Fundamental concepts and techniques

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Two basic rules in finance:

1. €1 now is worth more than €1 later
   - time value of money
   - expressed in *risk free interest rate*
   - price for postponing/advancing consumption
   - follows from 'human impatience' / productive investment opportunities
2. A safe €1 is worth more than a risky €1
   - market price of risk
   - expressed in risk premium
   - reward for bearing risk
   - follows from concave utility functions

Both are combined in risk adjusted discount / return rates

Time value of money

Two reasons why money now has higher value than money later:

1. Time preference or 'human impatience'
    - people prefer present to future consumption
    - not just impatience:
      cannot postpone everything
    - more general:
      income asynchronous with consumptive needs
      need to move money around in time

2. Productive investment opportunities
    - increase consumption later by giving up consumption now
    - puts a premium on postponement
    - pay a premium for the opposite

Consequence of time value of money:

- Amounts on different points in time cannot be directly compared
  - cannot say that €100 now is worth less (or more) than €108 next year
- amounts have to be moved through time to same point, adjusting for time value, called:
  - *compounding* if moved forward in time
  - *discounting* if moved backward in time

Interest is *compounded* when it

- is added to principal sum and
  starts earning interest (interest on interest)

Simple example: yearly interest rate 10%, compounded yearly

- deposit €100 in a bank
- after 1 year, 10% is added to your account ⇒ €110
- second year, interest over €110 is €11 ⇒ €121, etc.

Formula for future value, FV, after T years is

$$FV_T = PV(1+r)^T$$

PV is present value, r is interest rate.

Same principle applies to *discounting*, moving money back in time

- Future value of €100 at time T
- has value of $100/1.1 =$ €90.90 at T-1
- which has value of $90.90/1.1 =$ €82.60 at T-2, etc.

In formula, simply move interest rate factor to other side:

$$PV = \frac{FV_T}{(1+r)^T}$$

Can also re-write formula for the interest rate:

$$r = \sqrt[T]{\frac{FV_T}{PV}} - 1$$

is geometric average rate, $<$ than arithmetic if r fluctuates

Compounding periods not necessarily same as interest periods

- e.g. corporate bonds pay interest $2\times$ per year
  even though interest is annual rate
- 10% bond pays 5% every half year
  bondholders earn interest on interest in second half year
- *effective annual rate* is $1.05^2 = 1.1025$ or 10.25%
- if compounded quarterly $1.025^4 = 1.1038$ or 10.38%

Future value formula with variable compounding frequency, n, is:

$$FV_T = PV\left(1 + \frac{r}{n}\right)^{Tn}$$

If compounding frequency $n \rightarrow \infty$

- compounding periods become infinitesimal
- compounding becomes continuous

Future value formula found by multiplying Tn by r/r and splitting in n/r and rT :

$$FV_T = PV\left[\left(1+\frac{r}{n}\right)^{n/r}\right]^{rT}$$

Defining $c = n/r$

$$FV_T = PV\left[\left(1+\frac{1}{c}\right)^{c}\right]^{rT}$$

As c approaches infinity

$$\lim_{c\to\infty}\left(1+\frac{1}{c}\right)^{c} = e = 2.71828....,\text{base of natural logarithms}$$

Formulae then become:

$$FV_T = PVe^{rT} \quad \text{and} \quad PV = FV_T e^{-rT}$$

re-writing for the interest rate gives $FV_T/PV = e^{rT}$
Taking logarithms:

$$\ln\frac{FV_T}{PV} = \ln e^{rT} = rT$$

These logarithmic rates of return are frequently used in continuous time finance (option pricing)

Advantage of continuously compounded log-returns:

- additive over time, e.g. daily stock prices $S_0, S_1, S_2, etc.$:

$$\ln\left(\frac{S_1}{S_0}\times\frac{S_2}{S_1}\right) = \ln\frac{S_1}{S_0} + \ln\frac{S_2}{S_1} = \ln e^{r_1} + \ln e^{r_2} = r_1 + r_2$$

- But *not* additive across investments:
  - logarithmic transformation not linear, log of sum $\neq$ sum of logs

Advantage of discretely compounded returns $\frac{S_1 - S_0}{S_0}, \frac{S_2 - S_1}{S_1}$:

- weighted returns are additive across investments:
  - equally weighted portfolio of A (r=10%) and B (r=20%) is $\frac{1}{2}\times 10 + \frac{1}{2}\times 20 = 15$
- But not additive over time:
  - 5% over 10 years is $1.05^{10} = 1.629$ or 62.9%, not 50%

Annuities and perpetuities

- Cash flows (payments and receipts) often come in series
- called annuity (yearly) and perpetuity (for ever)
- use mathematical series properties to calculate value
- e.g. series of n payments of amount A:

$$PV = \frac{A}{1+r} + \frac{A}{(1+r)^2} + ... + \frac{A}{(1+r)^n}$$

We do not use annuities in this course

- look them up in the book if needed

One exception: *Gordon growth model*

- present value of perpetuity
- perpetuity = annuity with infinite number of payments

Formula easily derived (see book):

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

Formula for perpetuity with growth rate g is:

$$PV = \frac{A}{r-g}$$

assumes $r > g$

Gordon growth model:

- often used for its simplicity
- also in exam questions (easy for students)
- usually applied such that number for A is given

Example: stock price as discounted dividends

A stock is expected to pay €10 in dividends 1 year from now
dividends are expected to continue forever
and to grow with the inflation rate of 2%
investors expect a 10% return on the stock
Value of the stock is:

$$\frac{10}{.1 - .02} = €125$$

Utility and risk aversion

Finance studies people's choices among risky future vales
Choices express the *preferences* people have:

- prefer A to B: $A \succ B$
- prefer bundle 1 to 2: $B1 \succ B2$

Preferences based on what alternatives 'mean' to people

Economic concept for that is *utility,*

preferences are described by utility:

