

Artificial Intelligence (AI) for Investments
Prof. Abhinava Tripathi
Department of Industrial and Management Engineering
Indian Institute of Technology, Kanpur

Lecture - 09

In this lesson we will discuss the theory of efficient markets and behavioural finance. In the previous discussions the purpose of holding the firm's capital investment decision constant is to separate the decision from the financing decision. Strictly speaking this assumes that investment and financing decisions are independent in many circumstances, there is a reasonable assumption.

The firm is generally free to change its capital structure by repurchasing one security and issuing another. In that case there is no need to associate a particular investment project with a particular source of cash. The firm can think first about which projects to accept and second about which should be financed sometimes decisions about capital structure depend on project choice or vice versa and in those cases the investment and financing decisions have to be considered jointly.

We start the lesson by contrasting investment and financing decisions, the objective in each case is the same to maximize net present value or NPV. However, it may be harder to find positive NPV financing opportunities the reason it is difficult to add value by clever financing decisions is that capital markets are usually efficient by this we mean that fierce competition between investors eliminates profit opportunities and causes debt and equity issues to be fairly priced.

If you think that sounds like a sweeping statement you are right that is why we have devoted this lesson to explaining and evaluating the efficient market hypothesis. You need to understand that efficient market hypothesis not because it is universally true but because it leads you to ask the right questions. This is so because financing decisions seem overwhelmingly complex therefore, we start our discussion with this conceptual point.

We define efficient market hypothesis in more detail. The hypothesis comes in different strengths depending on the information available to investors then we review the evidence for and against efficient markets. The evidence for is considerable but over the years a number of puzzling

anomalies have accumulated. Advocates for rational and efficient markets also have a hard time explaining bubbles.

Every decade seems to find its own bubble, the 1980s real estate and stock market bubble in Japan, the 1990s technology stock bubble and the recent real estate bubble that triggered the subprime crisis. Part of the blame for bubbles goes to incentive and agency problems that can plague even the most rational people particularly when they are investing other people's money. But bubbles may also reflect patterns of irrational behaviour that have been well documented by behavioural psychologists.

We describe the main features of behavioral finance and the challenges that it poses to efficient market hypothesis. NPV competition for financing decisions, we discussed the computation of NPV of a liability.

(Refer Slide Time: 02:54)

Net Present Value (NPV) : Computation for Financing Decision

- It is helpful to separate investment and financing decisions
 - There are certain similarities between these decisions
 - The decisions to purchase a machine tool and to sell a bond each involves the valuation of a risky asset^b
 - In both cases, we end up computing the net present value
 - As part of its policy of encouraging small businesses, the government offers to lend your firm \$100,000 for 10 years at 3%. This means that the firm is liable for interest payments of \$3,000 in each of the years, 1 through 10 years, and responsible for repaying the \$100,000 in the final year

Although it is helpful to separate investment and financing decisions, there are basic similarities in the criteria for making them. The decisions to purchase a machine tool and to sell a bond each involved valuation of a risky asset. The fact that one asset is real and the other is financial does not matter. In both cases we end up computing net present values. The phrase net present value of borrowing may seem odd to us.

Consider the following example as part of its policy of encouraging small businesses the government offers to lend your firm 100,000 dollars for 10 years at 3 percent. This means that the firm is liable for interest payments of 3,000 dollars in each of the years from 1 to 10 and that it is also responsible for repaying the principal of 100,000 dollars in the final year.

(Refer Slide Time: 03:50)

NPV Computation for Financing Decision

- Should you accept this offer?
 - We can compute the NPV of the loan agreement in the usual way
 - NPV = amount borrowed – present value of interest payments – present value of loan repayment
 - $NPV = +100,000 - \sum_{t=1}^{10} \frac{3000}{(1+r)^t} - \frac{100000}{(1+r)^{10}}$
 - The only missing variable is r, the opportunity cost of capital
 - You need that to value the liability created by the loan

Should you accept this offer? We can compute the NPV of the loan agreement in the usual way the one difference that is the first cash flow is positive and subsequent cash flows are negative. For example, here NPV equal to amount borrowed minus present value of interest payments minus present value of loan repayment.

$$NPV = 100000 - \sum_{t=1}^{10} \frac{3000}{(1+r)^t} - \frac{100000}{(1+r)^{10}}$$

The only missing variable is r - the opportunity cost of capital, you need that to value the liability created by the loan.

(Refer Slide Time: 04:35)

NPV Computation for Financing Decision

- The government's loan to you is a financial asset
 - We can compute the NPV of the loan agreement in the usual way
 - A piece of paper representing your promise to pay \$3,000 per year plus the final repayment of \$100,000
 - It would sell for the present value of those cash flows discounted at r
 - The only missing variable is r , the opportunity cost of capital
 - What interest rate would my firm need to pay to borrow money directly from the capital markets rather than from the government?

We reason this way. The government's loan to you is a financial asset a piece of paper representing your promise to pay 3,000 dollars per year plus the final repayment of 100,000 dollars. How much would that paper sell if freely traded in the capital markets? It would sell for the present value of those cash flows discounted at r , the rate of return offered by other securities issued by your firm.

All you have to do to determine r is to answer the following question. What interest rate would my firm need to pay to borrow money directly from the capital markets rather than from the government?

