

Productivity and Efficiency Analysis

1) Introduction

a) *What is productivity and why it matters?*

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Why productivity is important?

"Productivity isn't everything, but in the long run it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker."

Paul Krugman (1992, p. 9)

Why productivity matters?

Solow (1957) shows that economic growth depends on:

- Factors of production (labor, capital)
- Productivity growth

Productivity : basic concepts

Inputs:

- Labor
- Capital
- Intermediate inputs (materials, energy)

→ Production process →

Output:

- Goods and services (sales, value added)
- Environmental bads (e.g., CO₂)

Productivity : basic concepts

Partial vs total productivity:

- *Labor productivity = output / labor input*
- *Total productivity*
= output aggregate / input aggregate
- *Environmentally adjusted (green) productivity?*

Productivity : basic concepts

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The term “productivity” can refer to

- *level of productivity* (e.g., output per worker)
- *change of productivity* over time (= productivity growth)

Productivity and efficiency analysis: disciplines

- A truly *multidisciplinary* field.
- 3 main disciplinary approaches:
- **Economics**
 - Growth accounting, industrial organization
- **Econometrics and Statistics**
 - Stochastic frontier estimation
- **Operations Research and Management Science**
 - Data envelopment analysis

Productivity and efficiency analysis: Impact

5 most cited articles (Google Scholar, 16.3.2020):

- Charnes et al. (1978), *EJOR*: 34,614 citations
- Farrell (1957), *J. Royal Stat. Soc.*: 22,124 citations
- Banker et al. (1984), *Man. Sci.*: 19,403 citations
- Solow (1957) *REStat*, 17,188
- Aigner et al. (1977), *J. Ectr.*: 12,270 citations

Productivity and efficiency: **basic concepts**

Several closely related terms, often used as synonyms in everyday language:

- *Productivity*
- *Efficiency*
- *Effectiveness*
- *Performance*

Productivity and efficiency: **basic concepts**

Productivity growth depends on

- **Technical progress**
- **Efficiency improvement**
 - Technical efficiency
 - Scale efficiency
 - Allocative efficiency
- **Structural change**
 - Entry and exit of units
 - Reallocation of resources between units

Efficiency analysis

Examples of research questions:

- Which units are the best performers? Which ones are the worst? *Benchmarking*

Efficiency analysis

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Efficiency analysis

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- How large is the performance gap between the evaluated unit and the best performer?
- Which factors explain efficiency differences across firms? What the firm management or policy makers could do to improve performance?

Productivity and efficiency analysis: applications

Many areas, some examples include:

- **Agriculture** (farms, production systems)
- **Banks** and financial institutions (branches, offices)
- **Education** (schools, universities etc)
- **Energy** (power plants, transmission and distribution)
- **Environment** (pollution)
- **Health care** (hospitals, health care centers)
- **Public services** (police stations, libraries)
- **Utilities** (gas, water, sewage, district heating)
- **Transportation** (airlines, railroads, cars)
- etc.

Productivity and efficiency analysis: aggregation

Levels of aggregation:

- Individual persons
- teams / plants / establishments
- firms
- industries
- regions
- countries

Next lesson

1b) Taxonomy of frontier estimation methods