Announcements

- Next class, please bring with you a calculator
- Question 4 from problem set 1 should be solved asap
- So you can solve question 13 from problem set 2 (use a spreadsheet…)
- Please check schedule (In November you'll need 2 extra classes)
- (New MEDFOR students) – Tomorrow 11 am – Department meeting room

Week	Days	Topic
1	12 and 14 Sept	1
2	19 and 21 Sept	1 and 2
3	26 and 28 Sept	2
4	3 Oct	2
5	10 and 12 Oct	2 and Test1
6	17 and 19 Oct	3
7	24 and 26 Oct	3
8	31 Oct and 2 Nov	3
9	7 and 9 Nov	3
10	14 and 16 Nov	3
11	21 and 23 Nov	3
12	28 and 30 Nov	4
13	5 and 7 Dec	4 and Test 2
14	12 and 14 Dec	Revision and Test 3

Determinants of interest rate

1. Time preference

2. Inflation

3. Risk

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Time preference

- It's related to the preference of having the money now or to wait for a certain time in future.
- Is the relative valuation placed on a good at an earlier date compared with its valuation at a later date .
- Someone with high time preference is focused substantially on his well-being in the present and the immediate future relative to the average person, while someone with low time preference places more emphasis than average on their well-being in the further future.

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Inflation and forest investment analysis

- We've all experienced rising prices – inflation- at one time or another.
  - Goods get more expensive → interest rate increases
- *Inflation* is an increase in the average price level, which reduces the purchasing power of the euro (or any other currency).
- *Inflation* is the rate at which the general level of prices for goods and services is rising and, consequently, the purchasing power of currency is falling. Central banks attempt to limit inflation, and avoid deflation, in order to keep the economy running smoothly.

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Measuring inflation…

- ??? Prices of products don't change at the same rate…
- Costs of an average basket of products and services are evaluated and weighted according to proportions consumed in different times. The variations in costs in this basket determines the average inflation.
- Imagine that the basket in 2014 had the cost of 7000€ and in 2015 the cost was 7336€.
  - The percentage rate of change in this cost is the annual inflation rate in 2015.
  - Subtract 1 from the cost in 2015 divided by the cost in 2014, and you get the % inflation.
  - Or,
  - Divide the actual change by the beginning value.

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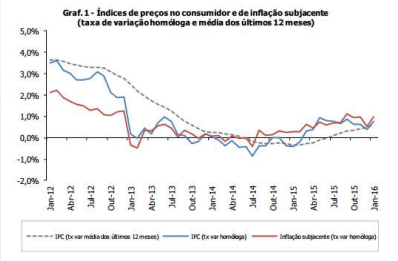
Measuring inflation…

- In practice the basket cost is translated into a index, the consumer price index (CPI) which is arbitrarily set to 100 in a base year. In Portugal, the base year is 2012 (INE, 2016).



- Average annual inflation rate f over an n-year period,

$$Average\ annual\ inflation\ rate = f = \sqrt[n]{CPI_n / CPI_0} - 1$$

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Measuring inflation…

- Producer Price Index (PPI)- shows the increases in prices for an average mix of industrial outputs, excluding services, from year to year.

TABLE 5-2
CONSUMER PRICE INDEX (CPI) AND PRODUCER PRICE INDEX (PPI)*

Year	CPI 1982–1984 = 100	% change in CPI†	PPI 1982 = 100	% change PPI†
1960	29.6	1.7	33.4	0.9
61	29.9	1.0	33.4	0.0
62	30.2	1.0	33.5	0.3
63	30.6	1.3	33.4	−0.3
64	31.0	1.3	33.5	0.3
65	31.5	1.6	34.1	1.8
66	32.4	2.9	35.2	3.2
67	33.4	3.1	35.6	1.1
68	34.8	4.2	36.6	2.8
69	36.7	5.5	38.0	3.8
1970	38.8	5.7	39.3	3.4
71	40.5	4.4	40.5	3.1
72	41.8	3.2	41.8	3.2
73	44.4	6.2	45.6	9.1
74	49.3	11.0	52.6	15.4
75	53.8	9.1	58.2	10.6
76	56.9	5.8	60.8	4.5
77	60.6	6.5	64.7	6.4
78	65.2	7.6	69.8	7.9
79	72.6	11.3	77.6	11.2
1980	82.4	13.5	88.0	13.4
81	90.9	10.3	96.1	9.2
82	96.5	6.2	100.0	4.1
83	99.6	3.2	101.6	1.6
84	103.9	4.3	103.7	2.1
85	107.6	3.6	104.7	1.0
86	109.6	1.9	103.2	−1.4
87	113.6	3.6	105.4	2.1
88	118.3	4.1	108.0	2.5
89	124.0	4.8	113.6	5.2
1990	130.7	5.4	119.2	4.9
91	136.2	4.2	121.7	2.1
92	140.3	3.0	123.2	1.2
93	144.5	3.0	124.7	1.2

*Data from CEA (1994).
†Percent change from previous year.

