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"<u>Restatement of the Theory of</u>

<u>Normal Backwardation</u>"

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Commodity Futures V. Restatement of the Theory of Normal Backwardation

Introductory Note: The following is a chapter from a forthcoming monograph; some of the cross references in the text therefore cannot be found in the present paper. This chapter will be preceded by another one containing an exposition and critique of Keynes' theory of normal backwardation, which may be found in the Treatise on Money, Vol. II, pp. 142-4; see also J.R. Hicks, Value and Capital (ist Ed.), pp. 137-9.

The author's earlier discussion papers on futures trading are listed in "Commodity Futures IV: An Empirical Test of the Theory of Normal Backwardation," CCDP Econ. 2124 (June, 1955). See also "Can Speculators Forecast Prices?", Review of Economics and Statistics, May 1957.

Commodity Futures V: Restatement of the Theory of Normal Backwardation

1   Types of markets

Before attempting to reformulate the theory of normal backwardation it

may be helpful to explain some of the technical terms involved.

In the first place two types of markets should be distinguished[13]:

13] The importance of this distinction was emphasized by G. Blau, "Some
Aspects of the Theory of Futures Trading," Review of Economic Studies,
1944-5, pp. 1-30.

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the cash market and the futures market. The transactions in the cash market

are concerned with lots that may vary as to quantity, quality, location and

delivery time, in accordance with the transactors' needs and which will usually

change ownership as a result of the transactions. In the futures market, on the

other hand, transactions are highly standardized as to quantity, quality, location

and delivery time; they are consequently very suitable for speculative purposes

(because standardization makes transaction costs low) but less so for merchandizing

(because few merchants will be interested in these standardized lots).

The cash market can be divided into two parts: the spot market and the

forward market. The characteristic of spot transactions is that they are for

immediate delivery; in the forward market delivery is at a later time, agreed

between buyer and seller. Spot transactions necessarily involve stocks that are

physically in existence, but forward transactions may refer to lots that are still

to be produced, such as growing crops. The futures market is historically an off-

shoot of the forward market, but now quite separate from it.

Because the transactions in the cash market are heterogeneous in so many respects a large number of prices is quoted simultaneously, and strictly speaking there is no one "cash price," or even one "spot price." For some purposes it is convenient, however, to designate one particular price as the spot price, namely the price of "contract grade" (the quality on which the futures contract is based) for immediate delivery.

In the futures market the number of different prices quoted simultaneously is much smaller than in the cash market. Since the main advantage of futures trading is the low level of transaction costs resulting from standardization the number of different "deliveries" simultaneously quoted is rarely more than seven or eight; in addition some markets quote different "contracts" (such as American cotton and Egyptian cotton at Liverpool), but this complication will be ignored here.

A vitally important connection between the cash and futures market is provided by the possibility of delivery. Technically and legally futures contracts, like cash contracts, envisage the ultimate transfer of ownership of the merchandise to which they refer. In practice most futures contracts are liquidated by offsetting transactions; thus a speculator who is long will usually close out his position by selling as many contracts as he had previously bought. But there is nothing to prevent longs from "standing on delivery," that is from holding their contracts until they mature (or buying them at maturity) and accepting actual merchandise in settlement. Such a course of action will be profitable whenever the futures price is below the spot price for contract grade[14];

14] In order to confine the exposition to essentials various complications of the delivery mechanism have to be ignored here.

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hence this type of arbitrage will prevent the futures price at maturity from falling below the relevant spot price at that time. On the other hand if the spot price for contract grade is below the price of the expiring future it will be profitable to buy contract grade spot and deliver it on futures contract. At maturity the spot price for contract grade must therefore be equal to the futures price.

Because of this connection the futures price at any time is often described as a forecast of the spot price at maturity. The analogy is useful as far as it goes, but two points should be borne in mind. In the first place, if the theory of normal backwardation (as revised) is correct, then the futures price is a biased forecast of the ultimate spot price; more particularly, it is biased downward. In the second place the futures price forecasts not only the ultimate spot price, but also the futures price at all subsequent times prior to maturity, since it is possible and customary to liquidate futures commitments before they expire. If supply and demand for futures were perfectly elastic there would be no conflict between these different forecasting functions, but if elasticities are less than perfect it is quite likely that the horizons of most traders do not extend all the way to maturity.

2 Types of traders

With the aid of the above discussion we can now define some important categories of traders. To do so we must imagine that the position of each trader in each commodity market is listed on a statement like a balance sheet, except in that the items are expressed in physical units (bales of cotton, tons of rubber, etc.) rather than in money. On the asset side appear all quantities the trader has

bought, whether in the cash or in the futures market, and on the liabilities
side all quantities he has sold. As assets should also appear growing crops,
which may be regarded as forward purchases, and the liabilities should include
quantities needed as raw material for the manufacturing of as yet nonexistent
products that have already been sold (for instance wheat needed to meet forward
sales of flour by a miller). It may be noted that forward or futures commitments
may occur on either side of the commodity balance sheet, but that spot commitments
(that is, stocks) can only be long.

