SESSION 2.4

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

**OR**

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

95%
EIRR <= 0.29

Mean = 0.1968441
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 RRPs 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