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

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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.

1. Introduction

Between 1973 and 1983, milk production in the European Union (EU) rose by 30 per cent while consumption rose by a mere 9 per cent (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 result a milk quota scheme was introduced on April 2, 1984. All EU members had the right to produce a certain quantity of milk.[1] Individual states were free to implement this policy at their own discretion within the comparatively liberal framework the EU had provided. The EU

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[1] 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.

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.[1] 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 paper's research 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.

2. Rationale for Hedging

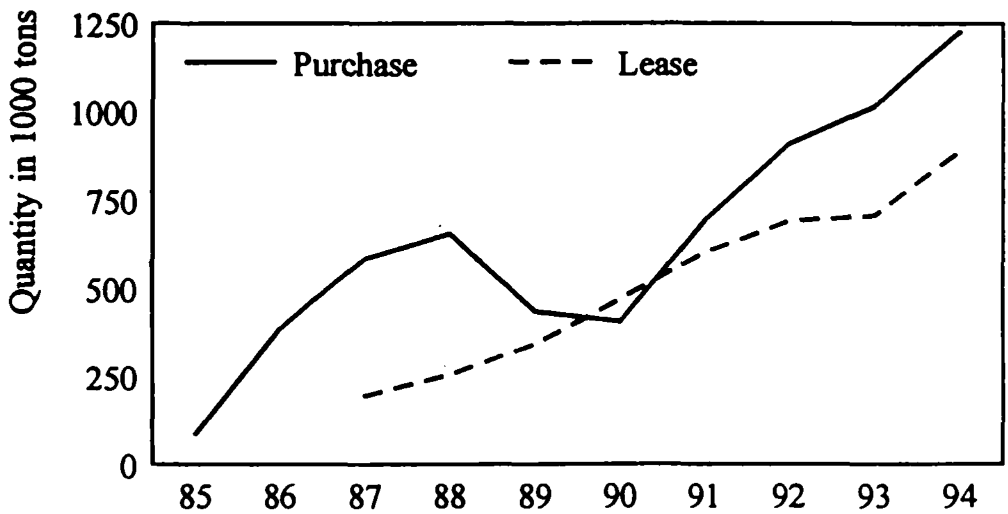
Spot Market of Milk Quotas

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: in 1994/1995, 23,500 participants.

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 tonnes 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 tonnes, 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.

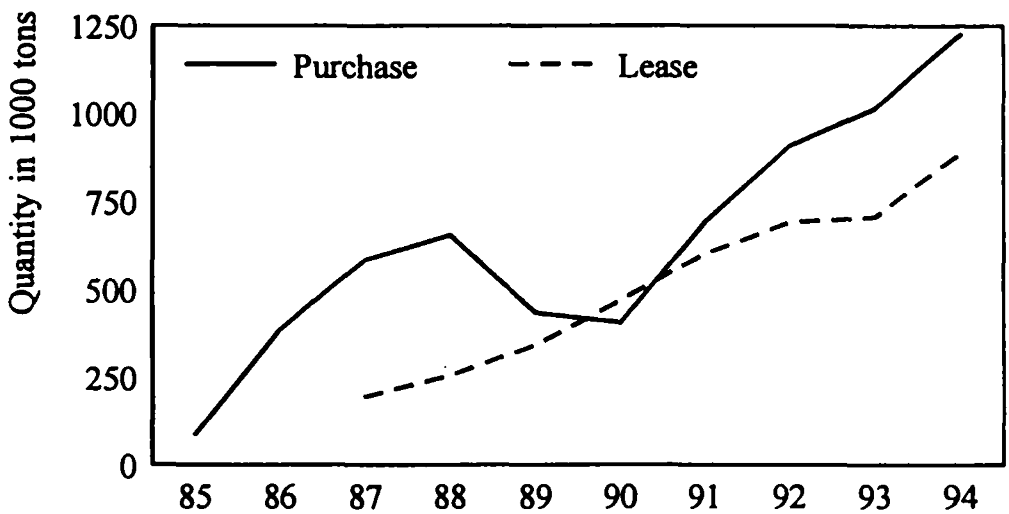
[1] In most cases land is only transferred for one year, taking care not to use it for dairy farming. After that year, the land loses its quota and is transferred back to the original owner whilst the quota remains with the purchasing farmer (Besseling, 1991). This construction has proven an effective 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.

