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ROGER W. GRAY

THE CHARACTERISTIC BIAS IN SOME THIN FUTURES MARKETS

Like a trail through dense undergrowth, a market comes into being only through use, and is improved through increased use. The little used trail, because time and energy are wasted in locating or negotiating it, is more costly to use than the well trodden path. One may pay too much to the guide on a difficult trail to justify the passage; by the same token the payment to the factotum on a thin market may outweigh the advantage of its use. One may, of course, learn the trail (or market characteristics) himself; but this too entails a cost.

As the flow of traffic increases, undergrowth is killed, obstacles are moved aside, circumvented, or simply worn away; traffic itself provides an added safety factor; and a trail, in short, becomes more clearly marked and easily traversed. The trail may come to be maintained or artificially improved, as through paving, and traffic over it regulated. Yet should much of its traffic abandon it, a cumulative reversal of the development process is likely to ensue. Maintenance may become slipshod, leading to a further decline in traffic; and in time the trail may be completely abandoned, soon thereafter to disappear.

Most of the literature on the economics of futures markets has pertained to well-developed, thriving markets—especially those for the grains and cotton, the modern turnpikes of our metaphor. These were at one time thin markets, but we lack adequate data for a thorough study of the wheat, corn, or cotton futures markets during their early stages of growth nearly a century ago. Meanwhile other futures markets have been developed, some of them quite recently, and an increasing amount of information has become available about them. Some of these, for examples the soybean and cocoa markets, have recently grown to such proportions that the designation “thin market” is no longer applicable; indeed, these may be the two most thriving markets today. Other markets, after showing promise, have fallen into disuse. The bran and the shorts markets were abandoned by their erstwhile users. The butter market fell a victim of government pricing policies; the government did not eliminate the road, but provided an irresistible alternative which led to its abandonment—a fate which has nearly befallen the cotton futures markets, and has reduced traffic on a number of others. The onion futures market, in contrast, is one which the Congress has closed, without providing any alternative other than the treacherous path which this route superseded.¹

¹ Public Law 85-839 makes it a misdemeanor to trade in onion futures.

The characteristic of some thin futures markets about which this paper centers is one which forces early abandonment of the trail analogy, although we shall return to it in concluding. The analogy is apt in suggesting a relationship between level of use and usefulness; but in thin markets, which are the chief concern here, we shall observe a tendency toward imbalance which is not elucidated by the trail analogy. Thin trails presumably accommodate travel in either direction equally well; thin futures markets apparently do not, although it is not obvious, and appears in some respects paradoxical, that this should be the case.

Some of the evidence (Table 1) on this score has been presented previously in another context (3); it is here interpreted more broadly than before, and at the same time a more intensive analysis of the performance of certain markets is provided. The results that are shown in this table are derived from a simple hypothetical trading routine that tests for balance or imbalance in a futures market by measuring statistically the general tendency for futures prices to rise over extended periods for which the beginning and ending spot prices were substantially the same. If maintaining a long position in a commodity future, by routinely switching out of the expiring future into the next one, produces profits (losses) over a lengthy period when spot prices do not change, then the futures market may be said to chronically under (over) estimate future prices—to be unbalanced, lopsided, or biased (downward or upward) in the terminology that will be employed here. The ideal date for switching from one future to another in such a routine is at or near the first trading day of the delivery month, this being the time at which the futures contract effectively “becomes” a spot commodity, in that delivery can then be made on the contract, thus making it possible to obtain a spot price series in the futures price series.

In all cases shown in Table 1, the commodity future was “purchased” at the closing price on the first day of the delivery month of the preceding (expiring) future. Thus, for example, the March wheat future was “purchased” on December 1, 1949, at 218½ cents; this was “sold” and the May future “purchased” on March 1, the May “sold” and the July “purchased” on May 1; and so on seriatim until March 1, 1958, when the March future was “sold” at 220¾ cents to complete 41 successive trades. Very nearly the same routine was followed in all cases, even to trading in the same five futures each year for bran and shorts as for wheat, corn, oats, and coffee, even though every month was a delivery month in bran and shorts futures. In the case of soybeans, the delivery months differed slightly from the others and also changed during the period, but still the trading dates were virtually the same as for the other commodities. The *t*-ratios in the final column test the hypothesis that the average price change in the various series of trades did not differ from zero. The first five markets tested were balanced over the period considered in the sense that this hypothesis is accepted; most of the remaining markets were unbalanced in the sense that the hypothesis is rejected. The *t*-ratio is a general statistic that permits ready comparisons among the various commodities and statements of probability (or level of significance) for each. There may also be interest in the next to last column, which gives the average profit (or loss) per “trade” before commissions.

The characteristic lopsidedness of some thin futures markets poses questions about their use that are addressed in the remainder of this paper. How, why, and

TABLE 1.—*t*-RATIOS COMPUTED TO TEST THE HYPOTHESIS THAT THE MEAN PROFIT FROM MAINTAINING A LONG POSITION DOES NOT DIFFER FROM ZERO

(Grain prices in cents per bushel; coffee and cocoa in cents per pound; bran and shorts in dollars per ton)

