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APPLIED COMMODITY PRICE ANALYSIS, FORECASTING AND MARKET RISK MANAGEMENT

## **Commodity Futures Contract Viability: A Multidisciplinary Approach**

by

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# **Commodity Futures Contract Viability: A Multidisciplinary Approach**

**Joost M.E. Pennings and Raymond M. Leuthold\***

We propose a framework in which the decisions and wishes of potential customers are investigated simultaneously with the necessary technical properties that need to be met for trading to take place. Within this framework the relationship between trading volume and hedging effectiveness is examined. Both basis risk and market depth risk are taken into account, and the relationship between farmer's characteristics and the probability of using futures is examined. The relationships are tested on a set of data gathered in a stratified sample of 440 farmers by means of computer-assisted personal interviews and on transaction-specific futures data. Structural equation models and multiple regression models are used to validate the relationships. The hedging effectiveness and the variables that play a role in the farmer's use of futures are related to the tools of the exchange.

## **Introduction**

Developing and introducing of a new commodity derivative is an expensive and time-consuming process. Insight in the aspects that influence the success/failure of derivatives seems therefore valuable. In this paper we will focus on agricultural commodity futures contracts as an example of an exchange-listed derivative. Two streams of literature have contributed to our understanding about the factors influencing the viability of futures contracts.

The first stream of literature is on a "marco-level" or non-subject level. It defines feasible commodities for futures trade based on an extensive list of required commodity attributes. A commodity needs the following attributes in order to have a viable futures market: 1) a 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; 4) supply and demand must be large; 5) supply must flow naturally to market and there must be breakdowns in an existing pattern of forward contracting (Gray; Black). These attributes focus on the technical aspects of the underlying commodity.

The second stream of literature is on the "micro-level" or subject level. It provides insight into the characteristics of corporations that are associated with the decision to use futures. Both finance research as well as agricultural economics research contributed to this strain of literature. In the finance studies, several factors such as the firm's risk exposure, its growth opportunity, the level of wealth, managerial risk aversion, financial distress costs, and the accessibility to financing appear to influence the decision of a corporation to adapt derivatives to their risk management toolbox (Smith and Stulz; Nance, Smith, and Smithson; Mian; Tufano; Lee and Hoyt; Géczy, Minton and Schrand;

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Carter and Sinkey; Howton and Perfect; Schrand and Unal; Visvanathan; Koski and Pontiff). In the agricultural economics literature attention has been paid to the factors influencing farmers use of futures. Several authors identified such factors as, experience, education, farm size, off-farm income, expected income change from hedging, age, farm organization meetings, leverage, risk management and marketing seminar participation, influencing the farmer's use of futures contracts (Goodwin and Schroeder; Shapiro and Brorsen; Asplund, Foster and Stout; Makus et al.; Musser, Patrick and Eckman; Patrick, Musser and Eckman).

The "macro-level" literature has received a lot of attention and has increased our insight into the technical commodity factors influencing viable commodity futures trade (Black; Tashjian). However, the above listed attributes considered necessary have proven themselves too strict to be useful as criteria for futures market success. Different types of (exotic) commodity derivatives contracts have been developed that do not have (all of) the attributes mentioned above, but are successful anyway.

The "micro-level" literature has increased our understanding of how firm characteristics and manager's characteristics influence the use of futures and hence, the viability of futures trade. Some studies assume that managers are risk averse. However, risk attitudes may differ across managers. Brockhaus, March and Shapira, and Smidts found large differences in risk attitudes among managers of corporations and farmers. Puzzling results were found regarding the influence of risk attitude on hedging behavior. Goodwin and Schroeder found that farmers with a stated preference for risk are *more* likely to adopt forward pricing than are risk-averse producers. One of the reasons for these contra-intuitive findings is the difficulty in measuring risk attitudes, and in more general, latent constructs in a realistic and accurate manner. These studies address relationships between and among variables that are not always directly observable (e.g., farmer's risk attitude), without taking measurement error into account. When such measures are used in models, the coefficients obtained will be biased. Another point of concern in the "micro-level" literature is that these studies assume enterprises to be homogenous regarding their choice process for futures. When estimating these models, data are treated as if they were collected from a single population. This assumption of homogeneity is often unrealistic. For example, farmers of different size or regions may have different decision structures. Hence, pooling the data across respondents is likely to produce misleading results.

