THE EFFICIENT MARKET HYPOTHESIS: A SURVEY

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Abstract

The efficient market hypothesis states that asset prices in financial markets should reflect all available information; as a consequence, prices should always be consistent with 'fundamentals'. In this paper, we discuss the main ideas behind the efficient market hypothesis, and provide a guide as to which of its predictions seem to be borne out by empirical evidence, and which do not. In examining the empirical evidence, we concentrate on the stock and foreign exchange markets.

The efficient market hypothesis is almost certainly the right place to start when thinking about asset price formation. The evidence suggests, however, that it cannot explain some important and worrying features of asset market behaviour. Most importantly for the wider goal of efficient resource allocation, financial market prices appear at times to be subject to substantial misalignments, which can persist for extended periods of time.

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1. Introduction

The efficient market hypothesis is concerned with the behaviour of prices in asset markets. The term 'efficient market' was initially applied to the stockmarket, but the concept was soon generalised to other asset markets.

In this paper, we provide a selective review of the efficient market hypothesis. Our aim is to discuss the main ideas behind the hypothesis, and to provide a guide as to which of its predictions seem to be borne out by empirical evidence, and which do not. In examining the empirical evidence, we concentrate on the stock and foreign exchange markets, though much of the discussion is relevant to other asset markets, such as the bond and derivatives markets.

The vast majority of the empirical work on the efficient market hypothesis in the stock and foreign exchange markets has been done using data on the US stockmarket and on exchange rates against the US dollar. Our review also has this focus. US markets are probably the deepest and most competitive financial markets in the world, so they provide a favourable testing ground for the efficient market hypothesis.

The next section of the paper provides a concise definition of the hypothesis, and discusses some of the subtleties involved in defining an efficient market. The following section, which forms the bulk of the paper, turns to the predictions of the efficient market hypothesis, and discusses how they hold up when confronted with the empirical evidence on asset market behaviour. The paper ends with a brief discussion and conclusion.

2. The Efficient Market Hypothesis

When the term 'efficient market' was introduced into the economics literature thirty years ago, it was defined as a market which 'adjusts rapidly to new information' (Fama *et al* 1969).

It soon became clear, however, that while rapid adjustment to new information is an important element of an efficient market, it is not the only one. A more modern definition is that asset prices in an efficient market 'fully reflect all available information' (Fama 1991). This implies that the market processes information rationally, in the sense that relevant information is not ignored, and systematic errors are not made. As a consequence, prices are always at levels consistent with 'fundamentals'.

The words in this definition have been chosen carefully, but they nonetheless mask some of the subtleties inherent in defining an efficient asset market.

For one thing, this is a strong version of the hypothesis that could only be literally true if 'all available information' was costless to obtain. If information was instead costly, there must be a financial incentive to obtain it. But there would not be a financial incentive if the information was already 'fully reflected' in asset prices (Grossman and Stiglitz 1980). A weaker, but economically more realistic, version of the hypothesis is therefore that prices reflect information up to the point where the marginal benefits of acting on the information (the expected profits to be made) do not exceed the marginal costs of collecting it (Jensen 1978).

Secondly, what does it mean to say that prices are consistent with fundamentals? We must have a model to provide a link from economic fundamentals to asset prices. While there are candidate models in all asset markets that provide this link, no-one is confident that these models fully capture the link in an empirically convincing way. This is important since empirical tests of market efficiency – especially those that examine asset price returns over extended periods of time – are necessarily joint tests of market efficiency and a particular asset-price model. When the joint hypothesis is rejected, as it often is, it is logically possible that this is a consequence of deficiencies in the particular asset-price model rather than in the efficient market hypothesis. This is the 'bad model' problem (Fama 1991).

Finally, a comment about the word 'efficient'. It appears that the term was originally chosen partly because it provides a link with the broader economic concept of efficiency in resource allocation. Thus, Fama began his 1970 review of the efficient market hypothesis (specifically applied to the stockmarket):

> The primary role of the capital [stock] market is allocation of ownership of the economy's capital stock. In general terms, the ideal is a market in which prices provide accurate signals for resource allocation: that is, a market in which firms can make production-investment decisions, and investors can choose among the securities that represent ownership of firms' activities under the assumption that securities prices at any time 'fully reflect' all available information.

The link between an asset market that efficiently reflects available information (at least up to the point consistent with the cost of collecting the information) and its role in efficient resource allocation may seem natural enough. Further analysis has made it clear, however, that an informationally efficient asset market *need not* generate allocative or production efficiency in the economy more generally. The two concepts are distinct for reasons to do with the incompleteness of markets and the information-revealing role of prices when information is costly, and therefore valuable (Stiglitz 1981).

3. The Predictions of the Efficient Market Hypothesis

The efficient market hypothesis yields a number of interesting and testable predictions about the behaviour of financial asset prices and returns. Consequently, a vast amount of empirical research has been devoted to testing whether financial markets are efficient.