- if A is preferred to B
  then utility of A, U(A), is larger than utility of B, U(B)

Is also true the other way around:

- if utility of A is larger than utility of B then A is preferred to B

$$A \succ B \Longleftrightarrow U(A) > U(B)$$

Utility is individual and situation-dependent:

- greedy $\Leftrightarrow$ generous people
- rich $\Leftrightarrow$ poor people
- old $\Leftrightarrow$ young people
- at home $\Leftrightarrow$ on the job $\Leftrightarrow$ holiday

To make a structured analysis possible, we make three very simple and general assumptions:

1. People are greedy: they prefer more of a good to less
2. Each additional unit gives less utility than its predecessor: the first beer tastes better than the next, etc.
3. Peoples' preferences are well-behaved, e.g.:
    1. asymmetric: $a \succ b \Rightarrow b \nsucc a$
    2. transitive: $a \succ b$ and $b \succ c \Rightarrow a \succ c$

These simple assumptions have important consequences

Third assumption means:

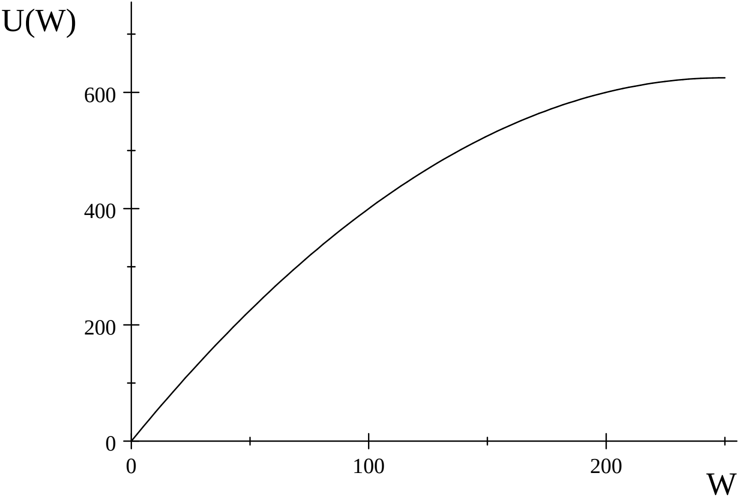
- preferences can be expressed in *utility function* that assigns numerical values to a set of choices

First and second assumptions mean:

- utility function is concave:
  - strictly increasing (positive marginal utility or positive first derivative)
  - at a decreasing rate (decreasing marginal utility or negative second derivative)

Well known utility functions are:

- logarithmic utility function: $U(W) = \ln W$
- quadratic utility function: $U(W) = \alpha + \beta W - \gamma W^2$



A typical utility function ($U = 5W - .01W^2$)

- W typically stands for wealth but can also mean apples, beer, bundle32, etc.
- Note that these utility functions are not so well behaved:
  - logarithmic utility function: $U(W) = \ln W$ requires W to be positive
  - quadratic utility function: $U(W) = \alpha + \beta W - \gamma W^2$ is only increasing over a certain range of values for W (up to the 'bliss point' $W = \frac{1}{2}\beta/\gamma$)

Financial markets often facilitate choices independent of utility functions, as we shall see, but we use them every now and then.

Why would it be an advantage to eliminate utility functions from the analysis?

From utility functions we derive 2 other important concepts:

1. Indifferences curves:
    - combinations of choices that give same utility
    - instruments in rational decision making process
    - their shape and location determine economic choices:
    - 'map' all indifference curves on all possible choices and chose alternative on highest indifference curve

2. Risk aversion:
    - risk is a negative quality, something to be avoided
    - (most) people require a reward to accept risk
    - follows from concave utility functions

To construct an indifference curve:

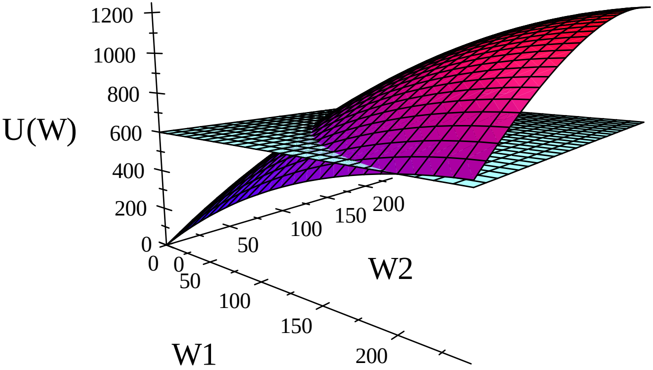
- plot utility as function of 2 $W's$ (wealth now, wealth next period or apples, pears, etc.)
  example:

$$U = 5W_1 - .01W_1^2 + 5W_2 + .01W_2^2$$

- Indifference curve is collection of points with same value of U, e.g.

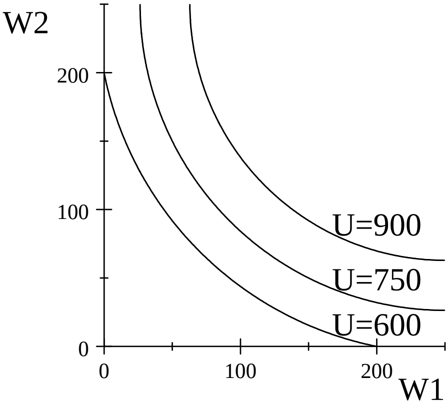
$$5W_1 - .01W_1^2 + 5W_2 + .01W_2^2 = 600$$

- Graphically, indifference curve is where utility surface intersects fixed value plane:



2 dimensional utility function and the U=600 plane

Seen from 'above' in W1-W2 plane indifference curves have their familiar shape, utility increases away from origin:



Indifference curves

Shape of indifference curves reflects:

