Section 21.7.1 considers a range of biases exhibited by managers of firms. Many managerial decisions are of an infrequent nature (e.g., capital restructuring, mergers) that offer limited learning opportunities. These decisions are often taken under extreme uncertainty, so not only is it unclear what the optimal decision is, methods for evaluating the quality of these decisions are also vague, and subject to alternative interpretations. On account of these reasons, when outcomes are bad, managers can blame luck, but when the outcomes are good they can ascribe them to their ability levels; this is known as *attribution-bias* (Langer and Roth, 1975; Bettman and Weitz, 1983; Bertrand and Mullainathan, 2001).

Managers and CEOs are also known to exhibit a great deal of *overconfidence*, and evidence indicates that more overconfident managers, purely because they might have been lucky, rise to the top (Goel and Thakor, 2008). Due to overconfidence, managers might overvalue their firms, therefore, relying on borrowing rather than raising equity for investments (Malmendier and Tate, 2005). Overconfident managers are also more likely to merge because they are overconfident of their abilities in turning around the target firm (Roll, 1986; Malmendier and Tate, 2008; Gervais et al., 2011).

Sections 21.7.2 and 21.7.3 consider two kinds of polar possibilities. In Section 21.7.2, we consider the possibility that managers are rational, but investors are potentially irrational and draw the implications for merger activity (Shleifer and Vishny, 2003). We consider the short- and long-run impacts of acquiring a firm through three different methods: cash, stock, and outright purchase of capital. We also consider empirical evidence on three main objectives of mergers (Baker and Wurgler, 2012). These objectives are: *maximizing fundamental values*; *catering* to increase stock prices above fundamental values; and *market timing*, i.e., taking advantage of temporary stock mispricing to issue new shares or repurchase old shares. In Section 21.7.3, we consider the other polar extreme of irrational managers and rational investors. Irrationality of managers takes the form of managerial overconfidence (Gervais et al., 2011). In this context, we also clarify the role of risk aversion, manager's ability, and alternative incentive schemes.

Finally, in Section 21.7.4, we consider *behavioral corporate signaling*. Classical corporate finance explains the existence of dividends, IPO underpricing, capital restructuring, and debt as costly signals to investors of the quality of the firm (Ross, 1977; Myers and Majluf, 1984; Harris and Raviv, 1985). However, empirical evidence shows that the main reason for issuing dividends is to take advantage of temporary mispricing of securities. Indeed, survey evidence rejects the main implications of the classical signaling model in corporate finance (Brav et al., 2005). When surveyed, managers reject the idea that dividends are costly signals of the competence of firms that might reduce the value of the firm. We consider the possibility that benevolent managers may signal the underlying earnings of the firm through dividends (Baker and Wurgler, 2011). Yet these signals do not reduce the value of the firm, nor do they signal the strength of the firm.

21.2 The efficient markets hypothesis

21.2.1 *An introduction to short selling*

We shall need the standard concept of a *short position* or *shorting* to understand some of the material in this chapter. Suppose that there are two time periods, $t = 1, 2$ and that there is a single security priced at P_1 in period 1. Ignore issues of time discounting. Suppose that investor A believes that the second period price, P_2, will be lower than P_1. It makes sense for investor A to sell the security in period 1 and buy it back in period 2. For physical goods, one generally needs

to have possession of the goods before one can sell them. This is not the case for financial instruments such as securities. It is possible that another investor, say, investor B, actually possesses the security. Investor A can then ask a broker to lend him n units of the security for one period. The broker borrows n units of the security from investor B and lends it to investor A for one period.

Investor A sells the security in period 1 and receives an amount of money equal to nP_1. In the next period, period 2, investor A purchases n units of the security at a price P_2 and returns the security to investor B, through the broker. The broker, who performs the financial intermediation, much as banks do, receives a brokerage fee for the service. The profit of investor A equals $n(P_1 - P_2) \gtrless 0$. Thus investor A can make a profit if beliefs turn out to be correct, but can also make a loss if they do not. In particular, this strategy of shorting is successful only if the actual price falls; thus, shorting is typically a response to expectations of a price fall in the future. If any dividends or interest payments accrue to the security during the period that it is in the possession of investor A, then these must be passed on to investor B, via the broker. There are also regulations on which types of securities can be shorted and when.[1] Indeed, these issues were part of the regulatory response to the 2007–2008 financial crises.

In the examples below, we use the following structure. Consider only two time periods, 1 and 2, and assume that at the end of period 2, investors simply sell all shares and spend the money on consumption. Consider an investor who has a choice between buying securities either in Ford or in General Motors. Since these companies sell similar products, we should expect that they are exposed to the same *fundamental risk* (say, involving the car industry as a whole). *Idiosyncratic risk*, on the other hand, is risk that is specific to each company such as a problem that might arise with brake disks or software in one of the companies; e.g., the problem with the so-called "defeat software" in VW cars in 2015 is an example of idiosyncratic risk. We assume that ex-ante, each company carries the same idiosyncratic risk. Suppose that the fundamental value of a security in each time period for each of the two companies is \$30. Since the risk and return on securities issued by both firms is similar, they are *close substitutes*.

