by Richard Zeckhauser and Victor Niederhoffer

The Performance of Market Index Futures Contracts

Market index futures contracts have captured much investor and broker attention and achieved substantial trading volume. Their success can presumably be traced to their ability to lower transaction costs for both hedgers and speculators. As an instrument for shorting the market, their advantages are particularly significant.

More importantly, market index futures contracts provide a streamlined instrument for capturing information, which is fed back to the spot market. This is demonstrated, not only by the heavy trading in the contracts, but by the evidence that futures prices move more rapidly to equilibrium value than spot prices and that futures prices often lie below the spot prices, despite the time value of money.

The most interesting hypothesis suggested by experience to date is that the futures index may, under some circumstances, be of independent value in predicting movements in the spot price. The record is brief and inconclusive; in particular, traders may not yet have accommodated themselves to the new set of opportunities offered by market index futures. Nevertheless, if, over the long run, the futures price for the index does prove helpful in forecasting the spot price in some identifiable circumstances, some of the more fundamental assumptions of modern finance theory will have to be reconsidered.

THE two central questions of modern finance are: How do financial instruments convey information about economic activities and spread the risks associated with them? And what limited set of financial instruments can most efficiently meet the needs of a modern economy?

Market index futures contracts were originally proposed as essential new financial instruments for capturing information and spreading risks. As we wrote in this journal in 1980, before market index futures contracts became a reality, these contracts can, in theory, serve valuable economic functions as both hedging and speculative instruments for various classes of investors.[1] Moreover, they can convey information about market expectations in a compact and economic manner. We predicted that market index futures contracts would gain widespread use and exceptional liquidity.

Market index futures contracts are no longer a matter of theoretical conjecture. Five years in the making, the futures contract on the Value Line Composite Index finally gained regulatory approval and began trading on the Kansas City Board of Trade on February 24, 1982. The Chicago Mercantile Exchange initiated trading in a futures contract on the Standard & Poor's 500 Index on April 21, 1982. On May 6, 1982, the New York Futures Exchange opened its futures market, using an index based on the New York Stock Exchange Composite Index. A month later, the Chicago Board of Trade, America's largest commodity exchange, won a battle against Dow Jones for the right to trade a futures contract based on the Dow Jones industrial index. Because the court

1. Footnotes appear at end of article.

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decision was later overturned, however, there is no immediate prospect of trading in that contract.

Volume of Trading

By any measure of user acceptance, market index futures contracts have been a remarkable success. Brokers, traders and the exchanges express delight with the new instrument. The underlying value of the daily trading in the three major contracts in a one-week period in the fall of 1982 averaged approximately $1.415 billion.[2] By comparison, the daily activity of the New York Stock Exchange during the same week was about $2.1 billion (approximately 60 million shares per day at an average price of roughly $35). In other words, market index futures achieved, in just a few months, a volume of trade two-thirds as great as that of the largest securities exchange. Currently, volume is growing at a rate of 10 per cent a month.

Market index futures have grown faster than any new futures contract in history. Their average daily volume of trade is about 4.5 times as great as the volume achieved by Treasury bond and bill futures, today's most popular contracts, six months after they began trading.[3] The contrast in the average daily margin required is still more dramatic. Six months after contract introduction, the required margin for the bonds and bills was less than 1 per cent of that for the three stock market index futures.

The level of trading in market index futures indicates that the contracts play a useful role in reducing transaction costs. (In the fictitious world of zero transaction costs and zero taxes—a useful extreme case often invoked in finance theory—investors would, of course, merely buy and sell whole portfolios of stocks when they wished to take a position in the market as a whole.) The transaction cost advantage is likely to be particularly significant for those who wish to short the market, because alternative investment vehicles are not available with any reasonable degree of liquidity (although a mutual fund that took only short positions in the market could conceivably provide such an alternative). Moreover, many institutions that may be unable to sell individual securities short, because of operating rules or concerns about liquidity, can participate on the short side in the highly liquid index futures.