- Decreasing marginal utility (2nd simple assumption)
    - the more units you already have of something, the less utility an additional unit of that something gives you
- Means in indifference curve context:
    - the more units you have of something, the more units you are willing to give up to get 1 unit of something else
    - if you have 10 apples and no pears you would give 3 apples for a pear and the other way around
- Individual preferences expressed in the way the curves are 'tilted' towards one of the axes
    - one person with 10 apples and no pears would give 3 apples for a pear, another person only 2

Risk aversion

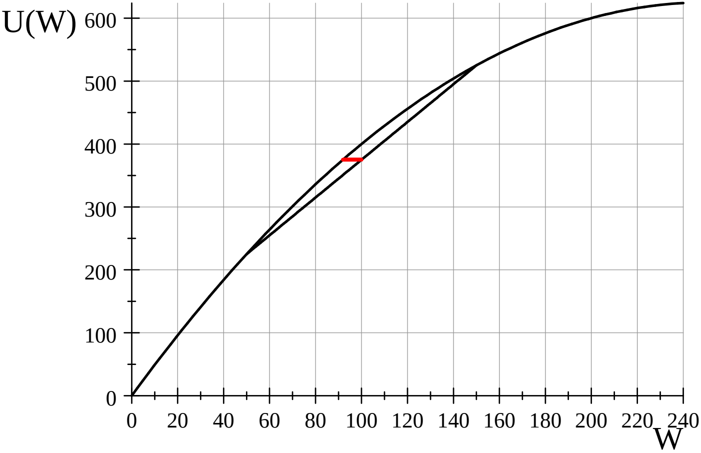
Look again at the utility function $U(W) = 5W - .01W^2$

- The utility of $100W$ is $U(100) = 500 - .01 \times 100^2 = 400$
- What if this 100 is not certain
  - but e.g. the expectation of 50 and 150 each with a probability of 50%?

We can calculate 2 things:

1. $U[E(W)]$ utility of expected wealth is on the curved utility function
2. $E(U[W])$ expected utility of wealth is a straight line interpolation (prob. weighted) between points on the curved utility function

Difference between the 2 reflects risk aversion



Utility function $U(W) = 5W - .01W^2$ and an uncertain value of (W)

Filling in the numbers:

- Quadratic utility function gives:
  - $U(50) = 250 - .01 \times 50^2 = 225$
  - $U(150) = 750 - .01 \times 150^2 = 525$
  - so that $E(U[W]) = (225 + 525)/2 = 375$
- Lower than 400 we calculated for $U(100)$

To how much certain W corresponds a utility of 375?

- Run function in reverse, gives $W = 91.89$ called *certainty equivalent*
- Required *risk premium* is $100 - 91.89 = 8.11$

Risk aversion follows from concave utility functions:

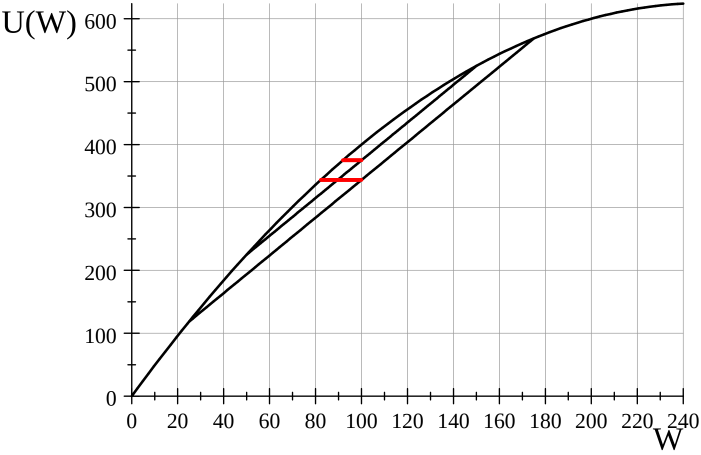
- If W 100$\rightarrow$ 150, U(W) 400$\rightarrow$ 525, increase 125
- If W 100$\rightarrow$ 50, U(W) 400$\rightarrow$ 225, decrease 175

We now try some different values: 25 and 175:

- same expectation, larger risk
- $U(25) = 125 - .01 \times 25^2 = 118.75$
- $U(175) = 875 - .01 \times 175^2 = 568.75$
- so that $E(U[W]) = (118.75 + 568.75)/2 = 343.75$

$U = 343.75$ corresponds to certain $W = 82.3$
the required risk premium is 17.7

- Required risk premium increases with risk
- also increases with curvature of utility function
    - used in *risk aversion coefficients*



Utility function $U(W) = 5W - .01W^2$ and 2 uncertain values of (W)

Discounting in investment analysis

Illustrate with an example, technology project ZXco

- technical and economic viability demonstrated in large test, cost €15 million
- now considering commercial launch

Management set following parameters:

- Cost of capital for project is 25%
    - includes time value of money and expected inflation
    - plus risk premium estimated from similar projects
    - thus defined, it is *opportunity cost of capital*
- corporate tax rate is 30%

Company's staff made following estimates:

Project details, amounts in €10^6 :

- will generate sales in 3 years, 250, 500 and 250
- sales start 1 year after investment
- 50% work will be outsourced
- operating costs are 35, 65 and 30
- requires investment now of 180, plus 15 paid for test
- investment depreciated in equal parts: $(180+15)/3=65$
- required working capital 10 now and 20, 35 after 1,2 years
- working capital liquidated last year

This gives following pro-forma income statement and balance sheet

(You can look up accounting statements in book if not familiar)

	year	0	1	2	3
	Income statement				
1	Sales	-	250	500	250
2	Cost of goods sold	-	125	250	125
3	Gross profit (1-2)	-	125	250	125
4	Operating expenses	-	35	65	30
5	Depreciation	-	65	65	65
6	Profit before taxes (3-4-5)	-	25	120	30
7	Tax @ 30%	-	7.5	36	9
8	Net profit (6-7)	-	17.5	84	21

	year	0	1	2	3
	Balance sheet				
9	Investment (gross)	195	195	195	195
10	Accumulated depreciation	-	65	130	195
11	Book value inv. year end (9-10)	195	130	65	0
12	Net working capital	10	20	35	0
13	Book value proj. year end (11+12)	205	150	100	0
14	Book value proj. year begin	0	205	150	100
	Book return on investment (8/14)		.085	.560	210

Accounting representation gives no clear decision criterion
Accept project or not?

