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The Efficient Markets Hypothesis

Syllabus objectives

1.1 Understand the principles of rational expectations theory

- 1.1.1 Three forms of the Efficient Markets Hypothesis and their consequences for investment management
- 1.1.2 Evidence for or against each form of the Efficient Markets Hypothesis

0 Introduction

In simple terms, an *efficient* security market is one in which the price of every security fully reflects all available information and hence is equal to its 'true' investment value. According to the Efficient Markets Hypothesis security markets *are* efficient.

This basic idea has been extended to allow for different forms of market efficiency corresponding to different levels of information. These are:

- *weak form* – market prices reflect all of the information contained in historical price data
- *semi-strong form* – market prices reflect all publicly available information
- *strong form* – market prices reflect all information, whether or not it is publicly available.

The importance of market efficiency derives from the fact that if markets are *inefficient* then investors with better information may be able to obtain higher investment returns. If, however, markets are *efficient*, then it is not possible to identify under- or over-priced securities, which can then be traded to generate excess risk-adjusted returns. Hence, it is not worth trying to do so.

This chapter therefore:

- describes the three different definitions of market efficiency
- discusses the evidence for and against the different forms of the Efficient Markets Hypothesis – which turns out to be largely inconclusive.

1 Rational expectations theory

1.1 Background

From the 1930s until the early 1960s, there was a widespread folklore about how to make money on the stock market. The dominant theory, going back to Adam Smith in the 1700s, was that markets are essentially fickle, and that prices tend to oscillate around some true or fundamental value.

Starting with the work by economist Benjamin Graham, traditional investment analysis involved detailed scrutiny of company accounts, to calculate fundamental values, and thus ascertain when a given investment is cheap or expensive. The objective would be to buy cheap stocks and sell expensive ones. Any excess performance thus obtained would be at the expense of irrational traders, who bought and sold on emotional grounds (a 'gut feeling', for example) and without the benefit of detailed analysis.

This detailed analysis is known as *fundamental analysis*.

By the 1960s, it had become clear that these supposedly foolproof methods of investment were not working. Strategies based on detailed analysis did not seem to perform any better than simple buy-and-hold strategies. Attempts to explain this phenomenon gave rise to the *Efficient Markets Hypothesis* (EMH), which claims that market prices already incorporate the relevant information. The market price mechanism is such that the active trading patterns of a small number of informed analysts can lead to accurate market prices. Uninformed (or 'cost-conscious', since actively trading incurs potentially unnecessary costs) investors can then take a free ride, in the knowledge that the research of others is keeping the market efficient.

This provides a strong argument in favour of the *passive* investment management style that we discuss below.

1.2 The three forms of the Efficient Markets Hypothesis

The academic literature has distinguished between different forms of the Efficient Markets Hypothesis, based on a finer dissection of exactly what constitutes *relevant information*. In particular, the following three forms of EMH are commonly distinguished:

Weak form EMH

The market price of an investment incorporates all information contained in the price history of that investment. Knowledge of a stock's price history cannot produce excess performance as this information is already incorporated in the market price. This form, if true, means that *technical analysis* (or chartism) techniques (*ie* analysing charts of prices and spotting patterns) will not produce excess performance.

Semi-strong form EMH

The market price of an investment incorporates all publicly available information. Knowledge of any public information cannot produce excess performance, as this information is already incorporated in the market price.

This form, if true, means that *fundamental analysis* techniques (*ie* analysing accounting statements and other pieces of financial information) will not produce excess performance.

Fundamental analysis uses information concerning the issuer of the security (*eg* turnover, profitability, liquidity, level of gearing) and general economic and investment conditions (*eg* real interest rates and inflation) in order to determine the 'true' or 'fundamental' value of a security and hence whether or not it is cheap or expensive.

Different stock exchanges have different levels of required disclosure of information. Hence it would be reasonable to expect different markets to have different levels of efficiency. For example, the New York Stock Exchange (NYSE), which requires a high level of disclosure, should be more efficient than a market with limited disclosure requirements.

There is also no commonly accepted definition of what constitutes publicly available information.

This can lead to problems when testing whether a particular market is actually efficient or not.

For example, unlike professional fund managers, private investors are unable to gain access to the senior management of companies.

