Environmental and Production Rights Futures: A New Booming Market?

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The primary function of rights (permits) is to guide incentives to achieve internalization of externalities (see Coase [1960], Demsetz [1976], and Hahn [1994]). In the past decade different kinds of rights have been introduced by national or supranational governments. The most well-known are: lead rights, SO_2 rights, and chlorofluorocarbon rights introduced by the U.S. government (all examples of environmental rights), and the milk and fishery rights introduced by the European Union and the government of Canada (both examples of production rights).

Most cash markets for rights have not yet been well-structured or developed (Pennings, Heijman, and Meulenberg [1997]). Because of fluctuations in prices of these rights in the cash market, firms are faced with a price risk. A futures market would enable them to hedge against this price risk.

The U.S. has taken the first steps toward developing a structured cash market and a futures market (see Sandor [1991] and Hahn [1994]). This article shows that the nature of rights and the fact that rights are linked to the production process mean that rights futures offer good possibilities for hedging.

A FUTURES MARKET FOR RIGHTS

In a futures market, transactions relating to commodity characteristics, time of delivery, deliv-

ery location, and unit of trading are standardized (Sandor [1973]). This standardization process for commodities can be very complicated, especially with respect to place of delivery and commodity characteristics (such as the basic deliverable grade). This is in contrast to the futures market for rights.

A right is a perfect homogeneous "commodity," i.e., the underlying commodity is identical to the commodity in the cash market, implying that there are no problems with delivery. Place of delivery is not important either, because delivery takes place by transferring book entries between accounts (Pennings, Meulenberg, and Heijman [1996]).

Rights futures contracts have no residual risk (i.e., basis risk) at maturity of the futures contract (see Black [1986]), and therefore hedging is more effective (see Castelino [1992] and Pirrong, Kormendi, and Meguire [1994]). Because price convergence is assured, there is never an instance when spot prices move one way while the futures settlement price moves another.

These characteristics of rights futures have a positive impact on the minimum-variance hedge ratio. The risk-minimizing or minimum-variance hedge ratio is equal to the covariance between the change in the spot price and the change in the futures price, divided by the variance in the change in the futures price (see Ederington [1979] and Paroush and Wolf [1989]).

$$N^* = -\frac{COV(\Delta S_t, \Delta F_t)}{VAR(\Delta F_t)} \qquad (1)$$

where N^* is the minimum-variance hedge ratio, COV is the covariance, ΔS_t is the change in the spot price, ΔF_t is the change in the futures price, and VAR is the variance.

Given the characteristics of rights, the price change in the spot price of rights is almost equal to the price change in futures, which results in a minimum-variance hedge ratio close to $N^* = -1$. The optimum hedge quantity should be very near the full production level.

For the viability of such a market, it is not only of interest that rights themselves are hedged effectively, as is shown by Equation (1), but also that rights futures lend themselves to cross-hedging the profit capacity of a complicated produc-

tion process. In theory, firms creating externalities, and thereby being affected by rights, will purchase or sell rights depending on their initial cost structure, up to the net benefit (see Tietenberg [1985] and Varian [1990]).

What does the price of a right indicate? Consider a competitive industry affected by environmental rights, i.e., a firm is only allowed to produce when it has environmental rights.[1] Note that the total rights allocated by the government are fixed. So:

$$Q = \alpha R$$

and

$$\sum_{i=1}^{N} R_i = R_0$$

where Q are the units of output, N is the total amount of firms, R_i are the units of environmental rights used by firm i, and R_0 are the total amounts of rights allocated by the government.

For simplicity, assume that a firm needs one environmental right in order to produce one unit of output, i.e., $\alpha = 1$.[2] Assume further that a competitive industry produces a homogeneous product such as electricity, so that the only barrier to entering the industry is the fact that environmental rights are needed for production, i.e., the only limited factor is the environmental rights.

The fact that the rights are the only limited factor 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. Whenever there is some fixed factor, in this case the rights, that prevents one from entering the industry, there will be an equilibrium rental rate for that factor. Even with a fixed amount of allocated rights, it is always possible to enter the industry by buying the position of a firm currently in the industry, i.e., buying environmental rights. The competition for rights among potential entrants forces up the prices to the point when the net benefit of producing equals the price of rights (see Varian [1990] and Pennings and Meulenberg [1996]).

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

$$P_R R_0 = P R_0 - C(R_0) \qquad (2)$$

where P_R is the price of rights, P is the price of the output, and C are the costs of production excluding those of buying the rights. The cost concept used in Equation (2) is broad, i.e., these costs include the reward for the production of means (capital and labor) and capital reserves in order for the firm to continue research and development, etc.

Equation (2) 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 costs of rights). Hence, the price of rights is a proxy for the performance of the industry. If the price of rights is high, the industry is performing well and is therefore willing to pay a high price for the right, and vice versa.

