price of whey powder nine month from now	1.82	1.40	4
I am able to predict the price of whey powder twelve month from now	1.82	1.47	4
The cash traders in the whey powder market ensure a clear price discovery	2.89	1.90	5
In the past, I used price risk management instruments in order to eliminate price risk	2.91	2.02	6
The price fluctuations in the whey powder market are large	6.55	0.93	3
I perceive price fluctuations in the whey powder market as a risk	5.36	1.50	5
I want to eliminate price risk, irrespective of the price level	5.27	1.68	5
I want the whey powder market to be stabilized around predetermined price levels	5.55	1.57	5

From Table 1 it appears that CEO's do not consider themselves capable of predicting the prices of whey powder and that this unpredictability is seen as a risk. The CEO's wish to eliminate this risk by stabilizing the total cash market. This can only be done through inventory control by the industry. Thus, we may expect CEO's to favor inventory control over cash forwards and futures.

In order to gain insight in both *instrumental* and *convenience* needs, the CEO's were asked to indicate the importance of some aspects of futures trading (cf. Chapter 2 for a detailed description of the instrumental and convenience needs). The following aspects were considered to be important: reducing price variability (Mean Important Score (MIS) 8.2, Standard Deviation (SD) 1.2), reliable clearing system (MIS 8.2 and SD 2.3), availability of price information (MIS 7.7 and SD 1.9), competent brokers (MIS 7.5 and SD 2.9) and easy access to the trading floor (MIS 7.0 and SD 1.9). The first aspect represents instrumental needs, whereas the other aspects represent convenience needs. There is a clear hierarchy in convenience needs. A reliable clearing system is perceived as the most important aspect of futures trading, which can be explained by the fact that the clearing system directly affects the financial position of the participants. This is followed by availability of information, competent brokers and easy access to the trading floor.

The likelihood of using one of the alternative ways of managing price risk was measured directly. The respondents were asked to distribute 100 points to indicate the probability of using one of the alternatives. Table 2 summarizes these results.

Table 2 *Probability of using one of the alternatives by distributing 100 points*

Price risk management instrument	Mean	Standard deviation
Futures contracts	35.5	24.55
Inventory control	44.5	27.44
Cash forwards contracts	20.0	18.03

We found a significant preference for inventory control as opposed to cash forwards and futures contracts (F statistic = 2.45, $p < 0.1$).

Inspection of the frequency distributions of the constant sum scale, which represents the probability of using the alternative price risk management instruments, revealed two typical response profiles. With cluster analysis using squared Euclidian distances and Ward's method (error sum of squares method (Punj and Stewart, 1983)) two distinct clusters were identified. Cluster 1 consists of five respondents who favor the use of futures (Response profile: Futures 48; Inventory Control 24; Cash Forwards 28). Cluster 2 consists of four respondents who favor inventory control (Response profile: Futures 20; Inventory Control 70; Cash Forwards 10). In order to explore the differences between these two clusters, we used the Mann-Whitney U-test to analyze the beliefs of the respondents regarding the three alternative instruments. We found that the two clusters differed as far as their knowledge/understanding of futures trading was concerned ("I understand how futures trading works", $z = -1.88$ [$p = 0.06$]; "The futures market provides a useful way of stabilizing returns", $z = -2.28$ [$p = 0.02$]). Moreover, Cluster 1 consisted of whey powder producers who trade their whey powder themselves, whereas Cluster 2 consisted of whey powder producers who do not trade whey powder themselves but sell it directly to a cash market trader. The latter group mainly consists of bulk producers without any interest in the marketing of whey powder.

We did not find a significant higher intention to use futures among senior managers who already had experience with price risk management instruments, nor did we find a significant higher intention to use futures among senior managers that were familiar with futures trading. We did find significant relationships between the relative intention to select futures and the following beliefs: the price fluctuations in the whey powder market are large ($\rho = 0{,}69$, $p < 0.05$), the futures market provides a useful way of stabilizing returns ($\rho = 0{,}69$, $p < 0.05$), the futures market is a useful aid in forward planning ($\rho = 0{,}78, p < 0.05$).

14.3.4 *Relevance of the Marketing-Finance Approach to Whey Powder Futures Contracts.*

The marketing-finance approach suggests that the opportunities for trade in whey powder futures are limited. From a technical point of view there might be problems of liquidity and hence hedging effectiveness. With respect to the cash market size and the homogeneity of the underlying product, futures trade would not be hindered. So, from a technical point of view, whey powder futures trade looks promising only when a sufficient number of speculators are in the market to offset the lack of liquidity which is to be expected when only hedgers enter the market (see Figure 1 and Figure 3 of Chapter 2). From a customer point of view we see that the majority of the whey powder producers favor price stabilization by inventory control (see Figure 1). Figure 1 uses a plus or a minus sign respectively to indicate which aspects of the marketing-finance approach have a positive or negative effect on the viability of a whey powder futures market.

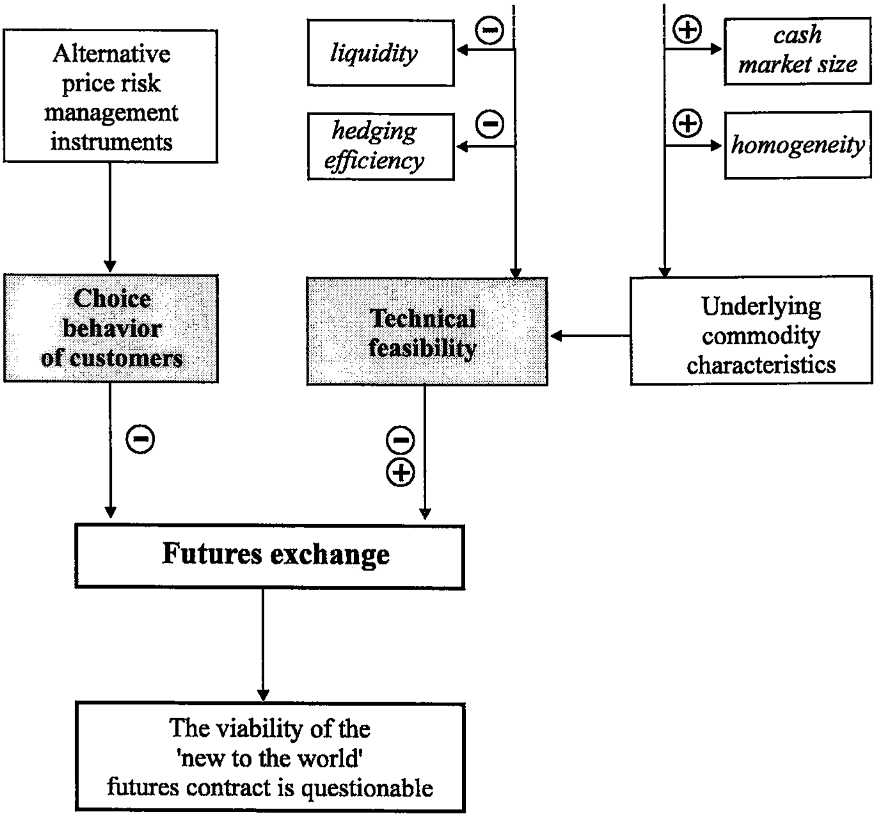

***Figure 1** The marketing-finance approach applied to whey powder futures contracts*

From the survey it appeared that the customer's understanding of the futures trade is an important determinant of the customer's engagement in the futures trade. Information dissemination of the pros and cons of futures trading may lead to a better understanding, thus reducing the psychological distance to a complex service such as the one provided by futures exchanges.

Note that inventory control, the alternative favored by the majority of the respondents, is difficult to establish, because it requires a central authority and strict discipline from all whey powder producers. During the in-depth interviews it appeared that it was hard to establish a central authority with the power necessary to take actions to restrict the behavior of individual firms. Moreover, inventory control might not be allowed by the European Union's anti-trust law. Therefore, futures may well be a second-best solution for whey powder producers. In this chapter we did not examine the needs for price risk reduction of the whey powder consumers, such as large food and feed companies, which might have an impact on our conclusions on the viability of whey powder futures.

Within the framework of this study it is interesting that the peripheral services such as price information and competent brokers are perceived as important by whey powder producers. Therefore, it seems valuable that the management of exchanges should pay attention to the peripheral services.

Thus, using the marketing-finance approach, the viability of whey powder futures is questionable. Both the finance and marketing approach, the latter in particular, show the weak market potential of a whey contract.

The complementarity of the results from the marketing survey with customers and the financial evaluation of a possible contract in the whey powder example demonstrates the value of the marketing-finance approach. Is this complementarity the optimal contribution a marketing-finance approach can make to the evaluation of success of a futures contract or can we do even better? Clearly, it is always useful to analyze more in depth both the consumer behavior and the financial features of the futures contract in order to improve the marketing-finance approach. But it seems to us that also further progress in the marketing-finance approach could be made by truly integrating both approaches. One might use the results from the first consumer analysis to improve the specification of one or more new futures contracts and afterwards test them in consumer research. In reverse one might use the results of the financial analysis to find out more specifically which consumer characteristics are relevant for consumer decision making and use this information afterwards for fine tuning specification and promotion of the futures contract. By such a sequential procedure of consumer research profiting from the results of financial analysis and vice versa the marketing-finance approach might serve futures exchange management best in their concrete policy of improving existing contracts respectively of introducing new contracts.

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References

Abhyankar, A.H. (1994), "Trading Round the Clock: Return, Volatility and Volume Spillovers in the Eurodollar Futures Markets", Paper presented at the sixth annual PACAP Conference, Jakarta, Indonesia, July 1994.

ABN AMRO (1996), "Structuurontwikkelingen Agrarische Sector". 1-21.

Admati, A.R. and P. Pfleiderer (1988), "A Theory of Intraday Patterns: Volume and Price Variability", *Review of Financial Studies,* 1, 3-40.

Affleck-Graves, J., S.P. Hegde, and R.E. Miller (1994), "Trading Mechanisms and the Components of the Bid-Ask spread", *Journal of Finance*, 49, 1471-1488.

Ajzen, I. and T.J. Madden (1986), "Prediction of Goal-Directed Behavior: Attitudes, Intentions, and Perceived Behavioral Control", *Journal of Experimental Social Psychology*, 22, 453-474.

Ajzen, I. and M. Fishbein (1980), *Understanding Attitudes and Predicting Social Behavior*. Englewood Cliffs, NJ: Prentice-Hall.

Albert, D., K.M. Aschenbrenner and F. Schmalhofer (1989), "Cognitive Choice Processes and the Attitude-Behavior Relation", In: *Attitudes and Behavioral Decisions* (pp.61-99). A. Upmeyer (Ed.), New York: Springer Verlag.

Ames, G.C.W., G.A. Shumaker and G. Myneni (1992), "Cross-hedging As a Pricing Strategy for Alternatives Crops: the Case of Southeastern Canola", *Journal of International Food & Agribusiness Marketing,* 4, 25-43.

Anderson, J.C. and D.W. Gerbing (1988), "Structural Equation Modeling in Practice: A Review and Recommended Two-Step Approach", *Psychological Bulletin*, 103, 411-423.

Anderson, R.W. and J.P. Danthine (1980), "Hedging and Joint Production, Theory and Illustrations", *Journal of Finance,* 35, 487-489.

Anderson, R.W. and J.P. Danthine (1981), "Cross Hedging", *Journal of Political Economy*, 89, 1182-1196.

Anderson, T.L. and P.J. Hill (1975), "The Evolution of Property Rights: A Study of the American West", *Journal of Law and Economics*, 18, 163-179.

Antonovitz, F. and R.D Nelson (1988), "Forward and Futures Markets and the Competitive Firm under Price Uncertainty", *Southern Economic Journal*, 55, 183-195.

Arrow, K.J. (1974), *Essays in the Theory of Risk Bearing*, Amsterdam, North-Holland Publishing Co.

Bagozzi, R.P. (1981), "Attitudes, Intentions, and Behavior: A Test of Some Key Hypothesis", *Journal of Personality and Social Psychology*, 41, 607-627.

Bagozzi, R.P. (1982), "A Field Investigate of Causal Relations Among Cognitions, Affect, Intentions, and Behavior", *Journal of Marketing Research*, 19, 562-584.