The "micro-level" literature and "macro-level" approach answer two complementary questions: will the farmer adopt futures? and, is the commodity suitable for futures trading? It seems interesting to investigate both questions simultaneously when trying to gain insight into the viability of commodity futures contracts.

In this paper we will first address concerns of past research within the two approaches. Then we propose a framework that will integrate the technical aspects of the underlying commodity and the decision-making needs of (potential) hedgers. The present study focuses on farmers, that is owner-managers of small and medium-sized enterprises (SMEs). An important difference between farmers and managers of a large enterprise lies in the fact that farmers do not have different functional departments such as research and development, manufacturing-quality control, sales and accounting. All these departments are combined within the farmer. The decision process is in such a case not that rationalized as in the case of large enterprises that have different functional departments.

Some of the concepts used by farmers might be psychological constructs (such as ‘level of understanding’) that are not directly measurable and therefore remain absent in accounting data used in recent studies about managers in large companies (Géczy, Minton and Schrand). These psychological constructs may very well play a part in the farmer’s use of futures.

This research makes a theoretical, a methodological, and a managerial contribution. *Theoretically*, we provide insight into the factors that play a role in the success of a futures contract, divided into two aspects, namely factors with a technical (market) character and factors dealing with the decision-making process of farmers with respect to hedging. We show that hedging effectiveness measures that take market depth risk into account reveal more coherence with trading volume than hedging effectiveness measures that do not take market depth into account. Moreover, we show that perceptions and psychological constructs influence farmers’ use of futures and that the heterogeneity of farmers leads to different segments such that within a segment the farmers’ behavior regarding futures is similar and between segments dissimilar. *Methodologically*, we take measurement error into account. We recognize that the theoretical constructs of interest are not always directly measurable, but must instead be estimated from multiple indicator measures. To obtain this objective, we use structural equation modeling in order to test our model and hypotheses. Structural equation modeling provides us with a method for estimating structural relationships among unobservable constructs and for assessing the adequacy with which those constructs have been measured. Moreover, we take into account that farmers may exhibit heterogeneity. *Managerially*, we propose a framework useful to exchanges that contains all relevant aspects, and hence is a powerful tool for designing commodity futures contract.

The remainder of the paper is structured as follows. First, we explain the differences and complementarities of the different approaches towards futures contract viability. Within these approaches the puzzling results in previous research are addressed. Thereafter, a conceptual framework is introduced that integrates both approaches. After the research method and the operationalization of the variables, different relationships between hedging effectiveness and trading volume on the one hand and farmer’s characteristics and use of futures on the other hand are estimated. Data obtained from 440 Dutch hog farmers by means of computer-assisted personal interviews and transaction-specific futures trade data constitute the input for this part of the research. We interpret the results in the concept of managerial decision-making concerning contract design and viability.

### **Conceptual Framework: A Multidisciplinary Approach towards Commodity Futures Contracts**

In the financial literature on futures contracts, the *commodity characteristics approach* and the *contract design approach* can be distinguished (Black). 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 *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*. To warrant hedging, the contract must be as close a substitute for the cash commodity as possible (Thompson, Garcia and Dallafior). Tashjian and McConnell 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.

Regarding commodity characteristics, those who have proposed alternative hedging effectiveness measures include Ederington; Howard and D'Antonio; Chang and Fang; and Hsin, Kuo, and Lee. All these measures try to indicate to what extent hedgers are able to reduce cash price risk by using futures contracts. Therefore, the extent to which a futures contract offers a reduction in overall risk is an important criterion for the managers of a futures exchange to evaluate the hedging performance. A key aspect of futures market performance is the degree of liquidity in the market (Cuny). A futures market is considered liquid if traders and participants can buy or sell futures contracts quickly with little price effect resulting from their transactions. However, in thin markets, the transactions of individual hedgers may have significant price effects and result in substantial 'transaction costs' (Thompson, Garcia and Dallafior). This phenomenon, which we will refer to as a lack of market depth, is particularly important for relatively small agricultural futures markets and might be especially true for new futures markets. We therefore propose to use an extended version of the Ederington measure by including market depth risk (Pennings and Meulenberg 1997a,b). It can be shown that when we include market depth risk in the Ederington measure, hedging effectiveness can be measured as:

$$(1) \quad HE = - \frac{b^* (\sigma_f^2 + \sigma_{md}^2 - 2\sigma_{fmd}) + b^* (-2\sigma_{sf} + 2\sigma_{smd})}{\sigma_s^2}$$

where  $\sigma_s^2$ ,  $\sigma_f^2$ ,  $\sigma_{sf}$ ,  $\sigma_{fmd}$  and  $\sigma_{smd}$  represent the subjective variances and the covariances of the possible price (subscript  $s$  and  $f$  denote spot and futures prices respectively) and market depth cost changes (denoted by  $md$ ) from time 1 to time 2, and

$b^*$  is the risk minimizing hedge ratio with  $b^* = \frac{\sigma_{sf} - \sigma_{smd}}{\sigma_f^2 + \sigma_{md}^2 - 2\sigma_{fmd}}$ .

If there is no market depth risk, the measure in (1) reduces to the Ederington measure. The application of this measure requires transaction-specific futures data and cash market data.

Often, alternative products or services will be available to meet the needs of the farmer, which is why we also pay attention to the farmers' decision-making process. Insight into the choice process provides us with clues about the necessary characteristics of a futures contract in order to be preferred over the other alternatives. The farmer compares the alternatives on the basis of different attributes or dimensions, e.g. the alternative's risk reduction capacity. The farmer's choice for any particular alternative depends on the importance placed by the farmer on these attributes as well as on how the alternatives differ with respect to these attributes in the farmer'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*. Service design refers to the contract specification and is related to the *core service* of the futures

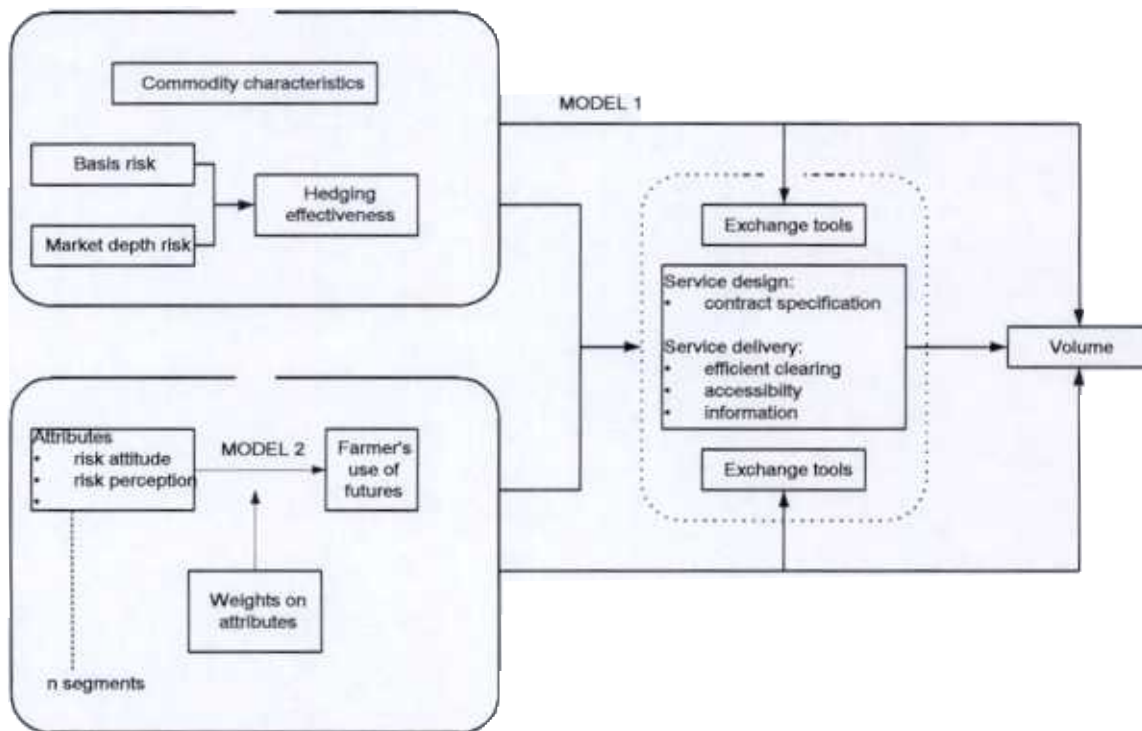
exchange (i.e. risk reduction). Service delivery refers to the way the core service is brought to the customer and is the result of the interaction between the futures exchange and the customer and is related to such factors as the clearing system, accessibility of brokers and the information provided by the trading system. Moreover, insight into why the farmer chooses the way he or she does provides valuable information in efficiently identifying certain target groups and customizing services. We will elaborate on two topics, that is the measurement issues when using perceptions and psychological constructs and the heterogeneity of farmers.