Clearly, fund managers have an advantage in terms of being able to form an opinion on the competence of the management team and the strategy of the company. Fund managers are also increasingly utilising 'alternative data' (*eg* satellite images, web searches, social media *etc*) to generate excess performance.

Even if information is publicly available, there is a cost involved in obtaining the information quickly and accurately. Any advantage achieved by acting on price relevant information could well be eroded by the cost of obtaining and analysing that information.

In other words, the cost of obtaining additional information could outweigh the additional returns that it might generate. Note that a necessary requirement for efficiency as it has been defined above is that the costs of both acquiring the relevant information and trading on the basis of it should be equal to zero. This must be the case if investors are to trade until security prices do reflect *all* available information.

Note that just because information is publicly available, it does not mean that everybody has read and understood it, *eg* the contents of the Subject CM2 course. This could be because:

- for many people – who do not wish to be actuaries or investment specialists – the costs of buying a Subject CM2 course outweigh the benefits that it confers
- most of the population is unaware of either the existence or the benefits to be derived from studying Subject CM2, or both!

Strong form EMH

The market price of an investment incorporates all information, both publicly available and also that available only to insiders. Knowledge available only to insiders cannot produce excess performance as this information is already incorporated in market prices.

Stock markets around the world are subject to regulation. Often rules exist to prevent individuals with access to price sensitive information, which is not yet public, from using this information for personal gain. For example, senior management involved in merger and acquisition talks are often banned from trading in the stock of their company. Such rules would be unnecessary if strong form efficiency held.

Question

Explain why such rules would be unnecessary.

Solution

Such rules would be unnecessary because it would not be possible for senior management to use this information to obtain higher investment returns by trading in the stock of their own company. Thus, senior management would not be at an advantage compared to other investors, who would correspondingly not be disadvantaged by such trades.

However, one can argue that if senior management were allowed to trade their own company's stock, then strong form EMH would be possible. Hence the existence of these rules prevents strong EMH from occurring.

Trading on the basis of privileged information that is not publicly available is sometimes known as *insider trading* or *insider dealing*. If insider trading does not occur, then the strong form Efficient Markets Hypothesis cannot hold, as there is then no mechanism by which security prices can incorporate inside information.

Question

What is the relationship between the three forms of market efficiency?

Solution

Publicly available information is a subset of all information, whether publicly available or not. Consequently strong form efficiency implies semi-strong form efficiency, in the sense that if a market is strong form efficient, then it must also be semi-strong form efficient.

Similarly as historical price data is a subset of all publicly available information, so a market that is semi-strong form efficient must also be weak form efficient.

Active versus passive investment management

The question of whether or not markets are efficient has important implications for investment management. Active fund managers attempt to detect exploitable mispricings, since they believe that markets are not universally efficient. Passive fund managers simply aim to diversify across a whole market, perhaps because they do not believe they have the ability to spot mispricings.

According to the Efficient Markets Hypothesis, active investment management, with its active trading policy and consequent higher level of management fees, cannot be justified.

Question

Why can active management not be justified according to the EMH?

Solution

According to the Efficient Markets Hypothesis, active investment management cannot be justified because it is impossible to exploit the mispricing of securities in order to generate higher expected returns. Even if price anomalies exist, then the costs of identifying them and then trading will outweigh the benefits arising from the additional investment returns.

If active investment management cannot be justified, then a more appropriate investment strategy might be simply to match or 'track' the market by holding a portfolio whose performance will closely replicate that of the market as a whole. In this way the fund should yield approximately the same level of investment returns as the market, whilst also enjoying the benefits arising from both diversification and lower dealing costs. In practice this is often achieved by matching or tracking an index that is representative of the investment market in question. Such index tracking is a very important example of a *passive* investment management style.

If markets are inefficient, we would expect active managers with above average skill to perform better than passive managers. However, performance should be considered *net* of various fees and transaction costs (*eg* brokerage, market impact). To demonstrate an exploitable opportunity in the market, the opportunity should be sufficiently large to remain intact even after all these costs are taken into account.

An alternative definition of efficiency sometimes used is therefore that prices reflect all available information up to the point at which the marginal costs and benefits of that information are equal. If these marginal costs and benefits differ between investors, some investors may enjoy an advantage over their peers.