Relative Popularity of the Contracts

To the extent that two contracts are designed to meet similar purposes, and their underlying values are strongly correlated, we would predict a larger market share for the one that performs best in representing the market accurately and providing substantial liquidity. Two (or more) strongly related market index futures could prosper simultaneously only if some customers had lower transaction costs on one exchange and other customers on the other. (For example, stock investors might be regular customers of firms with seats on the New York Futures Exchange. Commodities traders, by contrast, might find it more convenient and cheaper to trade on the Mercantile Exchange.[4])

The announced purposes of the three market index futures contracts now being traded are similar. To judge the extent to which the underlying indexes move together, we looked at the correlation coefficients in the monthly changes in prices. Table I provides the evidence for the period January 1, 1977 to August 1, 1982. Salomon Brothers prepared an equivalent analysis of weekly changes over the two-year period leading up to July 1982. The correlations were in the same qualitative order, as Table II shows.[5]

Not surprisingly, the New York Stock Exchange Composite Index and the Standard & Poor's 500—both broad-based arithmetic indexes—have the highest correlation. The substantially lower correlations for the Value Line and the Dow 30 can be explained by the fact that the former is a geometric index (it is also the most

Table I Correlation Coefficients Between Monthly Changes in Indexes

	R^2			
	NYSE	*S&P 500*	*Value Line*	*Dow 30*
NYSE	1			
S&P 500	0.993	1		
Value Line	0.922	0.986	1	
Dow 30	0.905	0.921	0.857	1

Table II Correlation Coefficients Between Weekly Changes in Indexes

	R^2			
	NYSE	*S&P 500*	*Value Line*	*Dow 30*
NYSE	1			
S&P 500	0.992	1		
Value Line	0.844	0.819	1	
Dow 30	0.869	0.885	0.758	1

inclusive); the latter contains only a small number of unrepresentative stocks.[6]

The competition in market index futures today resembles a classic duopoly. The Standard & Poor's 500 contract has an 80 per cent market share; its commissions per dollar of contract value are only a little more than half those of its nearest rival, the NYSE contract. The Value Line futures contract suffers two disadvantages in the competition for investor attention. First, as a geometric average, it does not represent the portfolio of any investor, hence is not useful to any investor who wants to hedge the risk of an actual portfolio. Second, it is traded on an exchange that is less familiar to stock market investors than either the Chicago Mercantile Exchange or the New York Futures Exchange. In the future, the positions of the initial contracts may wax and wane. More specialized index funds—for example, funds in particular industries—may also develop to meet investor needs.

Capturing Information

If all markets functioned perfectly and costlessly—and if all traders in markets were fully rational—a market index futures contract could not be expected to provide useful information. In this situation, the spot index itself would capture all relevant expectations with regard to future price. If a futures contract based on the index were established, arbitrage would assure that it traded at a fixed relationship to the spot price.[7]

On the other hand, even if all arbitrage opportunities are exploited, a market index futures contract may provide certain advantages over the spot index as an investment instrument. This is certainly the case when a spot contract in the market does not even exist (although some mutual funds may approximate this role). In such circumstances, we would expect the futures contract, with its low transaction costs, to elicit significant amounts of information. Through arbitrage, this information would feed back to affect the value of the spot index. Thus finding a fully arbitraged relationship between spot and futures prices does *not* imply that the futures contract captures no information. In the absence of the futures market, the spot price might be considerably different.

Evidence

There is no need to dwell further on the theoretical aspects of the relationship between spot and futures prices, since the record is available. Experience has proved that the futures contract and the index can trade well out of line.[8] Table III compares spot and futures prices for the Standard & Poor's 500 futures contract (the most widely traded of the futures) over the three-month period June 15 to September 15, 1982.[9] Contrary to the predictions of finance theory, the futures contract was frequently priced below the spot during this period. Furthermore, the relationship between the futures price and the spot price varied considerably.

In interpreting this evidence, two features are worth noting. First, since market index futures provide the only convenient instrument for selling the market short, the futures price may be biased downward (unless markets are perfect). If the bias is sufficient, the futures price might lie below the spot price. Second, the broad base of an index slows its response to market changes. If the market makes a significant move, some of the stocks in the index will not yet have traded. The index, based in part on premove prices of less actively traded stocks, will underrepresent the move. This lagged effect we call the "wait-to-be-traded" feature of a spot index. A futures contract, by contrast, attempts to jump to the equilibrium value of the index on each trade, hence provides a more accurate representation of

Table III Trading Relationships Between Standard & Poor's 500 Index and Its Nearest Futures Contract: Price of Future *Minus* Price of Spot at Closing

	Cents									
Future Minus Spot	−100 to −149	−50 to −99	0 to −49	0 to 49	50 to 99	100 to 149	150 to 199	200 to 249	250 to 299	300 to 349
	Number of Observations									
June 15 to September 15	6	7	4	9	5	7	3	1	1	2

Table IV Runs in Half-Hourly Price Movements of Standard & Poor's 500 Index (June 15, 1982–September 15, 1982)

	Spot Contract		*Futures Contract*	
Length of Run	*Positive Change*	*Negative Change*	*Positive Change*	*Negative Change*
1	63	53	109	110
2	35	36	49	56
3	14	26	34	21
4	15	9	11	14
5	6	5	3	5
6	1	4	1	1
7	1	3	3	3
8	3	1	1	1
9	-	-	-	-
10	1	1	-	-
11	-	1	-	-
12	-	-	-	-
13	1	-	-	-

the true value of the market.