If a trader's total assets and liabilities, thus defined, do not add up to
the same amount the trader is called a speculator. He is, more particularly,
a cash speculator if his cash commitments are net long or net short and a futures-
speculator if this is the case with his futures commitments. (He may be both
simultaneously, provided his total position is net long or net short.)

Those whose total assets are equal to their total liabilities may be re-
ferred to generically as difference-traders, for reasons which will become clear
in a moment. The most important species of this genus are the hedgers, whose
cash commitments (whether long or short) are exactly offset by futures commitments.
It is customary to distinguish hedgers by the sign of their futures position; thus
short hedgers are those who hold stock or have bought forward and have sold futures
as a hedge; long hedgers correspondingly are traders who have sold forward and
bought futures . The two other species of difference-traders are the cash straddlers
whose spot and forward commitments offset each other and the futures straddlers,
who are long in some future or futures and short in one or more others. They
will not concern us here.

The importance of the distinction between speculators and difference-traders lies in the way in which their respective profits are determined. The profit or loss of the typical speculator depends on the change in the price (or prices) of the commitment) in which he is long or short, whereas the financial result of the difference-trader depends on the change in the difference between the prices of his short and his long commitments. These changes are, of course, to be taken from the time at which the commitments are opened to the time at which they are closed. Thus if a trader buys spot wheat at $1.65 on January 1 and sells it on February 1 at $1.75, his profit per bushel is 10 cents, but if he had simultaneously hedged by selling an equal amount of May futures, whose prices are $1.55 and $1.70 on the two dates mentioned, his loss per bushel will be 5 cents, this being the change in the "basis."[15]

15] The "basis" is the difference between a spot price and a futures price.

These observations are trivial enough, but their consequences are not so trivial. The primary aim of traders is no doubt to maximize their ex-post profits given their financial resources; hence their actions will be decisively influenced by their views on the variables upon which their profit or loss depends. Thus speculators will be led mainly by their expectations as to the future course of an absolute price (futures price or spot price, as the case may be), hedges mainly by their expectations concerning the basis. It is also true, however, that traders are not born as hedgers or speculators (or indeed as traders): the same trader may be a speculator at one time, a hedger at another time.[16] Hence a

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16] As Professor Holbrook Working points out, "Some individuals and firms hedge only when they are particularly fearful of price decline." (Futures Trading and Hedging," American Economic Review, 1953, p. 320.)

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trader's decisions will also be related to prices other than those of his actual

commitments. Nevertheless it may be said that the only difference between specu-

lating and hedging is that a speculator hopes for favorable changes in an absolute

price and a hedger for favorable changes in the basis. Hedging, to put it concisely

though paradoxically, is really speculation on the basis.

Failure to grasp this fundamental point is behind the misunderstanding of

hedging that is sometimes found in the literature. Thus Mr. Kaldor [17] defines

17] In "A Symposium on the Theory of the Forward Market," Review of Economic
of Economic Studies 1939-40, p. 196 (his italics). It will be noted that Mr.
Kaldor does not distinguish between futures and forward trading, which in it-
self makes a satisfactory definition of hedging difficult.

hedgers as "those who have certain commitments, independent of any transactions

in the forward market ... and who enter the forward market in order to reduce

their risks arising out of these commitments." In other words, according to

him hedging is merely the result of an afterthought. Professor Working, on the

other hand emphasizes that a decision to hold hedged stocks, or engage in some

other form of hedging, involves equal consideration of the cash and futures markets.

He describes hedging as "a form of arbitrage, undertaken most commonly in expectation

of a favorable change in the relation between spot and futures prices" and adds

that "the fact that risks are less with hedging than without is often a secondary

consideration."[18] It will even be argued in the present paper that, when the

18] op. cit., p. 342.

scale of trading is considered, risk with hedging is not necessarily smaller than without hedging. In any case there can be no doubt that Professor Working's view of hedging has both logic and observation on its side, and it has therefore been adopted here. In the next section a new element will be introduced which gives substance to this view.

3 The significance of margin requirements

There is a technical feature of futures trading the importance of which is usually overlooked. Futures contracts are standardized agreements for future delivery and future payment. No money changes hands between buyer and seller at the time the contract is concluded; the buyer only pays his counterpart (who will, in general, not be the original seller since futures contracts are impersonal) when delivery is made. In the meantime both buyer and seller have to deposit a margin with the Clearing House of the market concerned. This margin has to be supplemented whenever price changes go against a trader so as to keep the initial margin intact. Thus a speculator who is long has to put up more margin when the price falls. Conversely a trader who is favored by price changes may, within limits, withdraw his margin.

