

# Teaching Transactional Cases with Simulation Software

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AALS Mid-Year Meeting

June 12, 2009

## DISCUSSION TOPICS



### • The Benefits of Simulation

- A Case Example: Petrolera Zuata
- A Brief Demo: Crystal Ball

## THE PROBLEM WITH POINT ANALYSIS

- Traditional spreadsheet analysis uses a single value (like the average) to represent uncertain or variable inputs
- This results in a static, or deterministic, result that might be unrepresentative of the range of possible outcomes

## AVERAGES CAN BE DECEPTIVE!

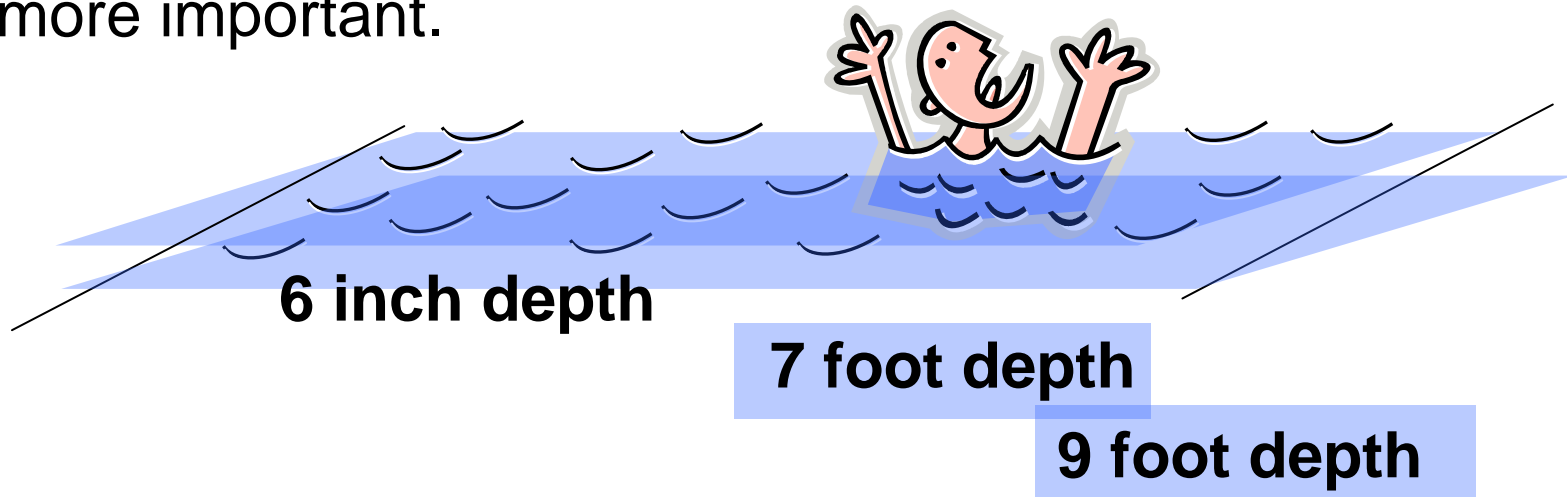
You want to cross a stream (to get to the other side)

You are told the **average** depth is 3 feet

You cannot swim...

**Most** of the stream is 6 inches deep...The rest is **deeper** (over your head)!

The average may be useful, but knowing the **range** of depths is more important.



# OTHER WAYS TO RUN THE ANALYSIS

Range of Outcomes

## Simulation

- Use ranges as inputs → thousands of outcomes with associated probabilities
- Easy to analyze and communicate

## What-if Analysis

- Even increments of values → multiple outcomes, but no associated probabilities
- Difficult to analyze

