CHAPTER 13

A FUTURES MARKET OF AGRICULTURAL PRODUCTION RIGHTS: AN APPLICATION TO THE DUTCH, ENGLISH AND WELSH MILK QUOTA MARKETS

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Summary

Farms are increasingly being affected by policies that involve production rights. Because fluctuation in prices of these rights in the cash market, farmers face a price risk. A futures market would enable them to hedge against this price risk. Rights futures have some features that differ from those of traditional commodity futures, which make them very suitable for futures trading. One such a feature of rights futures contracts 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 because delivery takes place by book entry and hence will not adversely affect the hedging effectiveness. In this article it is shown that, because of this nature of rights, relatively more will be hedged than in the case of traditional commodities. We argue that a futures market of rights can be an effective and efficient tool for managing price risk, and will illustrate this for milk quota. To provide insight into its viability, some indication is given what might happen if such a futures market was established in the Netherlands, England and Wales.

1 Introduction

Between 1973 and 1983, milk production in the European Union (EU) rose by 30% while consumption only rose by 9% (Braatz, 1992). This resulted in very large stocks of butter and milk powder, which put a strong pressure on the EU-budget due to the Common Agricultural Policy guaranteed price system. As a result a milk quota scheme was put into practice on April 2 1984. All EU-members had the right to produce a certain quantity of milk. Within a large framework, states were free to implement the policy at their own discretion. The EU has allowed the transfer of quotas within country borders. National governments must add their own rules to the framework of EU-regulations. Despite the fact that these EU-regulations require milk quota to be linked to land when buying or selling milk quota, in the Netherlands and the United Kingdom there are ways to circumvent this requirement. In 1987 member states were given the option to introduce quota leasing as a possibility of transferring quotas. The trade in milk quota is increasing every year, most of which occurs in the United Kingdom and the Netherlands. The underlying value of this trade in these two countries exceeded one billion US dollars in the milk year 1993/94 (Van Dijk and Pennings, 1995). For that reason our attention has been focused on England, Wales and the Netherlands.

2 Cash market of milk rights: need for hedging

In the EU most cash markets of milk rights have not been structured or developed well. Canada, on the other hand, developed a centralized spot market in the 1980s. There have been centralized spot markets of milk rights in Ontario since 1980 and in Quebec since 1985. In the EU such centralized spot markets have not been established yet.

England and Wales

As can been seen from Figure 1 total quantities transferred have grown continuously in England and Wales, and so has the quantity being put to lease.

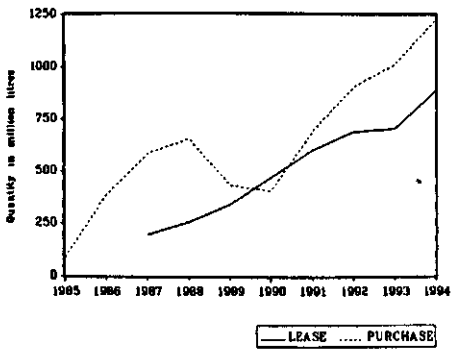

Figure 1. Milk quota being transferred in England and Wales
Source: National Dairy Council, 1995

The prices of milk quota have reached higher levels each year during the first five years of the scheme. Prices have fluctuated considerably, mainly at the end of the year.

The Netherlands

The development of the milk quota market in the Netherlands was given an additional boost by the introduction of leasing in 1989/90. Leasing is still gaining popularity. In 1988/89 about 300,000 tonnes of quota were transferred permanently among farms. The next year, after leasing had been introduced, total quantity transferred remained roughly the same; however, only 180,000 tonnes were transferred permanently, the rest was put to lease, indicating a shift towards temporary transfers. Figure 2 shows a rapid growth in leasing and a much slower growth in permanent transfers in succeeding years. In the quota year 1994/1995 18,078 lease contracts were concluded, an increase of 47% compared with the year before. Contracts for permanent transfers were 6,243 in number, an increase of 6% compared with the year before.

