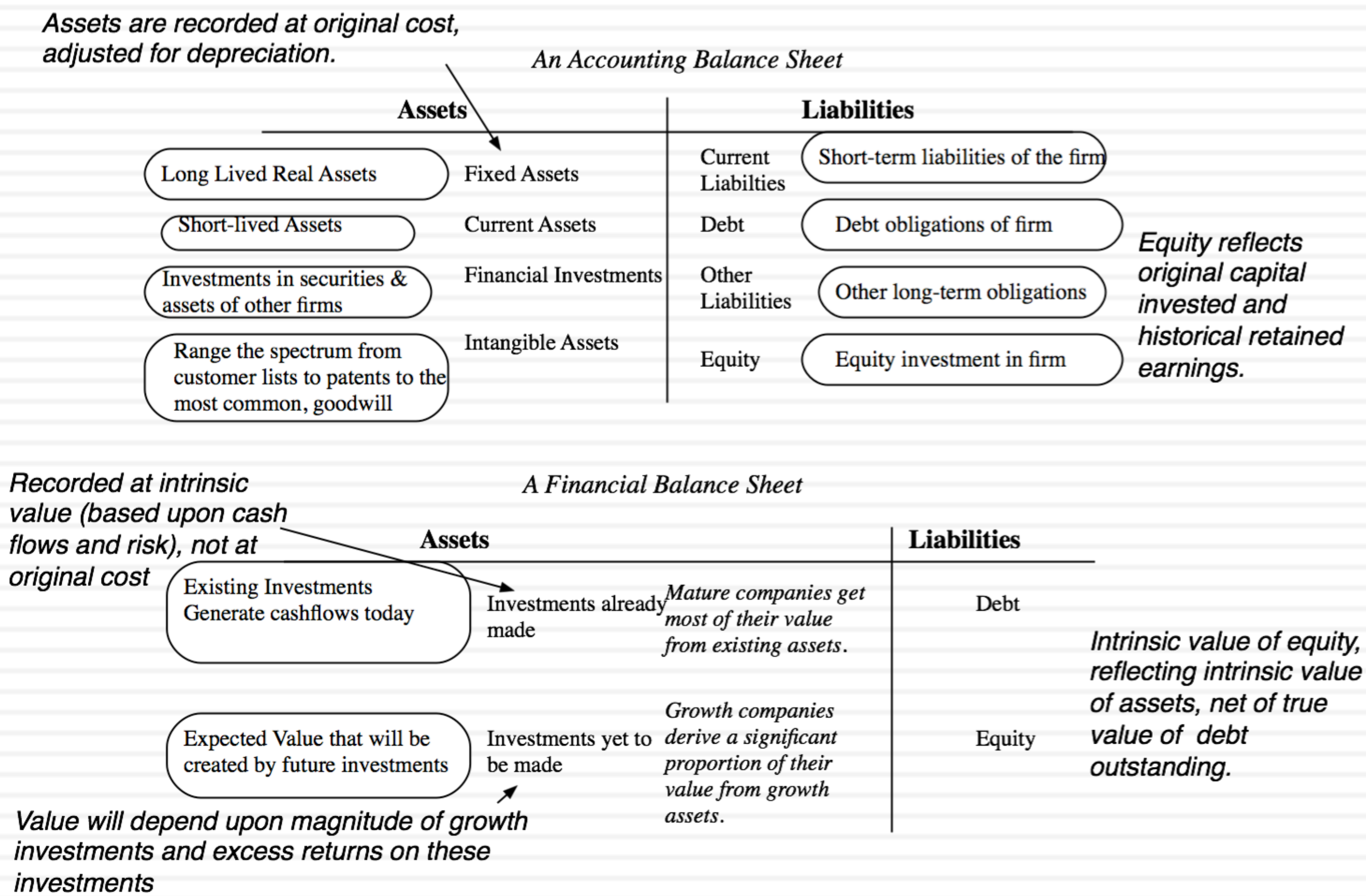
Email: adamodar@stern.nyu.edu
Website: http://www.damodaran.com
Blog: http://aswathdamodaran.blogspot.com
Twitter: @AswathDamodaran

THE VALUATION BERMUDA TRIANGLE:

BIAS, UNCERTAINTY AND COMPLEXITY

Aswath Damodaran

The Divide between Valuation & Accounting..



Valuation is simple. We choose to make it complex!

Value of growth

The future cash flows will reflect expectations of how quickly earnings will grow in the future (as a positive) and how much the company will have to reinvest to generate that growth (as a negative). The net effect will determine the value of growth. The expected cash flow is computed as net of taxes and reinvestment:

Expected Cash Flow = E(CF_n) = Expected After-tax Operating Income in year n - Reinvestment in year n

Cash flows from existing assets

The base earnings will reflect the earnings power of the existing assets of the firm, net of taxes and any reinvestment needed to sustain the base earnings.

$$Value\ of\ Business = \frac{E(CF_1)}{(1+r)} + \frac{E(CF_2)}{(1+r)^2} + \frac{E(CF_3)}{(1+r)^3} \ldots + \frac{Terminal\ Value_n}{(1+r)^n}$$

Terminal Value

This is the value that you attach to the business at the end of high growth. It can be a liquidation or going concern value.