In the case of speculative positions the initial margin is typically between 5 and 10 per cent of the money value of the contract for each of the two traders. During periods of violent price movements margin requirements are often increased by the Clearing House. For hedging and spreading the margin is usually considerably less than for speculation,[19] which may be explained by the fact that the differences

19] On the New York Cocoa Exchange, for instance, the margin is currently $900 per contract (30,000 lbs.) for long or short positions and $300 for spreads.

between the prices of close substitutes vary less than the prices themselves.[20]

To engage in futures trading a trader therefore has to have liquid funds, partly to deposit as margin, and also (if he is prudent) as a reserve to meet possible margin calls. In forward trading arrangements similar to margin requirements are also often made. Money is also necessary for spot trading (that is, for holding stocks) because lenders will rarely be willing to advance the entire value of inventories. In fact one of the most important reasons for short hedging is that bankers will finance a higher percentage of the value of hedged stocks than unhedged stocks.

If a firm can borrow, for instance, 90 per cent of the value of inventories when it hedges instead of 70 percent when it does not, then its own capital will support nearly three times as much trading in the former case than in the latter.[21]

This is probably the decisive advantage of short hedging, for in most firms the availability of low-cost capital is definitely limited, a phenomenon sometimes referred to as "capital rationing." In merchandizing firms in particular

the ability to borrow from banks is directly related to the size of inventories.
The cost of equity capital is considerably higher than the interest on bank
loans secured by collateral; perhaps 3 or 4 times as high in the case of part-
nerships and small corporations. In practice many firms, both small and large,
therefore accumulate much of their equity by internal saving. Merchants will
consequently tend to adopt methods of financing which economize equity capital
while permitting the largest possible use of commercial skill.

4   Specialization and finance

To illustrate this point it is necessary to consider in somewhat more detail
how price risks arise. It is conceivable that in a market all physically existing
stocks are held, or have been bought forward, by the consumers of the commodity
concerned.[22] In that case there would be no price risks on that particular

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22] Cf. Hicks (Value and Capital, p. 136) for the related notion of a "Futures
Economy."

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commodity. The reason why such a state of affairs is not found in practice is
primarily the existence of uncertainties of all kinds. These uncertainties show
up in the form of transaction costs, to be defined as the time and trouble needed
to find counterparts in trading. If there were no uncertainties of any kind
regular trading patterns could be established, with everybody knowing with whom
he could trade. In the presence of uncertainty trading patterns are of course
far from being completely irregular, but nevertheless sellers often are faced
with the choice of taking trouble to find buyers, or alternatively to hold unsold
stocks in the hope that buyers will turn up. Buyers face similar difficulties.

These problems are much aggravated by the heterogeneity which is characteristic of cash transactions and which results from differences in quantity, quality, location and delivery time. Heterogeneity makes it all the more difficult for producers to find buyers for the specific lots they want to sell, or for consumers to find sellers of the specific lots they want to buy. Hence there is scope for specialized middlemen, who can link buyers and sellers and whose knowledge of the commodity and the market helps to reduce the cost of concluding transactions. If all purchases and sales could be completely synchronized these middlemen would act merely as brokers; they would have no need for working capital to finance stocks, nor would they run any price risks. Brokers are in fact found in most commodity markets, but their intervention does not usually suffice to eliminate price risks. To achieve complete synchronization of purchases and sales would in itself require inordinate transaction costs, and some unsold inventories are therefore always held. The holders are partly producers, partly merchants. The latter are middlemen who, unlike brokers, are prepared to take price risks.

The holding of unhedged stocks, with the speculative risks it entails, is not the primary function of producers and merchants, and the capital needed for that purpose will not normally be used to best advantage. Producers need their capital primarily to finance their seed, equipment and personal subsistence while crops are growing; their income stems from their knowledge of farming methods, climatic and soil conditions and the price prospects of next year's crop, rather than from their ability to make short-term forecasts of the prices of already harvested produce. Similarly the primary business of a merchant is not to make more or less shrewd guesses as to the course of prices in general, but to have

the right types of his commodity at the time and place that suit his customers.[23]

23] In a wider sense, of course, merchandizing is itself a form of speculation. When we say that the business of a merchant is to have available the types of goods which buyers want, at the right time and place, then it is implied that the successful merchant will be rewarded by getting a higher price for those goods than an amateur would. Consequently a merchant might be described as a speculator in more specific commodities than the "general" speculator. The latter speculates in "cotton," whereas the former speculates in 1 3/32 strict low middling spotted, available in or near Greenville, North Carolina. Since fewer people are willing to undertake the merchandizing type of speculation, those who are so willing may find it worth their while to specialize in it. Although this is perhaps a more correct way of looking at the merchant's functions, it has seemed less confusing, and more in accord with ordinary usage, to reserve the term "speculation" to what in this footnote is called "general speculation."