While the 'bad model' problem plagues some of this research, it is possible to draw important conclusions about the informational efficiency of financial markets from the existing body of empirical research. This section presents a selective survey of the evidence. Our conclusions are summarised in the table and explained in more detail in the pages that follow.

Predictions of the Efficient Market Hypothesis	
Prediction	Empirical Evidence
Asset prices move as random walks over time.	Approximately true. However: Small positive autocorrelation for short-horizon (daily, weekly and monthly) stock returns. Fragile evidence of mean reversion in stock prices at long horizons (3–5 years).
New information is rapidly incorporated into asset prices, and currently available information cannot be used to predict future excess returns.	New information is usually incorporated rapidly into asset prices, although there are some exceptions. On current information: In the stockmarket, shares with high returns continue to produce high returns in the short run (*momentum effects*). In the long run, shares with low price-earnings ratios, high book-to-market-value ratios, and other measures of 'value' outperform the market (*value effects*). In the foreign exchange market, the current forward rate helps to predict excess returns because it is a biased predictor of the future exchange rate.
Technical analysis should provide no useful information	Technical analysis is in widespread use in financial markets. Mixed evidence about whether it generates excess returns.
Fund managers cannot systematically outperform the market.	Approximately true. Some evidence that fund managers systematically underperform the market.
Asset prices remain at levels consistent with economic fundamentals; that is, they are not misaligned.	At times, asset prices appear to be significantly misaligned, for extended periods.

3.1 Do Asset Prices Move as Random Walks?

Asset prices in an efficient market should fluctuate randomly through time in response to the unanticipated component of news (Samuelson 1965). Prices may exhibit trends over time, in order that the total return on a financial asset exceeds the return on a risk-free asset by an amount commensurate with the level of risk

undertaken in holding it. However, even in this case, fluctuations in the asset price away from trend should be unpredictable.[1]

This section examines the empirical evidence for this 'random walk hypothesis' for stock prices.[2] On balance, the evidence suggests that that the hypothesis is at least approximately true. While stock returns are partially predictable, both in the short run and the long run, the degree of predictability is generally small compared to the high variability of returns.

In the aggregate US sharemarket, above-average stock returns over a daily, weekly or monthly interval increase the likelihood of further above-average returns in the subsequent period (Campbell, Lo and MacKinlay 1997). However, for example, only about 12 per cent of the variance in the daily stock price index can be predicted using the previous day's return. Portfolios of small stocks display a greater degree of predictability than portfolios of large stocks. There is also some weak evidence that the degree of predictability has diminished over time.

In a related literature, a number of studies have found evidence of mean reversion in returns on stock portfolios at horizons of three to five years or longer (Poterba and Summers 1988; Fama and French 1988). This implies that a long period of below-average stock returns increases the likelihood of a period of above-average returns in the future. These conclusions are less robust, however, than the findings of short-run predictability in returns. The most important problem is that since long-horizon returns are measured over years, rather than days or weeks, there are far fewer data points available, making precise statistical inference difficult. For example, Poterba and Summers are unable to reject (in a statistical sense) the null hypothesis of no serial correlation in returns, even though their point estimates suggest a substantial degree of returns predictability, and despite their use of a span of sixty years of data.[3]

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1 The situation is complicated somewhat in particular circumstances, for example, for stocks that pay dividends. See LeRoy (1989) for a more formal and complete discussion.

2 We defer discussion on the short-run predictability of exchange rates to a later sub-section.

3 Other researchers (for example, Kim, Nelson and Startz (1988) and Richardson (1993)) confirm the lack of robustness of these long-horizon results.

3.2 Is New Information Quickly Incorporated into Asset Prices?

The efficient market hypothesis rapidly gained adherents after 1969 when it was first shown that stock prices respond quickly to new information, and subsequently display no apparent strong trends. Event studies, pioneered by Fama *et al* (1969), generally found this pattern of price adjustment following major events such as mergers, stock-splits or changes in firms' dividend policies.

Despite this general finding of rapidly adjusting stock prices, some puzzling results remain. Most notable among these is the stylised fact that stock prices do not adjust instantaneously to profit announcements. Instead, on average a firm's share price continues to rise (fall) for a substantial period after the announcement of an unexpectedly high (low) profit. This anomaly appears to be quite robust to changes in sample period and research methodology (Ball and Brown 1968; Chan, Jegadeesh and Lakonishok 1996; Fama 1998).

3.3 Can Current Information Predict Future Excess Returns?

In an efficient market, publicly available information should already be reflected in the asset price. In the stockmarket, for example, public information on price-earnings ratios, cash flows or other measures of value should not have implications for future share returns (unless these variables are revealing information about the riskiness of the asset). Likewise, in the foreign exchange market, the forward exchange rate should not help predict excess returns from holding interest-bearing assets in one currency rather than another. The history of asset prices should also have no predictive power for future asset returns.

