Corporate Finance

Reader

Prepared by

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2018.

Methodological expert:

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Preface

Corporate Finance comprises two courses: the related lecture and the seminar. The aim of the courses is to provide a comprehensive overview of the most important topics in Corporate Finance at bachelor level and to introduce how corporations make financial decisions. This reader is based on renowned corporate finance textbooks, such as Brealey, Myers and Allen's „Principles of Corporate finance", Damodaran's „Applied Corporate Finance" and Ross, Westerfield and Jordan's „Fundamentals of Corporate Finance". It is designed to follow the structure of the course and to make a contribution to mastering professional competencies of the students. This reader presents a theoretical framework used to address issues in project appraisal and valuation and it provides the students with the tools required for further studies in financial intermediation and investment. Each chapter is followed by a set of basic questions on both numerical and conceptual topics mainly excerpted from the referred textbooks. This reader includes sample tests and exams also.

2018.08.03.
Lecturer: Andreász KOSZTOPULOSZ

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Course information

Course title: CORPORATE FINANCE

Course code:

60C103 Lecture

60C104 Seminar

Credit: 3

Type: lecture and seminar

Contact hours / week: 1+1

Evaluation: Lecture: exam mark (five-grade), Seminar: practical course mark (five-grade)

Semester: 4th

Prerequisite course: Introduction to Finance

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Learning Outcomes

a) regarding knowledge, the student
- has a clear idea of the basic characteristics of the corporations' financial decisions
- is familiar with the concept of time value of money
- understands the relationship between risk and return
- is familiar with the basics of the asset valuation
- is aware of the guidelines and the planning, analysis, evaluating and implementing tools and methods of the financial management of resources and production factors
-has a good command of the basic linguistic terms used in the field of corporate finance

b) regarding competencies, the student
- is capable of calculating the financial consequences of economic processes and organisational events;
- can employ problem solving techniques in the preparation of corporate financial decisions with regard to their application requirements and limits;
- can cooperate with the financial managers of the firm;

c) regarding attitude, the student
- Behaves in a proactive, problem oriented way to facilitate quality work. As part of a project or group work the student is constructive, cooperative and initiative.
- Is open to new information, new professional knowledge and new methodologies. The student is also open to take on task demanding responsibility in connection with both solitary and cooperative tasks. The student strives to expand his/her knowledge and to develop his/her work relationships in cooperation with his/her colleagues.
- Is sensitive to the changes occuring to the wider economic and social circumstances of his/her job, workplace or enterprise. The student tries to follow and understand these changes.
- Is accepting of the opinions of others.

d) regarding autonomy, the student
- prepares and presents tasks and projects related to financial decisions independently or under general professional supervision
- conducts the tasks defined in his/her job description;
- takes responsibility for his/her analyses,
conclusions and decisions.

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Requirements

For the seminar (60C103): the practical course mark (five-grade) is based on the results of the two mid-term tests written during the semester. Opportunity to retake the mid-term test: once at the end of the semester. 51% of the points have to be collected in order to pass.

For the lecture (60C104): written exam during the examination period. Questions will cover the material of both the lecture and the seminar. At the end of the semester a grade based upon the tests will be proposed (if you accept it, you do not have to write the exam in the examination period).

Exam: written test in the examination period. Only those students who had passed the seminar (have grade „2" or better) may take the lecture exam. 51% of the points have to be collected in order to pass. Numerical calculator as well as annuity and discount tables can be used at the exam and the tests.

Class attendance is not compulsory but recommended as well as continuous (weekly) learning and practicing during the semester.

Grading

- 0-50%: fail
- 51-65%: pass
- 66-79%: satisfactory
- 80-89%: good
- 90-100%: excellent

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Course topics

The course is concerned with how corporations make financial decisions. We start by explaining what these decisions are and what they are seeking to accomplish. The students will acquire knowledge about the concept of present value, how investment opportunities are valued in financial markets, the basic measures of risk and methods for incorporating risk in valuation. The skills acquired during the course include applying various techniques for calculating present values and using the key capital budgeting techniques for evaluating projects. The course will help the students to ask the right questions when times change and new problems need to be analyzed. It also tells them which things they do not need to worry about. The course shows how managers use financial theory to solve practical problems leading the students to be devoted to performing high quality work in the field of corporate finance with responsibility.

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Part 1: What is Corporate Finance?

Learning outcome of the topic:

The students will learn the definition, function and purpose of financial decisions using the balance-sheet model of the firm. They will understand the first principles of corporate finance. They will be informed about the main characteristics of the corporation and the role of the financial managers. The primary goal of the corporation is also introduced and discussed.

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Corporate finance is about how corporations make financial decisions.

Financial decisions are related to obtaining, managing and financing different resources by means of money. We will cover the concepts that govern good financial decisions and get to know how to use the tools of the trade of modern finance.

We start by explainig what these decisions are and what they are seeking to accomplish.

What Do Corporations Do?

Corporations invest in real assets, which generate cash inflows and income. Corporations finance these assets by borrowing, by retaining and reinvesting cash flow, and by selling additional shares of stock to the corporation's shareholders (Stern – Chew 2003).

Suppose you decided to start a firm to make tennis balls. To do this, you hire managers to buy raw materials and you assemble a work force that will produce and sell finished tennis balls. In the language of finance: you make an investment in assets such as inventory, machinery, land and labor. The amount of cash you invest in assets must be matched by an equal amount of cash raised by financing. When you begin to sell tennis balls, your firm will generate cash. This is cash that you will be able to take out of the firm. You hope that the amount of cash you can take out of the firm is greater than the amount you put into it. This is the basis of value creation. The purpose of the firm is to create value for you, the owner. The value is reflected in the framework of the simple **balance sheet model** of the firm (Ross – Westerfield – Jordan 2009).

Balance Sheet Model of the Firm

Suppose we take a snapshot of the firm and its activities at a single point in time. Next figure shows a graphic conceptualization of the balance sheet.

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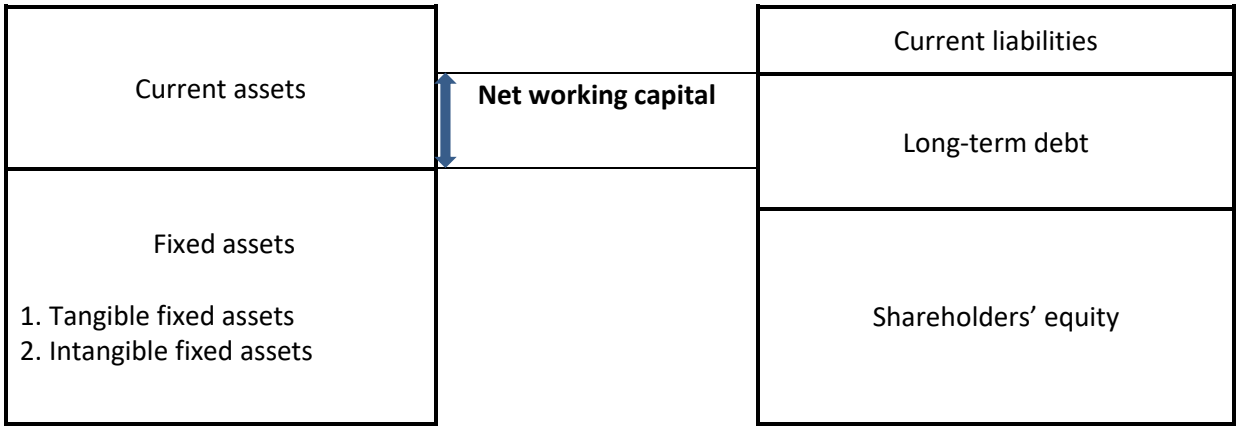
Figure 1.

Balance Sheet Model of the Firm



To carry on business a corporation needs an almost endless variety of real assets. The assets of the firm are on the left-hand side of the balance sheet. These assets can be thought of as current and fixed. **Fixed assets** are those that will last a long time such as a building. Some fixed assets are **tangible** – assets that you can touch – such as machinery and equipment. Other fixed assets are **intangible** such as patents, trademarks, brand name and the quality of management. The other category of assets**, current assets** comprises those that have short lives, such as inventory. The tennis balls that your firm has made but has not yet sold are part of its inventory.

Before a company can make an investment in an asset it must obtain finance which means that it must raise the money to pay for the investment. To pay for the assets the corporation sells claims are called **financial assets** or **securities**.

Take a bank loan as an example. The bank provides the corporation with cash in exchange for a financial asset, which is the corporation's promise to repay the loan with interest. An ordinary bank loan is not a security, however, because it is held by the bank and not sold or traded in financial markets.

Take a corporate bond as a second example. The corporation sells the bond to investors in exchange for the promise to pay interest on the bond and to pay off the bond at its maturity. The bond is a financial asset, and also a security, because it can be held by and traded among many investors in financial markets. Securities include bonds, shares of stock, and a dizzying variety of specialized instruments.

So the finacial choices available to large corporations seem almost endless. The form of financing or liabilities are represented on the right-hand side of the balance sheet. A corporation can raise money from lenders or from shareholders. If it **borrows**, the lenders contribute the cash, and the corporation promises to pay back the debt plus the rate of interest. If the shareholders put up the cash, they get no fixed return, but they hold shares of stock therefore get a fraction of future profits and cash flow and they control the corporation's direction, policies, and activities. The shareholders are equity investors who contribute **equity financing**. Corporations raise equity financing in two ways. First, they can issue new shares of stock. Second, the corporation can take the cash flow generated by its existing assets and reinvest the cash in new assets. In this case the corporation is reinvesting on behalf of existing stockholders. No new shares are issued.

Financial assets can be thought as long lived and short lived. A short-term debt is called a **current liability**. Short-term debt represents loans and other obligations that must be repaid within 1 year. Long-term debt is debt that does not have to be repaid within 1 year. Shareholders' equity represents the difference between the value of the assets and the debt of the firm. In this sense it is a **residual claim** on the firm's assets.

From the balance sheet model of the firm it is easy to see why finance can be thought of as the study of the following three questions (Ross – Westerfield – Jordan 2009):

a. In what long-lived assets should the firm invest? This questions concerns the left-hand side of the balance sheet. Of course, the type and proportion of assets the firm need tend to be set by the nature of business. We use the **terms capital budgeting and capital expenditures** (CAPEX) decisions to describe the process of making and managing expenditures of long-lived assets, because most large corporations prepare an annual capital budget listing the major projects approved for investment. The investment decision involves spending money.

b. How can the firm raise cash for required capital expenditure? This question corcerns the right-hand side of the balance sheet. The answer to this involves the firm's **financing structure**. This reflects the extent to which the firm relies on current and long-term debt and

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equity. The choice between long-term debt and equity financing is called the **capital structure decision**. **Capital** refers to the firm's sources of long-term financing. The financing decision involves raising money.

c. How should short-term operating cash flows be managed? This question concerns the upper portion of the balance sheet. There is a mismatch between the timing of cash inflows and cash outflows during operating activities. The financial manager must attempt to manage the cash flow gaps. Short-term cash flow management is associated with a firm's **net working capital**. Net working capital is defined as current assets minus current liabilities. It is the subject of **short-term finance**.

Investment Decisions

These concern the **left-hand side** of the balance sheet. The type and proportion of assets the firm need tend to be set by the nature of business.

We use the terms **capital budgeting** and **capital expenditures (CAPEX) decisions** to describe the process of making and managing expenditures of long-lived assets, because most large corporations prepare an annual capital budget listing the major projects approved for investment.

The investment decision also involves managing assets already in place and deciding when to shut down and dispose of assets if profits decline. The corporation also has to **manage and control the risks** of its investments.

Financial managers do not make major investment decisions in solitary confinement. They may **work as part of a team** of engineers and managers from manufacturing, marketing, and other business functions.

Do not think of the financial manager as making billion-dollar investments on a daily basis. Most investment decisions are smaller and simpler, such as the purchase of a truck, machine tool, or computer system. Corporations make thousands of these smaller investment decisions every year (Brealey – Myers – Allen 2006).

Financing Decisions

These corcern the right-hand side of the balance sheet and involves the firm's **financing structure**. This reflects the extent to which the firm relies on current

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and long-term debt and equity. The choice between long-term debt and equity financing is called the **capital structure decision**. **Capital** refers to the firm's sources of long-term financing.

In some ways financing decisions are less important than investment decisions. Financial managers say that "**value comes mainly from the asset side of the balance sheet**." In fact the most successful corporations sometimes have the simplest financing strategies.