Commodity and market	Dates of first purchase and last sale	Prices at beginning and ending dates		N	\bar{X}	<i>t</i> -Ratios ^a
		Expiring future	Next future			
Corn	Dec. 1, 1949–	128¾	130½			
Chicago Bd. of Trade	May. 1, 1958	126¼	125¼	42	— .35	.234
Wheat	Dec. 1, 1949–	218½	218½			
Chicago Bd. of Trade	Mar. 1, 1958	220¾	217⅞	41	— .22	.116
Oats	Sept. 1, 1948–	71⅞	74¼			
Chicago Bd. of Trade	Mar. 1, 1957	74¾	73	41	— .18	.152
Soybeans	May 1, 1955–	249⅞	241 ^b			
Chicago Bd. of Trade	July 1, 1959	223⅞	212⅞	25	.37	.107
Cocoa	May 1, 1955–	32.15	32.79			
N.Y. Cocoa Exchange	Dec. 1, 1959	31.27	30.39	23	.02	.032
Soybeans	Nov. 1, 1948–	243	242½ ^b			
Chicago Bd. of Trade	Sept. 1, 1953	259⅞	255⅞	25	9.23	2.221
Cocoa	Sept. 1, 1947–	30.93	28.20			
N.Y. Cocoa Exchange	May 1, 1955	32.15	32.79	39	1.29	1.189
Wheat	May 1, 1949–	216½	202½			
Mpls. Grain Exchange	July 1, 1959	205⅞	207⅞	41	3.35	2.279
Brazilian Coffee, N.Y.	May 1, 1950–	45.10	43.20			
Coffee & Sugar Exch.	Dec. 1, 1958	42.00	37.90	43	1.73	1.788
Bran, Kansas City	July 1, 1947–	58.50	51.50			
Board of Trade	May 1, 1952	53.00	49.00	24	2.35	1.886
Bran, Kansas City	July 1, 1953–	40.75	43.75			
Board of Trade	Dec. 1, 1956	41.75	43.88	17	—1.14	1.827
Shorts, Kansas City	July 15, 1947–	70.00	60.00			
Board of Trade	Sept. 1, 1952	62.25	60.90	26	2.63	2.398
Shorts, Kansas City	May 1, 1953–	55.45	50.75			
Board of Trade	May 1, 1956	48.00	no quot.	15	—1.54	2.429

^a For N = 30, a *t*-ratio of 2.042 is significant at the 5 per cent level.^b In computing *t* for soybeans, adjustments were made for price change, because the periods chosen had substantial net price change from beginning to end.

by whom are lopsided markets used? This concern with the physiology of the markets looks ultimately toward their growth prospects. Some markets have outgrown their bias, which can only mean that there have been reasons for, and ways and means of, using markets *against or despite* the bias.

There are ample indications that many users of lopsided markets are aware of their characteristic feature, so that it cannot be supposed that such markets are used under the mistaken impression that they are balanced, or used without any regard to the question of balance. The so-called discounts in the coffee and cocoa markets have been widely publicized (1, 11, 12) and are well known in com-

commodity commission firms as well as within the coffee and cocoa trades. Coffee importers, for example, take short positions in the market in full awareness of its tendency to underestimate prices by a few cents a pound annually.² Moreover, contract specifications in most markets have been revised from time to time in order to counteract apparent tendencies for the contract to favor buyers or sellers as demand or supply conditions change in the course of time. These revisions manifest awareness of bias, and stimulate further awareness. In conversations with users of the Minneapolis wheat futures market, the writer has encountered numerous references to the unbalanced situation there. Similarly, officers of milling firms in Minneapolis have alluded to the underestimates of price that prevailed on the Kansas City bran and shorts futures markets. The possibility that markets remain in use owing to ignorance of their lopsidedness is ruled out, not only by the foregoing considerations, but by the fact that the measurements of bias presented above cover a sufficiently long period to have made the bias apparent to any observant regular user. We turn to consider use patterns in these markets on the assumption that awareness of their imbalance does exist, reaffirming the need to understand how, why, and by whom they are used.

THE MARKETS FOR BRAN AND SHORTS

The futures markets for bran and shorts, after a quarter century of mostly unhealthy existence, died in November 1957 when the Board of Directors of the Kansas City Board of Trade suspended trading. Trade in these futures was never large, although it had flourished briefly between World War II and the Korean War. At that time price ceilings were encountered, the removal of which in 1953 failed to stimulate revival. The level of trade then sank rapidly and last minute efforts to revive it in the summer of 1957 were fruitless.

The distinctive feature of the bran and shorts markets was the overwhelming dominance of large hedging positions on both sides of the market. A larger proportion of the total open contracts consisted of contracts reported as hedging than for any other regulated market, and the difference between reported long and reported short hedging was seldom large. The speculative ratio in these markets was probably lower than that for any other futures market (6, Table 3, p. 194).

No quantitative breakdown of the hedging by industry affiliation is available, but it is possible to infer the pattern from trade sources and other studies. A survey of hedging practices in the mixed-feed industry (13) revealed that little hedging of inventories (short hedging) of bran and shorts was practiced; and that some use was made of the futures markets for procurement purposes, i.e., buying of futures contracts and taking delivery on them. The market discussion which appeared as a regular feature in the *Southwestern Miller*, a leading trade journal, frequently referred to buying of futures contracts by millfeed dealers or by feed manufacturers, but not to other sources of demand. The only selling referred to was that of flour mills, presumably the dominant source of supply of these futures contracts. Feed mixers did little or no forward selling of their feeds, and there is no indication that purchases of futures contracts were undertaken in conjunc-

² Even those importers who may have been unaware of the historical evidence that the market tended to underestimate future prices had evidence, in the mere presence of the discount at the time the short hedge was placed, that they incurred prospect of a hedging loss.

tion with such a practice. Nearly all of the sales, in brief, must have come from flour mills, with a scattered few from feed mixers protecting inventory. The purchases probably came from both millfeed dealers and feed mixers—dealers in protecting forward sales to mixers; mixers in anticipation of requirements but with no fixed price offset. Flour mills may have bought some futures contracts in protection of forward sales, but they were predominantly *sellers*; dealers and mixers may have sold some contracts to protect inventories, but they were predominantly *buyers*.