In this paper we recognize that farmers make decisions, based on their beliefs, which are formed by perceptions. For example, the perceived risk reduction performance may differ from the performance as reflected by hedging effectiveness measures such as in (1). Moreover, farmers may very well evaluate the hedging service provided by futures exchanges along with criteria other than just performance. That is, we take psychological constructs into account (Thaler 1993; 1997). Two empirical problems may arise when taking perceptions and psychological constructs into account. First, we have to make sure that we have *reliable* and *valid* constructs. We therefore propose to measure latent variables by a set of observable indicators (items) which are subjected to confirmatory factor analysis to assess their psychometric properties and unidimensionality. Confirmatory factor analysis permits a rigorous assessment of the stability of the latent variables and its psychometric properties (Reise, Widaman, and Pugh; Hair et al.; Yung). Second, relationships between and among latent theoretical concepts (constructs) that are not directly observable may result in biased coefficients because of *measurement error*. Therefore, we use structural equation modeling as it permits the explicit modeling and estimation of errors in measurement (Bollen 1989, 1996; Steenkamp and van Trijp; Bagozzi 1981, 1994; Baumgartner and Homburg; Lee and Wang).

Most models assume farmers to be homogenous regarding their choice process for futures. These models treat data as if they were collected from a single population. In the case that this assumption of homogeneity is violated, pooling data across farmers is likely to produce misleading results. In this paper we test whether there are different segments in our sample population regarding choice behavior.

The farmer's choice behavior is often not enough to obtain the optimal functional and technical properties of futures contracts. On the other hand, it remains unclear whether the feasible properties of futures generate sufficient demand. It seems, therefore, that a multidisciplinary approach to futures contracts, whether from the perspective of supply or demand side, complement each other in the process of developing, producing and marketing futures contracts.

Figure 1 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. Moreover it contains our research design by indicating which relations within this framework are empirically tested (indicated by models 1 and 2).



**Figure 1. A Conceptual Framework for Hedging Services**

## **Empirical Models and Procedures**

### *Research Design*

The research design consists of several steps. First, the criteria as formulated in the commodity characteristics approach are evaluated for the commodity under consideration. Hedging effectiveness is evaluated by analyzing the overall risk reduction capacity of the futures contract, thereby accounting for *basis risk* and *market depth risk*. The relationship between hedging effectiveness and volume is empirically investigated: Model 1 in Figure 1. In order to gain insight in the effect of market depth costs on volume, we calculate both the Ederington measure and the extended measure as formulated in (1). We expect to find that the extended measure is a better predictor of volume than the Ederington measure that does not include market depth risk.

The choice process regarding futures contracts is investigated by identifying the attributes used by the farmers in reaching a choice and the importance placed on these attributes. Because we expect farmers not to be a homogeneous population, we segment across farmers such that within a segment the choice process is similar and across segments dissimilar. The relationship between attributes and the choice behavior is empirically investigated: Model 2 in Figure 1.

The variables and attributes in the two approaches influence the viability of futures contracts, and these components are linked to the service design (contract specification) and the service delivery process of the futures exchange in a conceptual way. The exchange has different tools available which determine the service design and the service delivery. We relate the components to the tools of the exchange.



## Research Method

The Dutch hog industry is examined empirically. It represents a domain in which the technical conditions, as given in the commodity characteristic approach, have all been met. Although, from a technical perspective, the conditions would seem very favorable for a hog futures contract, only thirteen percent of Dutch hog farmers actually use futures contracts to cover their price risk (Pennings and Smidts). Therefore, this empirical domain may be considered ideal to illustrate the contribution of a multidisciplinary approach to commodity futures contract viability research.

