

Economics Training Series Introductory Course

Sensitivity and Risk Analysis

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Why Sensitivity and Risk Analysis

- Project returns are spread over time → costs and benefits are subject to uncertainty and may vary from the base case
- Sensitivity and risk analysis is an analytical framework for dealing with uncertainty. The objective is to reduce the likelihood of undertaking bad projects while not failing to accept good projects
- *References: Guidelines (1997), Handbook (2002), Technical Note 2 (2002)*

Sensitivity Analysis

- is the first step to risk analysis. Basically, it is a "What if" analysis testing which variables are important to project outcomes (NPV, EIRR)
- applies to all projects with quantified benefits and costs
- involves recalculating project outcomes (NPV, EIRR) for different values of major variables and combinations of variables
- when benefits are not valued, may use sensitivity analysis to assess impact of changed assumptions on unit costs only

Sensitivity Analysis: Procedure

- Determine key variables and their possible changes
- Re-calculate EIRR and NPV
- Calculate Switching Value

Switching Value

- Switching value is the value of the variable at which the project investment decision is changed. Usually is defined as percentage change from the base case.
- Percentage change in a variable required to reduce the net present value (NPV) to 'zero' at the chosen discount rate:

$$\text{Set NPV} = 0 \rightarrow v^* \rightarrow \text{SV} = 100\% \times (v^* - v^0)/v^0$$

OR

- Percentage change in a variable required to make the project EIRR equal a chosen discount rate (e.g., 12%):

$$\text{Set EIRR} = r \rightarrow v^* \rightarrow \text{SV} = 100\% \times (v^* - v^0)/v^0$$

Sensitivity Analysis: Presentation

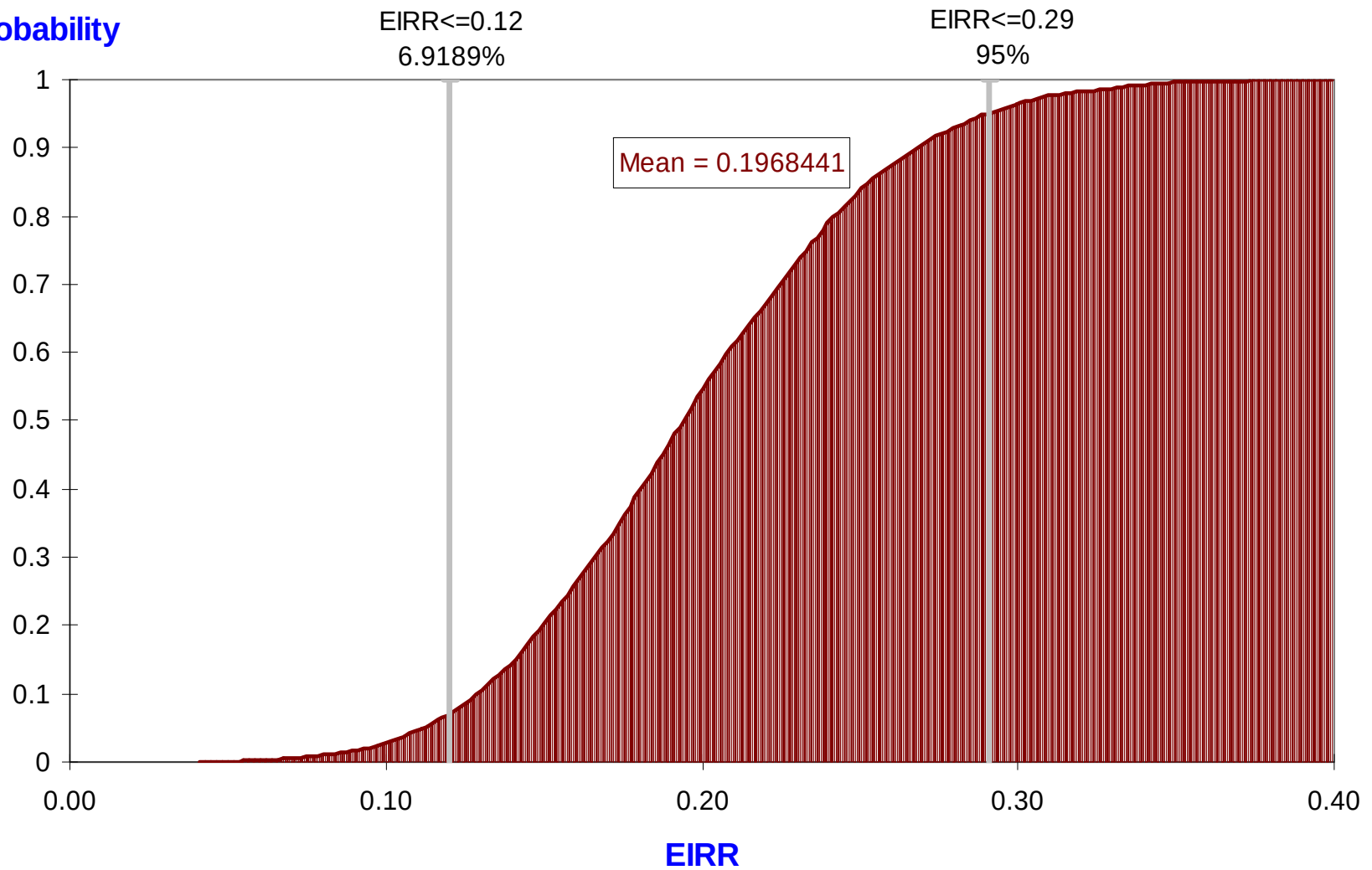
- Which variables have low switching values ?
- Have the calculations used realistic changes ?
- Do likely changes exceed switching values ?
- How likely are the combinations to occur ?

Risk Analysis

- A method to estimate the probability distribution of project outcome: $F(EIRR)$, $F(NPV)$
- Determine a probability distribution of values of key variables: $F(v_1)$, $F(v_2)$, $\dots$, $F(v_n)$
- Sample these values to determine a probability distribution of outcome
- Process greatly simplified by use of PCs and standard software packages

Distribution for Economic Rate of Return

Probability



Implications for ADB Operations

- risk analysis is used for consideration of projects one-by-one (i.e., not investment portfolio analysis)
- helps to identify relative importance of different variables as determinants of project returns
- analytic focus is on determining the likelihood that project returns (economic and financial, to economy and to particular groups) are unacceptable (i.e., $EIRR < EOCC$, or $NPV < 0$; and also $PIR < XX\%$)
- ultimately, leads to project re-design/incorporation of mitigating measures (including the appropriate allocation of risks among various project participants)

ERD'S Retro 2005 Findings

- Sensitivity and risk analyses were inadequate or poor in about half of the RRP's reviewed.
- Most projects applied sensitivity test but the analysis is generally limited to a mechanistic “plus 10% (20%) project costs”, “minus 10% (20%) of project benefits”, or “1-year delay in project implementation” (same as in Retros 2002 and 2003). Note that the focus of sensitivity test is on specific variables to inform project design.
- Only a small number of projects conducted quantitative risk analysis.

Final Notes

- There may be other risks very important to assess but cannot quantify (e.g., political and institutional risks).
- They are really a part of sensitivity and risk analysis and generally treated under qualitative risk analysis (e.g., risk matrix of typically low, medium, high impact).
- When risk is high (e.g., very small switching value, high probability that $EIRR < EOCC$), need to work out mitigating measures or change project design.

Thank you.