Universiteit Antwerpen
Faculteit Bedrijfswetenschappen en Economie

Economie ontcijferd

Waardering Jonge, Groeigerichte Ondernemingen

Prof. dr. Ine Paeleman

Economie ontcijferd 2023

Getting to know us…

Economie
ontcijferd

Waardering
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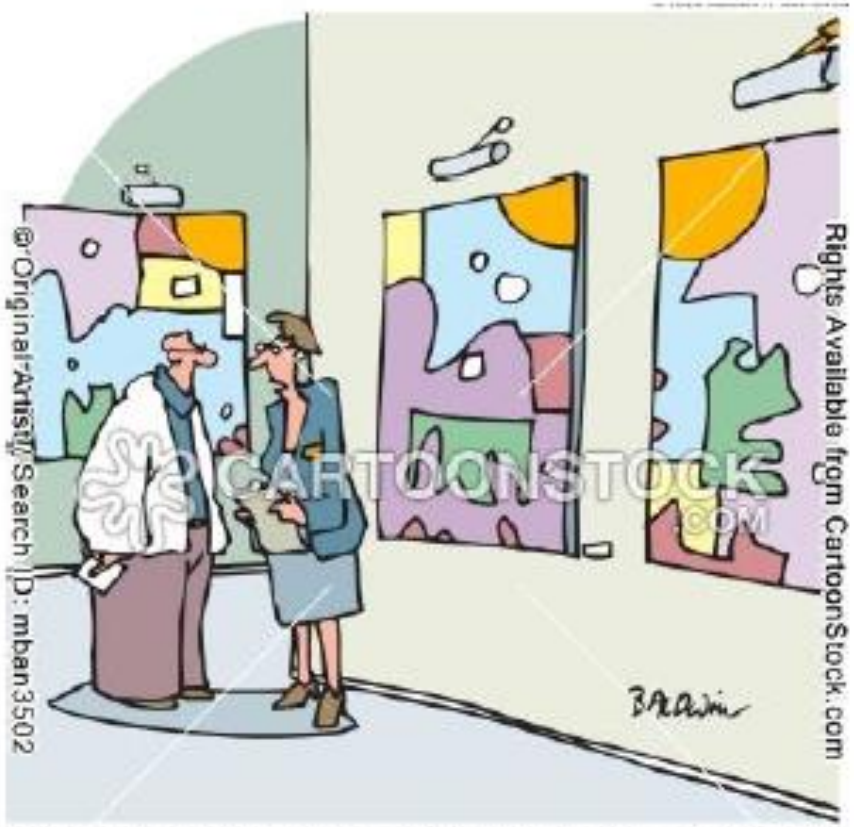


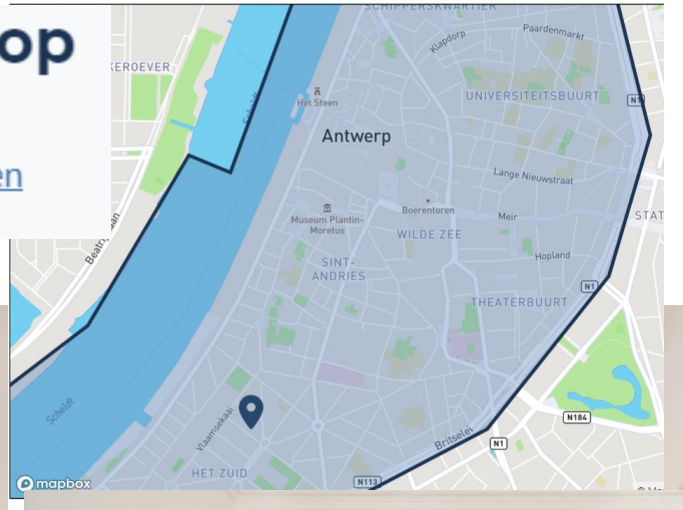
"What are they worth? Well, it's difficult to put a price on such extraordinary works of art. How much you got?"

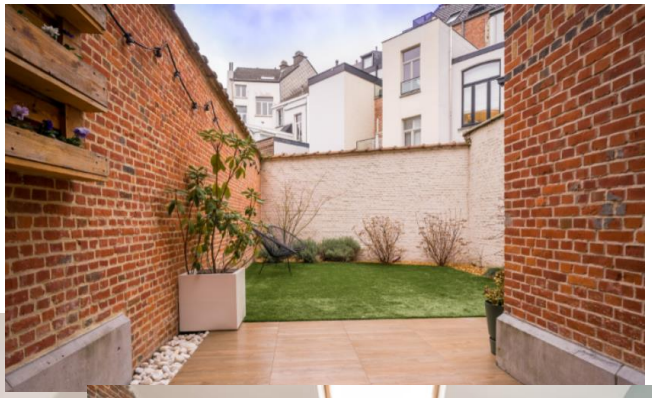
"Of course my business is worth what I am asking, it has amazing potential!"

