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How Far Can Macro-Economic Policies Help Revive India during the Pandemic? A Computable General Equilibrium Analysis

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Abstract

This study uses a computable general equilibrium model to analyse whether the economic relief package offered by the Indian Government to the affected parties during the COVID-19 pandemic had any lacunae or alternative policies and institutional arrangements could have been devised to minimise the economic losses caused by the pandemic in the country. The results reveal that existing economic relief packages saved a loss of almost 3 per cent in GDP. In contrast, spending 6 per cent of GDP as cash incentive to the producers would have resulted in only a 1 per cent fall in GDP. We argue that the pandemic raises transaction costs for the producer, and thus incentivising them will boost the supply of goods and services in the economy.

Keywords: COVID-19 pandemic, CGE model, Transaction cost, Indian economy, Fiscal policy

JEL Classification: C68, E62, I18, O53, D1, D2

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1. Introduction

The COVID-19 pandemic has created an unprecedented health and livelihood crisis for people around the world. Even three years after its outbreak, there is no sign of an end as new variants keep emerging. The world is now recognising the fact that COVID-19 has become an integral part of human life today and adaptation to it is the only feasible option. Although several vaccines against this virus have already been invented, and immunisation programmes are in progress across the world, maintaining physical distance and limiting economic activities still play an important role in reducing the spread of the virus. India is no exception to this phenomenon.

Initially, the Government of India had invoked the longest ever national lockdown from March to May 2020 to curb the spread of Coronavirus, and subsequently, several States in India also declared respective economic shutdowns. To help businesses tide over the adverse economic impacts of the lockdown, the Government of India had announced an economic benefits package worth Rs. 20 trillion in May 2020. This package was not only expected to compensate for the economic losses caused by the pandemic but also to incentivise the revival of economic activities in the country. In monetary terms, this relief package amounted to 10 per cent of India's Gross Domestic Product (GDP) during the fiscal year (FY) 2019-20. Of the total relief package, 60 per cent of the funds, equivalent to Rs. 12 trillion, were earmarked for fiscal incentives while the rest comprised monetary incentives. A disaggregated analysis reveals that of the total package of fiscal incentives, 41 per cent was allocated for agriculture, 20 per cent for transfer to households, 18.40 per cent for the other service sector, 8.45 per cent for industry, 4.43 per cent for construction, and the balance 7.72 per cent for medical services. Notwithstanding the incentives package, however, the GDP for India declined by 6 per cent in the fiscal year 2020-21 over the preceding fiscal year, 2019-2020. At the same time, the Private Final Consumption Expenditure (PFCE) and the Gross Fixed Capital Formation (GFCF) fell by 8 per cent and 11 per cent, respectively. As regards international trade, imports and exports fell by 11 per cent and 5 per cent, respectively, during the same period.

Critics have, however, argued that the new spending amounts to only 1 per cent of GDP, with the rest of the package comprising previously announced fiscal measures or interest subsidies on credit.[1] Apart from the debate about the effective level of support provided by the Government, the adequacy of the support offered is also a subject of debate. For example, Noble Laureate Professor Abhijit Banerjee has averred that the direct cash incentive component under the COVID relief package is insufficient for reviving the economy.[2] Other scholars, too, have pointed out the need to increase financial support during the pandemic, given the level of the financial crises faced by the poor, especially migrant labourers (Bhadra, 2021). In this context, the National Council for Applied Economic Research (NCAER) had suggested providing a separate package worth 3 to 5 per cent of GDP for ensuring faster revival of the Indian economy in the short run (NCAER, 2020). Analysts from the Bank of America, on the other hand,

[1] https://economictimes.indiatimes.com/news/economy/policy/indias-mammoth-covid-19-package-much-smaller-than-it-seems-says-fitch-solutions/articleshow/75823604.cms

[2] https://economictimes.indiatimes.com/news/economy/policy/india-among-worst-performing-economies-in-world-stimulus-inadequate-abhijit-banerjee/articleshow/78389453.cms?from=mdr

considered this relief package to be beneficial in the medium to long terms, even if it would not be able to mitigate financial distress in the short term.[3]

Given this backdrop, the question arises as to whether the Government's COVID relief package worth Rs. 20 trillion helped the Indian economy to minimise short-run economic losses caused by COVID-19. If the amount of the economic relief package was insufficient, what could have been the alternative options? Addressing the first question necessitates a counterfactual analysis within an economy-wide analytical framework. Our review of the literature (in Section 2) reveals that while economy-wide models implemented by various countries across the globe have been analysed in various studies, such studies are limited in the context of South Asia, in general, and India, in particular. However, since India has been severely affected by the pandemic, an economy-wide analysis on the Indian economy is critically needed. The economy-wide analytical framework considers linkages among various economic activities and therefore comprehensively explains how an exogenous impact on one activity transmits into other activities, thus providing an estimate of the economy-wide impact of various exogenous shocks on the economy. The Computable General Equilibrium (CGE) model built on the neo-classical theoretical foundation of economics is one of the most appropriate and rigorous tools for understanding economy-wide impacts of any shock. Therefore, the objective of this paper is to examine overall impact of COVID-19 on the Indian economy. A significant contribution of the paper is to unfold the COVID-19 relief package of the Indian economy and analyse the effectiveness of the relief package in compensating for economic losses in the short run. In addition, this study draws motivation from the study by Dasgupta, et al. (2020) to present the theoretical construct of the impact of COVID-19 on the Indian economy.

The paper unfolds as follows. Section 2 discusses the existing literatures on COVID-19 and identifies the key research gaps in the context of the Indian economy. Section 3 provides details of the methodology and the theoretical framework used in the study. The results from our analysis are presented in Section 4, followed by a discussion in Section 5 and presentation of the key takeaways in Section 6. The conclusion is delineated in Section 7.

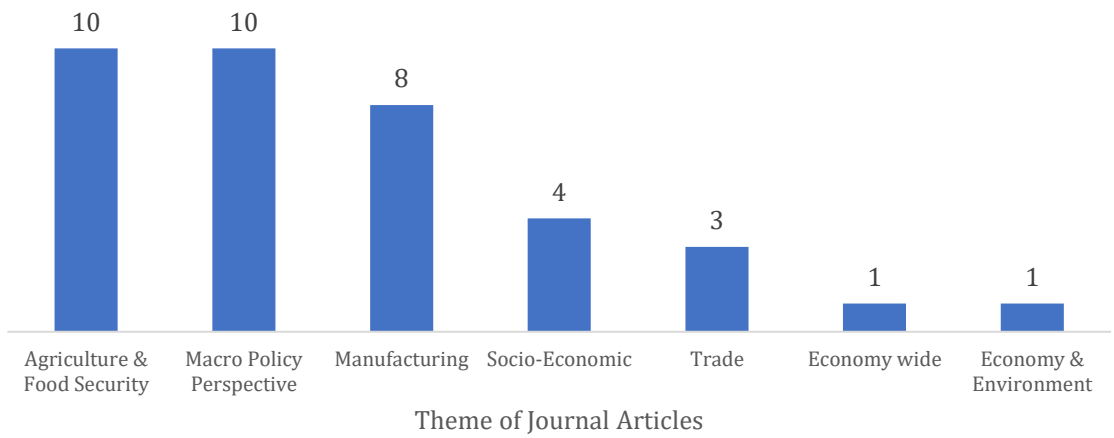
2. Survey of Literature

Our analysis of the existing academic work in this area in the context of India reveals that the literature published during the COVID-19 pandemic period is largely focused on individual sector-specific issues. Figure 1 provides an overview of the recent Indian studies on the pandemic.[4] In this figure, we have classified 37 journal articles focused on the Indian economy across different themes. As the figure shows, most studies have focused on the agriculture sector and the macro-economic policy perspective. The journal articles providing the macroeconomic policy perspectives are aggregate in nature as opposed to the articles offering an economy-wide analysis, which disaggregates the impact of macroeconomic policies across distinct economic activities. Figure 1 clearly indicates that only one journal article considers the economy-wide