Financing decisions may not add much value, compared with good investment decisions, but **they can destroy value** if they are stupid or if they are influenced by bad news.

Take Microsoft as an example. It is one of the world's most valuable corporations. Where did this market value come from? It came from Microsoft's product development, from its brand name and worldwide customer base, from its research and development, and from its ability to make profitable future investments. The value did *not* come from sophisticated financing. Microsoft's financing strategy is very simple: it carries no debt to speak of and finances almost all investment by retaining and reinvesting cash flow (Brealey – Myers – Allen 2006).

Short-term Decisions

It concerns the upper portion of the balance sheet. There is a mismatch between the timing of cash inflows and cash outflows during operating activities. The financial manager must attempt to manage the cash flow gaps.

Short-term cash flow management is associated with a firm's **net working capital**.

Net working capital is defined as current assets minus current liabilities. It is the subject of **short-term finance** (Brealey – Myers – Allen 2006).

First Principles of Corporate Finance

All of corporate finance is built on three principles, which we will call the investment principle, the financing principle, and the dividend principle. The investment principle determines where businesses invest their resources, the financing principle governs the mix of funding used to fund these investments, and the dividend principle answers the question of how much earnings should be reinvested back into the business and how much should be returned to the owners of the business.

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The Investment Principle

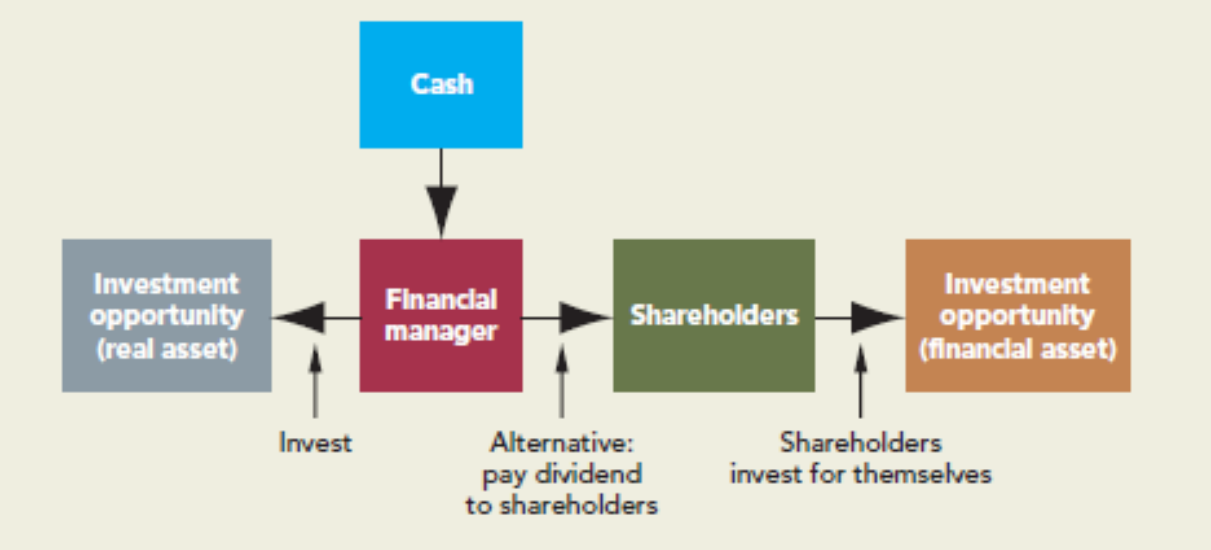
Invest in assets and projects that yield a return greater than the minimum acceptable hurdle rate. The hurdle rate should be higher for riskier projects and should reflect the financing mix used—owners' funds (equity) or borrowed money (debt).

Returns on projects should be measured based on cash flows generated and the timing of these cash flows; they should also consider both positive and negative side effects of these projects.

The figure below sets out the fundemental trade-off for corporate investment decision (Brealey – Myers – Allen 2006).

Figure 2.

The Investment Trade-off



Source: Brealey – Myers – Allen (2006)

The corporation has a proposed investment project (a real asset). Suppose it has cash on hand sufficient to finance the project. The financial manager is trying to decide whether to invest in the project. If the financial manager decides not to invest, the corporation can pay out the cash to

shareholders, say as an extra dividend. Assume that the financial manager is acting in the interests of the corporation's owners, its stockholders.

What do these stockholders want the financial manager to do? The answer depends on the rate of return on the investment project and on the rate of return that the stockholders can earn by investing in financial markets. If the return offered by the investment project is higher than the rate of return that shareholders can get by investing on their own, then the shareholders would vote for the investment project. If the investment project offers a lower return than shareholders can achieve on their own, the shareholders would vote to cancel the project and take the cash instead.

The minimum acceptable rate of return on the firm's investments is called a **hurdle rate** or **cost of capital**. It is really an **opportunity cost of capital,** because it depends on the investment *opportunities* available to investors in financial markets. Whenever a corporation invests cash in a new project, its shareholders lose the opportunity to invest the cash on their own. Corporations increase value by accepting all investment projects that earn more than the opportunity cost of capital.

The opportunity cost of capital depends on the risk of the proposed investment project. It's not just because shareholders are risk-averse. It's also because shareholders have to trade off risk against return when they invest on their own. The safest investments, such as government debt, offer low rates of return. Investments with higher expected rates of return—the stock market, for example—are riskier and sometimes deliver painful losses.

The opportunity cost of capital is generally *not* the interest rate that the company pays on a loan from a bank or on a bond. If the company is making a risky investment, the opportunity cost is the expected return that investors can achieve in financial markets at the same level of risk. The expected return on risky securities is normally well above the interest rate on corporate borrowing.

Managers look to the financial markets to measure the opportunity cost of capital for the firm's investment projects. Estimating the opportunity cost of capital is one of the hardest tasks in financial management.

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The Financing Principle and The Dividend Principle

Choose a financing mix (debt and equity) that maximizes the value of the investments made and match the financing to the nature of the assets being financed.

If there are not enough investments that earn the hurdle rate, return the cash to the owners of the business. In the case of a publicly traded firm, the form of the return—dividends or stock buybacks—will depend on what stockholders prefer.

What Is a Corporation?

Not all business are organized as corporations. There are other forms of organizing firms like the sole proprietorship or the partnership (general and limited)

Corporation has 3 distinct characteristics (Brealey – Myers – Allen 2006):

1. A corporation is a **legal entity**=it is a legal person that is owned by its shareholders. It can make contracts, borrow or lend money, sue or be sued. It pays its own taxes.
2. A corporation is legally distinct from its owners, therefore the shareholders have **limited liability**, which means that shareholders can only loose their entire investment in case of bankruptcy, but no more!
3. A corporation has **separeted ownership and control** as owners are rarely managing the firm

When a corporation is first established, its shares may be privately held by a small group of investors, perhaps the company's managers and a few backers. In this case the shares are not publicly traded and the company is **closely held**. Eventually, when the firm grows and new shares are issued to raise additional capital, its shares are traded in public markets such as the New York Stock Exchange. Such corporations are known as **public companies**. A large public corporation may have hundreds of thousands of shareholders, who own the business but cannot possibly manage or control it directly. This *separation of ownership and control* gives corporations permanence. It allows share ownership to change without influencing with the day-to-day business.

The separation of ownership and control can also have a downside, for it can open the door for managers and directors to act in their own interests rather than in the stockholders' interest (Tirole 2006).

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Conflicts between shareholders' and managers' objectives create *agency problems* (Damodaran 2015). Agency problems arise when *agents* work for *principals.* The shareholders are the principals; the managers are their agents.

Agency costs are incurred when

(1) managers do not attempt to maximize firm value and

(2) shareholders incur costs to monitor the managers and constrain their actions. Good systems of corporate governance can ensure that the shareholders' pocket are close to the managers' heart. So agency problems can be mitigated by good systems of corporate governance.

The Primary Goal of the Corporation

A large corporation may have hunderds of thousands of shareholders. There is no way that all the shareholders can be actively involved in management: authority has to be delegated to professional managers.

But how can managers make decisions that satisfy all the shareholders? These shareholders differ in many ways such as age, tastes, wealth, risk tolerance and investment horizon and strategy. Delegating the operation of the firm to professional managers can work only if the shareholders have a common objective. Fortunately there is a natural financial objective on which all shareholders agree:

Maximise the current market value of shareholders' investment in the firm and thus, their wealth (Brealey – Myers – Allen 2006).

Shareholders are made better off when the value of their shares is increased by the firm's decisions. So, a smart and effective manager makes decisions that increase the current value of the company's shares and the wealth of its stockholders. This increased wealth can then be put to whatever purposes the shareholders want. Although other potential objectives (survive, maximise market share or profit etc.) exist, these are consistent with maximising shareholder value.

Let's walk through the argument step by step, assuming that the financial manager should act in the interests of the firm's owners, its stockholders (Brealey – Myers – Allen 2006).

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1. Each stockholder wants three things:

a. To be as rich as possible, that is, to maximize his or her current wealth.

b. To transform that wealth into the most desirable time pattern of consumption either by borrowing to spend now or investing to spend later.

c. To manage the risk characteristics of that consumption plan.

2. But stockholders do not need the financial manager's help to achieve the best time pattern of consumption. They can do that on their own, provided they have free access to competitive financial markets. They can also choose the risk characteristics of their consumption plan by investing in more- or less-risky securities.

3. How then can the financial manager help the firm's stockholders? There is only one way: by increasing their wealth. That means increasing the market value of the firm and the current price of its shares.

The Role of the Financial Manager

What do financial managers do for a living?

Most large corporations have a **Chief Financial Officer (CFO)**, who oversees the work of all financial staff. The CFO is deeply involved in financial policy and financial planning and is in constant contact with the Chief Executive Officer and other top management. The CFO is the most important financial voice of the corporation, and explains earnings results and forecasts to investors and the media.

Below the CFO are usually a treasurer and a controller. The **treasurer** is responsible for short-term cash management, making capital expenditure decisions, and making finanncing transactions. The **controller** manages the company's internal accounting systems and oversees preparation of its financial statements and tax returns. Our discussion of corporate finance is much more relevant to the treasurer's function. The largest corporations have dozens of more financial specialized financial managers, including tax lawyers and accountants and so on.

However, financial managers do not make major financial decisions in solitary confinement. They may **work as part of a team** of engineers and managers from manufacturing, marketing and other business function.

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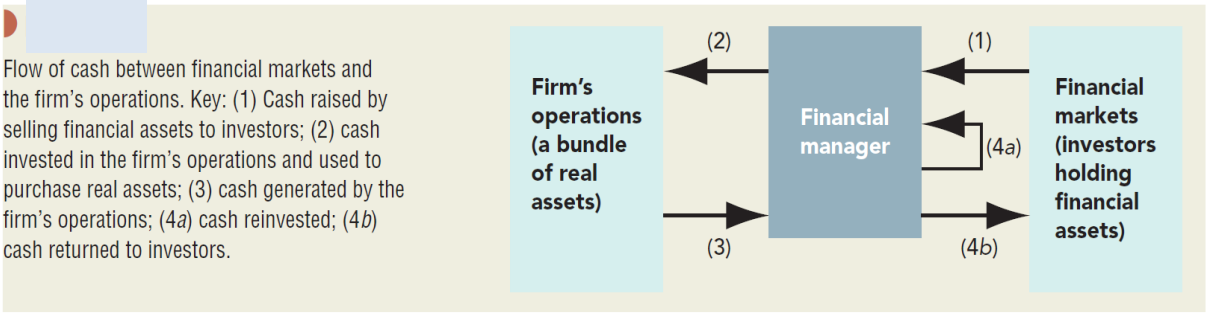
What is the essential role of the financial manager? Figure 3 gives one answer (Brealey – Myers – Allen 2006).

Figure 3.

Role of the Financial Manager



Source: Brealey – Myers – Allen (2006)

The figure traces how money flows from investors to the corporation and back to investors again. The flow starts when cash is raised from investors (arrow 1 in the figure). The cash could come from banks or from securities sold to investors in financial markets. The cash is then used to pay for the real assets (investments projects) needed for the corporation's business (arrow 2) Later, as the business operates, the assets generate cash inflows (arrow 3). That cash is either reinvested (arrow 4a) or returned to the investors who contributed the money in the first place (arrow 4b). Of course, the choice between arrows 4a and 4b is constrained by the promises made when cash was raised at arrow 1. Some cash flow is paid to the government as taxes.