Nominal and real rates of return

- The rate of return earned on investments measured in current € (including inflation) is typically called the **nominal** rate of return, or nominal interest rate.
  - Is the interest rate that is quoted by banks, credit cards, etc.
  - It is the rate you should use to discount actual, inflated future values (i.e., nominal future values).
- The *real rate of return* (also called the *real rate*) is the rate earned on a capital investment or a loan.
  - Specifically, inflation has been removed from the real interest rate.
  - The real interest rate should be used to discount future values that are expressed in current dollar values (i.e., real future values).

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Components of interest rate

- Pure interest rate = real rate of return earned by an imaginary, risk-free, perfectly liquid, tax-free investment with no transactions costs and a very short time period.
- Real interest rate : pure interest rate + factors
  - Risk premium (uncertainty)
  - Taxes (property taxes)
  - Time period (longer period – less liquidity and more uncertainty)
  - Illiquidity (difficulty of withdraw cash flow investment)
  - Transaction costs (appraisal fees, loan fees, commissions)
- Nominal rate= Real rate + inflation

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Determinants of interest rate

- **Relationship between current interest rate (i), real interest rate (r) and**

$$i = (1+r)(1+f) - 1$$

$$r = \frac{(1+i)}{(1+f)} - 1$$

$$f = \frac{(1+i)}{(1+r)} - 1$$

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Example

- If you wish to earn a real rate of at least 3% on an investment and you expect the inflation rate will be 4% during the investment period, what is the minimum nominal rate you must earn?

$$i = (1 + r)(1 + f) - 1$$

$$i = (1 + 0.03)(1 + 0.04) - 1 = 0.0712 = 7.12\%$$

- If the nominal interest rate earned on an investment was 8% and the inflation rate was 3% during the investment period, what real rate was earned on the investment?

$$r = (1 + i)/(1 + f) - 1$$

$$r = (1 + 0.08)/(1 + 0.03) - 1$$

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Nominal vs Real values

- A *nominal value* is a value expressed in the currency of the year in which the value occurs, i.e., a value that is expressed in € that have the purchasing power of € in the year when the value occurs.
  - Accounts inflation
- A *real value* is a value that is expressed in terms of € with the same purchasing power as € today, or at any other meaningful reference point in time.
- Witch one is more stable over the time? And why?