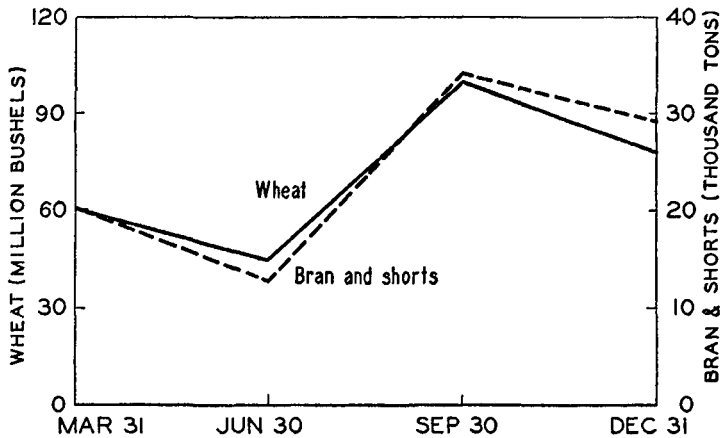
Evidently the futures markets for bran and shorts served primarily those who would do the buying and selling anyway, and little risk was transferred to outside speculators. There is evidence that these futures markets were used for merchandising purposes to a larger extent than other futures markets, in that approximately 10 per cent of all transactions eventuated in delivery, in contrast to the usual proportion of less than one per cent and a next highest proportion of 2.6 per cent (for wool tops) among all regulated markets during 10 postwar years (1947-56). The bran and shorts contracts called for sacked delivery in boxcars in the Kansas City freight yards, a feature which would facilitate delivery because most millfeeds emanating from Kansas City would have moved in this way in normal merchandising.

The normal operational hedging of flour mills calls for a long position in wheat futures when their net cash position (in wheat and flour) is short, and vice versa. Thus, for example, a forward flour sale is accompanied by a purchase of wheat futures; a purchase of wheat by a sale of wheat futures. Forward flour sales, whether hedged in wheat stocks or in wheat futures contracts, are slightly "over hedged" in that wheat produces more than just flour. A full balance is struck only when the by-product millfeeds, along with the flour, are sold ahead. This could be accomplished either by forward sales to millfeed dealers or feed mixers, or by sales of futures contracts.

The millfeeds, and also the manufactured feeds which consume about half of the millfeeds, are produced at a relatively even rate the year around. The marked seasonal variation in the level of open contracts in millfeed futures, and the close correspondence with the pattern of unfilled flour orders, both shown in Chart 1, indicate the close linkage between the millfeed futures markets and flour-mill operations. This suggests that the flour mills using bran and shorts futures have tended to determine the level of their use, since there is no good reason to expect either such wide variation or this particular pattern of variation from the demand side of these markets. At the same time it should be noted that nothing approaching full use of the bran and shorts futures markets was ever made by flour mills. It would have required from 10 to 20 times the level of open contracts reached in bran and shorts futures during their peak use (1947-51) to have fully hedged the unfilled flour orders of reporting mills. What proportion of these forward flour sales may have been matched by forward millfeed sales is unknown, but the bran and shorts futures markets accounted for a very small proportion.

Against this background of market use it is possible to interpret the price-behavior pattern of the postwar period. As was shown in Table 1, both of these markets were lopsided against the buying side (underestimated prices) for sev-

CHART 1.—Average End-Quarter Open Contracts in Bran and Shorts Futures Compared with Average End-Quarter Unfilled Flour Orders, 1947-56*



* Open contracts in bran and shorts futures from U.S. Dept. Agric., Com. Exch. Auth., *Commodity Futures Statistics* (Stat. Bul. 256), July 1955-June 1956; wheat sold into flour from compilations made by the Miller's National Federation, which includes most United States flour mills.

eral years (1947-1952), then for a somewhat briefer period, prior to their demise, both overestimated prices. There are two other major factors the timing of which corresponds fairly closely with the remarkable about-face in price behavior. The first of these is the price level: for both commodities the price was high by historical standards throughout the period of downward bias in futures prices, fell quite abruptly during a brief intervening period, and remained at relatively low levels during the period of upward bias in futures prices. The other corresponding factor is the level of open interest, which best measures the level of use that a market receives. This, along with the price level, reached an all-time peak in the early postwar period. Price controls occasioned by the Korean War discouraged market use and open interest declined sharply. A modest recovery was made in 1952-53, but this was shortlived, as the following year witnessed a drastic decline from which the markets never seriously rallied.

The correspondence in timing between the reversal of the bias and the changed levels of price and open interest allows the following explanation of the bias to be inferred. The habit or tradition of futures market use was well established in the flour-milling industry, in marked contrast to the feed-mixing industry. In seeking to round out their operational hedging policy by selling millfeed futures, millers evidently encountered great reluctance on the part of feed manufacturers to assume forward commitments. Yet at relatively high millfeed prices the millers built their short position up despite the general reluctance to buy, sacrificing something from prevailing price levels in order to project these levels into the future. Even the minor fraction of millfeed production that thus became reflected in the futures market forced it badly out of shape. A full routine hedging policy such as millers commonly employ in the wheat futures market would presumably have forced the millfeeds markets to absurdly low price levels.