If this formulation is correct, the spot index should possess considerable momentum—a tendency for successive price movements to be in the same direction—whereas the futures contract should have very little. To test this conjecture, we examined half-hourly price changes for each over the period July 15 through September 15, 1982, to see how long a series of changes in one direction persisted before a reversal. Such a series is called a run; its length is the number of changes in the given direction.[10]

Table IV shows the observed lengths of runs. For example, on 35 occasions the spot price rose in precisely two successive half hours and then turned down. If the signs of successive moves were independent, the probability of a run of length two would be half that of length one, three would be half of two, etc. A One Sample Run Test applied to the spot price rejects the null hypothesis of independence beyond the 0.0002 level ($z = 4.15$); that is, the spot index displays considerable momentum.

For the futures contract, on the other hand, the null hypothesis of independence in successive half-hourly price movements cannot be rejected even at the 0.05 level ($z = 1.49$).[11] In contrast to the spot, the futures contract attempts to jump to equilibrium.

Consider that the longest run in the spot was length 13, whereas the longest run in the futures contract was length eight. If each half-hourly trade were equally likely to be up or down, starting at any particular point, a run of length 13 would occur less than once in 4,000 times, but a run of eight would be expected once in 128 times. Assuming independence in successive price movements, in a series of this length a run of length 13 or more is exceedingly unlikely; one of at least length eight is very likely.[12]

The evidence is clear: The futures contract is not a redundant instrument for information capture. Its attempts to anticipate market movements are reflected in both its lack of momentum and its moves above and below the spot market. The central question then becomes whether movements in the futures contract on the index are actually valuable in predicting movements in the spot.

Do Futures Prices Have Predictive Value?

To address the value-in-prediction question, we looked at the experience of the Value Line contract from March 15 through June 15, 1982 and the experience of the Standard & Poor's 500 futures contract from June 15 through September 15, 1982. During these initial periods of operation, investors, speculators and hedgers were presumably still learning how to use the market index futures; thus some patterns, particularly those that initially offered opportunities for profitable arbitrage, might be expected to dminish or disappear over time. Furthermore, differences between the experiences of the two contracts might be expected because of the geometric nature of the Value Line contract. This property implies that the Value Line index will be biased downward over time, and that it will be substantially more difficult to arbitrage with any real market instrument. Moreover, the wait-to-be-traded phenomenon may be more significant with the Value Line because of its broader base.

For the Value Line index, we looked at the June 30 futures contract. For each day we computed the difference between the price of the futures contract and the price of the spot at closing, a variable we labeled the premium. We then examined three different movements in the spot price—to the next day open, to the next day close, and to the close three days later.

Looking at the period as a whole, we find that the larger the premium is—that is, the more the futures price exceeds the spot—the greater is the tendency for the spot to rise. The rank order correlation between the premium and the move in the spot to the next day open was 0.188; between the premium and the move in the spot to the next day close it was 0.258; and between the premium and the spot move over the next three days it was

0.173. This would suggest that, when the futures price lay above the spot it tended to rise, and vice versa. More refined analysis would examine the impact on these relationships of such factors as market direction, interest rates, government actions in the money market, and dividend payout schedules.[13]

For the Standard & Poor's index, we examined the September 30 contract. We divided the observations into two subperiods—from June 15 to July 30, 1982 and from August 1 to September 15, 1982. During the first period, the spot index fell 2 per cent. From July 30 to Setember 15, however, it was up by 16 per cent. As would be expected because of the time value of money, and the higher interest rates in the former period, the futures price was much greater relative to the spot in the first period. On only four of 32 closings was it below the spot, as opposed to 17 of 33 in the second period.

