Economies of Scale and Scope in R&D projects: Preliminary Results

High Level Advisory Group Meeting
April 2010, Vienna
Introduction and Framework of Analysis

• The basic question we are dealing with: economies of scale (and scope) in R&D projects
  – **Rationale**: R&D projects may experience *increasing returns* to **Scale** because of specialization, complementarities of resources and skills, and more efficient utilization of resources
    - A counter argument: *decreasing returns* to scale because of higher transaction and administrative costs associated the implementation of a large project
  – Similarly for **Scope**: *increasing returns* to scope may arise in the pursuit of multiple “sub-projects” within the same research effort because of e.g., cost savings, cross-fertilization of ideas and intermediate results, etc
    - A counter argument: (as above) diseconomies of scope because of transaction costs to managing a complex project
Conceptual Framework

Industry & Market environment
(Apropiability Regimes)

Partners' Characteristics (strategy, objectives, technological and other resources and experiences, etc)

Scale
- # of partners
- project budget

Scope
-diversity of activities (vertical)
-number of subprojects (horizontal)

Project Characteristics (degree of technical & commercial risk, built on past R&D, etc)
- Project Management (e.g., communication, coordination, trust, leadership, etc)
- Consortium’s Composition (size of partners, diversity of partners, SM/Es in the consortium etc)

Pool of Resources
- “Larger”
- “Heterogeneous”

Learning process

Transaction costs
- Administrative Coordination

Output Scope
- Social returns (i.e., knowledge spillovers)
- Private returns

Exploitation

Project Performance
• Scale and scope, as reflected (primarily) by consortium size and project budget, would exhibit an inverted-U shaped effect on project performance via its effect on the different “mediator” variables.
  – That is, scale and scope would have a positive influence on performance through a positive effect on the pool of resources and learning
  – and a negative effect by increasing the transaction costs, i.e., the administrative and coordination costs of running the project.
  – Other specific hypotheses will be discussed subsequently, when interpreting the results
Data and Measures

- The data collection process and the sample have been described in detail in another document; won’t be repeated here.
- Key descriptive statistics for the final sample used for analyses
  - 1172 observations (750 ROs + 422 enterprises)
  - 676 unique projects (328 projects with responses >= 2)
  - Lots of missing values: we had to be selective on the variables to represent the key constructs of interest
- All “composite” variables used in the analyses (see below) were constructed following Confirmatory Factors Analysis
Overview of Variables

- **Scale:**
  - $\log$ (number of partners)
  - $\log$ (project budget)
  - Notice that using the logarithm of scale allows the effect on performance of increased scale to be greater when moving from small-sized to medium-sized projects than when moving from large to very large projects.

- **Scope:**
  - `Project_included_sub_projects`: No/Yes (0/1) $\rightarrow$ (302 observations only)
  - Number of sub_projects $\rightarrow$ too many missing values
  - Because of the missing values, we use instead a proxy: A Likert item on “type of project”, extending from “R&D only” to “R&D up to market-oriented activities”

- **Project Performance**
  - 8 dimensions of performance
    - “achievement of project objectives”
    - Knowledge-related “outputs” (e.g., publications)
    - Technology-related “outputs” (e.g., models and simulations)
    - Network-related “outputs”
    - Research-capacity related impacts
    - Commercialization-related impacts
    - Product and process innovation (as a result of the project) (two dichotomous variables)
  - These are measures of performance at the level of the *individual* participant
  - The last three (commercialization, product, and process innovation concern *enterprises only*)
• **Mediators:**
  – Complementarity of resources
  – Absorptive Capacity
  – Transaction Costs → 2 dimensions derived from CFA → (clear objectives, coordination)
    • *These 2 dimensions were reverse coded for the analysis so that higher values represent “unclear objectives” and “difficulties in coordination”.*

• **7 classes of independent variables**
  – Project management
  – Project “nature”
  – Project “controls”
  – Partner “controls”
  – Resources devoted to the project
  – Firm “innovation history”
  – Environment

• In the attached document you may see a detailed description of the variables used in the analyses