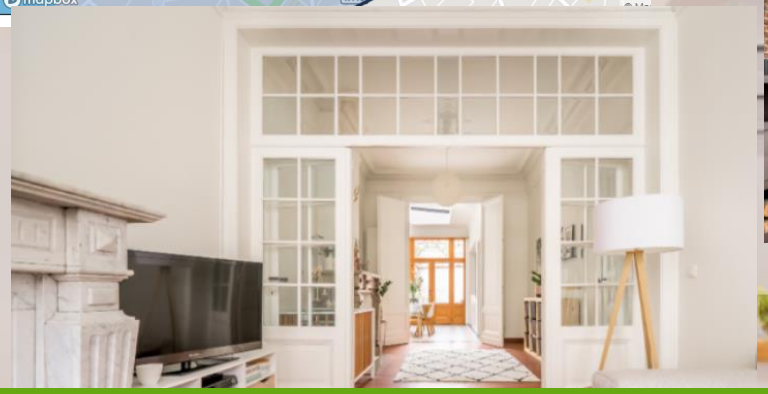
Herenhuis te koop

4 slaapkamers | 250 m²

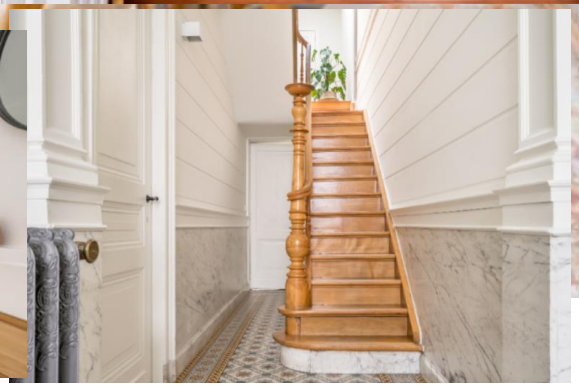
Verlatstraat 33 | 2000 – Antwerpen







WHICH PRICE WOULD YOU PAY FOR THIS HOUSE?



Which price would you pay for this house?

Price is what you pay.
Value is what you get.

What valuations is all about..

- **Understanding the business** (e.g. industry, market dynamics, corporate strategy, financial statement analysis, management, …)
- **Challenging the forecased company performance** (e.g. sales, EBITDA, earnings, net working capital, capital expenditures, …)
- **Selecting the most appropriate valuation approach**
- **Making the investment decision/recommendation**

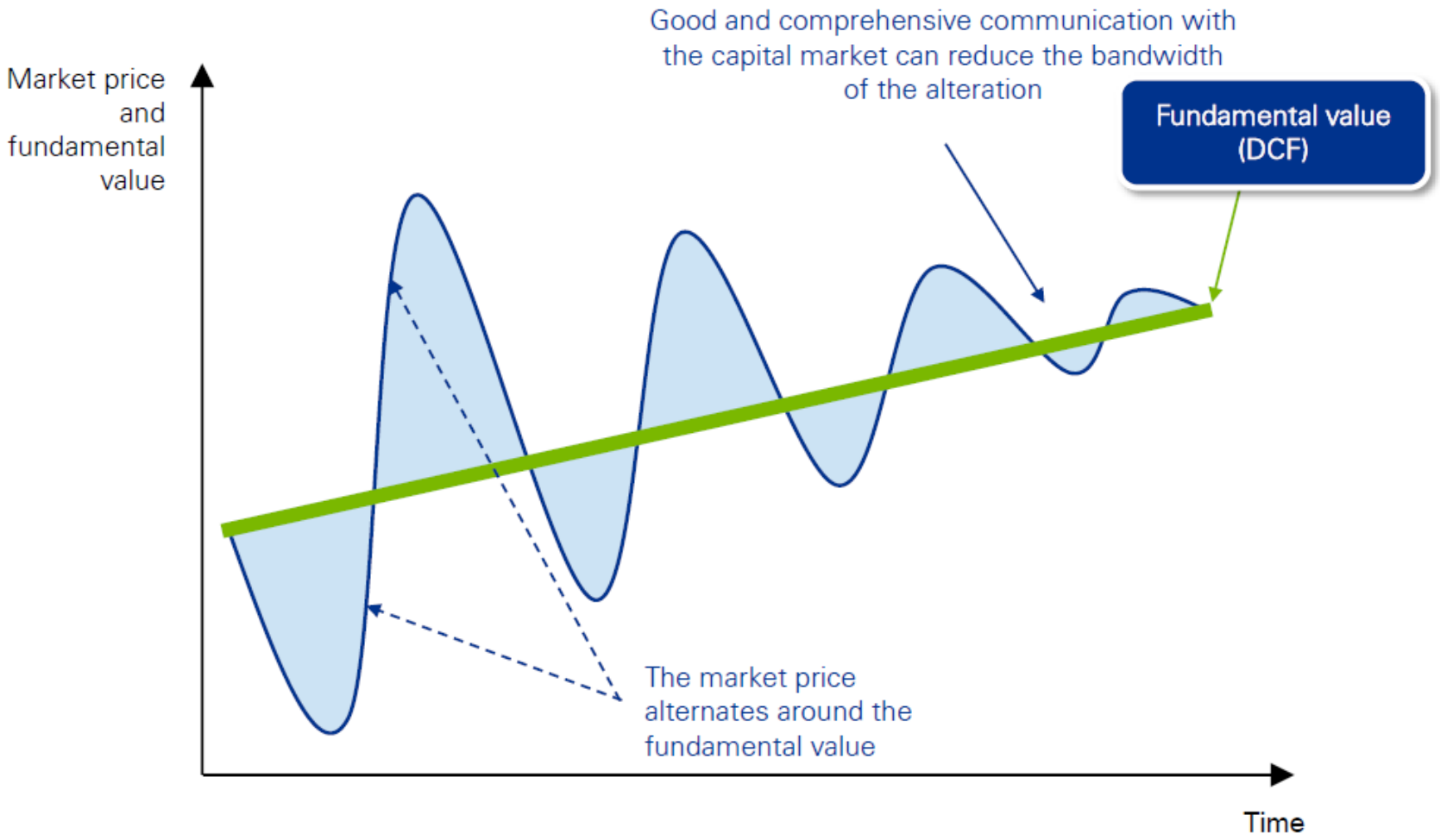
➔ A good valuation analysis connects narrative to numbers!

Hence valuation is **much more than pure financial mathematics…**

… however, **financial modeling is important**, and the quality of information is paramount.

Hence the GIGO (“Garbage In, Garbage Out”) principle applies to valuation.

