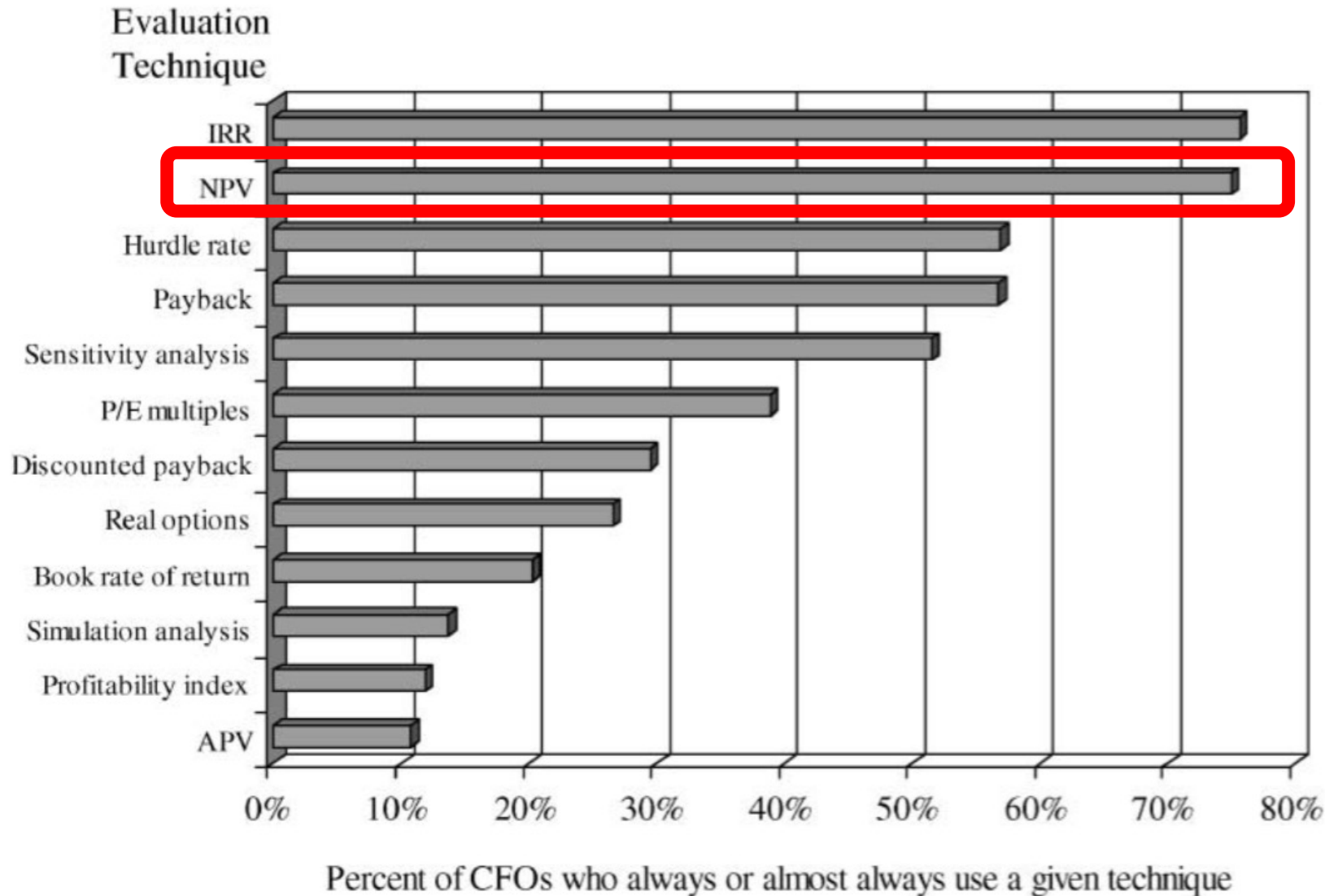# NPV variance

NPV

$$NPV = \frac{Year\ 1\ inflow}{(1+discount\ \%)^1} + \frac{Year\ 2\ inflow}{(1+discount\ \%)^2} + \frac{Year\ 3\ inflow}{(1+discount\ \%)^3} \ldots - Initial\ investment$$

NPV is used very frequently

75%

- Sample: 392 CFOs (Graham & Harvey, 2001)

Predictors:
- Large firms > small firms
- High debt ratio > small debt ratio

The NPV paradox

- "Although the NPV method is criticized by both practitioners and academics, the traditional NPV calculation is by far the most commonly used tool for [exploration & production] project valuation." (Willigers et al., 2017)

- "NPV is almost always applicable but is almost always wrong" (Fox, 2008)

- "the NPV rule as governing all capital budgeting decisions may not be appropriate" (Arya et al., 1998)

