Investment appraisal

Prof. Andrea Bonaccorsi

Investment

Types of investment

- Investment into fixed assets
    - Building
    - Plant, equipment
    - Fleet
    - Computer networks
- Investment into financial assets
    - Shares (variable income)
    - Obligations (fixed income)
    - Derivatives
- Investment into human capital
    - Schooling
    - Higher education

Formal structure of any investment

Initial **outflow of cash**

- purchase of equipment or other fixed assets
- subscription of shares and/or purchase of shares in the Stock Exchange Market
- subscription of obligations or bonds at the emission and/or purchase in the secondary market
- university fees + delta cost of living + opportunity cost of loss of revenue

Formally $-X_0$

Formal structure of any investment/2

Subsequent **inflow of cash**

Fixed assets

- utilization of fixed assets for the production of products and services

Shares

- dividend (yearly)
- capital gain (at the time of selling the shares)

Bonds

- interest (yearly)
- nominal value (at the time of expiration)

Higher education

- difference between the average wage of graduates and the average wage of people with high school degree

Formally $+ X_1 + X_2 + X_3 + X_4 + X_5 \ldots\ldots$

Formal structure of any investment/3

Definition of cash flow in the case of fixed investment.

Difference between monetary income and monetary costs

Monetary income = all income (with a delay represented by credit delay)
Monetary cost= all cost
(minus) Depreciation

Depreciation (amortization) reduces profits (hence cash outflows in the form of dividends payed to shareholders)
In some cases we have to include
(minus) Allocation for future expenses or risks

In general **Cash flow = Profits + Amortization**

Formal structure of any investment/4

Definition of cash flow in the case of fixed investment.

In the calculation of the initiali outflow we should include
- installation costs
- training costs
- initial production ramp-up

We should include
- opportunity costs

We should **not** include
- sunk costs (e.g. costs for feasibility studies that have been done before the decision to invest, since the final decision does not depend on incurring such costs- they are «sunk», that is, incurred whatever the decision)

Preliminary assessment

Any investment in which the sum of cash inflows is larger than the initial outflow should be considered positively.

Formally

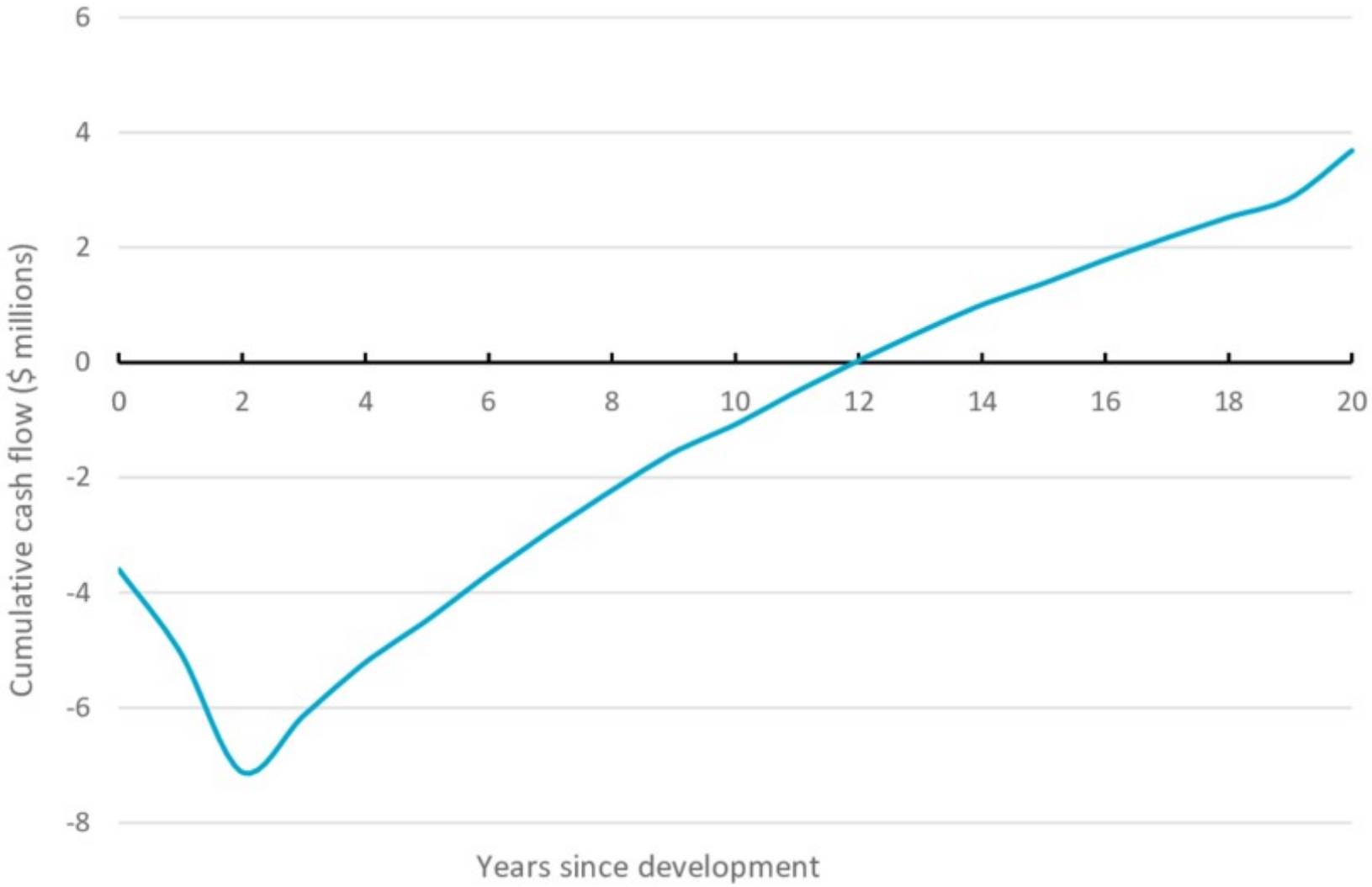
$$(X_1 + X_2 + X_3 + X_4 + X_5 \ldots\ldots\ldots) > X_0$$

