A Foray into tracking Economic Activities in Covid time through the Lens of High Frequency Indicators

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by

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Abstract

The study has constructed a coincident composite index of economic activities on a monthly frequency and attempted to fill the data gaps towards proper assessment of the economy on a real time basis. In the backdrop of the COVID-19 induced GDP contraction in Q1:2019-20 and the subsequent recovery that has set in, this study sets out to construct activity indices for the different components of demand: rural consumption, urban consumption, investment and other sources of demand, based on monthly data on 30 high-frequency indicators (HFIs) for the period from January 2016 to February 2021 using the principal component (PCA) analysis. Based on the analysis, it is observed that in September 2020, except for tractor sales and fertilizer sales, all the indicators in rural sector displayed an upward trend, implying better recovery. Even though demand recovered sharply and immediately in May 2020, the pace of recovery started to wane post June, with each passing month. Although there was some downturn in urban consumption demand in August, the former witnessed an upturn in September, mainly due to the relaxation of Covid-19-related restrictions. Investment demand after showing a V-shaped recovery in May, lost momentum but picked up sharply in September. General economic activities index was the slowest to recover post April and more so beyond June so far. The overall composite index of economic activity in India suggests that economic growth has bottomed out in April 2020 when activity went down by around 87 per cent from the pre-Covid-19 level. It is observed that economy started recovering after April due to resumption of economic activity in certain parts of the country after the relaxation of Covid-related restrictions in some states. However, although the economy started recovering after September 2020, due to resurgence of Covid-19 pandemic in February 2021, the pace of recovery has halted, which hints at a higher uncertainty in the economy going forward.

JEL Classification: E2, O, O4, O44, O47, O470
Key Words: GDP, Covid-19, Rural Demand, Urban Demand, Gross Fixed Capital Formation, Principal Component Analysis, Real-Time Activity Indicators.

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Introduction

Researchers in several countries are making forays into estimation of what is often described as real time GDP or use of high frequency indicators of real economic activities. In India these also gathered pace in recent years, especially in the aftermath of pandemic (Kumar, 2020, Bhadury, et al, 2020). Following the Covid-19 shock and the highly stringent lockdown in India, a sharp GDP contraction of 23.9 per cent during Q1:2020-21 came out to be worse than expected. This has led to several conjectures about the recovery path. As the Indian economy is currently at the cusp of a recovery which turned out better than expected in Q2: 2020-21, it may be a good idea to cross-check the performance of the economy through a composite index of real-time indicators of economic activities. The efficacy of the policy response deployed so far to tackle the Covid challenge will thus get tested by the timely assessment of incoming data of diverse dimension.

The utility of the exercise is not limited just to the ongoing crisis, but also during normal times, particularly, for the interregnum between two consecutive releases of the official statistics on GDP. For the emerging market economies like India, the problem is of greater magnitude as the lags in the release of data are longer than in developed countries. The delay in data releases of the key macroeconomic variables presents a challenge to the policymakers by restricting their ability to accurately assess current conditions. The availability of some barometers like activity indices that would allow decision-makers to discern trends as they unfold may improve the quality of economic assessments and, in turn, the decisions they make.

For instance, from a monetary policy perspective in India, the bi-monthly policy by the Reserve Bank of India takes place six times a year (February, April, June, August, October, and December), but the GDP data being quarterly in frequency are released only four times and that with a lag of two months, *i.e.,* in February, May, August and November. Thus, RBI takes recourse to nowcasting and in addition, like most central banks the RBI provides growth and inflation projections. Therefore, from the central bank's point of view, a kind of economic activity tracker in the absence of quarterly GDP estimates may be particularly useful. Further, given the fact that the majority of the people live in rural areas while the urban areas throws more frequent information on economic activities, some independent tracking of rural activities vis-à-vis urban activities could be of relevance at this stage of development of the country. In a similar vein, sustainability of activities critically depends on the act of investment, which needs to be monitored on an ongoing basis.

As a matter of fact, agricultural and allied activities across the country remained largely unaffected by the Covid-19 related lockdown, post-Q1 recovery was led by rural demand. Large-scale reverse migration and a good monsoon helped realize strong sales of fast-moving consumer goods (FMCG) products in rural markets and smaller towns during April-September 2020. As against the usual 20-25 per cent of sales for FMCG, emanating from India's villages, the FMCG industry saw 36 per cent of sales emerging from rural markets during the period. However, rural demand recovery cannot be a substitute for urban demand. For economic recovery to get entrenched on a sustainable basis, investment demand needs to get stabilized sooner than later.

In this backdrop, this study sets out to construct activity indices for the different components of demand: rural consumption, urban consumption, investment and other sources of demand, based on high-frequency indicators (HFIs). The indices so constructed are integrated into a composite index of economic activities which may act as a barometer for the Bank's bimonthly policies, particularly, in April and October when the preceding quarters are just over but the NSO's GDP estimates for the same quarter would be available only after about two months.

The rest of the paper is organized into six sections. Section II covers a brief review of the literature. Section III explains the methodology and data. This is followed by a discussion of demand-side indices in section IV, which feeds into the overall index presented in section V. This is followed by a concluding section: VI.