In the first period, the rank order correlations between the premium at close and the spot movement to the next opening was 0.180; with the spot move to the next close the correlation was 0.285; and with the spot move to close three days later it was 0.163. For the August 1 to September 15 period, the respective correlations were 0.461, 0.254 and −0.058. If the movements in the spot price were unrelated to the premium, a correlation as great as 0.461 would be observed less than one time in 100; a correlation as great as 0.285 or 0.254 would be expected less than one time in 10. For the Standard & Poor's 500 futures index over these periods, the relationship between the futures and spot prices had some predictive capability for short-term moves. This was true in both a small down market and a substantial up market.

The early experience with market index futures contracts thus indicates that futures prices have some ability to anticipate movements in the spot, particularly for the near term. It would be premature, however, to accept any simple formulation of such relationships. Any relationship that might be discovered today, for example, should be expected to evolve as it becomes known and as investors gain experience arbitraging spot and futures indexes. The wait-to-be traded and dividend timing effects remain to be fully assessed. Quite possibly, daily changes in the value of the premium of the futures price over the spot may prove more useful than the premium itself in predicting imminent spot movements. To assess the full value of these new instruments, we should like to know—and future research may tell us—how much the futures capture independent information that feeds back to the spot, thus helping the spot predict its own subsequent price.

An Example

An intriguing example of the informative feedback relationship between futures and spot prices is set forth every Friday at 4:12 P.M., when the Federal Reserve System announces to the public the money supply for the previous week ending Wednesday. Although the stock market itself closes at 4:00, futures contracts trade through 4:15. The Federal Reserve announcement has a potent effect on the futures market (and the cash bond market, which is also trading). In the remaining three minutes of trading it is not uncommon for the futures price to move 200 points (the equivalent of a 15 point move in the Dow 30).

During the period from May 28, 1982 through November 12, 1982, there were 22 money supply announcements. The average absolute move in the futures price from 3:00 P.M. to 4:15 P.M. was 83.3 points, in comparison to an average absolute move in the spot index from 3:00 to 4:00 P.M. of 19.4 points. Do these movements in the futures price predict movements in the spot?

On the 12 occasions when the futures price rose from 3:00 P.M. to close on Friday, the average move in the Standard & Poor's 500 index from Friday close to Monday noon was +40.3 points. On the 10 occasions when the futures fell in this late Friday period, the average move in the spot index from Friday close to Monday noon was −104.5. In a sample of this size, chance variation alone would produce a difference this large or larger less than one time in 1,000.

Some Thoughts on Regulation

Given the record, some of the criticisms that had been leveled against market index futures now seem almost quaint. It had been argued that there would be difficulties with delivery because of the lack of a physical instrument, and that the contracts would be no more than gambling instruments. It is now evident that investors, ranging from individuals to large investment banking concerns, are all discovering important uses for market index futures. In August 1982, for example, the $2.5 billion Westinghouse Electric Corporation pension fund employed market index futures as a low-cost anticipatory hedge, guarding against market rises when less than fully in-

vested. Its prudence was rewarded with a market rally.[14]

Although the success of the market index futures concept seems virtually assured, antagonistic regulation remains a troubling prospect. Congress has shown more than a passing interest in the contract. For example, the House Energy and Commerce Committee, chaired by Representative John Dingell of Michigan—best known in the regulatory arena as a staunch opponent of the regulation of automobiles—has questioned whether the public has been adequately protected from the dangers of these contracts. Congressman Dingell has suggested that the Securities and Exchange Commission may have erred in making the Commodity Futures Trading Commission responsible for overseeing market index futures.

The continuation of these charges and claims is not surprising, for the debate over market index futures is part of a broader tug-of-war over who should be allowed to trade what, and who should regulate. These jurisdictional battles are of particular moment now, when options contracts on a variety of futures are being introduced and tested. Precedents affecting their permissibility and regulation are being established. We would argue that experience with the market index futures contracts has been reassuring and hardly suggests the need for further regulation. ■