- book return $<$ CoC in 2 of 3 years
- could use their weighted averages:

$$\frac{205 \times .085 + 150 \times .56 + 100 \times .21}{205 + 150 + 100} = 0.269 > CoC \Rightarrow \text{Accept?}$$

- heavily influenced by depreciation
- ignores time & risk: later returns less valuable

Financial representation provides proper decision framework:

- uses only data relevant for decision
- uses cash flows as they occur, no arbitrary divisions over time

Financial representation makes 3 changes:

1. Replaces depreciation by cash outflow of investment
   - depreciation spreads costs over time to give yearly profits
   - not necessary for decision
   - note: time pattern of cash flows is relevant
2. Includes changes in net working capital
   - is cash outflow (and investment) too
   - sometimes 50% of investment, or more
   - liquidated last year: becomes cash inflow
3. Removes part of investment irrelevant for decision
   - €15 for test already paid
   - cannot be undone: sunk costs

Gives following cash flow statement

	year	0	1	2	3
	Cash flow statement				
1	Net profit	-	17.5	84	21
2	Depreciation	-	65	65	65
3	Change in net working capital	-10	-10	-15	35
4	Cash flow from operations (1+2+3)	-10	72.5	134	121
5	Cash flow from investment	-180			
6	Total cash flow (4+5)	-190	72.5	134	121
7	PV cash inflows @ 25%	205.7			
	Net present value NPV (6+7)	15.7			

Cash flows moved to same point in time (now):

- by discounting expected future values
- at opportunity cost of capital of 25%

Subtracting the investment gives the project's *Net Present Value* (NPV):

$$\frac{72.5}{1.25} + \frac{134}{1.25^2} + \frac{121}{1.25^3} = 205.7 - 190 = 15.7 = NPV$$

Decision rule:

- ZXco should go ahead with project if NPV$>$0
- then project adds to the value of the company

NPV is correct investment criterion, leads to value maximizing decisions (theoretical foundation later)

Some other aspects:

Project may generate more than cash flows:

- intangible assets like reputation and growth opportunities
- can be very valuable, discussed in real options analysis

Other investment criteria also used in practice, not as good as NPV:

- just saw *book rate of return:* flawed
- *payback period* = time to recover investment: even worse
- *internal rate of return* = discount rate that makes NPV=0
  - found by solving

$$-190 + \frac{72.5}{(1+r)} + \frac{134}{(1+r)^2} + \frac{121}{(1+r)^3} = 0 \quad \Rightarrow \quad \text{r=.3 or 30\%}$$

  - leads to correct decisions if used with rule: invest if IRR > CoC
  - but only for 'normal' cash flow patterns

Economic depreciation

- not necessary for investment decision (don't need profit per year, just cash flows)
- can be calculated anyway:
  - difference in project value from year to year, e.g.
  - now (t=0) value cash inflows is 205.7
  - 1 year later (t=1) 72.5 is realized, value remaining cash flows is:
$$\frac{134}{1.25} + \frac{121}{1.25^2} = 184.6$$
  - difference $205.7 - 184.6 = 21.1$ is economic depreciation
  - economic profit is $72.5 - 21.1 = 51.4$
  - return is $51.4/205.7 = 0.25$ or 25%

Calculations summarized in table:

Economic depreciation and return

	year	0	1	2	3
1	Cash inflows from project		72.5	134	121
2	PV cash inflows, year end	205.7	184.6	96.8	0
3	PV cash inflows, year begin	0	205.7	184.6	96.8
4	Economic depreciation (2-3)	-	-21.1	-87.8	-96.8
5	Profit from project (1+4)	-	51.4	46.2	24.2
6	Return on investment (5/3)		.25	.25	.25

Economic depreciation

- changes from year to year
- depending on how much of project is realized
- but return is constant

In accounting representation

- depreciation is arbitrarily set as a constant
- so that return jumps up and down
- makes second year exceptionally good (bonuses?)

Example project re-used later in marked efficiency

The role of financial markets

Theory: Fisher's optimal investment analysis

- Elegant illustration of the role of financial markets in decision making
- Investigates choice between investment and consumption over time
- Decisions made with indifference curves

Setting of Fisher's analysis:

- simple: 2 periods, no uncertainty, makes graphical analysis possible
- individuals decide what to do with their budgets (consume, save, invest)
- first without, then with financial market

Modelling consumption without financial market

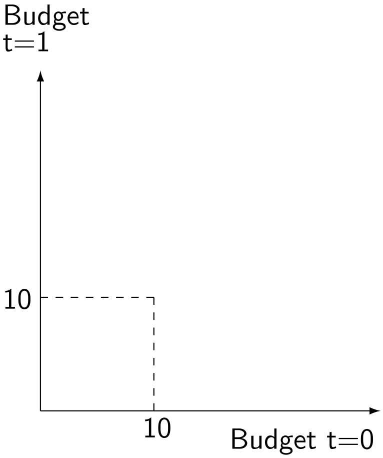
- looks absurdly restricted, is common, real life situation for employees in bureaucracies

Example: Institute of Industrial Economics, NTNU

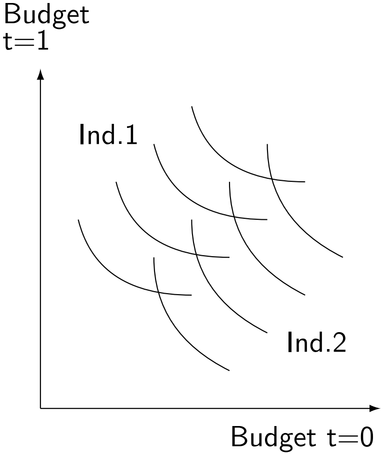
- Teaches economics, practices otherwise
- teachers get budget of NOK 10.000 per year
- cannot save or hoard budget, cannot borrow either
- can only be spent...