$$Going\ Concern\ Value_n = \frac{E(CF_{n+1})}{r-g}$$

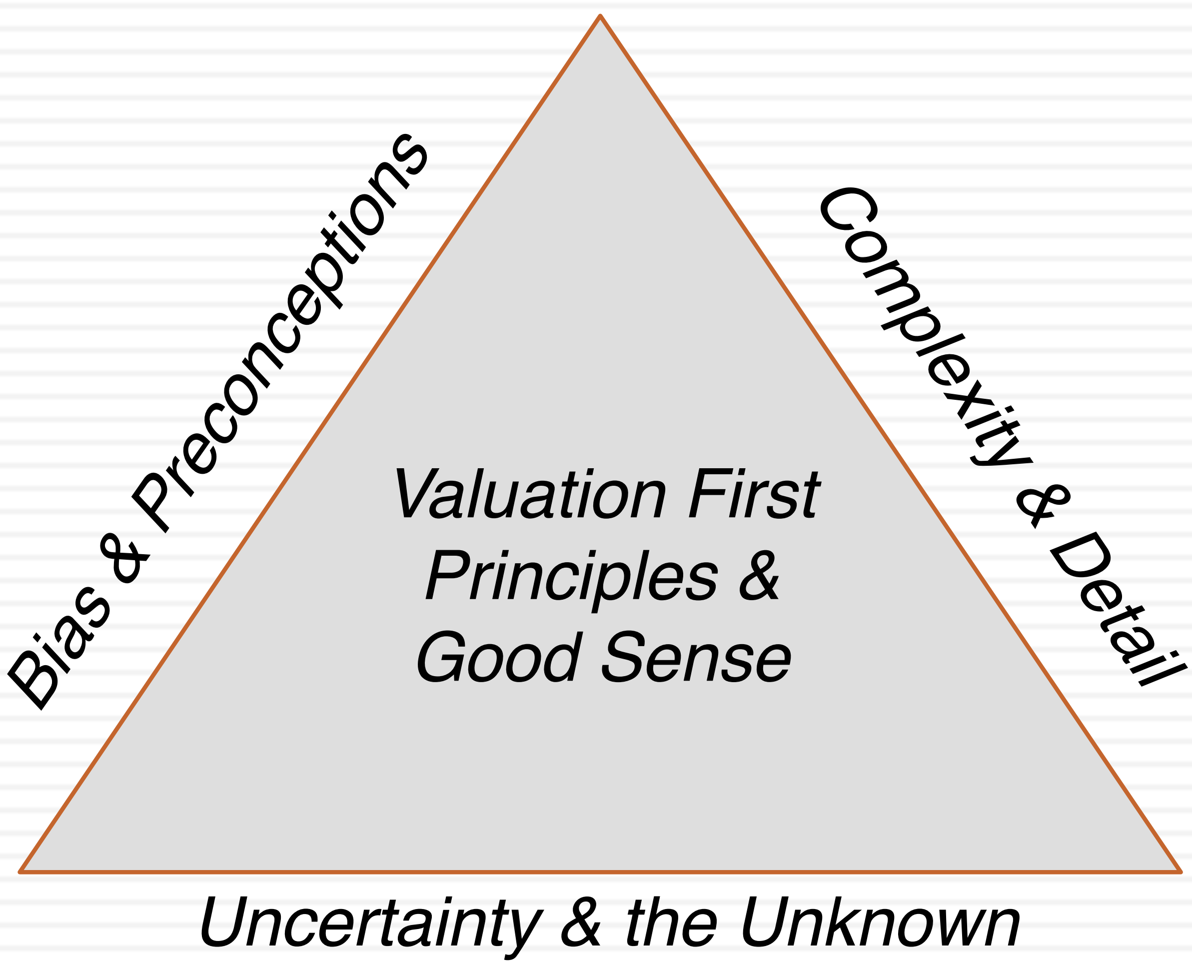
Cost of Capital

The cost of capital can be affected by the tax code, if it tilts towards debt over equity or vice versa. In much of the world, debt creates a tax benefit, because interest is tax deductible and the tax savings are at the margin (at the marginal tax rate).

Risk adjusted Discount Rate = r = Cost of capital = Cost of Equity (Equity/(Debt+Equity) + Cost of Debt (1-t) (Debt/(Debt+Equity)

$Going\ Concern\ Va$

But here's why valuation fails – The Bermuda Triangle of Valuation



I. Valuation Bias

- Preconceptions and priors: When you start on the valuation of a company, you almost never start with a blank slate. Instead, your valuation is shaped by your prior views of the company in question.
  - Corollary 1: The more you know about a company, the more likely it is that you will be biased, when valuing the company.
  - Corollary 2: The "closer" you get to the management/owners of a company, the more biased your valuation of the company will become.
- Value first, valuation to follow: In principle, you should do your valuation first before you decide how much to pay for an asset. In practice, people often decide what to pay and do the valuation afterwards.

Sources of bias

- The power of the subconscious: We are human, after all, and as a consequence are susceptible to
  - Herd behavior: For instance, there is the "market price" magnet in valuation, where estimates of intrinsic value move towards the market price with each iteration.
  - Hindsight bias: If you know the outcome of a sequence of events, it will affect your valuation. (That is why teaching valuation with cases is an exercise in futility)
- The power of suggestion: Hearing what others think a company is worth will color your thinking, and if you view those others as more informed/smarter than you are, you will be influenced even more.
- The power of money: If you have an economic stake in the outcome of a valuation, bias will almost always follow.
  - Corollary 1: Your bias in a valuation will be directly proportional to who pays you to do the valuation and how much you get paid.
  - Corollary 2: You will be more biased when valuing a company where you already have a position (long or short) in the company.