Example 21.29 *(Efficiency in financial markets): Let us work through an example to see how the arbitrage argument advanced by Friedman (1953) and Fama (1965), works to produce the efficient markets hypothesis. For whatever reason, say, on account of irrational investors, suppose that Ford shares drop to* \$20 *in period 1. Arbitrageurs jump on this opportunity to take a short position in GM shares. Consider an arbitrageur who borrows 6 GM shares in period 1. He sells them for* $30 \times 6 = \$180$ *in period 1 and buys* $\frac{180}{20} = 9$ *Ford shares with the money. The buying of Ford shares in this manner will continue until excess demand puts sufficient upward pressure on the price of Ford shares for them to equal the fundamental value of 30. Suppose that, as expected, on account of the activity of arbitrageurs, Ford shares revert to their fundamental value of 30 in period 2. Then the arbitrageur sells the 9 Ford shares for* $30 \times 9 = \$270$ *in period 2. Using this money he buys 6 GM shares for* $30 \times 6 = \$180$ *in period 2, which are returned back to the broker. The total profits of the investor equal* $270 - 180 = \$90$. *The efficient markets hypothesis holds because each security now equals its fundamental value; the presence of substitute securities, shorting activity, and the arbitrage activities of rational arbitrageurs are all critical to this result.*

Example 21.30 *(Substitute securities, shorting and protection from fundamental risk): The main advantage of taking a short position in a substitute security (GM in this case) is that it protects the investor from fundamental risk. To see this, suppose that in the second period, on*

[1] These and other insititutional details can picked up from any basic text on finance.

account of fundamental risk, the fundamental value of both securities unexpectedly drops to 20. *In this case, in period 2, the arbitrageur sells the 9 Ford shares for* $20 \times 9 = \$180$. *Using this money he buys 6 GM shares for* $20 \times 6 = \$120$ *in period 2, which are returned back to the broker. The total profits of the investor then equal* $180 - 120 = \$60$. *So, while fundamental risk reduces the price at which the Ford shares can be sold (fall in revenue from* \$270 *to* \$180*) it also reduces the cost of purchasing the GM shares (fall in cost from* \$180 *to* \$120*) that have to be returned back to the broker in period 2. Hence, the act of shorting, reduces the exposure of the investor to fundamental risk. However, legal constraints might prevent many investors, particularly mutual fund and pension managers from taking a short position. This exposes them to fundamental risk, hence, they might undertake insufficient arbitrage to ensure that price equals the fundamental value of the security.*

Example 21.31 *(Exposure to idiosyncratic risk remains): Taking a short position does not, however, protect the investor from idiosyncratic risk. Continue to assume the setup of Examples 21.29, 21.30. However, now suppose that in period 2, on account of idiosyncratic risk (say, recall of Ford cars because there was a problem with faulty brakes), the price of a Ford security drops to* \$20 *in period 2. The arbitrageur then sells the 9 Ford shares for* $20 \times 9 = \$180$ *in period 2. Using this money he buys 6 GM shares for* $30 \times 6 = \$180$ *in period 2, which are returned back to the broker. The total profits to the investor then equal* $180 - 180 = \$0$. *Worse, if the Ford securities drop to a price below* \$20*, the investor makes a loss.*

21.2.2 *Statement and implications of EMH*

The *efficient markets hypothesis* (EMH) has been a cornerstone in neoclassical finance. We give a brief outline of its definition and assumptions.

Definition 21.9 *EMH implies that the value of a security at any point in time equals its fundamental value, i.e., the present discounted value of all future dividends and earnings. All publicly available information is immediately incorporated into security prices. Otherwise prices would not be the same as fundamental values at some instant in time.*

The EMH rests on the following main assumptions.

- **A1:** *Rationality*: By and large, investors are assumed to be rational. In finance, rational investors are called *arbitrageurs*. Rationality has two requirements in this case.
  - (i) In response to new information, investors update their priors in a Bayesian manner.
  - (ii) When faced with a risky situation, investors have beliefs over outcomes and use subjective expected utility to evaluate the risky situation.
- **A2:** *Irrationality, if any, cancels out in the aggregate*: Any irrationality, if it exists at all, is random and so, in the aggregate, it is expected to cancel out.
- **A3:** *Irrational investors eventually exit the market*: If irrational traders bet on a price that is different from the fundamentals, then arbitrageurs will step in and make money off them. Since, irrational traders cannot continue to lose money forever, they must eventually exit the market.

How does one test the EMH? The implication of EMH is that prices should respond instantly to news that alters fundamental values. Thus, instantaneously, price should equal the new fundamental value. EMH implies the following six testable implications, T1–T6.

T1: Stale information should *not* affect current prices of securities. It must already have been incorporated into security prices on account of the activity of the arbitrageurs. Thus, past prices and returns should not affect current stock prices. This is known as the *weak form of EMH*.

T2: Any publicly available information should *not* affect current prices of securities. Such information is expected to be instantaneously incorporated into security prices. This is known as the *semi-strong form of EMH*.

T3: Investors should *not* be able to earn more than the average market profits by using information that might not be available to others (absence of *insider trading*). The expectation is that such information would be quickly picked up by other investors, wiping out any potentially abnormal profits. This is known as the *strong form of EMH*.

T4: Security prices must *not* first underreact to news about fundamental values, but then overreact to it before finally reverting to the new fundamental value, possibly over several periods.

T5: There should be *no* consistent differences in the prices of strictly substitute securities.

T6: Security prices should *not* react to *no-news*, i.e., news that is unrelated to fundamental values.

21.2.3 *Evaluating the theoretical case for EMH*

We first catalog, informally, some theoretical objections to the EMH that are treated more formally in subsequent sections.