What assumption would be violated if not everybody spends whole budget every year?

Consider budget space over 2 years (consisting of 1 point):

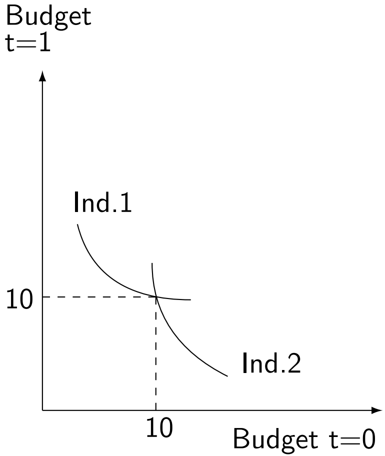


Budget space



Indifference curves in a budget space

Who wants to spend more this period, Ind.1 or Ind.2?



Consumption choices in a budget space

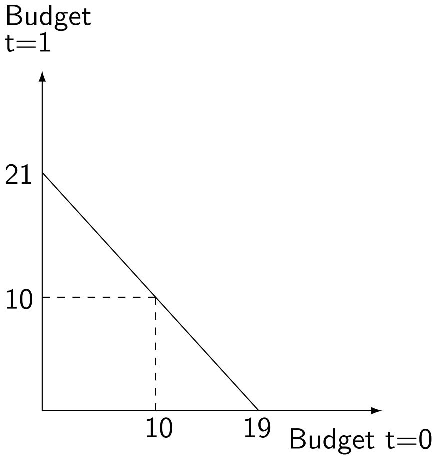
Financial market is now introduced:

- means the possibility to borrow and lend
- means also: move consumption back and forth in time
- often taken for granted, but has large impact: try buying a house without a mortgage loan

For simplicity we assume perfect financial market:

- no transaction costs
- no default (no uncertainty)
- people can borrow and lend at same rate without restrictions

Given 10% interest, what are max. amounts that we can spend in each period?

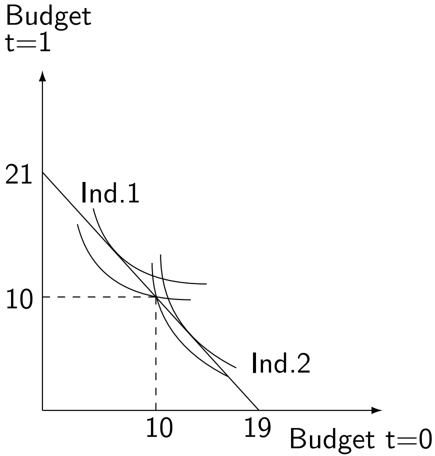


Budget line in budget space

- Slope of the budget line is $-(1+r)$, where r is interest rate (10%).
- Borrowing against next period's budget, we can spend $10+10/1.1=19$ this period
- Putting this period's budget in the bank we can spend $10+10\times1.1=21$ next period
- Introduction of a financial market makes nobody worse off and most people better off.

Who is not better off?

Financial markets enable people to jump to higher indifference curve:



Consumption choices in a budget space

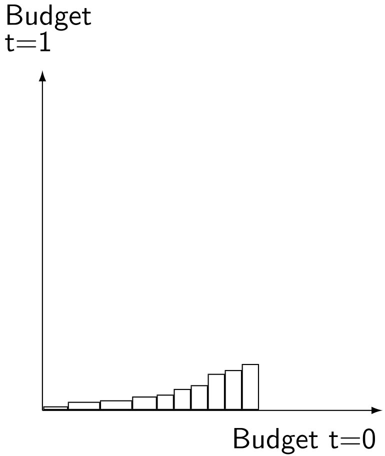
Productive investments

introduce possibility to invest in productive projects:

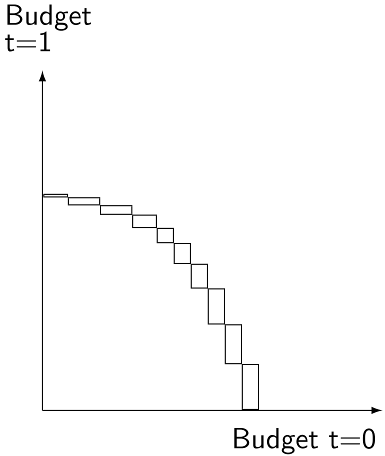
- good projects earn much more than interest rate
- not many good projects available
- next category of projects earns less, etc.
- worst projects earn much less than interest rate

Stylized shape of production possibilities obtained by:

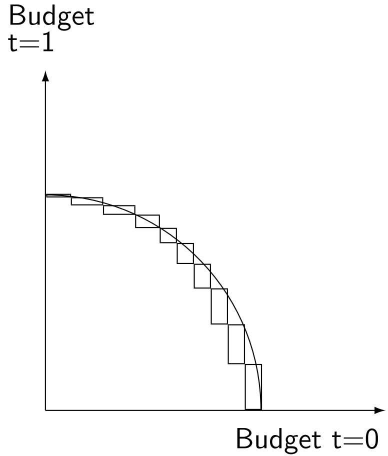
1. order projects bad-good (left-right)
2. take them cumulatively (right-left)
3. approximate with smooth line, called *investment frontier*