Biasing a DCF valuation: A template of "tricks"

If you want higher (lower) value, you can
1. Augment (haircut) earnings
2. Reduce(increase) effective tax rate
3. Ignore (Count in) unconventional cap ex
4. Narrow (Broaden) definition of working capital

Free Cashflow to Firm
EBIT (1- tax rate)
- (Cap Ex - Depreciation)
- Change in non-cash WC
= Free Cashflow to firm

If you want to increase (decrease) value, you can
1. Use higher (lower) growth rates
2. Assume less (more) reinvestment with the same growth rate, thus raising (lowering) the quality and value of growth.

Expected Growth in FCFF during high growth

If you want to increase (decrease) value, you can
1. Assume a longer (shorter) growth period
2. Assume more (less) excess returns over the growth period

Length of high growth period: PV of FCFF during high

Value of Operating Assets today
+ Cash & non-operating assets
- Debt
Value of equity

If you want to increase (decrease) value, you can add (subtract) premiums (discounts) for things you like (dislike) about the company.
Premiums: Control, Synergy, liquidity
Discounts: Illiquidity, private company

Cost of Capital
Weighted average of cost of equity & cost of debt

If you want to increase (decrease) value, you can
1. Assume a higher (lower) debt ratio, with the same costs of debt & equity. You may be able to accomplish this by using book (market) value debt ratios.
2. Use a lower (higher) equity risk premium for equity and a lower (higher) default spread for debt.
3. Find a "lower" ("higher") beta for your stock.
4. Don't add (add) other premiums to the cost of equity (small cap?)

Stable Growth
When operating income and FCFF grow at constant rate forever.

If you want to increase value, you can
1. Use stable growth rates that are economically impossible (higher than the growth rate of the economy)
2. Allow this growth to be accompanied by high positive excess returns (low reinvestment)
If you want to decrease value, you can
1. Use lower growth rates in perpetuity
2. Accompany this growth with high negative excess returns

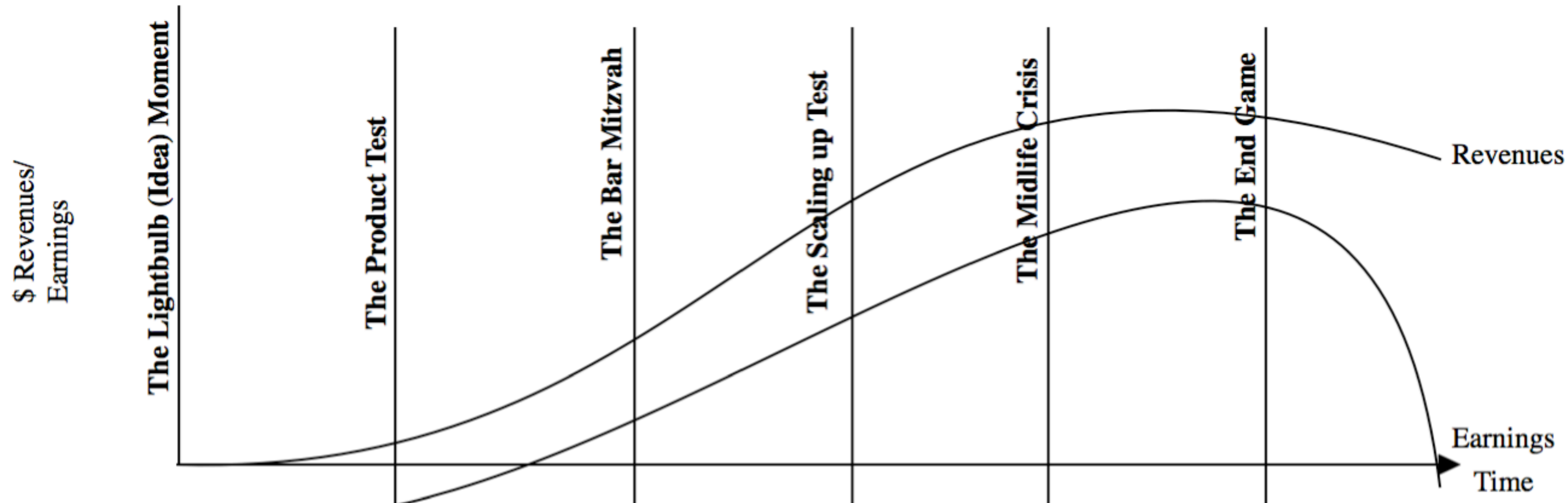
Dealing with bias: The “bad” ways

- Denial (I use only numbers): The easiest defense is to argue that you are only using numbers and that bias requires subjective judgments.
- False outrage (I am a “professional”): Valuation professionals point to the requirements of their professional groups (CPA, CFA, CVA etc.) that they be unbiased.
- Stamps of approval (It is a “FAIR” value, with my lawyer/accountant’s imprimatur): The most common response to bias is to add legal or accounting cover.
  - Legal fair value: In most countries, investment bankers have to sign a legal document that their value is a “fair” value.
  - Accounting fair value: Accountants have jumped into the mix and have set up standards for fair value.

Healthy responses to bias

1. Build processes that minimize bias, not maximize it: To the degree that a significant portion of bias comes from reward/punishment mechanisms, we need to build processes that disassociate the valuation outcome from compensation.
2. Be honest (at least with yourself): Even if you may not want to reveal your biases to your clients, you should at least be honest with yourself.
3. Bayesian valuation: It may be a good idea to require anyone valuing a company to state what they believe that they will find in the valuation, before they actually do the valuation. Anyone using the valuation should then have access to both the analyst's priors and the valuation.
4. Transparency about motives: All valuations should be accompanied with full details of who is paying for the valuation and how much, as well as any other stakes in the outcome of the valuation.