Notice how the financial manager stands between the firm and outside investors. On the one hand, the financial manager helps to manage the firm's operations, particularly by helping to make good investment decisions. On the other hand, the financial manager deals with investors – not just with shareholders but also with institutions such as banks and with financial markets.

Problem sets

1. Read the following passage:
"Companies usually buy (*a*) assets. These include both tangible assets such as (*b*) and intangible assets such as (*c*). To pay for these assets, they sell (*d*) assets such as (*e*). The decision about which assets to buy is usually termed the (*f*) or (*g*) decision. The decision about how to raise the money is usually termed the (*h*) decision."

Now fit each of the following terms into the most appropriate space:
financing, real, bonds, investment, executive airplanes, financial, capital budgeting, brand names.

2. Which of the following are real assets, and which are financial?
a. A share of stock.
b. A personal IOU.
c. A trademark.
d. A factory.
e. Undeveloped land.
f. The balance in the firm's checking account.
g. An experienced and hardworking sales force.
h. A corporate bond.

3. Vocabulary test. Explain the differences between:
a. Real and financial assets.
b. Capital budgeting and financing decisions.
c. Closely held and public corporations.
d. Limited and unlimited liability.

4. Which of the following statements always apply to corporations?
a. Unlimited liability.
b. Limited life.
c. Ownership can be transferred without affecting operations.
d. Managers can be fired with no effect on ownership.

5. Which of the following statements more accurately describe the treasurer than the controller?
a. Responsible for investing the firm's spare cash.
b. Responsible for arranging any issue of common stock.
c. Responsible for the company's tax affairs.

(Problems are from Brealey, Myers and Allen's „Principles of Corproate Finance")

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Part 2: Time value of money

Learning outcome of the topic:

The students will take the first steps toward understanding how assets are valued and capital investments are made. They understand the first most basic principle of finance related to the time value of money. They will be aware the different methods of expressing interest rate. They will be able to calculate the future and the present value of both a single amount of money and a multiple cash flow. Working through a simple numerical example they will understand the basics of evaluating investment projects by calculating the net present value of the project. The will be informed about how to adjust investment value for risk due to the second basic financial principle.

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The time value of money

A corporation shareholders want maximum value and the maximum honest share price. To reach this goal the company needs to invest in real assets that are **worth more than they cost** (Brealey – Myers – Allen 2006). Now we take the first steps toward understanding how assets are valued and capital investments are made.

Sometimes the problem of valuing assets is simplified by the **existence of an active** market in which these assets are bought and sold. No formal theory of value is needed. We can take the market's word for it.

But we need to go deeper than that. First it is important to know **how asset values are reached** in an active market. Second, the market for most corporate assets is pretty thin.

Companies are always searching for assets that are worth more to them that to others. An asset is worth more to you if you can manage it better than others can. But in that case, the market price of similar asset may not tell you what the asset is worth under your management. You need to know how asset values are determined.

The value of an asset depends on

- the **amount** of cash flows
- the **timing** of cash flows, and
- the **risk** of cash flows provided by the asset.

Money has a **time value** and the first most basic principle of finance:

a dollar today is worth more than a dollar tomorrow.

It is because money can be invested to earn interest or return on it.

Money can be invested to earn interest. So, if you are offered the choice between $100 today and $100 next year, you naturally take the money now to get a year's interest.

Financial managers make the same point when they say that **money has a time value** or when they quote the most basic principle of finance:

a dollar today is worth more than a dollar tomorrow.

If the value of money depends on its timing, we must not add them up, subtract or compare them directly. We have to set a common denominator which can be a single, common date.

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Suppose you invest $100 in a bank account that pays interest of r=7% a year.

In the first year you will earn interest of .07 X $100 = $7 and the value of your investment will grow to $107:

Value of investment after 1 year = $100 X (1 +r) = 100 X1.07 = $107

By investing, you give up the opportunity to spend $100 today and you gain the chance to spend $107 next year.

If you leave your money in the bank for a second year, you earn interest of .07 X $107 = $7.49 and your investment will grow to $114.49:

Value of investment after 2 years =$107 X1.07 = $100 X 1.07^2 = $114.49

Notice that in the second year you earn interest on both your initial investment ($100) and the previous year's interest ($7).

Thus your wealth grows at a **compound rate** and the interest that you earn is called **compound interest**.

If you invest your $100 for *t* years, your investment will continue to grow at a 7% compound rate to $100 X 1.07^t . For any interest rate *r*, the future value of your $100 investment will be

Future value of $100 =$100 X $(1 + r)^t$

The higher the interest rate, the faster your savings will grow. Next figure shows that a few percentage points added to the interest rate can do wonders for your future wealth (Brealey – Myers – Allen 2006)

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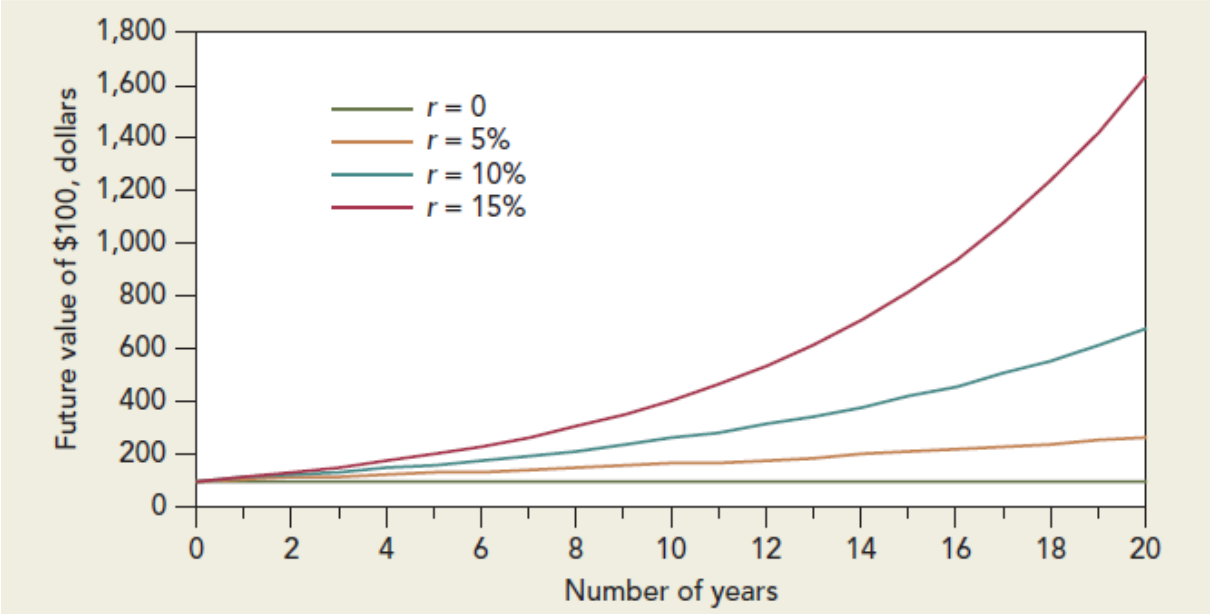
Figure 4.

How an Investment of $100 Grows With Compound Interest At Different Interest Rates?



Source: Brealey – Myers – Allen (2006)

For example, by the end of 20 years $100 invested at 10% will grow to $100 X $(1.10)^{20}$ = $672.75. If it is invested at 5%, it will grow to only $100 X $(1.05)^{20}$ = $265.33

The **future value (FV)** is the amount to which an investment will grow after earning interest. The fututre value of a cash flow, C_0, is:

$$FV = C_0 \text{ X } (1+r)^t$$

where *r* is the interes rate and *t* is the number of years or periods.

Calculating the Interest

When money is moved through time usually the concept of **compounded interest** is applied. Compound interest occurs when interest paid on the investment during the first period is added to the principal. In the following period interest is paid on the new principal.

This contrasts **simple interest** where the principal is constant throughout the investment period.

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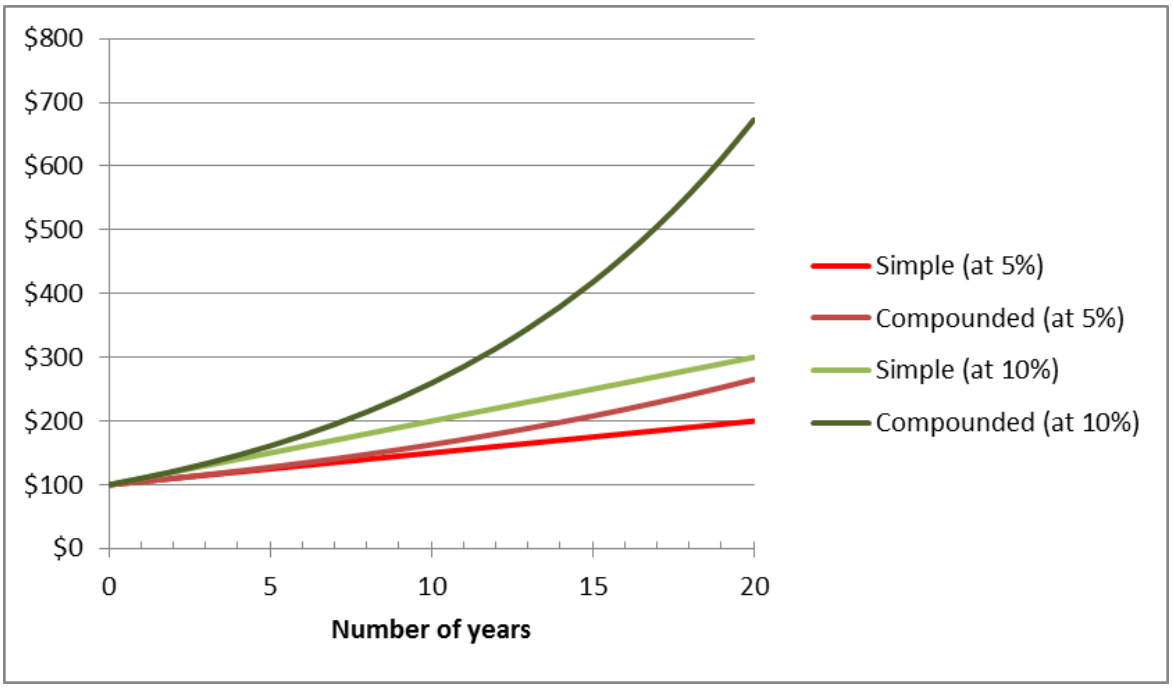
To illustrate the difference between simple and compounded interest consider the return to a bank account with principal balance of €100 and an yearly interest rate of 5%. After 5 years the balance on the bank account would be:

- €125.0 with simple interest: €100+5·0,05·€100=€125
- €127.6 with compounded interest: €100·1.05^5=€127,6

Thus, the difference between simple and compounded interest is the interest earned on interests. This difference is increasing over time, with the interes rate and in the number of sub-periods with interest payments (Figure 5.).

Figure 5.

The Difference Between Simple and Compounded Interest



Source: Brealey – Myers – Allen (2006)

Banks use the concept of simple interest for short periods (within 1 year) and compound interest for longer periods (over 1 year). In general, simple interest occurs when the bank determines the interest for a half-year or a month. In this case it simply divides the annual interest rate by 2 or 12.

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Quoted and Effective Interest Rate

We need to distinguish between the quoted annual interest rate and the effective annual rate. The quoted annual rate is usually calculated as the total annual payment divided by the number of payments in the year. When interest is paid once a year, the quoted and effective rates are the same. When interest is paid more frequently, the effective interest rate is higher than the quoted rate.

In general, if you invest $1 at a rate of *r* per year compounded m times a year, your investment at the end of the year will be worth $[1 + (r / m)]^{m}$ and the effective interest rate is :

$$\mathbf{r_{eff} = [1 + (r / m)]^{m} - 1}$$

For example, if you invest $100 in a bond that pays interest of 10% compounded semiannually, your wealth will grow to 1.05 X $100 = $105 by the end of six months and to 1.05 X $105 = $110.25 by the end of the year.

In other words, an interest rate of 10% compounded semiannually is equivalent to 10.25% compounded annually. We can say: the effective annual interest rate on the bond is 10.25%.

Let's take another example.

Suppose a bank offers you an automobile loan at an annual percentage rate, or APR, of 12% with interest to be paid monthly.

This means that each month you need to pay one-twelfth of the annual rate, that is, 12/12 = 1% a month. Thus the bank is quoting a rate of 12%, but the effective annual interest rate on your loan is

$1.01^{12} - 1 = .1268$, or 12.68%.