[3] https://www.firstpost.com/health/coronavirus-outbreak-govts-economic-stimulus-package-wont-stop-gdp-from-contracting-in-fy21-says-analysts-8378481.html
[4] The list is not exhaustive.

issues for India. The detailed list of references corresponding to Figure 1 is given in Annexure 1 of this paper.

Figure 1: Selected 37 Journal Articles Focused on the Indian Economy (Published between April 2020 and December 2021)



Source: Compiled by the authors.

In contrast to the articles on India, the pandemic-related analyses for other countries have, by and large, employed an economy-wide framework. For example, Table 1 presents a list of journal articles related to the economic impact analysis of COVID-19 using the CGE modelling framework. As this table shows, countries like South Africa, the United States, the United Kingdom, Brazil, and China and those in sub-Saharan Africa have used the CGE model for their respective economies to analyse policy issues pertaining to COVID-19. In contrast, the only available CGE model-based study for the Indian economy does not provide an analysis of the impact of the policy package with respect to the major economic parameters (see Table 1). Therefore, the need for developing a CGE model to conduct an economic impact analysis of COVID-19 on the Indian economy and to simulate various alternative economic policies to compensate for the losses due to this pandemic is an important research problem. This paper fills this critical gap by constructing a model for the Indian economy incorporating the COVID-19 related shocks. Using a Social Accounting Matrix (SAM) for India for the year 2017-18, this CGE model has been applied to assess the impact of the Indian Government's COVID-19 economic incentives under the following four different policy scenarios: first, the possible impact of the COVID-19 relief package of Rs. 20 trillion on India's economic performance; second, the impact of a direct transfer of Rs. 6000 to 80 per cent of India's population in a year; third, the impact of an income stimulation package (as in the second scenario), coupled with a 50 per cent exemption in production tax; and fourth, the likely impact on the Indian economy if the government spends an amount equal to 6 per cent of the national GDP to provide cash incentives to producers for generating increased employment and concomitant outputs. Since there is ambiguity in terms of the length of the pandemic period beyond the year 2020, we have solved the CGE model for a given period by considering 2017-18 as the base year when there was no pandemic. Thus, this study considers a counterfactual

analysis to capture the economic impact of a stimulus package in both scenarios, with and without the occurrence of the COVID-19 pandemic. In addition, this study explores possible alternative policy options for the Indian economy by solving the CGE model corresponding to alternative policy scenarios.

Table 1: Selected Journal Articles on the CGE Model and COVID-19

Authors	Focus Country	Key Indicators for Capturing COVID-related Shocks
Chitiga-Mabugu, Margaret, et al. (2020) *South African Journal of Economics*	South Africa	Productivity World price Remittances Transport cost
Peter B. Dixon et al. (2021), *The Australian Journal of Agricultural and Resource Economics*	USA	Seasonal labour shortage Agriculture and the pandemic
M. Keogh-Brown, M.R. et al. (2020), *SSM - Population Health*	UK	Labour shortage
World Bank (2020)	Countries in sub-Saharan Africa	Productivity FDI Tourism Labour Supply Capital utilisation
Warwick McKibbin et al. (2020), Economics in the Time of COVID-19	Global	Generic assumptions on the pandemic Different intensities of the spread of the virus
Porsse, A.A. et al. (2020), *Regional Science Policy & Practice*	Brazil	Labour shortage
Qi Cui (2021), Transport Policy	China	Inefficient transport sector
Pradhan et al. (2021), *Energy Economics*	India	Productivity shock due to COVID-19, UNFCCC commitments

3. Approach and Methodology

Between April 2020 and May 2020, the Government of India imposed a nationwide lockdown, which led to wide-ranging direct and indirect impacts on the economy. Most significantly, this created supply disruptions leading to an increase in costs associated with the production system. This was because producers were required to pay extra incentives to labourers to motivate them to continue their duties in the face of heightened health risks and restrictions on people's mobility. In addition, the producers needed to pay wages to permanent employees even when production had come to a standstill. Furthermore, due to restrictions on the transportation of non-essential commodities, there was an increase in logistics costs for the movement of non-essential commodities. All these factors led to a rise in costs of production and

distribution of non-essential commodities, because of which many producers suspended their production processes until the Government partially lifted the lockdown measures. Even after lifting of the lockdown, the affected labour force was out of work for at least 14 days.

Apart from the constraints to domestic trade, international trade was also disrupted due to the global economic shutdown measures initiated to curb the spread of the virus. On the other hand, health and medical services, and pharmaceuticals were rightly kept out of the purview of lockdown, and they functioned to their full capacity to meet the increased demand for health products and services. It is reasonable to assume that the productivity of health and medical services, and the pharmaceuticals sector rose during the pandemic to cope with the rise in demand for these products and services.

As far as the impact of the pandemic on the household's budget is concerned, the share of health expenditure in the total expenditure by households was expected to rise as compared to the 'no pandemic' situation. The restricted mobility and restrictions on social contact implied that the autonomous consumption expenditure of the households would fall. For example, the expenditure incurred by households on tourism and entertainment, which depends on the mobility of the household members, fell due to the cessation of these activities and the closure of transport services during the lockdowns. Moreover, a large section of the households faced loss of livelihoods due to the nationwide lockdown and the Government's policy to create containment zones in the pandemic-affected areas. According to a report by the Reserve Bank of India, a section of the households had to monetise their assets for consumption smoothening during FY 2020-21 (RBI, 2021).

Keeping these realities in mind, we have introduced certain assumptions in our model, and Table 2 describes these assumptions regarding additional costs incurred by various sectors of the Indian economy. The levels of the costs have been estimated based on the extent of shutdown of the activities initiated by both the Central and State governments in India. In India, the Central Government had imposed a complete shutdown of non-essential activities at the national level for about 66 days starting from 25 March 2020 till 31 May 2020. Subsequently, the State governments had prepared guidelines to lift lockdown measures in different phases. As a result, the smooth functioning of the economy was disrupted through most of FY 2020-21. We have conducted a systematic review of various government orders to estimate the sector-specific additional costs based on the length of the economic shutdown during FY 2020-21. For example, if the length of lockdown for an activity was two months (covering 16 per cent of the time in a year), we have assumed an additional production and distribution cost of about 16 per cent for that activity, and so on.