In this section, we discuss stockmarket anomalies – public information about stocks which helps to predict excess returns – as well as the puzzles in the foreign exchange market thrown up by the bias of the forward rate as a predictor of the future spot exchange rate. We also discuss technical analysis, a common practice in financial markets. We begin with a selection of stockmarket anomalies.[4]

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[4] Fama (1998) provides a recent review of this literature, including discussion of many anomalies not mentioned here. For recent Australian evidence on stockmarket anomalies, see Bradley and Alles (1999).

Value effects

Portfolios constructed from 'value' stocks appear to produce superior investment returns over long horizons. Value stocks are those with high earnings, cash flows, or tangible assets relative to the current share price. After controlling for firm size and the variance of portfolio returns, stocks with low price-earnings ratios outperform the market (Fama and French 1992). Also, portfolios of stocks with poor past returns produce higher returns than the market as a whole over subsequent periods. De Bondt and Thaler (1985) construct portfolios ordered across various measures of value, such as book-to-market, cash-flow-to-price and price-earnings ratios, sales growth and past returns history, using historical data on US stock returns. Along each of these dimensions, portfolios constructed from value stocks exhibit high future returns relative to 'glamour' portfolios over investment horizons of between one and five years. (Glamour stocks have the opposite characteristics to value stocks.) Lakonishok, Shleifer and Vishny (1994) reach similar findings, and also present evidence that the variability of returns from value portfolios is no greater than for glamour portfolios. Thus, the higher returns earned by value portfolios do not appear to be due to a higher level of risk.

Momentum effects

Although value stocks produce superior returns over long investment horizons, in the short run the opposite seems to hold. Jegadeesh and Titman (1993) find that portfolios with high returns in the recent past continue to produce above-average returns over a 3–12 month horizon. Chan, Jegadeesh and Lakonishok (1996) provide evidence that this 'momentum' in stock returns can be partially accounted for by the slow adjustment of the market to past profit surprises that was discussed earlier.

Size anomalies

Small stocks exhibit higher average returns (Banz 1981) although this may reflect a distressed-firm effect (Chan and Chen 1991). Since small firms include a disproportionate number of companies in financial distress, the higher expected returns experienced by small stocks may be a compensation for exposure to the risks associated with these distressed firms.

While there is some relationship between these anomalies, they do appear to be distinct phenomena. For example, small firms generally have lower price-earnings ratios and relatively poor past earnings growth (Chan, Hamao and Lakonishok 1991) and thus are more likely to be classified as value stocks. Nevertheless, measures of share value still have predictive power for stock returns even after controlling for firm size (Lakonishok, Shleifer and Vishny 1994).

The bias of the forward rate in the foreign exchange market

In an efficient risk-neutral foreign exchange market, the current forward exchange rate should be an unbiased predictor of the spot exchange rate at the settlement date of the forward contract. This ensures that the expected returns on interest-bearing assets in the two currencies are equal.[5]

Across a wide range of currencies and time periods, however, the current forward exchange rate has been shown to be a biased predictor of the future spot rate (Hansen and Hodrick 1980; Goodhart 1988; Frankel and Chinn 1991). Over the life of a forward contract, the spot exchange rate moves away from the initial value of the forward rate on average, rather than towards it.

This bias of the forward rate could be a consequence of a time-varying risk premium in the market, but no-one has been able to find fundamental-based explanations of this risk premium (Engel 1995).

Furthermore, forward-rate bias appears to be ignored by market participants when they are forming their exchange rate expectations. The expectations of market participants differ widely across individuals (Ito 1990). On average, however, participants expect, over the life of a forward contract, that the spot exchange rate will move towards the initial value of the forward rate (Froot and Frankel 1989). This expectation is misguided because, as we have seen, the spot exchange rate moves away from the initial value of the forward rate on average, rather than towards it. Thus, participants' average exchange rate expectations are not rational in the economists' sense of the word since relevant information is ignored.

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5 For expected returns to be equal, it is also necessary that covered interest parity holds, which it does to a very close approximation in deep, open capital markets.

Krugman (1993) sums up the evidence in these terms:

> For a number of years, there was a sort of academic industry that focused on testing the speculative efficiency of the forward exchange rate. A few early papers claimed to confirm that the forward rate was an efficient predictor of the subsequent change in the exchange rate (or more accurately, failed to reject the null hypothesis that it was an efficient predictor). Since the crucial paper by Hansen and Hodrick (1980), however, it has been obvious that this is not the case. Indeed, if anything, the correlation is negative. Now, this need not imply a rejection of efficiency if there are risk premia, especially shifting ones – although nobody thought large shifting risk premia were likely to be important until the devastating failure of simple efficiency ideas became apparent. In the end, however, it just won't wash. [There is a] huge and dispiriting literature on foreign-exchange-market efficiency: after more than a decade of work, it seems clear that nobody has found any reasonable way to 'save' the speculative efficiency hypothesis within the data …What we know how to model are efficient markets; what we apparently confront are inefficient ones.