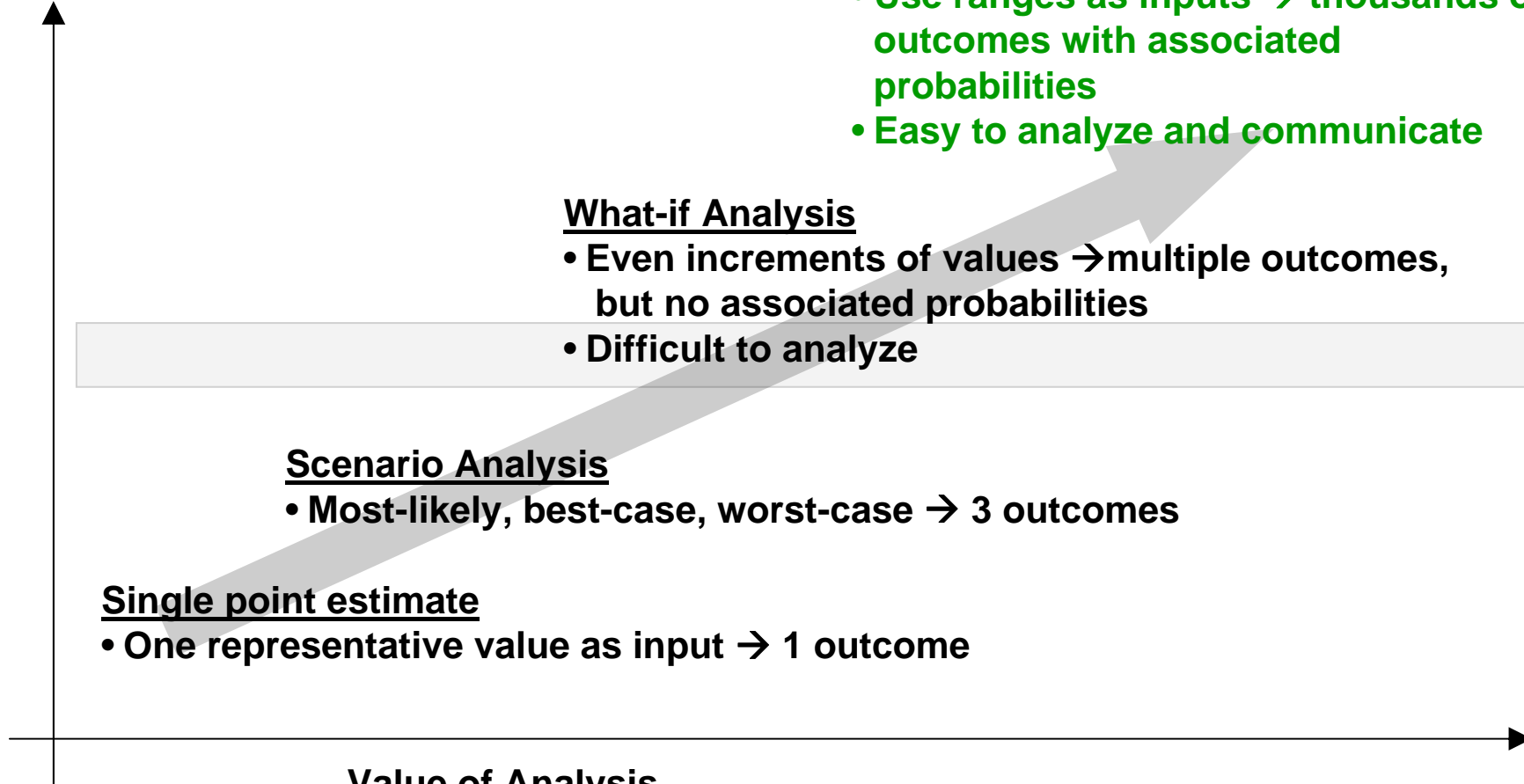
## Scenario Analysis

- Most-likely, best-case, worst-case → 3 outcomes

## Single point estimate

- One representative value as input → 1 outcome

Value of Analysis

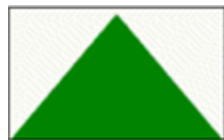


## HOW SIMULATION SOFTWARE CAN HELP THE ANALYSIS

- Simulation allows you to use realistic ranges for the values in a single spreadsheet cell to account for uncertainty or variability in inputs.
- For example, rather than rely on an average (and unlikely) service time of 4 hours, you can replace this single point estimate with a range of values from 1 to 8 hours.
- These ranges of values are represented by probability distributions, like the normal curve, that are generated from historical data or expert opinion