(Refer Slide Time: 05:18)

NPV Computation for Financing Decision

- Suppose that this rate is 10%
 - $$NPV = +100,000 - \sum_{t=1}^{10} \frac{3000}{(1.10)^t} - \frac{100000}{(1.10)^{10}}$$
 - $NPV = +100,000 - 56,988 = +\$43,012$
 - NPV calculations tell you just how much that opportunity is worth (\$43,012)
 - You don't need any arithmetic to tell you that borrowing at 3% is a good deal when the fair rate is 10%

Suppose this interest rate is 10 percent then,

$$NPV = 100000 - \sum_{t=1}^{10} \frac{3000}{(1.10)^t} - \frac{100000}{(1.10)^{10}}$$

$$NPV = 100000 - 56988 = \$43012$$

Of course, you do not need any arithmetic to tell you that borrowing at 3 percent is a good deal when the fair rate is 10 percent. But the NPV calculations tell you just how much that opportunity is worth that is 43,012.

It also brings out the essential similarity between the investment and financing decisions. To summarize in this video, we found that the NPV computation of liability that is financing is same as that of an asset. The computation offers an important quantitative estimate of the worth of the financing opportunity.

Differences between investment and financing decisions. We compare and contrast the investment and financing decisions.

(Refer Slide Time: 06:23)

Differences Between Investment and Financing Decisions

- Investment decisions and financing decisions differ from each other in contrasting ways
 - Financing decisions do not have the same degree of finality as investment decisions
 - It's harder to make money through smart financing strategies
 - Financial markets are more competitive than product markets
 - It is more difficult to find positive-NPV financing strategies than positive-NPV investment strategies

In some ways investment decisions are simpler than financing decisions, the number of different securities and financing strategies is well into the hundreds. There are also ways in which financing decisions are much easier than investment decisions. First financing decisions do not have the same degree of finality as an investment decisions, they are easier to reverse. Second it is harder to make money by smart financing strategies.

The reason is that financial markets are more competitive than product markets. This means it is more difficult to find positive NPV financing strategies than positive NPV investment strategies.

(Refer Slide Time: 07:01)

Differences Between Investment and Financing Decisions

- Capital investment decisions do not face competitive markets
 - Markets for financing are highly competitive
 - Numerous smart investors supply financing
 - Money flows across different financial markets in a seamless manner
 - Thus, it is expected that financing instruments would be fairly priced

When the firm looks at capital investment decisions it does not assume that it is facing perfect capital markets. It may have only a few competitors that specialize in the same line of business in the same geographical area and it may own some unique assets that gave it an edge over its competitors. Often these assets are intangible such as patents, expertise or reputation. All this opens up the opportunity to make superior profits and find projects with positive NPVs.

In financial markets your competition is all other corporations seeking funds to say nothing of the state local or federal governments that go to New York, London and other financial centres to raise money. The investors who supply financing are comparably numerous and they are smart. Money attracts brains, the financial amateur often views capital markets as segmented that is broken down into distinct centres.

But money moves between those sectors and it usually moves fast. In general, as we shall see firms should assume that the security is the issue are fairly priced, that takes us into the main topic of this chapter that is efficient capital markets. To summarize in this video, we compared the investment in financing decisions while the NPV competition of investment and financing decisions are similar, there are important differences.

For example, unlike the market for investment market for financing is extremely competitive. Hence it is extremely difficult to generate positive NPV financing. What is an efficient market? We will discuss the properties of an efficient market.

(Refer Slide Time: 08:45)

What Is an Efficient Market

- Security prices seem to follow a random walk
 - A process is a random walk process if the successive changes are independent
 - Consider a simple example of a coin-toss game
 - If it comes up heads, you win 3% of your investment; if it is tails, you lose 2.5%
 - The odds each week are the same, regardless of the value at the start of the week or of the pattern of heads and tails in the previous weeks

Security prices seem to follow random work. What is the random work process? A process is a random work process if the successive changes are independent that is the chance of getting an outcome is independent of its historical values. Consider a simple example of a coin tossing game at the end of each week a coin is tossed if it comes up heads you win 3 percent of your investment if it is tails, you lose 2.5 percent. This is a sort of random work losses though not strictly.

In the sense that is the odds each week are the same regardless of the value at the start of the week or of the patterns of heads and tails in the previous weeks.

(Refer Slide Time: 09:26)

What Is an Efficient Market

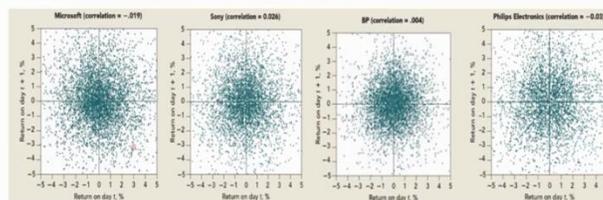
- As per the random walk model, the price changes are independent of one another
 - One can compute correlation coefficients between price changes at each of the successive days
 - If prices persist, then one can expect to find some correlation across price changes
 - No correlation if there is purely a random walk-in price changes

Similarly, as per random walk model the price changes are independent of one another just as the gains and losses in our coin tossing game, they were independent. One can easily set up tests to examine the patterns in these price movements, for example one can compute correlation coefficients between price changes at each of the successive days. If price is persist then one can expect to find some correlation across price changes and no correlation if there is purely a random walk in price changes.