II. Review of Literature

Although the construction of an index to track economic activities is an age-old practice, the nowcasting literature as such is at its nascent stage of development (Kumar, 2020). The use of high-frequency data to nowcast the low-frequency data is common among central banks nowadays. For example, the Federal Reserve Bank of New York releases a weekly economic index (WEI), constructed on ten indicators of real economic activity and scaled to align with the four-quarter GDP growth rates (Lewis *et al., 2020;* Bok *et al.*, 2017). Similarly, the Federal Reserve Bank of Atlanta uses high-frequency data for nowcasting the GDP growth (Higgins, 2014). The Bank of England also comes out with a nowcast number for GDP growth based on HFIs (Anesti et al., 2017). In the EMEs such as Brazil, Russia, India, China and Mexico, the use of HFI data in dynamic factor models is found to be consistent (Dahlhaus et al., 2017). In fact, the study found that DFMs satisfied property of directional accuracy and also provided reliable nowcasts for GDP growth

As regards India, one of the early studies attempted to predict the current quarter GDP following the bridge equation approach (Bhattacharya *et al.*, 2011). More recently, a composite index has been constructed using four indicators representing a mix of demand and supply dynamics on a daily frequency at the state level (RBI Monetary Policy Report, October 2020). The indicators considered were vehicle registrations; electricity consumption; air quality index; and Google and Apple mobility data. Y-o-Y growth in these indicators, with 2019 as the base, traced the movements of consumer demand and various economic activities, such as trade and transport, commercial and industrial activities, and labour force movement. Indices for 14 states were thus constructed by taking state-level data. Furthermore, an economic activity index for India was constructed by using the dynamic factor model (Kumar, 2020) on 27 HFIs covering activities relating to industry, services, global and miscellaneous sectors. It has also constructed individual sectoral indices, i.e., for industry, services, and global activities. Bhaduri, *et al*. (2020) constructed single-index dynamic factors (DF) using 6, 9 and 12 high-frequency indicators (HFIs). The extracted trend derived from the HFIs by using the DF model, provides real time assessment of the state of the economy. In a way, this method helps in identifying the sectors that are responsible for economic fluctuations.

Presently, various national and international agencies including the rating agencies publish India's GDP growth forecast regularly. Among the international organizations, IMF, World Bank, UNCTAD, OECD, Nomura, and ADB are the important ones to be mentioned in this regard, while among the rating agencies, the notable ones are Fitch Solutions, S&P Global Ratings, Moody's, Crisil, and India Rating. Many Indian agencies such as ICRA, NCAER, SBI, Citi Group, and DBS also publish their growth projections. Quite a few of the foregoing also construct economic activity index such as Nomura, DBS, and Citi Group. Since September 2007, the Reserve Bank has been conducting a survey of professional forecasters, which also provides a median forecast of growth in terms of GDP, GVA and their components. The latest round (67^{th}) of the survey covered 29 panelists.

Our approach to the construction of an economic activity index for India differs from the studies mentioned above in the sense that economic activities have been segregated into four categories, *viz*., rural consumption demand, urban consumption demand, investment activities, and other miscellaneous activities not classified under the former three categories. Such direct tracking from the demand side could be a valuable addition to the extant literature, particularly when the NSO itself estimates GDP primarily from the supply side. The individual key indicators from the

demand-side are regularly presented to the Monetary Policy Committee. But, in the absence of a composite index, making sense out of myriads of individual indicators remains a challenge. It is all the more so as India being a developing economy, the degree of development vastly varies across sectors/components, e.g., rural and urban, and consumption and investment. In fact, unlike the advanced economies, determinants of rural demand in India may not be the same as those of urban demand, given the gradual pace of provision of urban services to rural areas.

As the Covid-19 crisis has clearly illustrated, the rural segment, in general, and the agriculture sector, in particular, turned out to be the driving force of economic activities when the stringency of the lockdown rendered a large part of the economy non-functional. Rural consumption has stayed strong, in part helped by the sustained MSP procurement of food grains by the government at higher prices[2]. Bountiful monsoons further strengthened the prospects of agricultural output and rural demand. However, various indicators of rural demand may not move in tandem, and in such a situation, it becomes difficult to discern how the entire segment is moving. Because of this, there is a need to build up indices for rural demand and urban demand separately.

It is however felt that if this nascent recovery is to be sustained, urban demand cannot be overlooked, particularly when urban centres continue to be the vortex of activities and migrants get absorbed to the services sector across India's top cities[3]. Taking cognizance of the hardships faced by the urban poor, especially the migrant labourers in the wake of Covid-19, urban activities too have come into focus. Therefore, the exercise in hand could throw some light on the changing dynamics of rural versus urban contribution to the ongoing growth process.

III. Methodology and Data

Nowcasting exercises offer a rich scope of refinement towards enhanced predictive efficiency by augmenting existing models with spatial and real-time indicators daily, that are becoming available, including through the application of machine learning tools, web scraping, and artificial intelligence. Various studies have applied principal component analysis (PCA) for computation of weights for an index such as OECD (2008), and Goel and Garg (2018). The statistical procedures in these studies have been followed in the present study.