Table 2: Sector-specific Assumptions for Transaction Costs due to COVID-19 and the Economic Shutdown

Sectors	Level of Impact	Transaction Cost (% of Factor Payment)
Agriculture and allied sector	Not affected directly as it falls under the essential category.	0%
Mining and quarrying	Not affected directly as it falls under the essential category.	0%
Food processing industries	Not affected directly as it falls under the essential category.	0%
Tobacco, textiles, leather, paper, printing, metallic and non-metallic manufacturing, vehicle, other non-medical equipment manufacturing, hotel, and business services	Affected due to complete closure of production in the first quarter of 2020-21.	25%
Construction, retail, and wholesale trade	Affected due to complete closure of production beyond the first quarter of 2020-21.	33%
Energy and utility services	Not affected.	0%
Road and rail transport	Assuming closure for 60 days out 365 days in a year	16%
Air transport, ownership of dwelling unit, other households' services	Affected due to complete closure of services beyond the first quarter of 2020-21.	49%
Water transport	Sea transport for international trade was not affected but inland passenger transport was affected.	8%
Restaurant, Storage, legal and consumer services	Dine-in services were suspended in the restaurants but home delivery of essential food was allowed.	16%
Social and community service	Social gathering and entertainment services were suspended beyond the period of the first complete lockdown.	32%
Communication, financial, insurance and education services	No affected due to virtual mode of operation.	0%

Source: Authors' estimate.

In addition to the above-mentioned production and distribution costs, changes have occurred in the consumption pattern and prices as well, some of which are quantified by us using appropriate data sources (see Table 3).

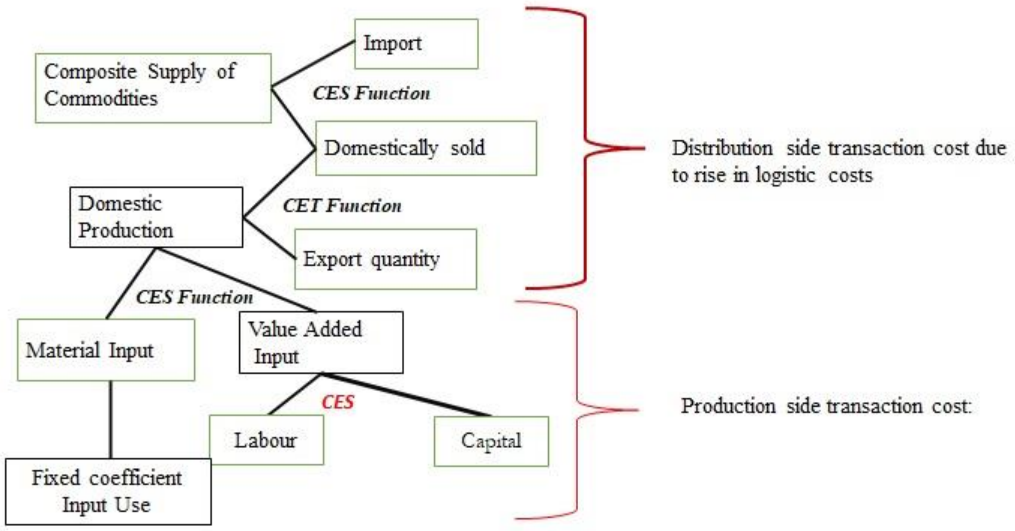
Table 3: Quantifying Other Channels of Impacts of COVID-19 in India

Channels	% Change as Compared to the no-COVID situation	Rationale of Assumptions
Autonomous consumption of households	1. 100% increase in the consumption of medical services and pharmaceutical items 2. 16% fall in textiles, leathers, non-essential manufacturing items 3. 25% fall in consumption of transport, hotel, and business services 4. 36% fall in social and personal services	The Google mobility data for Indian households between April 2020 and March 2021 provides the percentage change in people's mobility for different purposes between the normal and pandemic periods.
Logistic costs of cargo movement	1. 5% increase in logistic cost for essential commodities and 10% for non-essential commodities while moving domestically. 2. Logistic cost of international trade increases by 25%	Although goods transport was allowed, due to imposition of containment zone measures by local governments, the time taken for transportation showed an increase. Shortage of labour at various places also increased transport costs. Since the time required for the international movement of goods was higher than that for domestic movement, the logistics cost of international trade was higher for international trade than for domestic trade.
The world price of commodities	1. 5% increase for cereals, pulses, and vegetables 2. 17% increase for oilseeds 3. 1-3% fall in non-food crops, including tobacco and fibres 4. 1% fall in livestock products, including dairy and meat 5. 9-20% fall in mineral fuel prices 6. 1-3% fall in prices for leather and textile products 7. 18% increase in prices of machinery and equipment 8. Average 6% increase in the price of electronics and other manufacturing items.	Estimated using World Bank's commodity outlook data. Compare World Price Index for Commodities between 2019-20 and 2020-21 to capture the impact of COVID-19 on world prices.

Source: The authors.

In our model, we have captured the impacts of the above-mentioned channels by changing the values of the relevant parameters. Our model, built in the tradition of the IFPRI standard CGE model, follows a nested production function approach to build an algebraic system.[5] We have depicted a few elements of our CGE model (Figure 2) to highlight how various channels of the impact of COVID-19 are embedded into the working of the model.

Figure 2: Incorporating transaction costs in the nested Production structure of CGE model



Source: Authors.

Figure 2 describes the nested production structure of our CGE model, which contains three blocks – the value-added production bock, the export production block, and the composite block. The algebraic equations for each block are derived from the profit maximisation principle and three algebraic equations, in particular, have been considered, viz., the aggregate production/supply function of a commodity, the zero-profit condition, and the first-order condition for profit maximisation. As Figure 2 shows, the production costs due to extra payment for factors of production are included in the value-added production block while the distribution costs due to increase in the logistics costs are included in the export and import blocks of the nested production structure. Additionally, we have added the additional logistics cost during the domestic movement of goods, which has a direct impact on the prices of domestically sold commodities.