Fundamental Value (DCF)

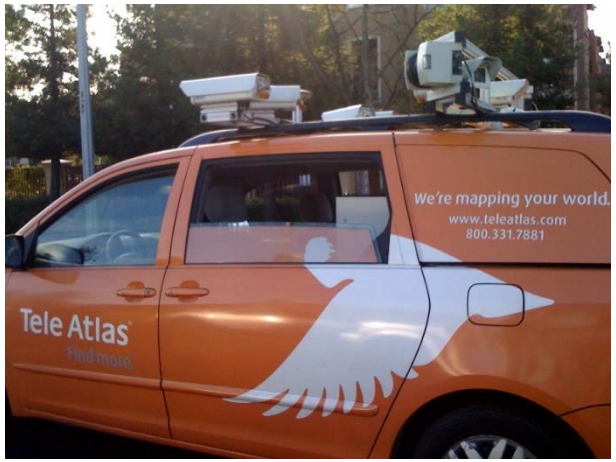


Unicorns

Belgium's first unicorn: billion-dollar start-up Collibra

Brussels-based data specialist Collibra – a spin-off of VUB, one of Flanders' 5 universities – has received USD 100 million from CapitalG, the investment arm of Google's parent company Alphabet. This makes the start-up worth more than USD 1 billion and the first-ever 'unicorn' in Belgium.

Source: Jan 2019, Flanders Investment Trade



Collibra is eerste Belgische techstart-up met waardering boven 1 miljard

Felix Van de Maele richtte Collibra in 2008 op. ©Collibra

Gents techbedrijf Combell krijgt miljardenstatus

©Emy Elleboog

Vlaams softwarebedrijf Deliverect meer dan 1 miljard waard

Zhong Xu en Jan Hollez richtten Deliverect op in 2018, nadat ze hun eerdere start-up Posios verkocht hadden aan het Canadese Lightspeed. ©rv

TOM MICHIELSEN | 21 januari 2022 21:28

deliverect
Online orders. Simplified.

How it works | Product | Integrations | Pricing | Resources | Sign in | Request a demo

We're a unicorn: $150 Million and 1.4B valuation in Series D Funding as we approach 100M orders

We are very excited to share that Deliverect has secured more than $150 million in Series D! With this new investment, we have crossed the $1 billion valuation threshold, which, beyond the purely financial aspect, essentially proves the value of our mission.

Airbnb mikt op waardering van 35 miljard dollar

Airbnb trekt na een moeilijk pandemiejaar alsnog naar de koerstabellen van de Nasdaq. ©REUTERS

Het bedrijf brengt 51,9 miljoen aandelen naar de markt, tegen een prijsvork van 44 à 50 dollar per aandeel. Airbnb kan zo aan de bovenkant van de vork 2,6 miljard dollar ophalen, tegen een waardering van 35 miljard dollar. Het platform staat qua waardering op uit de doden.

Source: December 1, 2020, De Tijd

Why is it important to understand how firms are valued?

- Investment decisions as **investor**

- New stock issues
- **Entrepreneurs**: negotiating with financiers

What is the problem with valuing early stage companies / ideas?

- Is not easy
- Valuation models are relatively straightforward, filling out the parameters is the hardest part
- Valuing an early stage company is
  - Tricky, i.e. difficult to forecast
  - Ambiguous
  - Difficult
  - Depending on wild assumptions
  - Depending on market sentiment
  - Many don’t survive = binary outcome

What influences the valuation of a company like HelloFresh?

What influences the valuation of a company like HelloFresh?

Valuation methods

1. The past: static methods
   - Book Value: not relevant
2. The future: dynamic methods
   - Dividend Discount Model: not relevant
   - Discounted Cash Flow method
   - The Risk-Adjusted DCF method
3. Rules of thumb: Multiples
4. The Venture Capital method

1. Discounted Cash Flow (DCF) Method

DCF method

$$Firm.value = \sum_{t=1}^{\infty} \frac{FCFF_t}{(1+r)^t}$$

DCF method

- **Step 1. Forecasting free cash flow of the firm**
  - (= free cash flow from operations, to all investors)

DCF method

- **Step 1. Forecasting free cash flow of the firm**
  - (= free cash flow from operations, to all investors)

Operational result (EBIT after taxes)
+ Depreciations and other non-cash expenses
- Change in NWC Requirement
= Cash flow from operations
- Investments → **CF from investing activities**
= Free cash flow (FCF)
- Interest expenses
- Loan repayment
- Dividends
} **CF from financing activities**
= Cash flow of the period
+ Beginning cash
= Cumulative ending cash

DCF method

- **Step 2. Estimating the cost of capital r**

$$Firm.value = \sum_{t=1}^{\infty} \frac{FCFF_t}{(1+r)^t}$$

r = Weighted average cost of capital (WACC)

= Gewogen gemiddelde kapitaalkosten

= Rendement vereist door alle investeerders

r = Equity% x rE + Debt% x rD(1-t)

= Eigen Vermogen/Totaal Vermogen
* Kosten van het Eigen Vermogen
+ Vreemd Vermogen/Totaal Vermogen
* Kosten van Vreemd Vermogen (1-t)