A further consequence is that those investment markets with the most freely available information and the lowest transaction costs are likely to be the most efficient. Thus, government bond markets tend to be more efficient than property markets.

The question of market efficiency therefore has a crucial bearing upon the choice of investment management style.

Question

Comment on the advantages that could be derived from 'insider trading' in a market that is strong form efficient.

Solution

If the market is strong form efficient, then there will be no advantage from insider trading because all the insider knowledge should be reflected in the current share price.

2 The evidence for or against each form of the Efficient Markets Hypothesis

2.1 Difficulties with testing the Efficient Markets Hypothesis

Tests of EMH are fraught with difficulty. There is a substantial body of literature proving the existence of mispricings, in contravention of EMH. Unfortunately, there is also a substantial body of literature providing evidence for various forms of EMH. Both schools of thought can cite a great deal of empirical evidence and an impressive wealth of statistical tests. It is reasonable to ask, from a philosophical point of view, how it could come about that we have categorical proof of mutually contradictory statements. One possible explanation is that many published tests make implicit and explicit, but possibly invalid, assumptions (for example, normality of returns, or stationarity of time series).

Consequently, a test that appears to disprove the Efficient Markets Hypothesis may actually be disproving something else.

We can note that whilst an apparent proof based upon historical data over one period of time might be valid for that particular period, it might not be valid for a subsequent time period, perhaps because the nature of the market or the available information has changed. We can also note that the parties involved in providing proof will have vested interests and may therefore be biased, publishing only those results that support their position.

Some of the differences are purely differences of terminology. For example, do we regard anomalies as disproving EMH, if transaction costs prevent their exploitation?

Thus, although it may in principle be possible to exploit temporary mispricings, it may not be possible in practice after appropriate allowance has been made for both transaction costs and the costs of obtaining information. Whether or not such a finding contradicts the EMH depends upon exactly how we define the EMH.

More subtle is the need to make an appropriate allowance for risk. The EMH is not contradicted by a strategy which produces higher profits than the market portfolio by taking higher risks. The market rewards investors for taking risks, so we expect, on average, a high-risk strategy to result in higher returns.

What would contradict the EMH is an investment strategy that provided returns over and above those necessary to compensate an investor for the risk they faced. Unfortunately, there is no universally agreed definition of risk, and no perfectly accurate way of measuring it.

We will consider a number of different measures of investment risk later in the course.

With these caveats in mind, we can now consider some empirical work.

Testing the weak form EMH

Using price history to try and forecast future prices, often using charts of historical data, is called *technical* or *chartist* analysis. Studies have failed to identify a difference between the returns on stocks using technical analysis and those from purely random stock selection after allowing for transaction costs. Credible challenges to Weak Form EMH took a long time to emerge, but recent econometric evidence suggests that stocks tend to exhibit short-run momentum (trending in the same direction) and medium-run mean-reversion (trending in opposite directions).

Question

Country X runs a national lottery in which the purchaser of a ticket selects six different numbers from 1 to 50 inclusive. If those same six numbers are then drawn randomly from a hat on live TV, the holder of the ticket wins a share of a large cash sum equal in value to the total ticket sales. Is the market for lottery tickets weak form efficient?

Solution

If the numbers drawn are truly random, then the market for lottery tickets is weak form efficient. This is because knowledge of the numbers that have been drawn in the past will not help you to predict the numbers that are likely to be drawn in the future, and thereby generate excess returns. It will also be semi-strong and strong form efficient, unless it is operated fraudulently.

Testing the semi-strong form EMH

The semi-strong form of the EMH has been where research has concentrated and where the debate is most fierce. We will consider tests of the EMH in two categories below: tests of informational efficiency and volatility tests.

Testing the strong form EMH

This is problematic as it requires the researcher to have access to information that is not in the public domain.

In order to decide if security prices do reflect all available information we ourselves need to have access to all available information – including information that is not publicly available.

However, studies of directors' share dealings suggest that, even with inside information, it is difficult to out-perform.

2.2 Informational efficiency

The EMH (in its various forms) states that asset prices reflect information. However, it does not explicitly tell us how new information affects prices.