Bagozzi, R.P. (1994), "Structural Equation Models in Marketing Research: Basic Principles". In: *Principles of Marketing Research*, R.P. Bagozzi (ed.), Cambridge, MA, Blackwell.

Bagozzi, R.P. (1994), *Advanced Methods of Marketing Research*. Blackwell Business.

Bagozzi, R.P. and M.F. van Loo (1991), "Motivational and Reasoned Processes in the Theory of Consumer Choice", In *Handbook of Behavioral Economics*, vol. 2B, ed. R. Frantz et al., Greenwich, CT: JAI, 401-438.

Bagozzi, R.P. and Y. Yi (1994), "Advanced Topics in Structural Equation Models", In: R.P. Bagozzi (ed.) *Advanced Methods of Marketing Research*, Blackwell, 1-51, Cambridge, MA.

Bailey, W. and K.C. Chang (1993), "Macroeconomic Influences and the Variability of the Commodity Futures Basis", *Journal of Finance*, 48, 555-573.

Baltussen, W. H. M. (1992), "Ammonia Emission in the Dutch Livestock Sector: Abatement Possibilities and Costs", *Tijdschrift voor Sociaal Wetenschappelijk Onderzoek van de Landbouw*, 7, 321-342.

Baltussen, W.H.M. (1993), "Milieubeleid en Omvang van de Intensieve Veehouderij", *LEI-DLO mededeling* 483.

Baltussen, W.H.M. e.a. (1993), "Marktonderzoek naar Binnenlandse Afzet van Dierlijke mest", *LEI-DLO, publikatie* 3,155.

Bass, F.M. (1969), "A New Product Growth Model for Consumer Durables", *Management Science,* 15, 215-227.

Bauer, R.A. (1960), "Consumer Behavior as Risk Taking", In: Cox, D.F. (ed.), *Risk Taking and Information Handling in Consumer Behavior*, Boston: Harvard University.

Bauer, R.A. (1967), "Consumer Behavior as Risk Taking", In: Cox, D.F. (ed.), *Risk Taking and Information Handling in Consumer Behavior*, Harvard University, Boston.

Baumgartner, H. and C. Homburg (1996), "Applications of Structural Equation Modeling in Marketing and Consumer Research: A Review", *International Journal of Research in Marketing*, 13, 139-161.

Bell, D.E and H. Raiffa (1982), "Marginal Value and Intrinsic Risk Attitude". In: H. Kunreuther (ed.) *Risk: A Seminar Series*, 325-349. International Institute for Applied Systems Analysis, Laxenburg, Austria.

Benson, J. and D.L. Bandalos (1992), "Second-Order Confirmatory Factor Analysis of the Reactions to Tests Scale with Cross-Validation", *Multivariate Behavioral Research*, 27, 459-487.

Berck, P. and S.G. Cecchetti (1985), "Portfolio Diversification, Futures Markets and Uncertain Consumption Prices", *American Journal of Agricultural Economics*, 67, 497-507.

Berkman, H. (1992), "*Trading Systems and Liquidity on Securities Markets*", PhD-thesis Erasmus University Rotterdam.

Berkman, H. (1993), "The Market Spread, Limit Orders, and Options", *Journal of Financial Services Research,* 5, 399-415.

Besseling, R.M.M. (1991), *Invloed van de Superheffing op de Britse Melkveehouderij,* Rijswijk: Produktschap voor Zuivel, p. 87.

Bessembinder, H. and P.J. Seguin (1993), "Price Volatility, Trading Volume, and Market Depth: Evidence from Futures Markets", *Journal of Financial and Quantitative Analyses*, 28, 21-39.

Bettman, J.R. and M. Sujan (1987), "Research in Consumer Information Processing". In: *Review of Marketing*, ed. M.J. Houston, Chicago, IL: American Marketing Association, 197-235.

Betts, E. (1994), "Understanding the Financial Customer". In *Retailing of Financial Services,* McGoldrick, P.J. and S.J. Greenland (eds.), McGraw-Hill Book Company, London, 41-84.

Bhoovaraghavan, S., A. Vasudevan and R. Chandran (1996), "Resolving the Process vs. Product Innovation Dilemma: A Consumer Choice Theoretic Approach", *Management Science*, 42, 232-246.

Bigelow, J.P. (1993), "Consistency of Mean-Variance Analysis and Expected Utility Analysis", *Economic Letters,* 43, 187-192

Black, D.G. (1986), "Success and Failure of Futures Contracts: Theory and Empirical Evidence", Monograph 1986-1 Salomon Brothers Center for the Study of Financial Institutions, New York.

Black, D.G. and W.L. Silber (1986), "Pioneering Products: Some Empirical Evidence from Futures Markets", New York University Salomon Brothers Center working paper, 359.

Böckenholt, U. and K. Kroeger (1993), "The Effect of Time Pressure in Multiattribute Binary Choice Tasks". In: *Time Pressure and Stress in Human Judgment and Decision Making,* O. Svenson & A.J. Maule (eds.), (pp. 195-214). New York: Plenum.

Booms, B.H. and M.J. Bitner (1981), "Marketing Strategies and Organizational Structures for Service Firms". In: *Marketing of Services*, Donnelly, J.H. and George, W.R (eds.), American Marketing Association, Chicago. pp. 47-51.

Boot, A.W.A. and A.V. Thakor (1993), "Security Design", *Journal of Finance*, 14, 1349-1378.

Bosch, J.D. and J.C. Johnson (1992), "An Evaluation of Risk Management Strategies for Dairy Farms", *Southern Journal of Agricultural Economics*, 24, 173-182.

Bowen, D.E. and B. Schneider (1988), "Services Marketing & Management: Implications for Organizational Behavior". In: *Research in Organizational Behavior: An Annual Series of Analytical Essays and Critical Reviews,* Staw, B.M. and L.L. Cummings (eds.), 10, 43-80.

Braatz, M. (1992), "Analyse des Milchquotenhandels, Dargestellt am Beispiel des Marktes für Milchquoten in Schleswig-Holstein", Wissenschaftsverlag, Kiel.

Brandstätter, H. (1997), "Becoming an Entrepreneur: A Question of Personality Structure", *Journal of Economic Psychology*, 18, 157-177.

Brasler, M. (1994), "Booming New Financial Markets in Milk Quotas", *Daily Telegraph,* (January 14th, 1994).

Brennan, M.J., and E.S. Schwartz (1990), "Arbitrage in Stock Index Futures", *Journal of Business*, 63, S7-31.

Brentani, U. de (1989), "Success and Failure in New Industrial Services", *Journal of Product Innovation Management,* 6, 239-258.

Brentani, U. de (1991), "Success Factors in Developing New Business Services", *European Journal of Marketing,* 25, 33-59.

Brentani, U. de (1995), "New Industrial Service Development: Scenarios for Success and Failure", *Journal of Business Research,* 32, 93-103.

Bressers, J.Th.A. (1988), "Effluent Charges can Work: the Case of the Dutch Water Quality Policy". In: Dietz, F.J. and W.J.M. Heijman, *Environmental Policy in a Market Economy,* Wageningen

Brorsen, B. (1989), "Liquidity Costs and Scalping Returns in the Corn Futures Market", *Journal of Futures Markets,* 9, 225-236.

Brorsen, B.W. and N.F. Fofana (1995), "Success and Failure of Agricultural Futures Contracts", Working paper of Oklahoma State University, Stillwater.

Brown, S.W., E. Gummesson, B. Edvardsson and B. Gustavsson (1991), *Service Quality: Multidisciplinary and Multinational Perspectives*, Lexington Books, New York.

Bulte, E., J.M.E. Pennings and W.J.M. Heijman (1996), "Futures Markets, Price Stabilisation and Efficient Exploitation of Exhaustible Resources", *Environmental & Resource Economics,* 8, 351-366.

Bulte, E.H. and J.M.E. Pennings (1997), "A Note on Overfishing, Fishing Rights and Futures Markets", *European Journal of Law and Economics* 4, 327-335.

Bunn, M.D. (1993), "Taxonomy of Buying Decision Approaches", *Journal of Marketing*, 57, 38-56.

Burell, A. (ed) (1989), *Milk quotas in the European Community*, C.A.B. International, Wallingford.

Burrell, A. (1990), "Producer Response to the EEC Milk Superlevy", *European Review of Agricultural Economics,* 17, 43-55.

Busemeyer, J.R. and J.T. Townsend (1993), "Decision Field Theory: A Dynamic Cognitive Approach to Decision Making in an Uncertain Environment", *Psychological Review*, 100, 432-459.

Camerer, C.F. and H. Kunreuther (1989), "Decision Process for Low Probability Events: Policy Implications", *Journal of Policy Analysis and Management*, 8, 565-592.

Carlton, D.W. (1984), "Futures Markets: Their Purpose, Their History, Their Growth, Their Successes and Failures", *Journal of Futures Markets,* 4, 237-271.

Carroll, J.D., P.E. Green, and C.M. Schaffer (1986), "Interpoint Distance Comparisons in Correspondence Analysis." *Journal of Marketing Research,* 23, 271-280.

Carroll, J.D., P.E. Green, and C.M. Schaffer. (1987), " Comparisons of Interpoint Distance in Correspondence Analysis: A Clarification", *Journal of Marketing Research,* 24, 445-450.

Castelino, M.G. (1992), "Hedge Effectiveness: Basis Risk and Minimum-Variance Hedging", *Journal of Futures Markets*, 12, 187-201.

Castelino, M.G., J.C. Francis, and A. Wolf (1991), "Cross-Hedging: Basis Risk and Choice of the Optimal Hedging Vehicle", *Financial Review*, 26, 179-210.

Catania, P.J. (1989), *Commodity Trading Manual*, Chicago Board of Trade.

Chan, L.K.C and J. Lakonishok (1993), "Institutional Trades and Intraday Stock Price Behavior", *Journal of Financial Economics,* 33, 173-199.

Chan, L.K.C. and J. Lakonishok (1995), "The Behavior of Stock Prices Around Institutional Trades", *Journal of Finance*, 50, 1147-1174.

Chang, J.S.K and H. Fang (1990), "An Intertemporal Measure of Hedging Effectiveness", *Journal of Futures Markets*, 10, 307-321.

Chang, J.S.K. and L. Shanker (1986), "Hedging Effectiveness of Currency Options and Currency futures", *Journal of Futures Markets*, 6, 289-305.

Chen, N-F., C.J. Cuny and R.A Haugen (1995), "Stock Volatility and the Levels of the Basis and Open Interest in Futures Contracts", *Journal of Finance*, 50, 281-300.

Childers, T.L. (1986), "Assessment of the Psychometric Properties of an Opinion Leadership Scale", *Journal of Marketing Research*, 23, 184-188.

Chordia, T. and A. Subrahmanyam (1995), "Market Making, the Tick Size, and Payment for Order Flow: Theory and Evidence", *Journal of Business*, 68, 543-575.

Chow, G.C. (1967), "Technological Change and the Demand for Computers", *American Economic Review*, LVII, 1117-1130.

Christie, W. and P. Schultz (1994), "Market Structure and Liquidity: A Transaction Data Study of Exchange Listing", *Journal of Financial Intermediation*, 3, 300-326.

Christie, W. and P. Schultz (1995), "Market Structure and the Intraday Pattern of Bid-Ask Spreads for NASDAQ Securities", *Journal of Business*, 69, 35-60.

Churchill, G.A. (1995), "*Marketing Research: Methodological Foundations*", The Dryden Press, Chicago.

Churchill, G.A., Jr. and J.P. Peter (1995), *Marketing: Creating Value for Customers*, Irwin, Burr Ridge, Illinois.

Coase, R.M. (1960), "The Problem of Social Cost", *Journal of Law and Economics*, 3, 1-44.

Conley, D.M. (1994), "Hedging Ratios and Effectiveness for Diesel Fuel and Gasoline in the Northern Plains", *Agribusiness: An International Journal*, 10, 305-317.

Corfman, K. (1991), "Comparability and Comparison Levels Used in Choices Among Consumer Products", *Journal of Marketing Research*, 16, 230-258.