The millers nevertheless sought to resume their use of the futures market after

the Korean War, only to find that open interest at half the prewar level was placed at a price sacrifice, partly owing to declining price levels. As the millers then quickly shied away, the little enthusiasm for futures trading that had been kindled among the feed interests was soon dissipated in a market that had now turned against them. Because of the experience gained in the market, or because prices had fallen, or both, the shoe was on the other foot after 1953. Buyers used the market at a premium just as sellers had previously used it at a discount. So long as millers were now unwilling to use the market on even terms, not even the modest level of trading that had been achieved in the early postwar years could be sustained. In their last-minute efforts to revive the market, officials of the Kansas City Board of Trade directed their appeal to the millers. Yet the same tradition that found millers initially disposed to use the market now militated against continued use. Their long experience with the wheat futures market had taught them that its greatest value was in any emergency; that even in unusual price conditions they could trade with little price effect. The bran and shorts futures markets had not accommodated them reasonably through a period of high prices; why should they now sustain it through a period of low prices?

Although the foregoing account is inferential, the factual pieces not only fit together in this arrangement, but taken together in whatever arrangement support some implications for market growth and development. A combination of three facts—the incomplete use made of these markets, the extraordinarily large proportion that was hedging, and the reversal from buyers' to sellers' market—together imply a particular *kind* of hedging. This is what is called *selective* hedging, which may be undertaken or not, depending upon price prospects, as distinct from routine hedging which assumes no need for forming judgment on price prospects. Hedging which depends so heavily upon price and market considerations seems to fit the usual definition of speculation. Hence the somewhat paradoxical implication of these facts is that while these markets illustrate the possibility of futures markets that subsist entirely upon hedging, they force a reconsideration of the distinction between speculation and hedging. Moreover, the limited usefulness of these markets suggests that no market which fails to attract a good deal of participation by speculators can adequately provide for routine hedging.³

If the degree of imbalance in these markets inhibited their growth, and gives evidence of the need for speculation in a futures market, it nevertheless did not prevent their continued use over a period of years. When this view of the markets is taken, accentuating the level and kind of use that their characteristics permitted instead of that which was prevented, it implies strongly that a weak futures market is better than none at all. Such a market provides at least "the freedom . . . to make a sale . . . that would not otherwise be possible" (7, p. 561), and a means of averting the plight bemoaned by one merchant, whose product has no futures market, in the following words, "What a frustrating thing . . . to sit for months in a falling market and be unable to sell even though . . . you were the only one who knew it was going to fall" (5, p. 42).

³ This suggestion, which finds further support in the remainder of this paper, has been spelled out in a recent paper by the same author (3).

THE COFFEE MARKET

The New York coffee futures market has not yet been completely abandoned, but it is one of those over which traffic (in our earlier metaphor) has been much reduced by a government price support program. First opened in 1882, this trail carried much traffic in the first decade of its existence and has enjoyed subsequent periods of (somewhat less) heavy traffic as well. It has been repaired from time to time, and has undergone infrequent major alterations, as must any thoroughfare in adapting to changing traffic requirements. More recently the Brazilian government has provided, in its coffee price support programs, a serious obstacle to some sorts of use and an alternative to other sorts of use of this route, with the result that traffic has fallen to a low ebb. Recently a business day passed without a single transaction in coffee futures; yet noteworthy as is the example that this market provides of the time honored principle that futures markets cannot thrive where prices are administered, its example of stubborn survival in these circumstances illustrates the equally cogent, less obvious, and more invigorating principle that hedging sustains futures markets.

The coffee futures market is not only thin (the level of open contracts since World War II has averaged somewhat less than the inventory of *one* large roaster) and lopsided (see Table 1), but its price characteristics have been of a kind that have been a source of confusion in futures trading theory. Coffee prices have been high by historical standards during the postwar era and, with only brief and partial exceptions, the pattern of futures price quotations has been for the near future to be highest and each subsequent future to be lower than the preceding one. This phenomenon manifests the error, or bias, in the market, which has recurrently underestimated the future price level and has thereby produced profits for routine buyers and losses for routine sellers of futures contracts.

These circumstances are widely recognized, and the response on the part of the coffee trade has been rational. A system of hedging or, for that matter, speculating too, has been widely recommended, if not so widely adopted. This system, variously known as "buying the discounts," a "perpetual hedge," or "carrying inventory in futures," consists simply of routine buying of futures contracts on the theory that these are underpriced and must tend to rise in price as the contract approaches maturity. This system is recommended by leading brokerage firms, and has been explained in pamphlets, trade journal articles, and books emanating from these firms or their affiliated research bureaus (cf. 1, 11, 12).

Though the foregoing analysis of the market has been adequate from the practical trading standpoint, closer inspection reveals superficialities in the trade analysis from the standpoint of the functioning of futures markets. These, when superimposed over the superficialities of the standard textbook analysis of futures trading, compound confusion. The widely divergent interpretations of futures price behavior given by well informed tradespeople and by outstanding economists are confusing not only because they diverge, but because both are mistaken.

In British parlance, "backwardation" is the term used to describe the situation in which spot prices are higher than futures prices, and near futures higher priced than distant futures; "contango" is used to describe the opposite relationship. Keynes (4, p. 143) spoke of "normal backwardation" because he thought of

futures prices as "normally" reflecting a risk premium paid to speculative buyers by hedging sellers; this would necessarily result in backwardation exceeding contango in the long run and thereby appearing to be the more nearly "normal" of the two relationships. The trade jargon in the United States, on the other hand, refers to "inverted" markets instead of backwardation; *and uses the term "normal" to describe what Keynes called a contango* (cf. 2, Ch. 13).