For example, the speed and extent to which it does so.

It is also empirically difficult to establish precisely when information arrives. For example, many events are widely rumoured prior to official announcements.

An example here is a merger. Should tests of efficiency be based upon the official announcement date of the merger or the date at which rumours concerning the likelihood of the merger first started – or possibly some date in between?

Many studies show that the market over-reacts to certain events and under-reacts to other events. The over/under-reaction is corrected over a long time period. If this is true then traders could take advantage of the slow correction of the market, and efficiency would not hold.

Over-reaction to events

Some of the effects found by studies can be classified as over-reaction to events, for example:

1. **Past performance: past winners tend to be future losers and vice versa. The market appears to over-react to past performance.**

   Hence it might be possible to make excess profits by selling shares in firms that have performed well recently and buying those that have performed badly. This is sometimes referred to as a *contra-cyclical* investment policy.

2. **Certain accounting ratios appear to have predictive powers: *eg* companies with high earnings to price, cashflow to price and book value to market value (generally poor past performers) tend to have high future returns. Again, this is an example of the market apparently over-reacting to past growth.**

3. **Firms coming to the market: evidence from a number of major financial markets including the UK and the US appears to support the idea that stocks coming to the market by Initial Public Offerings and Seasoned Equity Offerings have poor subsequent long-term performance.**

Under-reaction to events

There are also well-documented examples of under-reaction to events:

1. **Stock prices continuing to respond to earnings announcements up to a year after their announcement. This is an example of under-reaction to information which is slowly corrected.**

2. **Abnormal excess returns for both the parent and subsidiary firms following a de-merger. This is another example of the market being slow to recognise the benefits of an event.**

3. **Abnormal negative returns following mergers (agreed takeovers leading to the poorest subsequent returns). The market appears to over-estimate the benefits from mergers and the stock price slowly reacts as the optimistic view is proved to be wrong.**

Anomalies

All these effects are often referred to as 'anomalies' in the EMH framework.

A fast-growing area of research in finance is Behavioural Finance, which investigates whether such anomalies arise due to behaviour of individual investors which departs from that predicted by models based on rational expectations. However, this approach is still controversial in some circles, with some academics unconvinced that 'irrational' behaviour is an important determinant of aggregate asset pricing.

Even if the market is efficient, pure chance is going to throw up some apparent examples of mispricings. We would expect to see as many examples of over-reaction as under-reaction. This is broadly consistent with the literature to date.

The 2007/09 financial crisis led to many professors asking whether EMH (and other techniques discussed in CM2) should even form part of the syllabus. We should be critical of the theories and treat them as a structuring tool, a theoretical base rather than a dogma.

Even more important is the finding that the reported effects do not appear to persist over prolonged time periods and so may not represent exploitable opportunities to make excess profits. For example, the 'small companies effect' received attention in the early 1980s. This work showed the out-performance of small companies in the period 1960-80. However, if a strategy based on this evidence were to be implemented throughout the 1980s and early 1990s, the investor would have experienced abnormally low returns.

Other examples of anomalies, for example the ability of accounting ratios to indicate out-performance, are arguably proxies for risk (strategies exploiting these strategies are higher-risk than average). Once these risks have been taken into account, many studies, which claim to show evidence of inefficiency, turn out to be compatible with the EMH.

Question

Over the last five years, the shares of Company A have yielded an average investment return equal to twice that of Company B. Does this contradict the Efficient Markets Hypothesis?

Solution

Although Company A's shares have recently yielded more than Company B's shares, this does not contradict the Efficient Markets Hypothesis. This is because the EMH implies that it is not possible to identify shares that offer excess *risk-adjusted expected* returns. This is different from the situation described, which refers to actual *past* returns with no allowance being made for the relative riskiness of the two shares involved. Thus Company A may be inherently more risky than Company B.

2.3 Volatility tests

Several observers have commented that stock prices are 'excessively volatile'. By this they mean that the change in market value of stocks (observed volatility), could not be justified by the presence of news. This was claimed to be evidence of market over-reaction which was not compatible with efficiency.

Excessive volatility therefore arises when security prices are more volatile than the underlying fundamental variables that should be driving them.