Cornell, B. (1981), "The Relationship Between Volume and Price Variability in Futures Markets", *Journal of Futures Markets*, 1, 303-316.

Coyle, B.T. (1992), "Risk Aversion and Price Risk in Duality Models of Production: A Linear Mean-Variance Approach", *American Journal of Agricultural Economics*, 74, 849-859.

Cramer, J.S. (1986), *Econometric Applications of Maximum Likelihood Methods*, Cambridge University Press, Cambridge.

Cronbach, L.J. (1986)",Statistical Tests for Moderate Variables: Flaws in Analysis Recently Proposed", *Psychological Bulletin* 102, 414-417.

Cudeck, R. (1989), "Analysis of Correlation Matrices Using Covariance Structure Models", *Psychological Bulletin*, 105, 317-327.

Cuny, C.J. (1993), "The Role of Liquidity in Futures Market Innovations", *Review of Financial Studies*, 6, 57-78.

Currim, I.S. and R.K. Sarin (1983), "A Procedure for Measuring and Estimating Consumer Preferences Under Certainty", *Journal of Marketing Research*, 20, 249-256.

Czepiel, J.A., M.R. Solomon, C.F. Surprenant and E.G. Gutman (1985), "E.G. Service Encounters: An Overview". In: *The Service Encounter*, Czepiel, J.A., M.R. Solomon, and C.F. Surprenant, Lexington Books, Lexington, Massachusetts/Toronto, 3-15.

Dabholkar, P.A. (1994), "Incorporating Choice into an Attitudinal Framework: Analyzing Models of Mental Comparison Processes", *Journal of Consumer Research*, 21, 100-118.

Dabholkar, P.A. (1996), "Consumer Evaluations of New Technology-Based Self-Service Options: An Investigation of Alternative Models of Service Quality", *International Journal of Research in Marketing*, 13, 29-51.

Dairy Industry Newsletter (1993), *UK Milk Quota Prices Hit the Roof*, (4) 20.

Davey, E. and F. Maguire (1996), "A Hell of a Year", *Futures and Options World,* 297, 32-36.

Demsetz, H. (1976), "Toward a Theory of Property Rights", *American Economic Review,* 57, 347-379.

Dietrich, J.K. (1996), *Financial Services and Financial Institutions,* Prentice Hall International Editions, New Jersey.

Dijk, J.B. van and J.M.E. Pennings (1995), "Quota-handel in de Zes EU Landen", *Boerderij/Veehouderij,* 80, 18-19.

Domowitz, I. (1993a), "A Taxonomy of Automated Trade Execution Systems", *Journal of International Money and Finance,* 12, 607-631.

Domowitz, I. (1993b), "Equally Open and Competitive: Regulatory Approval of Automated Trade Execution in the Futures Markets", *Journal of Futures Markets,* 13, 93-113.

Duffie, D. and M.O. Jackson (1989), "Optimal Innovation of Futures Contracts", *Review of Financial Studies,* 2, 275-296.

Dwight, G. (1985), "Theory of the Firm With Joint Price and Output Risk and a Forward Market", *American Journal of Agricultural Economics,* 67, 630-635.

Dwyer, J. (1992), "California's Tradable Emissions Policy and its Application to the Control of Greenhouse Gases", In: *Climate Change, Designing a Tradable Permit system.* Paris: OECD.

Dyer, J.S. and R.K. Sarin (1982), "Relative Risk Aversion", *Management Science,* 29, 875-886.

Easingwood, C.J. (1986), "New Product Development for Service Companies", *Journal of Product Innovation Management,* 3, 264-275

Easingwood, C.J. and C.D. Storey (1993), "Marketplace Success Factors for New Financial Services", *Journal of Services Marketing,* 7, 41-54.

Easterbrook, F.M. (1986), "Monopoly, Manipulation, and the Regulation of Futures Markets", *Journal of Business,* 59, S103-S127.

Ederington, L.H. (1979), "The Hedging Performance of the New Futures Markets", *Journal of Finance,* 34, 157-170.

Edgett, S. and S. Parkinson (1994), "The Development of New Financial Services: Identifying Determinants of Success and Failure", *International Journal of Service Industry Management,* 5, 24-38.

Edwards, F.R. and M.S. Canter (1995), "The Collapse of Metallgesellschaft: Unhedgeable Risks, Poor Hedging Strategy, or Just Bad Luck", *Journal of Futures Markets*, 15, 212-264.

Ennew, C. (1990), "Product Strategy". In: *Marketing Financial Services* Ennew, C., T. Watkins and M. Wright (eds.), Heineman Professional Publishing Ltd., Oxford, etc., 80-95.

Ennew, C., C.W. Morgan and T. Rayner (1992), "Role of Attitudes in the Decision to Use Futures Markets: the Case of the London Potato Futures Market", *Agribusiness: An International Journal,* 8, 561-573.

Ennew, C., C.W. Morgan and T. Rayner (1992), "Objective and Subjective Influences on the Decision to Trade on the London Potato Futures Market", *Journal of Agricultural Economics*, 43, 160-174.

EPA, (1993), *Economic Incentives in Environmental Bills Introduced in The 102nd Congress*, Washington D.C.

Ewasechko, A.C. and T.M. Horbulyk (1995), "Interprovincial Reallocation of Market Sharing Quota for Industrial Milk", *Canadian Journal of Agricultural Economics,* 43, 191-202.

Fackler, P.L. and K.P. McNew (1993), "Multiproduct Hedging, Theory, Estimation, and an Application", *Review of Agricultural Economics,* 15, 521-535.

Fama, E.F. (1991), "Efficient Capital Market II", *Journal of Finance,* 46, 1575-1617.

Feldman, J.M. and J.G. Lynch (1988), "Self-Generated Validity and Other Effects of Measurement on Belief, Attitude, Intention, and Behavior", *Journal of Applied Psychology*, 73, 421-435.

Fern, E.F. and J.R. Brown (1984), "The Industrial/Consumer Marketing Dichotomy: A Case of Insufficient Justification", *Journal of Marketing*, 48, 68-77.

Figlewski, S. (1984), "Hedging Performance and Basis Risk in Stock Index Futures", *Journal of Finance*, 39, 657-669.

Figlewski, S., Y. Landskroner and W. Silber (1991), "Tailing the Hedge: Why and How", *Journal of Futures Markets*, 11, 200-212.

Fishbein, M. and I. Ajzen (1975), *Belief, Attitude, Intention, Behavior: an Introduction to Theory and Research.* Reading, MA: Addison-Wesley.

Fishburn, P.C. (1983), "Transitive Measurable Utility", *Journal of Economic Theory*, 31, 293-317.

Fishburn, P.C. (1988), "Normative Theories of Decision Making Under Risk and Uncertainty". In: Bell et al (eds), *Decision Making. Descriptive, Normative and Prescriptive Interactions*, 78-98. Cambridge University Press, Cambridge.

Fisk, R.A., S.A. Brown, S.W Brown and M.J. Bitner (1993), "Tracking the Evolution of the Services Marketing Literature", *Journal of Retailing*, 69, 61-103.

Fornell, C. and F.L. Bookstein (1982), "Two Structural Equation Models: LISREL and PLS Applied to Consumer Exit-Voice Theory", *Journal of Marketing Research*, 19, 440-52.

Foster, F.D. and S. Viswanathan (1993), "The Effect of Public Information and Competition on Trading Volume and Price Volatility", *Review of Financial Studies*, 6, 23-56.

Fourt, L.A. and J.W. Woodlock (1960), "Early Prediction of Market Success for New Grocery Products", *Journal of Marketing*, 25, 31-38

Franckle, C.T. (1980), "The Hedging Performance of New Futures Markets: Comment", *Journal of Finance*, 35, 1273-1279.

Franses, P.H. (1994a), "Fitting a Gompertz Curve", *Journal of the Operational Research Society*, 45, 109-113.

Franses, P.H. (1994b), "Modelling New Product Sales; An Application of Cointegration Analysis", *International Journal of Research in Marketing*, 11, 491-502.

French, K.R. and R. Roll (1986), "Stock Returns Variances: the Arrival of Information and the Reaction of Traders", *Journal of Financial Economics*, 17, 5-26.

Garcia, P., B. Adam and R.J. Hauser (1994), "The Use of Mean-Variance for Commodity Futures and Options Hedging Decisions", *Journal of Agricultural and Resource Economics,* 19, 32-45.

Gemmill, G. (1994), "Margins and the Safety of Clearing Houses", *Journal of Banking and Finance,* 18, 979-996.

Geppert, J.M. (1995), "A Statistical Model for the Relationship between Futures Contract Hedging Effectiveness and Investment Horizon Length", *Journal of Futures Markets,* 15, 507-536.

Gjerde, O. (1987), "Measuring Hedging Effectiveness in a Traditional One-Period Portfolio Framework", *Journal of Futures Markets,* 7, 663-674.

Glosten, L.R. and P.B. Milgrom (1985), "Bid, Ask and Transaction Prices in a Specialist Market with Heterogeneously Informed Traders", *Journal of Financial Economics,* 14, 71-100.

Goldberg, L.G. and G.A. Hachey (1992), "Price Volatility and Margin Requirements in Foreign Exchange Futures Markets", *Journal of International Money and Finance,* 11, 328-329.

Goldhar, J.D., L.K. Bragaw and J.J. Schwartz (1976), "Information Flows, Management Styles, and Technological Innovation", *IEEE Transactions on Engineering Management,* 23, 51-62.

Goldsmith, R.E. (1984), "Some Personality Correlates of Open Processing", *Journal of Psychology,* 116, 59-66.

Goldsmith, R.E. and C. Hofacker (1991), "Measuring Consumer Innovativeness", *Journal of the Academy of Marketing Science,* 19, 209-221.

Gray, R.W. (1978), "Why Does Futures Trading Succeed or Fail: An Analysis of Selected Commodities". In: *Readings in Futures Markets,* Volume 3: Views From the Trade. Peck, A.E. (ed.), Chicago, CBOT.

Grönroos, C. (1990), *Services Management and Marketing: Managing the Moments of Truth in Service Competition,* Lexington Books, Lexington, MA/Toronto.

Grossman S.J. and M.H. Miller (1988), "Liquidity and Market Structure", *Journal of Finance,* 43, 617-637.

Grossman, S.J. (1986), "An Analysis of the Role of 'Insider Trading' on Futures Markets", *Journal of Business*, 59, 129-146.

Grossman, S.J. (1989), "The Existence of Futures Markets, Noisy Rational Expectations and Informational Externalities". In: Grossman, S.J. *The Information Role of Prices*. Wicksell Lectures, London MIT Press, 62-90.

Grossmann S.J. (1992), "The Informational Role of Upstairs and Downstairs Trading", *Journal of Business*, 65, 509-528.

Gunjal, K. and B. Legault (1995), "Risk Preferences of Dairy and Hog Producers in Quebec", *Canadian Journal of Agricultural Economics*, 43, 23-35.

Hahn, R.W. (1982), "Implementation Tradable Emission Permits". In: I. Graymer, *Reforming Social Regulation Alternative Public Policy Strategies*, Beverly Hills.

Hahn, R. W. (1984), "Market Power and Transferable Property Rights", *Quarterly Journal of Economics*, 99, 753-765.

Hahn, R. W. (1986a), "Economic Prescriptions For Environmental Problems: How The Patient Followed The Doctor's Orders", *Journal of Economic Perspectives* 3, 95-114.

Hahn, R.W. (1986b), "Trade-offs in Designing Markets with Multiple Objectives", *Journal of Environmental Economics and Management*, 13, 1-12.

Hahn, R. W. (1994), "Getting More Environmental Protection For Less Money: A Practitioner's Guide", *Oxford Review Of Economic Policy*, 9, 112-122.

Hahn, R.W. and C.A. May. (1994), "The Behavior of the Allowance Market: Theory and Evidence", *Electricity Journal*, 7, 28-36.

Harnett, D.L and L.L. Cummings (1980), *Bargaining Behavior: An International Study*, Houston, Dame Publications.

Harris, L. (1990), "Liquidity, Trading Rules, and Electronic Trading Systems", Monograph Series in Finance and Economics, New York University, Salomon Brothers Center.