Cumulative cash

To verify the previous disequation we might build up a cumulative function of the form

Cumulative Cash Flow (CCF)

$CCF_0 = - X_0$
$CCF_1 = - X_0 + X_1$
$CCF_2 = - X_0 + X_1 + X_2$
$CCF_3 = - X_0 + X_1 + X_2 + X_3$
$CCF_4 = - X_0 + X_1 + X_2 + X_3 + X_4$
$CCF_5 = -X_0 + X_1 + X_2 + X_3 + X_4 + X_5$


6
4
2
0
-2
-4
-6
-8
0
2
4
6
8
10
12
14
16
18
20
Cumulative cash flow ($ millions)
Years since development

Theoretical problem

Do sums of money at different dates have the same value?

A thought experiment
Will you prefer a sum of 1,000 euro today, or the certainty to receive 1,000 euro in one year from now?
The deferred sum is certain, not risky (e.g. it is placed into a safe bank)

Most people **do prefer the sum today.**
Reasons

- cash (liquidity) gives the opportunity for people to transform the sum of money into a bundle of goods immediately and with certainty
- postponing the consumption is a sacrifice which must be compensated

Natural rate of discount = number that makes two sums at different dates indifferent for the agent.

Assumptions

We may assume the following

- time is homogeneous

- people reason as if the time were homogeneous- i.e. moving a sum of money from time 1 to time 2 is the same than moving from time, say, 10 to time 11

If this is acceptable then we are looking for the real number such that

$$X_1 = X_0 (1+r)$$

with $r > 0$.

Assumptions/2

If these assumptions hold the it is true that

$$X_1 = X_0 (1+r)$$

implies

$$X_{0 =} X_{1 /} (1+r)$$

Assumptions/3

If these assumptions hold the it is true that

$$X_2 = X_1 (1+r)$$

But we know that

$$X_1 = X_0 (1+r)$$

Hence

$$X_2 = X_1 (1+r) = X_0 (1+r) (1+r) = X_0 (1+r)^2$$

$$X_3 = X_2 (1+r) = X_1 (1+r) (1+r) = X_0 (1+r) (1+r) (1+r) = X_0 (1+r)^3$$

$$X_t = X_0 (1+r)^t$$

Discounted Cash Flow

$$DCF = - X_0 + X_1/ (1+r) + X_2/ (1+r)^2 + X_3/ (1+r)^3 + \ldots$$

$$DCF = \Sigma X_t/ (1+r)^t$$

Choice of the discount rate

Public investment

- Official discount rate of Central Bank
- Average interest rate of Treasury Bonds
- Low rate for long term public investment

Private investment

- WACC

Decision rule

Make an investment if DCF > 0.