Nominal and Real Rates of Interest

Cash flows can either be in **current (nominal)** or **constant (real)** dollars. If you deposit €100 in a bank account with an interest rate of 5%, the balance is €105 by the end of the year. Can €105 buy you more goods and services than €100 today? The answer depends on the rate of **inflation** over the year.

Inflation is the rate at which prices as a whole are increasing, whereas **nominal interest rate** is the rate at which money invested grows. The **real interest rate** is the rate at which the purchasing power of an investment increases.

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The formula for converting nominal interest rate to a real interest rate is:

$$real\ interest\ rate = \frac{nominal\ interest\ rate - inflation\ rate}{1 + inflation\ rate}$$

For small inflation and interest rates the real interest rate is approximately equal to **the nominal interest rate minus the inflation rate** (it is the well-known **Fisher equation**)

Calculating Present Value

We have seen that $100 invested for two years at 7% will grow to a future value of 100 X 1.07^2 = $114.49. Let's turn this around and ask **how much you need to invest today to produce** $114.49 at the end of the second year. In other words, what is the **present value** (PV) of the $114.49 payoff?

You already know that the answer is $100. But, if you didn't know or you forgot, you can just **run the future value calculation in reverse** and divide the future payoff by $(1.07)^2$:

Present value = PV = $\frac{\$114.49}{(1.07)^2}$ =$100

In general, suppose that you will receive a cash flow of C_t dollars at the end of year t. The present value of this future payment is

Present value = PV = $\frac{C_t}{(1+r)^t}$

You sometimes see this present value formula written differently. Instead of dividing the future payment by $(1 + r)^t$, you can equally well multiply the payment by $1/(1 + r)^t$. The expression $1/(1 + r)^t$ is called the **discount factor**. It measures the present value of one dollar received in year t.

For example, with an interest rate of 7% the two-year discount factor is

$DF_2 = 1/ (1.07)^2 = .8734$

Investors are willing to pay $.8734 today for delivery of $1 at the end of two years.

If each dollar received in year 2 is worth $.8734 today, then the present value of your payment of $114.49 in year 2 must be

Present value = DF_2 X C_2 =.8734 X 114.49 = $100

Here you can see present value of a future cash flow of $100 (Figure 6.) The longer you have to wait for your money, the less it is worth today (Brealey – Myers – Allen 2006).

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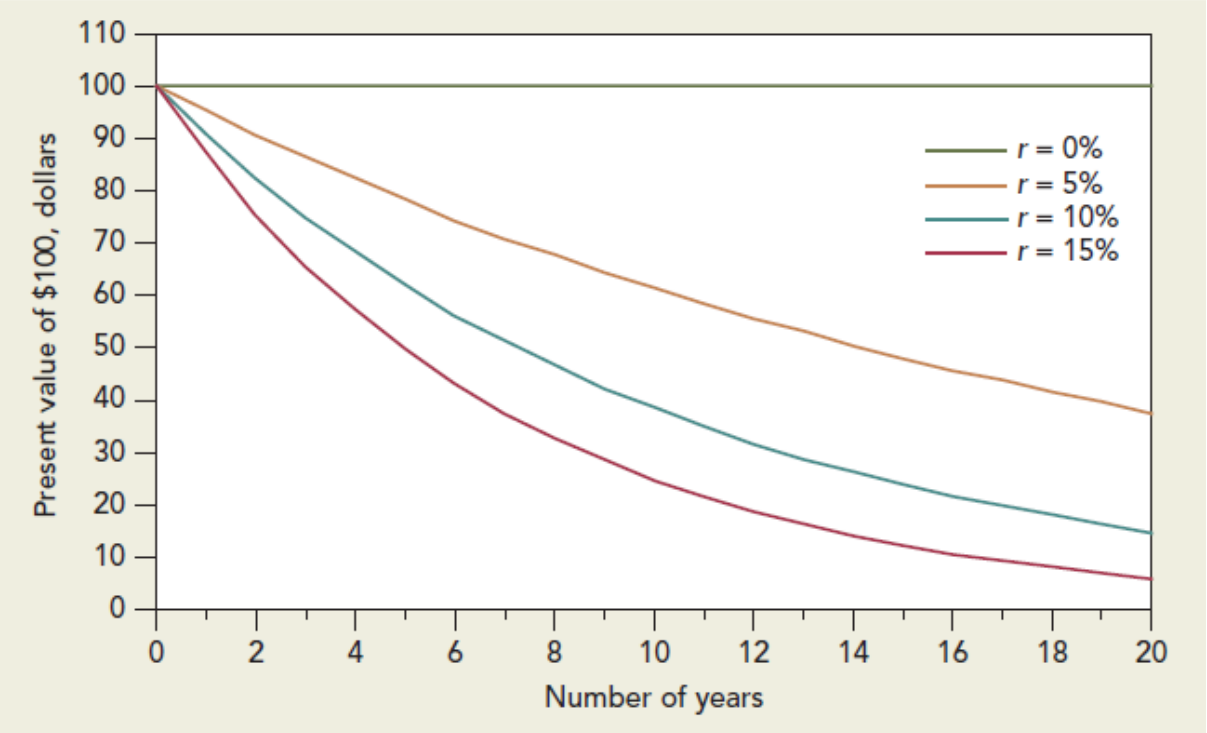
Figure 6.

Present Value of a Future Cash Flow of $100



Source: Brealey – Myers – Allen (2006)

Notice how small variations in the interest rate can have a powerful effect on the present value of distant cash flows.

At an interest rate of 5%, a payment of $100 in year 20 is worth $37.69 today.

If the interest rate increases to 10%, the value of the future payment falls by about 60% to $14.86.

An Example: Calculating the Present Value of an Office Block

How do you decide whether an investment opportunity is worth undertaking?

Suppose you own a small company that is contemplating construction of an office block (Brealey – Myers – Allen 2006).

The total cost of buying the land and constructing the building is $370,000, but

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your real estate adviser forecasts a shortage of office space a year from now and predicts that you will be able sell the building for $420,000. For simplicity, we will assume that this $420,000 is a sure thing. (It is an unrealistic assumption and we will disregard it later.)

You should go ahead with the project if the present value (PV) of the cash inflows is greater than the $370,000 investment. Suppose that the rate of interest on U.S. government securities is r = 5% per year.

The rate of return *r* is called the **discount rate**, **hurdle rate**, or **opportunity cost of capital**.

It is an opportunity cost because it is the return that is foregone by investing in the project rather than investing in financial markets. In our example the opportunity cost is 5%, because you could earn a safe 5% by investing in U.S. government securities. Present value was found by discounting the future cash flows by this opportunity cost.

Suppose that as soon as you have bought the land and paid for the construction, you decide to sell your project. How much could you sell it for?

That is an easy question. If the venture will return a surefire $420,000, then your property ought to be worth its PV of $400,000 today. That is what investors would need to pay to get the same future payoff. If you tried to sell it for more than $400,000, there would be no takers, because the property would then offer an expected rate of return lower than the 5% available on government securities. Of course, you could always sell your property for less, but why sell for less than the market will bear? The $400,000 present value is the only feasible price that satisfies both buyer and seller. Therefore, the present value of the property is also its market price.

The office building is worth $400,000 today, but that does not mean you are $400,000 better off. You invested $370,000, so the net present value (NPV) is $30,000. Net present value equals present value minus the required investment:

NPV = PV - investment = 400,000 - 370,000 = $30,000

In other words, your office development is worth more than it costs. It makes a net contribution to value and increases your wealth. The formula for calculating the NPV of your project can be written as:

$NPV = C_0 + C_1/(1 + r)$

Remember that C_0 , the cash flow at time 0 (that is, today) is usually a negative number.

In other words, C_0 is an investment and therefore a cash outflow. In our example, C_0 = -$370,000.

When cash flows occur at different points in time, it is often helpful to draw a time line showing the date and value of each cash flow.

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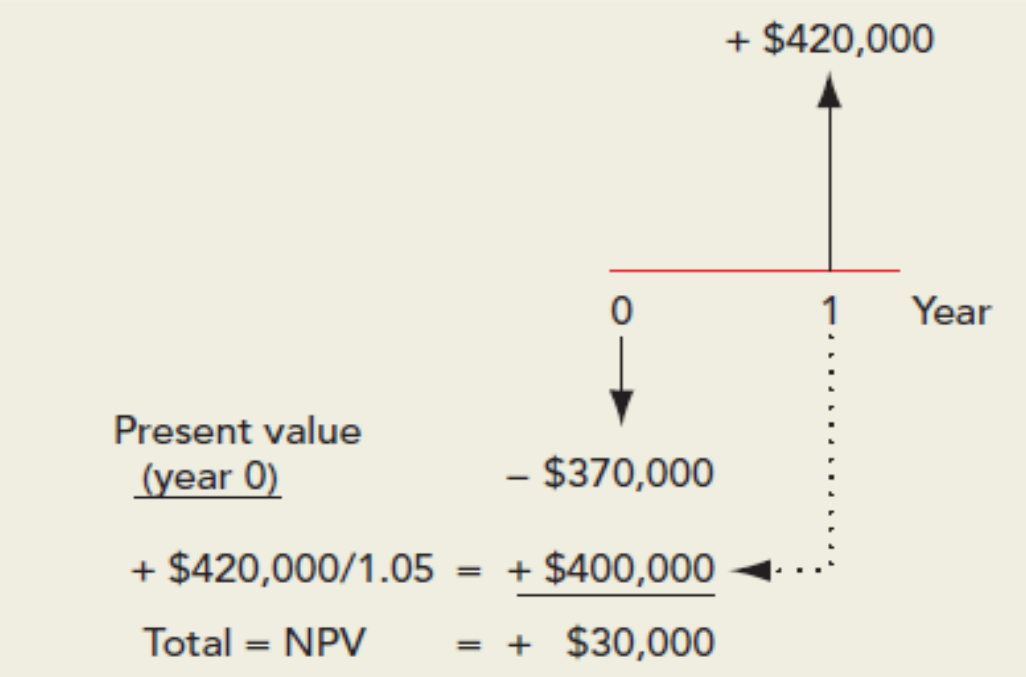
Next figure shows a time line for your office development. It sets out the present value calculations assuming that the discount rate *r* is 5%.

Figure 7.

Calculation Showing the NPV of the Office Development



Source: Brealey – Myers – Allen (2006)

Calculating the Present Value of an Office Block in 4 steps:

Step1: Estimating cash flows

Total cost of buying the land and constructing the building: – $370,000

Price at year 1: $420,000

Step2: Estimating the opportunity cost of capital

The risk-equivalent investment alternatives in the capital markets offer a 5% return, thus:

The opportunity cost of capital *r* = 5%

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Step3: Discounting future cash flow

$$PV = \frac{C_1}{1+r} = \frac{420{,}000}{1+0.05} = \$400{,}000$$

Step4: Going ahead with the project if the present value of the future cash flow is greater than the required initial investment, so the net present value (NPV) is positive.

NPV = 400,000 - 370,000 = $30,000

In other words, your office development is worth more than it costs. It makes a net contribution to value and increases your wealth.

Risk and Present Value

We made one unrealistic assumption in our discussion of the office development: we cannot be certain about the profitability of an office building. Those future cash flows represent the best forecast, but they are not a sure thing.

If the cash flows are uncertain, the calculation of NPV is wrong. Investors could achieve those cash flows with certainty by buying $400,000 worth of U.S government securities, so they would not buy your building for that amount. You would have to cut your asking price to attract investors' interest.

Here we can invoke a second basic financial principle: **a safe dollar is worth more than a risky dollar** (Brealey – Myers – Allen 2006).

Most investors avoid risk when they can do so without sacrificing return. However, the concepts of present value and the opportunity cost of capital still make sense for risky investments. It is still proper to discount the payoff by the rate of return offered by a risk-equivalent investment in financial markets. But we have to think of expected payoffs and the expected rates of return on other investments.

Not all investments are equally risky. The office development is more risky than a government security but less risky than a start-up biotech venture. Suppose you believe the project is as risky as investment in the stock market and that stocks offer a 12% expected return. Then 12% is the opportunity cost of capital. That is what you are giving up by investing in the office building and not
investing in equally risky securities.

Now recompute NPV with r = .12:

PV = $\frac{420{,}000}{1.12}$ = $375,000

NPV =PV - 370,000 = $5,000

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The office building still makes a net contribution to value, but the increase in your wealth is smaller than in our first calculation, which assumed that the cash flows from the project were risk-free.