Even though producers and merchants may be more competent than anyone else to predict general price trends, the law of comparative advantage will induce them to leave general speculation to those who, lacking that particular specialized knowledge, do not have better uses for their capital. Some general speculators, of course, may themselves specialize in their business by reason of ability or access to relevant information; such professional speculators are found in many commodity markets. A special category among them are the "scalpers," floor traders who make a living from price fluctuations occuring within the trading day.

The above does not mean that producers and merchants never speculate in the ordinary sense of the word: there are undoubtedly times at which merchants invest much of their capital in unhedged stocks or margins for futures speculation,[24]

24] It is noteworthy, however, that this is regarded as contrary to sound commercial practice.

and farmers (at least in the United States) are notoriously inclined to cash-
speculation, though they generally shun the futures market.

Merchants, particularly, are therefore interested in an arrangement which
allows them to perform their specialized merchandizing functions without in-
curring unwanted speculative risks. Such an arrangement, which is provided by
short hedging, may also be viewed as a capital-saving device. A numerical ex-
ample may help to illustrate this point.

Consider a merchant who has liquid funds of his own to the extent of $10,000.
His abilities are such that he can make a merchandizing profit of 20 per cent per
year on the value of his inventory, and an additional speculative profit of 5 per
cent of that value if he does not hedge. The difference between those two kinds
of profit is that the latter requires no special knowledge of marketing conditions,
so that it can be earned equally well in the cash and in the futures market. It
will be assumed that banks lend up to two-thirds of the value of unhedged stocks
and up to 90 per cent of the value of hedged stocks, in both cases at a rate of
6 per cent per annum. Furthermore the merchant holds a liquid cash reserve of
20 per cent of the value of unhedged stocks; in the case of hedged stocks he has
to deposit 3 per cent of their value as margin and he holds the same amount as
a cash reserve.

Under those conditions the merchant who does not hedge can hold stocks to
a value of $18,750, of which he has to finance $6,250 himself; the remaining $3,750
is his cash reserve. His merchandizing profit is $3,750, his speculative profit
$938, and his interest payment $750, leaving a net profit of $3,938.

If the merchant does hedge, his stock can have a value of $62,500. The
merchant's funds are divided between $6,250 for financing his inventory, $1,875

for margin on his futures position, and $1,875 for reserve. His merchandizing profit (any gains he may make in the cash market on this account being offset by losses in the futures market). With interest now at $3,375, net profit is $9,125.

So far the merchant who hedges has an advantage of $5,187, but this advantage may be offset by adverse movements in futures prices, more particularly by a tendency of futures prices to rise in relation to the spot price. It is precisely this tendency towards relative appreciation which is predicted by the theory of normal backwardation as will be more fully explained below. Thus if futures price were to rise 8 per cent per year in relation to the spot price (which is a reasonable estimate), the merchant who hedges would lose $5,000 on his futures position of $62,500, and this would nearly wipe out the advantage of hedging over not hedging.

By varying the above figures the reader can verify that short hedging will be the more advantageous the higher the rate of merchandizing profit per dollar of inventory, and the lower the rate at which futures prices tend to gain on the spot price, other conditions remaining unchanged. It follows that short hedging will be profitable only for the more skillful merchants, who are thereby enabled to have a much larger volume of trading than their non-hedging competitors. The possibility of hedging promotes specialization.

The assumption made in the above numerical example that equity capital is available in a fixed amount can easily be relaxed. Provided only that the rate of interest on equity capital is higher than the rate on bank loans the argument holds unchanged.

It also follows from the above argument that short hedging does not necessarily diminish the total risk incurred by a trader. It does in general reduce the risk

per unit (bushel, bale etc.), but the advantage of this is precisely that the hedger is enabled to carry a layer number of units, and thus to employ his merchandizing skill and equity capital more profitably. Rather than as a protective device short hedging should be regarded primarily as a specializing device.

5   Short hedging versus long hedging

We have now seen why traders may be prepared to sell futures even though there is a tendency for futures prices to move against them, that is, to rise. The existence of this tendency still remains to be demonstrated, but for the moment it may be taken for granted. It should be asked, however, why, if there is such a tendency it would not be even more profitable for traders to engage in long hedging, which is the exact opposite of short hedging. Long hedging, we may remind ourselves, entails being short in the cash market, and since it is not possible to be short in the spot market, long hedging means selling forward and buying futures. It may be practiced, for instance, by a miller who sells flour for later delivery without having wheat on hand, and who offsets his short sale by buying wheat futures. This type of hedge is in general by no means perfect,[25] for the varieties of wheat which the miller needs for his particular

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25] It will be argued below that it is even less perfect than short hedging.