Technical analysis

Technical analysis, or chartism, is the practice of identifying recurring patterns in historical prices in order to forecast future price trends. The technique relies on the idea that prices 'move in trends which are determined by the changing attitudes of investors toward a variety of economic, monetary, political and psychological forces' (Pring 1985, p 2) and that these trends are therefore predictable to some extent.

Technical trading rules, while many and varied, aim in general to identify the initiation of new trends. Some of the simpler rules include *filter rules* (buy when the price rises by a given proportion above a recent trough) *trading range breaks* (buy when the price rises by a given proportion above a recently established trading range) and *moving average intersections* (buy when a shorter moving average penetrates a longer moving average from below). For each rule, the analyst chooses the time horizon over which troughs and peaks are to be identified and moving averages calculated, as well as the threshold before a decision is made.

Most of these technical trading rules are simple and fairly inexpensive to implement. One would therefore not expect such rules to generate excess profits in an efficient market. The evidence on whether they do does not point clearly in one direction. There appear to be statistically significant excess returns to commonly used technical rules when they are applied to US dollar exchange rates over the past few decades (Levich and Thomas 1993; Osler and Chang 1995; Neely, Weller and Dittmar 1997).[6] In the stockmarket, the evidence is less clear-cut. Some studies (Brock, Lakonishok and LeBaron 1992; Sullivan, Timmerman and White 1998) report significant excess returns to technical trading rules, although out-of-sample performance is less convincing. Others, for example Allen and Karjalainen (1999), conclude that technical rules do not earn excess profits over a simple buy-and-hold strategy.

Perhaps more troubling for the efficient market hypothesis is that technical trading analysis exists at all. For reasons previously rehearsed, one might expect a marginal role for participants who search for patterns in the historical data, since this information could be of some use and is not completely costless to obtain. But this hardly seems sufficient to explain the extent of technical trading. For example, Allen and Taylor (1990) report that over 90 per cent of foreign exchange dealers in the London market used technical analysis to inform their forecasts one to four weeks ahead. It is hard to make sense of this almost universal usage of technical analysis if the foreign exchange market is an efficient one.

Implications for the efficient market hypothesis

In summary, the available evidence suggests that financial market returns are partly predictable, in ways that sometimes conflict with the efficient market hypothesis.

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[6] The first two of these studies select and test the technical trading rules over the same time periods, and may therefore be subject to selection bias. As Jensen and Bennington (1970) put it '…given enough computer time, we are sure that we can find a mechanical trading rule which "works" on a table of random numbers – provided of course that we are allowed to test the rule on the same table of numbers which we used to discover the rule'. Neely, Weller and Dittmar, however, conduct their tests out-of-sample, and so their study is immune from this criticism.

There have been several responses to this evidence. Many stockmarket anomalies may be due to 'data-snooping' (Lo and MacKinlay 1990). Most of the academic research on anomalies uses the same dataset (the CSRP dataset of daily US stock returns). Some anomalies may simply be an artefact of the statistical features of this dataset. Fama (1998) makes the related point that many anomalies are sensitive to the research methodology used, and disappear when reasonable changes in technique are applied. Nevertheless, other stockmarket anomalies – for example, post-earnings-announcement drift – have been shown to be quite robust.

It should also be noted that the extent of predictability observed in the data is never high. Whether for stocks, exchange rates or fixed-interest securities, and whether at short or long horizons, most of the variation in prices is unexpected. The small degree of predictability that is present may not be large or stable enough to provide the basis for a trading strategy capable of generating economic profits once transaction costs are taken into account. This may explain why market participants do not 'trade away' the observed predictability in asset returns.[7] However, it does not explain why such predictability exists in the first place.

Finally, observed predictability in returns may reflect variation over time in the size of the risk premium (Bollerslev and Hodrick 1992). This premium is the 'extra' return that investors require over and above the risk-free rate to compensate them for investing in a risky asset. However, as Hodrick (1990) and Lewis (1995) acknowledge, we have no satisfactory models of risk premia in either the stockmarket or the foreign exchange market. Whatever the correct model of risk premia, market agents must be extraordinarily risk-averse for the data on asset returns to be consistent with the efficient market hypothesis (Mehra and

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[7] In the foreign exchange market, Goodhart (1988) examines why participants don't trade on forward rate bias to earn excess profits. Drawing upon interviews with market practitioners, he concludes that such activity may occur, but is too limited in magnitude to eliminate forward rate bias. Banks hold only limited uncovered foreign exchange positions and close out loss-making positions quickly, corporations use the foreign exchange market mainly for hedging, while for individuals the rewards are not large enough to compensate for the risks and transaction costs involved (except for high-net-worth individuals). The substantial foreign-exchange speculation that does occur is not necessarily stabilising, because of the interaction of groups (such as chartists and fundamentalists) using different, and often contradictory, trading rules. A rational market participant with a long enough investment horizon could potentially take advantage of the bias in the forward rate, although Goodhart's view is that such investors do not dominate the market.

