



# Technical Efficiency of Indian Higher Educational Institutes

Course of Independent Study under Prof Rahul Nilakantan

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# Background

- Funding crunch in Higher Education in the public sector
  - Therefore, must use existing resources efficiently
- Pressure from the government to increase student intake in existing institutes and also opening new higher educational institutes
  - Do Higher Education Institutes experience increasing returns to scale?



# Research Question

- How technically efficient are Indian Higher Educational Institutes?
- Is there any efficiency difference between Public and Private HEIs?
- What is the nature of Returns to Scale that these institutes experience?

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# Methodology



# Data Envelopment Analysis (DEA)

- **Non-parametric, non-stochastic** method to estimate **production frontiers** (Production Possibility Curve)
- Used to obtain **technical efficiency** of units (**DMU**) by **comparison with peers**
- **OOTE**: Possibility of **increasing output** for a given level of input



# Output Oriented Technical Efficiency

Mathematically,

Each unit is compared to a linear combination of all other units. If  $X_i$  is input vector,  $Y_i$  is output vector,  $X_0$  and  $Y_0$  are input and output vector of target unit then TE of target unit is found by solving the following linear programming problem

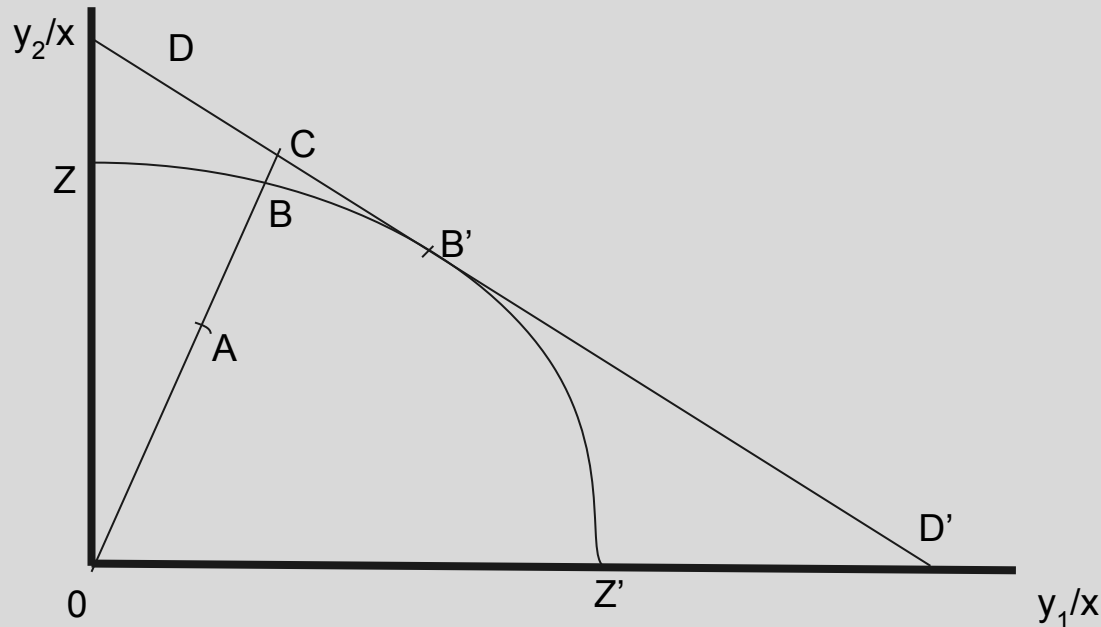
TE =  $\max_{\mu, \Phi_0}$  subject to

$$\sum_i \mu_i X_i \leq X_0$$

$$\sum_i \mu_i Y_i \geq \Phi_0 Y_0$$

Output efficiency score is  $1/\Phi_0$

# Output Oriented Model



- One input; Two output model
- TE of firm A is  $OA/OB$
- PPF shows different production possibilities by the unit



# Constant, Variable and Non-increasing RTS

RTS	Restriction on Weights ( $\lambda$ )
Constant	No restrictions
Variable	$\sum_i \lambda_i = 1$
Non-increasing	$\sum_i \lambda_i \leq 1$