1. *Availability of substitute securities*: Substitute securities are not always available.[2] The existence of such securities is essential to the argument for EMH because they allow investors to take a short position and, hence, protect themselves from fundamental risk (Examples 21.29, 21.30). The absence of substitute securities and fears of inability to insure against fundamental risk might dissuade arbitrageurs from undertaking the right level of economic activity that is required to ensure that prices of assets equal fundamental values.
2. *Investor sentiment and judgment heuristics*: The EMH assumes that investors use Bayes' rule to update their priors. Our discussion of judgment heuristics in Chapter 19 suggests that investors often do not use Bayes' rule correctly (e.g., base rates are underweighted). People are known to assign confidence intervals to their estimates that are too narrow and 90% of those surveyed report that they have above-average levels of intelligence and emotional ability.[3] At the same time, individuals can be too cautious and underestimate the likelihood of the sample. This is known as *conservatism* (see Chapter 19).
   In other contexts, individuals rely on *representativeness* and exhibit the law of small numbers. People use the *availability heuristic*, relying on their memory for the available information. However, all memories are not equally retrievable or salient. For instance, more recent events and more unusual events might be more salient and more retrievable, which can result in individual actions being biased. Any departure from Bayesian rationality, typically on account of judgment heuristics, is termed as *investor sentiment*. Other names for such investors include *unsophisticated investors* (Kyle, 1985) and *noise traders* (Black, 1986).

[2] See, Figlewski (1979), Roll (1988), Campbell and Kyle (1993). For a review see Shleifer (2000), Barberis and Thaler (2003).

[3] See Weinstein (1980) for an early study and Barberis and Thaler (2003) for references to the subsequent literature.

In example 21.29, suppose that the decrease in the original price of Ford securities in period 1 from \$30 to \$20 is caused by investor sentiment, say, noise traders. Arbitrageurs (or rational traders) then face an additional risk when they "short" GM securities. Namely, that investor sentiment may get worse in period 2. This problem may become even more serious due to the presence of *positive feedback traders*, i.e., traders who base their decision to buy an asset only if it performed well last period (De Long et al., 1990b). Following the lead of noise traders, such investors may be even more reluctant to buy Ford securities in period 2, increasing the downward pressure on Ford securities. Thus, mispricing of Ford securities in the first period, caused by investor sentiment, may persist in period 2.

In this case, Ford shares do not revert to their fundamental value of 30 in period 2. Suppose that on account of noise traders and positive feedback traders, the period 2 price of Ford securities turns out to be 15. In the two-period setup of Example 21.29, the arbitrageur sells the 9 Ford shares for $15 \times 9 = \$135$ in period 2. The investor then needs to purchase the 6 GM shares which cost $30 \times 6 = \$180$ in order to return them back to the broker. The total profits of the investor equal $135 - 180 = -\$45 < 0$. This is the risk created on account of noise traders and positive feedback traders, which might well limit arbitrage.

Indeed, if arbitrageurs can see through the behavior of noise traders then they might take actions that bet on mispricing getting worse. It might also be the case that noise traders take a long time to lose money and to exit the market. The result could be that arbitrageurs liquidate their positions before noise traders can exit the market because they cannot hold on to their positions for too long (Figlewski, 1979). This takes away the normal countervailing effect of arbitrageurs to bring price back in line with fundamental values; Section 21.3 below formalizes these issues. This simple example also demonstrates the dangers of holding on to entrenched positions, based on purely ex-ante plausibility, such as the following arguments given to undergraduate students in economics. (1) If there are any irrational agents, then rational agents will make money off them and drive them out of the market. (2) Any irrationality in the market cancels out in the aggregate. The work on judgment heuristics (Chapter 19) rejects this assumption. It shows that laypersons and experts have persistent and *systematic biases*. Hence, the probability that such errors point in the same direction, rather than canceling out, is much greater, with serious implications for financial stability.

Noise traders is not just a theoretical construct. Consider the evidence from the market price of shares in closed-end funds. The manager of a closed-end fund raises a fixed initial amount of money towards a fund. Additional money can neither be added to, nor withdrawn from the fund, although shares in the fund trade actively in the stock market. EMH predicts that the market price of a security in the fund should equal the net asset value (NAV) of the fund. However, systematic differences between the market price and NAV were found by Lee et al. (1991). To get some idea of these differences, consider the updated figures from Thaler (2015) drawn from closed-end funds: Shares in Gabelli Utility Trust sold at a premium of 18.2% over the NAV, while shares in Firsthand Technology Val sold at a discount of 37.4%.

Lee et al. (1991) also provide evidence to explain the following four *closed-end fund puzzles* that cannot be accounted for by classical models in finance. At the time of starting the fund, security prices trade at a sizable premium of about 7% due to start-up costs and underwriting costs. Within six months, the fund trades at a discount of 10%. There is

substantial variation in the premia and discounts over time. However, when there is a merger or liquidation or conversion of the fund to an open-end fund (to which money can be added and withdrawn), the market price converges to the NAV. Why do these systematic patterns of returns persist if all market participants are rational?

It turns out that the closed-end puzzles can be explained by the existence of noise traders. The basic idea is that individual investors are more likely to invest in the shares of small firms (which includes closed-end funds), relative to larger institutional investors. Thus, insofar as investor sentiment is more likely to be exhibited by small investors rather than institutional investors, the time variation of investor sentiment is likely to be reflected in the relative stock performance of small and large companies. Lee et al. (1991) were able to show that they could correlate well the premium/discount in the security prices of closed-end funds with the difference between the performance of small and large companies. For more empirical evidence on noise traders and a detailed discussion of the closed-end fund puzzles, see Shleifer (2000).

In addition to incompatibility with Bayes' rule and choosing on the basis of representativeness, or anchoring, several other forms of investor sentiment have been documented. Hindsight bias can lead to underestimation of financial volatility (Biais and Weber, 2009). In order to be induced to hold stocks, sellers must offer too high a premium on equities relative to bonds; this is known as the equity premium puzzle (Benartzi and Thaler, 1995). Investors also hold on to losing stocks for far too long and sell winning stock too early relative to the predictions of standard theory; this is known as the *disposition effect* (Odean, 1998). Both these phenomena can be explained using prospect theory (see Part 1 of the book). Benartzi and Thaler (1995) also demonstrate the importance of *framing effects* on investor choice. In particular, the decision of investors to buy stock depends on whether news about the performance is presented as *high, long-term, returns* or a *more finely presented series of fluctuating short-term stock returns*.