DCF method: example

FCF year 1 = - 50.000

FCF year 2 = -250.000

FCF year 3 = 100.000

FCF year 4 = 200.000

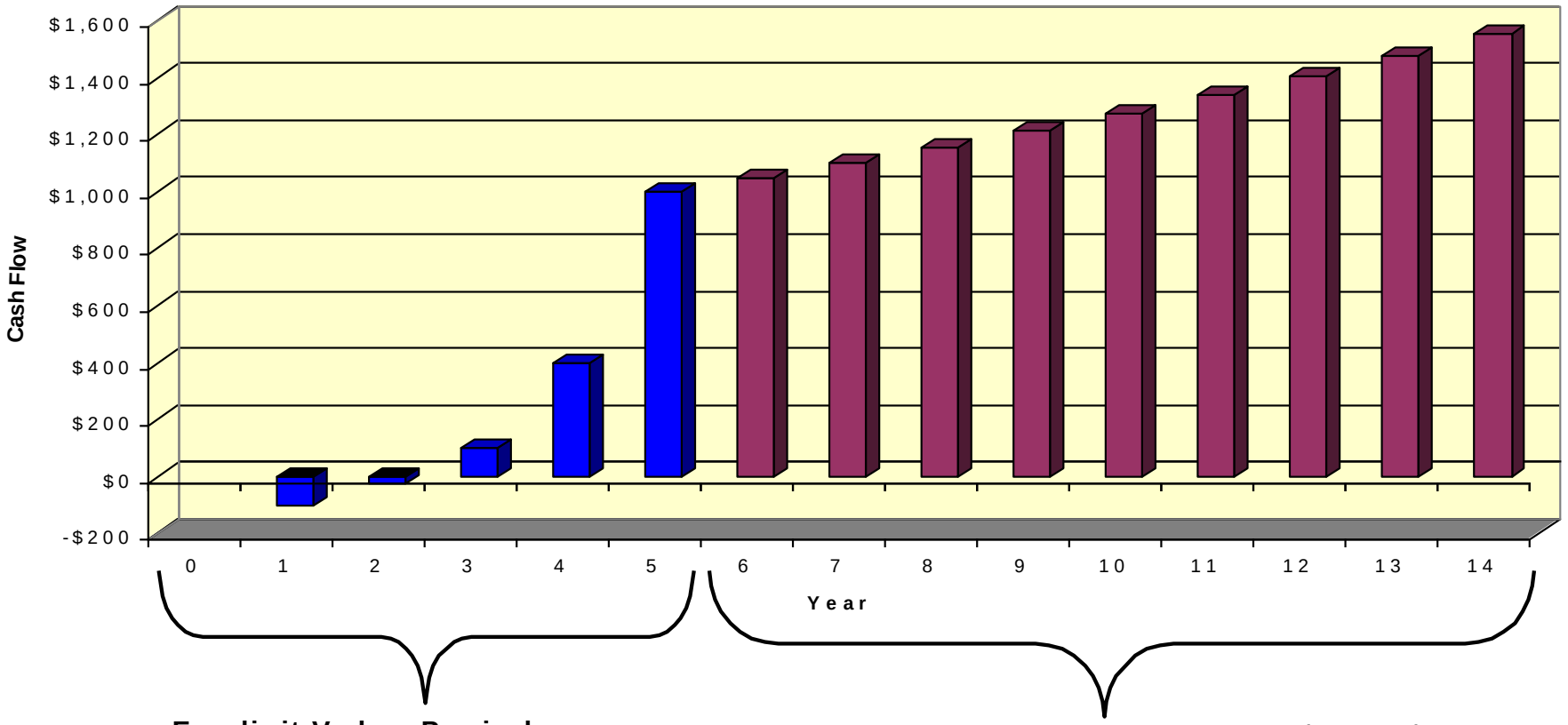
FCF year 5 = 500.000

WACC = 22%

Value at t0 = [-50.000/ (1.22)] + [-250.000/(1.22^2)] + [100.000/(1.22^3)] + [200.000/(1.22^4)] + [500.000/(1.22^5)]

Value for the first 5 years at t0 = €121.401

Using Continuing Value to Estimate the Worth of a New Venture



Explicit Value Period - Compute the present value of each periodic cash flow.

Continuing Value Period - Estimate the continuing value of the stream and the convert the continuing value to present value.

DCF method

- **Step 3. Estimating continuing value RH**

$$R_H = \frac{FCFF_{H+1}}{r - g}$$

DCF method: example

FCF year 5 = 500.000

Continuing value = FCF5 (1 + g) / (WACC - g)

Continuing value = 500.000 (1+2%) / (22% - 2%)

Continuing value = €2.550.000

Discount it back!

Continuing value$_{t=0}$: 2.550.000 / (1.22^5) = €943.498

DCF method

- **Step 4. Calculating & interpreting results**

➢ **Firm value =** $\sum_{t=1}^{H} \frac{FCFF_t}{(1+r)^t} + \frac{R_H}{(1+r)^H}$

$$R_H = \frac{FCFF_{H+1}}{r-g}$$

DCF method: example

Value for the first 5 years$_{t=0}$ = €121.401

Continuing value$_{t=0}$ = €943.498

TOTAL VALUE = €1.06mio

What are some fundamental problems with DCF method?

Problems with DCF valuation

- Difficult to assess the quality of growth in cash flows
- Terminal value
  - Will the firm make it to stable growth?
  - When will the firm become a stable growth firm? How will it look like?

- Essentially static!!

