SESSION 2.5

SENSITIVITY AND RISK ANALYSIS

Introductory Course on Economic Analysis of Investment Projects

Economics and Research Department (ERD)
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

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:
  
  Set $\text{NPV} = 0 \rightarrow v^* \rightarrow \text{SV} = 100\% \times \frac{v^* - v^0}{v^0}$

OR

- Percentage change in a variable required to make the project EIRR equal a chosen discount rate (e.g., 12%):
  
  Set $\text{EIRR} = r \rightarrow v^* \rightarrow \text{SV} = 100\% \times \frac{v^* - v^0}{v^0}$
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: \( F(\text{EIRR}), F(\text{NPV}) \)
- Determine a probability distribution of values of key variables: \( F(v_1), F(v_2), \ldots, F(v_n) \)
- 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

Mean = 0.1968441

EIRR <= 0.12
6.9189%

EIRR <= 0.29
95%

Mean = 0.1968441

Probability

EIRR

0.00 0.10 0.20 0.30 0.40

0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00

0.00 0.10 0.20 0.30 0.40

0.00 0.10 0.20 0.30 0.40
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.