Hasbrouck, J. and R.A. Schwartz (1988), "Liquidity and Execution Costs in Equity Markets", *Journal of Portfolio Management*, 14, 10-16.

Hill, J. and T. Schneeweis (1982), "The Hedging Effectiveness of Foreign Currency Futures", *Journal of Financial Research,* 5, 95-104.

Hiraki, T., E.D. Maberly and N. Takezawa (1995), "The Information Content of End-of-the-Day Index Futures Returns: International Evidence From the Osaka Nikkei 225 Futures Contracts", *Journal of Banking and Finance* 19, 921-936.

Hirshleifer, D. (1988), "Risk, Futures Pricing and the Organization of Production in Commodity Markets", *Journal of Political Economy,* 96, 1206-1220.

Hirshleifer, D. (1989), "Futures Trading, Storage and the Division of Risk: A Multiperiod Analysis", *Economic Journal,* 99, 700-719.

Hoffman, D.L. and G.R. Franke (1986), "Correspondence Analysis: Graphical Representation of Categorical Data in Marketing Research", *Journal of Marketing Research,* 23, 213-227.

Holden, C.W. and A. Subrahmanyam (1994), "Risk Aversion, Imperfect Competition, and Long-Lived Information", *Economic Letters,* 44, 181-190.

Horne, J.C. van (1986), *Fundamentals of financial management,* Prentice-Hall International, New Jersey.

Hosmer Jr., D.W. and S. Lemeshow (1989), *Applied Logistic Regression.* Wiley, New York.

Hotelling, H. (1931), "The Economics of Exhaustible Resources", *Journal of Political Economy,* 39, 137-175.

Howard, C. and L. D'Antonio (1984), "A Risk-Return Measure of Hedging Effectiveness", *Journal of Financial and Quantitative Analysis,* 19, 101-112.

Hsin, C-W, J. Kuo and C.W. Lee (1994), "A New Measure to Compare the Hedging Effectiveness of Foreign Currency Futures Versus Options", *Journal of Futures Markets,* 14, 685-707.

Huang, R.D. and H.R. Stoll (1994), "Market Microstructure and Stock Return Predictions", *Review of Financial studies,* 7, 179-213.

Huang, R.D. and H.R. Stoll (1996), "Dealer versus Auction Markets: A Paired Comparison of Execution Costs on NASDAQ and the NYSE", *Journal of Financial Economics,* 41, 313-357.

Hubbard, L. (1992), "Milk Quotas and Farm Asset Values", *National Westminster Bank Quarterly Review,* August, 38-48.

Huppes, G. (1992), *New Market-Oriented Instruments for Environmental Policies,* The Commission of the European Communities.

Jaccard, J., R. Turrisi and C.K. Wan (1990), *Interaction Effects in Multiple Regression.* SAGE Publications, New York.

Jaworski, B.J. and A.K. Kohli (1993), "Market Orientation: Antecedents and Consequences", *Journal of Marketing,* 57, 53-70.

Jaworski, B.J. and A.K. Kohli (1996), "Market Orientation: Review, Refinement, and Roadmap", *Journal of Market Focused Management* 1, 119-135.

Johnson, M.D. (1984), "Consumer Choice Strategies for Comparing Noncomparable Alternatives", *Journal of Consumer Research,* 11, 741-753.

Jolly, R.W. (1983), "Risk Management in Agriculture Production", *American Journal of Agricultural Economics,* 65, 1107-1113.

Jones, J.M. and C.J. Ritz (1991), "Incorporating Distribution into New Product Diffusion Models", *International Journal of Research in Marketing,* 8, 91-112.

Jöreskog, K. G. and D. Sörbom (1993), *LISREL 8: Structural Equation Modeling with the SIMPLIS Command Language.* Chicago, Scientific Software International, Inc.

Joseph, W.B. and S.J. Vyas (1984), "Concurrent Validity of a Measure of Innovative Cognitive Style", *Journal of the Academy of Marketing Science,* 12, 159-175.

Kahl, K. H. (1983), "Determination of the Recommended Hedging Ratio", *American Journal of Agricultural Economics,* 65, 603-605.

Kahneman, D. and A. Tversky (1979), "Prospect Theory: An Analysis of Decision Under Risk", *Econometrica,* 47, 263-291.

Kahneman, D. and A. Tversky (1982), "The Psychology of Preferences", *Scientific American,* 246, 162-170.

Kamien, M.I. and N.L. Schwartz (1976), "On the Degree of Rivalry for Maximum Innovative Activity", *Quarterly Journal of Economics,* 90, 245-260.

Keeney, R.L. and H. Raiffa (1976), "*Decisions With Multiple Objectives: Preferences and Value Tradeoffs*". Wiley, New York.

Keim, D.B. and A. Madhavan (1995), "The Anatomy of the Trading Process", *Journal of Financial Economics,* 37, 371-398.

Kent, C., D.L. Sexton and K.H. Vesper (1982), "*Encyclopedia of Entrepreneurship*". New Jersey, Prentiss-Hall, Englewood Cliffs.

Kilcollin, T.E. and M.E.S. Frankel (1993), "Futures and Options Markets: Their New Role in Eastern Europe", *Journal of Banking and Finance,* 17, 869-881.

Klaassen, G. (1994), "A Portrait of Emission Trading as a Young Instrument". Paper presented at the Fifth Annual Conference of the European Association of Environmental and Resource Economists, June 22-24, 1994, University College, Dublin.

Kohli, A.K. and B.J. Jaworski (1990), "Market Orientation: The Construct, Research Proposition, and Managerial Implications", *Journal of Marketing,* 54, 1-18.

Kotler, P. (1990), *Marketing Management: Analysis, Planning, Implementation and Control.* New York, Prentice Hall, Englewood Cliffs.

Krzysztofowicz, R. (1983), "Strength of Preference and Risk Attitude in Utility Measurement", *Organizational Behavior and Human Performance,* 31, 88-113.

Kumar, P. and D.J. Seppi (1994), "Information and Index Arbitrage", *Journal of Business,* 67, 481-509.

Kyle, A.S. (1985), "Continuous Auctions and Insider Trading", *Econometrica,* 53, 1315-1335.

Lance, C.E., J.A. LaPointe and M.A. Stewart (1994), "Tests of three Causal Models of Halo Rater Error", *Organizational Behavior and Human Decision Processes* 57, 83-96.

Lapan, H. and G. Moschini (1994), "Futures Hedging Under Price, Basis, and Production Risk", *American Journal of Agricultural Economics,* 76, 465-477.

Larouche, M. and R. Sadokierski (1994), "Role of Confidence in a Multi-Brand Model of Intentions for a High-Involvement Service", *Journal of Business Research,* 19, 1-12.

Larson, A.B. (1961), "Estimation of Hedging and Speculative Positions in Futures Markets", *Food Research Institute Studies,* 2, 203-212.

Lasser, D.J. (1987), "A Measure of Ex Ante Hedging Effectiveness for the Treasury Bill and Treasury Bond Futures Market", *Review of Futures Markets*, 2, 279-295.

Leavitt, C. and J. Walton, (1975) "Development of a Scale for Innovativeness". In: *Advances in Consumer Research*, 2, Mary Jane Schlinger (ed.), Ann Arbor, MI: Association of Consumer Research, 545-554.

Leavitt, C. and J. Walton (1988), "Openness of Information Processing as a Moderator of Message Effects on Behavior", faculty working paper, College of Business of Administration, Ohio State University.

Ledyard, J.O. and K. Szakaly-Moore (1994), "Designing Organizations for Trading Pollution rights", *Journal of Economic Behavior and Organization,* 25, 167-196.

Lehmann, B. and D.M. Modest (1994), "Trading and Liquidity on the Tokyo Stock Exchange: A Bird's Eye View", *Journal of Finance,* 49, 951-982.

Leuthold, R.M. and P.E. Peterson (1987), "A Portfolio Approach to Optimal Hedging for a Commercial Cattle Feedlot", *Journal of Futures Markets*, 7, 119-133.

Leuthold, R.M., P. Garcia and R. Lu (1994), "The Returns and Forecasting Ability of Large Traders in the Frozen Pork Bellies Futures Market", *Journal of Business*, 67, 459-473.

Lewis, T.R. and D.E.M. Sappington (1995), "Using Markets to Allocate Pollution Permits and Other Scarce Resource Rights under Limited Information", *Journal of Public Economics,* 57, 431-455.

Lien, D.H.D. (1993), "Risk-Return Measures of Hedging Effectiveness: the Case of Multiple Cash and Futures Markets", *Managerial and Decision Economics*, 14, 71-74.

Lindahl, M. (1989), "Measuring Hedging Effectiveness with R2: A Note", *Journal of Futures Markets*, 9, 469-475.

Lippman, S. and J. McCall (1986), "An Operational Measure of Liquidity", *American Economic Review*, 76, 43-55.

Liu, S-M., W.B. Brorsen, C.M. Oellermann and P.L. Farris (1994), "Forecasting the Nearby Basis of Live Cattle", *Journal of Futures Markets*, 14, 259-273.

Lord, S. (1993), "The European Community and the Environment", *Journal of Environmental Law,* 5, 261.

Lovelock, C. H. (1983), "Classifying Services to Gain Strategic Marketing Insights", *Journal of Marketing,* 47, 9-20.

Lovelock, C.H. (1996), *Services Marketing*. Prentice Hall International Editions, New Jersey.

Makus, L.D., B-H. Lin, J. Carlson and R. Krebill-Prather (1990), "Factors Influencing Farm Level Use of Futures and Options in Commodity Marketing", *Agribusiness: An International Journal*, 6, 621-631.

March, H.W. and D. Hocevar (1985), "Application of Confirmatory Factor Analysis to the Study of Self-Concept: First- and Higher Order Factor Models and Their Invariance Across Groups", *Psychological Bulletin*, 97, 562-582.

Massimb, M.N. and B.D. Phelps (1994), "Electronic Trading, Market Structure and Liquidity", *Financial Analysts Journal,* January-February.

McCarthy, S. (1992), "An Illustration of the Coase Theorem and the Consequences Externalities Have on Legal Rights", Discussion Papers, The University of Queensland, Australia.

McFadden, D. (1986), "The Choice Theory Approach to Market Research", *Marketing Science* 5, 275-297.

McQuiston, D.H. (1989), "Novelty, Complexity, and Importance as Causal Determinants of Industrial Buyer Behavior", *Journal of Marketing*, 67, 66-79.

Merton, R.C. (1995), "Financial Innovation and the Management and Regulation of Financial Institutions", *Journal of Banking and Finance,* 19, 461-481.

Meyer, J. and R.H. Rasche (1992), "Sufficient Conditions for Expected Utility to Imply Mean-Standard Deviation Rankings: Empirical Evidence Concerning the Location and Scale Condition", *The Economic Journal,* 102, 91-106.

Miller, C. (1995), "Environmental Rights: European Fact or English Fiction?", *Journal of Law and Society,* 22, 374-393.

Miller, D., M.F.R. Kets de Vries and J. Toulouse (1982), "Top Executive Locus of Control and its Relationship to Strategy-Making, Structure, and Environment", *Academy of Management Journal,* 25, 237-253.

Miller, M.H. (1990), "International Competitiveness of U.S. Futures Exchanges", *Journal of Financial Services,* 4, 387-408.

Moschini, G. (1988), "The Cost Structure of Ontario Dairy farms: A Microeconometric Analysis", *Canadian Journal of Agricultural Economics,* 36, 187-206.

Myers, R.J. and S.R. Thompson (1989), "Generalized Optimal Hedge Ratio Estimation", *American Journal of Agricultural Economics,* 57, 858-868.

Naik, G. and R.M. Leuthold (1988), "Cash and Futures Price Relationships for Nonstorable Commodities: An Empirical Analysis Using a General Theory", *Western Journal of Agricultural Economics,* 13, 327-338.

Nakata, C. and K. Sivakumar (1996), "National Culture and New Product Development: An Integrative Review", *Journal of Marketing,* 60, 61-72.

Narver, J.C. and S.F. Slater (1990), "The Effect of a Market Orientation on Business Profitability", *Journal of Marketing,* 54, 20-35.

Naylor, T.H. and J.M. Vernon (1969), *Microeconomics and Decision Models of the Firm.* Hartcourt, Brace & World, New York.