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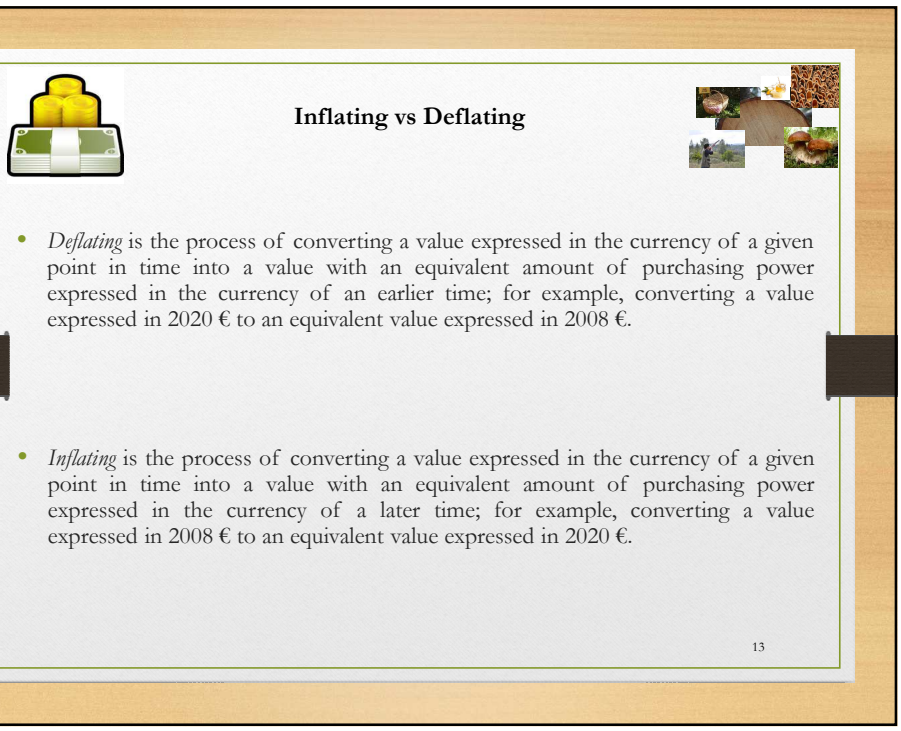
Inflating vs Deflating
• *Deflating* is the process of converting a value expressed in the currency of a given point in time into a value with an equivalent amount of purchasing power expressed in the currency of an earlier time; for example, converting a value expressed in 2020 € to an equivalent value expressed in 2008 €.
• *Inflating* is the process of converting a value expressed in the currency of a given point in time into a value with an equivalent amount of purchasing power expressed in the currency of a later time; for example, converting a value expressed in 2008 € to an equivalent value expressed in 2020 €.
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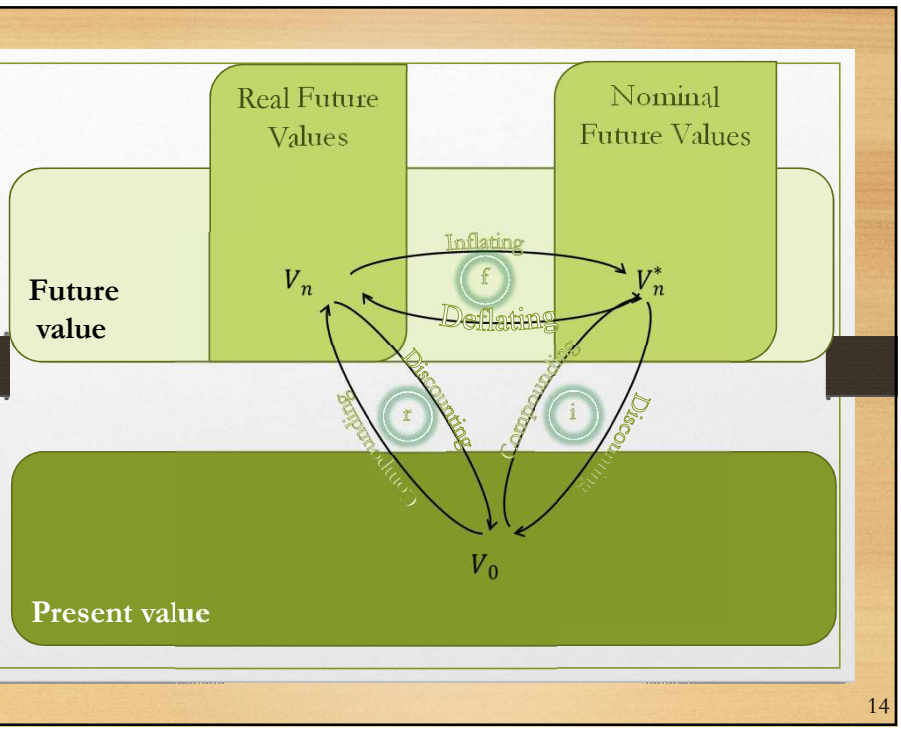
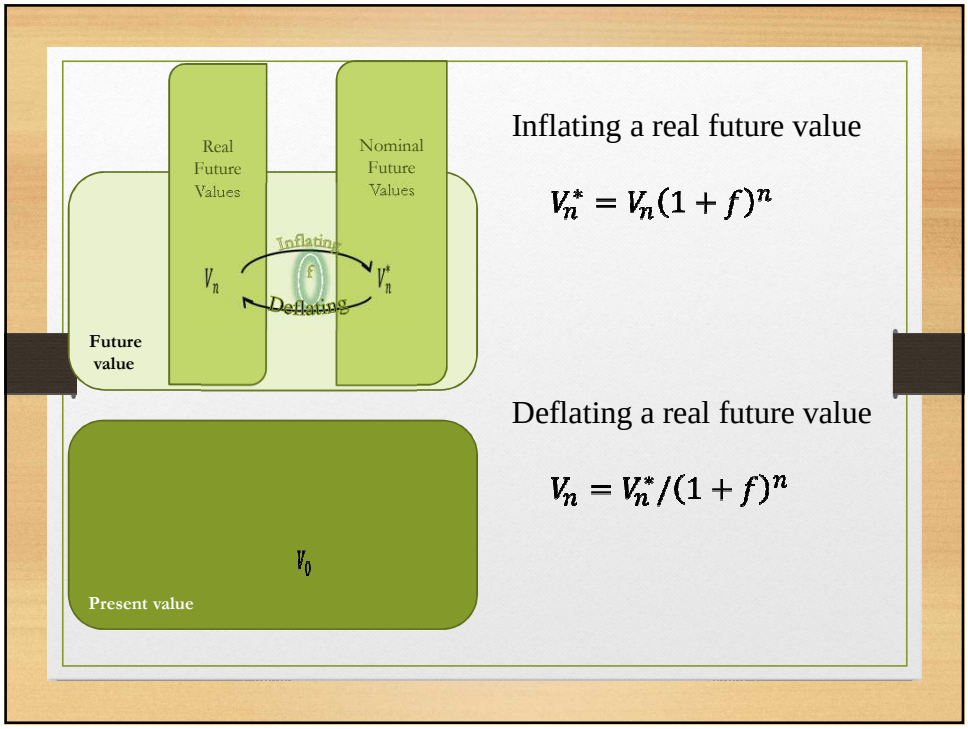