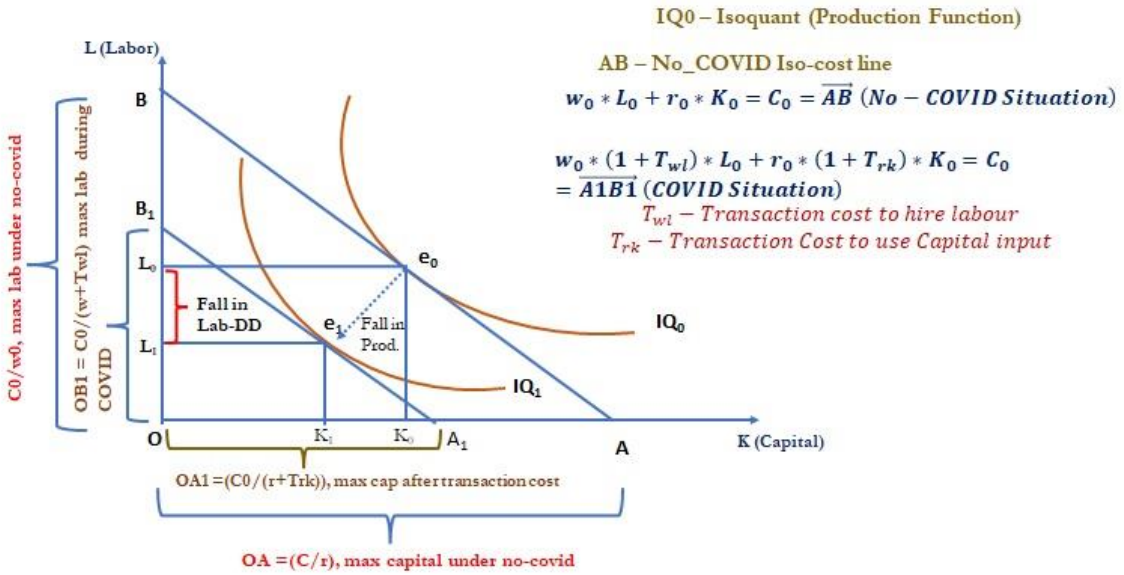
3.1. A Theoretical Construct

Before moving on to the empirical exercise, we attempt to provide a simple theoretical framework using the standard neoclassical theory. Figure 3 illustrates how COVID-19-led additional production costs impacted the economic behaviour of the producer. In Figure 3, we have drawn a typical production function by measuring

[5] See Lofgren et Al. (2002) for details of the structure of the IFPRI model.

capital (K) input on the horizontal axis and labour (L) input on the vertical axis. The IQ_0 curve represents an isoquant that describes imperfect substitution between labour and capital to produce a constant level output, say Q_0. Line AB is defined as an iso-cost line that satisfies the zero profit (revenue = cost) condition for the producer. The point e_0 is the producer's equilibrium point, as it satisfies the profit maximisation condition of the producer (i.e, the iso-cost line is tangent to the isoquant curve). Under a no-COVID situation, the horizontal intercept OA of the iso-cost line AB measures the maximum amount of capital that can be employed, given that the total cost budget of the producer is C_0 and that no labour is employed. Similarly, the vertical intercept OB is the maximum amount of labour that can be employed in the absence of capital, given the same total cost budget for the producer (i.e., C_0). Since the COVID-19 led economic shutdown imposes unexpected costs on the producer, the cost of hiring labour and capital increases. In Figure 3, we have defined T_{wl} and T_{wk} as the rates of additional costs on labour and capital due to the administrative restrictions imposed by the government during the pandemic. Now given C_0, the maximum amount of labour and capital will be less than if the labour could be hired under a no-COVID situation. As a result, both the vertical and horizontal intercepts of the iso-cost line decline to OB_1 and OA_1, respectively, and the new iso-cost line will be A_1B_1, implying a downward shift. Therefore, following the principle of profit maximisation, the new equilibrium will be obtained at point e_1. At the new equilibrium, the total output, labour, and capital in the economy will be lower than what they were in the pre-COVID situation.

Figure 3: Impact of Transaction Costs on Production – A Theoretical Perspective



Source: The authors.

The same graphical presentation can be adopted for the export production block and the composite output supply block of our CGE model. In the case of the export production block, the curve IQ_0 will be a locus of different combinations of export and domestic sales quantities such that total production remains the same across that curve. In other words, the IQ_0 can be called the output transformation curve under the export

supply block of Figure 2. The line AB will be called the market revenue curve, where the market revenue to the producer will remain the same corresponding to the different combinations of export and domestic sales quantities. The slope of this line will be the ratio of the domestic and export prices of the quantities. Finally, the tangency point e_0 will determine the equilibrium combination of the export and domestic sale. Now since the COVID-19-led economic shutdown causes a fall in production (as observed in Figure 3), the output transformation curve will shift downward and as a result, the total market revenue will also fall. Further, the COVID-19-led national economic shutdown and the containment measures imposed by the local governments across the various States in India increased the logistics time and costs. As a result, the domestic and export prices of the commodities were affected differently and hence the market revenue curve did not shift parallelly downward. In summary, COVID-19 caused a fall in domestic production, which in turn, reduced the export supply and domestic sale in the economy, but the rates of fall in exports and domestic sale were different due to the differential impact logistic transaction costs on their prices.

Again, in the case of the composite supply block, the curve IQ_0 of Figure 3 can be treated as the Armington composite output curve, which is a locus of different combinations of the domestically produced output and import (Lofgren, et.al., 2002; Armington, 1969). Along this curve, we observe the substitution between the import and domestic sale of a commodity. The line AB can be defined as the absorption of the total domestic spending on a commodity. In the standard CGE model, absorption is expressed as the sum of spending on domestic output and imports at a demand price that includes the cost of trade. Therefore, in this case, the slope of the line AB will be the ratio between the import and domestic price of the commodity. The tangency point e_0 will determine the equilibrium composition of import and the domestically produced quantity of the commodity.

COVID-19 affected not only India but also disrupted the entire global economy, which in turn, caused a rise in logistics costs associated with trade. Simultaneously, spending by the domestic consumer showed a decline due to the economic shutdown. These factors led to a downward shift of the absorption line (i.e., the AB line shifted downward to A_1B_1). As a result, the composite supply curve also shifted downward for obtaining the new equilibrium composition of domestic and imported commodities. Again, the position and slope of the absorption line depends on the extent of the fall in domestic spending and the changes in domestic and import prices due to the presence of transaction costs. An autonomous fall of exports from other countries to India was also experienced due to the disruptions caused by the pandemic in those nations. Since this model is a single country model, we have assumed foreign saving as an exogenous variable and that the flexible exchange rate ensures balance in external transactions. According to national accounts statistics, the foreign savings in India fell by almost 65 per cent during the FY 2020-21. This fall in foreign savings was accounted for in our model to capture the impacts of disruptions in the rest of the world on India. Thus, in summary, the COVID-19 pandemic caused an autonomous fall in the composite supply of commodities and the prices of commodities in both the domestic and international markets increased due to the rise in the cost of trade.

After presenting the simple theoretical construct, we next move on to the empirical equations.

3.2. The Empirical Model

In our CGE model, a household's demand is represented by a linear expenditure system (LES) derived from the maximisation of the Stone-Geary utility function (for details, see Blonigen et al., 1997, pp. 223-225, and Dervis et al. 1982, pp. 482-485). The algorithm for the demand function of the households is given in Equation (1) in Box 1. There are two parts to Equation 1: first is the subsistence or autonomous consumption, which is independent of the level of income; in the second part of the equation, consumption is proportionately linked with income. The autonomous consumption levels have been calibrated using estimates of income elasticity, the item-wise consumption share, and the Frish parameter. As explained in Table 3, autonomous consumption fell due to the lower mobility of the households. To capture this phenomenon, we have re-calibrated the consumption function by changing the item-wise consumption shares of different household groups. Further, the incomes of households also fell due to a decline in the domestic production and supply of commodities, as explained in Figure 3, and this phenomenon has been captured endogenously using an iteration process.

Box 1: Households and Government Demand Functions

$$E_i = P_i * \Upsilon_i + \beta_i (E - \sum P_i * \Upsilon_i) \qquad \text{Eq. (1)}$$

Υ_i subsistence level of consumption expenditure (Exogenous in the Model)

(Parameter of interest for demand side effect of COVID)

B_i Marginal Budget share

$\sum B_i = 1$, Engel aggregation condition

$\Upsilon_i = E * (\alpha_i - \beta_i) /$ Frisch

The closure rules of CGE models vary depending on the purpose of the study. Box 2 outlines the closure rule for our model.