Figure 1 Milk Quota Transferred in England and Wales



Source: National Dairy Council, 1995

Figure 2 Milk Quota Transferred in The Netherlands



Source: Produktschap 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 organisation 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 co-operatives 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. Co-operation 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 centralised spot market in the 1980s and there have been centralised spot markets for milk quotas in Ontario since 1980 and in Quebec since 1985 (Oskam, 1991). These centralised 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.

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 trader (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. 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 three per cent 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 is not yet sufficiently liquid. 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.

3. 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).[1] 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.[2]

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

[2] 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, 1997a).

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 sales/purchases over hedging in futures are quite clear. As with futures, the price 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 sales/purchases over hedging in futures are not valid. In this case, the advantages of futures markets - the highly organised methods of trading with the extreme standardisation 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 earlier. 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 maximise 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.[1] Garcia *et al.* (1994) provide additional evidence of the usefulness of the EV model compared to the negative exponential and Cox Rubinstein utility functions. In the EV model, the objective of the hedger is to maximise the objective function:

$$\Pi^{ce}_{t+1} = E_t\ (\Pi_{t+1}) - \lambda\ VAR_t\ (\Pi_{t+1}) \qquad (1)$$

where Π^{ce}_{t+1} is the certainty equivalent, $E_t\ (\Pi_{t+1})$ is the expected profit, given the information set at time t, and $VAR_t\ (\Pi_{t+1})$ 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 maximise 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:

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

[1] 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).

where $E_t\ (p_{t+1})$ is the expected cash price of milk given the information set at time t, α the hedge ratio,[1] 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.

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

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

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 $Var_t\ (p_{t+1})$, $Var_t\ (f_{t+1})$ and $Var_t\ (b_{t+1})$ 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 $Cov_t\ (p_{t+1}, b_{t+1})$, $Cov_t\ (f_{t+1}, p_{t+1})$ and $Cov_t\ (f_{t+1}, b_{t+1})$ 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:

$$\begin{aligned} Var_t\ (\Pi_{t+1}) &= (\alpha - 1)^2\ Var_t\ (f_{t+1}) + Var_t\ (b_{t+1}) + Var_t\ (p_{t+1}) \\ &- 2\ (\alpha - 1)\ Cov_t\ (f_{t+1}, b_{t+1}) + 2\ (\alpha - 1)\ Cov_t\ (f_{t+1}, p_{t+1}) - 2\ Cov_t\ (p_{t+1}, b_{t+1}) \end{aligned} \qquad (4)$$

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:

$$\alpha = \frac{-f_t + E_t\ (f_{t+1}) - TC}{2\lambda\ Var_t\ (f_{t+1})} + 1 - \rho_1 \frac{\sqrt{Var_t\ (p_{t+1})}}{\sqrt{Var_t\ (f_{t+1})}} - \rho_2 \frac{\sqrt{Var_t\ (b_{t+1})}}{\sqrt{Var_t\ (f_{t+1})}} \qquad (5)$$

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 terms 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

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

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., $\lambda \to \infty$ 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:

$$\alpha = 1 - \rho_1 \frac{\sqrt{Var_t\,(p_{t+1})}}{\sqrt{Var_t\,(f_{t+1})}} + \rho_2 \frac{\sqrt{Var_t\,(b_{t+1})}}{\sqrt{Var_t\,(f_{t+1})}} \qquad (6)$$

$Var_t\,(b_{t+1})$ 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 later.

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 quota, 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 quota, 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 quota. The competition for milk quota among potential entrants will force up prices to the point at which the net benefit of producing equals the price of milk quota (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 quota, 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:

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

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 quota) in a particular year. Hence, the lease price of milk quota 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 quota) 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.

4. 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 introduce successfully 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 here.

In the first stage, three well-known approaches in successful futures contract innovation are commonly used: the 'commodity characteristics' approach, the 'contract characteristics' approach and the 'efficient cross-hedge' approach. The first approach defines feasible commodities for futures trading based on an extensive list of required commodity attributes; the second one focuses on factors endogenous to the futures industry and the third approach combines the aforementioned approaches and emphasises that presence or absence of an efficient cross-hedge for the commodity underlying a new futures market is an important variable in explaining success.[1]

[1] 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).