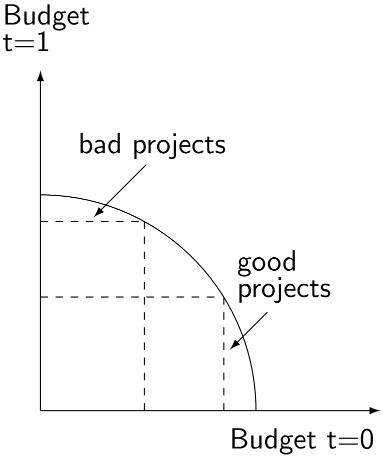
Investment opportunities



Investment opportunities, cumulative



Investment opportunities, cumulative + continuous approximation



Investment frontier

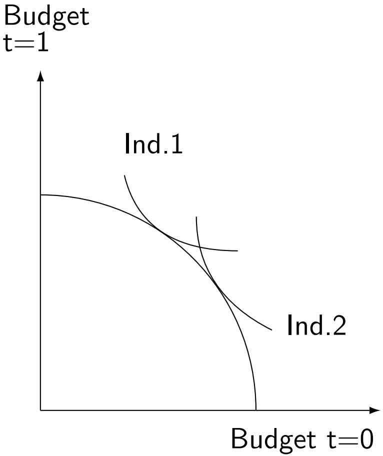
Good productive investments create wealth:

- by giving up consumption this period
- we can increase consumption next period
- with *more* than we give up this period

How is the investment level chosen?

Without financial markets the optimal investment plan depends on individual indifference curves:

- Ind. 2, who needs money, wants to invest little
- Ind. 1, who has money to spare, wants to invest more



Choices along investment frontier

Looks trivial, but has important consequence:

- Different investors have different ideas about which projects should be taken into production.
- 'Value' of a project depends on who wants to carry it out, i.e. it matters *'where the money comes from'*
- So there is *no* general rule saying which projects are worth while.
- Professional manager has to know the preferences of his or her clients or stockholders to make an optimal decision about investment plan.

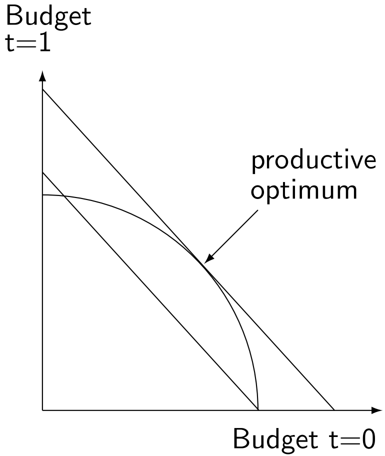
The introduction of a financial market remedies this all.

Financial market: optimal choices are made in 2 steps:

1. The optimal investment plan is chosen
2. Optimal consumption is chosen

To choose the optimal investment plan:

- start with the best projects and keep on investing until marginal rate of return on projects equals interest rate
- same as: select all projects with NPV ≥ 0
- is point where new budget line is tangent production opportunity curve
- both alternative allocations same marginal return
- cannot increase budget by changing: optimum



Optimal investment plan

The optimal investment plan:

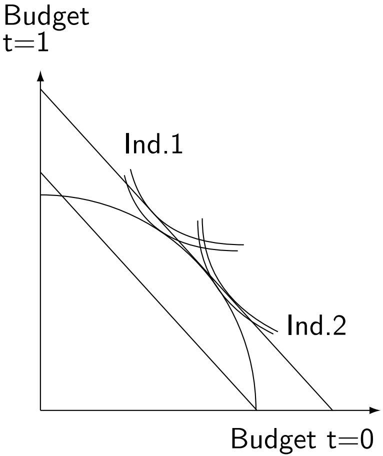
- gives the maximum budget for a given interest rate
- is familiar micro-economic result: optimum when marginal costs = marginal revenue

note that locus of optimum depends on slope budget line

How does budget line change if interest rate is higher?
Are more or less projects taken into production?

Optimal spending of this budget (= optimal consumption):

- reached by allocating wealth over time by borrowing and lending on financial market
- allows investors to jump to higher indifference curve



Optimal consumption choices

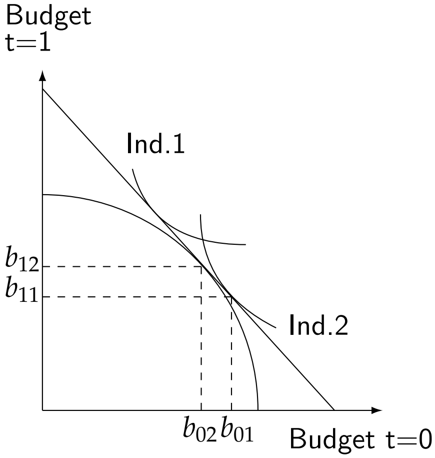
Introduction financial market has far reaching consequences:

- Again: nobody is worse off, most are better off
- Everybody agrees on the optimal investment plan
  - everybody prefers more budget to less
  - nobody needs productive investments to allocate consumption over time
- Investment and consumption decision can be separated
  - called Fisher separation
  - professional manager does *not* have to know preferences of clients or stockholders to make optimal decision about investment plan
  - makes separation of management and ownership possible

Some more important consequences:

- Managers can use objective market data (ROI, interest rate), ignore subjective preferences
- Doesn't matter where money comes from, only where it goes to
- Gives general rule which projects are worth while i.e. simple instruction to managers = goal of the firm:
  - *Maximize Net Present Value*
  - equivalent to: select all projects with NPV≥ 0
- Also shows why NPV is superior criterion:
  - max. profitability (%) would only include 'first' project
  - NPV only includes projects that earn more than interest rate
  - NPV gives proper allocation of investments

How does Ind. 2 reach her optimal spending pattern?