Prescott 1985; Hansen and Jagannathan 1991). Of course, we can always explain predictability in asset returns as reflecting changes in unobservable risk. But such an explanation is, as it stands, empirically empty.

3.4 Do Fund Managers Systematically Outperform the Market?

In our description of the efficient market hypothesis, we drew a distinction between a strong version of the hypothesis, in which asset prices fully reflect all available information, and a weaker, but economically more realistic, version in which prices reflect information only to the extent that there remain net benefits to collecting it.

Managed funds provide an interesting test of this distinction; they employ active managers who devote significant resources to uncovering information and whose performance can be compared with alternative passive strategies (such as buying-and-holding the market). The strong version of the efficient market hypothesis predicts that actively managed fund returns will equal passive returns *before* deducting management expenses, while the weaker version suggests that they will equal passive returns *after* deducting management expenses.

The earliest research using data from the 1950s and 1960s reported that net of expenses, managed funds under-performed a buy-the-market-and-hold strategy (Sharpe 1966 and Jensen 1968). Jensen found that net of expenses, the funds on average earned about one per cent per annum less than they should have given their level of systematic risk. Even gross of expenses, funds failed to match a passive strategy. More recent evidence has echoed these results. Lakonishok, Shleifer and Vishny (1992), for example, found that the equity component of US pension funds over the 1980s underperformed the Standard and Poors 500 Index of US shares by an average of 1½ to 2½ per cent per annum, before allowing for management fees. Funds would have performed better had they frozen the composition of their portfolios; their active management detracted value.

Studies on US mutual funds during the 1980s suggest somewhat better performance, although the improvement is only sufficient to generate returns, after deducting expenses, that roughly match those from a benchmark that involves no

active management (Grinblatt and Titman 1989; Lee and Rahman 1990; Malkiel 1995).

Another relevant issue is the consistency of fund performance. Although funds on average may fail to add value, this may not be true for all of them. It does appear that some fund managers have consistently performed better than their peers. On average, younger managers and those who received their university degrees from higher quality institutions perform better (Chevalier and Ellison 1996). Nevertheless, researchers who identify exploitable persistent traits in equity and fixed-income funds also point out that the edge gained by identifying a successful manager is usually insufficient to overcome the average underperformance of such funds (Brown and Goetzmann 1995; Kahn and Rudd 1995).

It remains unclear why underperforming funds survive in the marketplace. Poor performance does increase the probability of a fund being eliminated from the market (Brown and Goetzmann 1995). Apparently, however, it is difficult for potential users of fund management services to identify the better managed funds. Consistent with this is the observation that fees vary little across actively managed funds, implying that better performing funds are not in a position to profit from their better track records. Funds also go to lengths to differentiate their products, preventing simple comparisons of portfolio returns. Nevertheless, and perhaps in response to the generally poor performance of actively managed funds, there has been a marked rise in the quantity of funds invested passively.[8]

Overall then, the performance of actively managed funds is broadly supportive of the efficient markets hypothesis. After deducting management fees, actively managed funds usually do not outperform passively managed funds. If anything the puzzle is that active funds often underperform buy-and-hold strategies, even before management fees are deducted.

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[8] One estimate suggests that in the United States, 40 per cent of institutional funds are now invested to passively follow an index. In Australia, funds invested with index managers increased by an estimated 72 per cent in 1997–98, almost five times the growth rate of the market as a whole (Business Review Weekly, November 16, 1998, p 216).

3.5 Are Asset Prices Sometimes Misaligned?

The phenomena we have been discussing until now are important in helping to assess the extent to which the efficient market hypothesis is a convincing empirical description of the behaviour of asset prices. From the point of view of the broader efficiency of the economy, however, they seem less important. For example, if there are small risk-adjusted excess returns to be earned in asset markets, or small amounts of autocorrelation in asset prices, it is hard to imagine that this would have serious implications for the efficient functioning of the wider economy.

What is much more serious, however, is the possibility that asset prices are misaligned – that is, that they remain at levels a fair distance from those consistent with economic fundamentals, possibly for extended periods. This might be associated with significant economic costs, because the asset prices are then sending inappropriate signals, in terms of underlying economic costs and benefits, that will lead to economically inefficient investment and consumption decisions.

This section therefore examines evidence about whether asset prices do suffer from longer-run misalignments.

To begin, it is worth exploring the implications of the results discussed above for the issue of longer-run misalignment of asset prices. Evidence that asset prices respond rapidly to new information, that their movements are close to a random walk, and that fund managers rarely outperform the market on a consistent basis, seem to provide support for the idea that asset prices are (mostly) at levels consistent with fundamentals.

