A Dynamic Approach to Financial Risk in Nuclear New Build

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A Discount Rate Puzzle

- Standard empirical methods employing data on the stock returns of nuclear operators yield a very low discount rate for nuclear power projects.
  - Generally less than 7%.
- Widespread experience with financing nuclear new builds reveals much greater discount rates.
  - Generally greater than 10%.
- For new nuclear projects this discrepancy is very material.
  - Approximately, 2¢/kWh in the LCOE or more than a 20-25% change.
- How do we reconcile these two facts?
Recognizing the Dynamic Structure of Risk

- Risk is seldom constant across the value chain.
- 3 examples
  - Oil production.
  - Pharmaceuticals.
  - Nuclear power plants.
## Costs of Capital for Companies Operating at Different Points Along the Oil Value Chain

<table>
<thead>
<tr>
<th></th>
<th>Asset Beta</th>
<th>Asset Cost of Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>Royalty Trusts</td>
<td>0.194</td>
<td>7.2%</td>
</tr>
<tr>
<td>Exploration &amp; Production</td>
<td>0.873</td>
<td>12.2%</td>
</tr>
<tr>
<td>Integrated</td>
<td>0.684</td>
<td>10.8%</td>
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</tbody>
</table>
“The Risk-Return Staircase” in Pharma Drug Development

MIT Sloan Program on the Pharmaceutical Industry: Howe & Myers
Figure 5: Unconditional Variance of the Capacity Factor Through the Life of the Reactor

The Financial Risk on a Nuclear Project is Massively Front Loaded

Illustrative Discount Rate Calculation for a Nuclear Power Plant: mean scenario

<table>
<thead>
<tr>
<th>Project Year</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<tbody>
<tr>
<td>Cash Flows</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Revenue</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>405</td>
<td>1,093</td>
<td>1,391</td>
<td>1,304</td>
<td>513</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O&amp;M/Fuel/MC</td>
<td>23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net Cash Flow</td>
<td>-405</td>
<td>-1,093</td>
<td>-1,391</td>
<td>-1,304</td>
<td>-513</td>
<td>581</td>
<td></td>
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<tr>
<td>Present Values</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Revenue</td>
<td>9.0%</td>
<td>4,214</td>
<td>4,594</td>
<td>5,008</td>
<td>5,459</td>
<td>5,951</td>
<td>6,487</td>
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<tr>
<td>Construction</td>
<td>5%</td>
<td>4,053</td>
<td>3,851</td>
<td>2,951</td>
<td>1,707</td>
<td>488</td>
<td>0</td>
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<tr>
<td>O&amp;M/Fuel/MC</td>
<td>9.0%</td>
<td>161</td>
<td>175</td>
<td>191</td>
<td>208</td>
<td>227</td>
<td>247</td>
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<tr>
<td>Net Cash Flow</td>
<td>0</td>
<td>568</td>
<td>1,866</td>
<td>3,544</td>
<td>5,236</td>
<td>6,240</td>
<td>6,221</td>
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<tr>
<td>Implied Discount Rate on NCF</td>
<td>36.2%</td>
<td>15.4%</td>
<td>10.9%</td>
<td>9.4%</td>
<td>9.0%</td>
<td>9.0%</td>
<td></td>
</tr>
</tbody>
</table>

Average = 10%
Refine the dynamic modeling of risk.

- The stock market data is all about the cash flow risk on an operating nuclear plant.
- The problems with financing new build all pertain to risks during the construction phase.
- Risk is not constant throughout the life of a plant.
Three Caveats

- We already have very powerful and precise models. But we lack the tools with which to calibrate them. So what good are they?
- A key risk is construction. The proper assessment and gauge of construction risk is less a matter of modeling and more a matter of ruthless realism.
- This modeling generally treats the risks as exogenous. Many of them are not. More on that shortly.
Alternative Approaches

- **#1 The Hedger School**
  - This is the school which claims that nuclear, like other capital intensive power technologies such as wind, has a volatile operating margin which raises its discount rate. Especially in contrast to gas technologies which set the electricity price and are automatically hedged.
  - Goofy, but insouciant.
  - A stalking horse for subsidy.

- **#2 Clienteles and Agency**
  - Focus is on “who” will bear the risk.
  - Version A: Searching for the “one”.
  - Version B: Allocating risk to shape incentives and define commitment.
The End