

Learning Derivatives From Commodity Derivatives

FOREWORD TO *COMMODITIES AND COMMODITY DERIVATIVES: MODELLING AND PRICING FOR AGRICULTURALS, METALS AND ENERGY*, BY HELYETTE GEMAN, J. WILEY, 2004

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(c. 1220 words)

It is a great honor to find myself writing this foreword for my thesis director's book –although once someone's student, always her student, and it feels awkward to comment on one's supervisor's work. I was also pleased to find myself among its first readers, and benefit from its contents, as this work contains the first scientific compendium ever written on the intricacies linked to the physical nature of commodities.

Commodity options are not just interesting; they harbor all the pathologies encountered in the practice of derivatives, to the point of perhaps teaching us how to value derivatives with a different, deeper approach. Methodologists consider that to understand a phenomenon, there are two routes. The first consists in examining the regular, the ordinary, and the well-behaved, and excluding the unusual. The other consists in examining pathologies, the abnormal cases, then closing-in on the ordinary as the exception. Economists, alas, have traditionally tended to use the first method, by pushing the exceptions under the rug –while physicists and other hard scientists tend to resort to the second as a way to satisfy their curiosity about the world.

Why are commodity options the most interesting, and the least misunderstood, of all derivatives? And why are they the exception that would teach us about derivatives? I will attempt here to make a short list and show how we can generalize into the wrinkles of all options, including the generally perceived theory-friendly financial ones.

First, the temporal dimension. The action of borrowing and lending is hardly predictable in commodities. They are heavily grounded in their physical nature. We have been taught that securities are derived by arbitrage arguments that allow us to seamlessly borrow and lend, in order to move the asset and liability across the temporal dimension. This makes the passage from the spot to the forward (or future) seamless, smooth, and direct. In the arbitrage relationship, the forward equals the spot times some function of the differential between the yield and the cost of carry, more generally

$$F(t + \Delta t) = F(t) \text{Exp} \left\{ (r_1(t, t + \Delta t) - r_2(t, t + \Delta t)) \Delta t \right\}$$

where $F(t)$ is the forward for delivery at time t (hence the spot if t is the present), $r_{1(\cdot)}$ is the financing rate for the (marginal) borrower and $r_{2(\cdot)}$ is the yield of the underlying security, between time t and time $t + \Delta t$ respectively (pending on the numeraire used, r_1 and r_2 can be reversed). Accordingly, the forward contract is a mere extension to the spot, with stochasticity entering on occasion with one or both of the rates r_1 and r_2 being nondeterministic.

Now consider that you are trading in products that are not transferable into the future. Arbitrage becomes hardly possible –and, with it, the arbitrage argument. You may be dealing with a perishable commodity, like, say, an agricultural product. Storage can cause shrinkage in quantity, as with, say, electricity. The forward might not be born yet, as in the case of cattle. Forward oil may still be in the ground and might cost no carry to the producer, whereas the arbitrageur would have to bear onerous storage costs. The relationship might hold, owing to the activities of the producer, but for arbitrage reasons.

How do you deal with it? Clearly you need to treat every expiration like a separate underlying security. And you need to be careful about any arbitrage involving physical delivery.

How does it apply to the other derivatives? Consider currency options. Currencies, I was told when I started trading two decades ago, were “clean”. No worry, you just satisfy a forward obligation by buying spot and lending it, or vice versa. But every crisis, all except for one currency, the now defunct Deutschemark, started behaving like commodities. They become impossible to borrow, sometimes, as was the case of the Irish punt, in 1992, commanding as high as several thousand percent interest rates. The Canadian Dollar, the New Zealand and Australian currencies, all behaved unexpectedly outside the

textbook. Emerging market currencies almost always behave like commodities.

Had I been trained in commodities I would not have been squeezed on the occasion; I would have considered such possibility unlikely but a present risk. And every underlying security bears that risk, with no exception: bonds become impossible to find to satisfy a delivery obligation; stocks with heavy short interest become unavailable for the borrower. The only products that seem to escape such problem are options on futures.

The second point is the geographic limitation. While a security that you borrow is an abstract item, a mere balance sheet entry, commodities present location-specificity that can make arbitrages arduous. You can own all the oil you need in Rotterdam; if your delivery is in New York tomorrow, you will have a problem. In electricity, shortage in one part of a continent can rarely be compensated with excess elsewhere.

How does it apply to other derivatives? Consider the “safe” currencies again. Say that you have the currencies available in a Brazilian bank but that you have an offshore delivery obligation. The bank calls you to explain that the government forced exchange controls and that delivery will not be possible. You will have an immediate need to find offshore Brazilian currencies. There have been similar pressures with pricing differentials problems with almost all currencies.

The third point is the intricacy of storage. Commodities are “heavy”, unlike financial products. If you are expecting delivery and do not line up a warehouse you will be in trouble. Environmental agencies will not even let you dump your oil in the ocean. Cows are expensive to feed.

Do we have equivalent problems with cleaner derivatives? Of course: consider bonds that may be costly to own relative to your cost of carry, particularly when you have to borrow at a prohibitive short rate to fund them.

Fourth, the meat of the problem: dynamic hedging. Clearly it is not possible to dynamically hedge a security that you cannot short, sometimes cannot easily own, and that can be severely illiquid. Transaction costs can be monstrous. Fat tails and gaps thwart the argument that an option is a redundant security because it is safely replicated with a stream of dynamic hedges. We

have enough evidence of large deviations to realize that dynamic hedging is not attainable in practice.

Then how do people value options? Clearly options trade and we still manage to price them using risk-neutral probabilities. How do we do it? Simply by the actuarial method –the old approach brought forth by Bachelier over a century ago, with a risk-neutral twist. In the end he may have been right (adjusted for the use of the difference of the logarithms of the price instead of the price difference). We practitioners consider an option as simply the expected value of its payoff under some probability distribution, but not necessarily using dynamic hedging arguments.

As a Louis Bachelier advocate, Professor Geman organized an international conference in his honor in the summer of 2000. Furthermore, she spent some time in the world of insurance and only someone coming from insurance can manage to reconcile actuarial valuation with risk-neutrality (without the trap of dynamic hedging arguments). Reading this book, I come to realize that we finally vindicated Louis Bachelier. Commodities are teaching us that we do not dynamically hedge.

Enjoy this book and the accompanying training from the world of commodities.