Consequences

- Researchers studied 174 cases of fraudulent financial reporting
  - Fraudulent "facts" vs "forecasts"

- Forecasts based on unreasonable accounting assumptions
  - Form 40% of fraud cases
  - Account for 44% of economic losses

- Total damages by fraudulent *facts*: US$ 27 billion
- Total damages by fraudulent *forecasts*: US$ 23 billion

NPV

$$NPV = \frac{\boxed{Year\ 1\ inflow}}{(1+discount\ \%)^1} + \frac{\boxed{Year\ 2\ inflow}}{(1+discount\ \%)^2} + \frac{\boxed{Year\ 3\ inflow}}{(1+discount\ \%)^3} \ldots - Initial\ investment$$

Where do these cash inflows come from?

"It's impossible to forecast most projects' actual cash flows accurately" (Myers, 1984)

Forecasting is error-prone

- Future forecasts tend to be overly-optimistic
  - For longevity
  - For relationships
  - When dopamine is increased
  - In animal behaviour

- Executives are similarly overly-optimistic
  - In stock market returns
  - For firm earnings

Forecasting is error-prone

- CFO survey between 2001-2011

- *Over the next year, I expect the annual S&P 500 return will be:*
    - *There is a 1-in-10 chance the actual return will be less than ___%.*
    - *I expect the return to be: ___%.*
    - *There is a 1-in-10 chance the actual return will be greater than ___%.*