Interpretation

- moving a sum of money from current date to future dates generates a positive return
- after paying the agents who have conferred capital (either banks and shareholders) there is value left- this value adds to the overall value of the company

Internal rate of return

Find the real number k such that

$$DCF = \Sigma X_t / (1+k)^t = 0$$

Interpretation

- This number does not depend on the choice (perhaps arbitrary) of the analyst
- It is generated intrinsically by the size of cash flows and their timing

Internal rate of return vs DCF

These criteria deliver the same result when applied to a single investment. In fact if

$$DCF = \Sigma X_t / (1+r)^t > 0$$

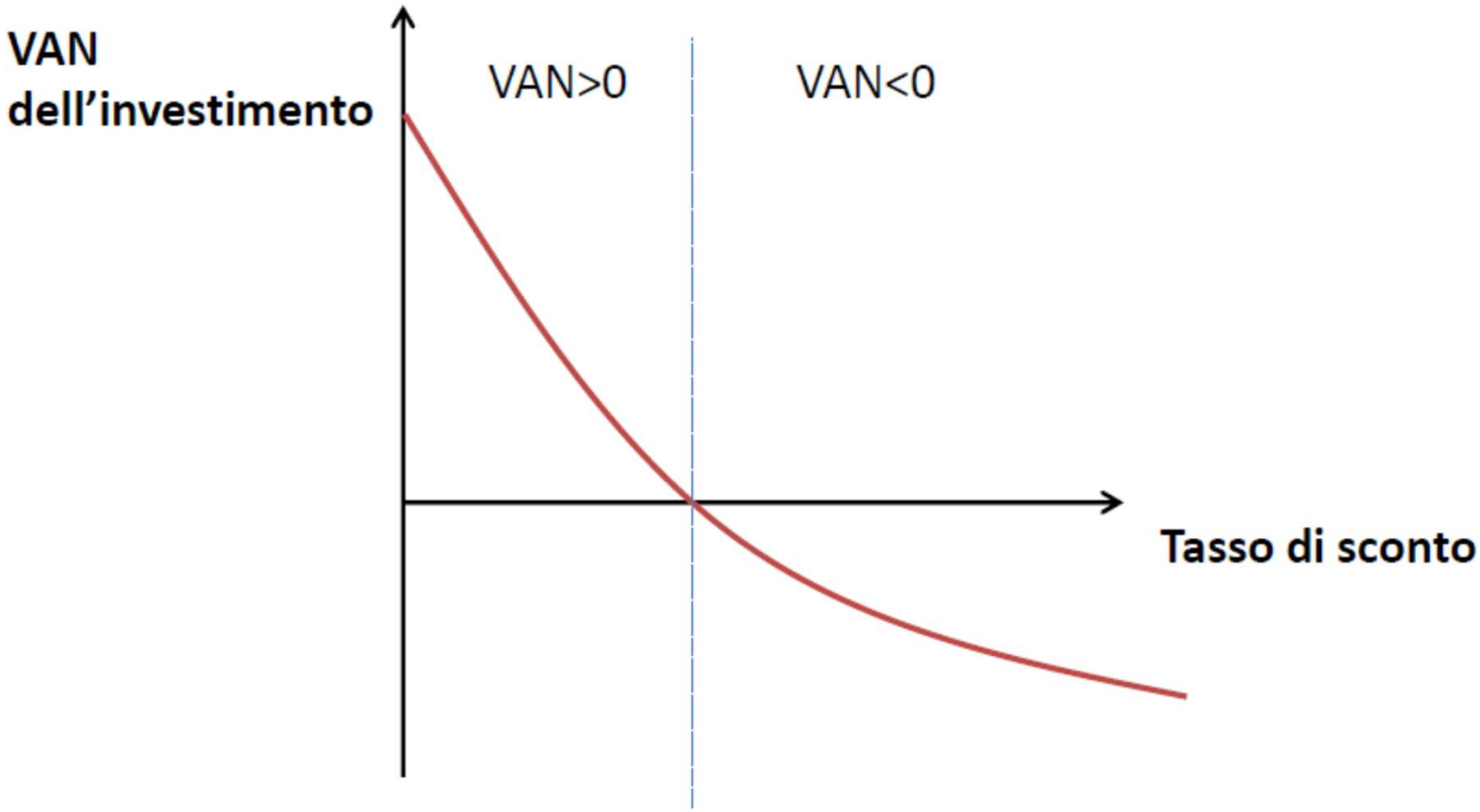
then IRR > discount rate r. In particular, IRR > WACC if the discount rate is fixed at the level of WACC.