The following quote from Shleifer (2000, p. 10) illustrates a set of other judgment heuristics and biases that run contrary to the assumption of EMH, further undermining the theoretical case for EMH:

> . . . it is difficult to sustain the case that people in general, and investors in particular, are fully rational. At the superficial level, many investors react to irrelevant information . . . Investors follow the advice of financial gurus, fail to diversify, actively trade stocks and churn their portfolios, sell winning stocks and hold on to losing stocks thereby increasing their tax liabilities, buy and sell actively and expensively managed mutual funds, follow stock price patterns and other popular models. In short, investors hardly pursue the passive strategies expected of uninformed market participants by the efficient market theory.

Heuristics also explain why there is far too much trading and churning of assets. Thaler (1999) reports that 700 million shares are traded on the NYSE. For 2005, Hong and Stein (2007) give a figure of $51 trillion in trading volume for the 50 members of the World Federation of Exchanges. This is too large a volume to be plausibly explained by classical theories in finance. Barber and Odean (2000) show empirically that there is far too much trading relative to a rational benchmark. Indeed, in their sample, and after taking account of trading costs, investors would have done better by trading less. Furthermore, in one possible manifestation of overconfidence, investors who traded the most, earn the lowest average returns.

The phenomenon of too much trading by market participants is different from the puzzle of limited stock market participation. Given the relatively high mean rates of returns, why are so many potential investors unwilling to invest? Barberis et al. (2006) argue that the answer lies in narrow framing of options in which individuals segregate stock market returns from other sources of income. Once this is assumed, then they invoke the tendency of individuals to reject small gambles, even those that are actuarially favorable (Tversky and Kahneman, 1992). Thus, a combination of first order risk aversion and narrow framing provides one possible rationalization of the puzzle of stock market participation.

Expected utility theory underpins EMH. In the general case under risk, the formula—prices of stocks equal the present discounted value of future dividends—relies on a first order linear stochastic difference equation that exploits the arbitrage relation between the returns on safe and risky assets (Blanchard and Fischer, 1989, ch. 5). We have seen in Part 1 of the book that, contrary to expected utility theory, the bulk of the empirical evidence supports *non-linear probability weighting*. In particular, individuals overweight small probability events and underweight high probability events. Furthermore, individuals may often think that an event is more probable than it actually is, e.g., the probability of an air-crash. In stock markets, overconfidence is a particularly salient factor that might cause *overassignment of probabilities*.

These two misperceptions (non-linear probability weighting and overassignment) have several implications that are studied under the emerging topic of the *psychology of tail events*. An important implication is that the market will price skewness in asset returns (Barberis and Huang, 2008). Suppose that the return on an asset is positively skewed. Then there is a small probability that the investor will earn very high returns. On account of the two misperceptions mentioned above, the demand for such assets is higher than it should ideally be, pushing up the prices and reducing the average returns. Empirical evidence is supportive of this prediction (Boyer et al., 2010). These ideas can also be used to explain the equity premium puzzle (De Giorgi and Legg, 2012): The two misperceptions lead investors to overestimate and overweight the small probability of a stock market crash, hence, they demand a premium for holding stocks relative to bonds.

In Part 1 of the book we documented two kinds of behaviors for very low probabilities; the first, overweighting of small and underweighting of large probabilities has been mentioned above. A second kind of behavior arises when we approach even lower probabilities; these extremely low probabilities are either underweighted or simply ignored (e.g., we do not scurry around to get insurance against an asteroid hitting us). This explains why individuals are reluctant to purchase insurance for low probability natural hazards and a host of other behaviors (see Part 1 for details). Taleb (2007) draws attention to this kind of behavior in his book, *The Black Swan*, where individuals assign very low probabilities to tail events. In this case, the misperceptions are the exact opposite of the two misperceptions reported above.

How do we know which of the two sets of misperceptions (overweighting or underweighting of very small probabilities) applies? A plausible suggestion is that the availability heuristic may help distinguish between the two cases (Barberis, 2013). Events that are rare and unusual do not bring to mind similar instances. Thus, individuals might have underweighted the probability of the stock market crash of 2008 because they could not recall how events similar to 2005 and 2006 led to a crash in the past.

3. *Professional arbitrageurs*: In actual practice, there are a large number of small and dispersed investors. Professional arbitrageurs typically make the bulk of their investments in financial markets on behalf of these small investors; we may term this as the *separation of brains and capital* (Shleifer and Vishny, 1997). Several features of the operation of professional arbitrageurs are relevant for the success of EMH. These mainly arise from the inability of dispersed and small investors to fully comprehend the operations of financial markets; thus, they rely on indirect signals of the ability of professional arbitrageurs. Among the indirect signals used by small investors are the following. (1) The end of year reports on the performance of professional arbitrageurs. (2) How well one professional manager does relative to another? (3) The performance of professional arbitrageurs relative to some publicly observed target, such as the S&P 500 Index.
   Each of these features creates serious distortions. Feature (1) often forces professional arbitrageurs to liquidate their positions in a loss making asset too quickly, even when holding on to such a position would have been beneficial in the longer run. This makes it difficult to counter the activity of noise traders.
   Feature (2) induces professional arbitrageurs to invest in similar assets so that each can avoid looking worse than each other; this is a form of *herding behavior* (Scharfstein and Stein, 1990). Feature (3) induces professional arbitrageurs to choose portfolios whose returns are closely aligned to the S&P 500 Index. There is some evidence that these distortions reduce the performance of professional arbitrageurs below that of passive investment strategies (Ippolito, 1989; Lakonishok et al., 1992).