(Refer Slide Time: 09:59)

What Is an Efficient Market

- Consider the following four correlation examples



- For example, the correlation between successive price changes in Microsoft was -0.019
- For Philips, this correlation was also negative at -0.030
- However, for BP and Sony, the correlations were positive at +0.004 and +0.026

Brealey, Myers and Allen, Principles of Corporate Finance, 10th, 11th, or 12th editions, Chapter 13

Consider the following four example of correlations as shown in the figure here, each dot shows a pair of returns for a stock on two consecutive days, the circle dot of Microsoft records a daily return of 3 percent positive and then minus 3 percent on the next day. The scatter diagram shows

no significant relationship between returns on successive days. If price movements persisted the correlation would be positive if there were no relationship it would be 0.

For example, the correlation between successive price changes in Microsoft was minus 0.019 this indicated that there was very simple tendency for price rises to be followed by price falls. For Philips this correlation was also negative at minus 0.30 however for BP and Sony the correlations were positive as plus .004 and plus 0.026 respectively. In these cases, there was a negligible tendency for prices to rise and to be followed by further price rises.

These figures suggest that successive price changes for all four stocks were effectively uncorrelated. Today's price change give investors almost no clue as to the likely change tomorrow. Imagine if this was not the case and that the changes in Microsoft's stock price were expected to persist for several months.

(Refer Slide Time: 11:33)

What Is an Efficient Market

- The Fig. shown here provides an example of such a predictable cycle
 - An upswing in Microsoft's stock price started last month when the price was \$20, and it is expected to carry the price to \$40 next month
 - Since Microsoft stock is a bargain at \$30, investors will rush to buy
 - As soon as a cycle becomes apparent to investors, they immediately eliminate it by their trading



Brealey, Myers and Allen; *Principles of Corporate Finance*. 10th, 11th, or 12th editions. Chapter 13

Now consider the figure shown here that provides an example of such a predictable cycle. You can see that an upswing in Microsoft stock price started last month when the price was 20 dollars and it is expected to carry the price to 40 dollars next month. As soon as the investors perceive this opportunity, they will act on it and it will evaporate immediately. Since Microsoft stock is a bargain at 30 dollars, investors will rush to buy.

They will stop buying only when the stock offers a normal rate of return. Therefore, as soon as the cycle becomes apparent to investors, they immediately eliminate it by trading activity. Such kind of cycle self-destructs as soon as they are recognized by investors. The stock price is instantaneously jumped to the present value of the expected future price. To summarize in this video, we discussed that efficient markets are those where prices follow random walk.

That is future price changes have no correlation with historical price changes. For every period these changes are independent, moreover in these markets any information related to price expectations is swiftly incorporated in prices as investors exploit the new information speedily. Theory of market efficiency, we will discuss the theory of market efficiency and also contrast the theory with the evidence available from real financial markets.

(Refer Slide Time: 13:01)

Theory of Market Efficiency

- Prices in competitive markets must follow a random walk
 - If past price changes could be used to predict future price changes, investors could make easy profits
 - All the information in past prices will be reflected in today's stock price, not tomorrow's
 - No one earns consistently superior returns in competitive markets
 - Thus, collecting more information may not help

As we have discussed that prices in competitive markets must follow a random walk, if past price changes could be used to predict future price changes investors could make easy profits. But in competitive markets easy profits do not last. As investors try to take advantage of the information in past prices, prices are just immediately until the superior profits from studying past price movements disappear.

As a result, all the information in past prices will be reflected in today's stock price not tomorrow's. Patterns in prices will no longer exist and price changes in one period will be independent of

changes in the next. In other words, the share price will follow a random walk. In competitive markets today's stock price must be already reflecting the information in historical prices.

But why stop there? If markets are competitive should not today's stock price reflect all the information that is available to investors. If so, securities will be fairly priced and security returns will be unpredictable. No one earns consistently superior returns in such a market. Collecting more information would not help because all available information is already impounded in today's stock prices.

(Refer Slide Time: 14:27)

Theory of Market Efficiency

- Economists define three levels of market efficiency
 - **Weak market efficiency:** prices reflect the information contained in the record of past prices
 - **Semi-strong form of efficiency:** prices reflect all the public information
 - **Strong form of efficiency:** prices reflect all the available information, including historical prices, public information, and private information
 - In a strong form efficient market, investment managers cannot consistently beat the market

Economists define three levels of market efficiency that are distinguished by the degree of information reflected in security prices. In the first level prices reflect information contained in the record of past prices this is called weak form of market efficiency. If markets are efficient in the weak form sense, then it is possible to make consistently superior profits by studying historical returns.

Prices we follow a random walk the second level of efficiency requires that prices reflect not just the past prices but all other public information. For example, information from the internet or financial press this is known as semi-strong form of market efficiency. If markets are semi-strong form efficient then prices will adjust immediately to public information such as the announcement of the last quarter's earning, a new issue of stock or a proposal to merge two companies.

With strong form market efficiency prices reflect all the information that can be acquired by painstaking analysis of the company and economy. In such a market we would observe lucky and unlucky investors but we would not find any superior investment managers who can consistently beat the market.