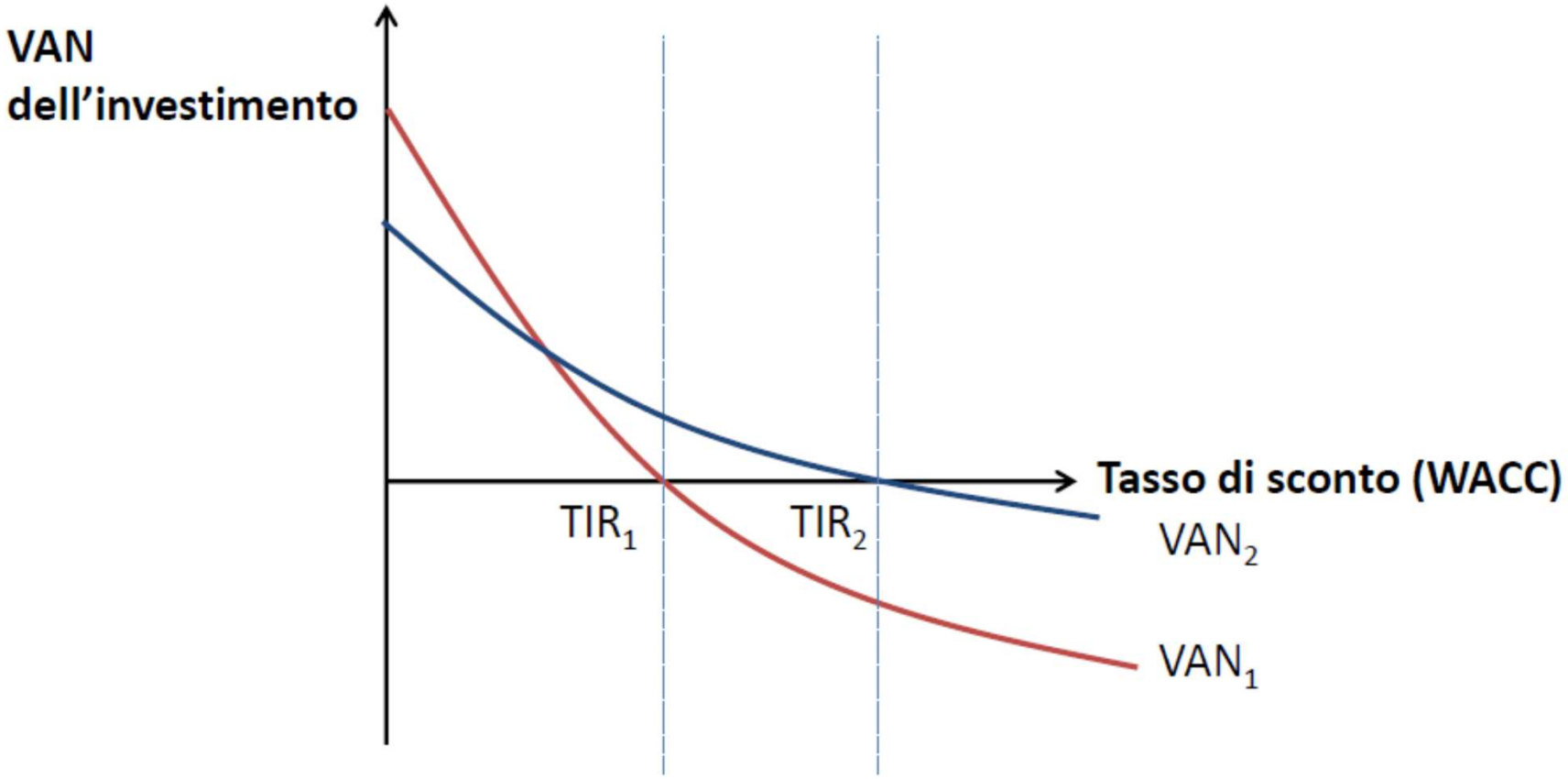
Interpretation:
- the investment generates value in excess of the cost of capital

Internal rate of return vs DCF

IRR is one of the roots of a polynomial expression, which has several solutions.

This implies that when two investments are compared, it is possible that the two criteria do not deliver the same decision.


VAN
dell'investimento
VAN>0
VAN<0
Tasso di sconto


VAN
dell'investimento
Tasso di sconto (WACC)
TIR1
TIR2
VAN2
VAN1