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Chapter Author: Kenneth French

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Kenneth R. French
GRADUATE SCHOOL OF BUSINESS, UNIVERSITY OF CHICAGO

Crash-Testing the Efficient Market Hypothesis

1. Introduction

The stock market crash of October 19, 1987, has generated an enormous amount of analysis and debate. In less than six months, commissions representing the President, Congress, the Securities and Exchange Commission, the Commodity Futures Trading Commission, the New York Stock Exchange, and the Chicago Mercantile Exchange have provided thorough reports. There also have been many academic papers written on the subject, and there are many more to come. Although the details and emphases differ, the question underlying most of these papers and reports is "What caused the crash and how can we prevent another one?" Was it caused by a breakdown of trading mechanisms or by portfolio insurance? Should the government require higher margins on futures contracts or should the public shun firms that profit from index arbitrage?

There is a basic issue that must be addressed before these and similar questions can be resolved. Was the crash a rational response to new information, or is it evidence that stock prices are set irrationally?

Under the efficient market hypothesis, prices reflect all available information. This hypothesis has been debated vociferously by academics for 20 years. Practitioners usually dismiss the debate as an irrelevant academic diversion. In fact, the competing views about market efficiency lead to different conclusions concerning the 1987 crash and its policy implications.

There are three broad interpretations of the dramatic price drop.

1. Stock prices were close to fundamental values before the crash. On October 19, 1987, investor panic or a breakdown of market mechanisms drove prices to irrationally low levels.
2. Stock prices were close to fundamental values both before and after October 19. The crash was a rational response to new information.

3. Stock prices were above fundamental values before the crash. The decline brought them closer to efficient levels.

Many of the recommendations in the commission reports and academic papers only make sense under the first interpretation, that the market crash drove prices to irrationally low levels. However, this is the least likely explanation. Under the other two interpretations, the crash maintained or improved market efficiency. Thus, from the perspective of market efficiency, policies to inhibit future crashes are misguided.

No one would argue that markets are perfectly efficient—that prices always equal fundamental values. The debate is about the size of the deviations from fundamental value. While defenders of market efficiency argue that these deviations are small and essentially irrelevant, skeptics contend that they are economically important. The October 1987 crash provides an unusual opportunity to examine the merits of the competing positions.

2. *Market Efficiency, Dividend Yields, and the Predictability of Returns*

If the market is efficient and expected returns are constant, stock returns are not predictable. Evidence of predictability has been accumulating for over 20 years. See, for example, Fama (1965), Fama and Schwert (1977), and Keim and Stambaugh (1986). The common conclusion, usually from monthly data, is that the predictable component of returns accounts for a small part (usually less than 3 percent) of stock return variances. Recent work by Fama and French (1987a, 1988), Poterba and Summers (1987), and Campbell and Shiller (1988) suggests that the predictable component is a larger fraction of long horizon returns. For example, Fama and French (1987b, 1988) show that ex ante dividend yields often explain more than 25 percent of 2–year to 4–year stock return variances. Some interpret this strong predictability as evidence that the market is inefficient. However, the data only allow rejection of the joint hypothesis that the market is efficient and expected returns are constant.

In fact, the behavior of expected returns identified by Fama and French (1987b, 1988) is consistent with a large class of equilibrium models. They never forecast reliably negative nominal, real, or excess stock returns for the value- or equal-weighted New York Stock Exchange (NYSE) portfolios. Forecasts of excess stock and bond returns move together. The variation in expected excess returns is larger for stock portfolios than for bond portfolios, and larger for low-grade bonds than for high-grade bonds. Finally, the level of forecasted excess returns is related to business conditions, low

when conditions are good and high when conditions are poor. Thus the forecasted returns fit preconceptions about risk premiums.

The evidence is also consistent, however, with simple models of an inefficient market in which prices take long swings away from fundamental values. In this framework, dividends measure fundamental value, so dividend yields change as prices wander away from rational levels. If the market will eventually correct its mistakes, current dividend yields provide information about future returns. When prices are irrationally low, dividend yields and expected returns are high. When prices are irrationally high, dividend yields and expected returns are low.