Nelson, R.D. (1985), "Forward and Futures Contracts as Preharvest Commodity Marketing Instruments", *American Journal of Agricultural Economics,* 76, 15-23.

Nelson, R.D. and R.A. Collins (1985), "A Measure of Hedging's Performance", *Journal of Futures Markets,* 5, 45-55.

Nelson, R.H. (1986), "Private Rights to Government Actions: How Modern Property Rights Evolve", *University of Illinois Law Review*, 361-386.

Nentjes, A. (1990), "De Economie van het Mestoverschot", *Tijdschift voor Milieukunde*, 159-163.

Netz, J.S. (1996), "An Empirical Test of the Effect of Basis Risk on Cash Market Positions", *Journal of Futures Markets*, 16, 289-311.

Neumann J. von and O. Morgenstern 1947, *Theory of Games and Economic Behavior* (2nd Ed.). Princeton University Press, Princeton.

Normann, R. (1991), *Service Management: Strategy and Leadership in Service Business*, John Wiley & Sons, Chichester.

Nothaft, F.E., V. Lekkas, and G. Wang (1995), "The Failure of the Mortgage Backed Futures Contract", *Journal of Futures Markets,* 15, 585-603.

Nunnallay, J.C. and I.H. Bernstein (1994), *Psychometric Theory* (3nd. Ed). McGraw-Hill, New York.

Nussbaum, B. (1992), "Phasing Down Lead in Gasoline in the U.S.: Mandates, Incentives, Trading and Banking". In: *Climate Change, Designing a Tradable Permit System,* Paris: OECD.

O'Reilly, C. (1989), "Corporations, Culture, and Commitment: Motivation and Social Control in Organizations", *California Management Review*, 31, 9-25.

Oliver, K. and R.E. Verrecchia (1994), "Market Liquidity and Volume Around Earnings Announcement", *Journal of Accounting and Economics,* 17, 41-67.

Opschoor, J.B. and H. Vos (1989), "Economic Instruments for Environmental Protection", Paris: OECD.

Oskam, A.J. (1989), "Principles of the EC Dairy Model", *European Review of Agricultural Economics,* 16, 463-497.

Oskam, A.J. (1991), "Quota Mobility and Quota Values and Their Influences on Structural Development of Dairy Farming", Paris: OECD.

Overdahl, J.A. and D.R. Starleaf (1986), "The Hedging Performance of the CD Futures Market", *Journal of Futures Markets*, 6, 71-81.

Ozment, J. and E.A. Morash (1994), "The Augmented Service Offering for Perceived and Actual Service Quality", *Journal of the Academy of Marketing Science*, 22, 352-262.

Parasuraman, A. (1995), "Measuring and Monitoring Service Quality". In: *Understanding Services Management: Integrating Marketing, Organizational Behavior, Operations and Human Resource Management* Glynn, W.J. and J.G. Barnes, 143-177.

Parasuraman, A., V.A. Zeithaml and L.L. Berry (1985), "A Conceptual Model of Service Quality and its Implications for Future Research", *Journal of Marketing,* 49, 41-50.

Parisi, F. (1995), "Private Property and Social Costs", *European Journal of Law and Economics,* 2, 149-173.

Park H.Y. and A. Sarkar (1994), "Measuring Changes in Liquidity of the Futures Market", Working paper, Office for Futures and Options Research University of Illinois at Urbana-Champaign.

Paroush, J. and A. Wolf (1989), "Production and Hedging Decisions in the Presence of Basis risk", *Journal of Futures Markets,* 9, 547-563.

Paul, A.B. (1976), "Farmers' Use of Forward Contracts and Futures Markets", *US Department of Agricultural Economic Research Service*, report, 320.

Peeters, M. (1992), *Marktcomform Milieurecht? Een Rechts-vergelijkende Studie naar de Verhandelbaarheid van Vervuilingsrechten*, Schoordijk-Instituut, W.E.J. Tjeenk Willink Zwolle.

Pekelney, D. (1993), "Emissions Trading: Applications to improve Air and Water Quality", *Pollution Prevention Review,* Spring 1993, 139-148.

Pennings, J.M.E. (1997), "Verschiebung des Preisrisikos mit Hilfe von Terminkontrakten in der Agrarwirtschaft", *Agrarwirtschaft*, 46, 344-348

Pennings, J.M.E. (1998), "Erwiederung: Diskussionsbeiträge Verschiebung des Preisrisikos mit Hilfe von Terminkontrakten in der Agrarwirtschaft", forthcoming *Agrarwirtschaft*

Pennings, J.M.E (1998), "The Information Dissemination Process of Futures Exchange Innovations: A Note", forthcoming *Journal of Business Research*

Pennings, J.M.E. and A. Smidts (1988), "Entrepreneurs' Risk Attitude Structure: Understanding Risk Management Behavior", Working paper Wageningen Agricultural University, Department of Economics and Management, Marketing and Consumer Behavior Group.

Pennings, J.M.E. and M.J.J.M. Candel (1997), "Modeling Choices of Small and Medium Sized Enterprises for the Hedging Service Provided by Futures Contracts", Proceedings of the 26th European Marketing Academy Conference, 1905-1914, 20-23 May 1997, Warwick, United Kingdom.

Pennings, J.M.E. and M.T.G. Meulenberg (1995), "De Opkomst van Agrarische Termijnmarkten", *Economische Statistische Berichten*, 80, 1105-1107.

Pennings, J.M.E. and M.T.G. Meulenberg (1996), "Environmental and Production Rights Futures: A New Booming Market?", *Derivatives Quarterly*, 3, 40-44.

Pennings, J.M.E. and M.T.G. Meulenberg (1997), "Grondstoffen Termijnmarkten: Ontwikkelingen en Innovaties", *Bedrijfskunde*, 69, 81-86.

Pennings, J.M.E. and M.T.G. Meulenberg (1997), "Hedging Risk in Agricultural Futures Markets". In: Wierenga, B. A. van Tilburg, K. Grunert, J-E.B.M. Steenkamp and M. Wedel (eds.), *Agricultural Marketing and Consumer Behavior in a Changing World*, Kluwer Academic Publishers, Boston, p. 125-140.

Pennings, J.M.E. and M.T.G. Meulenberg (1997), "Modeling Choice Behavior of Marketing Channel Members for the Services Provided by Financial Derivatives Exchanges", Working Paper Wageningen Agricultural University, Department of Marketing and Marketing Research.

Pennings, J.M.E. and M.T.G. Meulenberg (1997), "Hedging Efficiency: A Futures Exchange Management Approach", *Journal of Futures Markets*, 17, 599-615.

Pennings, J.M.E., and M.T.G. Meulenberg (1997), "A Futures Markets for Agricultural Production Rights: An Application to the Dutch, English and Welsh Milkquota Market". In: Huirne, R.B.M., J.B. Hardaker, and A.A. Dijkhuizen (eds) *Risk Management Strategies in Agriculture: State of the Art and Future Perspectives*, Mansholt Studies, Wageningen, p. 163-172.

Pennings, J.M.E. and M.T.G. Meulenberg (1997), "The Hedging Performance in New Agricultural Futures Markets: A Note", *Agribusiness: An International Journal,* 13, 295-300.

Pennings, J.M.E. and M.T.G. Meulenberg (1998), "New Futures Markets in Agricultural Production Rights: Possibilities and Constraints for the Dutch and British Milkquota Markets", forthcoming *Journal of Agricultural Economics*

Pennings, J.M.E. and W.J.M. Heijman (1996), "Prospects for an Electricity Futures Market: A Comment", *Resources Policy,* 21, 283-284.

Pennings, J.M.E., M.G.M. Wetzels and M.T.G. Meulenberg (1997), "The Marketing-Finance Interface Towards Financial Services", Proceedings of the 26th European Marketing Academy Conference in Warwick , 1915-1924, United Kingdom, 20-23 May 1997.

Pennings, J.M.E., M.T.G. Meulenberg and W.J.M. Heijman (1996), "Environmental Rights on the Futures Markets: An Application to the Dutch Manure Market", *Environmental and Resource Economics,* 7, 79-94.

Pennings, J.M.E., W.E Kuiper, F. ter Hofstede and M.T.G. Meulenberg (1998), "The Price Path Due to Order Imbalances: Evidence from the Amsterdam Agricultural Futures Exchange", forthcoming *European Financial Management*

Pennings, J.M.E., W.J.M. Heijman and M.T.G. Meulenberg (1997), "The Dimensions of Rights: A Classification of Environmental Rights and Production Rights", *European Journal of Law and Economics,* 4, 55-71.

Pennings, J.M.E. and D.F. Broens (1997), "Financial Derivatives Exchange Innovations: Reinforcement versus Cannibalism", Working Paper Wageningen Agricultural University, Department of Marketing and Marketing Research.

Peterson, P.E. and R.M. Leuthold (1987), "A Portfolio Approach to Optimal Hedging for a Commercial Cattle Feedlot", *Journal of Futures Markets,* 7, 443-457.

Pirrong, S.C., R. Kormendi and P. Meguire (1994), "Multiple Delivery Points, Pricing Dynamics, and Hedging Effectiveness in Futures Markets for Spatial Commodities", *Journal of Futures Markets* 14, 545-573.

Poitras, G. (1989), "Optimal Futures Spread Positions", *Journal of Futures Markets,* 9, 123-133.

Pope, R.D. and J.P. Chavas (1994), "Cost Functions under Production Uncertainty", *American Journal of Agricultural Economics,* 76, 196-204.

Posavac, S.S., D.M. Sanbonmatsu and R.H. Fazio (1997), "Considering the Best Choice: Effects of the Salience and Accessibility of Alternatives on Attitude-Decision Consistency", *Journal of Personality and Social Psychology,* 72, 253-261.

Powers, M.J. (1979), "Thin Markets a Regulatory Perspective, in Pricing Problems in the Food Industry", Madison, WS: N.C. Project 117, Monograph 7, February 1979.

Pratt, J.W. (1964), "Risk Aversion in the Small and in the Large", *Econometrica,* 32, 122-136.

Pulley, L.B. (1981), "A General Mean-Variance Approximation to Expected Utility for Short Holding Periods", *Journal of Financial and Quantitative Analysis,* 14, 361-373.

Punj, G. and D.W. Stewart (1983), "Cluster Analysis in Marketing Research: Review and Suggestions for Application", *Journal of Marketing Research,* 20, 134-148.

Puto, C.P. (1987), "The Framing of Buying Decisions", *Journal of Consumer Research,* 14, 301-315.

Putte, B. van den, J. Hoogstraten, and R. Meertens (1996), "A Comparison of Behavioral Alternative Models in the Context of the Theory of Reasoned Action", *British Journal of Social Psychology*, 35, 257-266.

Raju, P.S. (1980), "Optimum Stimulation Level: Its Relationship to Personality, Demographics, and Exploratory Behavior", *Journal of Consumer Research*, 7, 272-282.

Rindskopf, D. and T. Rose (1988), "Some Theory and Applications of Confirmatory Second-Order Factor Analysis", *Multivariate Behavioral Research*, 23, 51-67.

Robison, L.H. and P.J. Barry (1987), *The Competitive Firm's Response to Risk*. Macmillan Publishing Company, New York,

Robison, L.J. (1996), "The Analysis of the Firm's Response to Risk using Mean Variance Models", Proceedings EUNITA-seminar: Risk Management Strategies in Agriculture: State of the Art and Future Perspective, January 7-10, 1996.

Robison, L.J. and S.D. Hanson (1997), "Analysing Firm Response to Risk Using Mean Variance Models". In: Huirne, R.B.M., J.B. Hardaker and A.A. Dijkhuizen (eds), *Risk Management Strategies in Agriculture*, p. 121-137.

Rolfo, J. (1980), "Optimal Hedging under Price and Quantity Uncertainty: the Case of a Cocoa Producer", *Journal of Political Economy*, 88, 100-116.

Roll, R. (1984), "A Simple Implicit Measure of the Effective Bid-Ask Spread in an Efficient Market", *Journal of Finance*, 39, 1127-1139.

Ross, S. (1989), "Institutional Markets, Financial Marketing, and Financial Innovation", *Journal of Finance*, 44, 541-556.