Another glance at Table 1 will suffice to indicate that it is by no means obvious which is the "normal" price relationship in futures markets. For wheat and corn futures on the Chicago Board of Trade, not only for the periods covered here but for much longer periods, the average difference between spot and futures prices does not differ significantly from zero. Thus neither backwardation nor contango may be said to be normal. For a few postwar years backwardation prevailed in the soybean market, only to be superseded by balance as the market grew to maturity. In bran and shorts, extreme backwardation for four years was followed by extreme contango for three years, which was followed by death. In coffee and in wheat at Minneapolis, alone of the markets listed here, does backwardation appear to be normal; yet this relationship did not obtain in the interwar period on the Minneapolis wheat market nor in coffee prior to the valorization schemes. In no market does contango appear as a persistent tendency.

It seems preferable in view of the facts to forget about "normal" price relationships and to say that highly developed futures markets neither overestimate nor underestimate prices over very long periods of time; but that other, less well used markets, may persistently overestimate or underestimate prices over extended time periods (of at least a decade in some cases). The former are referred to here as balanced markets; the latter as lopsided markets.

Among the alternative pairs of terms that are used to describe the price relations among futures—contango vs. backwardation, premiums vs. discounts, carrying charges vs. inverse carrying charges—the last pair has the distinction of implying that the price relationship described affects the willingness of potential stockholders to carry hedged stocks of the commodity. The markets where "carrying charge" is the term commonly used by the trade are in fact markets in which traders have been keenly aware that substantial positive carrying charges had to exist when there were large stocks to be carried. Working, going a step farther, has called the carrying charge a price of storage, and has pointed out that an inverse carrying charge is therefore a negative price of storage, which can exist because some stocks must be carried for business convenience alone (9). Viewing the carrying charge (positive or inverse) as a price of storage opens a fruitful line of reasoning concerning the influences that determine the price of storage.

It has been shown that for certain markets the price of storage (carrying charge) is determined, as might reasonably be expected, by the volume of total stocks of the commodity (8; 9). That relationship could be seen most readily for such commodities as wheat in the United States prior to entry of the federal government as a major holder of stocks. Thereafter, the market-determined price of wheat storage depended, on the demand side, on the volume of *commercially* owned stocks.

Biased markets, in which prices are *generally* underestimated, require a somewhat different interpretation of an inverse carrying charge. In such a market an

inverse carrying charge may reflect seasonal or other temporary shortages, and in *addition* the general underestimate of future prices. It would be impossible to say for any particular price constellation how much inverse carrying charge was in reflection of temporary shortage and how much was due to bias in the market, yet the inversion would tend to be greater during a period of acute shortage and would also tend to vary seasonally for a commodity having a pronounced seasonal variation in production.

The fundamental difference in interpretation between inverse carrying charges in a balanced market and in a chronically lopsided market has not been drawn in any literature that I am familiar with.⁴ The simplest expression of this difference is that in a lopsided market the inverse carrying charges represent, at least in part, underestimates of price and hence advantage to the futures buyer, whereas in a balanced market they represent no better buys on the average than do carrying charges, and neither represents, on the average, a better purchase than sale. This distinction is of course implicit in the widely recommended "discount buying program" in lopsided markets, but the recommendation amounts to superficial induction so long as the underlying distinction is not explained. The tendency has been instead to reason about inverse carrying charges as though they reflected the same circumstances in both balanced and lopsided markets. An example of this tendency, illustrating the error that may result, will be provided next.

In a recent book devoted to futures trading, the very competent research director for a leading brokerage firm devotes a chapter to hedging in "normal" and in "inverted" markets. Of the latter he writes, "distant months will ordinarily fluctuate more slowly than near months" (2, p. 136). Before turning to some evidence that supports the *opposite* of these statements, I should point out that I sought and expected evidence in support of the above hypothesis, and was surprised and puzzled to discover such clear counter evidence as will be introduced here. The theory of the price of storage (9) requires that the spread between near and distant futures prices be interpreted *as* a price of storage, which of course suggests no necessary link between changing price *levels* and changing price *spreads*. Inverse carrying charges reflect current (usually seasonal) shortages of supplies and positive carrying charges reflect current (seasonal) surpluses. The aforementioned expectation of greater variability in near than in distant futures prices, valid as it is for the major futures markets, rests upon considerations other than the price of storage. The different spread behavior for coffee futures, to be introduced below, could be interpreted in much the same manner; i.e., it could be said that a price of storage is reflected in the spreads, that conditions of relative surplus and shortage are reflected in spread variations which are superimposed upon the general downward bias, but under circumstances that have tended to cause downward price movements of the distant future to be associated with decreases in the price of storage, thus causing the near future to move less than the distant.

The bias in the coffee futures market in Table 1 is considerably understated. This happens because an interim period of very different price behavior is included in the period covered there. In presenting a more detailed analysis of the coffee market here, therefore, a somewhat different period has been chosen, con-

⁴ Working dealt with a balanced market and thus did not encounter need for explaining the somewhat different behavior of unbalanced markets.

sisting of two unbroken periods which are separated by the briefer omitted period. After the results for this period have been shown, the distinctive characteristics of the omitted period will be described.

In order to keep the change in price level to a minimum after eliminating the interim period, as is necessary to avoid distorting the results, the beginning and ending dates for the entire period are somewhat different from those shown in Table 1. The Brazilian coffee contract was first "purchased" on December 1, 1949, (March contract) and the long position maintained in the manner described earlier by switching futures on the first day of each delivery month until May 1953, when sale of the May future then held was followed by no purchase until December 1, 1955. On that date the program was renewed, and continued to March 1, 1959. The net change in price level for these two periods together was -2.39 cents per pound, computed as follows:

December future on December 1, 1949	46.90
July future on July 1, 1953	56.67
Price change.....	+ 9.77

December future on December 1, 1955	49.90
March future on March 1, 1959	37.74
Price change.....	-12.16

$$\text{Net price change} = -12.16 + 9.77 = -2.39$$

Yet such was the bias that the gross profit for the 34 trades was 46.5 cents per pound and the *t*-ratio for the average profit was 2.88, which is significant at the 1 per cent level.