Ind. 2 reaches her optimal spending point as follows:

- at t_0 borrow the maximum against the t_1 budget, giving a total t_0 budget of 19
- of this 19, invest $19 \rightarrow b_{02}$ in productive assets, leaving $0 \rightarrow b_{02}$ for spending in t_1
- borrow against return of investment $(= 0 \rightarrow b_{12})$ the present value of $b_{12} \rightarrow b_{11}$, i.e. $b_{02} \rightarrow b_{01}$
- this gives optimal spending in both periods:
  - $0 \rightarrow b_{01}$ in t_0
  - $0 \rightarrow b_{13}$ in t_1

Or graphically:

Real world financial markets:

have many different functions, not just borrowing-lending

- Facilitate trade in wide range of financial contracts
- have an immense, complex infrastructure

Summarize their role in 4 functions:

1. Facilitate flow of funds
2. Price determination
3. Provide marketability and liquidity
4. Maintain system for settling payments and clearing

1. Flow of funds

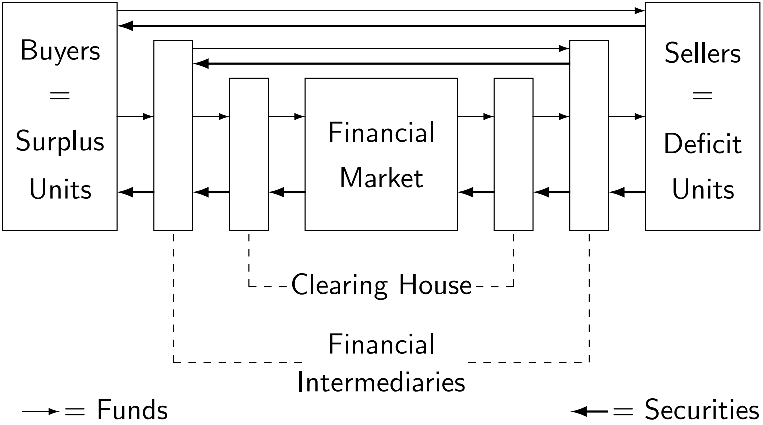
- from surplus units (money $>$ investment opportunities)
- to deficit units (money $<$ investment opportunities)

units can be people, businesses and governments

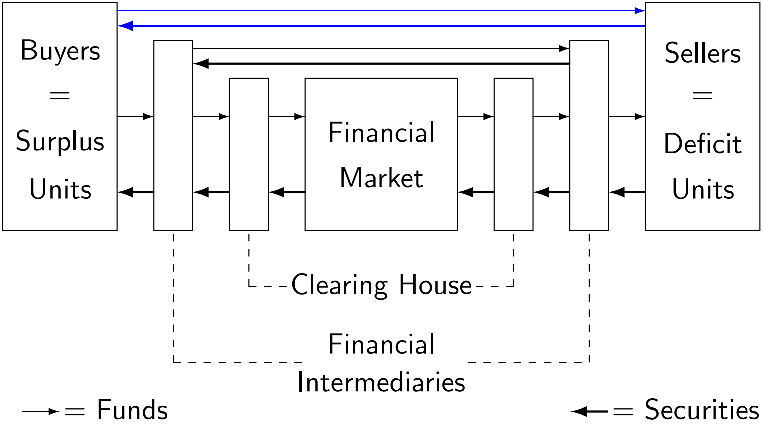
Efficient flow separates time patterns of income and investment/consumption
Has important benefits:

- allocation of capital to most productive uses
- also means: efficient risk transfer
- allows young people to buy house, save for retirement

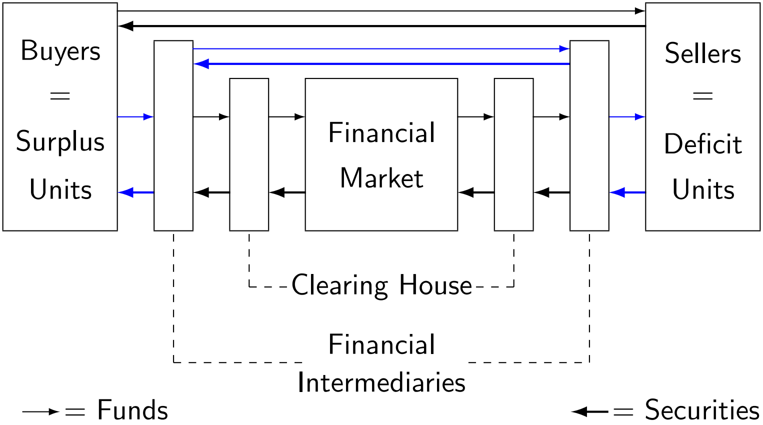
Flow can take many different routes



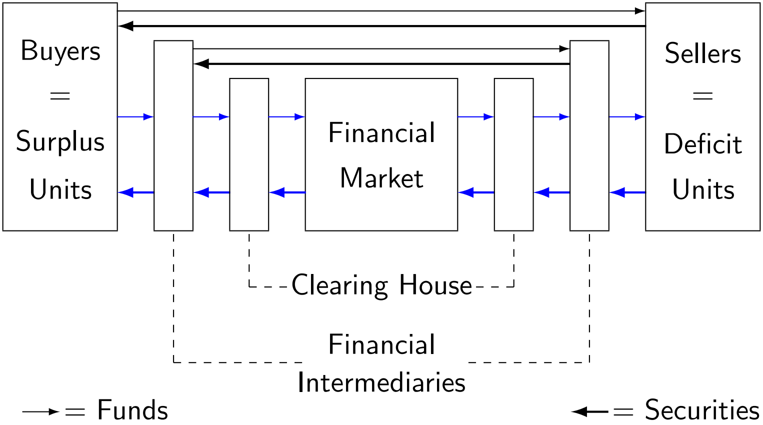
A schematic view of financial markets



Direct finance: straight from issuer to buyer, e.g.:
private placement: company sells block of shares to insurance company



Indirect finance: from issuer to buyer through financial intermediary without passing financial market, e.g.: bank takes deposits from savers, makes loans to businesses



Stock market transaction: from seller to buyer through broker and clearing house, e.g.:
private investor sells shares to other private investor

2. Price determination

- Time value of money
- Market price of risk

Process of establishing market prices is called *price discovery*

- can be organized in different ways (see later)
- if organized properly: market prices reflect all information

How can prices reflect all relevant information?