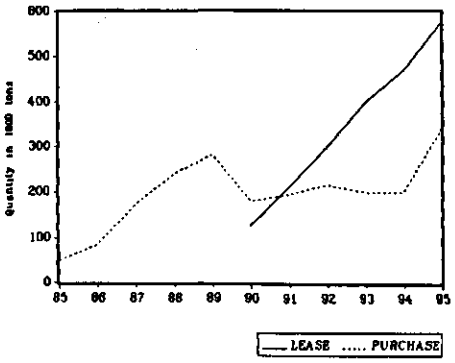

Figure 2. Milk quota being transferred in the Netherlands
Source: Product Board for Dairy Products, 1995

The distributions of milk quota prices in the milk price year 1993/94 for both buy/sell and lease are shown in Tables 1 and 2. The farmers are classified by the level of the milk quota price into five almost equal (in amount) dairy farm groups.

Table 1. Distribution of milk quota purchases/sales prices in Dutch Guilders in 1993/94

Number of dairy farms in class %	Price per kilogram of milk quota	Minimum price in class	Maximum price in class
20.2	2.81	0.56	3.99
17.8	4.06	4.00	4.15
21.9	4.22	4.16	4.31
20.5	4.38	4.32	4.45
19.6	4.85	4.49	5.84
100.0	3.96	0.56	5.84

Source: LEI-accounting, 1995

The data in Tables 1 and 2 have been obtained from a sample of 500 dairy farms. The price differences, in both buy/sell and lease, among the different classes are great, because in the Netherlands the spot market for milk quota is not transparent.

Risks

In the Netherlands and the United Kingdom most transactions are conducted with the help of intermediaries. Official brokers normally charge fixed mark up commission, so the largest share of the price risk is borne by the farmers. Traders in milk quota do take price risk and make cash forward contracts with farmers.

Table 2. Distribution of milk quota lease prices in Dutch Guilders in 1993/94

Number of dairy farms in class %	Price per kilogram of milk quota	Minimum price in class	Maximum price in class
20.5	0.3250	0.2074	0.3538
17.9	0.3808	0.3576	0.3999
22.6	0.4028	0.4000	0.4100
18.9	0.4299	0.4101	0.4401
20.1	0.4681	0.4421	0.6170
100.0	0.4013	0.2074	0.6170

Source: LEI-accounting, 1995

For both the United Kingdom and the Netherlands we have observed an increased trade in milk quota and considerable price differentials among regions and periods of time. This presents management problems for farmers. First, if the farmer intends to sell or buy milk quota, (s)he does not know the price at the end of the milk price year, so faces a price risk. Second, dairy farmers who sell milk quota at the end of the milk price year have to sell their dairy cows within a very short period, theoretically, within an infinitely short period of time, because after selling the milk quota they are no longer allowed to produce milk any longer for the next milk price year. Because of the farmers having to sell all dairy cows at once, they are not able to receive the best price for the herd. For the same reasons, problems will exist for farmers who want to expand their farms. Milk quota futures will provide an efficient tool for managing this price risk.

Futures markets provide participants with opportunities for hedging, and make the market transparent. On average, only 3% of the trade that is conducted is actually delivered (Catania, 1989). In the case of a futures market in rights, the actual delivery will be greater at the beginning of such a market, 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 case of a futures market in rights, because of their characteristics.

3 Optimal hedging ratio and hedging effectiveness

Futures contracts are standardized with respect to time of delivery, delivery location, quality and unit of trading (Sandor, 1973). This standardization process is very complicated for commodities, especially with respect to location of delivery and commodity characteristics (such as sort and form), causing basis risk. A right, however, is a perfect homogeneous 'commodity', *i.e.*, the underlying commodity of a rights futures contract is identical to the commodity in the cash market, implying that there are no problems with respect to delivery, because delivery takes place by transferring book entries between accounts (Pirrong *et al.*, 1994). Nor are there any problems with respect to quality.