The claim of 'excessive volatility' was first formulated into a testable proposition by Shiller in 1981. He considered a discounted cashflow model of equities going back to 1870. By using the actual dividends that were paid and some terminal value for the stock, he was able to calculate the *perfect foresight price*, the 'correct' equity price, if market participants had been able to predict future dividends correctly. The difference between the perfect foresight price and the actual price arises from the forecast errors of future dividends. If market participants are rational, we would expect no *systematic* forecast errors. Also if markets are efficient, broad movements in the perfect foresight price should be correlated with moves in the actual price as both react to the same news.

Shiller found strong evidence that the observed level of volatility in the S&P 500 stock index contradicted the EMH as such volatility was not in line with the subsequent fluctuations in the dividends.

In other words, Shiller found that actual security prices were more volatile than perfect foresight prices based upon the present value of future dividends.

However, subsequent studies, using different formulations of the problem, found that the violation of the EMH only had borderline statistical significance. Numerous criticisms were subsequently made of Shiller's methodology.

These criticisms covered:

- **the choice of terminal value for the stock price**
- **the use of a constant discount rate**
- **bias in estimates of the variances due to autocorrelation**
- **possible non-stationarity of the series, *ie* the series may have stochastic trends which invalidate the measurements obtained for the variance of the stock price.**

Although subsequent studies by many authors have attempted to overcome the shortcomings in Shiller's original work, there still remains the problem that a model for dividends and distributional assumptions are required. Some equilibrium models now exist which calibrate both to observed price volatility and observed dividend behaviour. However, the vast literature on volatility tests can at best be described as inconclusive.

2.4 Conclusion

The literature on testing the EMH is vast, and articles can be found to support whatever view you wish to take. It is possible to find research claiming incontrovertible evidence either for or against the EMH.

Question

An investment market is strong form efficient. Describe what would happen to the price of a company's shares if some positive information about the company becomes known. (Assume that nobody had known about this information in advance.)

Solution

1. The share price should go up.
2. This should happen immediately.
3. The share price should rise without bias, *ie* the market does not over-react or under-react.

Note that the answer to this question illustrates some of the ways that stock markets tend not to be fully efficient, *ie* information is not fed into share prices immediately and without bias.

Question

Is the following statement true or false?

'The semi-strong form of the Efficient Markets Hypothesis suggests that no investor will 'beat' the market in the long term.'

Solution

The laws of probability suggest that some investors will achieve returns in excess of the market even over the long term purely by chance. For example, they might happen to be holding a particular company's shares when some 'good' news is announced. However, the Efficient Markets Hypothesis suggests that no one will be able to do so systematically unless:

- they accept a higher level of risk than exhibited by the market as a whole, or
- they have inside information.

The chapter summary starts on the next page so that you can keep all the chapter summaries together for revision purposes.

Chapter 1 Summary

The Efficient Markets Hypothesis (EMH)

In an *efficient* security market the price of every security fully reflects all available and relevant information. The EMH states that security markets *are* efficient.

Three forms of the EMH are commonly distinguished:

1. *Weak form* – market prices incorporate all of the information contained in historical price data. If markets are weak form efficient, then technical analysis cannot be used to generate excess risk-adjusted returns.
2. *Semi-strong form* – market prices incorporate all publicly available information. If markets are semi-strong form efficient, then fundamental analysis cannot be used to generate excess risk-adjusted returns.
3. *Strong form* – market prices incorporate all information, whether or not it is publicly available. If markets are strong form efficient, then insider trading cannot be used to generate excess risk-adjusted returns.

In practice the level of efficiency depends on whether information is freely available, which in turn may depend on the level of disclosure required by regulation.

The importance of market efficiency derives from the fact that if markets are *inefficient* then investors with better information may be able to generate higher investment returns. If, however, they are efficient then active investment management is difficult to justify.

Tests of the EMH

Tests of the EMH are fraught with difficulty. Consequently, the empirical evidence is inconclusive concerning the extent to which security markets are in fact efficient in practice. However:

- studies of directors' share dealings suggest that, even with inside information, it is difficult to out-perform
- studies have failed to identify a difference between the returns on stocks selected using technical analysis and those from purely random stock selection
- research has concentrated on the semi-strong form of the EMH and in particular tests of informational efficiency and volatility tests.