In fact, however, this evidence has very little bearing on whether asset prices are mostly consistent with fundamentals. To see why, consider an asset market in which prices are subject to long-lived misalignments, instead of being closely tied to fundamentals. If misalignments grow and unwind gradually, the short-run behaviour of the asset price can look very like that from an efficient market. That is, the price can respond rapidly to relevant new information, and can exhibit short-run movements that are almost indistinguishable from a random walk. Despite this, however, the asset price may still spend most of its time a long way

from its fundamental value, as misalignments gradually grow or unwind (Summers 1986).

Furthermore, fund managers may find it difficult to consistently profit from such long-lived misalignments, for the same reason that econometricians have difficulty detecting them – because month-to-month or quarter-to-quarter excess returns in such markets are small on average and volatile. This difficulty is compounded if fund managers are restricted, perhaps for institutional reasons, in their ability to hold open positions in an asset market for long periods of time while they wait for a suspected misalignment to unwind.

These arguments do not demonstrate that asset markets *are* subject to longer-run misalignments. They simply point out that the empirical results we have discussed in earlier sections do not provide very compelling evidence that such misalignments are absent from asset markets.

We turn now to evidence that asset markets are, at times, subject to longer-run misalignments. We discuss three strands of evidence that point in that direction. The first two relate to the stockmarket, the third to the foreign exchange market.

The price of closed-end funds

The first strand of evidence relates to the price of closed-end funds. The efficient market hypothesis implies that asset prices should be at their fundamental value, which is intrinsically difficult to measure for most classes of assets. It is, however, far simpler to observe in the case of closed-end funds.

A closed-end fund consists of an actively managed portfolio of stocks which are all individually traded on a stock exchange. A fixed number of shares are then issued in the closed-end fund, which are themselves traded on a stock exchange. Unlike open-ended funds, which stand ready to accept more funds or redeem shares at the fund's value, shares in a closed-end fund cannot be liquidated but must be traded in a secondary market. The fund pays dividends equal to the weighted sum of the dividends paid by the stocks in its portfolio so the price of a share in a closed-end fund should reflect the value of the underlying assets.

Usually, however, it does not. Closed-end funds tend to begin trading at a premium but move quickly to a discount. Major US closed-end funds traded at an average discount of 10 per cent between 1965 and 1985 (Lee, Shleifer and Thaler 1990). The discounts vary substantially over time and are correlated across funds. Yet, on termination of a closed-end fund, the price converges to the net value of the assets in the fund.

Premia or discounts may reflect expectations of future performance in actively managing the portfolio. While there is some evidence that funds trading at discounts do subsequently perform worse than funds trading at premiums (Chay and Trzcinka 1992), discounts as the norm suggest that investors believe closed-end fund managers will consistently under-perform the market.

There have been attempts to explain why the discrepancy between the value of the closed-end fund and the underlying assets is not arbitraged away, based on the costs involved in doing so.[9] But they do not explain how the pricing discrepancy is consistent with an efficient market in the first place.

De Long *et al* (1990) argue that asset markets can fruitfully be analysed as though they are populated by two types of agents – those who are rational and understand the market, and those who trade on market noise, rather than news ('noise traders'). One of their reasons for preferring this model of financial markets to the efficient market model is that it provides a seemingly natural explanation for the tendency of closed-end funds to trade at a discount to their underlying asset value.

The explanation goes like this. For reasons possibly unrelated to fundamentals, the bullishness of noise traders about the future prospects for returns on risky assets waxes and wanes through time. In particular, they may become more or less bullish about the future prospects for a closed-end fund. If they become more bullish, the fund's price rises, if less bullish, it falls. The rational traders, who are risk-averse, are aware of the unpredictability of noise traders. For them to invest in the

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[9] Factors which make arbitrage costly include costs associated with short-selling the shares in the fund or the fund itself, low dividend yields (which raise holding costs) and high transaction costs (Pontiff 1996). There is also evidence that discounts are greater when interest rates are high, which raises the opportunity cost of the arbitrage.

closed-end fund, therefore, they require an extra return to compensate them for the risk associated with the noise traders' fluctuating bullishness. By trading at a discount, on average, the closed-end fund delivers this extra average return to the rational traders (since the dividend stream is determined by the underlying assets but the purchase price of the closed-end fund is lower). The fund trades at a discount that fluctuates through time with the bullishness of the noise traders, but may even trade at a premium if they are particularly optimistic.

This noise-trader model provides a possible explanation for the persistent tendency of closed-end funds to trade at a discount. But this framework is inconsistent with an efficient market, since it assumes that prices are influenced by a class of traders who misinterpret current information. It remains hard to explain the pricing of closed-end funds without some deviation from the efficient market model.