3. Was the Crash an Irrational Move Away from Rational Prices?

Most of the analysis and recommendations about the October price decline presume that the crash was undesirable. From the perspective of market efficiency, this view is appropriate if investor panic or a breakdown of market mechanisms drove prices from a level that was rational before the crash to a level that was irrationally low after the crash. This seems unlikely.

Dividend yields were at historically low levels before the crash. For example, the annual yield on the Standard and Poor's Composite Index (S&P 500) was 2.70 percent in September 1987. This was almost 2 percent lower than the average yield for 1926–86, 4.52 percent. September's dividend yield was lower than all but one of the 244 quarterly observations of the annual yield during the 1926–86 period. (The lowest was 2.67 percent in December 1972.) The October price shock raised the dividend yield to 3.71 percent at the end of December 1987.

Perhaps the extremely low dividend yields before the crash and the moderate yields after the crash reflect a rational change in expected returns. Alternatively, perhaps the increased dividend yields reflect a drop in prices from irrationally high levels toward more rational lower levels. It seems unlikely, however, that a movement away from historically low yields toward average values was caused by an irrational price drop.

4. The Efficient Market Interpretation

The stock market crash poses a challenge for champions of market efficiency. What new information reduced fundamental values by more than 20 percent on October 19, 1987? If the market was efficient before and after the crash, the price decline must have been caused by new information about future cash flows or about the rate at which those cash flows should be discounted.

Some potentially important news was released over the weekend before the crash. For example, the press reported speculation that the Federal Reserve would raise its discount rate, and the government announced its intention to allow the dollar to decline against the West German mark. On the morning of October 19, 1987, the United States bombed an Iranian oil platform in the Persian Gulf. Although these stories may have been important, few would argue that they changed expectations of future cashflows enough to explain the market crash.

The alternative is to consider news about expected returns. Fama and French (1988) show that shocks to expected returns are associated with opposite shocks to current prices. They call this relation the discount rate effect. Based on their point estimates for nominal returns on the value-weighted NYSE portfolio for 1941–86 (their longest period of roughly homoskedastic returns), a 1 percent increase in next year's expected return produces a 4 percent drop in the current price.

The dividend yield on the S&P 500 index was 2.70 percent at the end of September 1987 and 3.71 percent at the end of December. With these values, the 1941–86 nominal return regression in Fama and French (1988) implies an expected annual return of about 3 percent for the value-weighted NYSE portfolio before the crash and about 8 percent after. Because of the discount rate effect, this 5 percent increase in expected returns should lead to a price decline of about 20 percent—only slightly less than the 22 percent drop in the S&P 500 on October 19, 1987.

This expected return argument still leaves defenders of market efficiency in a quandry. Where is the news that raised expected returns from 3 percent to 8 percent? Perhaps prices fell because expected returns rose, but it seems more likely that expected returns rose because prices fell.

5. *The Bubble Hypothesis*

The most common interpretation of the market crash is that it was the inevitable collapse of a speculative bubble. As a bubble forms, prices rise above fundamental values. Investors realize that prices are irrationally high, but each buys in the belief that he will be able to sell before the price falls. In essence, each buyer believes a greater fool will buy from him. When the bubble bursts, prices plummet back toward fundamental values.

The behavior of stock prices around the crash supports this bubble scenario. There was a dramatic increase in prices (the Standard and Poor's Composite Index rose by 33 percent during the first nine months of 1987), followed by a cataclysmic decline (the S&P 500 fell by 9 percent during the week before the crash and by 22 percent on October 19, 1987). The behavior of dividend yields is also consistent with the bubble hypothesis. Yields

were at historically low levels in September and returned toward average values after the crash.

One of the critical components of the bubble hypothesis, however, is a consensus among investors that prices are irrationally high, coupled with each investor's belief that he will be able to sell before prices fall. There is little evidence of such a consensus before the crash. Many *now* claim that they knew prices were too high before the crash, but this selective recall does not fit the facts. For example, the October 20, 1987, *Wall Street Journal* described traders' reaction to the price drop as one of "stunned disbelief" (*WSJ* pg. 1). The first *Wall Street Journal* report of a newsletter that predicted the crash was not published until two days later, on Thursday, October 22. Thus, although the bubble theory is popular after the crash, it does not seem to be consistent with market opinion before the crash.