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brands of flour are usually different from the variety on which the futures contract is based, not to mention differences in location. Nevertheless millers, seeing that the futures price for wheat is well below the spot price, may well be prepared to sell flour forward while postponing their buying of wheat. We must now explain why, or rather when, long hedging is normally less important than short hedging.

It has already been pointed out that the ultimate futures price must be equal to the spot price of contract grade at delivery time. This also means that the current futures price cannot exceed the current spot price by more than the carrying charge (storage cost, deterioration and interest) between now and maturity, for if it did, a riskless profit could be made by selling futures and buying contract grade spot, carrying it until the maturity of the futures contract and then delivering it. In the notation previously used, with k designating the carrying charge, we have therefore $f \leq s + k$.

The futures price therefore cannot rise much above the spot price (since k is normally small compared to s), but there is no corresponding arbitrage which will prevent it from falling well below the spot price. To take advantage of a large "backwardation" (that is, a large value of s - f), a trader would have to buy futures and maintain a short position in the spot market, but we know that the latter feat is physically impossible. It is true that a large backwardation may induce those who already hold stocks which they do not need immediately to exchange those stocks for futures contracts, but this is not riskless arbitrage and does not provide an absolute limit on s-f. All it implies is that a large backwardation cannot arise if stocks are large, for then some stocks at least will not be urgently needed.

Consequently there is only one inequality linking s to f, and this asymmetry has important consequences for the relation between short and long hedging. To begin with let us restrict ourselves to transactions in deliverable grades. The inequality then places a limit on the losses of short hedgers and the profits of long hedgers. For the loss or gain due to hedging depends on the movement of s-f (the "basis"): an increase in s-f is favorable to short

hedgers and unfavorable to long hedgers. Thus if f is only a little below s+k short hedgers cannot lose much on their futures commitments and long hedgers cannot gain much on those commitments. On the other hand there is no converse limit on the profits of short hedgers and the losses of long hedgers, for prior to maturity the basis s-f can become very large, even though it must equal zero at maturity. It is clear from this that if s-f is small short hedging must outweight long hedging, and that long hedging can only be important if s is well above f.

Moreover the ultimate equality of the spot price and the futures price implies that the value of s+k-f at any time prior to maturity indicates the _average_ change of the basis during the remaining life of the contract. Hence selling of futures as a short hedge will be less unprofitable on the average if s+k-f is small, quite apart from the fact that the inequality s+k-f $\geq$ 0 then limits the possible loss most effectively. As s+k-f increases, the average loss on the futures side of short hedges goes up also, and the limit on the loss becomes less and less of a consolation. Conversely as s+k-f ceteris paribus increases long hedging becomes more attractive.

Before we can conclude that short hedging is a decreasing and long hedging an increasing function of s+k-f (and hence, since k does not vary much over short periods, of the basis s-f), a complication has to be faced. So far we have not talked about the determination of the basis itself, but this can now be easily explained (at least on the theoretical level)

6 <u>The basis as a function of the level of stocks</u>

In the short run, with which we are concerned in this chapter, the level of stocks may be regarded as given. Hence at any time, the pattern of spot and futures prices has to be such that the existing stocks are in the hands of owners who, at those prices, are willing to hold them. In a market without futures or forward trading stocks can only be held by speculators, about whose willingness to do so only long run statements can be made (see Section 5.8)

When a futures price is quoted in addition to the spot price, more definite statements can be made even for the short run. Speculators can now be long in the spot as well as in the futures market. Because of the possibility of delivery stocks and futures contracts are substitutes for each other, which means that an increase in the price of one will stimulate the demand for the other. Now a theorem of Hicks[26] asserts that if there is an upward shift in the excess

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26] <u>Value and Capital</u>, 1st Ed., p. 75, 317.

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demand for one out of a number of substitute commodities then the price of the commodity immediately affected will rise, and the prices of its substitutes will rise also, but less than proportionately. The obverse holds for a downward shift in excess demand, and consequently also for an increase in supply.

Hence if the supply of stocks increases the spot price must fall, and the futures price falls as well, but less than proportionately. This implies that the "relative basis" $\frac{s-f}{s}$ declines algebraically, and we conclude that <u>the relative basis is a declining function of stocks</u>[27] It also seems plausible

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27] This important theorem can also be justified with the aid of the concept of "convenience yield" introduced by Mr. Kaldor (<u>loc. cit</u>, p. 196). The convenience

yield of an inventory is the return to its owner resulting from mere availability; it can consequently be explained in terms of transaction costs. For our purpose the crucial point is that the marginal convenience yield of stocks is a diminishing function of the size of stocks. If stocks are small they will be held by those traders who are willing to pay a premium (in addition to carrying costs) for the privilege of holding them, but if stocks are large the marginal stockholder is likely to be a warehouse operator whose storage costs must be fully covered. Professor Working's theory of the "price of storage" (see his

is no doubt to be interpreted in this manner also, though his terminology is perhaps unfortunate. It should be added that Mr. Kaldor introduced the convenience yield as a constant rather than as a function of the level of stocks.