Informational efficiency

Many studies show that the market over-reacts to certain events and under-reacts to other events. The over/under-reaction is corrected over a long time period. If this is true then traders could take advantage of the slow correction of the market, and efficiency would not hold.

Over-reaction to events

- Past winners tend to be future losers and the market appears to over-react to past performance.
- Certain accounting ratios appear to have predictive powers, an example of the market apparently over-reacting to past growth.
- Firms coming to the market have poor subsequent performance.

Under-reaction to events

- Stock prices continue to respond to earnings announcements up to a year after their announcement.
- Abnormal excess returns for both the parent and subsidiary firms following a de-merger.
- Abnormal negative returns following mergers.

Volatility tests

Shiller first formulated the claim of 'excessive volatility' into a testable proposition in 1981. He found strong evidence that the observed level of volatility contradicted the EMH. However, subsequent studies using different formulations of the problem found that the violation of the EMH only had borderline statistical significance. Numerous criticisms were subsequently made of Shiller's methodology. These criticisms covered:

- the choice of terminal value for the stock price
- the use of a constant discount rate
- bias in estimates of the variances due to autocorrelation
- possible non-stationarity of the series, *ie* the series may have stochastic trends that invalidate the measurements obtained for the variance of the stock price.

Chapter 1 Practice Questions

1.1 A researcher has analysed the annual returns of equity stocks in a particular country over a 10-year period and has made the following observations:

Exam style

(a) Annual market returns in consecutive years have a negative correlation of –0.25.

(b) The closing value of the index of the 100 stocks with the highest market capitalisation has been found to be 1% higher on average on Fridays than on Mondays.

(c) Announcements of changes in companies' dividend policies typically take three months to become fully reflected in the quoted share price.

(d) The prices of a particular subset of stocks have been consistently observed to fall immediately following a favourable announcement and to rise immediately following an unfavourable announcement.

Discuss these observations in the light of the EMH. [4]

1.2 Discuss the following statement:

Exam style

The existence of fund managers who sell their services based on their alleged ability to select over-performing sectors and stocks and so add value to portfolios demonstrates that capital markets are not efficient. [6]

1.3 (i) Describe what is meant by an 'efficient market'.

(ii) Describe the three different forms of the Efficient Markets Hypothesis.

(iii) Discuss the implications of the Efficient Markets Hypothesis.

1.4 At the quarterly meeting of the Auger Close Investment Club, four members are making proposals for new equity investment for the club.

Exam style

Anna wants to buy shares in Armadillo Adventures, claiming that they have performed poorly in recent weeks and are due an upturn.

Brian wants to invest in Biscuits-R-Us. They have recruited a new head of marketing, who has had success at other companies. Brian feels that this new appointment will have a positive effect on the firm.

Cathy selects shares at random. This quarter she is recommending the club buy into Cash 4 Kidneys PLC.

Dennis wants the club to buy shares in Diamond Dentists ('DD'). His brother works for a major health insurer and has insider information that DD's shares will rise sharply in the near future, when it is announced that his company has appointed DD as its 'dentist of choice'.

For each club member, describe how their share selection strategy would work in strongly efficient, semi-strongly efficient, weakly efficient and inefficient markets. [7]

1.5 (i) Explain what is meant by an 'excessively volatile' market. [2]

Exam style

(ii) Describe how you would test if a market is 'excessively volatile'. [7]

(iii) Explain the practical and conceptual difficulties in using a test of an excessively volatile market to establish whether or not a market is efficient. [4]

[Total 13]

1.6 (i) Explain the implications of the Efficient Markets Hypothesis for investment trading strategies.

(ii) Explain why investors will still wish to have as much information as possible concerning a company and its securities before investing in it even if the Efficient Markets Hypothesis applies.