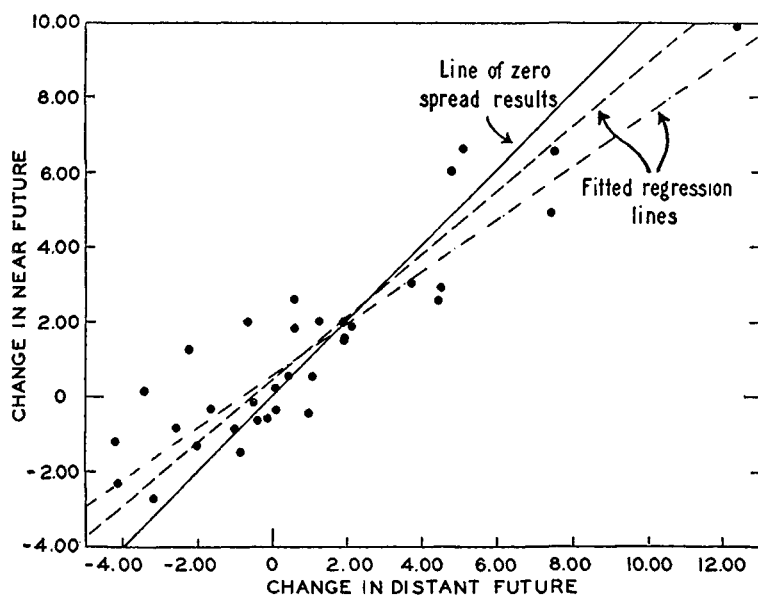
A test for results of *spreading between near and distant months* was conducted in an analogous manner over exactly the same period. In addition to buying the next future on the first day of the delivery month of the expiring future, the spread program involves also sale of the second future beyond that being purchased; so the complete spread program comprises the following routine:

- On March 1 close out any existing positions and buy May and sell September
- On May 1 close out any existing positions and buy July and sell December
- On July 1 close out any existing positions and buy September and sell March
- On September 1 close out any existing positions and buy December and sell May
- On December 1 close out any existing positions and buy March and sell July
- etc. seriatim.

This spread program turns out to have been a good hedge of the aforementioned discount buying program, in that the *distant months fluctuated more than the near months*, with the consequence that the spreads widened with declining prices and tended to narrow (though only slightly on balance) with rising prices. On an average, to state the facts in somewhat oversimplified form but with sufficient accuracy, near month prices rose about 90 per cent as much as distant month prices, and declined about 50 per cent as much. If the discount buying program was hedged by taking one spread position with each long position, the *t*-ratio was 3.59 instead of 2.88. The coefficient of variability in the near month price changes was 2.00, compared to 3.35 for the distant months. The correlation coefficient between change in spread and change in near future price was -.32 and between

change in spread and change in distant future price was $-.69$. Chart 2 shows the results for the 34 trading periods in such a way as to reveal the tendency for distant futures to decline and advance more than near futures. In this chart, the "line of zero spread results" of course represents a tendency for near and distant futures to rise and fall in the same amounts. The fitted regression lines show unequivocally that price changes in the distant future tended to be greater, not less, than in the near future.

CHART 2.—Relation Between Price Changes Between First Days of Successive Delivery Months in Near and Distant Futures, Brazilian Coffee, December 1, 1949–May 1, 1953 and December 1, 1955–March 1, 1959
(Cents per pound)



A more complete explanation of spread results in this market would entail considerations of seasonality and changes in the level of stocks, but we sought here to emphasize the relationship between spread results and price changes. We next interpret these results in terms of market characteristics and use.

There can be little doubt but that the dominant characteristic of the coffee market during the period under review has been the price support program of the Brazilian government. This program has been such as to leave little semblance of a free market in coffee. Much of the time price announcements were made on a sporadic and even day-to-day basis, leaving the private speculator in the position of having to outguess or anticipate the Brazilian officials. American speculators had little taste for risking their money on such a guessing game. There have also been discrepancies, the incidence and magnitude of which are inherently uncertain, between actual and officially quoted prices. These have been of sufficient importance, and the Brazilian policy sufficiently capricious, that the trade has probably doubted the sustainability of prevailing price levels during much of this period. Exchange rate manipulations, elaborate quota systems, and

similar devices have cast a shadow of uncertainty over coffee prices. Three major consequences tend to result from such conditions:

(1) The price-supporting government must provide for the carrying of the surpluses, seasonal as well as persistent, that accumulate. Private trade interests are unwilling to carry stocks over and above those required in their operations.

(2) Speculators shun the market. The futures market has of course provided the most convenient vehicle for speculation in coffee prices, and it is here that decline in speculator participation would be concentrated.

(3) Any lack of confidence in the sustainability of prices would be reflected in discounts on forward positions in futures and forward markets alike.