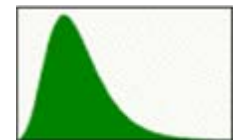
Normal



Triangular



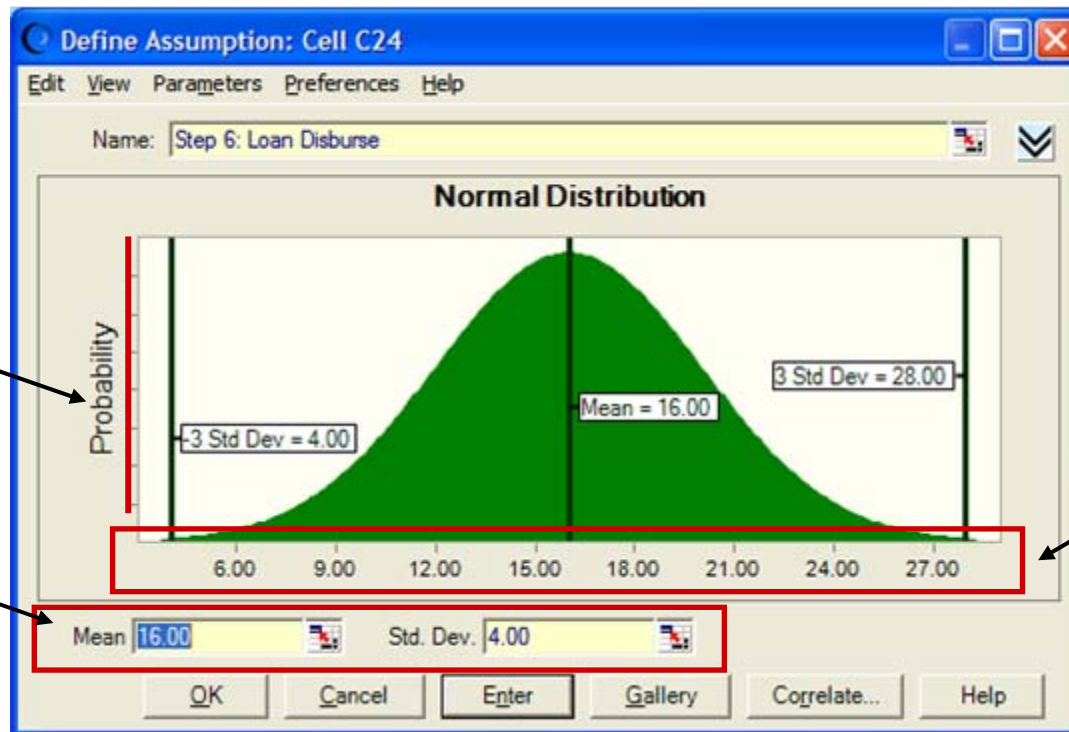
Uniform



Lognormal

## PROBABILITY DISTRIBUTIONS AS INPUTS

- With simulation software, a single spreadsheet cell can be defined to take on values according to a distribution with defined parameters.
- In this example a normal distribution with mean = 16 and std. dev. = 4



Probability

Parameters

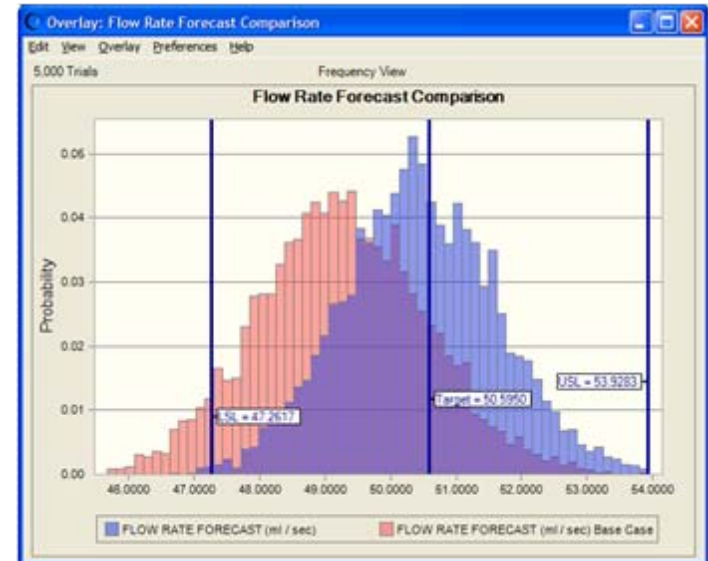
Range

# HOW SIMULATION SOFTWARE CAN HELP THE ANALYSIS

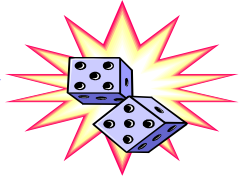
You can dynamically generate hundreds to thousands of outputs compared to the single output of a static spreadsheet

This form of simulation (Monte Carlo) randomly samples from the ranges defined in the uncertain inputs, recalculates the spreadsheet, stores and displays the outputs, and repeats the process

Sampling statistics such as mean, standard deviation, and percentiles are then utilized to provide valuable insights into the effects of variability on an output