Box 2: Closure Rule for Macroeconomic Constraints

Government	Rest of the World	Savings-Investment
Fixed government savings and fixed direct/indirect tax rate	Fixed foreign savings and flexible exchange rate	Flexible capital formation; fixed marginal propensity to savings for all non-government institutions

Source: Compiled by the authors.

The Social Accounting Matrix (SAM) for the Indian economy for the fiscal year 2017-18 has been used as the primary database for our CGE model. Ours is a static CGE model with the base year 2017-18. This SAM considers 111 economic activities and commodities, disaggregates households into expenditure quintile classes, and further classifies each quintile class into rural farm, rural non-farm, and urban households. The detailed description of this SAM is available in Pal et. al. (2020).

In a standard CGE model, most of the equations have four components—endogenous variables, elasticity parameter, share parameter, and shift parameter. The SAM provides data for initial values of all endogenous variables and the share parameters relevant for the algebraic equations of the model. The elasticity parameters of various equations are obtained from published literature and the shift parameters are calibrated using the share and elasticity parameters. As the SAM available for India is for the year 2017-18, we have calibrated our CGE model in such a way that it replicates the SAM of 2017-18. Moreover, since the year 2017-18 is a no-COVID year globally, the results for the year 2017-18 have been considered as the basis of our COVID-19 impact and the subsequent policy analysis for the Indian economy. Although the year 2018-19 was another no-COVID year, no SAM was available for the Indian economy for that year. However, we have compared the technological patterns and economic structure between 2017-18 and 2018-19 to check any significant inconsistencies in selection of the base year of our analysis. In Table 4, we have presented value added to the output ratio as a measure of technological change and the sector-specific share of value added in the total GDP at factor cost as the structure of the Indian economy for the years 2017-18 and 2018-19. As we do not find any significant variations between the two years, the selection of 2017-18 as the base year of this analysis is justified.

Table 4: Technological Pattern and Structure of the Indian Economy between 2017-18 and 2018-19

Aggregate Sectors of the Indian Economy	**VA/Output Ratio Describes the Technology Pattern**		**Structure of the Economy**	
	2017-18	**2018-19**	**2017-18**	**2018-19**
Agriculture, forestry and fishing	78%	78%	18%	18%
Mining and quarrying	61%	63%	2%	2%
Manufacturing	25%	23%	17%	16%
Electricity, gas, water supply and other utility services	35%	35%	3%	3%
Construction	36%	36%	8%	8%
Trade, hotels, transport, communication, and services related to broadcasting	69%	68%	19%	19%
Financial, real estate and professional service	43%	43%	20%	21%
Public Administration, defence, and other services	72%	73%	14%	14%
Total	N.A.	N.A.	100%	100%

Source: Estimated by the authors.

4. Policy Scenarios

This study has used a static model with which we have conducted a counterfactual analysis with and without factoring in COVID-19 shocks to the economy. Additionally, we have simulated this model for various alternative COVID-19 relief packages for the Indian economy. Table 5 provides a detailed description of various

analytical scenarios and the associated assumptions made to solve this static model. As mentioned in the table, the first two cases present the no-COVID and COVID-shock scenarios that provide a context for the extent of the impact of COVID-19 on the Indian economy. In the third scenario, we have solved the CGE model with the Rs. 20 trillion COVID-19 relief packages announced by the Government of India during the period April-May 2020. On the other hand, we have proposed and explored the last three scenarios as alternatives to the Rs. 20 trillion economic relief packages of the Government of India. The results corresponding to these analytical scenarios have been delineated after the table.

Table 5: Analytical Scenarios

Scenario	**Descriptions**
Base Run	No_COVID-19_Threats
Scenario 1: COVID Shock	❑ Almost 10% of working hours lost due to sickness and quarantine. ❑ Increase in the cost of production due to the shutdown–the sector-specific assumption is given in Table 2. ❑ Increase in transportation time for products – described in Table 4. ❑ Double medical expenses for households & fall in autonomous consumption of non-essential commodities due to low mobility (Rural HHs Mobility fall by 14%; Urban Households by 32%) and households' savings (fall by 5%)–described in Table 4. ❑ 50% fall in productivity of trade and transport sector and 100% rise in medical and pharmaceuticals sectors. ❑ Fall in foreign savings by 65%.
Scenario 2: COVID + Rs 20 trillion Package	The fiscal stimulus under the COVID relief package announced in May 2020 can be classified into the following broad economic instruments: ❖ Interest subsidy (78%) ❖ Wage Subsidy (8%) ❖ Income transfer (13%) ❖ Medical Expenditure (1%) The monetary policy under the COVID relief package is treated as an increased capital supply. ❖ 4% of No-COVID GDP is treated as additional capital supply to the economy.
Scenario 3: COVID + Income Stimulus	Total 6.43 trillion fiscal stimuli that include: ✓ Households' income transfer Rs. 6000/capita/year to the bottom 80% of households (Rs. 6.24 trillion) ✓ Medical and food distribution same as previous scenario (0.19 trillion packages) ✓ No other subsidies The monetary policy remains intact.
Scenario 4: Scenario 4 + Income Stimulus Plus Reduction in	Total 7.64 trillion fiscal stimuli that include: ✓ Households' income transfer Rs. 6000/capita/year (Rs. 6.24 trillion) ✓ 50% exemption in Production taxes (Rs. 1.2 trillion) ✓ Expenses on medical and food distribution (Rs. 0.19 trillion)

Production Taxes	
Scenario 5: COVID + Production-linked Incentive	✓ Spent Rs. 12 trillion (6% of GDP) on wage and capital payment subsidy to reduce transaction cost to the producer. ✓ Expenses on medical and food distribution (Rs. 0.19 trillion)

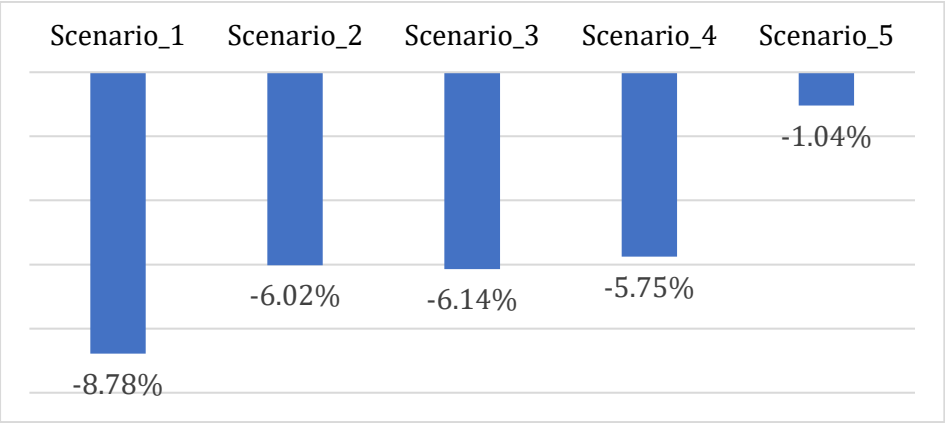
Source: The authors.

