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The Pricing of Commodity-Linked Bonds: Discussion

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DISCUSSION

J. E. INGERSOLL*: In his paper Schwartz uses the now classic option pricing methodology to value a relatively new variety of corporate bond whose principal is guaranteed, at the holder's option, in a commodity numeraire. Precisely, the owner of the bond can choose to be repaid at maturity in either cash or a specified quantity of a given commodity. Typically the cash equivalent of the latter may also be selected.

The methodology employed is standard and correct so I need not go into its details. By concentrating on the issue as it is narrowly defined here, however, I think that the broad applicability of this type of problem has not been sufficiently emphasized. Many currently available financial assets have payoffs which depend on the maximum (or minimum) of two stochastic variables. Some examples are bonds which are payable in more than one currency, co-signed loans, and joint event insurance.¹

I would like to confine my discussion to one point, the difference between commodities and assets. It would be difficult and probably pointless to present precise definitions of commodities and assets. Certainly the precious metals, for example, have properties of each class. Three fairly safe generalizations, however, are that commodities are more expensive to store, are subject to larger transactions costs, and trade in less active markets than the financial assets typically handled in option problems. The "perfect" market and continuous trading assumptions are therefore subject to more than the usual skepticism.

In addition, Brennan [2] has documented that at least some commodities are stored even when their expected price changes net of carrying costs are negative. The usual explanation for such behavior is that the commodities return a service or convenience yield to their owner. In the case of gold or silver the convenience yield may be thought of as the utility of the "rental" derived from the use of jewelry, for example. Cootner explains convenience yield as the value of the option to sell the inventory quickly if prices are believed to be at a transitory high level.

Whatever the cause, the convenience yield is a portion of the return on the commodity (asset) not reflected in the price change. In this respect it is like a dividend on stock although it cannot be precisely measured. The existence of a convenience yield requires a change in the hedging derivation of the pricing equation (12). The return on the commodity is now $dP/P + cdt$. If c depends only on P , V , r , and t , the derivation still goes through and the seventh term in (12) becomes $(rP - c)B_p$. (If the convenience yield is proportional to P , the closed form solution is only slightly modified.²) On the other hand, if c depends upon stochastic variables other than P , V , and r , the four asset hedge used here cannot be made riskless except under singular conditions. In this case a method such as that in Geske [4] would be required.

Another way to handle the convenience yield is to use the futures price of the

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¹ Abowd and Manaster [1], Johnson [5], and Stulz [7], address some of these examples as well as other related problems not listed here.

² See Merton [6] for a solution to the option problem with proportional dividends.

commodity rather than the spot price (if one with a sufficiently long maturity is available). Cox, Ingersoll, and Ross [3] have shown that, although not the price of an asset, a futures price satisfies the same equilibrium as asset prices and, therefore, may be treated as such in a portfolio hedge as required here. The "return" on the future price does not, of course, include the convenience yield.³ Thus, the use of a futures price eliminates the problem of a stochastic convenience yield.

³ Since a futures contract does not require any investment, the "return" on the futures price does not include interest either.

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