Assuming that the profitability of individual firms is closely related to that of the industry, the firm now has the opportunity to use a single (rights) futures contract to hedge against adverse revenue in the industry in which it operates, regardless of the complexity of the production process, instead of using a complicated and perhaps non-existent futures contract spread. So futures rights are not only an efficient tool for hedging against adverse fluctuations in prices of rights, but also for hedging against adverse fluctuations in the profit capacity of the production process. This cross-hedge is effective if the comovement of the performance of the industry and futures of rights is reliable and consistent (see Anderson and Danthine [1981], Black [1986], and Ames and Myneni [1992]).

Some futures exchanges are already planning to introduce futures contracts for rights because their specific characteristics make them very suitable for futures trading, as has been outlined here. Recently, the Chicago Board of Trade took the first concrete steps toward such a market when it, with the cooperation of the U.S. Environmental Protection Agency, conducted an auction for SO_2 rights. This organized spot and forward market is viewed as a logical first step toward full futures trading.

CONCLUSIONS

More and more firms are being affected by rights introduced by governments to internalize externalities. Rights form a production cost that

has an impact on a firm's profit. Because of price fluctuations, they create an additional risk for the firm; rights futures will therefore meet the firms' needs for hedging.

This article shows that the characteristics of rights make them very suitable for futures trading. The possibilities of using rights for one's own hedging and cross-hedging mean that they are of interest to both the futures industry and the firms affected by rights.

ENDNOTES

[1]The same holds for production rights.
[2]Relaxing this assumption will not change the conclusions of the analysis.

REFERENCES

Ames, G.C.W., and G.A. Myneni. "Cross Hedging as a Pricing Strategy for Alternatives Crops: The Case of Southeastern Canola." *Journal of International Food & Agribusiness Marketing*, 4 (1992), pp. 25-43.

Anderson, R.W., and J.P. Danthine. "Cross Hedging." *Journal of Political Economy*, 89 (1981), pp. 1182-1196.

Black, G.D. "Success and Failure of Futures Contracts Theory and Empirical Evidence." Salomon Brothers Center for the Study of Financial Institutions, New York, 1986.

Castelino, M.G. "Hedge Effectiveness: Basis Risk and Minimum-Variance Hedging." *Journal of Futures Markets*, 12 (1992), pp. 187-201.

Coase, R.M. "The Problem of Social Cost." *Journal of Law and Economics*, 3 (1960), pp. 1-44.

Demsetz, H. "Toward a Theory of Property Rights." *American Economic Review*, 57 (1976), pp. 347-359.

Ederington, L.H. "The Hedging Performance of the New Futures Markets." *Journal of Finance*, 34 (1979), pp. 157-170.

Hahn, R.W. "Getting More Environmental Protection for Less Money: A Practitioner's Guide." *Oxford Review of Economics Policy*, 9 (1994), pp. 112-122.

Paroush, J., and A. Wolf. "Production and Hedging Deci-

sions in the Presence of Basis Risk." *Journal of Futures Markets*, 9 (1989), pp. 547-563.

Pennings, J.M.E., W.J.M. Heijman, and M.T.G. Meulenberg. "The Dimensions of Rights: A Classification of Environmental Rights and Production Rights." *European Journal of Law and Economics*, Forthcoming, 1997.

Pennings, J.M.E., and M.T.G. Meulenberg. "A Futures Market for Agricultural Production Rights: An Application to the Dutch, English and Welsh Milk Quota Market." Proceedings of the EUNITA-seminar, Risk Management Strategies in Agriculture: State of the Art and Future Perspective, 1996.

Pennings, J.M.E., M.T.G. Meulenberg, and W.J.M. Heijman. "Environmental Rights on the Futures Markets: An Application to the Dutch Manure Market." *Environmental & Resource Economics*, 7 (1996), pp. 79-94.

Pirrong, S.C., R. Kormendi, and P. Meguire. "Multiple Delivery Points, Pricing Dynamics, and Hedging Effectiveness in Futures Markets for Spatial Commodities." *Journal of Futures Markets*, 14 (1994), pp. 545-573.

Sandor, R.L. "Chicago Board of Trade Clean Air Futures for Emissions Allowances Program Risk Management." *Financial Exchange*, 10 (1991), pp. 9-10.

——. "Innovation by an Exchange: A Case Study of the Development of the Plywood Futures Contract." *Journal of Law and Economics*, 16 (1973), pp. 119-136.

Tietenberg, T.H. *Emissions Trading: An Exercise in Reforming Pollution Policy*. Washington, D.C., 1985.

Varian, H.R. *Intermediate Microeconomics*. New York: W.W. Norton & Company, 1990.