Misalignment in aggregate stock prices

> If the efficient markets hypothesis was a publicly traded security, its price would be enormously volatile. Following Samuelson's (1965) proof that stock prices should follow a random walk if rational competitive investors require a fixed rate of return and Fama's (1965) demonstration that stock prices are indeed close to a random walk, stock in the efficient markets hypothesis rallied … A choppy period then ensued, where conflicting econometric studies induced few of the changes in opinion that are necessary to move prices. But the stock in the efficient markets hypothesis – at least as it has traditionally been formulated – crashed along with the rest of the market on October 19, 1987. Its recovery has been less dramatic than that of the rest of the market. (Shleifer and Summers 1990)

A second strand of evidence suggesting that asset prices are sometimes misaligned comes from an examination of stockmarket crashes. After rising by 33 per cent over the first nine months of 1987, the Standard and Poors 500 Index of US shares fell by 9 per cent over the week before 19 October, and then by 22 per cent on that day. There was some news in the week leading up to the crash that might have been expected to have an adverse effect on stock prices. This news included the announcement of a larger-than-expected trade deficit, the revelation that a key Committee of the US Congress would support the elimination of the tax benefits of leveraged buyouts, and press speculation that the Federal Reserve would raise its

discount rate (French 1988). Nevertheless, it is hard to imagine a plausible model of fundamental value in which the small amount of information observed could have triggered a rational fall in stock prices of the magnitude seen.

Perhaps much of the rise in share prices over the first nine months of 1987 represented the formation of a speculative bubble, with prices rising above fundamental value (French 1988). Investors may have thought that prices were rising to irrationally high levels, but each one bought in the belief that s/he would be able to sell before the price fell. When the bubble burst, prices collapsed back towards fundamental values. If this is a reasonable interpretation of events, then the aggregate US stockmarket was badly misaligned, but only for a period of perhaps several months leading up to the crash.

How common are such misalignments? 1987 is, after all, not the only time in recent history when concerns about stockmarket misalignment have come to the fore. Nine years later, after a substantial run-up in aggregate US stock prices, the Chairman of the Federal Reserve System, Alan Greenspan (1996), commented:

> Clearly, sustained low inflation implies less uncertainty about the future, and lower risk premiums imply higher prices of stocks and other earning assets. We can see that in the inverse relationship exhibited by price-earnings ratios and the rate of inflation in the past. But how do we know when irrational exuberance has unduly escalated asset values, which then become subject to unexpected and prolonged contractions as they have in Japan over the past decade?

Whether or not aggregate US stock prices were at unduly escalated values when this speech was delivered, it is interesting to juxtapose these comments with the experience of the subsequent 2½ years when aggregate US stock prices rose by a further 80 per cent (as measured by the S&P 500 Index). Even acknowledging the likely evolution of fundamentals over this 2½ years, this experience demonstrates just how hard it is to assess whether a given level of asset prices is consistent with fundamentals, or alternatively, evidence of speculative excess. As events are unfolding, such assessments are as difficult for participants in the market to make as they are for outsiders.

This difficulty of making real-time judgements about fundamental value is part of the reason why asset market misalignments can survive for extended periods. Even very large asset price movements may not generate a market consensus at the time that prices have become misaligned. (If they did generate such a consensus, then the misalignment would presumably be rapidly unwound.) Only with the benefit of hindsight does something close to a consensus emerge that, during some episodes like the several months before October 1987, asset prices were badly out of line.

Misalignment in the foreign exchange market

Misalignment also seems to be a serious problem in the foreign exchange market at times. Economists' almost complete inability to explain short to medium-run movements of floating exchange rates on the basis of economic fundamentals has led many to reject the efficient market hypothesis as providing a convincing description of the foreign exchange market, and to conclude instead that floating exchange rates are subject to significant misalignments at times.

Floating exchange rates are quite volatile, with year-to-year movements of about 10 to 15 per cent. Economic fundamentals, however, explain almost none of these movements. In a paper that changed the direction of research on exchange rates, Meese and Rogoff (1983) showed, for floating exchange rates between major industrial countries, that no existing exchange rate model based on economic fundamentals could reliably out-predict the naïve alternative of a 'no-change' forecast for horizons up to a year. This was true despite the fact that the model forecasts were based on the actual realised values of future explanatory variables in the model.

There have been many attempts to overturn this striking result. And while some researchers have developed models based on fundamentals that can out-predict a 'no-change' forecast, the basic thrust of the Meese-Rogoff result remains intact. No-one has yet been able to uncover economic fundamentals that can explain more than a modest fraction of year-to-year changes in exchange rates.[10]

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[10] For example, MacDonald and Taylor (1993) present an economic-fundamentals-based model that generates one-year-ahead forecasts of the USD/DM exchange rate with a root mean square error 11 per cent less than that from a 'no-change' forecast. This implies, of course,

An alternative, less formal, type of evidence suggesting that exchange rates are sometimes subject to significant misalignments is based on an examination of episodes in which exchange rates moved by large amounts, with no apparent changes in economic fundamentals significant enough to justify these movements.