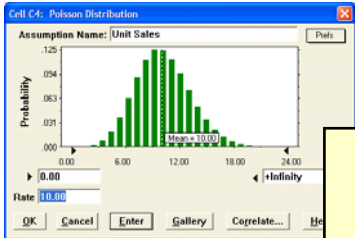


# HOW MONTE CARLO SIMULATION WORKS

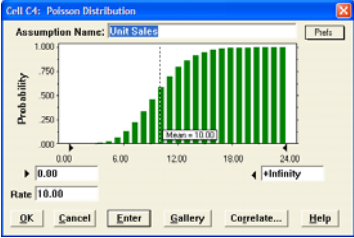


START HERE  
Generate a Random  
Number (between 0 and  
1)

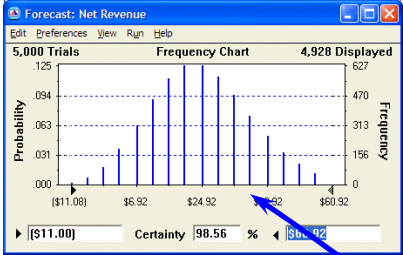
Generate next Random  
Number (between 0 and 1)



Transform Probability  
Distribution of input to  
Cumulative Probability  
Distribution



Convert Random  
Number to Sampled  
Value of input



Recalculate Model and  
Record Simulation Outputs  
from this Trial

Sampled Value is used  
in this trial of  
Spreadsheet Model

PRODUCT PROFORMA	
Unit Sales	10
Sales Price	\$ 40.00
Total Revenue	\$ 100.00
Variable Cost/Unit	\$ 5.50
Total Variable Cost	\$ 55.00
Total Fixed Cost	\$ 20.00
Total Cost	\$ 75.00
Net Revenue	\$ 25.00