Consider a farmer who can lock in the price risks regarding milk rights with the help of milk rights futures. We assume that the only production costs are the costs of acquiring milk rights, which will not affect our conclusions. Given that the farmer wishes to maximize the expected revenue in the next time period adjusted for risk, where risk is measured by the variance of the expected revenue, the objective function can be based on the expected value-

variance (EV) model (Peck, 1975; Kahl, 1983; Barry and Robison, 1987). The EV approach is justified because we use this model for determining the relationship between the variables and for showing the direction of change in relevant variables if changes occur in other factors that comprise the decision environment. We do not use the EV model for its measurability.[1] The objective function can be expressed as:

$$\Pi_{ce} = E(\Pi) - \lambda VAR(\Pi) \tag{1}$$

where Π_{ce} is the certainty equivalent, $E(\Pi)$ is the expected revenue and $VAR(\Pi)$ represents the variance of the revenue. λ denotes the risk parameter which, for risk-averse decision makers, is positive, thus providing compensation for risk bearing (Pratt, 1954). At time t the farmer wishes to maximize the certainty equivalent for the next period $t+1$. Given that the cash positions are predetermined, the expected processing margin at time $t+1$ equals the revenue from selling the main product minus the cost of buying the milk rights in the cash and futures markets, corrected for the transaction costs and the basis, where the basis is defined as the local cash price minus futures price. The expected revenue can now be written as:

$$E(\Pi) = p\beta - [\alpha(f_t - f_{t+1}) + \beta(f_{t+1} + b_{t+1}) + |\alpha| TC] \tag{2}$$

where p_{t+1} is the price of milk, α the amount of milk quota being hedged, β the total amount of milk quota needed, which equals the total amount of milk produced, f_t the futures price at which the contract is opened, f_{t+1} the expected settlement futures price, b_{t+1} is the expected basis at maturity and TC the transaction costs.

Let $\sigma^2_{p_{t+1}}$, $\sigma^2_{f_{t+1}}$ and $\sigma^2_{b_{t+1}}$ be the variance of the milk price, the variance of the settlement futures price and the variance of the basis, respectively. The variance of the revenue is now given by:

$$VAR(\Pi) = (\alpha - \beta)^2 \sigma^2_{f_{t+1}} + \beta^2 \sigma^2_{b_{t+1}} + \beta^2 \sigma^2_{p_{t+1}} - 2\beta(\alpha - \beta)\sigma_{f_{t+1}b_{t+1}} + 2\beta(\alpha - \beta)\sigma_{f_{t+1}p} - 2\beta^2 \sigma_{p_{t+1}b_{t+1}} \tag{3}$$

where p_{t+1}, f_{t+1} and b_{t+1} have a constant variance conditional on the information available at time t given by:

$$\sigma^2_{p_{t+1}} = E(p_{t+1} - E_t(p_{t+1}))^2$$

$$\sigma^2_{f_{t+1}} = E(f_{t+1} - E_t(f_{t+1}))^2$$

$$\sigma^2_{b_{t+1}} = E(b_{t+1} - E_t(b_{t+1}))^2$$

The optimal hedging amount can be derived by taking the first derivatives from Π_{ce} with respect to α. Hence, the optimal hedging amount can be expressed as:

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[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), Pulley (1981), Tew *et al.* (1991) and Robison and Hanson (1997) (this volume).

$$\alpha = \frac{-f_t + f_{t+1} - TC}{2\lambda\sigma^2_{f_{t+1}}} + \beta - \frac{\beta\sigma_{f_{t+1}\beta}}{\sigma^2_{f_{t+1}}} + \beta\rho\frac{\sigma_{b_{t+1}}}{\sigma_{f_{t+1}}} \tag{4}$$

where ρ is the correlation coefficient between the basis and the futures price at maturity. Castelino (1992) showed that usually this correlation is negative. As a result equation (4) implies that, if the variance in the basis increases, less will be hedged. Because of the characteristics of rights, as explained in the beginning of this section, the variance of the basis will be small. So, normally more will be hedged in the case of rights than in the case of hedging traditional commodities, since the latter introduces basis risk.