To these factors, one could add transaction costs of arbitrage which might prevent market efficiency. Transaction costs include the cost of finding information about which shares are mispriced relative to their fundamental values, as well as the brokerage fees for taking a short position (D'Avolio, 2002).

21.2.4 *The empirical evidence on efficiency of financial markets*

The early evidence in the 1960s till about the mid 1970s repeatedly confirmed the EMH (Fama, 1965, 1970; Jensen, 1978). It focused mostly on T1 and T2 above, i.e., the weak and the semi-strong forms of the EMH. Fama (1965) found that stock prices approximately follow a random walk. Fama et al. (1969) suggested the use of *event studies* to test for the EMH and these became very popular. The basic idea was to focus on a particular event. For instance, the announcement of earnings or dividends, news of a takeover or divestiture, news about the issue of new shares or repurchases of existing shares, and other news about changes in management or of management strategy. Researchers then checked to see if there was an effect on security prices, subsequent to these events, as information became stale. The expectation was that the effect of the news would be incorporated immediately, or even prior to the announcement of news. The results were predominantly supportive of the EMH; see Fama (1970) for a review.

Since the late 1970s there have been serious challenges to the EMH. The theoretical and empirical objections have not only focused on T1 and T2 above, but also on T3–T6. Unfortunately for the EMH, and despite econometric and data caveats, all of the implications in T1 to T6 were not only rejected, but the theoretical case for them was found to be on shaky ground (Shleifer, 2000; Barberis and Thaler, 2003). We have considered some elements of the theoretical case in Section 21.2.3 above and more details are considered later, but in this section we focus on the empirical evidence.

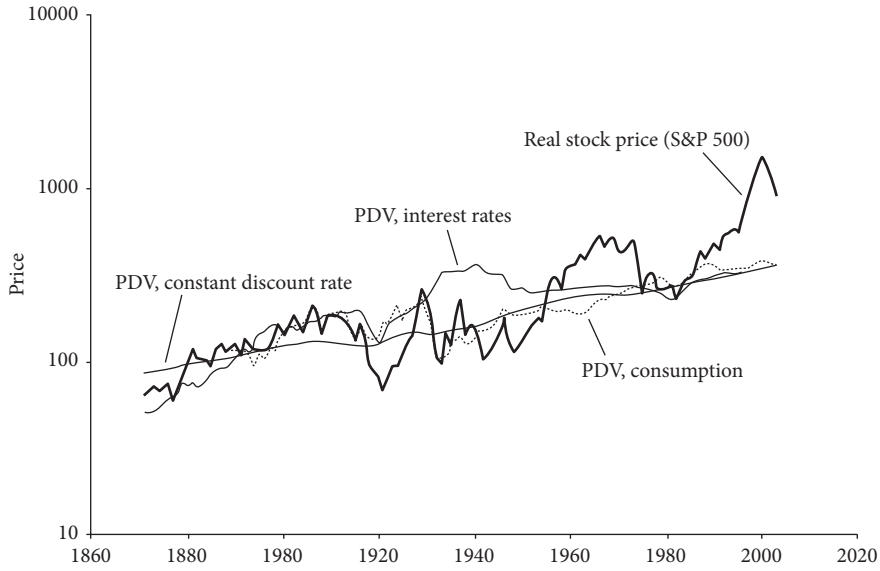

Figure 21.1 A plot of price and dividends against time.
Source: Shiller (2003) with permission from the American Economics Association.

The empirical evidence against EMH has been extensively documented.[4] Shiller (1981) provided an early empirical challenge to the EMH. He found *excess volatility* in stock prices that could not be explained by fundamental values. Denote by P_t, the price of a stock at time t, by I_t the information set at time t, and by $E[D \mid I_t]$ the conditional expected present value of subsequent dividends. Then the EMH states that $P_t = E[D \mid I_t]$, or $P_t = D + u_t$, where u_t is a mean zero random variable. Thus,

$$D = P_t - u_t. \tag{21.1}$$

Under EMH, all information is incorporated in prices, thus, u_t and P_t are uncorrelated. Denoting by $V(x)$, the variance of x, (21.1) implies that:

$$V(D) = V(P_t) + V(u_t). \tag{21.2}$$

Since variances are non-negative, it follows that an implication of EMH is

$$V(P_t) \leq V(D). \tag{21.3}$$

A plot of P_t and D against time is shown in Figure 21.1; these variables are labeled respectively as "Real Stock Price (S&P 500)" and "PDV, Constant Discount Rate." D was proxied by the present value of actual dividends paid in the following year. From Figure 21.1, it is evident that $V(P_t) >$

[4] There are several good surveys; see, for instance, Shleifer (2000), Barberis and Thaler (2003), Subrahmanyam (2008), and Barber and Odean (2013). There are two textbook treatments that use a behavioral economics perspective to cover a wide terrain in behavioral finance; see Akerlof and Shiller (2008) and Shiller (2015).