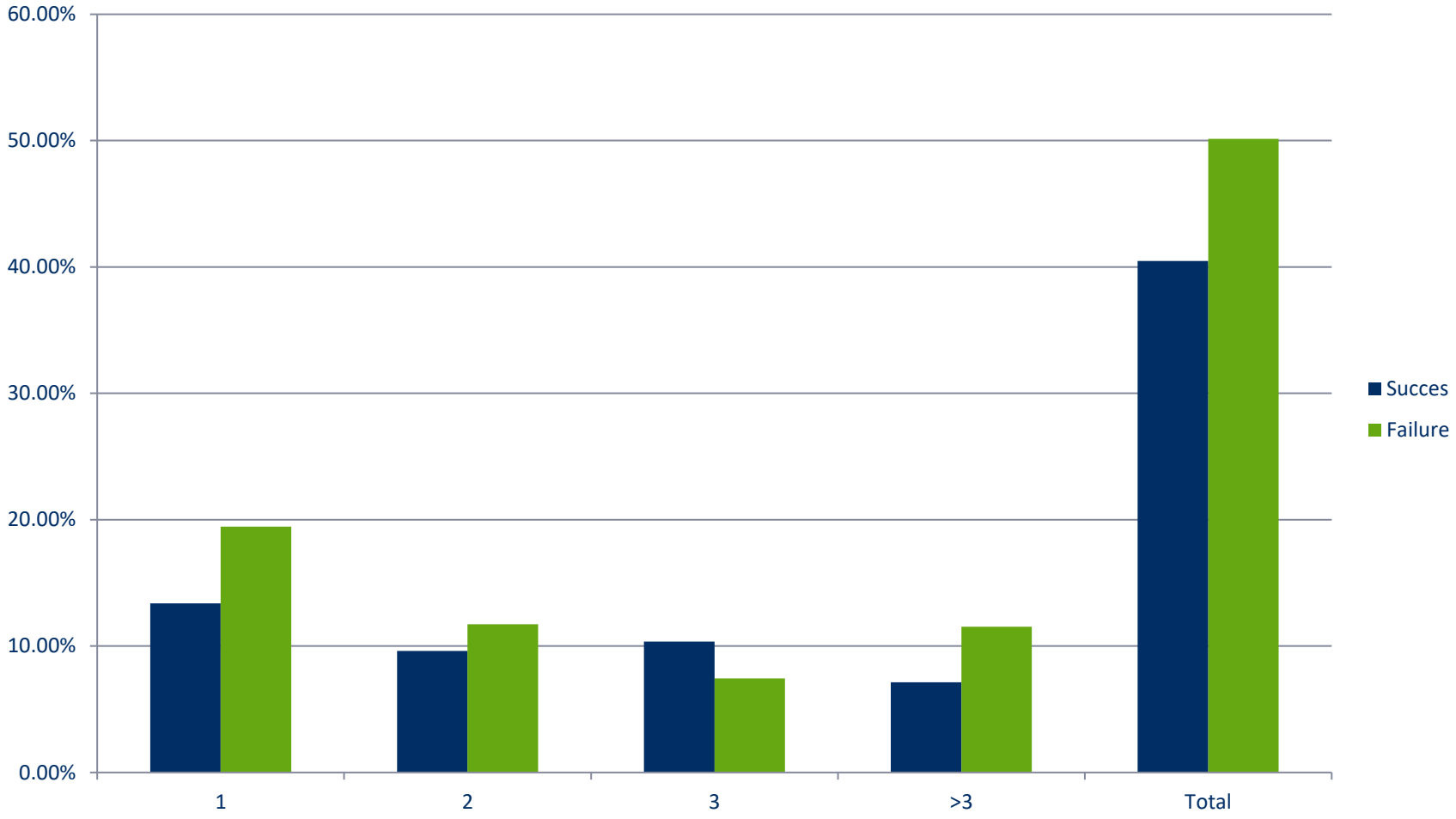
What does DCF not consider?

- First (negative) cash flows are certain, future positive cash flows are uncertain
    - **Probability-adjusted DCF**

- If success, then **additional capital** is required
    - Investment staging
    - Leads to capital increase – new shares issued
    - **Dilution** for initial shareholders

2. Probability-adjusted DCF method

Half of all VC backed companies fail



X-axis: investment round

Based upon analysis of 800 European VC deals

Traditional DCF assumes

- Only one phase: firms don’t fail
    - No risk of not being able to raise funding in a new funding round
    - No risk of passing to a next development phase (e.g. drug development)

Need to adjust DCF method to entrepreneurial setting =

Probability-adjusted DCF takes discrete failure scenarios into account

Example: Drug development

Conditional probabilities: moving from one stage to another

Phase 1: Cash flows are certain

Phase 2: Cash flows are conditional on passing Phase 1

Example: Drug development probability (risk) adjustment factor

	Phase I	Phase II	Phase III	FDA phase	FDA Approval
Phase I	100%				
Phase II	67%	100%			
Phase III	30%	45%	100%		
FDA Approval phase	25%	37%	83%	100%	
FDA Approval	20%	30%	67%	81%	100%

e.g. 30% = 67% * 45%

When valuing a project before Phase I, the cash flows will *first* be adjusted with probabilities of reaching the focal phase; *then* the risk adjusted cash flows will be discounted with the expected return.

Based upon J.J.Stewart, Biotech valuations for the 21st century,
Milken Institute Policy Brief 2002, n° 27

