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NPV vs. rNPV

Modern forecast-based valuation methods are almost exclusively some sort of discounted cash flows approach. In the life sciences mainly two methods are applied, net present value (NPV, which actually denotes the result of a discounted cash flows approach) and risk-adjusted net present value (rNPV). The difference between the two methods is in the consideration of the risk involved in the asset that is to be valued. NPV accounts for all risk by the discount rate, while rNPV includes attrition risk by multiplying the cash flows with their probability before discounting them – with a different discount rate than NPV.

A recent survey from Biostrat and Avance[1] revealed that NPV is the preferred valuation method of investors and rNPV is the standard method within pharma and biotech companies. To put that in context we need to know that the pharmaceutical industry is in a special position compared to other industries. The development path of drug development projects is highly regulated and standardised, projects have to go through defined phases. Statistical analysis then reveal which phases account for how many failures. These statistical results are generally referred to as attrition rates or as transition probabilities, often a bit loosely as success rates. These success rates quantify the risk of drug development projects depending on their stage, type of molecule, and disease area. The success rates, although based on historical data, which – we all have heard it – are not indicative for the future, allow comparing the risk of different projects in a clear and sharp way. It is therefore not surprising that the industry professionals in pharma and biotech eagerly use this information in their valuations. Investors are less proficient in using success rates in valuations because often drug development is only one sector of their investment universe, maybe together with medtech, cleantech, and IT. And in view of applying a uniform valuation method across all their investments they cannot apply rNPV because the other industries simply do not offer the same wealth of information about the risk of a project like the pharmaceutical industry.

Suggested discount rates

Of course, the use of two valuation methods raises the questions how comparable they are and which one, if any, is better. We approach this question with a comparison of the two methods using three prototype projects similar to the Avance-Biostrat survey. The projects are assumed to have peak sales of USD 500 mn and USD 1,000 mn for oncology indications. A preclinical project has 14%, a phase 2 project 23%, and a phase 3 project 52% success rate.

The survey suggests the discount rates displayed in table 1.

Table 1: Discount rates from Avance-Biostrat survey.

Stage	NPV	rNPV
Preclinical	40.1%	18.6%
Phase 2	26.7%	16.0%
Phase 3	19.5%	13.5%

[1] http://www.avance.ch/avance_biostrat_discount_survey.pdf

About rNPV discount rates relatively little has been written. For NPV discount rates several tables go around within the industry. Next to the dataset from the survey we offer three more, from Rodman & Renshaw (table 2), Pepperdine (table 3), and Frei/Leleux (table 4).

Table 2: Discount matrix, Source: Rodman & Renshaw.

	Relative Risk		
	Below Average	Average	Above Average
Preclinical	45%	55%	65%
IND	40%	50%	60%
After phase 1	35%	45%	55%
After phase 2	20%	30%	40%
After phase 3	10%	20%	30%
Approved	5%	15%	25%

Table 3: Private cost of capital data (gross annualized), Source: Pepperdine Private Capital Markets Project summary report.

Cost of capital Value in USD mn	1st quartile	Median	3rd quartile
VC start-up	35% 2	40% 3	50% 5
VC early stage	30% 4	35% 8	45% 10.5
VC expansion	20% 12.3	30% 20	40% 33.5
VC late stage	20% 25	30% 35	35% 75
Angel seed	30% 0.9	50% 1	100% 2
Angel start-up	30% 1.2	40% 2	75% 2.5
Angel early stage	25% 2	35% 3	50% 6
Angel expansion	20% 3	30% 5	40% 10
Angel late stage	20% 2.5	30% 10	40% 20

The Pepperdine data is not limited to drug development investments and therefore little meaningful for our purposes.

Table 4: Discount matrix, Source: Frei/Leleux[2].

Stage	Discount rates
Generating leads	70%-100%
Optimising leads/preclinical	50%-70%
Phase 1	40%-60%
Phase 2	35%-50%
Phase 3	25%-40%

Comparison of the two methods

We now run the valuation using these different sets of discount rates and see what discount rates compare to each other.