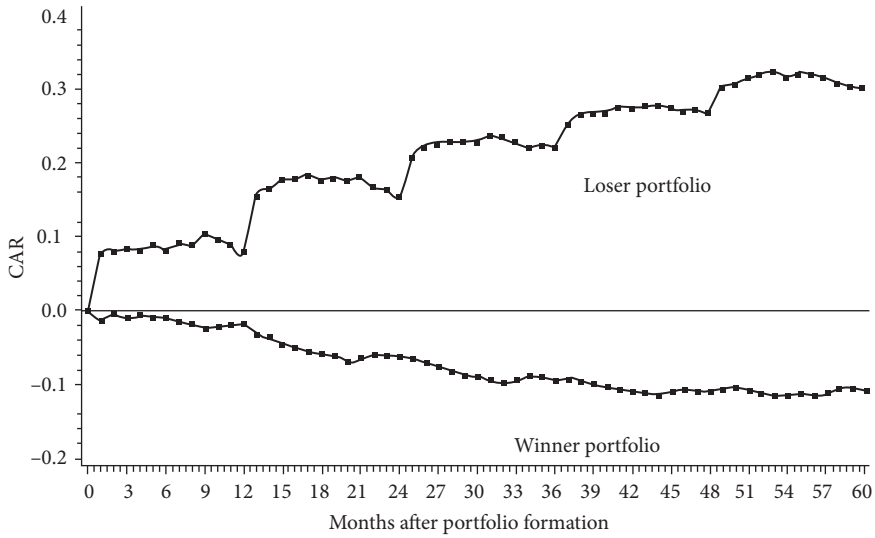

Figure 21.2 Cumulative average residuals for *W* and *L* portfolios of 35 stocks.

Source: De Bondt, W. F. M. and Thaler, R. (1985). "Does the stock market overreact?" *The Journal of Finance* 40: 793–805. © American Finance Association. With permission from John Wiley & Sons.

V (*D*), contradicting EMH. In other words, there is excessive stock price volatility relative to the predictions of the theory. This should not come as a surprise to behavioral economists. Stock market decisions are often likely to be based on investor sentiment and behavioral features that create another source of price volatility; these factors are not taken into account under classical finance. These results were challenged by Marsh and Merton (1986), mainly in terms of the proxies used for D and P_t as well as issues of time-invariant interest rates. However Shiller's basic result was borne out by several papers that strove to address the Marsh and Merton (1986) critique (Barberis and Thaler, 2003).

The weak form of EMH is contradicted by several studies. De Bondt and Thaler (1985) look at the performance of winners (W) and losers (L), over the past three years, on the New York Stock Exchange over the time period 1926–1982. They then compute the returns on W and L stocks for the following five years, controlling for the relative risks of the two stocks. They find that W stocks and L stocks give, respectively, low and high subsequent returns. They explain their results by positing that the stock prices have overreacted in the past. The returns on W (respectively, L) stocks overshot (respectively, undershot) their fundamental values. The result is that the market gradually corrects for the mispricing. This directly contradicts weak form EMH because past performance is able to predict future returns. Figure 21.2 plots the "cumulative average residuals" for Winner and Loser portfolios of 35 stocks over five years (60 months); for any asset, the residual is an estimate of the difference between the return on the asset and the market portfolio.

Similar arguments can be used to explain why companies with high *market to book value ratios* (MBVR) in the past do worse in the future (De Bondt and Thaler, 1987; Fama and French, 1992; Lakonishok et al., 1994). Stocks of such companies are also sometimes called *glamour stocks*. A high MBVR in the past could indicate overreaction, which is gradually corrected in the future by a drop in stock prices. This contradicts weak-form EMH because stale information on MBVR helps to predict future returns.

One response in classical finance has been to interpret the MBVR as a measure of fundamental risk of a company. Hence, a high MBVR is associated with higher risk and lower subsequent returns (Fama and French, 1993, 1996a). However, not everyone is persuaded by the interpretation of MBVR as a measure of fundamental risk (Lakonishok et al., 1994; Mackinlay 1995; Daniel and Titman, 1997).[5]

Another violation of the weak form of EMH is the *momentum effect* (Jegadeesh and Titman, 1993). They classify portfolios into deciles based on performance in the previous six months. The main finding is that portfolios in the top deciles in the previous six months give about 10% higher returns relative to those in the bottom deciles for the next six months.[6] They consider a trading strategy that buys past winners and sells past losers. This strategy earns a compounded excess annual return of 12.01% on average.

The semi-strong form of the EMH is contradicted by several pieces of evidence. EMH requires public news to be immediately reflected in stock prices. However, there is evidence of a *post-earnings-news drift*; prices move in the same direction as the initial public news (up if the news is good and down if it is bad) for a significant amount of time. This post-public-news drift is well documented for a range of public news such as earnings news (Bernard and Thomas, 1989, 1990; La Porta et al., 1997), share repurchase news (Ikenberry et al., 1995), stock issue news (Loughran and Ritter, 1995; Spiess and Affleck-Graves, 1995), and new dividend issues (Michaley et al., 1995).

Another piece of evidence comes from the *January effect*. Using data over the period 1904–1974, Rozeff and Kinney (1976) find that the average stock market returns during the month of January were 3.48%, compared with an average monthly return of 0.42% during the remaining 11 months of the year, which is eight times higher. The January effect is found in many other studies (De Bondt and Thaler, 1985). Rozeff and Kinney used an equally weighted index of New York Stock Exchange prices, hence, their results could have been caused by the overweighting of small firms. This was confirmed by Reinganum (1983). The January effect cannot be fully explained by risk considerations and issues of tax liability. Since the company size and the time of the year are both public information, this evidence contradicts the semi-strong form of EMH.

EMH requires prices of strictly substitute securities to show no consistent differences (see T5 above). This is rejected by the evidence (Lamont and Thaler, 2003). This evidence is immune to the Fama (1970) critique mentioned above. Froot and Dabora (1999) examine the share prices of large *Siamese twin* companies. These are companies that (i) have merged at some point in the past, but operate in geographically separate areas, and (ii) pool their cashflows, but each twin retains its own stock. So if companies A and B are Siamese twins who have merged on an $x : y$ basis ($x + y = 1$), then shares in company A are a claim to x% of the total cashflows of the merged company. If, as EMH suggests, prices of shares equal fundamental values, then the ratio of share prices of companies A and B should also be in the proportion $x : y$.