Chapter 1 Solutions

1.1 (a) ***Annual market returns are negatively correlated***

This observation suggests that, over annual time periods, the market tends to systematically overreact to new information and hence that the market may not be semi-strong form efficient. [½]

In addition, trading rules could be developed based on this information that could generate excess, risk-adjusted returns, which suggests that this observation is inconsistent with the weak form of the EMH. [½]

(b) ***The index is higher on Fridays than on Mondays***

The observation suggests that there is a consistent tendency for prices on Fridays to be 'inflated', while prices on Mondays are 'depressed', *ie* there is a systematic bias present in the prices. [½]

Trading rules could be developed based on this information (*eg* buy on Monday, sell on Friday) that could generate excess, risk-adjusted returns, which suggests that this observation is inconsistent with the weak form of the EMH. [½]

(c) ***Announcements take three months to be reflected***

If the semi-strong form of the EMH holds, public dividend announcements should have an immediate effect on the share prices as the market should respond quickly and accurately to new information. [½]

This observation suggests that the market is not semi-strong form efficient. [½]

(d) ***Prices fall following a favourable announcement***

The prices are reacting when information is made public. This suggests that the prices have previously been distorted by insider information. [½]

Therefore, this observation contradicts the strong form of the EMH. [½]

[Total 4]

Note that, once a particular form of the EMH is contradicted, this also contradicts any of the stronger forms.

1.2 The Efficient Markets Hypothesis (EMH) suggests that it is not possible to achieve excess risk adjusted investment returns using investment strategies based only on certain subsets of information. The existence of fund managers who sell their services based on their alleged ability to select over-performing sectors and stocks does not demonstrate that capital markets are inefficient. [1]

In particular, the semi-strong form of the EMH suggests that excess risk-adjusted investment returns cannot be obtained using only publicly available information. [½]

In certain investment markets, it may therefore be possible (and legal) to achieve excess returns using privileged or inside information, which would not contradict the semi-strong form of the EMH. [½]

More generally, the EMH does not preclude managers achieving higher investment returns by adopting 'riskier' investment strategies and receiving due reward for the risks taken. [½]

It says precisely that it is not possible to develop investment strategies that yield excess risk-adjusted returns – though it is difficult to determine exactly how risk should be interpreted in this context. [½]

Some fund managers must necessarily achieve higher than average returns over a given short time period – *eg* several years. The point of the EMH is that managers cannot consistently achieve above excess returns. Moreover, they cannot guarantee to achieve excess returns over any particular time period. [1]

Finally, rather than reflecting any market inefficiency in contradiction of the EMH, the existence of such managers may instead reflect the following facts:

- Individual investors may be unaware of the EMH or choose not believe it and hence may be inclined to believe the claims of such managers and so place money with them. [½]
- Certain individual investors may choose to believe the claims of such managers, reflecting the fact that investment decisions are often made on the basis of subjective and emotional factors, in addition to, or instead of, on the basis of financial theory. [1]

For the above reasons, the existence of such fund managers does not therefore demonstrate that capital markets are inefficient. [½]

[Total 6]

1.3 (i) ***Definition of efficient market***

An efficient market is one in which every security's price equals its investment value at all times.

In an efficient market information is fully reflected in the price.

This means that share prices adjust instantaneously and without bias to new information.

(ii) ***Three forms of Efficient Markets Hypothesis***

The strong form requires that prices reflect all information that is currently known – whether or not it is publicly available.

The semi-strong form requires that prices reflect all information that is publicly available.

The weak form requires that prices fully reflect all information contained in the past history of prices.

(iii) ***Implications of the Efficient Markets Hypothesis***

The past history of prices is a subset of publicly available information, so a market must be weak form efficient if it is semi-strong form efficient. Similarly, if it is strong form efficient it must also be semi-strong and weak form efficient.

The Efficient Markets Hypothesis does not imply that beating the market is impossible, since investors could out-perform the market by chance, or by accepting above average levels of risk.

However, it does imply that it is not possible consistently to achieve superior risk-adjusted investment performance net of costs without access to superior information.

Weak form efficiency implies that it is impossible to achieve excess risk-adjusted investment returns purely by using trading rules based upon the past history of prices and trading volumes. It therefore suggests that technical analysis cannot be justified.

If only weak form efficiency applies, excess risk-adjusted returns are still possible by good fundamental analysis of public information.

The semi-strong form means that prices adjust instantaneously and without bias to newly published information. This implies that it is not possible to trade profitably on information gained from public sources. So neither fundamental analysis (without insider information) nor technical analysis will yield excess risk-adjusted returns.

Fundamental analysis may still, however, aid investors in selecting the investments that are most suitable for meeting their investment needs and objectives.