In a market so dominated by a price support program, it is not surprising that its futures market should wane. The imbalance of the futures market undoubtedly reflects the reigning uncertainty and the inadequacy of speculation, both of which flow from the Brazilian support efforts, but it may also reflect, quite directly, the hedging that remains to sustain the futures market. To anyone accustomed to thinking of hedging as more or less routine protection of inventories, the behavior of coffee futures prices must immediately suggest prohibitive hedging costs. Who are the hedgers and what are the circumstances in which they are willing to pay the implied costs? The chief sellers in this market are the importers who, when they buy coffee in Brazil for later resale in the United States, have occasion to cover the unsold coffee in futures. The first and most important characteristic of their use of the coffee futures market is that its level is very low and declining. The circumstances in which importers hedge in this market are rare; out of recognition of the costs, their use of the futures market is highly *selective*. *Ex post*, the coffee futures is one which underestimates prices; *ex ante*, the hedger then is drawn into the role of price forecaster. As he comes to recognize that this discount market more or less repeatedly corrects itself at the expense of the seller, he realizes that its *general* usefulness to him is greatly impaired, and that its usefulness has come to depend upon his ability to select the specific occasions on which it may reward him more than it costs him. Where he might, as a routine hedger in a balanced market, do his import buying with strict regard to the price *relationship* between the coffee purchased and the relevant future, he must instead, as a selective hedger in a lopsided market, seek more or less continuously to forecast what the spot price will subsequently be. If, in his judgment, the relevant future at the time is a good forecast of what the spot price will be subsequently, then he may hedge in futures. If he deems the future a low forecast, he may sell in the forward green coffee market, a non-futures market in which sales of particular lots of coffee are made for forward delivery. If he thinks neither of these markets will serve him well, but nevertheless has a sanguine view of the future level of coffee prices, he may well buy coffee for importation without any hedge.

The importer has also the incentive to hedge as an aid to financing his transaction. Bankers have a standard practice of advancing more funds on hedged inventory, a practice which may sometimes be questionable in a case where routine hedging is so costly as it would be in the coffee market, but which would never-

theless encourage hedging. Smaller profits per unit on borrowed capital can be preferable to larger profits per unit on owned capital.

Another characteristic of price behavior in this market is that spreads have tended to widen more after they have already widened relative to the previous delivery month; and to narrow more after they have already narrowed. I infer that spreads have tended to widen owing to the pressure of hedge sales in the distant future. On the assumption that it is the initiative or lack of initiative of selling hedgers that tends to dictate the spread pattern (which widens on price declines and is stable or narrows slightly on price increases), then this tendency of spread movements to continue suggests that the selective hedging of importers is successful. The short hedges, that is to say, tend to cost more when they are worth more. That the hedger does use distant futures is indicated in the fact that the concentration of open interest by delivery months is further removed from the current date in coffee than in other futures markets—including those where long period stock carrying is facilitated by hedging. Incidentally, the carrying of selling hedges in *distant* futures, even on a routine basis, would be not quite so costly as our measurement of bias implies, because the distant future does not rise so much on an average as does the near future.

It is also true that price concessions have been made, at various times and through various devices, by Brazilian sellers. These would presumably augur price weakness and serve as a further stimulus to hedging, at the same time that the favorable buying terms in Brazil and unfavorable selling terms in New York futures might be viewed as mutual offsets.

Biased markets, as we have seen, are thin markets, used for hedging by only a small segment of potential hedgers. In the coffee market, during the years when it has been biased downward, hedging of stocks has been done mainly by importers. The inverse carrying charges that have prevailed in that market, representing a negative price of storage, have impelled importers to do business, so far as possible, on a hand-to-mouth basis. To be able to serve their customers, they must carry some stocks, not only afloat, but also in United States warehouses; but they have tended to keep those stocks near a minimum to hold down costs.

Looking to the *causes* of the continuously negative price for hedged storage of coffee, it appears clearly a price determined largely by governmental action in Brazil. The government there has chosen to carry coffee stocks at its own expense. This presumably would have resulted in a market price of storage averaging about zero if the coffee futures market could have remained a balanced one. But because speculators tend, wisely, to avoid a market where the price is subject to arbitrary change by any group (or government) that holds dominant influence, the coffee market was left with little ability to carry the load of risk that some private holders of coffee stocks wished to shift to it. Consequently the price of hedged storage of coffee has been persistently negative.

The period which has been omitted from the foregoing analysis comprises 12 successive "trading periods" extending from July 1, 1953 to December 1, 1955. More information is available for this period than for the longer one because the Federal Trade Commission conducted an investigation of coffee prices which covered a part of this period (10) and for which data were procured that are not

regularly available. Prices of all futures had reached OPS ceilings in March 1953, as a result of which trading was suspended. Shortly thereafter ceilings were removed and prices moved upward to levels which the controls had previously prevented their reaching. This was followed by a major crop scare in July, with widespread and insistent reports of frost damage, leading to general price advances, with little or no effect on price spreads. This price rise had no sooner run its course than the Brazilian government announced, early in December, a 25 per cent increase in the loan rate on coffee, precipitating the sharpest price increase of the entire postwar period. A group of Brazilian traders immediately began buying in all futures (except the expiring December future), continuing their buying until the price of each future had risen by approximately 25 per cent. It seems obvious that these traders assumed that futures prices had conformed to the pre-existing loan rates and that the new loan rates, which they viewed as sustainable, would affect the entire set of futures prices alike. Subsequently, as the Brazilian buyers accepted their profits, traders in the United States bought all futures in what proved to be an abortive tailing action. Losses were taken in these positions as prices declined moderately in all futures, after which prices declined still further as prospects for the 1954 crop appeared reasonably good and as the 1953 frost damage reports proved ultimately to have been overdrawn. Thus ended six successive trading periods during which price movements were very wide (the *average* change in near futures price during these six intervals was larger than the *largest* change in any other single interval since the war) and during which spread changes were only nominal as virtually the same wide changes occurred in the distant as in the near futures.