### *Data Collection and Procedures*

A questionnaire was developed on the basis of literature, and 40 test interviews were conducted to ensure correct interpretation of the questions. The survey consisted of personal computer-guided interviews. Care was taken to build a user-friendly interface. In line with Hershey, Kunreuther and Schoemaker and Hershey and Schoemaker, we believe that the main source of bias is caused by experiments and interviews that does not match the real decision situation of the subjects under consideration. Therefore, we paid a lot of attention to the design of our interview instrument so that it resembles farmers' decision-making process within their own very real business context. A total of 440 managers participated (the interview was stratified along farm size and region).

The interview consisted of several parts. After having been asked several background questions (pertaining to size of the enterprise, age, education level and debt-to-asset ratio, where the latter was measured on a 10 point scale with 1 = debt-to-asset ratio 1-9%, 2=10-19% etc.) the farmers were confronted with statements about futures contracts. The statements about the use of futures were measured on bipolar nine-point Likert scales with the end-poles labeled as "strongly disagree" and "strongly agree". The statements tapped the constructs exercising entrepreneurial freedom and perceived performance (a detailed description of the scales and its psychometric properties can be obtained from the authors).

Because farmers often base their decision also on the opinions of the members of their decision unit (such as husband or wife, partner and advisors) we included the farmer's perception of the extent to which significant others think that he or she should engage in futures trading. We assume that if the farmer believes that relevant others expect him/her to make use of the hedging service of futures contracts, this will influence the farmer's probability of using futures contracts. The influence of the decision unit was measured by asking the farmer to indicate the extent to which significant persons surrounding him/her thought that he/she should or should not use futures as a hedging tool by distributing 100 points across the two options.

Based on the depth interviews, constructs characterizing farmers that are expected to influence their use of futures contracts were included. We used scales as introduced by studies in marketing, psychology, and management. In developing the scales, we adhered to the iterative procedure recommended by Churchill. All scales were subjected to explorative factor analyses along with confirmatory factor analysis to test for their reliability and unidimensionality (Hair et al.). Moreover, we conducted structural equation modeling to test for their validity. The following characteristics were included in this study: market orientation (Jaworski and Kohli), level of understanding (Ennew, Morgan and Rayner) risk attitude and perceived risk exposure (a description and the

psychometric properties of the scales can be obtained by the authors). Finally, the probability of using futures contracts was measured by asking the respondent to distribute 100 points across using futures as a hedging tool or not using them as a hedging tool.

In order to measure the hedging effectiveness which takes both basis risk and market depth risk into account, we gathered transaction-specific data from the nearby hog futures contract traded at the Amsterdam Exchanges over the period 1990-1998 (the only relevant futures contract for Dutch hog farmers). 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. In the case of order selling imbalance, market depth costs were calculated as the area between the downward-sloping price path and the price for which the hedger enters the futures market, hence

$$(2) \quad LC = PF^1 \cdot N - \sum_{i=1}^N (PF^i)$$

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 market depth costs in the case of 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

$$(3) \quad LC = \sum_{i=1}^N (PF^i) - PF^1 \cdot N.$$

Having determined the market depth costs, spot prices (obtained from the central Dutch cash hog price market) and the closing prices of the futures contract, both the Ederington measure and the extended measure in (1) can be calculated.

## Results

### *Presentation of Empirical Results of Model 1 in Figure 1*

Table 1 tabulates the hedging performance measured by the Ederington measure and the value of the proposed measure as presented in (1). 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 hog 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 market depth risk into account, whereas the Ederington measure only takes basis risk into account. This is in line with recent findings of Pennings et al., who found that the hog futures contract traded at the Amsterdam Exchanges faces market depth problems.