Froot and Dabora (1999) examine three pairs of Siamese Twins. (1) Royal Dutch Petroleum and Shell Transport and Trading, PLC. (2) Unilever NV and Unilever PLC. (3) SmithKline Beecham. Rosenthal and Young (1990) had already shown that there is a significant departure of the relative

[5] A more satisfactory objection is that the book value might not adequately capture the fundamental value of the firm. For instance, firms that have excellent future growth prospects have high book to market values; in contrast those that are perceived to face agency problems have low book to market values. For attempts to construct a better measure of MBVR, but in the context of merger decisions of firms, see Ang and Cheng (2006) and Dong et al. (2006).

[6] Grinblatt and Moskowitz (2004) use tax factors to explain a part of the momentum effect. However, tax factors cannot explain the momentum effect in its entirety.

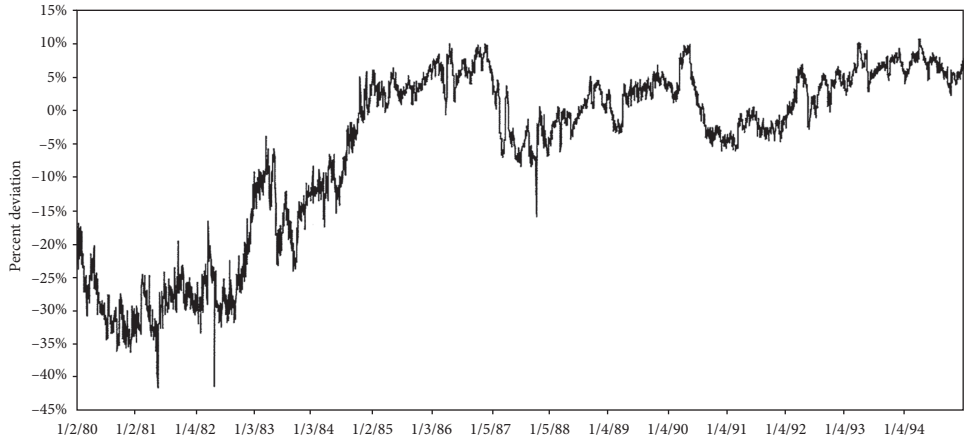

Figure 21.3 Log deviations of prices from the predicted 1.5 : 1 ratio for Royal Dutch and Shell Transport.
Source: Reprinted from *Journal of Financial Economics* 53(2): 189–216. Kenneth A. Froot and Emil M. Debora. (1999). "How are stock prices affected by the location of trade?" Copyright © 1999, with permission from Elsevier.

share prices of Royal Dutch-Shell and Unilever NV and Unilever PLC from the predicted ratio under EMH. Froot and Dabora report two main findings:

(a) Traded price is rarely in the proportion $x : y$, contradicting the EMH. Consider, for instance, Royal Dutch and Shell Transport, which merged in 1970 on a 60:40 or 1.5:1 basis. So a share in Royal Dutch is a claim to 60% of the cash flow of the merged companies. The percent deviations of the ratio of prices from the predicted 1.5:1 basis are significant and shown in Figure 21.3. Similar disparities are reported for all three pairs of companies in Froot and Dabora.

(b) The price of the stock of each twin is highly correlated with the market index shares where the twin predominantly trades. For instance, when the US stock market performs relative to the UK market, then share prices of Royal Dutch, predominantly traded on the US stock market, rise relative to Shell, which is predominantly traded in the UK market. The same effect is obtained when the US dollar appreciates against the British pound.

A corollary of T5 is that controlling for the degree of differences in assets, their returns should be similar. However, the well-known equity premium puzzle (see Part 1 of the book), is a counterexample. Stocks are riskier than bonds, however, the 7% a year premium on stocks over bonds, averaged over a sufficiently long period, is too large to be explained, even accounting for the level of risk (Mehra and Prescott, 1985; Benartzi and Thaler, 1995).

Finally, we turn to the last implication of EMH that security prices should *not* react to no-news (see T6 above). The stock market crash of 1987, in which the Dow Jones fell by 22.6%, did not follow any apparently relevant news. Cutler et al. (1991) find that no major news accompanied the 50 largest one-day stock price movements since World War II. A corollary of T6 is that prices of stocks should not be affected by factors that are unrelated to fundamentals; for the evidence from Treasury bills see Duffee (1996), Krishnamurthy (2002), and Greenwood and Vayanos (2010).

Evidence relevant for T6 also comes from the inclusion of new stocks into the S&P 500 index. From time to time, some of the existing stocks in the index are withdrawn because, say, companies merge or are taken over. New stocks are then used to replace the withdrawn stocks with the objective of maintaining the representativeness of the index. The EMH predicts no change in the price of the stock that has been newly inducted into the index. The reason is that the induction, per se,

does not convey any new information about the company that was not available earlier. However, the evidence is that there is substantially increased trading in the freshly inducted stocks, contradicting T6; see, for instance, Harris and Gurel (1986), Shleifer (1986), Wurgler and Zuravskaya (2002).

Another piece of evidence comes from the literature on bubbles/sunspots in asset prices (Shiller, 2003). Speculative bubbles could cause departures of the price of an asset from fundamental values. However, as this departure worsens, the situation becomes unsustainable. Investors start expecting a reversion of prices towards the fundamental value. When the bubble bursts, there is a large change in the price of the asset without any apparent news. Similarly, stock prices often react to an announcement of an increase, or an initiation of dividends when such events convey no new news about fundamentals. The traditional explanations have sometimes relied on "dividends as a signaling device." However, see Benartzi et al. (1997) who do not find any evidence that a dividend increase signals future changes in earnings.