Real Future Values
Nominal Future Values
Future value
V_n
V_n^*
Inflating
f
Deflating
Discounting
r
Compounding
Compounding
i
Discounting
V_0
Present value
14

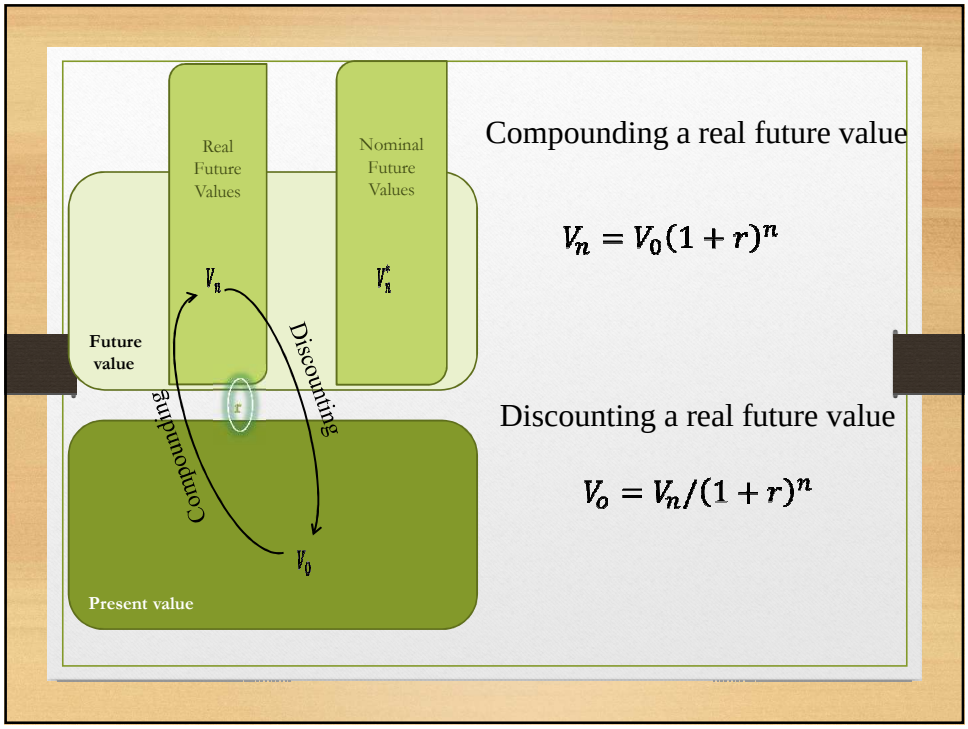


Inflating a real future value

$$V_n^* = V_n(1+f)^n$$

Deflating a real future value

$$V_n = V_n^*/(1+f)^n$$

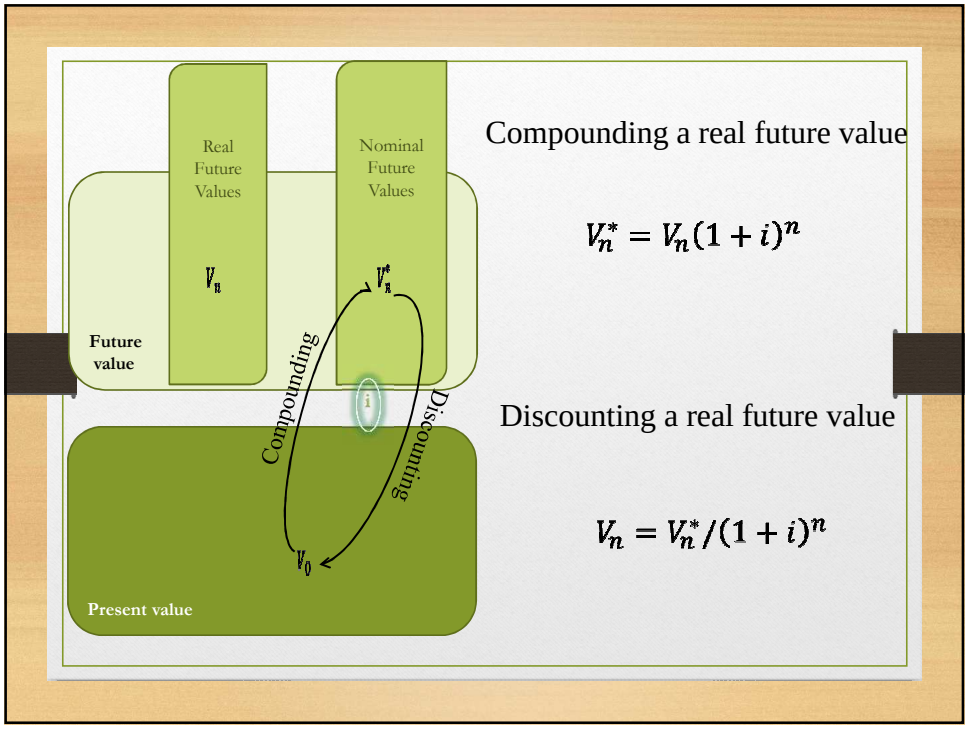


Compounding a real future value

$$V_n = V_0(1+r)^n$$

Discounting a real future value

$$V_o = V_n/(1+r)^n$$



Compounding a real future value

$$V_n^* = V_n(1+i)^n$$

Discounting a real future value

$$V_n = V_n^*/(1+i)^n$$

Examples

- The current stumpage price for premium oak sawtimber is 450€/m^3. If you expect the real price of premium oak to increase 2% per year, and if you expect inflation to be about 3% per year, what do you expect the nominal price of premium oak sawtimber to be in 10 years?

- Vo=450€/m^3
- r = 2% per year,
- f = 3% per year,
- V^*_{10} =?

$$i = (1+r)(1+f) - 1$$

$$i = (1+0.02)(1+0.03) - 1$$

$$i = 0.0506$$

$$V_n^* = V_n(1+i)^n = V_{10}^* = 450\ (1+0.0506)^{10} = 737.20€/m3$$

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Examples