Rust, R.T. and R.L. Oliver (1993), "Service Quality: Insights and Managerial Implications from the Frontier". In: *Service Quality: New Directions in Theory and Practice, Sage Publications* Rust, R.T. and R.L. Oliver, Thousand Oaks, etc, 1-20.

Rust, R.T., A.J. Zahorik and T.L. Kiningham (1996), *Service Marketing*, Harper Collins College Publishers, New York.

Ruyter, K. de and M. Wetzels (1996), "Are Some Services More Equal than Others: an Investigation into the Hierarchy of Services Concept", Workshop on Quality Management in Services VI, 15-16 April 1996, Madrid, Spain.

Ryan, M.J. (1982), "Behavioral Intention Formation: The Interdependency of Attitudinal and Social Influence Variables", *Journal of Consumer Research*, 9, 263-278.

Ryan, M.J. and E.H. Bonfield (1975), "The Fishbein Extended Model and Consumer Behavior", *Journal of Consumer Research*, 2, 118-136.

Sandor, R.L (1991), "Chicago Board of Trade Clean Air Futures for Emissions Allowances Program Risk Management", *Financial Exchange*, 10, 9-10.

Sandor, R.L. (1973), "Innovation By an Exchange: A Case Study of the Development of the Plywood Futures Contract", *Journal of Law and Economics*, 16, 119-136.

Savage L.J (1954), *Foundations of Statistics*. Wiley, New York.

Scheuing E.E. and J.M. Johnson (1989), "A Proposed Model for New Service Development", *Journal of Services Marketing*, 3, 25-33.

Schoemaker, P.J.H. (1980), "*Experiments on Decisions Under Risk: The Expected Utility Hypothesis*". Martinus Nijhoff, Boston.

Schoemaker, P.J.H. (1982), "The Expected Utility Model: its Variants, Purposes, Evidence and Limitations", *Journal of Economic Literature* 20, 529-563.

Selwyn, J. (1993), "Theoretical Advantages of Emission Permits", *Acid News*, 5, 11-12.

Shafer, C.E. (1993), "Hedge Ratios and Basis Behavior: an Intuitive Insight?", *Journal of Futures Markets*, 13, 837-847.

Sharma, S. (1996), *Applied Mulivariate Techniques*. Wiley, New York.

Sherman, S.J. (1980), "On the Self-Erasing Nature of Errors of Prediction", *Journal of Personality and Social Psychology*, 39, 211-221.

Shimp, T.A. and A. Kavas (1984), "The Reasoned Action Applied to Coupon Usage", *Journal of Consumer Research*, 11, 795-809.

Shimp, T.A. and W.O. Bearden (1982), "Warranty and Other Extrinsic Cue Effects on Consumers' Risk Perception", *Journal of Consumer Research*, 9, 38-46.

Shostack, L. G. (1984), "Service Design in Operating Environment". In: *Developing New Services*, George, W. R. and C. Marshall (Eds.), 27-43.

Shostack, L.G. (1977), "Breaking Free from Product Marketing", *Journal of Marketing*, 41, 73-80.

Silber W.L. (1981), "Innovation, Competition, and New Contract Design in Futures Markets", *Journal of Futures Markets*, 1, 123-155.

Sinn H.W. (1983), *Economic Decisions Under Uncertainty*. North-Holland, Amsterdam.

Slater, S.F. and J.C. Narver (1995), "Market Orientation and the Learning Organization", *Journal of Marketing*, 59, 63-74.

Smidts, A. (1990), *Decision Making Under Risk: A Study of Models and Measurement Procedures With Special Reference to the Farmer's Marketing Behavior*, Dissertation Wageningen University, Pudoc, Wageningen.

Smidts, A. (1997), "The Relationship Between Risk Attitude and Strength of Preference: A Test of Intrinsic Risk Attitude", *Management Science*, 43, 357-370.

Smith, T. and R.E. Whaley (1994), "Estimating the Effective Bid-Ask Spread From Time and Sales Data", *Journal of Futures Markets*, 14, 37-455.

Snedecor, G.W. and W.G. Cochran (1994), *Statistical Methods*. Ames: Iowa State University Press.

Steenkamp, J-B.E.M. and H.C.M. van Trijp (1991), "The Use of LISREL in Validating Marketing Constructs", *International Journal of Research in Marketing*, 8, 283-299.

Stein, J.J. (1991), *International Financial Markets: Integration, Efficiency, and Expectations*, Blackwell, Oxford and Cambridge.

Stewart, J. (1991), *Econometrics*, New York: Philip Allan.

Stoll, H.R and R.E. Whaley (1993), *Futures and Options: Theory and Applications*, South-Western Publishing Co, Cincinnati Ohio.

Stoll, H.R. (1989), "Inferring the Components of the Bid-Ask Spread: Theory and Empirical Tests", *Journal of Finance*, 44, 115-134.

Stone, R.N. and J.B. Mason (1995), "Attitude and Risk: Exploring the Relationship", *Psychology and Marketing*, 12, 135-153.

Storey, C.D. and C.J. Easingwood (1996), "Determinants of New Product Performance: A Study in the Financial Services Sector", *International Journal of Service Industry Management*, 7, 32-55.

Swartz, T.A., D.E. Bowen and S.W. Brown (1992), "Fifteen Years after Breaking Free: Services Then, Now and Beyond". In: *Advances in Services Marketing and Management: Research and Practice*, Swartz, T.A., D.E. Bowen and S.A. Brown, JAI Press, Greenwhich/London, 1, 1-21.

Tallard, G. and L. Curtin (1991), "Quota mobility: the Canadian Experience", as annex by Oskam, A.J. and Speijers, D.P., Quota Mobility: the Sale, Lease and Redistribution of Milk Production Quotas in OECD Countries, Paris: OECD, Directorate for Food, Agriculture and Fisheries.

Tashjian, E. (1995), "Optimal Futures Contract Design", *Quarterly Review of Economics and Finance*, 35, 153-162.

Tashjian, E. and J.J. McConnel (1989), "Requiem for a Market: An Analysis of the Rise and Fall of a Financial Futures Contract", *Review of Financial Studies*, 2, 1-23.

Tashjian, E. and M. Weissman (1995), "Advantages to Competing with Yourself: Why an Exchange Might Design Futures Contracts With Correlated Payoffs", *Journal of Financial Intermediation*, 4, 133-157.

Telser, L.G., and H.N. Higinbotham (1997), "Organized Futures Markets: Costs and Benefits", *Journal of Political Economy*, 85, 969-1000.

Tew, B.V., D.W. Reid and C.A. Witt (1991), "The Opportunity Cost of a Mean Variance Efficient Choice", *The Financial Review*, 26, 31-43.

Thompson, S.R. and M.L. Waller (1987), "The Execution Cost of Trading in Commodity Futures Markets", *Food Research Institute Studies*, 20, 141-163.

Thompson, S.R. and M.L. Waller (1988), "Determinants of Liquidity Costs in Commodity Futures Markets", *Review of Futures Markets,* 7, 110-26.

Thompson, S.R., M.L. Waller and D. Seibold (1993), "Comparison of Liquidity Costs Between the Kansas City and Chicago Wheat Futures Contracts", *Journal of Agricultural and Resource Economics,* 18, 185-197.

Thompson, S.R., P. Garcia and L. Dallafior (1994), "The Demise of the High Fructose Corn Syrup Futures Contract: A Case Study", OFOR paper number 94-06. University of Illinois at Urbana-Champaign.

Tietenberg, T.H. (1985), *Emissions Trading: an Exercise in Reforming Pollution Policy,* Washington.

Tietenberg, T.H. (1989a), "Acid Rain Reduction Credits", *Challenge,* 25-29.

Tietenberg, T.H. (1989b), "Marketable Emission Permits in the United States: A Decade of Experience". In M. Neumann, K.W. Roskamp, *Public Finance and Performance of Enterprises,* Detroit.

Tietenberg, T.H. (1990), "Economic Instruments for Environmental Regulation", *Oxford Review of Economic Policy,* 6, 17-33.

Tietenberg, T.H. (1992), *Innovation in Environmental Policy,* Maine.

Trapp, J.N., and F.C. Eilrich (1991), "An Analysis of Factors Affecting Oklahoma City Feeder Cattle Basis", *Applied Commodity Price Analysis, Forecasting, and Market Risk Management,* Proceedings of the NCR-134 Conference, pp 180-192.

Turvey C.G. and T. G. Baker (1990), "A Farm-Level Financial Analysis of Farmers' Use of Futures and Options Under Alternative Farm Programs", *American Journal of Agricultural Economics,* 72, 946-957

Tussing, A.R. and D.B. Hatcher (1994), "Prospects For An Electricity Futures Market", *Resources Policy,* 20, 135-141.

Tversky, A. and D. Kahneman (1981), "The Framing of Decisions and the Psychology of Choice", *Science,* 211, 453-458.

Tzang, D.N. and R.M. Leuthold (1990), "Hedge Ratios Under Inherent Risk Reduction in a Commodity Complex", *Journal of Futures Markets,* 10, 497-505.

USEPA, (1990), *Clean Air Act Amendments of 1990, detailed summary of titles*, Washington D.C.

USEPA, (1992a), *Acid Rain Program, Overview*, Washington, D.C.

USEPA, (1992b), *Acid Rain Program, Allowance Auctions and Direct Sales*, Washington D.C.

Varian, H.R. (1990), *Intermediate Microeconomics*. W.W. Norton & Company, New York.

Wagner, W.H. and M. Edwards (1993), "Best Execution", *Financial Analysts Journal*, January-February, 65-71.

Wakker, P. and D. Deneffe (1996), "Eliciting von Neumann-Morgenstern Utilities When Probabilities Are Distorted or Unknown", *Management Science*, 42, 1131-1150.

Walsh, J. M. (1993) *Barriers to Development of a Market for Emission Permits,* Report CBOT, Chicago.

Ward, R.W. and F.A. Dasse (1977), "Empirical Contributions to Basis Theory: the Case of Citrus Futures", *American Journal of Agricultural Economics,* 59, 71-80.

Ward, R.W. and R.M. Behr (1974), "Market Liquidity in the FCOJ Futures Markets", *American Journal of Agricultural Economics,* 56, 150-154.

Ward, R.W. and R.M. Behr (1993), "Futures Trading Liquidity: An Application of a Futures Trading Model", *Journal of Futures Markets,* 3, 207-724.

Weber, E.U. and R.A. Milliman (1997), "Perceived Risk Attitudes: Relating Risk Perception to Risky Choice", *Management Science*, 43, 123-144.

Webster Jr, F.E., (1998), "Rediscovering the Marketing Concept", *Business Horizons,* 31, 29-39.

Wierenga, B., A. van Tilburg, K. Grunert, J-B.E.M. Steenkamp and M. Wedel (1997), *Agricultural Marketing and Consumer Behavior in a Changing World*, Kluwer Academic Publishers, Boston

Williams, R. (1993), "The Future of Milk Marketing", *Journal of Agricultural Economics,* 44, 1-13.

Wilson, W.W. (1984), "Hedging Effectiveness of U.S. Wheat Futures Markets", *Review of Research in Futures Markets,* 3, 64-79.

Winterfeldt, D. von and W. Edwards (1986), *Decision Analysis and Behavioral Research.* Cambridge University Press, Cambridge.

Wochnowski, H. (1995), "Die Bedeutung der Scalierung bei Multiattribut-modellen der Qualitatsmessung", *Marketing ZFP,* 3, 195-201.

Working, H. (1953), "Futures Trading and Hedging", *American Economic Review,* 43, 314-34.

Working, H. (1960), "Speculation on Hedging Markets", *Food Research Institute Studies,* 1, 185-270.

Working, H. (1962), "New Concepts Concerning Futures Markets and Prices", *American Economic Review,* 52, 431-59.

Working, H. (1977), "Price Effects of Scalping and Day Trading", Selected writings of Holbrook Working, Ann Peck, Ed., Chicago: CBOT, 181-193.

Zeithaml, V.A. (1981), "How Consumer Evaluation Processes Differ between Goods and Services". In: *Marketing of Services* Donnelly, J. and W. George (eds.), American Marketing Association, Chicago, IL, 186-190.