Constant Returns to Scale	$TE_{CRS} = TE_{VRS}$
Decreasing Returns to Scale	$TE_{VRS} = TE_{NIRS}$
Increasing Returns to Scale	$TE_{CRS} = TE_{NIRS}$





# Data Source

- [National Institutional Ranking Framework \(NIRF\), Ministry of Human Resource Development 2018 Ranking](#)
- Top **50** units - trying to compare units of similar quality
- **Inputs:** Faculty, Expenditure (Capital+Operational)
- **Outputs:** Number of Graduates, Citations (Scopus), External Research Funding (Sponsored Research + Consultancy Earnings)

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# Results




# TE of Indian vs Australian Institutes

Mean TE of Indian Engineering Universities (VRS) = 0.85

Mean TE of Indian Management Universities (VRS) = 0.73

Mean TE of Australian Universities (VRS) = 0.95



# TE of Institutes of National Importance vs others

- No significant difference between average TE of public (0.62) and private (0.63) Management HEIs
- No significant difference between average TE of public (0.75) and private (0.76) Engineering HEIs
- Our results challenge the general perception that Private sector is more efficient than Government Sector
- Similar findings are observed on the financial sector (Kumar et al, 2013):
  - TE of PSBs varies from 0.828 to 0.955 and that of private sector banks varies from 0.877 to 0.940
  - Difference in the average TE scores between the above two types of banks is found to be insignificant except during the year 1999



## TE of Research Oriented vs Teaching Oriented Institutes

- Research oriented means (Students/SCOPUS) score exceeds median score
- No significant difference between Teaching oriented (0.59) and Research oriented (0.66) Management HEIs
- No significant difference between Teaching oriented (0.756) and Research oriented (0.76) Engineering HEIs
- Being research oriented or teaching oriented doesn't have an effect on efficiency just like Australian example (Abbott and Doucouliagos, 2001)



## Australian Universities: TE of Research Oriented vs Teaching Oriented Institutes

- For Australian universities
  - Teaching- mean - 0.963 , s.d- 0.077
  - Research- mean- 0.926, s.d- 0.155
  - P-value-0.344

The s.d. can be explained as Teaching Institutes follow the same pedagogy they have less variability and research institutes experiment, and therefore have more variability. *Both in case of India and Australia there is no significant difference between efficiency of teaching and research oriented Institutes.*



## Expansion: Returns to Scale (Management)

- **Constant:** IIT Bombay, IIT Roorkee (SoM)
- **Increasing:** IIM Udaipur, IIT Kanpur, IIM Shillong
- **Decreasing:** All other IIMs and IITs' SoMs (13 others)

Government shouldn't force Institutes for expansion as this would lead to resource wastage. Newer IIMs and IITs can have some degree of expansion though.



## Expansion: Returns to Scale (Engineering)

- **Constant:** IIT Madras, IIT Delhi, IIT Kanpur, NIT Durgapur, MNNIT Allahabad, NIT Calicut
- **Increasing:** IIT Hyderabad, IIT Indore, IIT Bhubaneswar, IIT Ropar, IIT Patna, IIT Gandhinagar, IIT Mandi
- **Decreasing:** All other IITs and NITs (13)

It makes sense for expansion only for newer IITs. They have a potential to expand intake.





# Limitations

- **No Quality Check:** There is no control or check on the quality of student output, i.e. the number of graduate student
  - Graduate students from IIT-B would not be same as those from newer NITs
  - No metric to assign quality - Lack of Data therein
- **Only Top 50 by NIRF Rankings**
  - To compare 'similar' institutes - too much deviance between 1st and 100th
  - Paucity of time - difficult to collect relevant data and then perform analysis
- Operational expenditure may be correlated with faculty strength



# Further Research

- **Stage two analysis:** why are technical efficiency values are what they are?
- Improving technical efficiency of Higher Educational Institutes
  - What steps to take?
  - How to maximise efficiency?
  - Which institutes should get more resources to improve?

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# Thank you!

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