(Refer Slide Time: 15:50)

Theory of Market Efficiency

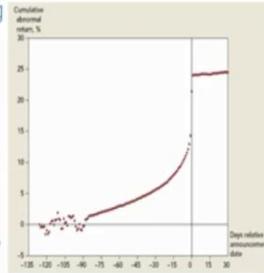
- How to test different forms of efficiencies
 - **Weak market efficiency:** researchers examine the profitability of various technical trading rules employing historical price information
 - **Semi-strong form of efficiency:** researchers examine how fast public information (such as dividend announcements) is incorporate into prices
 - To analyze the semi-strong form of the efficient-market hypothesis, researchers measure how rapidly security prices respond to different items of news, such as earnings or dividend announcements, news of a takeover, or macroeconomic information

In order to test the weak form of a hypothesis researchers measure the profitability of some of the trading rules used by those investors who claim to find pattern in security prices. These are statistical tests to examine the predictability of future prices using current prices. These are mostly time series tests related to forecasting. To analyse the semi-strong form of market hypothesis, researchers measure how rapidly security prices respond to different items of news such as earnings or dividend announcements, news of a takeover or macroeconomic information.

(Refer Slide Time: 16:28)

Theory of Market Efficiency

- Consider an example of news that a company being a target of acquisition coming into public
- The graph shows the abnormal returns on the firms that are target take-overs
- The prices of the target stocks jump up on the announcement day, but from then on, there are no unusual price movements
- The announcement of the takeover attempt seems to be fully reflected in the stock price on the announcement day



Brealey, Myers and Allen; Principles of Corporate Finance, 10th, 11th, or 12th editions, Chapter 13

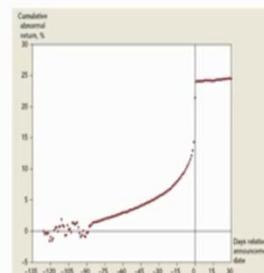
Consider an example of news that a company is being target of acquisition coming into public. It is of great interest to examine how security prices would respond to this news. Consider the figure shown here. The performance of the stocks of target companies compared with that of the market. The prices of the target stocks jump on the announcement day but from then on they are no unusual price movements.

The announcement of the takeover attempt seems to be fully reflected in the stock price on the announcement day.

(Refer Slide Time: 17:03)

Theory of Market Efficiency

- The graph shows the abnormal returns on the firms that are target takeovers
- The acquiring firms usually must pay a substantial takeover premium to get the deal done
- Stock prices drift up before date zero, as investors gradually realize that a takeover may be coming
- Within the day, the new stock prices reflect (at least on average) the magnitude of the takeover premium



Brealey, Myers and Allen; Principles of Corporate Finance, 10th, 11th, or 12th editions, Chapter 13

The graph here shows the abnormal returns on the firms that are target takeovers. Since the acquiring firm usually have to pay a substantial takeover premium to get the deal done the target stock price increases as soon as the takeover bit is announced. The figure here shows the average pattern of the stock's target returns before and after the announcement of a takeover that is day zero in the figure.

Stock prices drift up before date 0 as investors gradually realize that a takeover may be coming. On the announcement day prices jump up dramatically, the stock price adjustment is immediate and complete. After the big price move on the public announcement day the run-up is over and there is no significant further drift in the stock price either upward or downward. Thus, within the day the stock price says reflect at least on average the magnitude of the takeover premium.

(Refer Slide Time: 18:01)

Theory of Market Efficiency

- Strong form of efficiency: tests of the strong form of the hypothesis have examined the recommendations of professional security analysts
- Researchers examine whether mutual funds and pension funds can outperform the market
- Evidence suggests that professionally managed funds fail to recoup the costs of management
- It appears that in some years they do well and not so well in others
- It would be difficult to believe that some managers possess superior abilities to others

Test of strong form of hypothesis have examined the recommendation of professional security analyst and have looked for mutual fund or pension funds that could predictably outperform the market. Some researchers have found a slight persistent outperformance but just as many have concluded that professionally managed funds failed to recoup the cost of management. It has been observed that some years these funds and portfolio managers do better than market but in many more years they do worse as well.

To control for fund specific differences, low beta, and large form stocks each one needs to be compared with a benchmark portfolio of similar securities. Many studies have done this with the following conclusion: the funds earned a lower return than the benchmark portfolios after expenses and roughly match the portfolios before expenses. It would be surprising if some managers were not smarter than others and could earn superior returns.

But it seems difficult to spot the smart ones and the evidence from literature suggests that the top performing managers on a given year have about an average chance of failing on their faces the next year as well.

(Refer Slide Time: 19:16)

Theory of Market Efficiency

- The evidence of efficient markets has convinced many professional and individual investors to give up the pursuit of superior performance
- The implication is less focus on active management as more and more people follow passive investment strategies by investing in market indices over long horizons
- However, if everybody invests in index funds, then nobody will collect new information
- An efficient market needs some smart investors who gather information and attempt to profit from it
- There must be some profits available to allow the costs of information to be recouped

The evidence on efficient markets has convinced many professionals and individual investors to give up the pursuit of superior performance. They simply buy the index which maximizes the diversification and cuts the cost to the bone. Individual investors can buy index funds which are mutual funds that track stock market indices. There is no active management and therefore so costs have become very low.

But how far can indexing go, not 200 percent? If all investors hold index, funds then nobody will be collecting information and prices will not respond to new information when it arrives. An efficient market needs some smart investors who gather information and attempt to profit from it.

To provide incentives together costly information prices cannot reflect all the information. There must be some profits available to allow the cost of information to be recouped.