**Table 1. Regression of Hedging Performance, and Hedging Effectiveness Measure on Annual Volume, 1989-1998**

Hedging performance $\beta$		$t$ -value	$p$ -value	$Adjusted R^2$	
Ederington Measure	0.92	0.90	7.7	0.00	0.81
Extended Hedging Effectiveness Measure	0.87	0.99	9.09	0.00	0.91

The relationship between the two hedging effectiveness measures and the trading volume was estimated in a simple regression model in which the annual volume in the

period 1989-1998 is the dependent variable and the hedging effectiveness (based on the nearby futures contract) the independent variable. From Table 1 it can be concluded that the hedging effectiveness is an important determinant in explaining the futures contract volume, which is in line with the findings of Tashjian and McConnell. Moreover, Table 1 shows the extended measure having a better fit than the Ederington measure. That is, hedging effectiveness measures which take market depth risk into account reveal more coherence with trading volume than hedging effectiveness measures that do not take market depth into account. Hence, the market place takes market depth risk into account when using futures, thereby influencing its viability.

#### *Presentation of Empirical Results of Model 2 in Figure 1*

We estimated the influence of the several variables measured in the personal computer guided interview on the farmer's probability of using futures. Several farmers' characteristics were measured with self-report measures (i.e. scales). Each of these variables is treated as a latent variable that is measured by a set of observable indicators (items). Observable variables may be assumed to be measured with error. When such measures are used in linear models, the coefficients obtained will be biased. In this paper we recognized that the theoretical constructs of interest are not directly measurable, but must instead be estimated from multiple indicator measures. To obtain this objective, we used structural equation modeling in order to test the model. Structural equation modeling permits the explicit modeling and estimation of errors in measurement (Bollen 1989, 1996; Steenkamp and van Trijp; Bagozzi 1981, 1994; Baumgartner and Homburg; Lee and Wang). The coefficients in the structural equation model represent theoretical cause-and-effect relationships among latent variables, which underlie the observed variables, and as such, they are the parameters of our interest. The model is estimated using Maximum Likelihood in the LISREL 8 program (Jöreskog and Sörbom). The estimated model parameters and related statistical information are presented in Table 2.

First, we model the probability of using futures contracts across the whole sample. That is, we do not take heterogeneity into account, hence assuming the sample to be homogeneous. In this case the following factors were significant in the model and had the expected positive sign: the decision unit, the perceived performance, exercising entrepreneurial freedom and level of understanding. Surprisingly, risk attitude and perceived risk exposure were not significantly related to the probability of using futures, a puzzling result that was found by others as well (Makus et al.; Shapiro and Brorsen).

We suspect the sample not to be homogenous, that is, we expect that different groups of farmers may employ a different decision process. If this is the case, we might find that different factors influence their choice behavior, and that the common factors are weighted differently. Using cluster analysis, it appeared that we could distinguish between two groups based on their cash-trading behavior. Segment I (N = 120) consists of farmers who sell their hogs to a cooperative, segment II consists of farmers who sell to a trader (N=320). Interesting to note is that these two segments did not significantly differ regarding age and education. So, both segments may look alike on first sight, however different factors influence their use of futures contracts.

From Table 2 it becomes clear that risk attitude and perceived risk exposure do play a role in segment I. Moreover, the debt-to-asset ratio plays a role. As was the case for the whole sample, the decision unit and the perceived performance influence the use

**Table 2. Variables Explaining Farmer's Probability of Using Futures for the Whole Sample and Different Segments Using Structural Equation Models**

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		Explanatory variables							
Probability of using futures		DU	PERF	ENTF	MO	RA	PRE	DTA	UNDER
Total sample (N=440)	$\beta$	0.269	0.196	0.186	*	*	*	*	0.132
	t-value	5.759	4.179	3.992	*	*	*	*	2.043
	Fit statistics	$\chi^2/\text{df} = 4.4$ $p = 0.00$ RMSEA = 0.09 GFI = 0.97 TLI = 0.78							
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Segment I (N=120)									
Spotmarket: cooperative	$\beta$	0.202	0.204	*	*	0.308	0.233	0.090	*
	t-value	2.180	2.478	*	*	3.437	2.230	2.078	*
	Fit statistics	$\chi^2/\text{df} = 1.1$ $p = 0.22$ RMSEA = 0.03 GFI = 0.94 TLI = 0.95							
-----									
Segment II (N=320)									
Spotmarket: trader	$\beta$	0.274	0.198	0.265	0.111	*	*	*	*
	t-value	5.668	4.085	5.370	2.003	*	*	*	*
	Fit statistics	$\chi^2/\text{df} = 2.1$ $p = 0.01$ RMSEA = 0.05 GFI = 0.98 TLI = 0.92							