Following these six intervals of very wide price change and of stability in the spreads came six additional trading periods of moderately wide price change and extreme spread widening. Near futures prices rose in four of the six intervals, for a net increase of 18.3 cents per pound at the same time that the distant futures underwent a net price decline of 1.5 cents per pound. The *average* spread change for these six intervals was considerably larger than the *maximum* spread change in any other postwar trading interval. There may have been no true downward bias of futures prices during this period; the large inverse carrying charges that emerged are reasonably attributable to the fact that stocks of coffee in both the United States and Brazil fell to far the lowest levels of the postwar period and a real current shortage was reflected in the price structure.⁵

The 12-interval period just discussed, but eliminated from the earlier analysis, was one which saw the partial restoration of coffee prices to more natural in-

⁵ The Federal Trade Commission implies that there was something undesirable in the presence or actions of the Brazilian traders during the period of the survey, when Brazilian traders held substantial net long positions. This seems a curious interpretation for a market which has been so chronically out of balance as this one for lack of buying; but the authors did not have the survey period in this larger perspective. For the twelve trading periods which embrace the F.T.C. survey period, the average "bias" in the coffee futures market, measured as the change in price of the near future minus the difference between successive near futures, was .58 cents per pound, in contrast to 2.31 cents per pound for the remaining 34 trading periods. The "bias" was almost eliminated during the period of the F.T.C. study! Their analysis of spreads concludes: "The erratic fluctuations in the spread among the various futures indicates that the market reflected numerous reappraisals of the expected future course of coffee prices. The tendency for the distant futures to sell at discounts under the nearby futures indicates a general lack of confidence in the future level of coffee prices. The many apparent reappraisals in market judgment as reflected by the change in spreads may reflect the lack of adequate knowledge of stocks and crop conditions" (10, pp. 421-425). Yet the spread fluctuations seem less erratic in the light of this interpretation.

fluences. A real shortage caused prices to rise above the loan rate, which was subsequently raised. Later the shortage of stocks in the United States led to a steep inverse carrying charge.

OTHER MARKETS

The other markets represented in Table 1 have not been analyzed so intensively as the coffee and millfeeds markets. Two of these markets, those for soybeans and cocoa, deserve comment because of the interesting change that has taken place in their "balance," and the bearing that this has upon the observations made at the beginning of this article.

During the early postwar period, while the soybean futures market was growing but not yet thriving, it was biased against sellers. The writer has seen no published reference to this imbalance, but was recently told by good authority that it was a quite widely recognized phenomenon around the Chicago Board of Trade at the time. With subsequent growth this market achieved balance, as Table 1 indicated.

A similar thing happened to the cocoa futures market, which has been widely publicized as a discount market in which a routine buying program was recommended. In the example published by a large brokerage firm, the period covered is embraced by the *first* period shown for cocoa in Table 1 (11, p. 46). The profits from routine buying happen not to have been significant at the 5 per cent level over this period; but there is no quarreling with the example which shows merely that such a program *was* profitable. Subsequently, as the level of use of the cocoa market rose substantially, it too became a well balanced market, as indicated by the very low average profits from maintaining a long position since 1955.

It is not only true, then, that among the markets tested here the thin ones appear to be lopsided and the better used ones balanced; but in at least these two cases the relationship applies to the same market at different stages of its development. The implications for futures market growth are worth contemplating. The futures markets for soybeans and cocoa are quite possibly the world's two best used commodity markets. Certainly soybeans must be ranked first, in view of the sheer volume of business transacted in this market. The cocoa market might seem an unlikely candidate for the second rank, until due attention is given to the potential level of use, for cocoa is not so important a commodity in commerce as wheat or a host of other commodities. A clearer impression of the level of use of the cocoa market is conveyed in a comparison with coffee. Coffee imports into the United States average about five times as large in volume as cocoa imports, yet open interest in cocoa futures has averaged about three times that in coffee futures in recent years. The potential futures market use that inheres in a commodity trade depends of course on the nature and extent of that trade. Coffee and cocoa are strongly similar commodity trades from a United States viewpoint, suggesting that the cocoa futures market is approximately 15 times as well used as the coffee futures market. Apparently speculators who felt unable to cope with the kind of influence exerted by the Brazilian government are not similarly afraid of that exerted by the African cocoa marketing boards.

Two of the best, if not the two best, futures markets in the world were, only a few years ago, thin and lopsided. Before despairing utterly of prospects for the

recovery of sick markets, the revival of dead ones, or the creation of new ones, it may be well to think of these two.

It is also worth noting that a market which undergoes a very substantial decline, such as the Chicago wheat futures market, can retain the balance that was achieved at earlier higher business levels. Even though most of the stock-carrying that was formerly done by using this market is now done by the government, a trade that has learned the value of a futures market apparently does not relinquish it easily, but continues to find sufficient buying and selling opportunities in it to keep the market in balance. Yet in the cases of bran and shorts, commodities that have not been supported in price or stockpiled, the markets never achieved balance because the trade never came close enough together in appraisals of price prospects to encourage further use and bring price ideas even closer together.

So we end where we began. The more a market is used the more useful it becomes, as with a trail. But evidence has been provided on a distinction which may be important to future analyses of growth prospects or diagnoses of weakness in particular markets—namely, that thin markets tend to be lopsided. Instead of asking what might be needed to stimulate traffic, or why traffic fails to develop, it may be desirable to first ascertain the breakdown according to direction and then ask, figuratively, why traffic in one direction does not develop to balance that in the opposite direction. Evidence has been provided that some thin and lopsided markets have been sustained by hedgers. A futures market on the margin of subsistence will probably always be a somewhat unbalanced market on which hedging costs are high. The significant requirement for balance is enough participation by speculators to balance the hedging. The thriving markets are those with adequate speculation to serve hedging needs economically.

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