6. *Rational and Irrational Information Aggregation*

By a process of elimination, I am inclined toward the conclusion that prices were above fundamental values before the crash, but that investors did not know they were too high. Standard models of rational information aggregation, such as Diamond and Verrechia (1981) and Admati (1985), imply that prices equal fundamental values *on average*. If the amount of noise in the system is sufficiently large, prices can be arbitrarily far away from fundamental values. Thus, it is easy for rational models to explain prices that are too high. The challenge is to describe a rational (and plausible) model in which traders can infer that they have made an enormous error from a small amount of bad news.

The alternative is to consider the possibility of irrational behavior. Financial economists are justifiably reluctant to introduce irrationality into models of market equilibrium. Rational models have explained a wide range of economic phenomena. More important, there is no standard framework to constrain the sort of irrationality one might introduce. In general, financial economists have resisted the temptation to use ad hoc assumptions of irrationality to "explain" individual anomalies or events. At the risk of appearing weak-willed, I will yield to that temptation.

In standard models of information aggregation, economic agents rationally combine their own private information with the information they infer from observed prices and volume. Perhaps real investors put too much weight on market signals and not enough on their own information. For example, French and Roll (1985) find that stock return variances are much lower when markets are closed than when they are open. They suggest this may imply that investors over-react to each other's trades.

From this perspective, the typical investor's private information before

the crash was more pessimistic than the information implied by prices. However, because the typical investor put too much weight on the market information, he mistakenly believed he was atypical and that other investors were more optimistic. This misperception could have led to irrationally high prices before October 19, 1987.

Several pieces of bad news were released on October 14–16. For example, on Wednesday, October 14, the government announced that the trade deficit for August was $15.7 billion. The Brady Commission (1988) reports that this "was about $1.5 billion above the figure expected by the financial markets." There was also news that the House Ways and Means Committee would support legislation to eliminate the tax benefits of leveraged buyouts and to impose a new tax on greenmail profits. On Thursday, the Administration announced its reluctance to support the dollar against foreign currencies. On Friday, there was an Iranian attack on a U.S.-flagged oil tanker in the Persian Gulf.

In my scenario, these events corroborated the private information held by investors. With this confirmation, each investor increased the weight he placed on his own information and reduced the weight he placed on the market. This, in turn, caused him to make large revisions in his assessment of fundamental values and in the price he was willing to pay for stocks. To each investor's surprise, others were making similar large revisions. General confirmation of individuals' pessimistic private information led to large price declines. The Dow Jones Industrial Average fell by 95 points on Wednesday, 57 points on Thursday, and 108 points on Friday. At the time, the Wednesday and Friday drops were the largest absolute changes in history. These large price responses, in turn, led investors to conclude that others also had pessimistic private information. Thus, the big news that drove prices down on October 19 may have been the market's large response to moderately bad news over the previous three trading days.

This story was developed to interpret the events of October 1987. It would be interesting to see whether a more explicit model along these lines could explain any other phenomena.

7. Should We Outlaw the Next Crash?

One of the most important proposals in the Brady Commission's (1988) report on the stock market crash is a recommendation that circuit breakers, such as price limits and trading halts, should be implemented in all equity markets. These circuit breakers would halt trading for a variety of reasons, including excessive price changes, excessive volume, and large order imbalances. The apparent benefits from circuit breakers and similar mech-

anisms to slow sharp price declines depend on one's interpretation of the 1987 crash.

Stock market prices provide important signals about the productivity of capital. If the market is inefficient, resource allocations based on these signals are distorted. Thus, one way to evaluate regulations that are intended to impede the next crash is to ask whether they will improve market efficiency.

From the perspective of market efficiency, circuit breakers and other mechanisms intended to slow large price changes are desirable if investor panic or a breakdown of market mechanisms drove prices to an irrationally low level during the 1987 crash. However, this explanation of the crash is the least likely of the interpretations I consider.