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, where there is 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 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 as indicated by the 'efficient cross-hedge approach'.[1] 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 Pennngs, 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 earlier, 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) can 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 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 monopolisation 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 analysed. 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.

[1] 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.

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-term 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:

$$V = \frac{CS}{FCZ} * HR * VLCT \qquad (9)$$

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 7,000 kilograms 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.

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 very rapidly. 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

Figure 3 Futures Contract A - United Kingdom

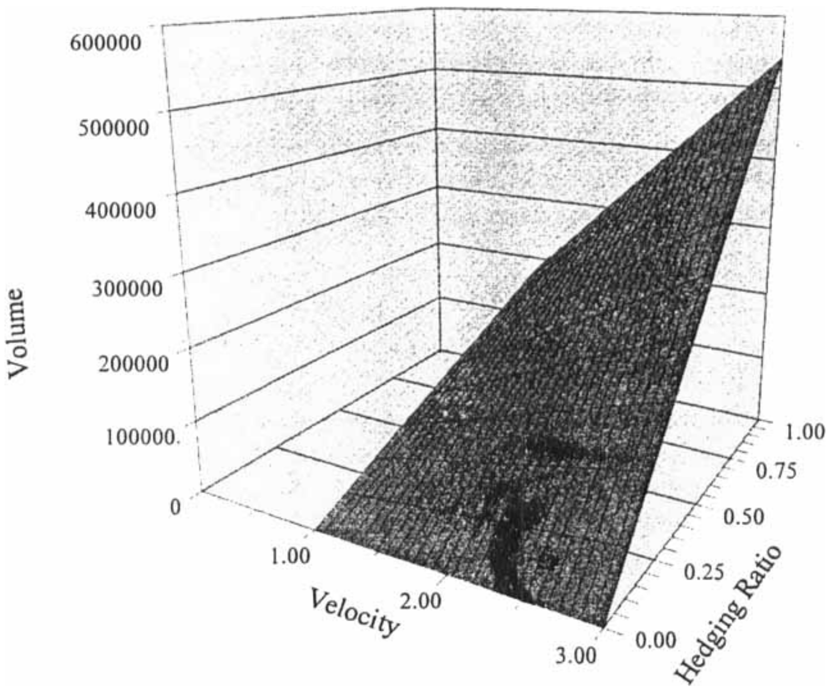


Figure 4 Futures Contract B - United Kingdom

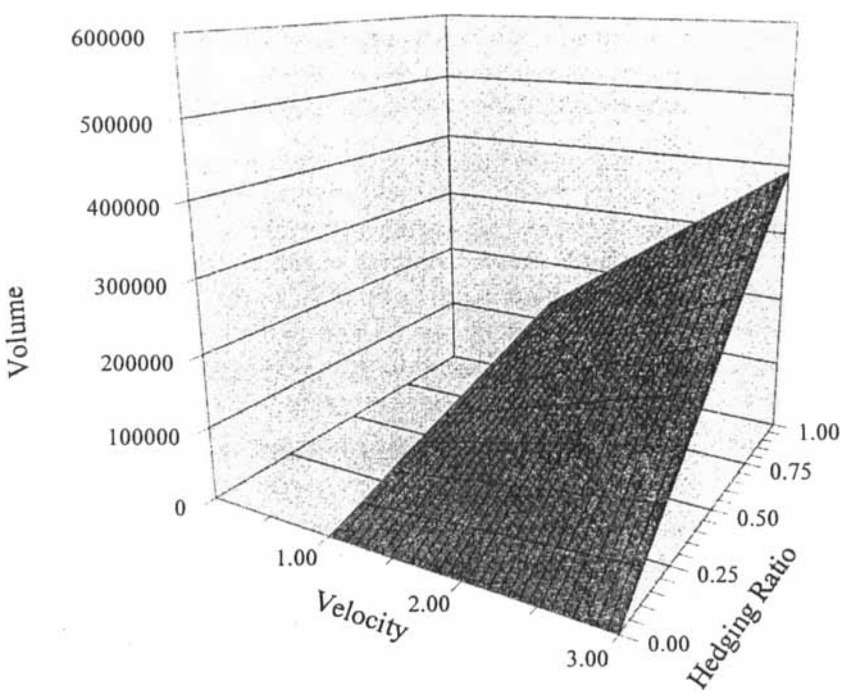


Figure 5 Futures Contract A - The Netherlands

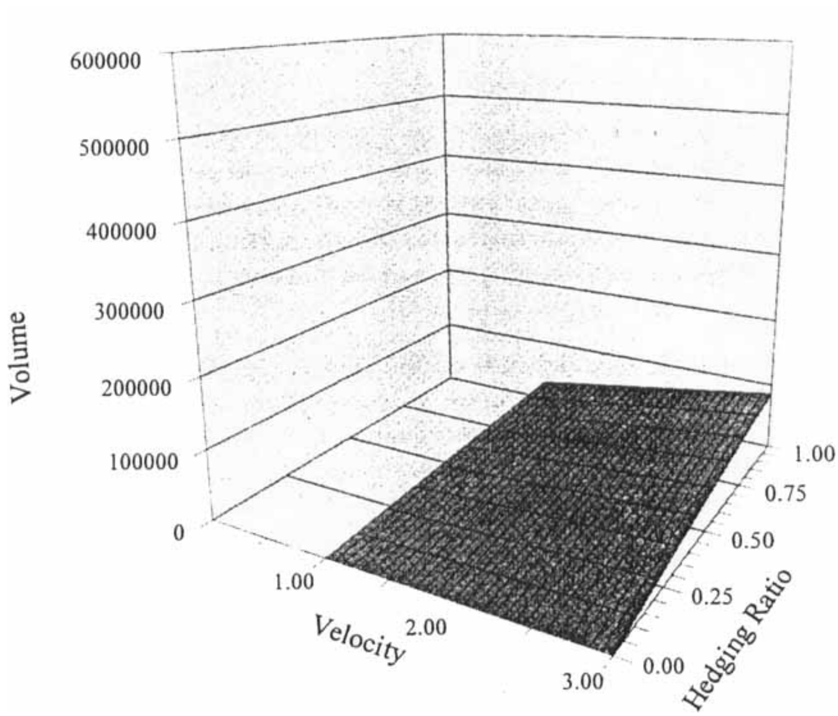
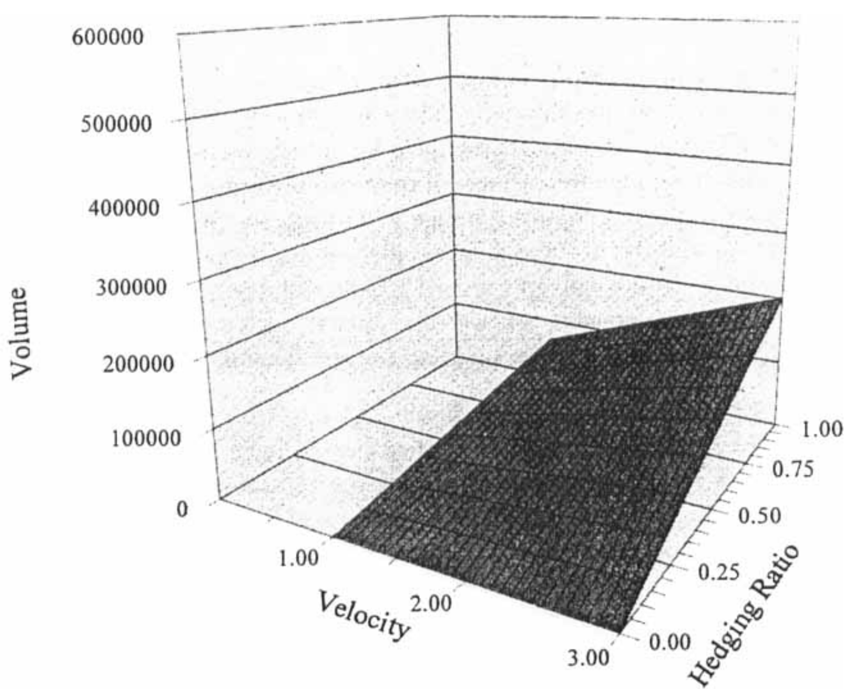


Figure 6 Futures Contract B - The Netherlands



might expect the hedging ratio to be smaller than 1, making the values of VLTC 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 *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. A recent study by Pennings and Candel (1997) among 500 hog farmers has 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.

5. 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, rights futures 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.

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