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that the behavior of hedgers is more influenced by the relative basis than by

the "absolute" basis s-f, although for simplicity we have previously argued

in terms of the latter. Hence if hedging depended only on the basis a rise in

stocks would make short hedging more attractive and long hedging less attractive.

This is exactly as it should be, for short hedging is one of the ways in which

stocks can be held, whereas long hedging involves leaving stock-holding to others.

The willingness to hedge, however, depends not only on the basis but also

on the level of stocks itself. From the descriptions of long and short hedging

it is clear that both will be the more attractive, other things being equal, the

higher the correlation between spot and futures prices. Indeed hedging could not

be profitable at all unless there were some minimum of correlation. Now the level

of stocks has a direct bearing on the relative price movements of different varieties

of the commodity concerned, and particularly on geographical price differentials.

If stocks are large all these different prices must move closely together, since

stocks can then easily be shifted to offset unusual price relations. The market,

though still heterogeneous, is then relatively perfect, and hedgers may reasonably

expect that the particular prices in which they are interested will be highly cor-

related with the futures price. If stocks are small, on the other hand, the market

becomes more "spotty": it disintegrates into regional submarkets between which there are no regular flows. In the case of seasonal commodities these tendencies are particularly marked because large stocks are normal just after harvest, when they have to more from producing areas to distributive and consuming centers in close response to geographical price differentials. Stocks are small just before harvest when they have normally reached consuming locations and are less likely to move again.[28]

28] The relation between stock size and inter-price correlation can be most easily visualized by considering the effect of an accidental destruction of stocks, for instance as the result of a warehouse fire.

Thus we see that, other things being equal, large stocks facilitate hedging (whether long or short) and small stocks make hedging more difficult. But we also know that large stocks imply a small basis, which in turn stimulates short hedging and discourages long hedging. Consequently in the case of short hedging the stock effect and the basis effect work in the same direction, but in the case of long hedging they work in opposite directions. The rate of change (regardless of sign) with respect to the basis is therefore likely to be larger for short hedging than for long hedging.

Hence we can conclude that the volume of short hedging is a declining function of the basis and an increasing function of the size of stocks. About long hedging no such definite statement can be made, for it is not possible to say a priori whether the stock effect or the basis effect will dominate.[29] Our previous

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29] In addition to the factors mentioned long hedging will often depend on the relation between spot and forward prices in the market for derived products (such as wheat flour when the commodity primarily considered is wheat) for long hedging is much practiced by processors.

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statement that short hedging must exceed long hedging when the basis is small

(or stocks are large) clearly remains unaffected by the argument of the present

section. Combining the various tendencies, however, it seems more than likely

that as the basis becomes larger (and stocks smaller) there must come a point

where long hedging equals, and subsequently outweighs, short hedging. An excess

of long hedging can therefore not be ruled out completely, though it will be argued

below that such an excess is abnormal.

7   Long-run characteristics of speculation

In order to settle this point it is necessary to complete the discussion

of the different groups of traders by considering the speculators. About their

short-run behavior nothing much can be said at this stage, but for the long run

some informative propositions can be asserted.

In Section 55.3 we saw that speculation requires equity capital: in the

case of cash-speculation because banks will only finance a part of the value

of stocks, and in the case of futures-speculation because of margin requirements

and the necessity of a reserve for meeting additional margin calls. In the long

run this cash has to earn a return, for otherwise it would be diverted to other

uses. For the moment it will be assumed that this return has to be a money return,

the possibility that the return is merely psychological will be examined presently.

According to this argument, then, speculators must have a certain measure of success

on the average, though not necessarily in any given period of time.

In a futures market, consequently, speculation cannot be perpetually balanced;

in other words, there cannot always be as many long speculators as there are short

speculators. For in a futures market the gains of any category of traders must

be exactly equal to the losses of all other traders[30], and hence if longs and

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shorts matched each other their combined profit would be zero, and so would be the return on their equity. Futures speculation is therefore normally unbalanced. In the spot market, of course, speculation is always unbalanced because it is not possible to be long.

It does not follow from this argument that futures-speculators have to be either always net short or always net long; it would also be possible for speculative commitments to alternate between net long and net short. It will be shown later, however, that on the average (but not necessarily all the time) hedgers must be short, and hence speculators must normally be net long.