II. Valuation Uncertainty: A Feature, not a Bug..



	Stage 1	Stage 2	Stage 3:	Stage 4	Stage 5	Stage 6
Growth stage	Start-up	Young Growth	High Growth	Mature Growth	Mature Stable	Decline
Description	Have an idea for a business that meets an unmet need in the market.	Create a business model that converts ideas into potential revenues & earnings	Build the business, converting potential into revenues.	Grow your business, shifting from losses to profits	Defend your business from new competitors & find new markets	Scale down your business as market shrinks.

Sources of uncertainty

- Estimation versus Economic uncertainty
  - Estimation uncertainty reflects the possibility that you could have the “wrong model” or estimated inputs incorrectly within this model.
  - Economic uncertainty comes the fact that markets and economies can change over time and that even the best medals will fail to capture these unexpected changes.
- Micro uncertainty versus Macro uncertainty
  - Micro uncertainty refers to uncertainty about the potential market for a firm’s products, the competition it will face and the quality of its management team.
  - Macro uncertainty reflects the reality that your firm’s fortunes can be affected by changes in the macro economic environment.
- Discrete versus continuous uncertainty
  - Discrete risk: Risks that lie dormant for periods but show up at points in time. (Examples: A drug working its way through the FDA pipeline may fail at some stage of the approval process or a company in Venezuela may be nationalized)
  - Continuous risk: Risks changes in interest rates or economic growth occur continuously and affect value as they happen.

Dealing with Uncertainty: The "bad" ways

- Paralysis & Denial: When faced with uncertainty, some of us get paralyzed. Accompanying the paralysis is the hope that if you close your eyes to it, the uncertainty will go away
- Mental short cuts (rules of thumb): Behavioral economists note that investors faced with uncertainty adopt mental short cuts that have no basis in reality. And here is the clincher. More intelligent people are more likely to be prone to this.
- Herding: When in doubt, it is safest to go with the crowd.. The herding instinct is deeply engrained and very difficult to fight.
- Outsourcing: Assuming that there are experts out there who have the answers does take a weight off your shoulders, even if those experts have no idea of what they are talking about.
- Divine Intervention: Praying for intervention from a higher power is the oldest and most practiced risk management system of all.

And the dark side will beckon..

- With young start up companies, you will be told that it is "too difficult" or even "impossible" to value these companies, because there is so little history and so much uncertainty in the future.
- Instead, you will be asked to come over to the "dark side", where
  - You will see value metrics that you have never seen before
  - You will hear "macro" stories, justifying value
  - You will be asked to play the momentum game
- While all of this behavior is understandable, none of it makes the uncertainty go away. You have a choice. You can either hide from uncertainty or face up to it.

Twitter Pre-IPO Valuation: October 27, 2013

Starting numbers

	Last 10K	Trailing 12 month
Revenues	$316.93	$534.46
Operating income	-$77.06	-$134.91
Adjusted Operating Income		$7.67
Invested Capital		$955.00
Adjusted Operatng Margin		1.44%
Sales/ Invested Capital		0.56
Interest expenses	$2.49	$5.30

On revenues and margins
1. Start with your end vision on revenues (total market & market share) and work backwards.
2. Make your best judgment on a target margin and how you will get there.

On reinvestment
1. Tie reinvestment to sales
2. Keep track of your invested capital & ROIC over time.

Revenue growth of 51.5% a year for 5 years, tapering down to 2.5% in year 10

Pre-tax operating margin increases to 25% over the next 10 years

Sales to capital ratio of **1.50** for incremental sales

Stable Growth
g = 2.5%; Beta = 1.00;
Cost of capital = 8%
ROC= **12**%;
Reinvestment Rate=2.5%/12% = 20.83%

Terminal Value$_{10}$= 1466/(.08-.025) = $26,657

	1	2	3	4	5	6	7	8	9	10
Revenues	$ 810	$1,227	$1,858	$2,816	$4,266	$6,044	$7,973	$9,734	$10,932	$11,205
Operating Income	$ 31	$ 75	$ 158	$ 306	$ 564	$ 941	$1,430	$1,975	$ 2,475	$ 2,801
Operating Income after tax	$ 31	$ 75	$ 158	$ 294	$ 395	$ 649	$ 969	$1,317	$ 1,624	$ 1,807
- Reinvestment	$ 183	$ 278	$ 421	$ 638	$ 967	$1,186	$1,285	$1,175	$ 798	$ 182
FCFF	$(153)	$ (203)	$ (263)	$ (344)	$ (572)	$ (537)	$ (316)	$ 143	$ 826	$ 1,625

Operating assets	$9,705
+ Cash	321
+ IPO Proceeds	1295
- Debt	214
Value of equity	11,106
- Options	713
Value in stock	10,394
/ # of shares	582.46
Value/share	$17.84

Terminal year (11)

EBIT (1-t)	$ 1,852
- Reinvestment	$ 386
FCFF	$ 1,466

Cost of capital = 11.12% (.981) + 5.16% (.019) = 11.01%

Cost of capital decreases to 8% from years 6-10

Failure Adjustment
1. Adjust your value for chance of failure.
2. Adjust for options and shares with different voting rights.