Note: Beta is the standardized regression coefficient which shows the relationship between the probability of using futures and the latent constructs. All variables included in the models have a *t*-value that is significant at the 5% level, variables that did not meet this criteria were not included in the model and are represented by an asterisk. DU is the decision unit, PERF, the perceived performance of futures, ENTF the value of exercising entrepreneurial freedom, MO the market orientation, RA the risk attitude, PRE the perceived risk exposure, DTA the debt-to-asset ratio and UNDER the level of understanding. RMSEA is the root mean square error of approximation, GFI the goodness-of-fit index and TLI the Tucker Lewis Index (Jöreskog and Sörbom).

of futures. The value of taking heterogeneity into account is shown in this case for risk attitude and perceived risk exposure. If we treat the sample as homogenous we would have concluded that risk attitude and perceived risk exposure did not influence the use of futures contracts, something that does not comply with financial theory.

In this paper the model fit is evaluated using different types of fit indices recently developed in the literature. We use the likelihood-ratio Chi-square statistic, Goodness-of-Fit Index (GFI), Tucker Lewis Index (TLI), and the Root Mean Squared Error of Approximation (RMSEA) to evaluate the model fit (Jöreskog and Sörbom). The fit statistics show that the model that covers the whole sample has a modest fit, while the model that describes the use of futures contracts for segment I shows a very good fit. The same holds for Segment II. In this segment it was found that market orientation and exercising entrepreneurial freedom are factors that influence the probability of using futures, along with the decision unit and the perceived performance.

It seems that farmers in segment I use “financial structure” characteristics (as imbedded in the debt-to-asset ratio, risk attitude and the perceived risk reduction exposure) in their decision to engage in futures, whereas the farmers in segment II use “marketing” characteristics (imbedded in market orientation and exercising entrepreneurial freedom) in their decision to engage in futures. Farmers in segment I (cooperative farmers) can be described as more conservative, in the sense that they attach a lot of value to “continuing the farm operation for successors” whereas farmers who sell to traders (segment II) attach value to “keeping up with markets and trying to get the high prices”.

In this study we find three factors influencing farmer’s use of futures contracts that were not found in previous studies. Two factors, exercising entrepreneurial freedom and market orientation, are psychometric constructs. A reason for not finding them in previous studies might be that both are latent variables that can not be detected in accounting data. Moreover, measurement error in previous studies might mask these variables. Both variables are important cues for the exchange to improve their attractiveness. For example, the management of a futures exchange may use this information for its promotion of futures and in developing and redesigning futures contracts. It would seem valuable to position futures as an extra tool to increase the farmer’s degrees of freedom in the market place. When designing futures contracts, the futures exchange may increase the compatibility of futures with other instruments available to the farmer, thereby increasing its attractiveness “as an extra tool”. Although the farmer ultimately makes the choice on his/her own, other important individuals are involved in the decision process, that is, the members of the farmers decision unit. These individuals consisted in our study of the successor, wife/husband and bank advisor. We found that the opinion of these individuals, who are important to the farmer when futures are concerned, influenced the farmer’s behavior towards trading of futures.

#### *Discussion of Empirical Findings vis-à-vis Tools of the Exchange*

We now discuss the relation between the factors we found to influence the viability of futures in the context of the tools the futures exchange has available. The tools of the futures exchange can be linked to the exchange service design (related to the core service) and service delivery (related to the peripheral services).

Table 3 indicates which factors relate to the viability of futures trade based on the previous results and the exchange’s tools. Hedging effectiveness is related to the service

design, and hence, the core businesses of the futures exchange. The two main components: basis risk and market depth risk can be related to the contract specification (standardization process) and the trading system, respectively. In our empirical study we showed that the hog futures contract is facing market depth risks. An open outcry system is employed by the Amsterdam Exchanges for trading. 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 for the hog futures contract. The broker only has insight into his/her own order book. The farmer has no information on outstanding orders. Information provided by the exchange seems of vital importance. Moreover, market depth risk might be reduced by implementing a mechanism for slowing down the trade process if order imbalances do occur and to improve market depth by reporting these. Lehmann and Modest report such a mechanism on the Tokyo Stock Exchange, where warning quotas are issued when a portion of the trade is executed at different prices. Also the order book information can be improved. An order book mechanism that allows potential participants to view real-time limit orders, displaying the desired prices and quantities at which participants would like to trade, might improve the market depth risk.