The value of the office building depends, therefore, on the timing of the cash flows and their risk.

The $420,000 payoff would be worth just that if you could get it today. If the office building is as risk-free as government securities, the delay in the cash flow reduces value by $20,000 to $400,000.

If the building is as risky as investment in the stock market, then the risk further reduces value by $25,000 to $375,000.

Unfortunately, adjusting asset values for both time and risk is often more complicated than our example suggests. Therefore, we take the two effects separately.

Calculating Present Values When There Are Multiple Cash Flows

One of the nice things about present values is that they are all expressed in current dollars—so you can add them up (Brealey – Myers – Allen 2006). In other words, the present value of cash flow (A + B) is equal to the present value of cash flow A plus the present value of cash flow B.

Suppose that you wish to value a stream of cash flows extending over a number of years. Our rule for adding present values tells us that the total present value is:

$$PV = \frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \frac{C_3}{(1+r)^3} + \cdots + \frac{C_n}{(1+r)^n}$$

This is called the **discounted cash flow** (or **DCF**) formula. A shorthand way to write it is

$$PV = \sum_{t=1}^{n} \frac{C_t}{(1+r)^t}$$

To find the net present value (NPV) we add the (usually negative) initial cash flow:

$$NPV = C_0 + PV = C_0 + \sum_{t=1}^{n} \frac{C_t}{(1+r)^t}$$

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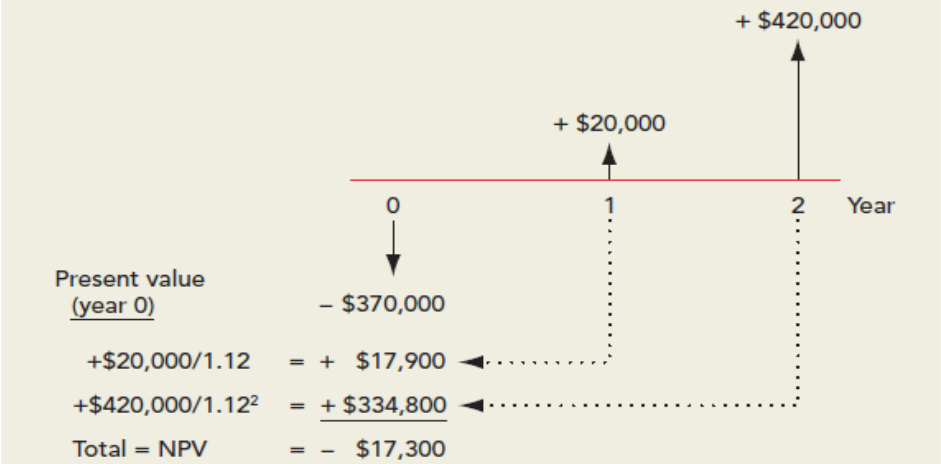
Figure 8.

Calculating the Present Value with Multiple Cash Flows



Source: Brealey – Myers – Allen (2006)

Example for Present Value with Multiple Cash Flows

Your real estate adviser suggests that you rent out the office building for two years at $20,000 a year, and predicts that at the end of that time you will be able to sell the building for $400,000. Thus there are now two future cash flows—a cash flow of C_1 = $20,000 at the end of one year and a further cash flow of C_2 = (20,000 + 400,000) = $420,000 at the end of the second year.

The present value of your property development is equal to the present value of C_1 plus the present value of C_2.

Figure 8. shows that the value of the first year's cash flow is $C_1/(1 + r)$ = 20,000/1.12 = $17,900 and the value of the second year's flow is $C_2/(1 + r)^2$ = 420,000/1.12² = $334,800.

Therefore our rule for adding present values tells us that the total present value of your investment is

$$PV = \frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} = \frac{20{,}000}{1.12} + \frac{420{,}000}{1.12^2} = 17{,}900 + 334{,}800 = \$352{,}700$$

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Problem Sets.

1. If you invest $100 at an interest rate of 15%, how much will you have at the end of eight years with simple and compounded interest?

2. Suppose you invest $232,000 in a bank account for 2 years. The value of your investment will grow to $312,180 with compounded interest. What is the annual interest rate?

3. Which would you prefer?

a. An investment paying interest of 12% compounded annually.

b. An investment paying interest of 11.7% compounded semiannually.

c. An investment paying 11.5% compounded monthly.

Work out the value of each of these investments after 1, 5, and 20 years.

4. You are quoted an interest rate of 6% on an investment of $10 million. What is the value of your investment after four years if interest is compounded…

a. annually?

b.semi-annually?

c. quarterly? or

d. monthly?

5. Suppose that the inflation rate is 20% and the nominal interest rate is 22.4%. What is the real interest rate? What is the difference between the precise and the approximate rate (estimated by the Fisher equation)?

6. If the cost of capital is 9%, what is the PV of $374 paid in year 9?

7. If the PV of $139 is $125, what is the discount factor?

8. At an interest rate of 12%, the six-year discount factor is .507. How many dollars is $507 worth in six years if invested at 12%?

9. If the one-year discount factor is .905, what is the one-year interest rate?

10. If the two-year discount factor is .7561, what is the one-year interest rate?

11. A project produces a cash flow of $432 in year 1, $137 in year 2, and $797 in year 3. If the cost of capital is 15%, what is the project's PV?

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12. A machine costs $380,000 and is expected to produce the following cash flows:

Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Cash flow ($000s)	50	57	75	80	85	92	92	80	68	50

If the cost of capital is 12%, what is the machine's NPV?

(Problems are from Brealey, Myers and Allen's „Principles of Corproate Finance".)

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Part 3: Shortcut Formulas for Calculating the Time Value of Cash Flows

Learning outcome of the topic:

The students learn how to use level shortcut formulas for calculating present values. They learn how to value an investment that delivers a steady stream of cash flows forever (a perpetuity) and one that produces a steady stream for a limited period (an annuity). They will be informed about valuing investments that produce growing cash flows. The formulas are illusrated by applications to some personal financial decisions.

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How to Value Perpetuities

Perpetuity = an investment periodically delivering a regular, steady stream of cash flows forever

The securities called consols are perpetuities. These are bonds that the government is under no obligation to repay but that offer a fixed income for each year to perpetuity.

We would like to endow a foundation with the aim to provide $1 million a year in perpetuity, starting next year (Brealey – Myers – Allen 2006).

So, if the interest rate is 10%, you are going to have to write a check today for

Present value of perpetuity = C / r = $1 million / 0.1 = $10 million

Thus your $10 million endowment would provide the foundation with its first payment in one year's time.

If the stream of payments start one period from now, the PV (given the discount rate *r* and the cash payment *C)* is finite:

$$PV = \frac{C}{r}$$

The perpetuity formula tells us the value of a regular stream of payments **starting one period from now**. If you also want to provide an **up-front sum**, you will need to lay out an extra $1 million, so the present value is $11 million.

Sometimes you may need to calculate the value of a perpetuity that does not start to make payments for several years.

For example, suppose that you decide to provide $1 million a year with the first payment **four years from now**.

We know that in year 3 this endowment will be an ordinary perpetuity with payments starting in one year.

So our perpetuity formula tells us that in year 3 the endowment will be worth $1/ *r* = 1/.1 = $10 million.

But it is not worth that much **now**. To find *today's* value we need to multiply by the three-year discount factor:

$1/(1+r)^3 = 1/(1.1)^3 = .751$.

Thus, the "delayed" perpetuity is worth $10 million X .751 = $7.51 million.

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Shortcut for Growing Perpetuities

Sometimes the cash flow of a perpetuity is growing at a constant *g* rate. In this case

$$\begin{aligned} \text{PV} &= \frac{C_1}{1+r} + \frac{C_2}{(1+r)^2} + \frac{C_3}{(1+r)^3} + \cdots \\ &= \frac{C_1}{1+r} + \frac{C_1(1+g)}{(1+r)^2} + \frac{C_1(1+g)^2}{(1+r)^3} + \cdots \end{aligned}$$

If we assume, that ***r* is greater than *g* (*r >g*)**, our calculation simplifies to

$$PV\ of\ growing\ perpetuity = \frac{C_1}{r-g}$$

What if ***g is greater than r*** ? PV is infinite that is to say the cash flows in the sum are growing even after being discounted, so the the sum is growing over any limit.

How to Value Annuities

An **annuity** is an asset that pays a fixed sum each period (year, month etc.) for a specified number of periods.

The **equal-payment house mortgage** is a common example of an annuity. So are interest payments on most bonds.

General formula is:

Present value of annuity $= C\left(\frac{1}{r} - \frac{1}{r(1+r)^n}\right)$

Remembering formulas is about as difficult as remembering other people's birthdays (Brealey – Myers – Allen 2006).

But as long as you bear in mind that an annuity is equivalent to the difference between an immediate and a delayed perpetuity, you shouldn't have any difficulty (Figure 9.)

An annuity that makes payments in each of years 1 through 3 is equal to the difference between two perpetuities.

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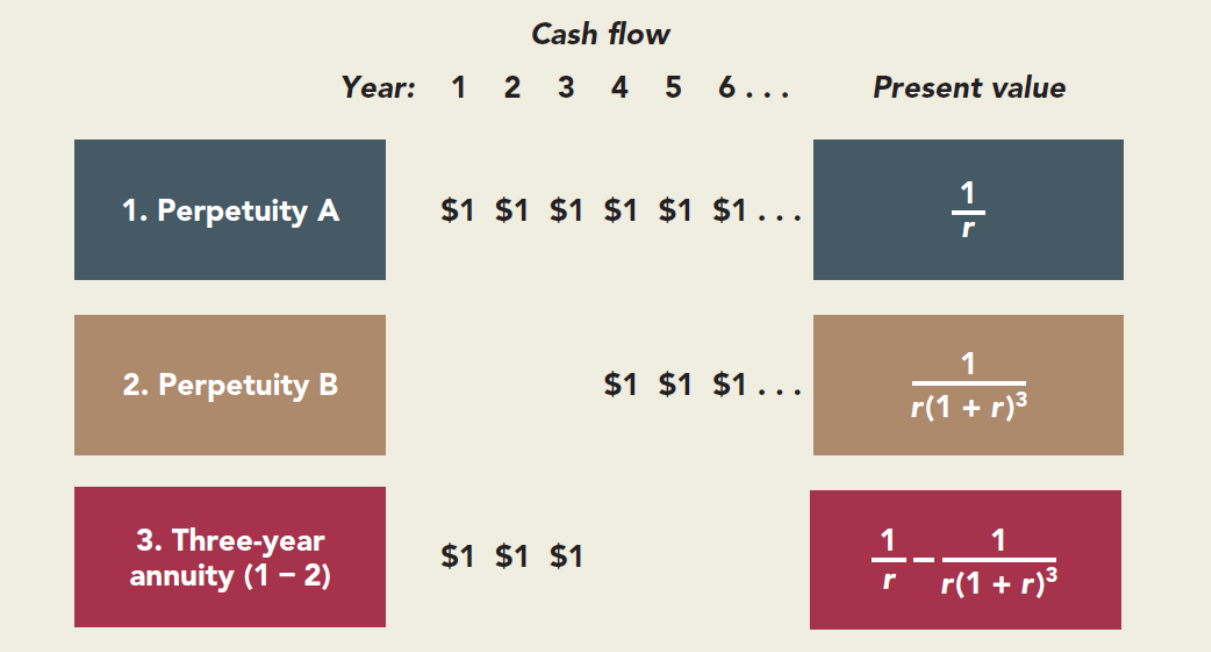
Figure 9.

An annuity is equivalent to the difference between an immediate and a delayed perpetuity



Source: Brealey – Myers – Allen (2006)

We can also use annuity table for calculating the present value of an annuity.

Sometimes we use the annuity formula to **find the amount of the payment given the present value**.

Suppose that you take out a $250,000 house mortgage from your local savings bank.

The bank requires you to repay the mortgage in equal annual installments over the next 20 years. It must therefore set the annual payments so that they have a present value of $250,000. Thus,

PV = mortgage payment X 20-year annuity factor = $250,000

Mortgage payment = $250,000/20-year annuity factor

Suppose that the interest rate is 12% a year, then

20-year annuity factor = 7.469 and

Mortgage payment = 250,000 / 7.469 =$33,472

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The mortgage loan is an example of an **amortizing loan**. „Amortizing" means that part of the regular payment is used to pay interest on the loan and part is used to reduce the amount of the loan.