But if the costs are small relative to the total market value of traded securities, then the financial market can still be close to perfect efficient. To summarize in this video, we discussed that it is extremely difficult to predict prices in financial markets that is they follow random walk model of price changes. The theory of market efficiency suggests three forms of market efficiency that is weak form, semi-strong form and strong form of efficiency.

Weak form efficiency suggests that one cannot predict prices using historical information. Semi-strong form efficiency suggests that one cannot predict prices using publicly available information. Semi-strong form efficiency is the highest form of efficiency that one cannot predict prices using any information including private information, semi-strong form of efficiency suggests that one cannot predict prices using publicly available information.

A strong form efficiency is the highest form of efficiencies suggesting that one cannot predict prices using any information including private information. The evidence against market efficiency we will discuss the evidence against market efficiency, we will also discuss some of the plausible explanations to these violations of market efficiency.

(Refer Slide Time: 21:40)

The Evidence Against Market Efficiency

- Research suggests that there are indeed anomalies that can be exploited and contradict the notion of market efficiency
 - What exactly is an anomaly?
 - In an efficient market, it is not possible to find expected returns greater (or less) than the risk-adjusted opportunity cost of capital
 - $P = \sum_{t=1}^{\infty} \frac{C_t}{(1+r)^t}$; future cash flows (C_t) and the opportunity cost of capital (r)
 - If price equals fundamental value, the expected rate of return is the opportunity cost of capital, no more and no less

Research has concluded that efficient market hypothesis is a remarkably good description of reality. However, a number of research articles in literature suggest that there are indeed anomalies that can be exploited and contradict the notion of market efficiency. What exactly is this anomaly? So, far we have connected market efficiency to the absence of opportunities to make money.

More precisely in an efficient market it is not possible to find expected returns greater or less than the risk adjusted opportunity cost of capital. This implies that every security trades at its fundamental value based on future cash flows that is C_t and the opportunity cost of capital r so the discounted price formula is

$$P = \sum_{t=1}^{\infty} \frac{C_t}{(1+r)^t}$$

If price equals fundamental value, then the expected return is the opportunity cost of capital no more and no less. If price differs from fundamental value, then investors can earn more than the cost of capital by selling if the price is too high and buying when it is too low.

(Refer Slide Time: 22:57)

The Evidence Against Market Efficiency

- The principle tells us that you can't identify a superior return unless you know what the normal expected return is
 - We need an asset pricing model to determine the relationship between the risk and expected returns
 - The most used asset pricing model is the CAPM
 - Several CAPM violations have been found in the literature
 - This includes the abnormally high returns on the stocks of small firms vis-à-vis large firms
 - Investors may demand higher returns for bearing the risk associated with small stocks

This comes from the principle of common stock valuation. However, the principal tells us that you cannot identify superior returns unless you know what the normal expected return is. Therefore, if you try to determine whether a market is efficient you usually have to adopt an asset pricing model that specifies the relationship between risk and expected return. Any test of market efficiency is then essentially a combined test of efficiency and the asset pricing model.

Any test of an asset pricing model is also a combined test of the model and market efficiency. The most commonly used asset pricing model is CAPM. A number of CAPM violations have been found in the literature, this includes the abnormally high returns on the stocks of small firms, vis-a-vis large firms. Now this may mean one or many of the several things, first it could be that investors have demanded a higher expected return from small firms to compensate for some risk factor that is not captured in the simple capital asset pricing model.

Those who believe that the small firm effect is a pervasive phenomena can point to the fact that small firm stocks have provided a higher return in many other countries. However, it is also observed that the small firm effect seems to have disappeared as it is documented. Third, the small form effect would be important exception to the efficient market theory.

An exception that gave investors the opportunity for consistently superior returns over a period of several decades.

(Refer Slide Time: 24:32)

The Evidence Against Market Efficiency

- If these anomalies offer easy pickings, you expect to find a number of investors eager to take advantage of them
 - However, this seems to be surprisingly difficult for investors to get rich by picking these
 - Some of the calendar anomalies include day of the week effect
 - Long-term investors are usually less concerned with these short-term mispricing
 - They are more interested in long-lasting inefficiencies such as the earnings announcement puzzle and new issue puzzle

If these anomalies offer easy pickings you would expect to find the number of investors eager to take advantage of them. It turns out that while many investors do try to exploit such anomalies it is surprisingly difficult to get rich by doing so. We have built on the small firm effect but there is

no shortage of other puzzles and anomalies. Some of them relate to the short-term behaviour of stock prices for example returns appear to be higher in January than in other months.

They seem to be lower on Monday than on other days of the week and most of the daily returns come at the beginning and end of the day. Long-term investors are usually less concerned with these short-term risk pricings, they are more interested in the long-lasting inefficiencies such as the earnings announcement puzzle. It seems that investors under react to the earnings announcement and become aware of the full significance only as the further information arise.

The new issue puzzle when firms issue stock to the public investors typically rush to buy. On average those lucky enough to receive the stock receive an immediate gain. However, researchers have found that these early gains often turn into losses.

(Refer Slide Time: 25:53)

The Evidence Against Market Efficiency

- Another interesting phenomenon is bubbles and market efficiency
 - Bubbles: prices can no longer be justified with fundamentals
 - Valuation of stocks from scratch through methods such as dividend growth model is extremely difficult
 - Easier to estimate tomorrow's price relative to today's price
 - When investors lose confidence in prices, prices become inefficient and volatile
 - Most of the tests of market efficiency are concerned with relative prices and focus on whether there are easy profits to be made

Another interesting phenomena is bubbles and market efficiency. There are cases where prices can no longer be justified with fundamentals, valuation of stocks from scratch through methods such as dividend growth model is extremely difficult. As the assumptions related to growth and opportunity costs are very difficult to make. It is often easier for investors to price a common stock related to yesterday's price or related to today's price of comparable securities.