5. Analysis of the Results

5.1. Impact on GDP

Figure 4 reveals that without government intervention, India's GDP could have fallen by almost 9 per cent due to COVID-19 led disruptions in economic activities (Scenario 1), but instead fell by 6 per cent after the initiation of the Rs. 20 trillion economic relief package (Scenario 2). Our model shows that if the government had alternatively intervened with the household's income stimulus package (i.e., Scenario 3), the GDP would have fallen almost at the same rate (i.e., 6.14 per cent). Further, we find that if the government had exempted 50 per cent of the production taxes (e.g., excise duty to the producer embedded in GST since 1 July 2017) along with the income stimulus package for households (i.e., Scenario 4), the fall in GDP would have been 5.75 per cent, which would have created no significant boost to the economy. However, if the government had spent Rs. 12 trillion (which is equivalent to the fiscal portion of the stimulus package) to provide production-linked cash incentives to producers (i.e., Scenario 5), the loss to the Indian economy would have been only 1 per cent of its GDP during the pandemic (see Figure 4), which is markedly lower than in the other scenarios discussed.

Figure 4: Impact of COVID-19 and Alternative Relief Packages for the on Indian Economy



Source: Computation and analysis of the CGE Model.

5.2. Sectoral Impacts

Since the CGE model is an economy-wide one, we have solved it to estimate the impact of COVID-19 on sectoral Gross Value Added (GVA) for the Indian economy and the results are given in Table 6. As observed from the table, all the sectors except that of medical services would have recorded a fall in their GVA due to the COVID-19-led economic disruptions and without any government interventions to minimise economic losses (see scenario 1 in Table 4). In this scenario, the greatest losses in value added are estimated in the mining (30 per cent), petroleum (23 per cent), hotels and restaurants (21 per cent), and forestry (18 per cent) sectors. Since the economic shutdown led to non-operation of various non-essential economic activities during 2020-21, the demand for fuel had also declined, which reduced the demand for the mining sector's output. As a result, we have found a significant contraction in the GVA of the mining and petroleum sectors, even though these sectors were exempted from the lockdown. Similarly, the forestry sector remained exempted from the lockdown, but the closure of construction activities, and the paper, furniture, and other industries that used forestry products as inputs caused a significant decline in the GVA of the sector. On the other hand, the contraction in the hotels and restaurant sector was largely due to the direct impact of the lockdown. It is also interesting to note that due to the COVID-related shock and without any government intervention (i.e., Scenario 1), the agriculture and livestock sectors faced losses in their GVA by 3.35 per cent and 0.7 per cent, respectively, despite also being exempted from the lockdown (see Table 4). This fall has been postulated as the result of limited market access and contraction of demand in the other sectors in the economy. However, in the relief package, the government allocated a large share of its fiscal stimulus for agriculture, livestock, micro food enterprises, and other micro and small industries, which resulted in a positive impact on agriculture (2.32 per cent), livestock (6.05 per cent), pharmaceuticals (4.26 per cent) and the medical sector (9.72 per cent) (see Scenario 2 in Table 4). These four sectors also observed a growth in GVA across the other alternative economic package scenarios outlined in this study (see Table 6). However, the production-linked cash incentive to the producer is estimated to be effective in reducing the loss in GVA across various sectors in India (see Scenario 5 in Table 4). Moreover, the residual 'other services' sector registered a positive change (0.09 per cent) in GVA due to the production-linked incentive package.

Table 4: Impact of COVID-19 and Alternative Economic Relief Package on Sectoral Performance

	Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**	**Scenario 5**
Crop sector	**-3.35%**	**2.32%**	**4.52%**	**5.20%**	**3.85%**
Livestock and fisheries	**-0.70%**	**6.05%**	**10.26%**	**12.33%**	**10.95%**
Forestry	-18.28%	-16.14%	-16.24%	-16.09%	-13.92%
Mining	-29.92%	-28.86%	-32.72%	-32.85%	-28.52%
Food processing	-7.98%	-3.71%	-0.05%	0.53%	0.70%
Tobacco and beverages	-14.91%	-11.84%	-8.56%	-7.94%	-5.00%
Textiles and leathers	-12.51%	-9.24%	-6.04%	-5.48%	-2.33%

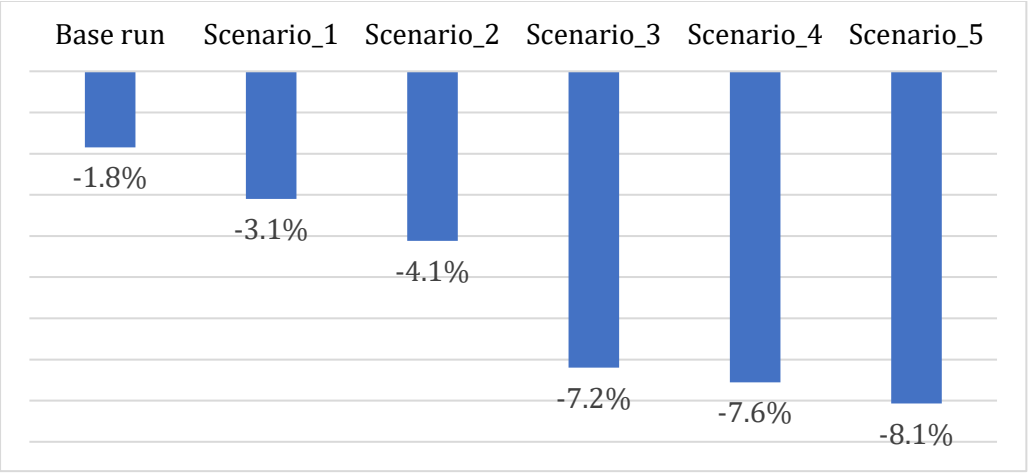
Petroleum and gases	-23.53%	-21.53%	-22.27%	-21.98%	-17.49%
Pharmaceuticals	**-0.14%**	**4.26%**	**4.64%**	**5.32%**	**9.11%**
Chemical	-8.42%	-5.55%	-5.78%	-5.46%	-2.12%
Electricity	-18.00%	-16.03%	-17.42%	-17.18%	-11.88%
Construction	-9.00%	-8.12%	-16.86%	-17.24%	-8.61%
Other manufacturing	-12.06%	-10.93%	-16.65%	-16.90%	-7.88%
Trade and transport	-8.23%	-5.56%	-5.48%	-5.12%	-0.66%
Hotels and restaurants	-21.14%	-18.95%	-18.96%	-18.50%	-13.31%
Medical	**3.91%**	**9.72%**	**10.42%**	**11.36%**	**16.61%**
Other services	-8.99%	-7.15%	-8.39%	-7.86%	0.09%

Source: Computation and analysis of the CGE Model.