If the strong form is correct then the market reflects all known knowledge about the company and consequently excess risk-adjusted returns are possible only by chance. This implies that insiders cannot profit from dealing on inside information, *ie* insider trading is not profitable.

1.4 ***Anna***

Anna makes her recommendation based on the past price history of the investment. If weak form EMH holds, then the current share price already reflects the information contained in the past price history, so there would be no advantage in using this approach. [1]

Similarly, if the semi-strong or strong form of EMH holds, there is no advantage in using this approach. [½]

If the market was inefficient, Anna's strategy may be beneficial. [½]

Brian

Brian makes his recommendation based on company information that is in the public domain. If semi-strong form EMH holds, then the current share price already reflects relevant public information, so there would be no advantage in using this approach. [1]

Similarly, if the strong form of EMH holds, there is no advantage in using this approach. [½]

If the market is inefficient or only weak form efficient, Brian's strategy may be beneficial. [½]

Cathy

The approach of choosing stocks at random provides no advantage, whatever the level of market efficiency. [½]

If strong form EMH holds, this strategy is no worse than any other. [½]

Dennis

Dennis makes his recommendation based on insider information. If strong form EMH holds, then the current share price already reflects all relevant information, so there would be no advantage in using this approach. [1]

If the market is inefficient or weak or semi-strong form efficient, Dennis's strategy may be beneficial (though it could be questionable on ethical grounds). [1]

[Total 7]

1.5 (i) ***Excessively volatile markets***

An excessively volatile market is one in which the changes in the market values of stocks (the observed volatility) are greater than can be justified by the news arriving. This is claimed to be evidence of market over-reaction, which is not compatible with efficiency. [2]

(ii) ***Testing if a market is excessively volatile***

To test if a market is excessively volatile you need a long history of prices and cashflows for one of the securities in question – *eg* for the market in a particular equity, you would need many months or years of share prices and dividend payments. [1½]

A discounted cashflow model based on the actual dividends that were paid and some terminal value for the share could then be used to calculate a perfect foresight price for the equity. This would represent the 'correct' equity price if market participants had been able to predict future dividends correctly. [1½]

The difference between the perfect foresight price and the actual price arises from the forecast errors of future dividends. If market participants are rational, there should be no systematic forecast errors. [1½]

Also if markets are efficient, then broad movements in the perfect foresight price should be correlated with moves in the actual price as both are reacting to the same news and hence the same changes in the anticipated future cashflows. [1½]

If instead the actual price changes are greater, then this would suggest that the market in the particular equity is excessively volatile. [1]

[Total 7]

This was the approach adopted by Shiller.

(iii) ***Practical and conceptual difficulties***

These include:

- the difficulty of choosing an appropriate terminal value for the share price [1]
- the difficulty of choosing an appropriate discount rate at which to discount future cashflows – in particular, should it be constant? [1]
- possible biases in the estimates of the variances because of autocorrelation in the time series data used [1]
- possible non-stationarity of the time series data used, *ie* it may have stochastic trends which invalidate the measurements obtained for the variance of the stock price [1]
- the distributional assumptions underlying the statistical tests used might not be satisfied [½]
- the distributional characteristics of the share prices and dividends are unlikely to remain constant over a long period of time. [½]

[Maximum 4]

1.6 (i) ***Implications of the Efficient Markets Hypothesis***

The Efficient Markets Hypothesis implies that it is impossible, except by chance, to make abnormal profits using trading strategies that are based on only past share prices (weak form), publicly available information (semi-strong form) or any information (strong form).

In practice, however, the definition has sometimes been refined to preclude the possibility of systematically higher returns after allowing for transaction costs.

Market efficiency also implies that active investment management (which aims to enhance returns by identifying under- or over-priced securities) cannot be justified and consequently provides a rationale for passive investment management strategies, such as index tracking.

(ii) ***Information***

Even if markets are efficient, investors will still wish to have as much information as possible concerning a company and its securities in order to identify the characteristics of the shares, *eg* the volatility of returns, risk, income and capital growth *etc.* An appreciation of these will enable investors to make an informed decision whether or not to hold the security as part of a portfolio designed to meet their investment objectives.