Cost of Equity
11.12%

Cost of Debt
(2.5%+5.5%)(1-.40)
= 5.16%

Weights
E = 98.1% D = 1.9%

On cost of capital
1. Make it forward looking.
2. Don't try to incorporate risks (like failure) that it was never meant to carry.
3. Let it change over time as your company changes.
4. Don't spent too much time on it.

Riskfree Rate:
Riskfree rate = 2.5%

\+

Beta
1.40

90% advertising (1.44) + 10% info svcs (1.05)

D/E=1.71%

x

Risk Premium
6.15%

75% from US(5.75%) + 25% from rest of world (7.23%)

2.1. Have a Story

Favored Tools
- Accounting statements
- Excel spreadsheets
- Statistical Measures
- Pricing Data

The Numbers People

Illusions/Delusions
1. Precision: Data is precise
2. Objectivity: Data has no bias
3. Control: Data can control reality

A Good Valuation

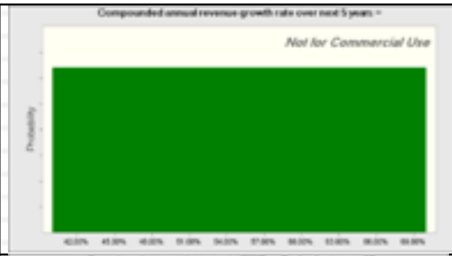
Favored Tools
- Anecdotes
- Experience (own or others)
- Behavioral evidence

The Narrative People

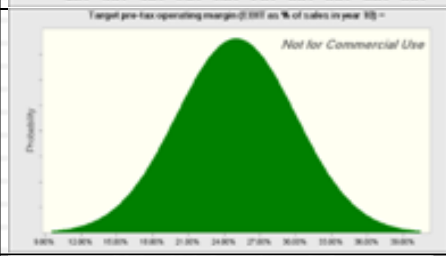
Illusions/Delusions
1. Creativity cannot be quantified
2. If the story is good, the investment will be.
3. Experience is the best teacher

2.2. Face up to uncertainty

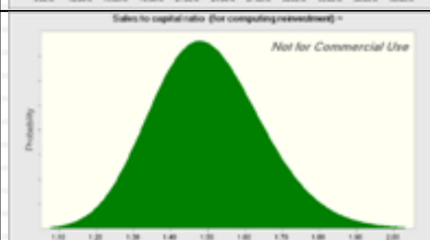
Revenue Growth Rate
Distribution: Uniform
Expected Value = 55%
Minimum Value: 40%
Maximum Value: 70%



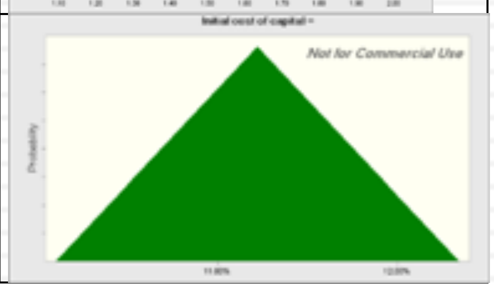
Target Operating Margin
Distribution: Normal
Expected Value = 25%
Standard Deviation = 5%