Zeithaml, V.A., A. Parasuraman and L.L. Berry (1985), "Problems and Strategies in Services Marketing", *Journal of Marketing,* 49, 33-46.

Zeithaml, V.A., L.L. Berry and A. Parasuraman (1996), "The Behavioral Consequences of Service Quality", *Journal of Marketing,* 60, 31-46.

Zilcha, I. and U. Broll (1992), "Optimal Hedging by Firms with Multiple Sources of Risky Revenues", *Economic Letters,* 39, 473-477.

Summary

Due to the recent and proposed reductions in price support for agricultural products, as a part of the European Union's common agricultural policy, an increase in price volatility for agricultural raw materials is perceptible. This causes an increase in price risk, both for the primary agricultural company and the affiliated agribusiness. For a risk-averse entrepreneur, the higher price volatility in the market of agricultural raw materials will increase his or her need for price risk management instruments, such as futures contracts.

Not only does an increased price volatility further the use of existing futures contracts for raw materials, it also leads to the introduction of new ones. Moreover, the introduction of production and environmental rights forms an additional impulse to the development of futures contracts as well. Recent developments in computer-guided trading systems will further enhance the attractiveness and accessibility of the futures contract as a price risk management instrument. In addition, the introduction of a single European currency will give an extra impulse to trade in (commodity) futures contracts, since it obliterates one of the traditional difficulties in futures contract specification, standardization after currency and thus makes national futures markets more attractive for participants from other European countries. The developments mentioned above - increased price volatility in the spot market of agricultural raw materials, the introduction of negotiable production and environmental rights, the rise of computerized trading systems and the introduction of a single European currency - all add to the great interest in agricultural futures markets which exists among financial

institutions. For several European futures markets, among which the Amsterdam Exchanges, the London International Financial Futures & Options Exchange and the Marché à Terme International de France, this has been the cause for the development of new agricultural futures contracts. However, futures contracts involve a substantial risk of failure. Of the 40 futures contracts launched around the world in 1995, only a few were successful in their first year. The development and introduction of futures contracts is an expensive and time-consuming process, especially when it concerns entirely new contracts. For this reason, insight into the market for hedging services is desirable.

In this doctoral thesis we will focus on those aspects of the risk reduction services provided by futures exchanges which lie in the interdisciplinary field between marketing and finance. The services offered by futures contracts will be investigated from two approaches: the *finance approach* and the *marketing approach*.

The *finance approach* to financial services is a normative approach: it answers the question 'which necessary conditions will have to be met to make a particular financial service successful?' Fulfilling these necessary conditions, however, does not guarantee the market success of financial services. Their success also depends on the extent to which they succeed in meeting the needs of (potential) customers at a competitive price. The latter point of view stems from the marketing tradition, which holds that customer needs occupy a central position in the development of products and services.

The *marketing approach* conducts qualitative and quantitative research into the need for financial services and the market potential of a particular financial service. In many cases, alternative products or services will be available to satisfy the entrepreneur's needs. For this reason, the marketing approach pays a lot of attention to the entrepreneur's decision making process. In our particular case the entrepreneur's decision making process concerning price risk management instruments. Insight into the way in which an entrepreneur reaches a decision and why he or she decides the way he or she does, provide the marketer with clues on how to market the hedging service. Given the necessary conditions imposed by the finance approach, the results from the marketing approach may serve to compose the characteristics of a particular financial service.

When creating a particular service, the marketing approach, in its preoccupation with customer needs, tends to pay only limited attention to issues of technical feasibility, whereas the finance approach tends to undervalue customer needs in favor of the technical aspects of a particular service. A combination of the marketing approach (with its stress on desirability from a customer perspective) and the finance approach (with its focus on the technical feasibility of a service) seems to offer a solution to this problem. Therefore, the development of new futures contracts would be served by a combined use of the marketing and the finance approach.

Apart from the integration of both approaches, a further deepening of each approach would be beneficial. This thesis elaborates on a number of aspects which stem from the finance approach, e.g. hedging efficiency and liquidity. The perspective has been shifted from portfolio to exchange management. Furthermore, the optimal hedge ratio and optimal "commodity product spread" have been deducted for rights futures. The marketing approach has also been elaborated upon, in that an investigation has taken place of the how and why of the choices which entrepreneurs make concerning the covering of price risk and, more particularly, concerning futures contracts.

This study consists of three parts. Part I systematically discerns the different sources of risk that emerge from transactions on the futures market. This classification has been used to develop new measures for a futures market's hedging effectiveness and liquidity, which provide both the exchange management and the hedger with insight into the risk-reducing capacity of futures contracts. Moreover, a conceptual model for over-all risk reduction has been developed, on the basis of which a measure for hedging effectiveness has been developed. Contrary to the existing measures, this one does not focus on portfolio performance, but on the hedging function of a futures contract. This measure, as opposed to others, takes into account the fact that futures contracts on the one hand realize a reduction of price risk in the spot market, and on the other hand, introduce a risk of their own, which is inherent to the futures trade. Our measure discerns basic risk and market-depth risk. Moreover, it takes into account the costs of commission. Let this measure be the distance between the hedging service offered by the futures exchange and the 'perfect hedge', an ideal situation where the hedging service eliminates risk in the spot market without introducing an additional risk of its own, then this distance can be subdivided into a systematic and a non-systematic part. The systematic part, caused by the specifications of the futures contract and the structure of the futures exchange, can be managed by the futures exchange, whereas the non-systematic part is beyond the exchange's influence. The measure for hedging effectiveness provides the hedger with a means to compare the competitiveness of different futures contracts. It incorporates not only the characteristics of the futures contract, but also the spot market risks. The measure's futures market risk component indicates the hedging quality of the futures contract. The spot market price risk component emphasizes the need for price risk reduction. The empirical results, based on data from the Amsterdam Exchanges (Agricultural Futures Markets), show the measure's usefulness for an exchange management.

As an important determinant of the hedging effectiveness of futures contracts, liquidity, or, more accurately put, market depth has been studied more closely. Contrary to earlier investigations into market depth, we show that the price path is non-linear due to market order imbalances. The market depth measure developed consists of two dimensions, which can be related logically to the futures market's toolbox. Our findings indicate that market depth is preferably to be valued along the two dimensions that constitute its basis.

Not just motives of a financial-economic nature play a part in the entrepreneur's decision to trade on the futures market. Therefore, it is of the utmost importance to study the decision making behavior of entrepreneurs concerning price risk management instruments. To this study, Part II of this book has been devoted. In this part, a decision making model has been developed which tells us how entrepreneurs decide and why they decide the way they do, concerning price risk management instruments. In this context, risk attitude is an important concept. Methodological research was conducted into the way in which risk attitude is measured within economics (the "expected utility framework") and within marketing-psychometrics (risk attitude scales). During large-scale experiments, the risk attitude measures developed were tested for construct validity by checking for convergent validity and nomological validity. The different risk attitude measures correlate significantly, indicating convergent validity. Moreover, the value function (obtained using the rating technique) does not correlate with the risk attitude measures, indicating discriminant validity. The psychometric risk attitude scale performs well on the self-report measures, contrary to the measure obtained from the lottery technique and the intrinsic risk attitude obtained through relating the utility function (itself obtained using the lottery technique) and the value function. However, the risk attitude measure and the intrinsic risk attitude greatly outperform the psychometric scale where the relation with actual behavior is concerned.

After having gained more insight into the risk attitude construct, the decision making behavior of entrepreneurs was modeled. Important elements affecting his or her decision making behavior were: the extent to which the entrepreneur feels that the use of futures will enhance his or her *entrepreneurial freedom* (as compared to other price risk management instruments), his or her *understanding* of the functioning of futures contracts (compared to his or her understanding of other relevant price risk management instruments) and the *performance* of futures contracts in the field of price risk reduction (compared to that of other relevant price risk management instruments).

The decision making process of entrepreneurs appears to have a two-phase structure. During the first phase, the entrepreneur decides whether futures contracts constitute a relevant alternative and should thus be in his or her toolbox. In this phase the aforementioned elements entrepreneurship, understanding and performance are of great importance.

During the second phase of the decision making process, when futures contracts are already a part of the entrepreneurs toolbox, the difference between the entrepreneur's psychological reference price and the actual futures market price becomes an important factor in the decision for or against entering the futures market. The components entrepreneurship and performance remain of importance during this phase of the decision process, whereas understanding no longer plays a part in the second phase.

Due to the structure of futures markets, the process of disseminating information about innovative futures contracts, henceforth the *information dissemination process*, is of great influence on the success of a futures contract. This has been investigated for an information dissemination process in which the brokers from the exchange spread the information among the potential users of a futures contract.

Part III of this study is devoted to an investigation into the feasibility of futures contracts on rights. First, an overview and a taxonomy are presented of the different environmental and production rights in agriculture and outside of it. The prices of these rights reflect the production rent. We show that the specific characteristics of rights increase hedging effectiveness. From this point of view, rights futures seem an interesting instrument for eliminating spot market price risk. We further show that the use of rights futures may be highly effective in situations of "spreading", where production has been restricted by rights.

By integrating the marketing and finance approach, the insight into the market for hedging services is increased. On the one hand a marketing-finance approach broadens our knowledge of existing markets, on the other hand it improves the development process of hedging services. By using both approaches, potential problems, as well as opportunities, can be discovered in an early stage. Thus, our investigation into rights futures yields that, from a finance perspective, these new futures contracts have highly convenient features and are therefore efficient instruments to cover price risk. The marketing perspective, however, reveals that potential users perceive futures markets as very complex and therefore do not perceive futures contracts as alternative price risk management instruments.

The marketing-finance approach is an integral approach which contains all aspects relevant to draw conclusions about the viability of a futures market. The marketing-finance approach yields insight into the policy measures which a futures market might take to create and secure a viable futures market. In this book much attention has been paid to subjects pertaining to one of both approaches which demanded further deepening in order to reach a fruitful integration of both approaches. Further elaboration of this marketing-finance approach is of great importance to an efficient and effective futures market policy.

Samenvatting

Met de recente en verder voorgenomen reductie van de prijssteun aan landbouwprodukten, in het kader van het gemeenschappelijk landbouwbeleid van de Europese Unie, is een toename in de prijs-volatiliteit van agrarische grondstoffen waar te nemen. Hierdoor neemt het prijsrisico toe, zowel voor het primaire agrarische bedrijf als de daarmee verbonden agribusiness. Voor een ondernemer die risico-mijdend is zal deze grotere prijs-volatiliteit in de markten van agrarische grondstoffen de behoefte aan prijsrisico management-instrumenten, zoals termijncontracten, vergroten.

Niet alleen bevordert de grotere prijs-volatiliteit het gebruik van bestaande agrarische grondstoffentermijncontracten, zij leidt ook tot de introductie van nieuwe termijncontracten. Ook de introductie van productierechten en milieurechten geeft de ontwikkeling van termijncontracten mogelijk een extra impuls. De recente ontwikkelingen in computergestuurde handelssystemen zullen de aantrekkelijkheid en toegankelijkheid van termijncontracten als prijsrisico managementinstrument verder doen toenemen. Daarbij zal de introductie van één Europese munt de handel in (goederen-)termijncontracten een extra impuls geven, aangezien één van de moeilijkheden van de termijncontract-specificatie, standaardisatie naar muntsoort, komt te vervallen en nationale termijnmarkten nu aantrekkelijker worden voor deelnemers uit andere Europese landen.

De bovengenoemde ontwikkelingen - grotere prijs-volatiliteit in de effectieve markt van agrarische grondstoffen, de introductie van verhandelbare productierechten en milieurechten, de opkomst van geautomatiseerde handelssystemen en de komst van één Europese munt - dragen bij tot de grote interesse van financiële instituten voor agrarische termijnmarkten. Deze ontwikkelingen zijn voor verschillende Europese termijnmarkten, waaronder de Amsterdam Exchanges, de London International Financial Futures & Options Exchange en de Marché à Terme International de France, reden geweest om nieuwe agrarische termijncontracten te ontwikkelen. Het risico van een mislukking is echter substantieel bij termijncontracten: van de 40 termijncontracten die in 1995 wereldwijd werden gelanceerd, hadden slechts enkele een succesvol eerste jaar. Het ontwikkelen en introduceren van termijncontracten is een kostbaar en tijdrovend proces, vooral wanneer het gaat om volledig nieuwe contracten. Inzicht in de markt voor hedging services is derhalve wenselijk.