- 13,346 estimates

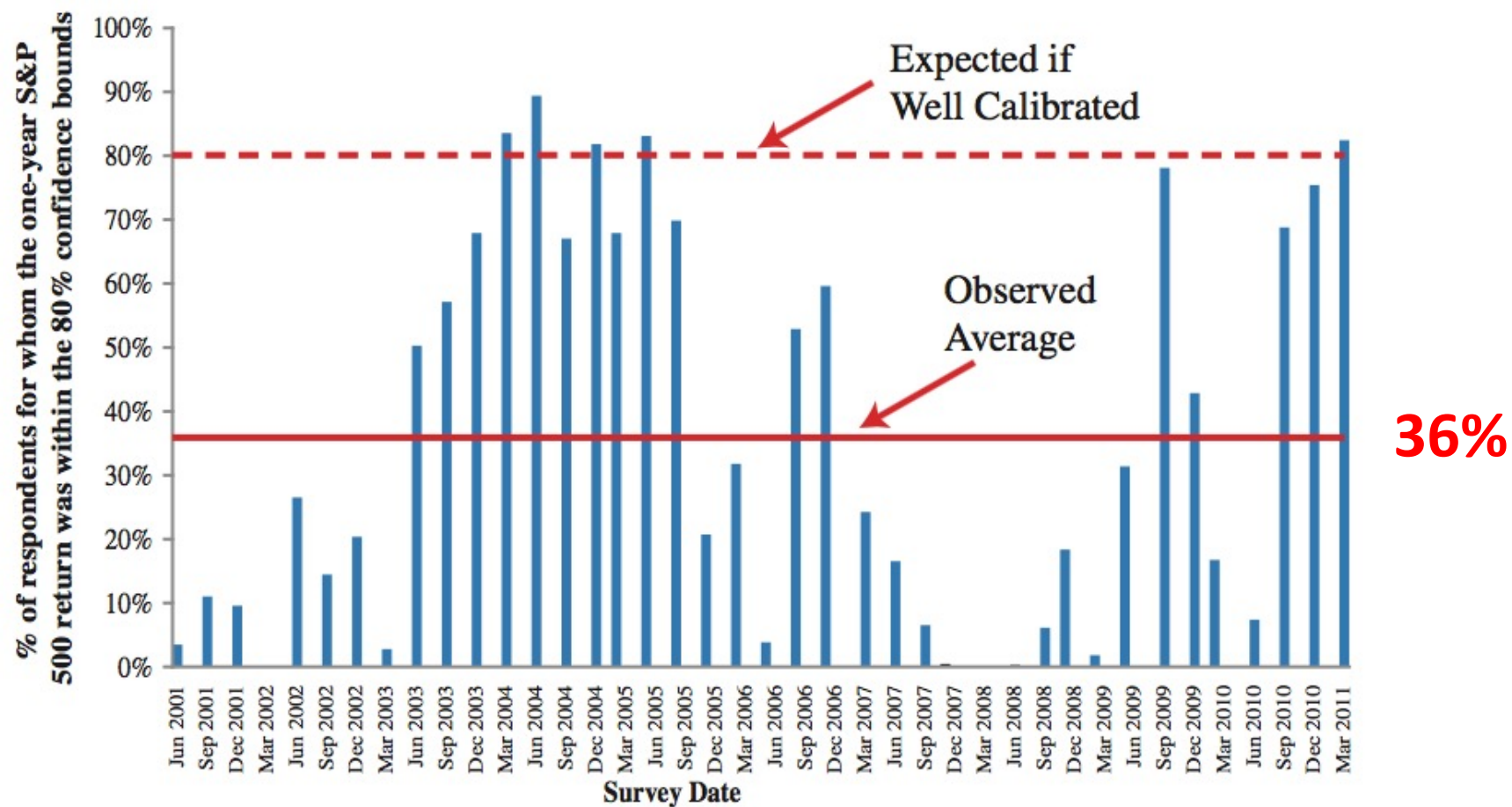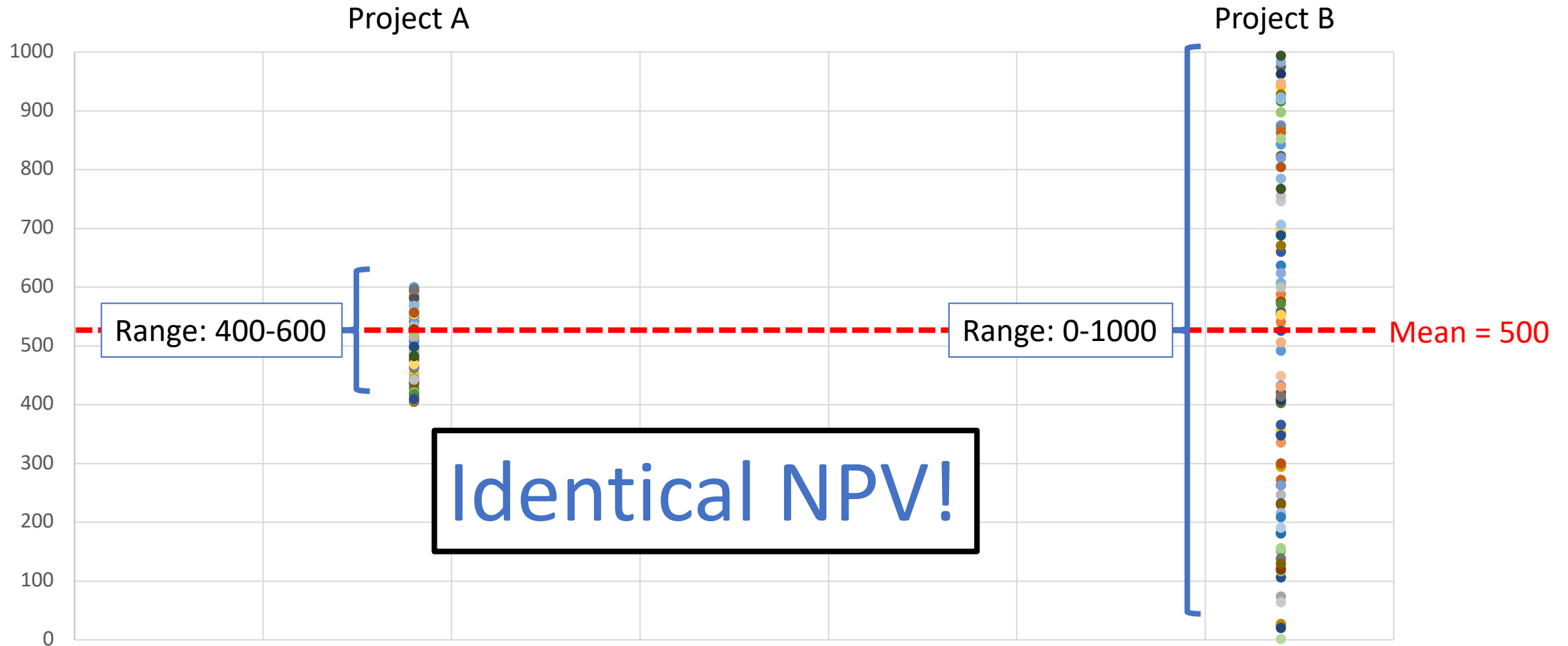# Forecasting is error-prone

FIGURE I

Time-Series of CFO Miscalibration

Paying attention to variance

- Ranges are frequently used for forecast estimates
  - 80% of the time between 2002-2010

- Taking account of variance increases forecasting accuracy

Paying attention to variance - Example

Project A

Project B

Range: 400-600

Range: 0-1000

Mean = 500

Identical NPV!

Will you rely more on both measures equally?

Summary

- NPV is used a lot, but criticised by some

- The costs of poor forecasting are potentially high

- NPV relies on forecasting

- Executives may underestimate forecast variance

Bottom line

- Pay attention to cash inflow variance

- Not all NPVs are created equal
  - NPV based on more variance should be weighted less than other measures