## Research Question

The Production Possibility Frontier: A Microeconomic Perspective to Optimising Spare Capacity

## Research Method

This research domain will, broadly, require microdata about firms and their operations which includes important variables that will be used as covariates in determining causality towards the spare capacity metric. We have found an extensive and reliable set of data spanning two decades from the World Bank Group. From around 140 countries, the data from the 20 most populous countries will be used, because it is important to understand how increasing aggregate demand can be satisfied with the current resources available at disposal. This data will be paired by the Inflation data library from the same source.

Data wrangling will be the next procedure as datasets will be cleaned and merged to form one final point of analysis. We will use Double Lasso for the feature selection to choose appropriate covariates. Next, using these covariates, we will deploy novel causal ML methods such as meta-learners and generalized random forests. These methods will estimate an unbiased treatment effect for the treatment of our choice to the spare capacity. We will run these methods for different treatments to draw a holistic causal conclusion on our research question. Lastly, appropriate policy suggestions will be proposed in lieu of the findings and the data available, in order to optimise spare capacity in firms.

## Academic Context

Spare Capacity refers to the resources that are underutilised and therefore leading to lower output compared to if all the resources were being fully utilised. ‘Resources’ here indicates the quantity and quality of land, labour and capital.

Bogdan Vorotilin in their MA Economics Thesis from Kyiv School of Economics is one of the few researchers who formulates a quantitative model regarding the factors that can potentially affect production capacity (Vorotilin 2009). Although, the research is highly theoretical and does not make use of real time data to test whether the production capacity function can be mapped onto the real world statistics available. Nevertheless, the research proposes interesting ideas, particularly as to the way the technology boom has ever-changed the production processes across the world. Our paper adopts certain elements and considerations proposed in Vorotilin’s research such that the covariates chosen for the spare capacity analysis are indeed inclusive of those introduced in past literature.

Furthermore, in 2016, for researchers professors from Mumbai, India, published a paper in the IJERT, devising a capacity planning model for manufacturing organisations using Analytical Hierarchy Processing (Raundal Et. Al, 2016). The primary aim of the paper was to use AHP for allocating uniform workload across several different manufacturing plants in

India, and in turn also optimising the use of production capacity such that minimal resources are wasted. Ultimately, their research satisfied their aim and improved the overall supply chain and production processes. However, the research conducted mainly only focused on the construction company, Larson and Toubro, and its production in India. Another limitation was that the fundamental methodology was AHP which did not shed light on the individual factors which indeed enhanced the production capacity, and therefore, the findings of this research may not necessarily be applicable to other industries, countries or even supply chains.

Lastly, there is a significant amount of literature available that determines the factors affecting productivity, which may in turn optimise spare capacity. Assistant Professor Tezcan conducted nonparametric regression on data to infer the factors affecting productivity. Their findings indicate that return on assets and sales are found to be statistically significant. Yet again, the data used only analyses top 100 firms from Turkey, and only measures the relationship between variables and labour productivity, ruling out other factors of production and resource groups. Other research papers also analyse factors that affect productivity, but are focused specifically on one country and/or industry.

**How your research fits?**

This paper analyses spare capacity and the covariates affecting it. It is vital to investigate these variables because (i) in an aggregate sense, it informs us the potential increase in output without leading to inflationary pressure, and (ii) in a microeconomic sense, it aids decision making in individual firms as to investment in which areas of the business production change will lead to the highest increase in output. Despite these fundamental benefits to the economy and profitability of firms, there is no past research conducted that tests the variables affecting spare capacity using real world data.

As mentioned in ‘Academic Context’, a close substitute of spare capacity is productivity, for which there is plentiful literature available. Productivity measures the level of output per unit input. Yet, unlike spare capacity, it does not assume the number of input units to be constant in the short run. For instance, improving productivity may require reducing the number of workers and increasing the number of machinery; but the former cannot be a possible solution to reduce spare capacity, as spare capacity holds the assumption that number of inputs have to be constant.

Therefore, this research paper will be the first to investigate the aforementioned research domain and suggest firms and policy makers with ways to optimise the resources that they already have.

**Timeline**

Week 5 - finish detailed literature review + finish complete data loading

Week 6 - learn causal inference using machine learning

Week 7 - finish data analysis

Week 8 and 9 - write the first draft

Week 10 - finish second and final draft

Week 11 & 12 - complete publishing requirements

**Publication Goals**

I aim to publish my research paper in the Journal of Young Investigators. Since I am 18 and starting university in August, 2022, I am eligible for this journal. For the same, I will need to make a few changes in the format of my paper. I will need to include the following sections:

- Title page
- Abstract
- Author summary
- Introduction
- Materials and methods
- Results
- Discussion
- References
- Appendices
- Acknowledgements
- Conflict of interest/disclosure
- Figures and tables

The three main aspects that will be judged are scientific quality, quality in structure and writing.

https://www.jyi.org/submit/manuscript-requirements

**Roadblocks and Concerns**

One of the potential issues that I may face is the literature review process. This is because there is minimal research regarding factors affecting spare capacity and production capacity. To counter this problem, I may also have to purchase certain papers/articles or access them through an institutional email id.

Another major concern that I have is the level of sophistication of my quantitative analysis in my research such that not only is each method and process valid, but also consistently at the level of undergraduate studies. This is because my research paper will compete with those of

other undergraduates who are likely to have more experience and knowledge than I do. Since my research domain is fairly under-explored, it may give me an edge, however, I will have to put significant amount of effort doing the right things. For this issue, the guidance of my mentor is invaluable as he is experienced in the field of causal inference. I will also make sure to review my paper for grammatical errors, sophistication in writing and mathematical mistakes several times before publishing. Another potential solution is to examine the papers published by the journal previously and make sure to incorporate certain aspects in my research paper as well.