Table 5: Valuations for preclinical project.

USD 500 mn			USD 1,000 mn		
rNPV	NPV	Value	rNPV	NPV	Value
17%	29.7%	10	17%	29.6%	55
18%	30.6%	7	18%	30.6%	46
19%	31.5%	4	19%	31.7%	38
20%	32.4%	2	20%	32.8%	31
21%	33.1%	0	21%	33.8%	26
22%	33.9%	-2	22%	34.8%	21
23%	34.6%	-3	23%	35.8%	17

The difference to the NPV discount rates suggested in the literature is striking. The discount rate tables suggest average rates of 55% to 85%. This would require sales estimates of USD 2,381 mn to USD 14,144 mn for the projects only to

[2] P. Frei and B. Leleux, "Valuation – what you need to know", Nature Biotechnology, August 2004.

achieve a positive value! In our opinion this is completely unrealistic. If a project has expected sales of more than USD 2 billions, let alone USD 14 billions, and an average risk profile, then their value must be highly positive. Imagine a biotech company having just one such project in its pipeline. It is difficult to imagine how people using these discount tables manage to justify investments in any (!) early-stage company. Of course, using very short timelines and very low costs these numbers might be corrected. But we rather suggest working with realistic assumptions (it links the values to reality…). With the 40.1% discount rate from the survey a potential blockbuster project in preclinical stage would be worth USD 4 mn.

For phase 2 projects we receive the following results:

Table 6: Valuations for phase 2 project.

USD 500 mn			USD 1,000 mn		
rNPV	NPV	Value	rNPV	NPV	Value
14%	25.8%	72	14%	23.3%	287
15%	26.8%	61	15%	24.4%	250
16%	27.9%	50	16%	25.6%	217
17%	28.9%	41	17%	26.7%	189
18%	29.9%	33	18%	27.8%	165
19%	30.8%	26	19%	28.9%	143
20%	31.8%	20	20%	30.0%	124
21%	32.7%	14	21%	31.1%	107
22%	33.6%	10	22%	32.2%	93
23%	34.5%	6	23%	33.2%	80

The discount tables suggest a NPV discount rate of 45%. This means that a project needs a sales potential of USD 918 mn to have a positive value.

Table 7: Valuations for phase 3 project.

USD 500 mn			USD 1,000 mn		
rNPV	NPV	Value	rNPV	NPV	Value
10%	16.4%	475	10%	15.5%	1,109
11%	17.5%	404	11%	16.6%	990
12%	18.6%	356	12%	17.7%	885
13%	19.8%	314	13%	18.8%	792
14%	20.9%	277	14%	19.9%	710
15%	22.0%	244	15%	21.0%	636
16%	23.1%	214	16%	22.2%	571
17%	24.2%	188	17%	23.3%	512
18%	25.4%	165	18%	24.4%	460
19%	26.5%	144	19%	25.5%	413
20%	27.6%	125	20%	26.6%	372

The discount tables suggest a NPV discount rate of 30%. This means that a project needs a sales potential of USD 245 mn to have a positive value.

Conclusion

In the valuations we have used published success rates, i.e. average risk profiles for oncology projects. A juxtaposition with proposed NPV discount rates revealed completely unrealistic minimum sales assumptions, especially for early-stage projects. Apparently success rates are not as easy to factor into the discount rate as assumed by the authors of the mentioned discount tables.

The results from the survey are on the other hand surprisingly close with the exception of the preclinical example. But

this might also be connected to sometimes higher sales expectations before they need to be reduced due to later findings. In fact, discount rates for both NPV and rNPV might be dependent on the sales assumptions as well as on the success rates.

This short analysis has not investigated the effect of changing success rates on the discount rates. But we expect a difficult to quantify relationship between success rates and NPV discount rates. We therefore strongly suggest to use rNPV with the success rates as a direct input instead of NPV, where the success rates are factored into the discount rate in an obscure way.