

PART

Two

Noise Traders

CHAPTER 4

Noise Traders and the Law of One Price

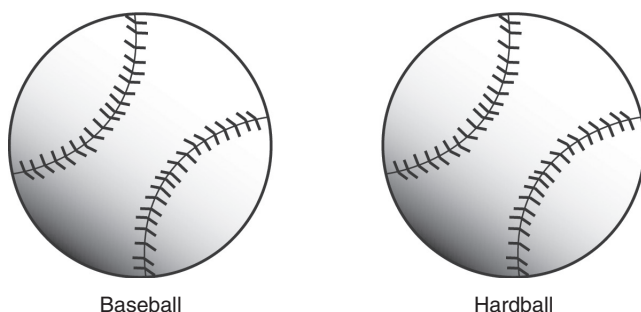
One of the very first things a student learns in beginning economics is that if two commodities are identical, then they will command identical prices in the marketplace. If the price of the two commodities should ever diverge, buyers will buy the cheaper of the two, and sellers will sell the more expensive of the two, pushing the divergent prices toward each other. It is likely that someone will try to buy the commodity in the cheap market and sell it in the more expensive market and earn an *arbitrage* profit. Thus, the *law of one price* emerges: two identical commodities must have the same price almost all the time.

THE LAW OF ONE PRICE AND THE CASE OF FUNGIBILITY

All of this seems simple enough, as long as we are comfortable with the definition of *identical*. What if two things are identical, but we refer to them by different names? Are they still identical? Do they still command the same price in the marketplace? Imagine a factory that produces baseballs. Suppose that every second baseball produced is called a *hardball*, whereas all others produced are called *baseballs*. But suppose in every respect there is absolutely no physical difference between a *hardball* and a *baseball*. They are the exact same thing except for their differing names. Can a *hardball* have a different price than a *baseball*? (See Figure 4.1.)

The two items above are not strictly identical because they have different names. This difference in name allows for the possibility that market participants may see them as truly different and that it may be possible for these two physically identical items to have different prices. If we think of these as assets, then we could say that the efficient market hypothesis (EMH) requires that these two items have identical prices since all information about them is the same. A *behavioral economist* might argue otherwise.

Baseball versus Hardball

**FIGURE 4.1** Can These Two Have Different Prices?

The different names might lead to different prices, even when the items themselves are physically indistinguishable.

Imagine a baseball-hardball machine that costlessly converts hardballs into baseballs and baseballs into hardballs, one for one in each case. If the price of baseballs and hardballs were to differ, then one should buy the cheaper of the two, feed it into the machine, and out would come the other, which could then be sold at a profit. This is a simple example of arbitrage. This type of costless conversion is known as *fungibility*.

There are many examples of fungibility in financial markets. Options in certain combinations and most futures contracts are completely fungible into the underlying instruments from which they derive their value. Owning a gold future is simply another way of owning gold, and if the owner of a gold future does not sell the future, then delivery of gold will take place on the future's delivery date. In this manner, the gold future owner becomes the owner of actual gold. This is an example of fungibility. The simple arbitrage of the baseball-hardball machine example is possible in the options and futures markets, though in a more complicated fashion.

What happens if the hardball and the baseball are not fungible? An easy way to make them not fungible is to put an indelible label on each. Each hardball would have the label *hardball* imprinted on it, and each baseball would have the label *baseball* imprinted on it. Then the arbitrage process might fail.

Suppose hardballs have the higher price. A buyer of hardballs might hold out for the product with the preferred label, even though, except for labeling, there is absolutely no physical difference. In the absence of fungibility, there is a clear possibility that the prices of two "identical" things might command different prices (almost all the time). There is no simple

arbitrage that produces a guaranteed profit in finite time by buying one and selling the other. In principle, nothing forces the prices to equality, absent fungibility.

The reason fungibility is an important issue is that many seemingly identical pairs of securities are not fungible. The most famous example is the stock pair consisting of Royal Dutch common stock (a Netherlands corporation) and Shell common stock (a British corporation).¹ This pair represents different amounts of ownership in the same company. The former is entitled to 40 percent of all the earnings of the company, while the latter is entitled to 60 percent of all of the earnings of the company. The price of three shares of Royal Dutch should always be approximately equal to the price of two shares of Shell, if the law of one price holds. There simply is no difference between three shares of Royal Dutch and two shares of Shell regarding their economic claims on the company. But, as is well known, Royal Dutch and Shell rarely trade at a 1.5 ratio and can diverge from that ratio by substantial margins and for indefinite periods of time.