- traders reveal private info in prices they ask and bid
- adjust their bid-asks in reaction to other traders' bid-asks
- all this affects market prices, called *information aggregation*

Markets where prices reflect all info are called *efficient*

Example from old days: vegetables auction

- Farmers produce cabbages, sail them to market
- each lot is numbered, sailed through the trading floor
- Buyers sit on trading floor:
  - individual greengrocers
    (who may have had demand for cabbage)
  - wholesalers
  - buyers from sauerkraut canneries
    (who have to fill their production capacity)
- express their info in prices they bid (by pressing button)
- they observe who buys at what price
- adjust their bids for next lot ⇒ *information is aggregated!*

This is how it worked until the 1970s.

3. Provide marketability and liquidity

Marketability: easiness of selling financial contracts
Liquidity: how much value is lost in the transaction

- Allows investors to switch from and to cash
- Allows investment period $\neq$ security's maturity

Markets increase liquidity/marketability:

- primarily by size:
  - attract large number of buyers and sellers
  - more or less continuous trading
  - spread costs over very many transactions
- also by effectiveness, infrastructure, environment ('city')

4. System for settling payments and clearing

- Start in 1700s: bank clerks exchanging cheques
- Today: enormous number of transactions every day
- requires a huge electronic infrastructure

Exchanges have *clearing houses* to settle transactions:

- see to it that deals are properly executed
  - sellers get paid, buyers receive securities
- position themselves between buyer and seller
- take over counter party risk

Financial markets have many segments:

Classified by security and organization. e.g.:

- Organization of the market:
  - Exchanges have a central meeting place
    - traditionally, demand and supply met on trading floor
  - Over-the-counter markets are networks of dealers
    - dealers stand ready to buy-sell at bid-ask prices
- Price discovery process:
  - Order driven markets: buyers & sellers trade with each other
    - both send their orders to market through brokers
  - Quote driven markets: buyers & sellers trade with dealers
    - dealers act as *market makers* by quoting bid-ask prices

Most markets are a mixture of segments and systems, details in the book

Financial intermediaries facilitate transactions

Modern markets are large and complex

- participants cannot do all deals themselves
- Intermediaries provide professional assistance

Summarize their role in three categories:

1. Transformation of flow of funds
2. Reduction transaction and information costs
3. Provision of investment services

1. Transformation of the flow of funds

Surplus flow does not match deficit flow, intermediaries make them match, e.g. banks transform deposits into loans

	Deposits	Loans
Number	large	smaller
Denomination	small amounts	larger amounts
Maturity	short	long
Currency	domestic	also foreign
Risk	risk free	risky

Pooling gives diversification effect

- many small short-term loans give stable long term pool
- pooling loans reduces impact of defaults

2. Reduction of transaction/information costs

Consider following situation:

- 10 private households with small savings of €30 000 each
- want to make a €300 000 loan
- to a small company at the other end of town

How do households handle contract, creditworthiness, terms, uncertainty (household may suddenly need money), etc.?

- practical problems virtually insurmountable

Role of financial intermediaries:

- reduce problem to choosing a bank

3. Provision of investment services, a few examples

Brokers (stock brokers) provide access to financial markets

- route clients' orders to trading-floor or -system
- charge a fee, called *commission*
- do not hold positions in securities (like *dealers* do)

Investment banks work at the other end

- help companies in issuing securities
- also assist in large corporate deals, e.g. mergers

Mutual funds provide portfolio services

- holding well diversified portfolio requires size and skills
- mutual funds provide that expertise to small investors

Suppose you want to invest in the stock market

what steps must you take?

1. Open a brokerage account and deposit money
    - brokers provide access to stock markets
    - broker checks your account and carries out your order
    - charges your account for expenses and commission
    - stores the shares for you
2. Decide what position you want: long or short
    - Long position: buy shares and hold them
        - profits from price increase
        - very common, especially for (very) long run
    - Short position: borrow shares from broker and sell them
        - buy them back in market after agreed period
        - profits from price decrease

Short selling in practice

In practice, you and I cannot short sell:

- broker will not agree
- if he does, will demand a safety deposit
  - called *margin* of, say, 30%
  - also retains proceeds from selling stock
- will also charge a fee
- authorities forbid short selling in turbulent times

Financial models usually assume perfect markets:

- no restrictions on short selling
- no margin or other costs

3. Decide what order you want to give to your broker
    - a *limit order*:
        - specifies number of shares at what price or better
        - guarantees max./min. price you pay/get
        - not guaranteed to be executed
        - more expensive than market order (higher commission)
    - a *market order*:
        - specifies number of shares at best available prices
        - specifies no max./min. price
        - guaranteed to be executed
    - you can add more details to your order (at a price)
        - time period for which a limit order is valid
        - *all-or-nothing* order: precise number of shares or none
        - *stop-loss* order: market order to sell, activated at a certain price level

4. If your broker receives your order:
    - broker will check your brokerage account
    - send your order to the market, different routes
        - broker may have access to trading floor exchange
        - if not, send order to broker who has
        - or to third market maker (dealer)
        - or send to dealer in OTC market
        - or to electronic trading system
    - If your order finds a match in the market
        - clearing house will execute the order
        - you have established your position in the stock market!