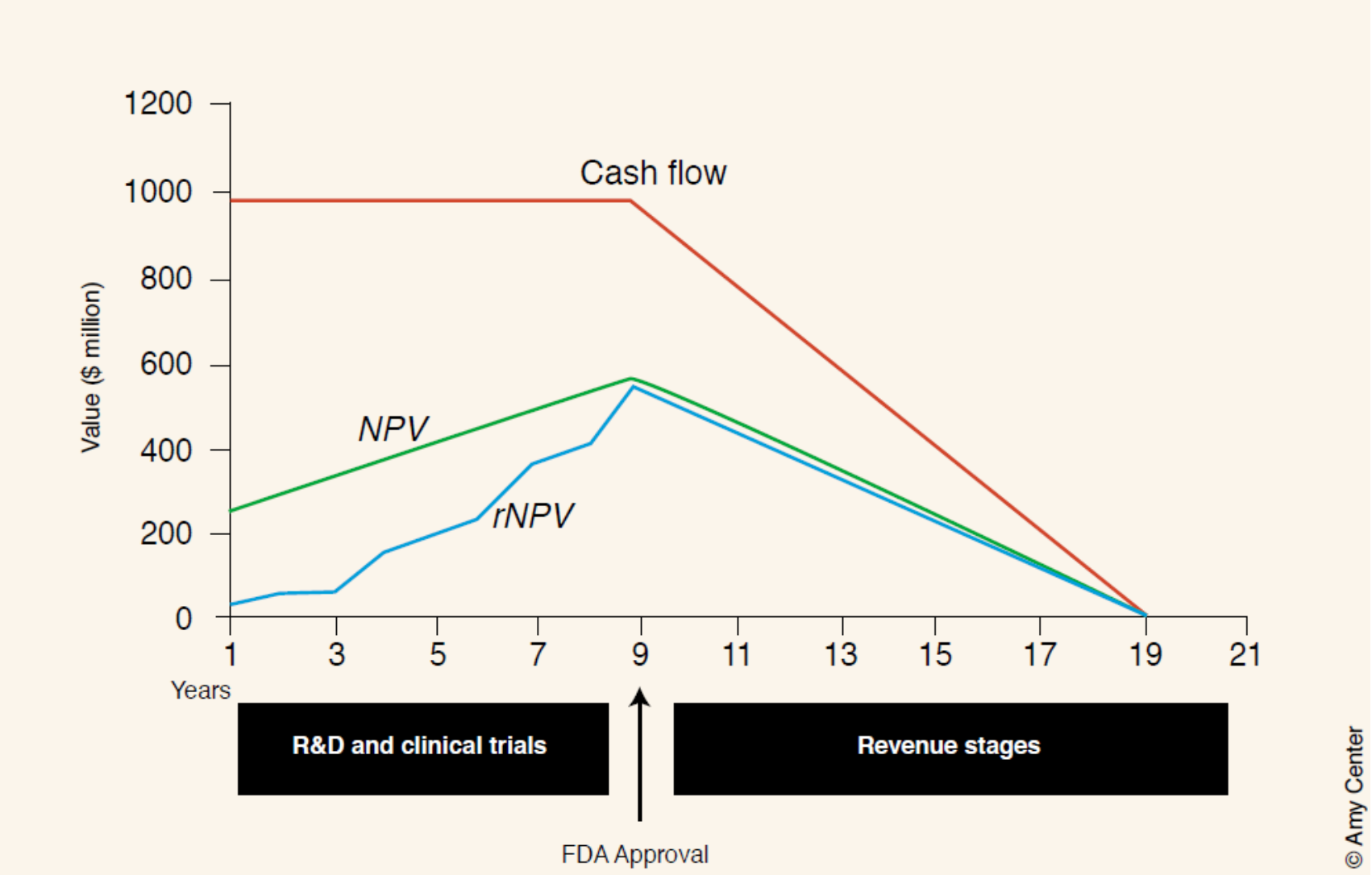
Traditional DCF assumes

- Only one phase: firms don’t fail
    - No risk of not being able to raise funding in a new funding round
    - No risk of passing to a next development phase (e.g. drug development)

- **Probability-adjusted DCF** takes discrete failure scenarios into account

EXERCISE

The Value of Biotechnology



The Value of Biotechnology

What should they charge for Acmed today?

- Payoff = $100 mio/year for 10 years = $1 bio (beginning in year 9)
- Costs = $23 mio:
    - Phase 1 (clinical trials, outsourced): $900,000
    - Phase 2 (clinical trials, outsourced): $3 mio
    - Phase 3 (clinical trials, outsourced): $15 mio
    - Animal studies to support phase 2: $1 mio
    - Animal studies to support phase 3: $1.5 mio
    - FDA approval: $1.6 mio

The Value of Biotechnology

- Time to complete:
  - Phase 1: 0.5-1 year
  - Phase 2: 1.5 years
  - Phase 3: 3.5 years
  - FDA approval: 1.5 years
- RISK inherent to each stage:

	Phase I	Phase II	Phase III	FDA phase	FDA Approval
Phase I	100%				
Phase II	67%	100%			
Phase III	30%	45%	100%		
FDA Approval phase	25%	37%	83%	100%	
FDA Approval	20%	30%	67%	81%	100%

- Determining the value of the wager series is to **risk-adjust** both the **payoff** and the **costs**.

The Value of Biotechnology

What are the costs? (given!)

- Phase 1 (clinical trials, outsourced): $900,000 ➔ YEAR 1

- Phase 2 (clinical trials, outsourced): $3 mio
- Animal studies to support phase 2: $1 mio

  ➔ $4 mio ($2 mio each year because phase 2 = 2 years) ➔ YEAR 2, 3

- Phase 3 (clinical trials, outsourced): $15 mio
- Animal studies to support phase 3: $1.5 mio

  ➔ $16.5 mio (phase 3 = 4 years, 4.125 each year) ➔ YEAR 4, 5, 6, 7

- FDA approval: $1.6 mio ➔ YEAR 8

The Value of Biotechnology

= 3mio + 1mio = 4mio
=> Over 2 years: 2mio each year

= 15mio +1.5mio = 16.5mio
=> Over 4 years: 4.125mio each year

Years	1	2	3	4	5	6	7	8	9	10
Phase I	-900									
Phase II		-2000	-2000							
Phase III				-4125	-4125	-4125	-4125			
FDA Phase								-1600		
Payoff									100000	100000
Total cash flows (€1000)	-900	-2,000	-2,000	-4,125	-4,125	-4,125	-4,125	-1,600	100,000	100,000

FDA approval: $1.6 mio ➔ YEAR 8

Payoff = 100mio each year

The Value of Biotechnology

Years		1	2	3	4	5	6	7	8	9	10
Phase I		-900									
Phase II			-2000	-2000							
Phase III					-4125	-4125	-4125	-4125			
FDA Phase									-1600		
Payoff										100000	100000
Total cash flows (€1000)		-900	-2,000	-2,000	-4,125	-4,125	-4,125	-4,125	-1,600	100,000	100,000
Probability at start of **Phase I**											
Risk-adjusted cash flows		-900	-1,340	-1,340	-1,244	-1,244	-1,244	-1,244	-400	20,000	20,000
Discount rate	20%										
Discount factor		0.83	0.69	0.58	0.48	0.40	0.33	0.28	0.23	0.19	0.16
Risk-adjusted discounted cash flows		-750.00	-930.56	-775.46	-599.77	-499.81	-416.51	-347.09	-93.12	3,876.13	3,230.11
Risk-adjusted NPV@Phase I	**15,088.38**										

Until year 18!!

	Phase I	Phase II	Phase III	FDA phase	FDA Approval
Phase I	100%				
Phase II	67%	100%			
Phase III	30%	45%	100%		
FDA Approval phase	25%	37%	83%	100%	
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The Value of Biotechnology

Years		1	2	3	4	5	6	7	8	9	10
Phase I		-900									
Phase II			-2000	-2000							
Phase III					-4125	-4125	-4125	-4125			
FDA Phase									-1600		
Payoff										100000	100000
Total cash flows (€1000)		-900	-2,000	-2,000	-4,125	-4,125	-4,125	-4,125	-1,600	100,000	100,000
Probability at start of **Phase I**		100%	67%	67%	30%	30%	30%	30%	25%	20%	20%
Risk-adjusted cash flows		-900	-1,340	-1,340	-1,244	-1,244	-1,244	-1,244	-400	20,000	20,000
Discount rate	20%										
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Risk-adjusted discounted cash flows		-750.00	-930.56	-775.46	-599.77	-499.81	-416.51	-347.09	-93.12	3,876.13	3,230.11
Risk-adjusted NPV@Phase I	**15,088.38**										

Until year 18!!