Not only by the optimal hedging ratio, but also by the minimum-variance hedge ratio are we able to show that more rights will be hedged than traditional commodities (Ederington, 1979; Paroush and Wolf, 1989). Theoretically, if basis risk is zero, the minimum-variance hedge ratio is unity and residual risk is zero (Castelino, 1992).

In looking for viability of such a futures market, it is not only interesting that rights themselves can be hedged effectively, but also that rights futures lend themselves to cross hedging the revenue capacity of the farm. In theory, farmers affected by rights will purchase or sell rights, depending on their initial cost structure, up to the net benefit (Varian, 1990). The total rights allocated by the government are fixed. So:

$$Q_i = \phi R_i \quad \text{and} \quad \sum_{i=1}^{N} R_i = R_0$$

where Q_i are the units of output used by firm i, R_i are the units of rights used by firm i, N is the total number of firms and R_0 is the total number of rights allocated by the government. For reasons of simplicity, assume that the firm needs one right in order to produce one unit of output[2], *i.e.*, $\phi = 1$. Assume further that the only entry barrier to the industry is the fact that rights are needed in order to produce, *i.e.*, the only limiting factor is the rights. The fact that the only limiting factor is the rights implies that the price of rights can be seen as an economic rent. The economic rent generated in the production process is allocated to the rights. Even with a fixed number of rights allocated, it will always be possible to enter the industry by buying rights. The competition for rights among potential entrants will force up the prices of the rights to the point at which the net benefit of producing equals the price of rights (Varian, 1990).

The value of the rights at industry level can be expressed as:

$$P_R R_0 = pR_0 - C(R_0) \tag{5}$$

where P_R is the price of rights and $C(R_0)$ is the cost of production excluding the cost of buying the rights. The cost concept used in equation (5) is broad, *i.e.*, these costs include the reward for the factors of production (of land, labour and capital (including capital reserves), as well as other costs).

Equation (5) shows that the price of rights reflects the possibilities of marketing the output (*i.e.*, the output price) and the cost structure of the production process (excluding the cost of rights). Hence, the price of rights is a proxy for the performance of the industry. If the

[2] Relaxing this assumption will not change the conclusions of the analysis.

industry's performance is good, then buyers are willing to pay a high price for the right, and *vice versa*. So, futures rights are not only an efficient tool for hedging against adverse price fluctuations of rights, but also for hedging against adverse fluctuations in the revenue capacity of the production process (Anderson and Danthine, 1981; Black, 1986; Ames and Myneni, 1992).

4 Viability of a futures market of milk rights

From the list of criteria other authors have considered necessary for selecting commodities for futures trading (Carlton, 1984; Black, 1986; Brorsen and Fofana, 1995), the following characteristics can be selected for success or failure of futures contracts.

1. One's own hedge should bear less risk than the existing cross hedge contract.
2. Volatility of price of the commodity in cash market.
3. The liquidity cost of using one's own futures markets should be lower than that of using the existing cross-hedge futures markets.
4. The cash market must be large.
5. The marketing channel must not be vertically integrated nor highly concentrated.
6. The cash market must be active.
7. The commodity traded must be homogeneous.

These criteria are all satisfied for milk rights, but because of space limitations, they are not elaborated upon.

We propose two kinds of contract specifications. Futures (1) is defined as the right to produce an amount of milk each milk year as long as the EU milk policy is maintained. Futures (2) is defined as the right to produce an amount of milk for a particular milk price year. The first contract is connected with the milk quota buy/sell market, the latter with the lease market. Farmers who intend to quit dairy production or want to expand their milk quota in the long run can use contract 1. Contract 2 is suited for short-term quota sales or acquisitions.