In other words, they generally take yesterday's prices correct adjusting upward or downward on the basis of today's information. If information arrives smoothly then as time passes investors become increasingly confident that today's price level is correct but when investors lose confidence in the benchmark of yesterday's price there may be a period of confused trading and volatile prices before a new benchmark established.

Second most of the tests of market efficiency are concerned with relative prices and focus on whether there are easy profits to be made. It is almost impossible to test whether stocks are correctly valued because no one can measure true value with any precision with methods such as dividend growth model and stay confident about it.

(Refer Slide Time: 27:10)

The Evidence Against Market Efficiency

- It may be impossible to prove that market levels are, or are not, consistent with fundamentals
 - Now and again investors seem to be caught up in a speculative frenzy, and asset prices are inflated much beyond fundamentals
 - Bubbles can result when prices rise rapidly, and more and more investors join the game on the assumption that prices will continue to rise
 - Lots of money is lost when these bubbles burst

It may be possible to prove that market levels are or are not consistent with fundamentals. However, every now and again investors seem to be caught up in a speculative frenzy and asset prices then reach levels that at least with hindsight cannot be easily justified by the hope outlook for profits and dividends. Investors refer to such occasions as bubbles, bubbles can result when prices rise rapidly and more and more investors join the game on the assumption that prices will continue to rise.

These bubbles can be self-sustaining for a while it can be rational to jump on the bandwagon as long as you are sure that there will be greater fools that you can sell out but remember that lots of money will be lost perhaps by you when the bubbles burst. For example, dot com bubble of 2010

Japanese stock market bubble from 1990s. To summarize in this video, we discussed that efficient market theory is a reasonably good description of market reality.

To summarize in this video, we discussed that efficient market theory is a reasonably good description of market reality. However, over the years a number of anomalies have been observed such as day of the week effect, month of the year effect, small firm effect etcetera. Many of these anomalies have disappeared once identified by the investors various plausible explanations have been offered to explain these anomalies.

First it is extremely difficult to assert the fundamental price and therefore difficult to maintain with the price that is different from the fundamental prices. Often the examination of market efficiency is also a test of asset pricing model that is how accurately that asset pricing model is held. Next many times anomaly may not indeed be an anomaly but additional returns may be the compensation for some unidentified risk factor.

For example, small firm effect is considered as a premium desired by the investors to hold small stocks as they may be considered risky. Many times, markets are not consistent with the fundamentals and in such scenarios the bubbles burst leading to huge losses.

Investor psychology and behavioural finance, we discussed the behavioural aspects that drive prices away from their fundamental and efficient values.

(Refer Slide Time: 29:34)

Investor Psychology and Behavioral Finance

- Often, prices depart from fundamental values
 - This may be so because people are not rational all the times
 - This manifests in their attitude toward risk: people are particularly loath to incur losses
 - Prospect theory: investors are more averse to losing than their affinity toward gain
 - Beliefs about probabilities: investors often make errors in assessing the probability of uncertain events
 - They place higher weights on more recent events

Often prices depart from fundamental values. One of the interesting explanations provided by behavioural psychology is that people are not 100 percent rational 100 percent of the times. They showed up investors attitudes to risk and the way they assess probabilities. We will discuss these aspects one by one. First attitudes towards risk. Psychologists have observed that while making risky decisions people are particularly road to incur losses.

It seems that investors do not focus solely on the current value of their holdings but look back at whether their investments are showing as a profit or loss. For example, if I sell my holding of IBM stock for 10,000 dollars I may feel on the top of the world if the stock only cost me 5,000 dollars but I will be much less happy if it had cost 11,000 dollars. This observation is the basis for prospect theory.

Prospect theory states that the value investors place on a particular outcome is determined by the gains or losses that they have made since the asset was acquired or the holding last attribute and the investors are particularly averse to the possibility of even a very small loss and need a high return to compensate for it. Next, we have beliefs about probabilities. Investors often make errors in assessing the probability of uncertain events.

Psychologists have found that when judging possible future outcomes investors individually tend to look back at what happened in a few similar situations. As a result, they are led to place too

much weight on the small number of recent events. For example, an investor might judge that an investment manager is particularly skilled because he has beaten the market for three years in a row or that three years of rapidly rising prices are good indication of future profits from investing in the stock market.

The investor may not stop to reflect on how little one can gain or learn about the expected returns from three years experience.

(Refer Slide Time: 31:46)

Investor Psychology and Behavioral Finance

- Also, investors are slow in updating their beliefs in the presence of new evidence
- Most investors are systematically biased due to overconfidence and consider themselves better-than-average stock pickers
- Such biases help in anomalies and bubbles
- Limits to arbitrage: these are limits to which smart investors can carry out arbitrage and drive prices toward efficient values
- Arbitrage is an investment strategy aimed to generate guaranteed superior returns without any risk
- However, these are not as risk-free as the theory might suggest

Also, very individuals are too conservative in their nature that is they are too slow to update their beliefs in the face of new evidence. People tend to update their beliefs in the correct direction but the magnitude of the change is less than rationally or rationality would require. Another systematic bias is overconfident investors that is overconfidence. Most investors think they are better than average stock pickers.