- You wish to endow your alma matter with a fund that will generate a real value of $1000 each year, forever, for scholarships. The fund is expected to earn a nominal rate of 8% and inflation expected to average 3.5%.
  - What real rate of return is the fund expected to earn?
    - p = 1000
    - I = 8 % per year,
    - f = 3.5% per year,
    - V_0 =?

$$r = \frac{1+i}{1+f} - 1 = \frac{1.08}{1.035} - 1 = 4.35\%$$

How much money you will need to place in the fund to ensure that a real value of $1000 can withdraw each year?

$$Vo = \frac{p}{r}$$

$$= \frac{1000}{0.0435} = \$23000$$

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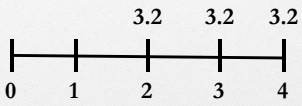
Examples

A forestry firm plans to conduct fuel treatments that encompass three annual costs amounting to 3.2 € / ha starting 2 years from now. Calculate the present value of these costs. (nominal rate (i) = 0.06)



$K_1 = 3.2\ [1-(1+0.06)^{-3}] / 0.06 = 8.55$

$K_0 = 8.55 / (1+0.06)^1 = 8.06$ € /ha

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Examples

A forestry firm wants to compute the future value of a series of revenues resulting from three cork extractions starting 9 years from now (108 € / ha (i = 0.05))

And now, calculate the present value :

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