Under all other interpretations, circuit breakers would reduce efficiency and distort the market's price signals. For example, if the 1987 crash was simply an efficient market's response to news about expected future cashflows or expected returns, restrictions on price changes would drive a wedge between observed prices and fundamental values. Similarly, if the crash was the conclusion of a speculative bubble, circuit breakers slow the market's adjustment toward rational prices.

The Brady Commission's (1988) circuit breaker recommendation may not have been motivated by concerns about market efficiency, but rather by the possibility that the crash itself lowered fundamental values. For example, perhaps uncertainty created by the cataclysmic price decline increased required returns. Alternatively, perhaps the sudden reduction in wealth disrupted consumers' spending plans and lowered the market's expectation of future cash flows.

This feedback, from the market to the economy, is procyclical. A drop in fundamental values lowers stock prices which drives fundamental values down further. The possibility of preventing procyclical feedback is attractive. However, there is no reason to believe that circuit breakers or other mechanisms designed to delay large price changes will reduce this feedback. There is little theory or evidence about how this feedback mechanism works. Perhaps circuit breakers would have reduced the feedback from October 19, 1987, by spreading the price decline over several days. However, it is also possible that such trading halts would have created more disruptions and increased the feedback.

8. Conclusions

Because fundamental values are unobservable, researchers trying to test whether the aggregate price level is rational are forced to use an indirect approach. The usual method is to test whether observed returns are

consistent with some equilibrium model. For example, the classic model in these tests says that expected returns are constant and that prices follow a random walk. Since the tests are indirect, researchers can never reject market efficiency; they can reject only the joint hypothesis of market efficiency and a particular equilibrium model.

Large news events and large stock price changes provide another indirect way to examine market efficiency. If markets are efficient and prices equal fundamental values, information that changes fundamental values also changes prices. Thus, financial economists have argued that the market's ability to distinguish between real and cosmetic changes in reported earnings is evidence of efficiency. Similarly, if prices always equal fundamental values, each price change must reflect a change in fundamental value.

Economists are not good at explaining observed price changes. Rather than view this failure as evidence of inefficiency, many financial economists blame our crude models of the relation between observable information and unobservable fundamental values. For example, perhaps Roll (1984) is unable to explain changes in the price of orange juice futures because he does not include all relevant information, or because he uses the wrong functional form. However, it is hard to imagine a plausible model of fundamental value in which the small amount of information observed on October 19, 1987, could trigger a rational 22 percent drop in prices.

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REFERENCES

Admati, A. R. 1985. A noisy rational expectations equilibrium for multi-asset securities markets. *Econometrica* 53 (May): 629–657.

Brady, N. F., et al. 1988. *Report of the Presidential Task Force on Market Mechanisms.* Washington, DC, U.S. Government Printing Office.

Campbell, J. Y., and R. J. Shiller. 1988. Stock prices, earnings, and expected dividends. Working Paper, Princeton University (January).

Diamond, D. W., and R. E. Verrechia. 1981. Information aggregation in a noisy rational expectations economy. *Journal of Financial Economics* 9 (September): 221–235.

Fama, E. F. 1965. The behavior of stock market prices. *Journal of Business* 38 (January): 34–105.

Fama, E. F., and K. R. French. 1987a. Permanent and temporary components of stock prices. *Journal of Political Economy.* Forthcoming, April 1988.

Fama, E. F., and K. R. French. 1987b. Forecasting returns to corporate bonds and common stock. Working Paper, University of Chicago (December).

Fama, E. F., and K. R. French. 1988. Dividend yields and expected stock returns. *Journal of Financial Economics.* Forthcoming.

Fama, E. F., and G. W. Schwert. 1977. Asset returns and inflation. *Journal of Financial Economics* 5 (November): 115–46.

French, K. R., and R. Roll. Stock return variances: The arrival of information and the reaction of traders. *Journal of Financial Economics* 17 (September): 5–26.

Keim, D. B., and R. F. Stambaugh. 1986. Predicting returns in the stock and bond markets. *Journal of Financial Economics* 17 (December): 357–390.

Poterba, J. M., and L. Summers. 1987. Mean reversion in stock returns: evidence and implications. (National Bureau of Economic Research, Cambridge MA), August. Unpublished manuscript.

Roll, R. 1984. Orange juice and weather. *American Economic Review* 74 (December): 861–880.