Footnotes

1. Victor Niederhoffer and Richard Zeckhauser, "Market Index Futures Contracts," *Financial Analysts Journal*, January/February 1980, pp. 49-55.
2. In the week of September 27 to October 1, 1982, the most actively traded contract was for December 1982. An average of roughly 2,300 December '82 contracts traded daily in the Value Line, 8,050 in the New York Stock Exchange Composite Index, and 16,250 in the Standard & Poor's. With index prices at roughly 131, 70 and 121, respectively, contract values were approximately $65,500, $35,000 and $60,500. (Each contract represents 500 units of its index.) The open interests in these December '82 contracts, indicating the amount of capital at risk, were on the order of $2,536 million, $4,154 million and $11,419 million, respectively.
3. Six months after those contracts were introduced, they had average daily volumes of 280 and 540 contracts respectively, with average contract values at that time of $920,000 and $95,000.
4. Dwight Grant usefully extended our January/February 1980 article by considering the number of contracts in a particular index that should trade at a particular time. He demonstrates that, to reduce end-of-contract transaction difficulties, it will be worthwhile to have two overlapping contracts in the same market index. Ignoring the differential transaction cost argument, he concludes that contracts in more than one similar index are not desirable, for they will reduce the liquidity of the overall market in index futures. See "Market Index Futures Contracts: Some Thoughts on Delivery Dates," *Financial Analysts Journal*, May/June 1982, pp. 60-63.
5. Reproduced, with permission, from Nick Hanson, Tony Estep, Cal Johnson and Jonathan Singer, "Futures Contracts on Stock Indexes" (Salomon Brothers Inc, New York, July 13, 1982).
6. Historically, the Dow 30 has been the most widely cited indicator of market performance. It is startling how poorly the index itself—as opposed to changes in its price—correlates with the broad market indexes. For the 67-month period covered in Table I, the New York Stock Exchange and Standard & Poor's indexes correlated at 0.996. They correlated at 0.973 and 0.952 with the Value Line. Their correlations with the Dow 30, however, were only 0.643 and 0.701.
7. The correct theoretical relationship would be:

   $$F = S(1+r-d)^x \quad .$$

   Here F is the futures price, S the spot price, r the riskless rate of interest, d the average dividend rate for stocks in the index, and x the fraction of a year until expiration. For example, if the spot price were 100, the riskless rate of interest 14 per cent, and the dividend rate 6 per cent, then a future coming due in one year (i.e., $x = 1$) would trade at 108.

   If interest rates are uncertain, a market projecting interest rates will also be required if perfectly functioning markets are to render market index futures redundant.
8. Calculations on the early experience of the Value Line Composite Index, from February 24 to June 10, 1982, are provided in Richard Zeckhauser and Victor Niederhoffer, "Predictions Fulfilled: The Early Experience of Market Index Futures Contracts," in Frank Fabozzi, ed., *Readings in Investment Management* (Homewood, Illinois: Richard D. Irwin, 1983).
9. From mid-June to mid-July the spot index rose by 0.75 per cent. From mid-July to mid-August, the spot index was down 7 per cent; from mid-August to mid-September it was up 20 per cent. Because of the time value of money, the expected excess of the futures price over the spot price should decrease as the time until contract expiration decreases.
10. The next day open was treated as the next half hour after a closing price. If the price was unchanged on a half-hourly basis, that quote was not counted. For example, $-, +, 0, +, -$, is a series

with a positive run of length two.

11. See Sidney Siegel, *Nonparametric Statistics* (New York: McGraw-Hill, 1956), pp. 52-60.

12. The exact computation of the likelihood is complex, since trials in successive periods are not independent.

    None of our computations looked at the magnitude of changes. One could imagine a situation in which there is no momentum on an expected value basis, but substantial momentum in terms of signs. After a plus, the probability of a plus would be great, but its expected value would be small. A minus—i.e., a reversal—would tend to be associated with a much larger absolute movement. Many financial indexes appear to illustrate this phenomenon.

13. We delved deeper, for example, and noticed that the Value Line Composite Index rose from March 15 through April 30 by 8.5 per cent and fell by 8 per cent from May 1 through June 15. Examining those two periods individually, we found a *negative* rank correlation between the premium and the spot moves to the next open, next close, and three-day close in the first period, but a *positive* rank correlation for all three in the May 1 through June 15 period. Conceivably the market was shaking down in the initial period, or perhaps periods of rises are quite unlike periods of declines.

    The Spearman rank correlation coefficients are, respectively, −0.219, −0.236 and −0.407 for the first period, and 0.614, 0.390 and 0.191 for the second. The correlations for three-day movements are not valid in any traditional sense, for there is a built-in dependence in the results from one day to the next. The positive coefficients with the moves to next open and next close in the second period are both significant at the 0.05 level; the negative coefficients for the first period are not significant at the 0.10 level. (See Sidney Siegel, *Nonparametric Statistics*, pp. 195–241.)

14. *Pensions and Investment Age*, October 25, 1982, p. 1.