An Example of an Amortizing Loan

This time it is a four-year loan of $1,000 with an interest rate of 10% and annual payments. If you borrow $1,000 at an interest rate of 10%, you would need to make an annual payment of $315.47 over four years to repay that loan with interest, because the four-year annuity factor is 3.170 and 1,000/3.170=315.47.

So, the annual payment needed to repay the loan is $315.47.

In other words, $1,000 divided by the four-year annuity factor is $315.47.

At the end of the first year, the interest charge is 10% of $1,000, or $100. So $100 of the first payment **is absorbed by interest**, and the remaining $215.47 is used to reduce (or"**amortize**") the loan balance to $784.53.

Next year, the **outstanding balance is lower**, so the interest charge is only $78.45. Therefore $315.47 -$78.45 = $237.02 can be applied to amortization. Because the loan is progressively paid off, the fraction of each payment devoted to interest **steadily falls over time**, while the fraction used to reduce the loan increases. By the end of year 4 the amortization is just enough to reduce the balance of the loan to zero (Figure 10).

Figure 10.

Calculations for an Amortizing Loan

Year	Beginning-of-Year Balance	Year-end Interest on Balance	Total Year-end Payment	Amortization of Loan	End-of-Year Balance
1	$1,000.00	$100.00	$315.47	$215.47	$784.53
2	784.53	78.45	315.47	237.02	547.51
3	547.51	54.75	315.47	260.72	286.79
4	286.79	28.68	315.47	286.79	0

Source: Brealey – Myers – Allen (2006)

It is important to know that if the maturity is long and the interest is relatively high you have to pay almost only interest and the amortization of the loan is minimal for the first half of the maturity.

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Special Problems with Annnuities

1. **PV annuity due**: a level stream of regular payments starting **immediately.** An annuity due is worth (1 + *r*) times the value of an ordinary annuity. We can use our annuity table to find the present value of an annuity due: we decrease the number of years by 1 and we add 1 to the number that we picked out of the table.

2. **„Delayed" annuity:** we need to multiply by the proper discount factor.

3. **Future value of an annuity:** we need to multiply the present value by $(1+r)^t$.

Problem Sets.

1. An investment costs $1,548 and pays $138 in perpetuity. If the interest rate is 9%, what is the NPV?

2. A piece of land produces an income that grows by 5% per annum. If the first year's income is $10,000, what is the value of the land? The interest rate is 10%.

3. A common stock will pay a cash dividend of $4 next year. After that, the dividends are expected to increase indefinitely at 4% per year. If the discount rate is 14%, what is the PV of the stream of dividend payments?

4. As winner of a breakfast cereal competition, you can choose one of the following prizes:

a. $100,000 now.

b. $180,000 at the end of five years.

c. $11,400 a year forever.

d. $19,000 for each of 10 years.

e. $6,500 next year and increasing thereafter by 5% a year forever.

If the interest rate is 12%, which is the most valuable prize?

5. A mortgage requires you to pay $70,000 at the end of each of the next eight years. The interest rate is 8%.

a. What is the present value of these payments?

b. Calculate for each year the loan balance that remains outstanding, the interest payment on the loan, and the reduction in the loan balance.

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6. Perhaps your ambition is to buy a sailboat; but that means some serious saving. You estimate that once you start working, you could save $20,000 a year out of your income and earn a return of 8% on these savings. How much will you be able to spend after five years?

7. David and Helen Zhang are saving to buy a boat at the end of five years. If the boat costs $20,000 and they can earn 10% a year on their savings, how much do they need to put aside at the end of years 1 through 5?

8. You have just read an advertisement stating, “Pay us $100 a year for 10 years and we will pay you $100 a year thereafter in perpetuity.” If this is a fair deal, what is the rate of interest?

9. A leasing contract calls for an immediate payment of $100,000 and nine subsequent $100,000 semiannual payments at six-month intervals. What is the PV of these payments if the annual discount rate is 8%?

10. Kangaroo Autos is offering free credit on a new $10,000 car. You pay $1,000 down and then $300 a month for the next 30 months. Turtle Motors next door does not offer free credit but will give you $1,000 off the list price. If the rate of interest is 10% a year, (about 83% a month) which company is offering the better deal?

11. The annually compounded discount rate is 5.5%. You are asked to calculate the present value of a 12-year annuity with payments of $50,000 per year. Calculate PV for each of the following cases.

a. The annuity payments arrive at one-year intervals. The first payment arrives one year from now.

b. The first payment arrives in six months. Following payments arrive at one-year intervals (i.e., at 18 months, 30 months, etc.).

(Problems are from Brealey, Myers and Allen’s „Principles of Corproate Finance”)

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Part 4: Valuing Bonds and Stocks

Learning outcome of the topic:

The students will learn how to apply the tools of time value calculations to valuing securities such as bonds and stocks. They will learn the basic terms related to bonds and stocks. They will understand the pricing model of bonds and stocks, and they will be able to calculate the yield to maturity of bonds and the cost of equity capital.

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Valuing Bonds Using PV Formulas

A bond is a publicly traded debt contract that specifies a **fixed set of cash flows** which the issuer has to pay to the bondholder. The cash flows consist of a **coupon** (interest) payment until maturity as well as repayment of the par value of the bond at maturity.

Every year until the bond matures, you collect regular interest payments. At maturity, when you get the final interest payment, you also get back the **face value** of the bond, which is called the bond's **principal.**

Value of bond = PV (cash flows) = PV (coupons)+ PV (par value)

= PV (annuity of coupon payments) + PV (final payment of principal)

French government bonds, known as OATs (short for Obligations Assimilables du Trésor) pay interest and principal in Euros (€). Suppose that in December 2015 you decide to buy €100 face value of the 8.5% OAT maturing in December 2019 (Brealey – Myers – Allen 2006)

Each December until the bond matures you are entitled to an interest payment of .085 X100= €8.50.

This amount is the bond's **coupon.**

When the bond matures in 2019, the government pays you the final €8.50 interest, plus the principal payment of the €100 face value.

Your first coupon payment is in one year's time, in December 2009. So the cash payments from the bond are as follows:

2016 2017 2018 2019

€8.5 €8.5 €8.5 €108.5

What is the present value of these payments? It depends on the opportunity cost of capital, which in this case equals the rate of return offered by other government debt issues denominated in Euros.

In December 2008, other medium-term French government bonds offered a return of about 3.0%. That is what you were giving up when you bought the 8.5% OATs. Therefore, to value the 8.5% OATs, you must discount the cash flows at 3.0%:

$PV = 8.5/1.03 + 8.5/1.03^2 + 8.5/1.03^3 + 108.5/1.03^4 = €120.44$

You may have noticed a shortcut way to value this bond. Your OAT amounts to a package of two investments.

The first investment gets the four annual coupon payments of €8.50 each. The second gets the €100 face value at

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maturity. You can use the annuity formula to value the coupon payments and then add on the present value of the final payment.

PV = 8.5 X (PVIFA=3.717) + 100 X (DF=0.888)= €120.44

We just used the 3% interest rate to calculate the present value of the OAT.

Now we turn the valuation around: If the price of the OAT is 120.44%, what is the interest rate? What return do investors get if they buy the bond?

To answer this question, you need to find the value of the variable *y* that solves the following equation:

$120.44 = 8.5/(1+y) + 8.5/(1+y)^2 + 8.5/(1+y)^3 + 108.5/(1+y)^4$

The rate of return *y* is called the bond's **yield to maturity.** In this case, we already know that the present value of the bond is €120.44 at a 3% discount rate, so the yield to maturity must be 3.0%. If you buy the bond at 120.44% and hold it to maturity, you will earn a return of 3.0% per year.

The only general procedure for calculating the yield to maturity is trial and error. You guess at an interest rate and calculate the present value of the bond's payments. If the present value is greater than the actual price, your discount rate must have been too low, and you need to try a higher rate.

The more practical solution is to use a spreadsheet program (Excel) to calculate the yield.

How Common Stocks Are Valued?

The discounted- cash-flow (DCF) formula for the present value of a stock is just the same as it is for the present value of any other asset. We just discount the cash flows by the return that can be earned in the capital market on securities of comparable risk.

Shareholders receive cash from the company in the form of a stream of dividends. So:

PV (stock) = PV (expected future dividends)

And what about the capital gain?

The cash payoff to owners of common stocks comes in two forms:

(1) cash dividends and

(2) capital gains or losses.

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Suppose that the current price of a share is P_0 , that the expected price at the end of a year is P_1 , and that the expected dividend per share is DIV_1 .

The rate of return that investors expect from this share over the next year is defined as the expected dividend per share DIV_1 plus the expected price appreciation per share $P_1 - P_0$, all divided by the price at the start of the year P_0 :

$$Expected\ return = r = \frac{DIV_1 + P_1 - P_0}{P_0}$$

On the other hand, if you are given investors' forecasts of dividend and price and the expected return offered by other equally risky stocks, you can predict today's price:

$$Price = P_0 = \frac{DIV_1 + P_1}{1 + r}$$

What exactly is the discount rate, *r,* in this calculation? It's called the **market capitalization rate** or **cost of equity capital,** which are just alternative names for the opportunity cost of capital, defined as the expected return on other securities with the same risks.

At each point in time *all securities in an equivalent risk class are priced to offer the same expected return* (Brealey – Myers – Allen 2006)

This is a condition for equilibrium in well-functioning capital markets. It is also common sense.

But What Determines Next Year's Price?

We have managed to explain today's stock price P_0 in terms of the dividend DIV_1 and the expected price next year P_1. Future stock prices are not easy things to forecast directly. But think about what determines next year's price. If our price formula holds now, it ought to hold then as well:

$$P_1 = \frac{DIV_2 + P_2}{1 + r}$$

That is, a year from now investors will be looking out at dividends in year 2 and price at the end of year 2. Thus we can forecast P_1 by forecasting DIV_2 and P_2 , and we can express P_0 in terms of DIV_1 , DIV_2 , and P_2 : AND SO ON…

In fact we can look as far out into the future as we like, removing *P* s as we go. Let us call this final period *H.*

This gives us a general stock price formula:

$$P_0 = \sum_{t=1}^{H} \frac{DIV_t}{(1+r)^t} + \frac{P_H}{(1+r)^H}$$

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In principle, the horizon period *H* could be infinitely distant. Common stocks do not expire of old age.

As *H* approaches infinity, the present value of the terminal price ought to approach zero.

We can, therefore, forget about the terminal price entirely and express today's price as the present value of a perpetual stream of cash dividends. This is usually written as:

$$P_0 = \sum_{t=1}^{\infty} \frac{DIV_t}{(1+r)^t}$$

This discounted-cash-flow (DCF) formula for the present value of a stock is just the same as it is for the present value of any other asset. We just discount the cash flows—in this case the dividend stream—by the return that can be earned in the capital market on securities of equivalent risk. Some find the DCF formula implausible because it seems to ignore capital gains. But we know that the formula was *derived* from the assumption that price in any period is determined by expected dividends *and* capital gains over the next period (Brealey – Myers – Allen 2006).

Estimating Cost of Equity Capital

Suppose, for example, that we forecast a constant growth rate for a company's dividends. This does not preclude year-to-year deviations from the trend: it means only that *expected* dividends grow at a constant rate.

Such an investment would be just another example of the growing perpetuity, so:

$$P_0 = \frac{DIV_1}{r-g}$$

Our growing perpetuity formula explains P_0 in terms of next year's expected dividend DIV_1, the projected growth trend *g,* and the expected rate of return on other securities of comparable risk *r.* Alternatively, the formula can be turned around to obtain an estimate of *r* from DIV_1, P_0, and *g:*

$$r = \frac{DIV_1}{P_0} + g$$

An approach to estimating long-run growth starts with the payout ratio, the ratio of dividends to earnings per share (EPS) determining the plowback ratio:

Plowback ratio=1-payout ratio=$1 - \frac{DIV}{EPS}$

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Growth rate can be derived from applying the return on equity (ROE) to the percentage of earnings plowed back into operation (Brealey – Myers – Allen 2006):

g= ROE X Plowback ratio=$\frac{EPS}{book\ equity\ per\ share}$

Problem Sets.

1. A 10-year German government bond (bund) has a face value of €100 and a coupon rate of 5% paid annually. Assume that the interest rate (in Euros) is equal to 6% per year. What is the bond's PV?

2. A 10-year U.S. Treasury bond with a face value of $10,000 pays a coupon of 5.5% (2.75% of face value every six months). The semiannually compounded interest rate is 5.2% (a sixmonth discount rate of 5.2/2 = 2.6%). What is the present value of the bond?