Two speculators who trade with each other cannot make money both at the same time but may be prepared to continue trading because each is confident that he is better than the other. Overconfidence shows up in the certainty that people express about their judgments they consistently overestimate the odds that the future will turn out as they say and underestimate the chances of unlikely events. These behavioural biases help in explaining anomalies such as bubbles.

(Refer Slide Time: 32:49)

Investor Psychology and Behavioral Finance

- For example, trading costs can be significant, and some trades are difficult to execute
- To sell a stock short, you borrow shares from another investor's portfolio, sell them, and then wait hopefully until the price falls and you can repurchase the stock back for less than you sold it for
- If you're wrong and the stock price increases, then sooner or later, you will be forced to repurchase the stock at a higher price (therefore at a loss) to return the borrowed shares to the lender
- In addition, there are costs and fees to be paid, and in some cases, you will not be able to find shares to borrow

As prices rise, they generated increased optimism about the future and stimulated additional demand. The more that investors like the profits, the more confident they become in their views and the more willing they are to bear the risk that next month may not be so good. Next you have limits to arbitrage, there are plenty of hard headed professional investors managing huge sums of money.

Why do not these investors bail out of overpriced stocks and force their prices down to their fair values? One reason is that there are limits to arbitrage that are limits on the ability of rational investors to exploit marketing efficiencies. Strictly speaking arbitrage means an investment strategy that guarantees superior returns without any risk. In practice arbitrage is defined more casually as a strategy that exploits market efficiency and generates superior returns and when prices return to fundamental values.

Such strategies can be very rewarding but they are rarely risk-free. In an efficient market if prices get out of line, then arbitrage forces them back. The arbitrageur buys the under-priced securities pushing up their prices and sells the overpriced security is pushing down their prices. The arbitrageur earns a profit by buying low and selling high and waiting for prices to converge to fundamentals.

Thus, arbitrage trading is often called converges trading. In practice arbitrage is harder than it looks trading costs can be significant and some trades are difficult to execute. For example, suppose that you identify an overpriced security that is not in your existing portfolio then you want to sell high but how do you sell a stock that you do not own. It can be done but you have to sell the stock short.

To sell a stock short you borrow shares from another investor's portfolio sell them and then wait hopefully that until the price falls and you can buy this stock back for less than what you sold it for. If you are wrong and the stock price increases then sooner or later you will be forced to repurchase the stock at a higher price and therefore at a loss to return the borrowed shares to the lender.

But if you are right and the price does fall you purchase you repurchase pocket the difference between the sale and purchase prices and return the borrowed shares. In addition, there are costs and fees to be paid and, in some cases, you will not be able to find the shares to borrow. To summarize in this video, we discussed that often individuals do not behave rationally these behavioural aspects cause or dry prices away from their efficient values.

For example, people are particularly averse to losses they often put additional way to more recent events in the probabilities, also there are limits to arbitrage. These issues force prices to remain away from their fundamental values over considerably long periods of time. Key implications of market efficiency, we will discuss the practical implications of market efficiency for real world markets.

(Refer Slide Time: 36:00)

Key Implications of Market Efficiency

- The efficient-market hypothesis emphasizes that arbitrage will rapidly eliminate any profit opportunities and drive market prices back to fair value
 - Lesson 1: Markets Have No Memory: the weak form of the efficient-market hypothesis states that the sequence of past price changes contains no information about future changes
 - Lesson 2: Trust Market Prices: in an efficient market, you can trust prices, for they impound all available information about the value of each security
 - Lesson 3: Read the Entrails: if the market is efficient, prices impound all available information; and therefore, can tell us a lot about future worldview of that stock

The efficient market hypothesis emphasizes that arbitrage will rapidly eliminate any profit opportunities and drive market prices back to their fair values. Behavioural finance specialists may concede that there are no easy profits but argue that arbitrage is costly and sometimes slow working. So, that deviations from fair value may persist sorting out the puzzles will take time but we suggest that financial managers should assume at least as a starting point that there are no free lunches to be had in financial markets.

The no free lunch principle gives us the following six lessons of market efficiency. Lesson one, is markets have no memory that is the weak form of efficient market hypothesis which states that the sequence of past price changes contain no information about future changes. Economists expressed the same idea more concisely when they say that the market has no memory, sometimes financial managers seems to act as if this was not the case.

For example, after an abnormal market price managers prefer to issue equity rather than debt. The idea is to catch the market while it is high, similarly, they are often reluctant to issue stock after a fall in prices. The second lesson is trust market prices. In an efficient market you can trust prices for they impound all the available information about the value of each security. This means that in an efficient market there is no way for most investors to achieve consistently superior returns.

To do so you do not only have to know more than anybody anyone else you also need to know more than everybody else. This message is important for the financial manager who is responsible for the firm's exchange rate policy or for its purchases and sales of debt. If you operate on the basis that you are smarter than others are predicting currency changes or interest rate movements instead of using consistent rational financial policy you will act on the whims and fancies that may prove wrong very often.

Third lesson is read the entrails. If market is efficient prices impound all the available information. Therefore, if we can only learn to read the entrails security prices can tell us a lot about the future. The market's assessment of the company security can also provide important information about the firm's prospect. Thus, if a company's bonds are trading at low prices, you can reduce that the firm is probably in trouble.