For most investors, it is very hard to beat the stock market. For instance, Malkiel (1990) points out that, on average, mutual and pension fund managers are not able to beat passive investment strategies. This would, on the face of it, seem to rescue the EMH (Rubinstein, 2001). However, as Barberis and Thaler (2003) point out, on closer examination, this just turns out to be a confusion between necessary and sufficient conditions. The EMH implies that

$$\text{"Prices equal fundamental values} \Rightarrow \text{no arbitrage opportunities."}$$

However, the absence of arbitrage opportunities is only a necessary, but not sufficient condition for stock prices to equal fundamental values. Hence,

$$\text{"No arbitrage opportunities} \not\Rightarrow \text{prices equal fundamental values."}$$

Thus, the lack of success of actual fund managers in beating the stock market cannot be taken as evidence that prices equal fundamental values, or that the EMH holds.

The rejection of EMH has not gone unchallenged; see for instance Fama (1970). News that is favorable for returns might also be associated with changes in the risk from holding the security. So we need a model that incorporates both risk and return (the capital asset pricing model is one such model). Suppose that for some security, the level of return and exposure to risk go up following some news about the security. Furthermore, suppose we observe that prices are below fundamental values, yet sufficient arbitrage activity does not take place. The Fama (1970) critique would imply that we do not see enough arbitrage precisely because the security is more risky now and the higher return justifies the greater risk. So there is no need for further arbitrage to put downward pressure on the return.

Every empirical finding that is contrary to the EMH could then be challenged on this technical ground. However, this possibility was already checked for in the results of stock market underreaction and overreaction by De Bondt and Thaler (1985), reported above. They measured risk using the then dominant model in finance, the capital asset pricing model (CAPM), under which the only risk relevant for the pricing of an asset is the covariance of the stock returns with the market portfolio; the correlation between the two is called "beta." They found the beta value for winners to be 1.37 and the beta value for losers to be 1.03. Thus, losers were actually less risky than winners, which goes in the reverse direction to Fama's critique. Beginning with a series of papers in the early 1990s, written by Fama and French, the response in classical finance has been to debunk the CAPM model (Fama and French, 1996a,b). Fama and French went on to construct

three factor and five factor models with additional explanatory variables that were proposed to give a better measure of risk, but it is not clear if these models are supported by the empirical evidence (Fama and French, 2015).

It is worthwhile to review some of the evidence of the success, or lack of it, of individual investors in beating the stock market. In general, the evidence suggests that, on average, individual investors earn below market rates of pre-tax return on investments, whether one takes account of transaction costs or not. However, for very short run investments, say, a week, the performance of individual investors is better, at least based on US data. This evidence is nicely summarized in Barber and Odean (2013) that we draw on here.

Based on the trading records of 10,000 investors, Odean (1999) gave evidence documenting below-average returns of individual investors in the absence of transaction costs of trade. Barber and Odean (2000) replicate these results in the presence of transaction costs from the trading records of 78,000 investors. Their main findings are as follows. First, transaction costs are the main reason for the underperformance of individual investors relative to the market. Second, those investors who traded more are, on average, more likely to realize lower returns. For instance, the difference in annual rates of return between the 20% of investors who trade the most and the 20% who trade the least, is 7 percentage points.

These results have been widely replicated in other countries. For holding periods ranging from a day to six months, Barber, Lee, et al. (2009) examine trading data from Taiwan over 1995–1999. Individual investors buy stocks that subsequently perform poorly and sell stocks that subsequently perform strongly. The behavior of institutional investors is the opposite, suggesting poor stock picking skills on the part of individual investors. Grinblatt and Keloharju (2000) show, for Finnish data, that individual investors earn low returns. Furthermore, they have poor stock selection abilities. They are net buyers of stocks that have weak future performance, while institutional investors are net buyers of stocks that do well subsequently. Poor stock selection ability of individual investors is also found for US data (Hvidkjaer, 2008; Barber, Odean, and Zhu, 2009).

For investments over a short horizon, say, one week, the evidence from the US suggests that individual investors perform quite well (Barber, Odean, and Zhu, 2009; Kaniel et al., 2012; Kelly and Tetlock, 2013). However, these results are not supported by Taiwanese data (Andrade et al., 2008; Barber, Lee, et al., 2009). For Finland, empirical evidence suggests that investors make losses on limit orders[7] but gains on market orders (Linnainma, 2010), but the opposite result is found for Taiwan (Barber, Lee, et al., 2009).

There is substantial heterogeneity in investors' skills. There is some evidence that there might be a positive correlation between cognitive skills and investor performance (Korniotis and Kumar, 2013; Grinblatt et al., 2012) and a negative correlation between age and investor performance (Korniotis and Kumar, 2009). A strong gender effect has been noted by Barber and Odean (2001) who report two main findings. First men trade more than women. Second, those who trade more earn lower profits. Gender effects on the extent of trading are found for Germany, although these are weakened once we take account of risk aversion (Dorn and Huberman, 2005).

Men are often found to be more overconfident than women in empirical studies. This is one possible reason why men trade more and so realize lower returns (Glaser and Weber, 2007; Grinblatt and Keloharju, 2009). Evidence from US data indicates a strong correlation between self-reported measures of competence and the extent of trading (Graham et al., 2009).

[7] A limit order is an order placed with a brokerage firm to buy or sell a fixed number of shares at a specified price or better.