Three examples give the flavour of this evidence. From mid 1980 to early 1985, the US dollar appreciated against the Deutsche Mark by about 90 per cent, only to completely unwind this appreciation by 1988. Similarly, the Yen appreciated by about 75 per cent against the US dollar from mid 1991 to April 1995; this appreciation was completely unwound by mid 1998. Finally, over the two days, 6 to 8 October 1998, the Yen appreciated by 16 per cent against the US dollar. Given the behaviour of relevant macroeconomic variables (inflation rates, money growth, output growth, interest rates, etc) over these periods, it is hard to rationalise exchange rate movements of these magnitudes in terms of economic fundamentals, even with the benefit of hindsight.[11]

The available evidence does suggest that misalignments in the foreign exchange market *are* eventually unwound. Economic fundamentals assert themselves in the end. Tests of purchasing power parity (PPP), for example, provide support for the importance of fundamentals in the long run. Provided enough data are used, strong statistical evidence emerges that PPP holds as a long-run proposition for industrial-country exchange rates. The rate of convergence to this long run is, however, very slow, with consensus estimates implying that the half-life of deviations from PPP is about four years (Froot and Rogoff 1995). This long half-life is again suggestive that misalignments in the foreign exchange market take a long time to unwind.

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that the remaining 89 per cent of the variation in the exchange rate change remains unexplained.

[11] The combination of tight monetary and loose fiscal policies in the US should have implied an appreciation of the US dollar in the early 1980s. Nevertheless, the magnitude of the observed appreciation still seems hard to justify based on fundamentals alone.

Frankel and Rose (1995) summarise the evidence in these terms:

> [There is] (i) a role for fundamentals that puts an eventual limit on the extent to which a speculative bubble can carry the market away from equilibrium, so that fundamentals win out in the long run, (ii) something like a combination of risk-aversion and model uncertainty … that in the short-run is capable of breaking the usual rational-expectations arbitrage that links the exchange rate to its long-run equilibrium, and (iii) some short-run dynamics that arise from the trading process itself (e.g. noise trading that generates volatility which swamps macro fundamentals on a short-term basis). These three elements could be described, respectively, as (i) the eventual bursting of speculative bubbles, (ii) the potential for speculative bubbles, [and] (iii) the endogenous genesis and prolongation of speculative bubbles.

4. Discussion and Conclusion

The introduction of the efficient market hypothesis thirty years ago was a major intellectual advance. The hypothesis provided a powerful analytical framework for understanding asset prices, and has been responsible for an explosion of research into their behaviour.[12]

Within a decade, the efficient market hypothesis was so well established that Jensen (1978) was prompted to write that he believed there to be 'no other proposition in economics which has more solid empirical evidence supporting it'.

Such confidence portends a reversal, and the subsequent twenty years of research and asset-market experience have rendered the efficient market hypothesis a much more controversial proposition.

On some issues, the evidence continues to suggest that the hypothesis gives the right answers, at least to a close approximation. Asset price movements over short horizons are close to a random walk, new information is rapidly incorporated into asset prices (at least most of it is), and fund managers rarely outperform the stockmarket on a consistent basis.

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[12] Ball (1990) provides an extended discussion on the contribution made by Fama *et al* (1969) in the paper that introduced the term 'efficient market'.

Nevertheless, despite these successes, other features of asset-market behaviour seem much harder to reconcile with the efficient market hypothesis. Some stockmarket anomalies have been shown to be quite robust, including surviving extension to alternative sample periods. In this category, for example, is post-earnings-announcement drift. In the foreign exchange market, the bias of the forward exchange rate as a predictor of the future spot exchange rate has resisted explanations based on economic fundamentals for over a decade. Instead, the evidence from surveys suggests participants in the foreign exchange market do not have rational expectations on average, in violation of one of the building blocks of the efficient market hypothesis.

Supporters of the efficient market hypothesis can argue that many seeming violations of the hypothesis are instead examples of the 'bad model' problem. Under this interpretation, predictable excess returns represent compensation for risk, which is incorrectly measured by the asset-pricing model being used. While this is a logical possibility, it presumably applies with progressively less force the longer the violations remain unexplained using models based on the efficient market hypothesis.

Longer-run asset price misalignments almost certainly represent the most serious manifestation of the failure of the efficient market hypothesis. Most tests of the hypothesis do not provide evidence, one way or another, about the possibility of such misalignments. Other types of evidence, however, strongly suggest that such misalignments exist, at least at times.

In the stockmarket, the pricing of closed-end funds is hard to understand as the outcome of an efficient market. The 1987 stockmarket crash, and the unprecedented run-up in US stock prices over the 1990s are both hard to understand except in terms of markets which have moved some distance away from levels consistent with fundamentals.

The inability of models based on economic fundamentals to explain more than a small fraction of the year-to-year movements in floating exchange rates has undermined confidence in the capacity of the efficient market hypothesis to provide a convincing description of this market. This confidence has been further

eroded by the anomalous behaviour of the US dollar in the 1980s and the Yen in the 1990s.

The efficient market hypothesis is almost certainly the right place to start when thinking about asset price formation. Both academic research and asset market experience, however, suggest that it does not explain some important and worrying features of asset market behaviour.

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