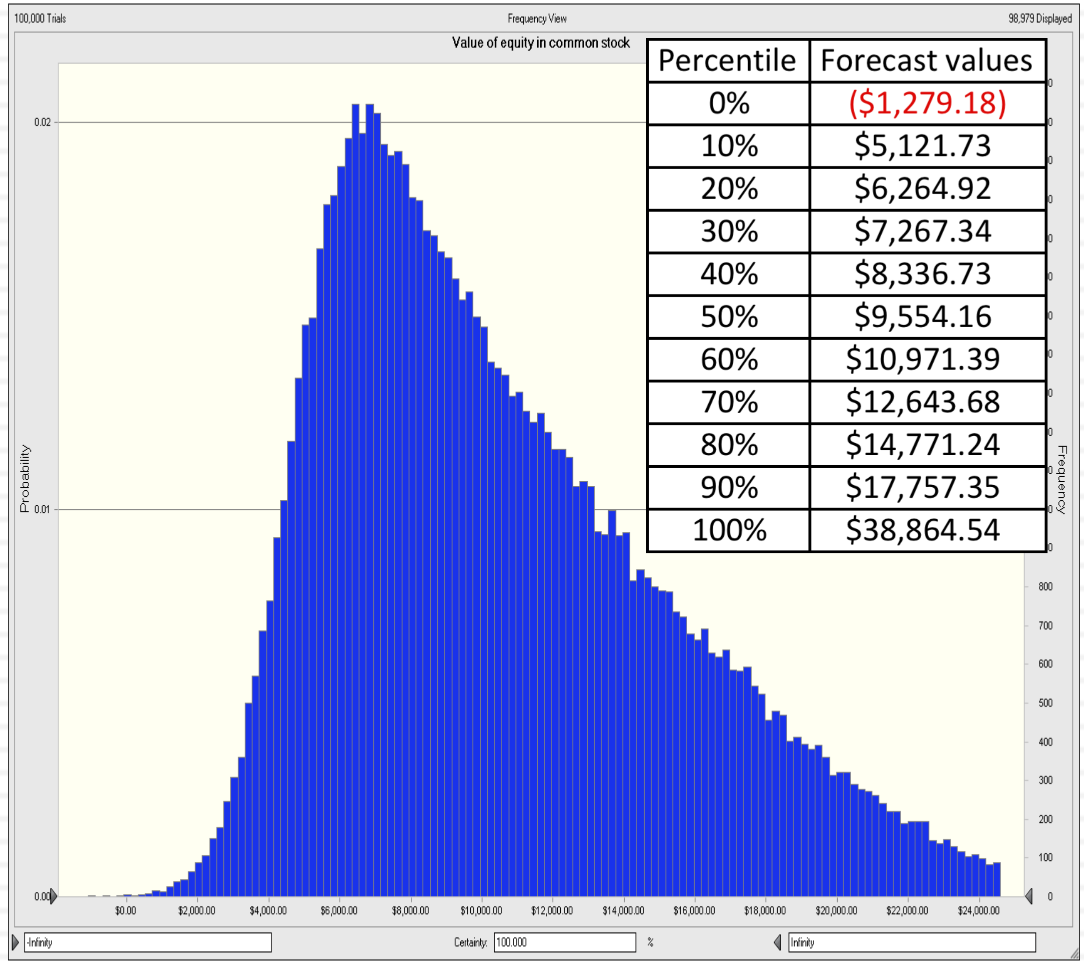


Sales to Capital Ratio
Distribution: Lognormal
Expected value: 1.50
Standard deviation: 0.15



Cost of Capital
Distribution: Triangular
Expected value: 11.22%
Minimum value: 10.02%
Maximum value: 12.22%





Percentile	Forecast values
0%	($1,279.18)
10%	$5,121.73
20%	$6,264.92
30%	$7,267.34
40%	$8,336.73
50%	$9,554.16
60%	$10,971.39
70%	$12,643.68
80%	$14,771.24
90%	$17,757.35
100%	$38,864.54

2.3. And don't give up, since your payoff is greatest when you feel most uncertain

Weather changeability for Honolulu, Hawaii

Temperature	Last Month	Last Year
Average change in high temperature day-to-day	1.7°	1.2°
Average change in low temperature day-to-day	1.5°	2.0°

Precipitation	Last Month	Last Year
Chance of dry day after a precip day	67%	81%
Chance of precip day after a dry day	7%	13%

Further changeability analysis »

Weather forecast accuracy for Honolulu, Hawaii

Last Month

MeteoGroup	**88.44%**
Persistence	**81.80%**
CustomWeather	**78.23%**
The Weather Channel	73.12%
AccuWeather	69.89%
Weather Underground	62.10%
National Weather Service	48.39%
Foreca	44.35%
WeatherBug	32.26%

Last Year

MeteoGroup	**88.50%**
CustomWeather	**85.87%**
AccuWeather	**81.82%**
The Weather Channel	81.56%
Persistence	80.44%
Weather Underground	67.07%
National Weather Service	59.90%
Foreca	57.52%
WeatherBug	37.09%

Weather changeability for Epping, North Dakota

Temperature	Last Month	Last Year
Average change in high temperature day-to-day	8.5°	7.7°
Average change in low temperature day-to-day	7.1°	8.6°

Precipitation	Last Month	Last Year
Chance of dry day after a precip day	50%	65%
Chance of precip day after a dry day	38%	20%

Further changeability analysis »

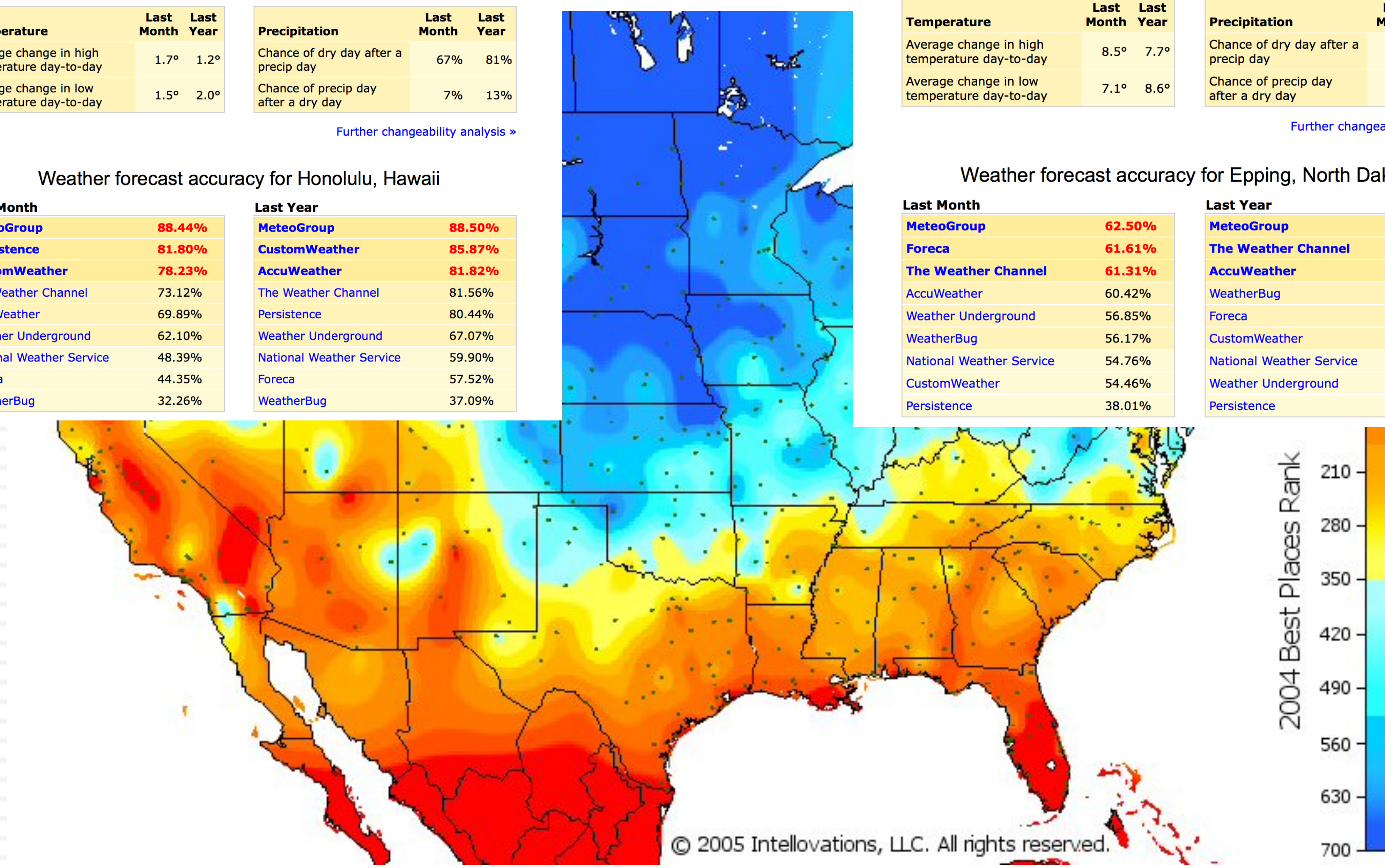
Weather forecast accuracy for Epping, North Dakota