Why doesn't the law of one price work in this case? The answer is lack of fungibility. You cannot buy three shares of Royal Dutch and convert those shares into two shares of Shell (British). If you buy shares in either company, the only available method of disposal is to sell them.

If you could convert the cheaper shares into the more expensive shares at a three-to-two ratio, then simple arbitrage would bring the prices together, but you cannot do the conversion. No machine is available. The only thing available is the marketplace. That lack of fungibility has, in practice, meant that those who purchase the cheaper of the Shell stocks and an offsetting position² in the more expensive (on a three-to-two ratio) have lingered in that transaction with no particular tendency for the prices to equalize.

If two commodities are identical and fungible (in the sense that one could be converted into the other and vice versa at minimal cost), then the law of one price should hold. But if fungibility is not present, then it is an open question whether the prices of two identical but not fungible assets will converge. The famous example of Royal Dutch and Shell is a very public example of identical things that lack fungibility for which the law of one price doesn't seem to hold.

¹ See the exposition of the twin Shell stocks by Andrei Shleifer in *Inefficient Markets* (New York: Oxford University Press, USA, 2000), Chapter 2.

² Offsetting position means a short sale, or borrowing the stock from a holder and selling it, planning to repurchase the stock at a later date and return it to its original owner.

What If Identical Things Are Not Fungible?

Now let us imagine two identical assets that cannot be transformed one into another except by selling one and buying the other. This is the truly interesting case for the EMH. The fungibility case has a mechanical way of resolving itself and is more an exception than the norm in financial markets. Things that seem almost identical in financial markets are typically not fungible one into the other.

Can prices of two identical, but not fungible, things, like our baseball and hardball, diverge and maintain that divergence for a significant period of time, perhaps even indefinitely? The EMH would say that the prices of two things, even if not fungible, should be identical or virtually identical most of the time. That sounds vague, but it is nonetheless a demanding requirement, as we shall see.

If prices in the marketplace are not right, then someone has to be buying and selling at these incorrect prices. There have to be buyers willing to pay too much or sellers willing to sell for too little in order to keep prices from being the right prices. What does the phrase “right prices” mean? It means the prices that rational, knowledgeable participants would be willing to buy or sell something for.

One can easily imagine that there might be individuals who think that our baseballs and hardballs are different things. Individuals perhaps lack the knowledge to know that the baseball and hardball are identical. But, in time, surely they would learn that they are not truly different. Then, it becomes hard to imagine that anyone would pay more for one than the other. But what if there were people that could never be convinced that these two identical items were identical? Perhaps they don’t learn, or perhaps they think the fact that they are labeled differently is enough to constitute a true difference.

Can two identical things with different names be different? For our purposes, the answer is no. They should be considered the same thing. But the deeper question is: can they have different prices? If they cannot have different prices, then the EMH, at least for this case, is validated. If different prices can prevail for products that differ only by label, then much other economic theorizing, not just the EMH, could be challenged as well.

How could these prices be different? Someone has to be willing to pay a higher price for one than for the other.

The Friedman View

Milton Friedman provided an argument in the context of currency markets that amounted to a defense of the EMH:

*Despite the prevailing opinion to the contrary, I am very dubious in fact that speculation in foreign exchange would be destabilizing. . . . People who argue that speculation is generally destabilizing seldom realize that this is largely equivalent to saying that speculators lose money, since speculation can be destabilizing only if speculators on the average sell when the currency is low in price and buy when it is high.*³

Friedman was discussing whether speculators were a destabilizing influence in currency markets. He is arguing that speculators, traders who move prices away from efficiency, will lose money, suggesting that *smart* traders will push prices back toward efficiency while they take the opposite positions and that such speculators will eventually lose all of their capital.

The modern version of Friedman's argument introduces the notion of noise traders, which would include not only Friedman's speculators but other market participants as well. Friedman's argument, updated, would be that noise traders as a group would lose money as they foolishly buy at high prices and sell at low prices.