Let us consider the case where speculators are usually net long. Long speculation must then be profitable on the average, and this is only possible if futures prices have a tendency to rise. Moreover the rise in the futures price must be just rapid enough to give the marginal long speculator a return on his equity sufficient to prevent him from investing his cash elsewhere. The larger the rate at which the futures price tends to rise, the greater the long interest will be. A rising tendency of the futures price is quite consistent with approximate constancy of the spot price; indeed the latter phenomenon will normally entail the former, as we shall see.

The relation between the net long interest and the rate at which the futures price tends to rise may be viewed as a supply function for long speculative commitments Though essentially a long-run relation, it is not without its short-run effects Thus it is sometimes observed that when in a speculative market the price has stayed more or less constant over (say) a number of weeks "long liquidation" occurs that is, some "tired" longs reduce their position, thereby lowering the price. Long liquidation also frequently reinforces price falls brought about by other factors.

By similar reasoning a normal net short position of futures-speculators requires a tendency for the futures price to fall. If the net speculative position alternates between long and short in a systematic manner (as might for instance be the result of seasonal influences) the futures price has to have a rising tendency at times when the longs are predominant and a falling tendency when the shorts prevail. This applies only, however, if the alternation is regular and foreseeable; in other cases only the sign of the average position (taking all time periods together) will be relevant.

We must now examine how likely it is that the return which speculators have to earn on their capital will take the form of money profits. If speculators were mainly gamblers, who regard the futures market as a substitute for Monte Carlo, or if they were persistently ignorant of the success of their speculations, it is conceivable that they might stay in the market despite recurrent net losses. Monte Carlo does not lose its customers (or rather, it steadily attracts new ones to replace those who drop out) because people are willing to pay for the thrills of uncertainty, and a similar situation might conceivably exist in the commodity markets. Now there have undoubtedly been periods when the general public took

part in trading to an unusual extent. The classic examples are the Dutch

tulip craze of 1637 and the Mississippi bubble of 1720; more recently the

late 1920s offered similar spectacles, and so, on a rather smaller scale,

did the years immediately following World War II. In all these cases it is

hard to say how much of the increased public participation was due to a mere

desire to get rich quickly and how much to love of gambling. The fact that all

these episodes were quite short suggests that love of gambling, if present at

all, is not sufficient to sustain speculation on any large scale in the face of

continued losses. Although love of gambling is therefore a theoretical possibi-

lity, we may probably ignore it for practical purposes.

The other possibility, namely that speculators remain persistently ignorant

of the monetary success of their ventures, is of greater empirical interest. It

is hardly likely to arise in the futures market, where traders can easily determine

their gains or losses, and if necessary are reminded of the latter by margin calls.

But in the cash market, and especially in the spot market, the situation is dif-

ferent. Cash speculation may be linked to production or consumption, and an easy

way of allocating total gains or losses may not be available. Thus a farmer who

speculates in his own crop (either before or after harvest) can only determine

his gains or losses from speculation (as distinct from production) by comparing

the price he actually received with the one prevailing at some fixed date (say

the date of harvest)[31], taking account of storage cost and interest. It is

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31] How to fix this date poses a serious problem. Unless there is government
price control most farmers cannot completely avoid price speculation. It is true
that they can sell forward or sell futures, but this does not entirely solve

the difficulty because the size and grade of the crop are not precisely known until it is harvested. In some branches of agriculture forward sales are made before harvest with the buyer taking the risk of size and grade, thus fruit is often sold on the tree, but this practice is not widespread elsewhere. The date of harvest therefore seems a logical comparison date. For non-agricultural primary producers, such as mines, forward selling is much more practicable and indeed quite common.

doubtful whether many farmers ever make such calculations, and it is entirely conceivable that speculation in already harvested produce is persistently un-profitable.[32] For reasons that are not clear farmers rarely hedge their un-

32] In an unpublished study Professor T.A Hieronymus of the University of Illinois analyzed the selling tactics of a number of soybean producers. He found a general conviction that it was wise for farmers to hold their crop for a considerable time, though the actual pattern of sales did not betray much acumen. The results of Section 7.3 below do not indicate that during the season spot prices tend to rise by more than the carrying cost. The seasonal price pattern would probably be altered, however, if farmers did sell their crops immediately after harvest without making the proceeds available for the financing of inventories.

sold crops, though the dealers who buy them usually do hedge. To the extent, however, that there are professional dealers who do not habitually hedge and nevertheless stay in business it is unlikely that the spot price fails to rise by the cost of carrying stocks. It is possible though, that these dealers have marked skill in choosing the periods during which they hold unhedged stocks, so that only during those periods a rising tendency of the spot price (less carrying charge) can be inferred.

8 Stochastic equilibrium

One further preparation is necessary before the normal size of stocks can be discussed: we must define the notion of "normal." By the normal size will be

meant the average level of stocks in stochastic equilibrium, which is in turn

defined as the condition in a commodity market where stocks and flows, though

they may oscillate randomly or periodically, have no upward or downward trend

in the long run. In other words, stochastic equilibrium is found in a market

without long-term growth or decline. It is a theoretical notion which is

certainly not immediately applicable to all actual markets, but it may help

to clarify the analysis. Its purpose is similar to that of Professor Hicks's

"equilibrium over time" (cf. Section 4.4 above).