Discount rate (cost of capital for biotech firms; R&D risk considered separately): 20%

The Value of Biotechnology

Years	1	2	3	4	5	6	7	8	9	10
Phase I	-900									
Phase II		-2000	-2000							
Phase III				-4125	-4125	-4125	-4125			
FDA Phase								-1600		
Payoff									100000	100000
Total cash flows (€1000)	-900	-2,000	-2,000	-4,125	-4,125	-4,125	-4,125	-1,600	100,000	100,000

Probability at start of **Phase II**										
Risk-adjusted cash flows		-2,000.00	-2,000.00	-1,856.25	-1,856.25	-1,856.25	-1,856.25	-597.60	30,253.50	30,253.50
Risk-adjusted discounted cash flows		-1,388.89	-1,157.41	-895.18	-745.99	-621.65	-518.05	-138.98	5,863.33	4,886.11
Risk-adjusted NPV@Phase II	**24,032.08**									

Until year 18!!

	Phase I	Phase II	Phase III	FDA phase	FDA Approval
Phase I	100%				
Phase II	67%	100%			
Phase III	30%	45%	100%		
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The Value of Biotechnology

Years	1	2	3	4	5	6	7	8	9	10
Phase I	-900									
Phase II		-2000	-2000							
Phase III				-4125	-4125	-4125	-4125			
FDA Phase								-1600		
Payoff									100000	100000
Total cash flows (€1000)	-900	-2,000	-2,000	-4,125	-4,125	-4,125	-4,125	-1,600	100,000	100,000

Probability at start of **Phase II**		100%	100%	45%	45%	45%	45%	37%	30%	30%
Risk-adjusted cash flows		-2,000.00	-2,000.00	-1,856.25	-1,856.25	-1,856.25	-1,856.25	-597.60	30,253.50	30,253.50
Risk-adjusted discounted cash flows		-1,388.89	-1,157.41	-895.18	-745.99	-621.65	-518.05	-138.98	5,863.33	4,886.11
Risk-adjusted NPV@Phase II	**24,032.08**									

Until year 18!!

The Value of Biotechnology

Years	1	2	3	4	5	6	7	8	9	10
Phase I	-900									
Phase II		-2000	-2000							
Phase III				-4125	-4125	-4125	-4125			
FDA Phase								-1600		
Payoff									100000	100000
Total cash flows (€1000)	-900	-2,000	-2,000	-4,125	-4,125	-4,125	-4,125	-1,600	100,000	100,000

Probability at start of **Phase III**										
Risk-adjusted cash flows				-4,125.00	-4,125.00	-4,125.00	-4,125.00	-1,328.00	67,000.00	67,000.00
Risk-adjusted discounted cash flows				-1,989.29	-1,657.74	-1,381.45	-1,151.21	-308.85	12,985.05	10,820.87
Risk-adjusted NPV@Phase III	**58,838.79**									

Until year 18!!

	Phase I	Phase II	Phase III	FDA phase	FDA Approval
Phase I	100%				
Phase II	67%	100%			
Phase III	30%	45%	100%		
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The Value of Biotechnology

Years	1	2	3	4	5	6	7	8	9	10
Phase I	-900									
Phase II		-2000	-2000							
Phase III				-4125	-4125	-4125	-4125			
FDA Phase								-1600		
Payoff									100000	100000
Total cash flows (€1000)	-900	-2,000	-2,000	-4,125	-4,125	-4,125	-4,125	-1,600	100,000	100,000

Probability at start of **Phase III**				100%	100%	100%	100%	83%	67%	67%
Risk-adjusted cash flows				-4,125.00	-4,125.00	-4,125.00	-4,125.00	-1,328.00	67,000.00	67,000.00
Risk-adjusted discounted cash flows				-1,989.29	-1,657.74	-1,381.45	-1,151.21	-308.85	12,985.05	10,820.87
Risk-adjusted NPV@Phase III	**58,838.79**									

Until year 18!!

The Value of Biotechnology

Years	1	2	3	4	5	6	7	8	9	10
Phase I	-900									
Phase II		-2000	-2000							
Phase III				-4125	-4125	-4125	-4125			
FDA Phase								-1600		
Payoff									100000	100000
Total cash flows (€1000)	-900	-2,000	-2,000	-4,125	-4,125	-4,125	-4,125	-1,600	100,000	100,000

Probability at start of **FDA approval Phase**										
Risk-adjusted cash flows								-1,600	81,000	81,000
Risk-adjusted discounted cash flows								-372.11	15,698.34	13,081.95
Risk-adjusted NPV@FDA approval Phase	**78,605.73**									

Until year 18!!

	Phase I	Phase II	Phase III		FDA phase	FDA Approval
Phase I	100%					
Phase II	67%	100%				
Phase III	30%	45%	100%			
FDA Approval phase	25%	37%	83%		100%	
FDA Approval	20%	30%	67%		81%	100%

The Value of Biotechnology

Years	1	2	3	4	5	6	7	8	9	10
Phase I	-900									
Phase II		-2000	-2000							
Phase III				-4125	-4125	-4125	-4125			
FDA Phase								-1600		
Payoff									100000	100000
Total cash flows (€1000)	-900	-2,000	-2,000	-4,125	-4,125	-4,125	-4,125	-1,600	100,000	100,000

Probability at start of **FDA approval Phase**								100%	81%	81%
Risk-adjusted cash flows								-1,600	81,000	81,000
Risk-adjusted discounted cash flows								-372.11	15,698.34	13,081.95
Risk-adjusted NPV@FDA approval Phase	**78,605.73**									

Until year 18!!