From Model 2 it appeared that the farmer's perceived performance played an important role when deciding to use futures contracts. This result is in coherence with our finding that the hedging effectiveness is positive and significantly related to the trading volume. Performance is directly related to contract specification and the trading system, both influencing the risk reduction capacity of the exchange's service. The members of the decision unit play an important role in the farmer's use of futures. This implies that promotion and education efforts should not only be tailored to the farmer, but also on advisors surrounding the farmer. The farmer's level of understanding of futures is positively related to the probability of using futures, thereby supporting the view that education programs for farmers are valuable.

Farmers are heterogeneous regarding their decision-making behavior. We could distinguish between two types of latent segments based on their cash-trading pattern. In segment I the risk attitude and perceived risk exposure were determinants of futures use. Both elements can be related to the service design, in particular the contract specification, which influences the risk reduction capacity of the futures contract, and the clearing with respect to credit and default risk. Perceived risk exposure dictates the importance and need of education. In this segment also the debt-to-asset ratio was an important determinant. High leveraged farmers may find futures an attractive risk-reduction tool, which makes it interesting to specify futures and come up with a palette of futures that can reduce fluctuations in farmers' profit. Clearing aspects, especially default risks, are important to high-leveraged farmers.

Farmers who focus on the marketing aspects of their farm operation characterize segment II. Market orientation was a determinant when choosing futures. Providing accurate real time information by the trading system is attractive for this group of farmers. In this segment farmers value using futures as a way to exploit their entrepreneurial freedom, that is, the fact that futures provide them the opportunity to increase their degrees of acting in the market place. The value the farmer attaches to entrepreneurial freedom presents a challenge for the futures exchange both for the service design as service delivery. It appeared that if the farmer perceives the use of futures

**Table 3. Overview of Factors Influencing the Viability of Futures Contracts and Their Relationship with the Exchange Toolbox**

	Futures Exchange Tools			
	Service design		Service delivery	
	Contract specification	Trading system	Clearing	Promotion
<b>Model 1: Market</b>				
Hedging effectiveness				
• Basis risk	X			
• Market depth risk		X		
<b>Model 2: Decision-maker</b>				
Perceived performance	X	X		
Decision unit				X
Level of understanding				X
<b>Segment I</b>				
Risk attitude				
• Risk aversion	X		X	X
• Risk seeking	X		X	X
Perceived risk exposure				X
Debt-to-asset ratio	X		X	
<b>Segment II</b>				
Market orientation		X		X
Entrepreneurial freedom	X	X		X

contracts as an instrument with which one fixes all prices in advance, the futures contract was not attractive because, in the perception of the farmer, the futures contract was a constraint on his/her entrepreneurial freedom. However, if the farmer perceived the futures contract as an extra tool in his/her marketing plan, futures were valued as a tool that increases the entrepreneurial freedom. For the exchange, it is important to promote futures contracts as one way of marketing the commodity, thereby increasing the different pay-off structures. Promotion and education on this aspect seems valuable. Moreover, it seems interesting to make the futures contract compatible with other risk management practices of the farmer. This may have an implication for the contract design.

The most interesting result is, however, that farmer's are heterogeneous and that the exchange needs to use different tools for different segments. Identifying the different segments is a challenge. With this information the futures exchange is able to target their marketing efforts (the so-called direct marketing). Based on the characteristics of the different segments, they are able to select a group of potential customers, to which they offer risk reduction service, which was designed to match the customers' choice profile. This implies differentiation of the services offered by exchanges. In our empirical study the segments could easily be observed by the exchange, because they relate to the farmer's cash trading pattern. A challenge for further research in this regard is to create a method that simultaneously estimates all parameters such that a set of parameters identifies the segments to which farmers belong, and represents the structural equation model within segments. Recent findings of Jedidi, Jagpal and DeSarbo on general finite mixture structural equation model seem interesting in this respect.

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