Last Month

MeteoGroup	**62.50%**
Foreca	**61.61%**
The Weather Channel	**61.31%**
AccuWeather	60.42%
Weather Underground	56.85%
WeatherBug	56.17%
National Weather Service	54.76%
CustomWeather	54.46%
Persistence	38.01%

Last Year

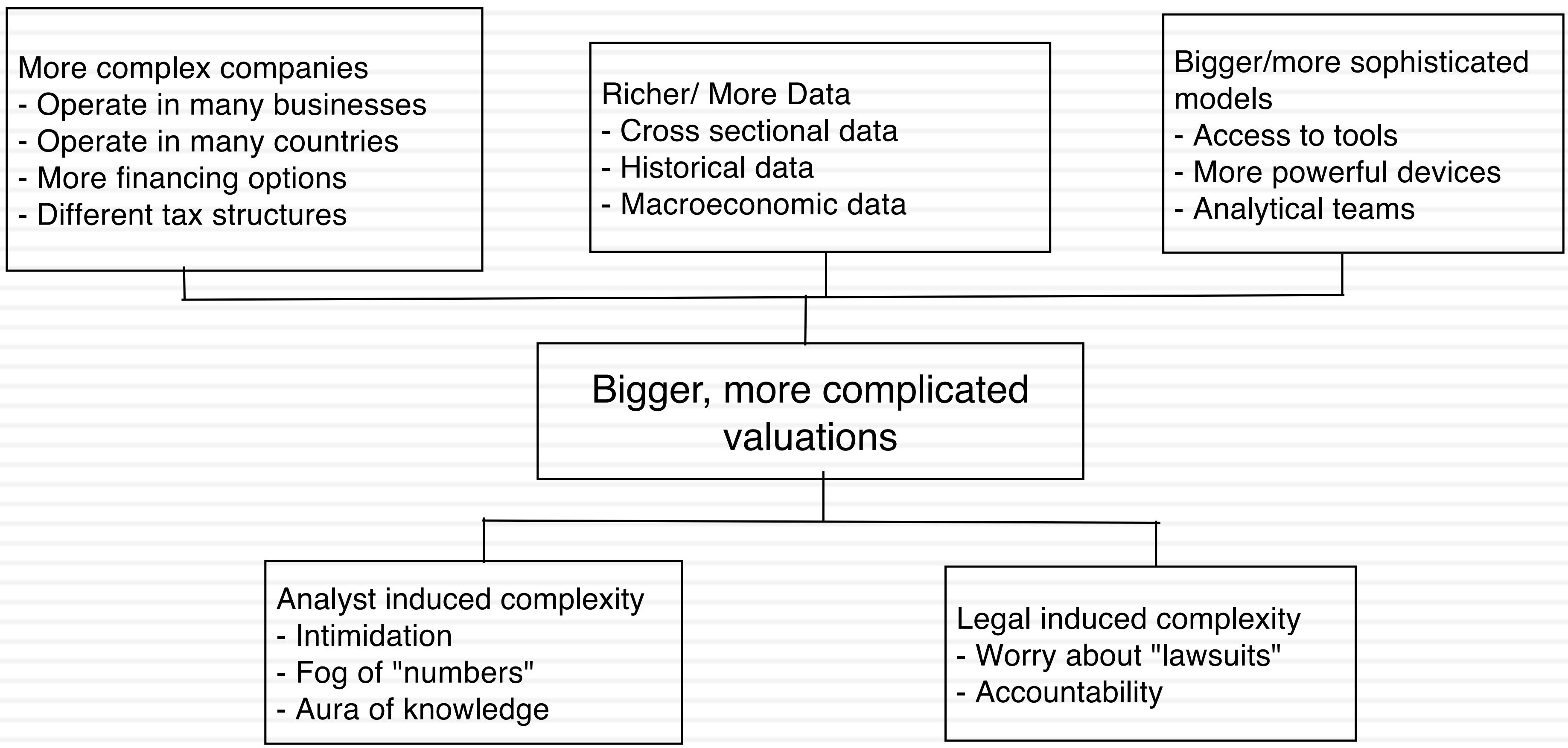
MeteoGroup	**66.97%**
The Weather Channel	**66.73%**
AccuWeather	**64.86%**
WeatherBug	64.80%
Foreca	62.75%
CustomWeather	62.70%
National Weather Service	62.64%
Weather Underground	61.38%
Persistence	44.09%



2.4. A sobering reminder: You will be “wrong” and it is okay

- No matter how careful you are in getting your inputs and how well structured your model is, your estimate of value will change both as new information comes out about the company, the business and the economy.
- As information comes out, you will have to adjust and adapt your model to reflect the information. Rather than be defensive about the resulting changes in value, recognize that this is the essence of risk.
- Remember that it is not just your value that is changing, but so is the price, and the price will change a great deal more than the value.