3. Here are the prices of three bonds with 10-year maturities:

Bond Coupon (%)	**Price (%)**
2	81.62
4	98.39
8	133.42

If coupons are paid annually, which bond offered the highest yield to maturity?

4. A 10-year bond is issued with a face value of $1,000, paying interest of $60 a year. If market yields increase shortly after the T-bond is issued, what happens to the bond's

a. Coupon rate?

b. Price?

c. Yield to maturity?

5. Are the following statements are true or false? Explain why.

a. If a bond's coupon rate is higher than its yield to maturity, then the bond will sell for more than face value.

b. If a bond's coupon rate is lower than its yield to maturity, then the bond's price will increase over its remaining maturity.

6. Company Z's earnings and dividends per share are expected to grow indefinitely by 5% a year. If next year's dividend is $10 and

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the market capitalization rate is 8%, what is the current stock price?

7. Company Y does not plow back any earnings and is expected to produce a level dividend stream of $5 a share. If the current stock price is $40, what is the market capitalization rate?

8. Consider the following three stocks:

a. Stock A is expected to provide a dividend of $10 a share forever.

b. Stock B is expected to pay a dividend of $5 next year. Thereafter, dividend growth is expected to be 4% a year forever.

c. Stock C is expected to pay a dividend of $5 next year. Thereafter, dividend growth is expected to be 20% a year for five years (i.e., until year 6) and zero thereafter.

If the market capitalization rate for each stock is 10%, which stock is the most valuable? What if the capitalization rate is 7%?

9. Company Q's current return on equity (ROE) is 20%. It pays out two-fifth of earnings as cash dividends (payout ratio = .4). Current book value per share $22.5. At this point the share price is $45 Book value per share will grow as Q reinvests earnings.

a.) How can we estimate the growth rate of dividends, if the dividend policy remains unchangeable?

b.) What is the rate of return that investors expect form this share?

c.) What will be the book value of the share at the end of year 2?

(Problems are mostly from Brealey, Myers and Allen's „Principles of Corproate Finance".)

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Part 5: Investment Valuation

Learning outcome of the topic:

The students will learn the general rules of making investment decisions. They will understand how to develop a set of project cash flows considering these rules. They will be informed about the possible measures (net present value, payback period, book rate of return, internal rate of return) that companies may look at when making investment decisions, and they will be aware of the the advantages and disadvanteges of these measures as well.

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There are 3 main types of financial decisions:

1. Investment decisions:

In what long-lived (tangible or intangible) assets should the firm invest? (=purchase of real assets)

2. Financing decisions:

How can the firm raise cash for required capital expenditure? (= sale of financial assets)

3. Short-term finance:

How should short-term operating cash flows be managed? (= managing net working capital)

Investment decisions concern the **left-hand side** of the balance sheet. The type and proportion of assets the firm need tend to be set by the nature of business.

We use the terms **capital budgeting** and **capital expenditures (CAPEX) decisions** to describe the process of making and managing expenditures of long-lived assets, because most large corporations prepare an annual capital budget listing the major projects approved for investment.

How to Decide to Go Ahead With an Investment?

1. The company needs to forecast the project's cash flows

2. Discounting cash flows at the opportunity cost of capital to arrive at the project's NPV

3. If the NPV is positive, then the project increases shareholder value.

But how to develop a set of project cash flows?

You should follow three general rules (Brealey – Myers – Allen 2006):

1. Only cash flow is relevant.

2. Always estimate cash flows on an incremental basis.

3. Be consistent in your treatment of inflation.

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Rule 1: Only Cash Flow Is Relevant

Don't confuse cash flow with accounting income or profit! *Income includes some cash flows and excludes others, and it is reduced by depreciation charges, which are not cash flows at all.*

Always estimate cash flows on an after-tax basis.

Record cash flows only when they occur and not when work is undertaken or a liability is incurred.

Income statements are intended to show how well the company is performing. Therefore, accountants *start* with "dollars in" and "dollars out," but to obtain accounting income they adjust these inputs in two ways. **First**, they try to show profit as it is *earned* rather than when the company and its customers get around to paying their bills. **Second**, they sort cash outflows into two categories: **current expenses** and **capital expenses**. They deduct current expenses when calculating income but do not deduct capital expenses. There is a good reason for this. If the firm lays out a large amount of money on a big capital project, you do not conclude that the firm is performing poorly, even though a lot of cash is going out the door. Therefore, the accountant does not deduct capital expenditure when calculating the year's income but, instead, **depreciates it over several years**. As a result of these adjustments, income includes some cash flows and excludes others, and it is reduced by depreciation charges, which are not cash flows at all. It is not always easy to translate the customary accounting data back into actual dollars. If you are in doubt about what is a cash flow, simply count the dollars coming in and take away the dollars going out.

You should also make sure that cash flows are recorded *only when they occur* and not when work is undertaken or a liability is incurred. For example, taxes should be discounted from their actual payment date, not from the time when the tax liability is recorded in the firm's books.

Rule 2: Estimate Cash Flows on an Incremental Basis

The value of a project depends on *all* the additional cash flows that follow from project acceptance.

Do Not Confuse Average with Incremental Payoffs

Include All Incidental Effects

Do Not Forget Working Capital Requirements

Forget Sunk Costs

Beware of Allocated Overhead Costs

Remember Salvage Value

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Separate Investment and Financing Decisions

Include Opportunity Costs

Here are some things to watch for when you are deciding which cash flows to include:

Do Not Confuse Average with Incremental Payoffs Most managers naturally hesitate to throw good money after bad. For example, they are reluctant to invest more money in a losing division. But occasionally you will encounter turnaround opportunities in which the *incremental* NPV from investing in a loser is strongly positive.

Conversely, it does not always make sense to throw good money after good. A division with an outstanding past profitability record may have run out of good opportunities. You would not pay a large sum for a 20-year-old horse, sentiment aside, regardless of how many races that horse had won.

Include All Incidental Effects It is important to consider a project's effects on the remainder of the firm's business. For example, suppose Sony proposes to launch PlayStation 4, a new version of its video game console. Demand for the new product will almost certainly cut into sales of Sony's existing consoles. This incidental effect needs to be factored into the incremental cash flows.

Sometimes a new project will *help* the firm's existing business. Suppose that you are the financial manager of an airline that is considering opening a new route to Chicago. When considered in isolation, the new route may have a negative NPV. But once you allow for the additional business that the new route brings to your other traffic out of Chicago, it may be a very worthwhile investment.

You should also recognize after-sales cash flows to come later**.** Financial managers should forecast all incremental cash flows generated by an investment. Sometimes these incremental cash flows last for decades. When GE commits to the design and production of a new jet engine, the cash inflows come first from the sale of engines and then from service and spare parts.

Do Not Forget Working Capital Requirements Net working capital (often referred to simply as *working capital*) is the difference between a company's short-term assets and liabilities. The principal short-term assets are accounts receivable (customers' unpaid bills) and inventories of raw materials and finished goods. The principal short-term liabilities are accounts payable (bills that *you* have not paid). Most projects entail an additional investment in working capital. This investment should, therefore, be recognized in your cash-flow forecasts.

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Similarly, when the project comes to an end, you can usually recover some of the investment. This is treated as a cash inflow. We supply a numerical example of working-capital investment later.

Forget Sunk Costs Sunk costs are like spilled milk: They are past and irreversible outflows. Because sunk costs are bygones, they cannot be affected by the decision to accept or reject the project, and so they should be ignored.

Beware of Allocated Overhead Costs We have already mentioned that the accountant's objective is not always the same as the investment analyst's. A case in point is the allocation of overhead costs. Overheads include such items as supervisory salaries, rent, heat, and light. These overheads may not be related to any particular project, but they have to be paid for somehow. Therefore, when the accountant assigns costs to the firm's projects, a charge for overhead is usually made. Now our principle of incremental cash flows says that in investment appraisal we should include only the *extra* expenses that would result from the project. A project may generate extra overhead expenses; others may not. We should be cautious about assuming that the accountant's allocation of overheads represents the true extra expenses that would be incurred.

Remember Salvage Value When the project comes to an end, you may be able to sell the plant and equipment or redeploy the assets elsewhere in the business. If the equipment is sold, you must pay tax on the difference between the sale price and the book value of the asset. The salvage value (net of any taxes) represents a positive cash flow to the firm.

Some projects have significant shut-down costs, in which case the final cash flows may be *negative.* For example, in the case of mining companies.

Separate Investment and Financing Decisions. We take no notice of how that project is financed. It may be that the firm decide to finance the project partly by debt, but if it does we will not subtract the debt proceeds from the required investment, nor will we recognize interest and principal payments as cash outflows. We analyze the project as if it were all-equity-financed, treating all cash outflows as coming from stockholders and all cash inflows as going to them. We approach the problem in this way so that we can separate the analysis of the investment decision from the financing decision. But this does not mean that the financing decision can be ignored. We have to recognize the effect of financing choices on project values (for example tax effect).

Include Opportunity Costs The cost of a resource may be relevant to the investment decision even when no cash changes hands.

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For example, suppose a new manufacturing operation uses land that could otherwise be sold for $100,000. This resource is not free: it has an opportunity cost, which is the cash it could generate for the company if the project were rejected and the resource were sold or put to some other productive use.

This example warns you against judging projects on the basis of "**before versus after**." A manager comparing before versus after might not assign any value to the land because the firm owns it both before and after. **The proper comparison is with or without**. Comparing the two possible (with or without) "afters," we see that the firm gives up $100,000 by undertaking the project (Figure 11.). This reasoning still holds if the land will not be sold but is worth $100,000 to the firm in some other use.

Figure 11.

„Before v. after" OR „With or without"

Do not judge projects on the basis of "before versus after."

Before	Take Project	After	Cash Flow, Before versus After
Firm owns land	→	Firm still owns land	0

The proper comparison is „with or without":

With	Take Project	After	Cash Flow, with Project
Firm owns land	→	Firm still owns land	0

Without	Do Not Take Project	After	Cash Flow, without Project
	→	Firm sells land for $100,000	$100,000

Source: Brealey – Myers – Allen (2006)

Sometimes opportunity costs may be very difficult to estimate; however, where the resource can be freely traded, its opportunity cost is simply equal to the market price. Why? It cannot be otherwise. If the value of a parcel of land to the firm is less than its market price, the firm will sell it. On the other hand, the opportunity cost of using land in a particular project cannot exceed the cost of buying an equivalent parcel to replace it.

Rule 3: Treat Inflation Consistently

Discount nominal cash flows at a nominal discount rate.

Discount real cash flows at a real rate.

Never mix real cash flows with nominal discount rates or nominal flows with real rates.

Interest rates are usually quoted in **nominal** rather than **real** terms. For example, if you buy an 8% Treasury bond, the government promises to pay you $80 interest each year, but it does not promise what that $80 will buy. Investors take inflation into account when they decide what is an acceptable rate of interest.

If the discount rate is stated in nominal terms, then consistency requires that cash flows should also be estimated in nominal terms, taking account of trends in selling price, labor and materials costs, etc. This calls for more than simply applying a single assumed inflation rate to all components of cash flow. Labor costs per hour of work, for example, normally increase at a faster rate than the consumer price index because of improvements in productivity. Tax savings from depreciation do *not* increase with inflation; they are constant in nominal terms because tax law allows only the original cost of assets to be depreciated.

Of course, there is nothing wrong with discounting real cash flows at a real discount rate. In fact this is standard procedure in countries with high and volatile inflation.

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A Checklist of Forecasting Cash Flows

Here is **a checklist of forecasting cash flows** that will help you to avoid mistakes (Brealey – Myers – Allen 2006):

1. Discount cash flows, not profits.

a. Remember that depreciation is not a cash flow (though it may affect tax payments).

b. Concentrate on cash flows after taxes. Stay alert for differences between tax depreciation and depreciation used in reports to shareholders.

c. Exclude debt interest or the cost of repaying a loan from the project cash flows. This enables you to separate the investment from the financing decision.

d. Remember the investment in working capital. As sales increase, the firm may need to make additional investments in working capital, and as the project comes to an end, it will recover those investments.

e. Beware of allocated overhead charges for heat, light, and so on. These may not reflect the incremental costs of the project.

2. Estimate the project's incremental cash flows—that is, the difference between the cash flows with the project and those without the project.

a. Include all indirect effects of the project, such as its impact on the sales of the firm's other products.

b. Forget sunk costs.

c. Include opportunity costs, such as the value of land that you would otherwise sell.