But Noise Traders, if Sufficiently Diverse, May Not Matter

Imagine some individuals who are irrationally willing to pay more for a baseball than a hardball. Isn't it reasonable to suppose that there may be other individuals who are irrationally willing to pay more for a hardball than a baseball? Perhaps degrees of irrationality are randomly distributed about the true rational outcome. Then, such irrational individuals may offset one another. A kind of law of large numbers might come into play that has the baseball lovers counterbalanced by the hardball lovers so that the prices of the two remain approximately identical—offsetting irrationality, we might suppose. Eugene Fama made precisely this argument in his defense of the EMH⁴ against the argument that noise traders would disrupt matters.

The Noise Trader Agenda

It has long been known that there are many, often silly, reasons that people buy and sell stocks. No one pretends that all traders and investors are completely rational; common observation suggests that is not the case. But the very existence of noise traders is not sufficient to invalidate the EMH.

³ Milton Friedman, *Inefficient Markets* (Chicago, University of Chicago Press: 1953), 175.

⁴ Eugene Fama, "Efficient Capital Markets: A Review of Theory and Empirical Work," *Journal of Finance* 25, no. 2 (May 1970): 383–417.

In order to show that the EMH is in trouble, at least two conditions must be met. We will call these two conditions the *noise trader agenda*:

1. Noise trader behavior must be *systematic*. Noise traders must be shown not to simply cancel one another out. If some are too optimistic and others are too pessimistic, then one group may simply cancel out the effect of the other. Instead, there must be something like herd activity, such that a large group of noise traders, or a small group with a large amount of assets, behave in a similar manner.
2. Noise traders need to survive economically for a significant period of time. If all noise traders do is lose money through their noise trading, then their impact will be limited. Noise traders need to make substantial and persistent profits under some conditions. Otherwise, noise traders are simply cannon fodder, as Friedman suggests, for the smart traders.

NOISE

Where does the term *noise trader* come from, and what does it mean? Noise trading is normally defined by what it is not. A noise trader is not the rational, knowledgeable trader or investor who is commonly assumed in finance theory. The noise trader is doing something else. A noise trader could be as harmless as a year-end tax seller, paying no attention to values at the moment of sale. It could be a grandmother buying a present of stock for a grandchild, where the main interest in the stock is that the company produces something appealing to children, regardless of the inherent investment merits of the company itself.

Fischer Black's 1985 Presidential Address to the American Finance Association

The concept of noise in a financial market context has its first modern expression in Fischer Black's address to the American Finance Association meetings in December 1985. Black's talk on that occasion was simply entitled "Noise."⁵ Noise, in a scientific context, almost invariably refers to "white noise" or "Brownian motion." Intuitively, this notion of noise is describing something that bounces around with no particular direction. But the bouncing around is stable. Figure 4.2 is a typical depiction of white noise.

⁵ See Fischer Black, "Noise," *The Journal of Finance* 41, no. 3 (July 1986); Papers and Proceedings of the Forty-Fourth Annual Meeting of the American Finance Association, New York, NY, December 28–30, 1985, 529–543.

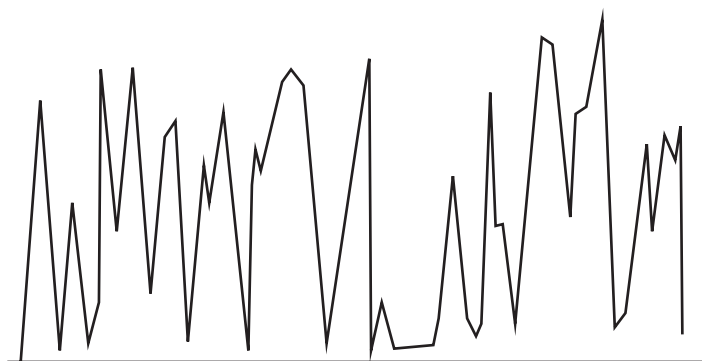


FIGURE 4.2 White Noise

Notice that the pattern is continuous but erratic. Modern financial theory uses white noise to characterize the pattern of stock prices,⁶ so Black's lecture was aimed at an audience that was familiar with this notion of noise.

