IO Analysis to Assess the Economic Impact of the Lock-Down to COVID-19

Some Notes

Tejal Kanitkar (Associate Professor, National Institute of Advanced Studies, Bengaluru)

These are notes detailing the analysis undertaken by me that has been published as a few article. The notes discuss the methodology used to do the IO analysis. The Excel Workbook also uploaded here can be downloaded to check the numbers.

This is work in progress and should not be circulated. It is uploaded here only to provide some details of the methodology and results from the IO analysis, as well as to get constructive feedback on the same.

Introduction

The COVID-19 pandemic has already caused severe impacts in some sectors and is likely to cause long-term economic slowdown across the world. This short analysis presents a measure of the potential economic loss as well as the economic package that would be required to overcome that loss. This analysis focuses on India.

Instead of a neo-classical CGE analysis, a standard Input-Output (IO) analysis is done here so that sectoral impacts and expenditures required can be separately categorized. Since the analysis is not one of forecast and only done for one year, the input-output coefficients are assumed to be valid. The non-substitutability limitation of the IO analysis does not play a major role here.

However, the latest IO table available for India published by the Ministry of Statistics and Programme Implementation is for the year 2007-08. The National Centre for Applied Economic Research (NCAER) has an IO table for the year 2013-14. However, the World IO Database[1]does has IO tables for 48 countries including India for years 2000 to 2014. It also has the Socio Economic Accounts for these years for India. So the WIOD (World Input Output Database) was used for this analysis.

IO 2014 to IO 2020

The IO table available from the WIOD is a 45 sector matrix.

From the IO table for 2014, the matrix of technical coefficients, [A] is calculated using equation 1. Then the standard Leontief matrix [L] is calculated using equation 2.

$$A = Z \times \hat{x}^{-1} \qquad 1$$

$$L = [I - A]^{-1} \qquad 2$$

Where Z is the matrix of intermediate consumption by each sector, x is the vector of total output from each sector, $\hat{x}$ is a square matrix with diagonal elements representing the total output.

A pro rata increase of 8% p.a. in the final demand between 2014 and 2020 is then assumed to get the final demand vector for 2020. The IO coefficients are assumed to be constant over this 6 year

[1] http://www.wiod.org/release16

period. Some adjustment is made manually in the major sectors to reflect the real growth in demand in these sectors (this is being validated and checked through other databases)

The GVA is the sum of the total compensation paid out to labour as well as capital in a given year. The labour to capital ratio (LC ratio) is also assumed to remain constant over this short time period.

With a 8% increase per annum in 'f', we get a new value of 'f', say f_{2020}. Using the standard Leontief equation, i.e. $x = L \times f$ we get x_{2020}. We can therefore calculate Z_{2020}, GVA_{2020} and create an IO matrix for 2020. The IO Table for 2020 thus calculated is shown in Table 3.

Losses from COVID-19

The next step is to estimate the total loss in output due to COVID-19. The estimates vary across different reports and there is it is difficult to arrive at a single consistent estimate of loss across sectors. In this analysis therefore four scenarios are presented based on the loss of working days in each sector.

The output is assumed to be uniformly produced across the year. Therefore a loss of working days can be translated to a total loss in the sector in value terms. This loss is an output loss (i.e. a Δx), but the standard linear IO analysis using the Leontief matrix requires a change in the final demand. The change in output is converted to a change in final demand using the methodology discussed by Miller and Blair (2009), i.e. dividing the total outputs vector by the diagonal L square matrix. The resultant Δf is the corresponding loss in final demand. This methodology has been used by Okuyama (2007, 2014) to estimate the economic impacts of natural disasters. With the new post COVID-19 estimations of loss therefore, a new IO can be constructed and GVA_{loss} can be calculated. The total loss in GVA in all four scenarios run (given in the Excel sheet) is shown in Table 1.

Table 1. Loss in GVA post COVID-19 In Three Scenarios

Scenarios	Average Loss of Work Days (Number)	Loss of GDP (Million USD)	Loss of GDP (Rs. Lakh Crore)	% Loss in GDP
Sc-1	13	196442	15	7%
Sc-2	27	392885	29	13%
Sc-3	47	684594	51	23%
Sc-4	67	969484	73	33%

The support that will be required therefore for any sort of recovery would be significant. To put the numbers in some perspective, in India's annual budget outlay, the revenue expenditure this fiscal year was expected to be approximately 347 Billion USD and capital expenditure approximately 56 Billion USD. Given the potential loss from COVID-19 the Government will have to significantly increase the expenditure on both fronts.

References

Miller, R. E., & Blair, P. D. (2009). *Input-output analysis: foundations and extensions*. Cambridge university press.

Okuyama, Y., & Santos, J. R. (2014). Disaster impact and input–output analysis. *Economic Systems Research*, *26*(1), 1-12.

Okuyama, Y. (2007). Economic modeling for disaster impact analysis: past, present, and future. *Economic Systems Research*, *19*(2), 115-124.