The Value of Biotechnology

Years		8	9	10	11	12	13	14	15	16	17	18
Phase I												
Phase II												
Phase III												
FDA Phase		-1600										
Payoff			100000	100000	100000	100000	100000	100000	100000	100000	100000	100000
Total cash flows (€1000)		-1,600	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000

			Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18
Probability at start of **FDA approval**												
Risk-adjusted cash flows	0		100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000
Risk-adjusted discounted cash flows			19,381	16,151	13,459	11,216	9,346	7,789	6,491	5,409	4,507	3,756
Risk-adjusted NPV@FDA approval	**97,503.50**											

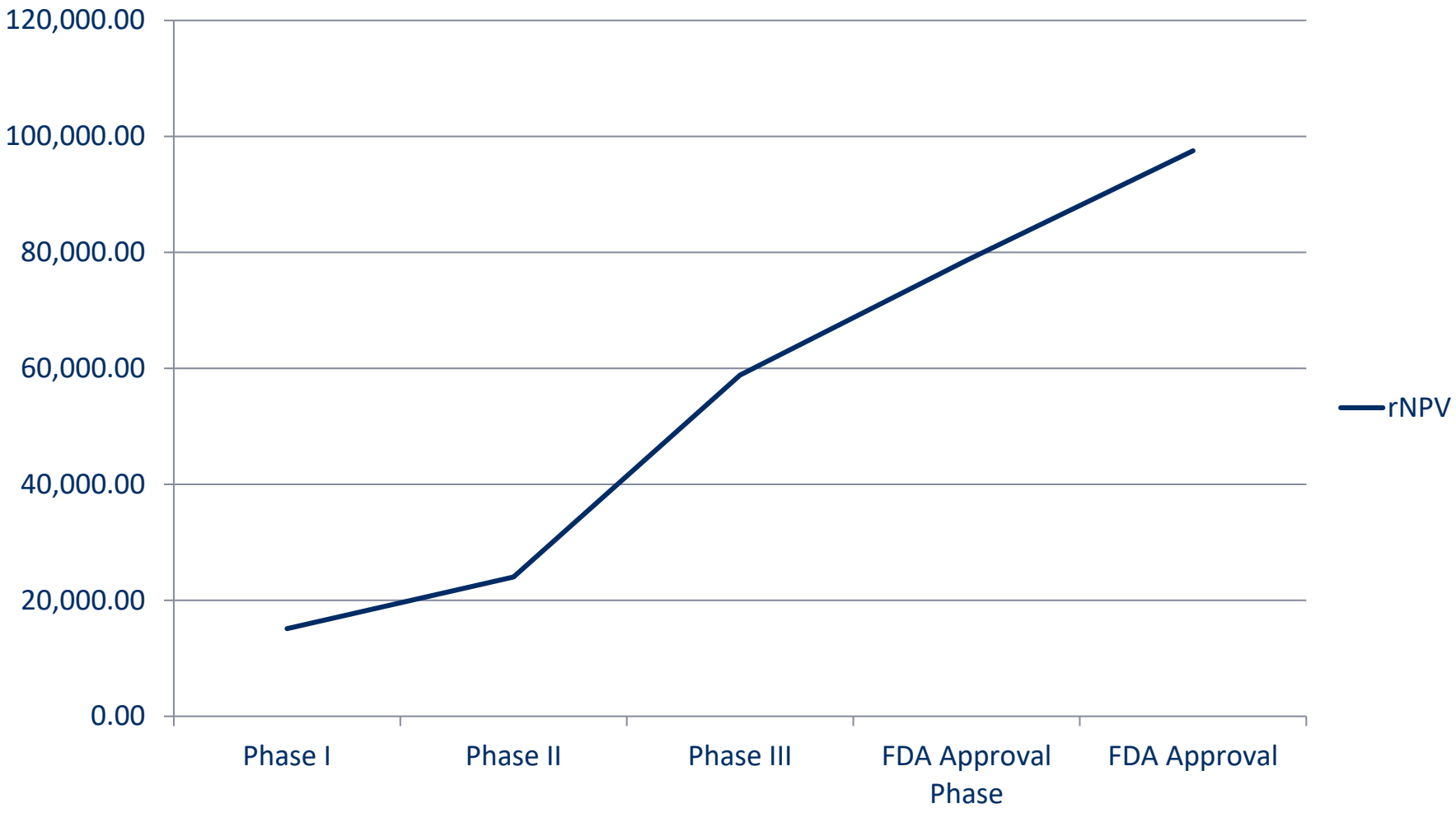
	Phase I	Phase II	Phase III	FDA phase	FDA Approval
Phase I	100%				
Phase II	67%	100%			
Phase III	30%	45%	100%		
FDA Approval phase	25%	37%	83%	100%	
FDA Approval	20%	30%	67%	81%	100%

The Value of Biotechnology

Years		8	9	10	11	12	13	14	15	16	17	18
Phase I												
Phase II												
Phase III												
FDA Phase		-1600										
Payoff			100000	100000	100000	100000	100000	100000	100000	100000	100000	100000
Total cash flows (€1000)		-1,600	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000

				Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18
Probability at start of **FDA approval**				100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Risk-adjusted cash flows	0			100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000
Risk-adjusted discounted cash flows				19,381	16,151	13,459	11,216	9,346	7,789	6,491	5,409	4,507	3,756
Risk-adjusted NPV@FDA approval	**97,503.50**												

The Value of Biotechnology



Valuation of entrepreneurial companies

WRAP-UP

DCF value in early investment rounds overestimates value

- Does not take probability of failure into account
- Expected return of, e.g. 35%, only compensates for business risk, illiquidity, efforts
- Use **probability adjusted DCF** - especially important if multiple investment rounds are anticipated

WRAP-UP

Valuation is as much **an art** as it is a science

- Experience plays an important role in assessing the value of early-stages companies
- Intangibles including the track record of the team, the value of the IP, the future size of the market, … play a key role in determining the value of a company

- At the end of the day, the price one pays to make an investment will depend on the bargaining power of the entrepreneur and the investors and the overall sentiment in the market

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