Consider the following example, suppose that investors are confident that interest rates are said to rise over the next year. In that case they will prefer to wait before they make long-term loans and any firm that wants to borrow long-term money today will have to offer the inducement of higher rates of interest. In other words, the long-term rate of interest will have to be higher than the one-year rate.

Differences between these long-term interest rate and the short-term interest rate tell you something about what investors might expect to happen to short-term rates in future.

(Refer Slide Time: 39:10)

Key Implications of Market Efficiency

- The efficient-market hypothesis emphasizes that arbitrage will rapidly eliminate any profit opportunities and drive market prices back to fair value
 - Lesson 4: There Are No Financial Illusions: investors are only concerned with the firm's cash flows and the portion of those cash flows to which they are entitled
 - Lesson 5: The Do-It-Yourself Alternative: in an efficient market, investors will not pay others for what they can do equally well themselves
 - Lesson 6: Seen One Stock, Seen Them All: investors don't buy a stock for its unique qualities; they buy it because it offers the prospect of a fair return for its risk. This means that stocks are like perfect substitutes for each other

Lesson four is that there are no financial illusions, in an efficient market there are no financial illusions. Investors are only concerned with the firm's cash flows and the proportion of those cash flows to which they are entitled. However, there are occasions on which managers seem to assume that investors suffer from financial illusion. For example, some firms devote considerably long-time ingenuity to the task of manipulating earnings reported to stockholders.

This is done by creative accounting that is by choosing accounting methods that stabilize and increase reported earnings. Presumably firms go to this trouble because management believes that stockholders take the figures at face value. The theory of efficient markets suggests that investors cannot be fooled by such financial illusion. Lesson number five is do it yourself native. In an efficient market investors will not pay others for what they can do equally well for themselves.

As we shall see many of the controversies in corporate financing centre on how well individuals can replicate corporate financial decisions. For example, companies often justify mergers on the grounds that they produce a more diversified and hence more stable firm. But if investors can hold the stocks of both companies, why should they thank the companies for diversifying. It is much easier and cheaper for them to diversify than it is for the firm.

The financial manager needs to ask the same question when considering whether it is better to shoot debt or common stock. If the firm issues debt it will create financial leverage as a result the

stock will become more risky and it will offer higher expected return. But stockholders can obtain financial leverage without the firm's issued debt they can borrow on their own accounts. The problem for financial manager is therefore to decide whether the company can issue debt more cheaply than individuals shareholders.

Lesson number six Seen one stock, Seen them all. Investors do not buy a stock for its unique qualities they buy it. Because it offers the prospect of a fair return for its risk this means that stocks are likely to be perfect substitutes to each other. Therefore, the demand for a company stock should be highly elastic if its prospective return is low related to its risk nobody will want to hold that stock. If the reverse is true that, is it offers higher return related to its risk everybody will want to buy that stock.

(Refer Slide Time: 41:52)

Key Implications of Market Efficiency

- The efficient-market hypothesis emphasizes that arbitrage will rapidly eliminate any profit opportunities and drive market prices back to fair value
 - Lesson 1: Markets Have No Memory
 - Lesson 2: Trust Market Prices
 - Lesson 3: Read the Entrails
 - Lesson 4: There Are No Financial Illusions
 - Lesson 5: The Do-It-Yourself Alternative
 - Lesson 6: Seen One Stock, Seen Them All

To summarize in this video, we discussed the implications of efficient market hypothesis for real markets starting with first markets have no memory and future changes in prices are independent of historical changes. Second markets are the best judge for company prospects and therefore prices reflect what to expect about the firm in future. Third on average one should trust markets and not on the supremacy of financial managers.

Fourth investors cannot be fooled by artificially manipulating financial statements that is creating financial illusions. Fifth investors do not remark reward financial markets for the actions that they

can themselves replicate at cheap costs. And finally, six stocks are perfect substitutes to each other that is if one stock offers lower expected return corresponding to its risk then nobody will hold it and if it offers higher risk adjusted returns then everybody will hold it.

Competition with investors will tend to produce an efficient market. In such a market prices will rapidly impound any new information and it will be difficult to make consistently superior returns. We may indeed hope but all we can rationally expect in an efficient market is a return just sufficient to compensate us for the time value of money and for the rest we bear. The efficient market hypothesis comes in three different flavours the weak form of the hypothesis states.

That prices efficiently reflect all the information in the past series of stock prices. In this case it is impossible to earn superior return simply by looking for patterns in stock prices. In other words, prices change are random the semistrong form of the hypothesis states that prices reflect all published information that means it is impossible to make consistently superior returns just by reading the newspaper looking at the company's annual accounts and so on.

The strong form of the hypothesis states that stock prices effectively impound all available information. It tells us that superior information is hard to find because in pursuing it you are in competition with thousands perhaps millions of active intelligent and greedy investors. The best you can do in this case is to assume that securities are fairly priced. Limits to Arbitrage can explain why assets may get out of line with fundamental values.

Behavioral finance which relies on psychological evidence to interpret investor behaviour is consistent with many of the deviations from market efficiency. Behavioral finance says that investors are averse to even small losses especially when recent investment returns have been disappointing, investors may rely too much on a few recent events in predicting the future. They may be overconfident in their predictions and may be sluggish in reacting to new information.