5.3. Impacts of COVID-19 on the Fiscal Deficit

Figure 5 presents the estimated fiscal deficit of the Indian economy under various scenarios. This figure shows that without the COVID-19 pandemic, the fiscal deficit of the government of India would have remained at around 2 per cent of GDP but it increased to 3 per cent due to COVID-19-led economic socks (see the Base Run and Scenario 1 in Figure 5). The fall in tax revenue of the government due to the pause in several activities led to an increase in the fiscal deficit of the government. Although there was a provision for a large fiscal incentive to producers and consumers under the actual relief package, the fiscal deficit was 4 per cent, which is not as large as expected given the apparent size of the package (see Scenario 2 in Figure 5). However, we observe fiscal deficits in the range of 7-8 per cent of GDP under the last three alternative packages where we propose a direct cash transfer either to boost the income of the households or to incentivise producers to produce more (see Scenarios 3-5 in Figure 5).

Figure 5: Fiscal Deficit (% of GDP Base Year 2017-18)

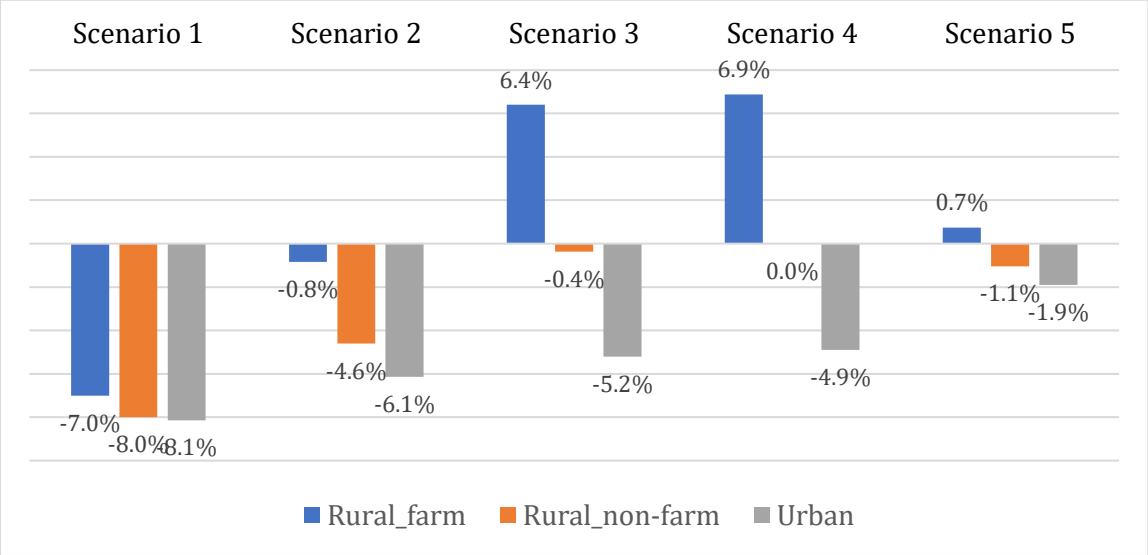


Source: Computation and analysis of the CGE Model.

5.4. Impacts of the Relief Package on Household Income

In Figure 6, we have presented the impact of the COVID-19 shock and the associated alternative relief packages on the incomes of households in India. This figure shows that the group of rural farm households faced a 7 per cent loss in income, while the COVID-induced loss was estimated to be 8 per cent for rural non-farm and urban households, and without any government intervention, i.e., Scenario 1 in this study. The government's relief packages helped reduce the loss in incomes of rural farm households to 0.8 per cent, and that of rural non-farm households and urban households to 4.6 per cent and 6.1 per cent, respectively (see Scenario 2 in Figure 6). On the other hand, the income stimulus packages (i.e., Scenarios 3 and 4) would have led to a gain of 6-7 per cent in the incomes of rural farm households. These relief packages also minimised the loss in the incomes of rural non-farm households to 0.4 per cent under Scenario 3, and no loss in income under Scenario 4. On the other hand, urban households still faced loss in their incomes by almost 5 per cent even with the Government's income stimulus packages (i.e., under Scenario 3). With a production-linked incentive package (Scenario 5), rural farm households achieved an increase of 0.7 per cent increase in income during the pandemic period, and the losses in income among rural non-farm and urban households were 1 per cent and 2 per cent, respectively (see Figure 6).

Figure 6: Impact of Alternative Scenarios on Households' Income

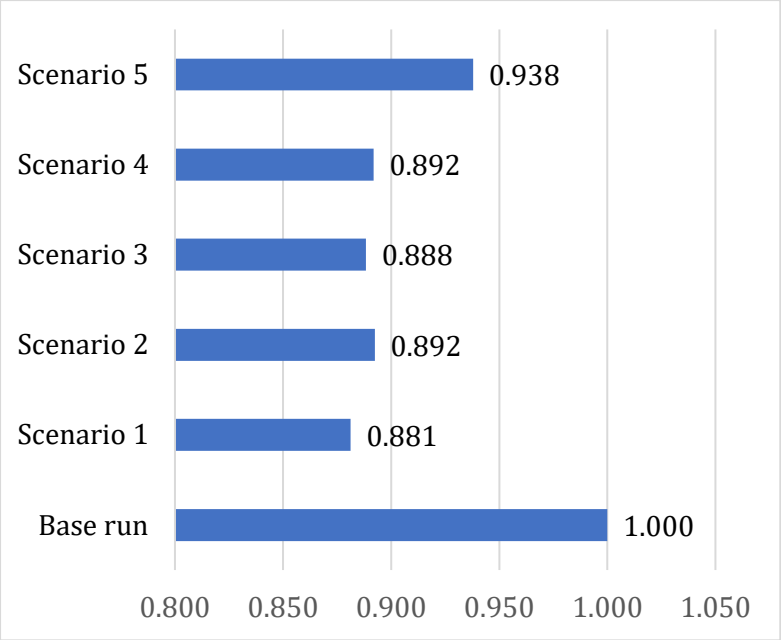


Source: Computation and analysis of the CGE Model.

The loss in households' income is linked with a rise in unemployment perpetrated by the lockdowns. Since the theoretical foundations of CGE model are based on neoclassical economics, unemployment is assumed to be non-existent. Instead, this model assumes a flexible wage to maintain equilibrium in the labour market. The standard CGE model solves for a Real Wage Index, which is 1 corresponding to the base case, and this implies that labour demand is equal to labour supply. Therefore, if model results in a Real Wage Index that is less than 1, it will imply the presence of excess

labour supply in the market and that workers are willing to work at a lower wage so that they get some income instead of being totally unemployed. Similarly, a Real Wage Index greater than 1 implies that labour demand is higher than labour supply and that producers will pay higher wages. Therefore, the Wage Index obtained from the CGE Model can be used as an indicator of employment and unemployment corresponding to various alternative policy scenarios. In Figure 7, we have explained the Model's estimated Real Wage Index of the Indian economy corresponding to the COVID-19 shock and various alternative economic relief packages scenarios. As this figure exhibits, the Real Wage Index fell by 0.88 due to the COVID-19 shock, which implies a 12 per cent fall in labour demand as compared to the no-COVID situation. The Rs. 20 trillion economic relief package (Scenario 3) resulted in the Wage Index value rising to 0.89, signifying a marginal improvement over Scenario 2. The Real Wage Index also hovers around 0.89 under Scenarios 4 and 5. In contrast, the Real Wage Index stabilises at 0.94 in Scenario 6, which implies a 6 per cent lower demand for labour in the market in comparison to the base situation (Scenario 1).