The following assumptions apply:

1. A futures contract represents 7000 kilograms of milk quota (this amount equals the average yearly production of a dairy cow) with a specific fat percentage;
2. The dairy farmer uses the minimum variance hedge which, in the case of milk rights, means that (s)he hedges 100% of his/her spot market transactions; and
3. The turnover of the futures contract is, because of a lack of empirical insight into the cash market and futures market of milk rights, cautiously set at one, *i.e.*, hedgers trade only with hedgers on the futures market.

In order to calculate the volume generated by hedgers, the size of the cash market is divided by that of the futures contract.

The amount of milk quota that is bought and sold in the spot market is not expected to increase. This in contradistinction to leasing of milk quota. The reason is that dairy farmers who sell their quota will, in general, go out of business. Farmers who continue to be in business will use futures contract 2, because of the high fixed cost involved in buying milk

quota. The group of dairy farmers with the smallest production scale, *i.e.*, potential sellers of quota, is decreasing. This phenomenon will have an impact on the future of futures contract 1. This group of farmers will use the futures market to manage their price risk, which consists of two components: the price of their herds and of the milk quota. The volume in hypothetical futures market 1 is therefore expected to decline steadily.

We are aware of the fact that the procedure followed is a simple one and omits some important variables. Research is being conducted, built upon work of Black (1986) and Brorsen and Fofana (1995), which includes variables, such as spot price variance, vertical integration and so on.

The estimates in Table 3 show that the idea of establishing a futures market of milk quota in the Netherlands and England and Wales would be an interesting one, if compared with the existing European agricultural futures markets. Note that the estimates in Table 3 are the volume generated by hedgers; we did not incorporate the volume generated by scalpers and speculators. Further research is being conducted. It includes the volume generated by speculators and a model with variables, such as cash price variance, vertical integration and so on, in order to estimate futures contract volume.

Table 3. Volume of contracts generated by hedgers on the (hypothetical) futures markets in the Netherlands (NL) and England and Wales (E&W)

Year	Hypothetical futures contract 1		Hypothetical futures contract 2	
	NL	E&W	NL	E&W
1990	25,714	59,680	18,000	68,871
1991	27,857	101,966	30,142	88,695
1992	30,857	133,367	42,714	101,598
1993	28,571	149,097	57,149	103,866
1994	28,571	180,543	67,143	130,543

Source: our own calculations, 1995

The volumes calculated strongly depend on the assumption that farmers hedge all of their cash position, which is an optimistic assumption. They also depend on whether turnover of the futures market is one, *i.e.*, that hedgers trade with hedgers, which is a pessimistic assumption. Therefore, we calculated the volumes for 1994 for different levels of turnover and hedging ratios, as shown in Tables 4 and 5.

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Table 4. Volume of contracts traded on the (hypothetical-) futures markets in 1994 at different levels of turnover and hedging ratio

Hedging ratio	Turnover		
	1	1.5	2
1	Contract 1 180,543 Contract 2 130,543	Contract 1 270,815 Contract 2 195,815	Contract 1 361,086 Contract 2 261,086
0.6	Contract 1 108,326 Contract 2 78,325	Contract 1 162,488 Contract 2 117,488	Contract 1 216,651 Contract 2 156,651

Table 5. Volume of contracts traded on the (hypothetical-) futures markets in 1994 at different levels of turnover and hedging ratio in The Netherlands

Hedging ratio	Turnover		
	1	1.5	2
1	Contract 1 28,571 Contract 2 67,143	Contract 1 42,856 Contract 2 100,714	Contract 1 57,142 Contract 2 134,286
0.6	Contract 1 17,143 Contract 2 40,286	Contract 1 25,713 Contract 2 60,428	Contract 1 34,258 Contract 2 80,571

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