III. Complexity in valuation



Sources of complexity

- Globalization: As companies globalize, valuations are getting more complex for a number of reasons:
  - Risk assessment has to factor in where a company operates and not where it is incorporated.
  - Currency choices proliferate, since a company can be valued in any of a half a dozen currencies (often to value different listings)
- Shifting and volatile macro economic risks have created changing risk premiums and strange interest rate/exchange rate environments.
- More complex accounting standards have created longer, more complicated, more difficult to read financial statements.
- More complicated holding structures (cross holdings, shares with different voting rights), motivated by tax and control reasons, make valuations more difficult.

Manifestations of complexity

- Mysterious terms/acronyms: A feature of complex valuation is line items or terms that sound "sophisticated" but you do not know or are not sure what they mean or measure. (For an added layer of intimidation, make them Greek alphabets…)
- Longer, more detailed valuations: The level of detail that you see in valuations, with hundreds of line items and dozens of inputs, is staggering (and scary).
- What if and scenario analysis: While there is a place for asking what if questions and scenario analysis in valuation, the ease with which it can be done has opened the door to abuse, with the primary objective becoming cover, no matter what happens.

Dealing with Complexity: The ”bad” ways

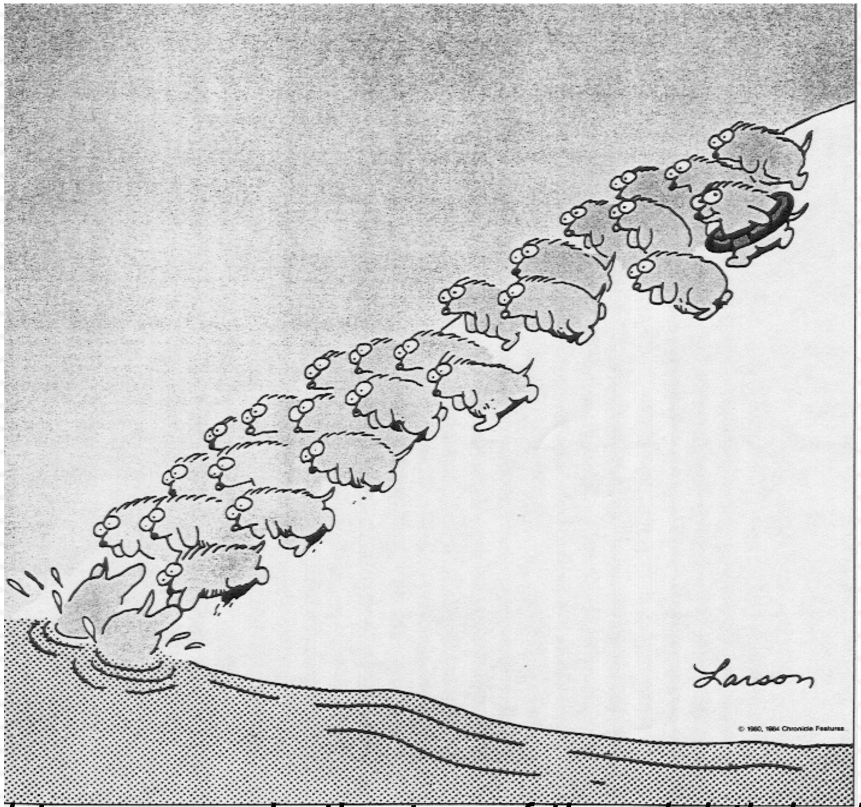
- Input fatigue: Analysts who are called upon to estimate dozens and dozens of inputs, often with little information to do so, will give up at some point and input “numbers” just to get done. It is “garbage in, garbage out…
- Black box models: The models becomes so complicated that what happens inside the model becomes a mystery to those outside. Consequently, analysts essentially claim no ownership or responsibility for the output from the model. “The model did it” becomes the refrain.
- Suspension of common sense: The dependence on models becomes so complete that analysts lose sight of common sense and mangle the valuation of the simplest assets.

Healthy responses to complexity

1. <u>Parsimonious valuations</u>: Never estimate more inputs than you absolutely have to. Less is more. When faced with the question of adding more detail/complexity, ask yourself whether it will make your valuation more precise (or just make it look more precise).
2. <u>Go back to first principles</u>: The fundamentals of valuation don't change, just because you are faced with complexity. Always fall back on first principles.
3. <u>Focus on key levers</u>: Even when there are dozens of inputs in a valuation, the valuation itself is a function of three or four key value drivers (which may be different for different companies). Keep your focus on those variables

Parting advice

" One hundred thousand lemmings cannot be wrong" *Graffiti*



We thought we were in the top of the eighth inning, when we were in the bottom of the ninth.. *Stanley Druckenmiller*