Figure 7: Impact of Alternative Relief Packages on the Wage Index



Source: Estimated by the authors.

It is evident from the results that the Indian economy contracted significantly due to COVID-19. The model predicted an almost 6 per cent contraction in GDP in India during FY 2020-21, which is approximately equal to the official estimate by the Central Statistical Office of India. Further, the trends in sectoral GVA due to this pandemic are akin to the official estimates for the broad sectors of the Indian economy. The detailed official estimates are given in the Appendix to this paper. As this model is a static model which solves for the base year (No-COVID year) 2017-18 and considers 2020-21 as a COVID-shock year, it is difficult to compare the model results with the official data in absolute terms. However, our estimated pattern of the impact of COVID-19 across economic activities closely mimics official data for the Indian economy for the year 2020-21. This implies that the assumptions related to COVID-19 and the existing

economic relief package are consistent with reality. The key takeaways from our analysis have been discussed in the next section.

6. Key Takeaways

First, despite several critiques of the existing Rs. 20 trillion economic relief package, we can argue that the package helped to stimulate the economy. The lower Real Wage Index implies that many economic activities are not operating at their full capacity, which is causing a scarcity of labour demand. The fiscal deficit burden of the government has increased from 1.8 per cent to 4 per cent of GDP after the advent of the sizeable economic relief package. However, it must also be noted that the GDP under the Rs. 20 trillion packages (Scenario 3) is lower than the GDP under the No-COVID situation (i.e., base run), and therefore, the absolute amount of the fiscal burden after disbursement of the relief package is much lower than that observed under a no-COVID situation. The relief package amounted to 6 per cent of GDP of the no-COVID year as the fiscal support towards economic recovery. Hence, we can argue that the demand for credit has not increased to its desired level, and hence, the credit-linked subsidy remains under-utilised in the short run. Essentially, the credit demand by producers would increase with an increase in confidence regarding their effective market. However, the disruption in supply chains continued for most of 2020-21 due to the nationwide lockdown followed by the containment zone policy of the local governments. In addition, predictions about the subsequent waves of the pandemic adversely affected the producers' confidence, thereby leading to a lowering of production. On the other hand, the Government of India sought to bolster demand by providing cash incentives to households as well to compensate for the loss in income of poor households. However, it seems that this demand-side management failed to adequately boost the economy during the pandemic period. The model results relating to our income stimulus packages (Scenarios 4 and 5) predicted a contraction in the economy despite the Government package, suggesting that the size of the stimulus needs to be expanded further to reverse the tide.

It is thus logical to believe that under a pandemic situation, the Indian economy is a supply-constrained rather than a demand-constrained economy. Economists may counter this proposition by arguing that the CGE model is based on the neo-classical economic theory, which believes in supply-side management to achieve equilibrium in the economy. However, Dasgupta and Rajeev (2020), using the Keynesian theoretical framework, have explained that in the pandemic situation, the Indian economy is supply-constrained. Therefore, we argue that a production-linked cash incentive package would augment producer confidence, enabling them to increase output, which in turn, would lead to an increase in both the labour demand and household income. This is evident in our Scenario 6, which suggests a GDP loss amounts of only 1 per cent and the maximum income loss of only 2 per cent, corresponding to the losses suffered by relatively rich urban households.

The model results also reveal that rural farm households gain more than rural non-farm and urban households. This is due to two reasons: first, agricultural operations remained exempted from the economic shutdown, and second, many of the marginal farmer households benefited from the direct cash transfers during the pandemic period. There is no doubt that this type of policy outcome may be of interest to policymakers, but the sustainability of this outcome is questionable due to two

reasons. First, if the supply side does not improve, unemployment will rise, which will exacerbate poverty, and consequently, a direct cash transfer will increase the fiscal burden on the government. Second, many economic activities are not fully operational and hence the tax revenue to the government will not improve much to finance the excess burden of the fiscal deficit. In this context, the results of this study indicate that the fiscal deficit would be around 7 per cent of GDP if 80 per cent of the bottom quintile of the population are given a cash transfer of Rs. 6000 to strengthen the demand side of the economy, which will still result in a contraction in GDP of around 5.75 per cent contraction in GDP during the pandemic year. In contrast, the production-linked cash incentive would increase the fiscal deficit to around 8 per cent, but this will result in a contraction of only 1 per cent in GDP. Therefore, based on the model results of this study, we recommend production-linked incentives, as they are more effective than demand-targeting measures such as income transfers to households. However, to accomplish that, the government would need to shoulder a sizeable fiscal burden.

Although empirical results show that production-linked incentives result in better policy outcomes, it is possible that producers could misuse these incentives by, for example, submitting inflated invoices to claim subsidies under the production-linked subsidy scheme. However, this can be easily checked with the production valuation for the GST payment as the GST bill should increase proportionately with the increase in the invoiced value of production. Another check can be made digitally by mapping the *e-shram* portal registration number of the worker with the industry they are engaged with.

7. Conclusion

Experts are of the opinion that this pandemic will not end soon, rather, Coronavirus will remain an integral part of our regular life for a significantly long time. Therefore, it is imperative to adapt to this situation. In this context, this study has conducted an economy-wide analysis within the CGE modelling framework to assess the impact of COVID-19 on the Indian economy and possible alternative economic relief packages for ensuring better socio-economic outcomes. The advantage of such an analytical tool is that it facilitates the accounting of linkages among various economic activities within and outside the domestic economy.

On the policy front, three key takeaway messages have emerged for the Indian economy. First, the Rs. 20 trillion economic relief package helped the economy during the pandemic year. Second, though the fiscal support under the mega economic relief package was equivalent to 6 per cent of national GDP, it has not delivered commensurately sizeable outcomes. The fiscal deficit did not increase due to the low demand for credit-linked subsidies, which was the primary focus in that economic relief package. Third, the Indian economy under the pandemic is a supply-constrained one, where income-boosting measures may not be effective. Therefore, this study recommends the provision of a production-linked cash incentive to producers to boost employment and thereby the incomes of households.

It is important to note that the COVID-19 vaccine and the development of natural immunity among the population helped improve people's mobility and producers' confidence, enabling them to expand their businesses. However, this natural process of recovery took take a longer period depending on the reproductive rate of the virus. We

have already experienced several pandemic waves between March 2020 and January 2022, and experts are predicting several future waves in the coming years as well. All this may delay the process of recovery. Therefore, strengthening the health system to ensure improved treatment facilities for infected persons should be a priority to boost the confidence of both producers and consumers enabling the operation and even expansion in capacity of economic activities in the future. To accomplish this goal, there is also a need for technological innovation to improve the physical contactless supply chain in the economy.

Finally, this study is not free from limitations, with the consideration of a static model being one of them. A static model was adopted for achieving simplicity, to provide an initial exploration into the relative value of different relief measures. Since economic recovery is a long-term phenomenon, a dynamic model would be more suitable for the analysis. To address this lacuna, we plan to set up a dynamic version of the model in the future to capture the long-term implications of COVID-19 on the Indian economy.

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