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**FROM SYNCRUDE ...**



**... TO OIL**

# PROJECT OVERVIEW



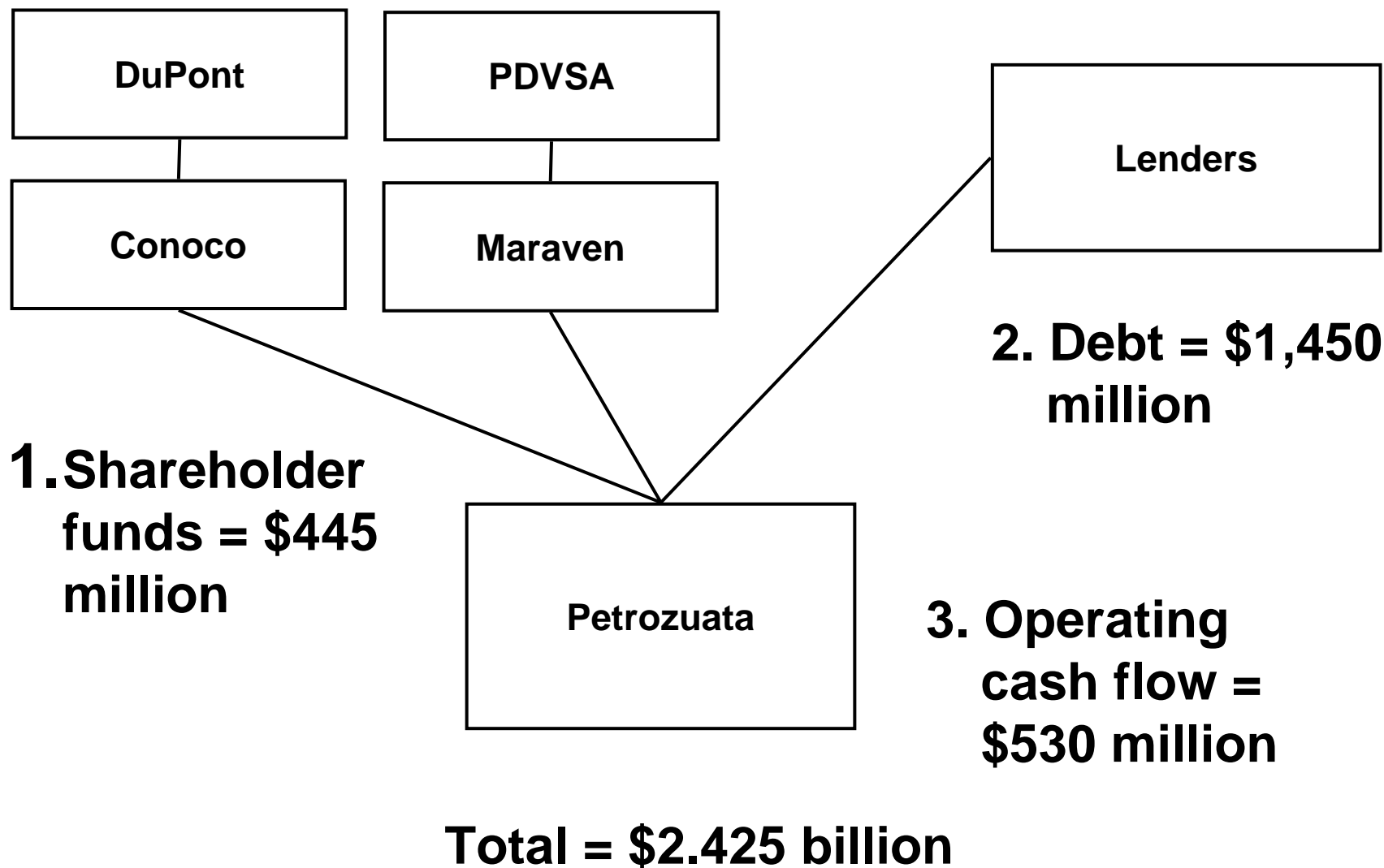
3. UPGRADER  
AND  
TERMINAL

2. PIPELINE

1. OIL WELLS

**Project cost = \$2.425 BILLION**

# THE PROPOSED TRANSACTION



## CASE QUESTIONS

1. Should PDVSA use project finance or traditional internal debt finance?
2. What are the most important operating risks?  
How can these risks be mitigated?
3. Should Petrozuata raise the debt from commercial banks, public bonds, or privately placed bonds?
4. What rating will the bonds earn?

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## 2. WHAT ARE THE MOST IMPORTANT OPERATING RISKS?



- **Pre-completion risks**
- **Post-completion risks**
- **Sovereign risks**



## PRE-COMPLETION RISKS

Risk	Mitigants
<p>1. Resource Risk – crude must be of sufficient quality to upgrade</p>	<ul style="list-style-type: none"> <li>• Degolyer &amp; MacNaughton report</li> <li>• Concoco purchase agreement</li> </ul>
<p>2. Technology Risk – a project's use of complex or untested technology may lead to cost overruns or delays</p>	<ul style="list-style-type: none"> <li>• Conoco has experience with upgrading technology</li> <li>• Stone &amp; Webster independently evaluated technology</li> </ul>
<p>3. Timing Risk – project has three segments and is complex; must be finished to realize cash flow</p>	<ul style="list-style-type: none"> <li>• Stone &amp; Webster evaluated execution</li> <li>• Technologies are known</li> <li>• Participants have experience</li> </ul>

## POST-COMPLETION RISKS

Risk	Mitigants
<p>1. Market Risk – Prices and quantities of future output are uncertain</p>	<ul style="list-style-type: none"> <li>• Concoco 35 year off-take agreement</li> <li>• Prices tied to price of Maya</li> <li>• Break even price for project is low: \$8.63 per barrel</li> <li>• Chem systems found price estimates reasonable</li> </ul>
<p>2. Supply / Input Risk – the raw materials must be available at anticipated terms for the life of the project</p>	<ul style="list-style-type: none"> <li>• Utilities are owned by PDVSA or the government</li> <li>• Post-completion the project will supply its own electricity, gas, and water</li> </ul>
<p>3. Throughput Risk – The project must perform as expected through the life of the project</p>	<ul style="list-style-type: none"> <li>• The participants have experience</li> <li>• The pipeline is buried and in a sparsely populated area</li> <li>• Engineers did not expect the crude's density to vary</li> <li>• Stone &amp; Webster evaluation</li> </ul>

# SOVEREIGN RISKS

Risk	Mitigants
1. Exchange Rate Risk – the bolivar may depreciate significantly versus the \$	<ul style="list-style-type: none"> <li>•Project revenues are in dollars</li> </ul>
2. Inflation risk – relative price changes of inputs and outputs may effect project profitability	<ul style="list-style-type: none"> <li>•As long as relative purchasing power parity holds, exchange rates should move to offset inflation</li> </ul>
3. Expropriation risk – The domestic government may seize project assets, seize project cash flows, or increase tax rates	<ul style="list-style-type: none"> <li>•Petrozuata is the first in a series of planned projects</li> <li>•Any direct expropriation may cut off capital needed to fund other projects</li> <li>•Diversion of syncrude may be difficult since there are few refineries able to process the crude</li> <li>•PDVSA has assets in the US (CITGO)</li> </ul>

## AND THEN ...

**“We have buried that perversion that was the oil opening,” crowed Mr Chávez. “Anyone who doesn't like that can go elsewhere.”**



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