3. Treat inflation consistently.

a. If cash flows are forecasted in nominal terms, use a nominal discount rate.

b. Discount real cash flows at a real rate.

These principles of valuing capital investments are the same worldwide, but inputs and assumptions vary by country and currency.

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The Net Present Value Investment Rule

Net present value (NPV) is the difference between a project's value and its costs. To find the NPV we add the (usually negative) initial cash flow.

$$NPV = -C_0 + \sum_{t=1}^{n} \frac{C_t}{(1+r)^t}$$

The **net present value investment rule** states that firms should only invest in projects with positive net present value.

When calculating the net present value of a project the appropriate discount rate is the opportunity cost of capital, which is the rate of return demanded by investors for an equally risky project. Thus, the net present value rule recognizes the time value of money principle.

To find the net present value of a project involves several steps:

How to find the net present value of a project?

1. Forecast cash flows

2. Determine the appropriate opportunity cost of capital, which takes into account the principle of time value of money and the risk-return trade-off

3. Use the discounted cash flow formula and the opportunity cost of capital to calculate the present value of the future cash flows

4. Find the net present value by taking the difference between the present value of future cash flows and the project's costs

There exist several other investment rules:

- book rate of return
- payback rule
- internal rate of return (IRR)

To understand why the net present value rule leads to better investment decisions than the alternatives it is worth considering the desirable attributes for investment decision rules. The goal of the corporation is to maximize firm value. A shareholder value maximizing investment rule is:

- based on cash flows
- taking into account time value of money
- taking into account differences in risk

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The net present value rule meets all these requirements and directly measures the value for shareholders created by a project. This is far from the case for several alternative rules.

The **book rate of return** is based on accounting returns rather than cash flows:

Book rate of return

Average incone divided by average book value over project life:

$$Book\ rate\ of\ return = \frac{average\ book\ income}{average\ book\ value\ of\ assets}$$

The main problem with the book rate of return is that it only includes the annual depreciation charge and not the full investment. Due to tike value of money this provides a negative bias to the cost of the investment and, hence, makes the return appear higher. In addition no account is taken for risk. Due to the risk return trade-off we might accept poor high risk projects and reject good low risk projects.

Payback rule

The payback period of a project is the number of years it takes before the cumulated forecasted cash flow equals the initial outlay.

The **payback rule** only accepts projects that „payback" in the desired time frame.

This method is *flawed* primarily because it ignores later year cash flows and the present value of future cash flows. The latter problem can be solved by using a payback rule based on discounted cash flows.

Internal rate of return (IRR)

Defined as the rate of return which makes NPV=0. We find IRR for an investment project lasting *n* years by solving:

$$NPV = C_0 + \frac{C_1}{(1+IRR)} + \frac{C_2}{(1+IRR)^2} + \frac{C_3}{(1+IRR)^3} + \cdots + \frac{C_n}{(1+IRR)^n} = 0$$

The IRR investment rule accepts projects if the project's IRR exceeds the opportunity cost of capital, i.e. when *IRR>r*.

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Finding a project's IRR by solving for NPV equal to zero can be done using a financial calculator, spreadsheet or trial and error calculation by hand.

The IRR investment rule faces a **number of pitfalls** when applied to projects with special cash flow characteristics:

1. *Lending or borrowing?*

With certain cash flows the NPV of the project increases if the discount rate increases. This is contrary to the normal reltionship between NPV and discount rates.

2. *Multiple rates of return*

Certain cash flows can generate NPV=0 at multiple discount rates. This will happen when the cash flow stream changes sign (for example due to high maintenance costs). In addition it is possible to have projects with no IRR and a positiv NPV.

3. *Mutually exclusive projects*

Firms often have to choose between mutually exclusive projects. IRR sometimes ignores the magnitude of the project due to having a percentage rate form. Large projects with lower IRR might be preferred to small projects with larger IRR.

4. *Term structure assumption*

We assume that discount rates are constant for the term of the project. What do we compare the IRR with if we have different rates for each period? It is not easy to find a traded security with equivalent risk and the same time pattern of cash flows.

Finally note that both the IRR and the NPV investment rule are **discounted cash flow methods**. Thus, both methods possess the desirable attributes for an investment rule since they are based on cash flows and allows for risk and time value of money. Under careful use both methods give the same investment decisions (whether to accept or reject a project). However, they **may not give the same ranking of projects** which is a problem in case of mutually exclusive projects.

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Problem sets

1. Which of the following should be treated as incremental cash flows when deciding whether to invest in a new manufacturing plant? The site is already owned by the company, but existing buildings would need to be demolished.

a. The market value of the site and existing buildings.

b. Demolition costs and site clearance.

c. The cost of a new access road put in last year.

d. Lost earnings on other products due to executive time spent

2. a. What is the payback period on each of the following projects?

	Cash Flows ($)				
Project	C_0	C_1	C_2	C_3	C_4
A	−5,000	+1,000	+1,000	+3,000	0
B	−1,000	0	+1,000	+2,000	+3,000
C	−5,000	+1,000	+1,000	+3,000	+5,000

b. Given that you wish to use the payback rule with a cutoff period of two years, which projects would you accept?

c. If you use a cutoff period of three years, which projects would you accept?

d. If the opportunity cost of capital is 10%, which projects have positive NPVs?

e. “If a firm uses a single cutoff period for all projects, it is likely to accept too many shortlived projects.” True or false?

f. If the firm uses the discounted-payback rule, will it accept any negative-NPV projects? Will it turn down positive-NPV projects? Explain.

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3. a. Calculate the net present value of the following project for discount rates of 0, 50, and 100%:

Cash Flows ($)		
C_0	C_1	C_2
−6,750	+4,500	+18,000

b. What is the IRR of the project?

4. You have the chance to participate in a project that produces the following cash flows:

Cash Flows ($)		
C_0	C_1	C_2
+5,000	+4,000	−11,000

The internal rate of return is 13%. If the opportunity cost of capital is 10%, would you accept the offer?

5. Consider a project with the following cash flows:

C_0	C_1	C_2
−100	+200	−75

a. How many internal rates of return does this project have?

b. Which of the following numbers is the project IRR:

(i) 50%; (ii) 12%; (iii) 5%; (iv) 50%?

c. The opportunity cost of capital is 20%. Is this an attractive project? Briefly explain.

(Problems are from Brealey, Myers and Allen's „Principles of Corproate Finance".)

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Sample tests

First mid-term sample

1. Which of the following is/are real asset(s)?

a. A share of stock.
b. A personal IOU.
c. A trademark.
d. A corporate bond.

2. If you invest $500 at an interest rate of 12%, how much will you have at the end of five years with simple interest?

a. $560
b. $671
c. $800
d. $881

3. Suppose you invest $150,000 in a bank account for 4 years. The value of your investment will grow to $204,073 with compounded interest. What is the annual interest rate?

a. 8%
b. 9%
c. 15%
d. 36.05%

4. What is the effective annual rate if the quoted annual interest rate is 8%, and interest is compounded quarterly?

a. 8.00%
b. 8.24%
c. 9.00%
d. 36.05%

5. Suppose that the inflation rate is 7% and the nominal interest rate is 15%. What is the difference between the precise and the approximate real interest rate (estimated by the Fisher equation)?

a. -0.52%
b. 1.00%
c. 0.60%
d. 7.00%

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6. An investment costs $52,125 and pays $6375 in perpetuity. The first cash inflow is today. If the interest rate is 12%, what is the NPV?

a. -$51,593.75
b. -$45,218.75
c. -$5,375.00
d. $1,000.00
e. $7,375.00

7. A common stock has paid a cash dividend of $60 today. After that, the dividends are expected to increase indefinitely at 5% per year. If the discount rate is 14%, what is the PV of the stream of future dividend payments?

a. $429
b. $450
c. $667
d. $700

8. „Best Car" Autos offers an "easy payment" scheme on a new Mercedes of $10,000 a year, paid at the end of each of the next five years, with no cash down. What is the car really costing you if the interest rate is 7%?

a. $14,025
b. $26,000
b. $41,000
c. $50,000

9. Suppose that you take out a 15-year mortgage loan of $225,000 at an interest rate of 10%. What is your total payment a year? (The bank requires you to repay the mortgage in equal annual installments.)

a. $15,000
b. $22,500
c. $29,582
d. $36,664

10. Suppose that you take out a 15-year mortgage loan of $225,000 at an interest rate of 10%. How much of the second year payment goes to reduce the size of the loan? (The bank requires you to repay the mortgage in equal annual installments.)

a. $7,082
b. $7,790
c. $20,000
d. $29,582

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1. True or false?

The value of a share equals the discounted stream of future earnings per share.

2. True or false?

If a bond's coupon rate is lower than its yield to maturity, then the bond will sell for more than face value.

3. What is the PV of $36,000 if the amount is due in equal monthly installments on the first day of each month for a year? The opportunity cost of capital is 12%.

4. What is the PV of $36,000 if the amount is due in equal monthly installments on the 15th day of each month for a year? The opportunity cost of capital is 12%.

5. How much can we accumulate on a bank account if we invest $519 at the end of the next 9 years? The interest rate is 13%.

6. You receive $519 for 9 years, the first payment will be in 6 years. What is the PV of this cash flow at an interest rate of 13%.

7. A 10-year U.S. Treasury bond with a face value of $10,000 pays a coupon of 6% (3% of face value every six months). The semiannually compounded interest rate is 4% for a year. What is the present value of the bond?

8. A strip is a special type of Treasury bond that repays principal at maturity, but makes no coupon payments along the way. Strips are also called zero-coupon bonds. A 10-year strip has a face value of $10,000. What is the strip's YTM if its price is $4,600?

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9. The required return of a stock is 15%. The company paid a dividend of $100 this year. What is the stock price if the expected growth rate of the dividend is 7%?

10. The company's expected earnings is $286 per share in a year. The market capitalization rate is 14%. The company's return on equity is 20%. What is the value of the company's stocks if the payout ratio is 85%?

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Solutions for the sample tests

First mid-term sample

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b. $26,000
b. $41,000
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c. $29,582
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1. True or false?

The value of a share equals the discounted stream of future earnings per share. **FALSE**

2. True or false?

If a bond's coupon rate is lower than its yield to maturity, then the bond will sell for more than face value. **FALSE**

3. What is the PV of $36,000 if the amount is due in equal monthly installments on the first day of each month for a year? The opportunity cost of capital is 12%.

PV=$3,000*(PVIFA$_{1\%,12}$=11.26)*(1+0.01)=$34,117.8 OR
PV=$3,000*(1+PVIFA$_{1\%,11}$=10.37)=$34,110

4. What is the PV of $36,000 if the amount is due in equal monthly installments on the 15th day of each month for a year? The opportunity cost of capital is 12%.

PV=$34,117.8 /(1+0.005)=$33,948.1 OR PV=$34,110/(1+0.005)=$33,940.3

5. How much can we accumulate on a bank account if we invest $519 at the end of the next 9 years? The interest rate is 13%.

FV=$519*(PVIFA$_{13\%,9}$=5.132)*(1+0.13)^{9}=$8001.29

6. You receive $519 for 9 years, the first payment will be in 6 years. What is the PV of this cash flow at an interest rate of 13%

PV=$519*(PVIFA13%,9=5.132)*(DF13%,5=0.543)=$1,446.3

7. A 10-year U.S. Treasury bond with a face value of $10,000 pays a coupon of 6% (3% of face value every six months). The semiannually compounded interest rate is 4% for a year. What is the present value of the bond?

PV=$10,000*0.03*(PVIFA$_{2\%,20}$=16.35)+$10,000*(DF$_{4\%,10}$=0.676)=$4,905+$6,760=$11,665

8. A strip is a special type of Treasury bond that repays principal at maturity, but makes no coupon payments along the way. Strips are also called zero-coupon bonds. A 10-year strip has a face value of $10,000. What is the strip's YTM if its price is $4,600?

YTM=(10,000/4,600)$^{1/10}$ – 1=0.0807 that is 8.07%

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9. The required return of a stock is 15%. The company paid a dividend of $100 this year. What is the stock price if the expected growth rate of the dividend is 7%?

P=$100*1.07/(0.15-0.07)=$1,337.5

10. The company's expected earnings is $286 per share in a year. The market capitalization rate is 14%. The company's return on equity is 20%. What is the value of the company's stocks if the payout ratio is 85%?

g=20%*(1-0.85)=3% and with this g PV=$286*0.85/(0.14-0.03)=$2,210

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