Fischer Black was both an academic and a practitioner. At least half of his working days were spent in Wall Street or Chicago security trading operations. Black was intimately familiar with the diversity of trader motives and activities. He describes a variety of different types of noise traders. The definition of a noise trader is elusive in Black's talk (as it is in the entire literature), but Black provides the following definition: "Noise trading is trading on noise as if it were information."⁷ That definition begs the question as to what exactly is noise, which Black elsewhere in the talk describes as something characterized by "a large number of small events." It is not completely clear what Black means here, but the talk is descriptive of many aspects of trading markets that those who trade for a living would quickly recognize.

Following are the opening lines of Black's presentation:

I use the word "noise" in several senses in this paper. In my basic model of financial markets, noise is contrasted with information. People sometimes trade on information in the usual way. They are correct in expecting to make profits from these trades. On the other

⁶Salih Neftci, *An Introduction to the Mathematics of Financial Derivatives* (New York, Academic Press, 1996). Neftci gives a simple explanation of Brownian motion and its equivalent, a Wiener process, on pages 148–149. Neftci's book is an intuitive and easy-to-read description of the role that white noise plays in modern finance.

⁷Black, "Noise," 531.

*hand, people sometimes trade on noise as if it were information. If they expect to make profits from noise trading, they are incorrect.*⁸

Black defines noise traders indirectly by what they are not. A noise trader is someone who is not trading on *information*. By information, Black implicitly means relevant and true information such as might be useful in predicting the future earnings of a publicly traded company. It is not clear from Black's description what a noise trader actually does, but it is clear what a noise trader doesn't do. Black's noise trader is not the rational, information-seeking investor that is typically portrayed in the efficient market paradigm.

In the preceding section, we defined a noise trader as someone willing to buy or sell at "incorrect" prices. In the hardball/baseball story, a noise trader would be someone willing to pay a different amount for a hardball than for a baseball even though they are the same asset. Someone who doesn't use information would fit both Black's definition and our definition. There is no way around the idea that if you want the EMH to be violated, you will need to have models that incorporate noise traders. Without them, you simply can't get identical, nonfungible things to trade at different prices.

As the father of the noise-trading concept, Black seemed little bothered by the implications of noise trading: "Noise makes financial markets possible, but also makes them imperfect."⁹

But Black goes on to say, "With a lot of noise traders in the market, it now pays for those with information to trade. . . . Most of the time, the noise traders will lose money by trading, while the information traders as a group will make money."¹⁰

After a description of how information traders move prices back to their correct value, Black concludes: "I think almost all markets are efficient almost all of the time. 'Almost all' means at least 90 percent."¹¹

Fischer Black's talk paradoxically introduced the notion of noise trading, but concludes that the EMH withstands the impact of noise traders. But Black was not the first to see things this way.

It is clear that Black shares the Friedman view, outlined earlier, and that his talk in 1985 can be interpreted as an update of the earlier Friedman position with one important caveat. Black left open the door to critics of the EMH when he observed: "In other words, I do not believe it makes sense to create a model with information trading but no noise trading where

⁸Black, "Noise," 529.

⁹Ibid., 530.

¹⁰Ibid., 530.

¹¹Ibid., 533.

traders have different beliefs and one trader's beliefs are as good as any other trader's belief."¹²

Behavioral finance would look back to the following remark as a prescient preview of the direction noise trader research would take: "Noise makes financial markets possible, but also makes them imperfect."¹³

Friedman would not have agreed with Black that noise traders played a positive and essential role in financial markets. Friedman saw such activity as foolish and mostly as a nuisance. Friedman seemed to feel that noise traders were simply sitting ducks for rational traders to take money from. Other than that, noise traders need not be considered and could not influence asset prices in any significant way. It is clear that Black's presidential address moves away from Friedman by asserting that noise traders are essential to financial markets, that they impact prices constantly, and that they cannot be left out of any serious financial market theorizing.

The Friedman-Black Path for Noise Traders

The arguments advanced by Milton Friedman and Fischer Black suggest the pathway ahead for critics of the EMH. Inserting noise traders into models of the financial system, as Black insisted upon, and dealing with what we earlier referred to as the *noise trader agenda*, could enable the existence of noise traders to pose a challenge to the presumed efficiency of financial markets.

In the following chapter we consider a financial model developed by four academics that seeks to provide the *noise trader agenda* and pose a serious theoretical challenge to the EMH.

¹² Black, "Noise," p. 531.

¹³ Ibid., 530.