In dit proefschrift zullen wij ons richten op aspecten van termijnmarkten die liggen op het raakvlak van marketing en finance ten aanzien van de risico reductie service ("hedging service"). De diensten die termijncontracten aanbieden zullen onder de loep genomen worden vanuit twee benaderingen: de *finance benadering* en de *marketing benadering*.

De *finance benadering* van financiële diensten is een normatieve: 'aan welke noodzakelijke voorwaarden dient te worden voldaan om de financiële dienst tot een succes te maken?' Het voldoen aan deze noodzakelijke voorwaarden garandeert echter niet het marktsucces van financiële diensten. Het succes van deze diensten hangt mede af van de mate waarin zij de behoeften van potentiële cliënten bevredigen tegen concurrerende prijzen. Dit gezichtspunt komt vanuit de marketingtraditie, die stelt dat produkten en diensten dienen te worden ontwikkeld naar de behoeften van de klant.

De *marketing benadering* onderzoekt kwalitatief en kwantitatief de behoefte aan financiële diensten en het marktpotentieel van een bepaalde financiële dienst. Vaak zullen er alternatieve producten of diensten zijn die de behoeften van de ondernemer bevredigen. Daarom wordt in de marketing veel aandacht besteed aan het besluitvormingsproces van de ondernemer, in ons geval het besluitvormingsproces van de ondernemer ten aanzien van prijsrisico managementinstrumenten. De wijze waarop de ondernemer tot een beslissing komt en waarom de ondernemer beslist zoals hij beslist geeft de marketeer aangrijpingspunten over de wijze waarop hij de hedging service moet vermarkten. Uit de resultaten van dit onderzoek kunnen dan de karakteristieken van een bepaalde financiële dienst worden samengesteld, gegeven de noodzakelijke voorwaarden die uit de finance benadering volgen.

Vaak levert de marketing benadering het probleem op dat het technisch niet haalbaar is om zo'n dienst te ontwikkelen. Een combinatie van de *marketing* benadering ("welke dienst is *wenselijk* vanuit het perspectief van de cliënt?") en de *finance* benadering ("welke dienst is *haalbaar* vanuit technisch oogpunt?") lijkt hiervoor een uitkomst te bieden. Een succesvolle ontwikkeling van nieuwe termijncontracten is gebaat bij een gecombineerd gebruik van de marketing benadering en finance benadering.

Naast de integratie van beide benaderingen zijn beide benaderingen gebaat bij een verdere verdieping. In dit proefschrift zijn enkele aspecten uit de finance benadering - zoals hedging efficiency en liquiditeit - verder uitgewerkt. Het perspectief is verlegd van portfolio's naar het management van de beurs. Tevens is de optimale hedge ratio en de optimale "commodity product spread" afgeleid voor rechtentermijncontracten. De marketing benadering is in deze studie uitgewerkt op het vlak van het *hoe* en *waarom* van de keuzen die ondernemers ten aanzien van prijsrisico-afdekking, in het bijzonder ten aanzien van termijncontracten maken.

Deze studie bestaat uit drie delen. In Deel I worden op systematische wijze de verschillende risico bronnen onderscheiden die voortvloeien uit transacties op de termijnmarkt. Met gebruik van deze classificatie zijn nieuwe maatstaven voor de hedging effectiviteit en de liquiditeit van een termijnmarkt ontwikkeld, die zowel voor de hedger als voor het management van de termijnbeurs inzichten verschaffen in de risico reducerende capaciteit van termijncontracten. Tevens is een conceptueel model voor algehele risicoreductie ontwikkeld en op basis van dit model is een maatstaf voor hedging efficiëntie ontwikkeld. In tegenstelling tot de bestaande maatstaven richt deze maatstaf zich niet op de prestaties van een portfolio maar op de hedgefunctie van het termijncontract. Deze maatstaf houdt, in tegenstelling tot andere maatstaven, rekening met het feit dat termijncontracten enerzijds een reductie van prijsrisico in de effectieve markt realiseren, maar anderzijds een eigen risico introduceren dat inherent is aan termijnhandel. Onderscheiden worden basisrisico en marktdiepte-risico. Daarbij houdt de door ons voorgestelde maatstaf rekening met de commissiekosten. Beschouwt men deze maatstaf als de afstand tussen de hedge-dienst zoals aangeboden door de termijnbeurs en de 'perfecte hedge', de ideale toestand waarin de hedging service het risico in de effectieve markt elimineert zonder zelf risico te introduceren, dan kan deze afstand worden onderverdeeld in een systematisch deel en een niet-systematisch deel. Het systematisch deel, veroorzaakt door de specificaties van het termijncontract en de structuur van de termijnbeurs, kan door de termijnbeurs beheerst worden, terwijl het niet-systematisch deel buiten de invloedssfeer van de beurs valt. De maatstaf voor hedge-effectiviteit verschaft de hedger een middel om de concurrentiepositie van verschillende termijncontracten te vergelijken. Niet alleen de kenmerken van het termijncontract maar ook de risico's in de effectieve markt zijn geïncorporeerd in de maatstaf. De termijnmarkrisico-component van de maatstaf geeft de hedging kwaliteit van het termijncontract aan. De effectieve markt prijsrisico-component legt de nadruk op de behoefte aan prijsrisico reductie. De empirische resultaten, gebaseerd op data van de Amsterdam Exchanges (Agrarische Termijnmarkten), tonen het nut van de maatstaf voor het management van een termijnbeurs aan.

Aangezien de liquiditeit een belangrijke determinant is van de hedging effectiviteit van termijncontracten, is liquiditeit, of beter gezegd marktdiepte, nader bestudeerd. In tegenstelling tot vroegere onderzoeken naar marktdiepte hebben wij laten zien dat het prijspad, tengevolge van situaties van het niet in balans zijn van markt orders, niet lineair is. De ontwikkelde maatstaf van liquiditeit bestaat uit twee dimensies, die op een logische manier kunnen worden gerelateerd aan het beleidsinstrumentarium van de termijnbeurs. Onze bevindingen duiden erop dat marktdiepte bij voorkeur moet worden geëvalueerd langs de twee dimensies die aan marktdiepte ten grondslag liggen.

Niet alleen financieel-economische overwegingen spelen voor de ondernemer een rol om wel of niet op de termijnmarkt te handelen. Daarom is het van uiterst groot belang om het beslissingsgedrag van ondernemers ten aanzien van prijsrisico managementinstrumenten te bestuderen. Dit hebben wij gedaan in Deel II van dit boek. In dit deel is een beslissingsmodel ontwikkeld dat ons leert *hoe* en *waarom* ondernemers beslissen zoals ze beslissen ten aanzien van prijsrisico managementinstrumenten. Een belangrijk concept in deze context is risico-attitude. Daarom hebben wij methodologisch onderzoek verricht naar de wijze waarop risico-attitude binnen de economie ("expected utility framework") en de marktkunde-psychometrie (risico-attitude schalen) worden gemeten. Door middel van grootschalige experimenten zijn de ontwikkelde risico-attitude maatstaven getoetst op construct validiteit, door te testen op convergentie validiteit en nomologische validiteit. De verschillende risico-attitude maten correleren significant met elkaar wat duidt op convergentie validiteit. Bovendien correleert de waarde functie (verkregen middels de 'rating' techniek) niet met de risico-attitude maatstaven, wat duidt op discriminant validiteit. De psychometrische risico-attitude schaal doet het goed ten aanzien van de zelf-gerapporteerde maatstaven in tegenstelling tot de risico-attitude maat verkregen met de loterij techniek en de intrinsieke risico-attitude verkregen middels het relateren van de nutsfunctie (verkregen middels de loterij techniek) met de waarde functie. De risico-attitude maat en de intrinsieke risico attitude doen het daarentegen veel beter dan de psychometrische schaal waar het gaat om de relatie met daadwerkelijk gedrag.

Na meer inzicht te hebben verkregen in het risico-attitude construct, is het beslissingsgedrag van de ondernemer gemodelleerd. Belangrijke elementen in het beslissingsgedrag van de ondernemer waren: de mate waarin de ondernemer denkt dat hij zijn *ondernemerschap* beter of slechter kan uitoefenen door termijncontracten te gebruiken (vergeleken met andere prijsrisico managementinstrumenten), het *begrip* dat hij heeft van de werking van termijncontracten (vergeleken met andere relevante prijsrisico managementinstrumenten), en de *prestaties* van termijncontracten op het gebied van prijsrisico-reductie (vergeleken met andere relevante prijsrisico managementinstrumenten).

Het blijkt dat het beslissingsproces van ondernemers een tweefasenstructuur heeft. In de eerste fase beslist de ondernemer of termijncontracten een relevant alternatief voor hem zijn en derhalve tot het beleidsinstrumentarium behoren. In deze fase zijn de elementen ondernemerschap, begrip van termijnhandel en prestaties van groot belang.

In de tweede fase van het beslissingsproces, als termijncontracten reeds tot het beleidsinstrumentarium van de ondernemer behoren, is het verschil tussen de psychologische referentieprijs van de ondernemer en de prijs in de termijnmarkt belangrijk voor het wel of niet deelnemen aan de termijnmarkt. De componenten ondernemerschap en prestaties zijn ook in deze fase van het beslissingsgedrag van belang, dit in tegenstelling tot de component begrip van termijnhandel, die geen rol speelt in fase 2.

Door de structuur van de termijnmarkt heeft het informatie verspreidingsproces van termijncontract innovaties een belangrijk invloed op het welslagen van een termijncontract. Dit is onderzocht voor een informatie proces waarbij deze informatie via de makelaars van de beurs aan potentiële gebruikers van het termijncontract wordt doorgeven.

Deel III van onze studie gaat over de mogelijkheid van termijncontracten voor rechten. Eerst wordt een overzicht gegeven en een taxonomie geïntroduceerd van de verschillende milieu- en productierechten binnen en buiten de landbouw. De prijzen van deze rechten weerspiegelen de productie "rent". We laten zien dat de specifieke karakteristieken van rechten de hedging effectiviteit vergroten. Vanuit dat gezichtspunt lijken rechtentermijncontracten dan ook een interessant instrument voor prijsrisico-afdekking. Verder laten we zien dat het gebruik van rechtentermijncontracten uiterst effectief kan zijn in "spreading" situaties waarbij de productie beperkt is door rechten.

Door de marketing en finance benadering te integreren wordt het inzicht in de markt voor hedging services vergroot. Enerzijds verbreedt dit onze kennis ten aanzien van bestaande markten (waarom zijn sommige markten succesvol en andere niet?) anderzijds verbetert de marketing-finance benadering het ontwikkelingsproces van hedging services. Door beide benaderingen te gebruiken komt men al snel op het spoor van mogelijke problemen dan wel mogelijkheden. Zo leert het onderzoek naar rechtentermijncontracten ons dat het vanuit een finance benadering bekeken, deze nieuwe termijncontracten zeer prettige eigenschappen hebben en derhalve een efficiënt instrument zijn om prijsrisico's af te dekken. Bezien we rechtentermijncontracten vanuit een marketing oogpunt dan zien we dat de potentiële gebruikers termijnmarkten als complex ervaren, waardoor termijncontracten niet als een alternatief prijsrisico managementinstrumenten gepercipieerd worden.

De marketing-finance benadering is een integrale benadering welke alle relevante aspecten bevat om conclusies te trekken ten aanzien van de levensvatbaarheid van een termijnmarkt. De marketing-finance benadering geeft inzicht in de beleidsmaatregelen die door de termijnmarkt kunnen worden genomen om een levensvatbare termijnmarkt te creëren en te behouden. In dit boek is veel aandacht besteed aan onderwerpen die betrekking hebben op één van de twee benaderingen en welke verdere verdieping vereisen om een vruchtbare integratie van beide benaderingen te bewerkstelligen. Verdere uitbouw van deze marketing-finance benadering is van groot belang voor een doeltreffend en doelmatig beleid van termijnmarkten.

Curriculum Vitae

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