The difference between stochastic equilibrium and equilibrium over time

is twofold. In the first place the former is defined by "expectations" in the

psychological sense, that is to say by people's views on what will happen in

the future. The difficulties resulting from this idea have already been listed

in an earlier chapter. For a "stochastic equilibrium" nothing need be assumed

about psychological expectations.[33] The second difference is closely related

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33] Although, to avoid confusion, we have not done so, the mathematical
concept of expectation (which is quite different from its psychological
counterpart) could be appropriately applied to the definition of stochastic
equilibrium. A market is in stochastic equilibrium if the mathematical ex-
pectation of stocks and flows is constant (apart from seasonal variations,
if any). The notion of stochastic equilibrium was suggested by the theory
of stationary stochastic processes.

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to the first, but of smaller importance: equilibrium over time is defined by

reference to prices, stochastic equilibrium by reference to quantities (stocks

and flows). It is the latter that are of more fundamental interest in economics,

though it was mainly analytical convenience that prompted the choice.

In fact constancy of average stocks and flows implies constancy of average prices, or rather of price_schedules. By a price schedule is meant an array of simultaneously quoted prices for different grades, locations and delivery times, including futures prices. Forward and futures prices are to be understood as referring not to a fixed date (say May 1) but to a date at a fixed distance from the time of quotation (say 90 days from now).[34] Average

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34] The former type is used in commodity markets, for reasons explained in Section 2.5 . In the foreign exchange market, which is of a rather different nature, the latter type is common.

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constancy of the price schedule does not mean, consequently, that the price of the May future is approximately constant, but rather that the 90-day futures price (and all similarly defined futures prices) has no trend.

In the remainder of this chapter it will be assumed, for simplicity, that there is only one futures price, namely for delivery tommorrow. Moreover we shall speak, as everywhere in this chapter, of "the" spot price, which is to be interpreted as representing the entire array of spot prices. Forward prices will be ignored for the moment.

The price schedule under these assumptions consists of only two prices, the spot price and the futures price for delivery tommorrow. Stocks and holdings of futures contracts, as well as flows, depend upon these two prices and also on other factors, such as the weather, "expectations" and prices in other markets. The non-price factors, on the assumption of stochastic equilibrium, cancel out in the long run; and since the prices in other markets can in turn be reduced to non-price factors, their influence in the long run is also negligible. The

relation between the two prices and the stocks and flows is such (as shown in the Mathematical Appendix) that constancy of the latter implies constancy of the former. Stochastic equilibrium therefore has the same consequences for prices as for quantities.

9   Normal backwardation reestablished.

We can now at last gather the threads of the argument and assumble them into a proof of the normal backwardation theorem. In addition to the simplifying postulates made previously it will also be assumed that the commodity under consideration is free from seasonalities in production and consumption. This assumption will be removed in the next chapter.

It will be helpful to start the investigation by asking under what conditions long hedging can exceed short hedging. A provisional answer to this question has already been given in section 5.6, viz. that this can only occur when stocks are small. Smallness, however, is relative, and there is no a priori reason why stocks should not be normally "small." We shall now show, therefore, that the kind of smallness under consideration is indeed abnormal, and that, in other words, it cannot persist for any length of time.

If long hedging exceeds short hedging, futures-speculators must be net short, since in the futures market as a whole the longs and the shorts must balance. In Section 5.7 we have seen, however, that futures-speculators can only be net short on the average if futures prices have a persistent tendency to fall. Moreover for long hedging to exceed short hedging the basis must be large, that is to say, the spot price must be well above the futures price. But since at maturity the spot price and the futures price even more rapidly than the futures price. A tendency for the spot price to fall is of course inconsistent

with stochastic equilibrium, though it may well prevail over shorter periods of time.

Consequently in long-run equilibrium short hedging must exceed long hedging, speculators must be net long, and the futures price must tend to rise. This establishes the theory of normal backwardation.

It remains to analyze at what average rate the futures price must rise on the average. This will depend on the elasticity of supply of speculative commitments. The larger the average rise in the futures price, the greater the net long volume of speculation that will be forthcoming. Hence the normal backwardation must be just sufficient to elicit long speculative commitments that will offset the hedging commitments, which are net short. Now the net volume of hedging depends on the basis, but if the spot price is constant on the average the basis will equal the rate of backwardation. The larger the rate of backwardation, the less hedgers will be net short; the equilibrium rate of backwardation is thus determined. The relation between the basis and the size of stocks furthermore determines the normal size of the latter.