[2] Monthly Economic Monitor, Ministry of Finance, Government of India, August 2020.

[3] Inter-state migration flows have accelerated from 5-6 million persons between 2001-11 to close to 9 million persons between 2011-16 (Source: Economic Survey, 2017).

We have used monthly data on 30 indicators for the period from January 2016 to February 2021 (Table 2 and Annex Table 1). Since the indicators are in different units of measurement, they have been normalised into a specified range (between 0 and 1) by linear scaling technique, also known as min-max normalization *a la* OECD (2008) in the following way:

$$Z_i = \frac{X_i - Min(X_i)}{Max(X_i) - Min(X_i)} \qquad (1)$$

where Z_i is the normalized value and X_i is the indicator value. The value of Z varies between 0 and 1.

Kaiser-Meyer-Olkin (KMO) statistic measure the strength of relationship among variables and it indicates whether correlations between variables can be explained by other variables in the dataset. Its value ranges between 0 and 1. Further, Bartett's tests is used to judge whether original variables are sufficiently correlated for correlated, i.e. correlation matrix is not an identity matrix[4]. We have performed both Kaiser-Meyer-Olkin (KMO) and Bartett's tests for sampling adequacy and robustness for each of the four sectors separately and found that the test results satisfy the sample adequacy and robustness (Appendix Tables 2(i) to 2(iv))[5]. As per the literature (chiefly, Mooi and Sarstedt, 2011; Hoque, 2014), the PCA exercise will be meaningful only when the correlation coefficients in most of the cases are more than 0.30. Accordingly, the correlation matrix among the variables was calculated for each of the four sectors and they were found to conform to the desired norm. If the value of KMO statistic is equal to or greater than 0.50 then it may be considered that the data are suitable for PCA analysis (Constantin, 2014; Goel and Garg, 2018). Further, if the null hypothesis is rejected under Bartlett's Test at conventional level, then we may conclude that the correlation matrix is not an identity matrix.

Subsequently, for the PCA analysis, the indicators to be included in sectoral and overall indices, was decided based on the scree plot and eigenvalue-one criterion or Kaiser's criterion following OECD (2008) and Andrews (2012) [6]. Finally, we judge the principal components based

[4] The null hypothesis under Bartett's test is correlation matrix is identity matrix against the alternative hypothesis that the correlation matrix is not an identity matrix. Further, in order to test the null hypothesis under Bartett's test, chi-square statistic is computed.

[5] The dataset is considered suitable for PCA if KMO statistic is equal or higher than 0.50. In the present context, KMO turned out more than 0.50, excepting rural demand for which it was close to 0.50. The Bartlett's test is another indicator for judging whether original variables are sufficiently correlated. The null hypothesis that variables are uncorrelated or correlation matrix is an identity matrix was rejected for each of the four sectors. Therefore, original variables are taken to be correlated, which is mandatory for the adequacy of PCA (Goel and Garg, 2018).

[6] Under eigenvalue-one criterion, those factors or principal components are selected which possess eigenvalues larger than 1, individual variance explaining more than 10 per cent; and cumulative contribution to overall variance more than 60 per cent.

on the cumulative contribution to overall variation. Ideally, individual variation should be more than 10 per cent and cumulative should be more than 60 per cent. Thus, the weight of each variable is calculated based on the PCA and rotated component loading matrix. In this study, for rural consumption, we have taken three principal components whose eigenvalues are more than one. In case of urban consumption, we have taken two principal components, while in case of investment activities, we have chosen two principal components. Further, we took only one principal component for general activity based on the eigenvalue greater than one.

Our composite index of aggregate demand is on the lines of coincident economic indicators (CEIs) published by the Federal Reserve, which are essentially designed for nearly real-time assessment on how the economy is performing. By computing an index out of several HFIs, we can eliminate some of the noises associated with individual indicators and hence can provide a more reliable measure of economic activities.

Table 1: List of Variables

Rural Demand	**Urban Demand**	**Investment Demand**	**General Economic Activities**
1. Tractors Sales	1. CMIE: Urban Employment	1. Railway Revenue earning freight Traffic	1. Electricity Demand
2. Motorcycles Sales	2. Domestic Air Passenger Traffic	2. Industrial Fuel: LSD	2. CMIE: Total Unemployment
3. CMIE: Rural Employment	3. Passenger Vehicles Sales	3. Industrial Fuel: Bitumen	3. Composite PMI
4. Diesel Consumption (HSD)	4. Scooter Sales	4. Road Fuel: HSD	4. Net Exports: Merchandise Trade
5. Diesel Consumption (LSD)	5. Petrol Consumption: Motor Spirit	5. Cargo handled at major ports	5. Net Exports: Services Trade
6. Fertiliser	6. Petrol Consumption: Liquified Petroleum Gas	6. Steel Consumption	
7. MGNREGA	7. NEFT Transactions	7. Infrastructure goods production	
	8. RTGS Transactions	8. Cement Production	
	9. Mobile Transactions	9. Capital Goods Imports	

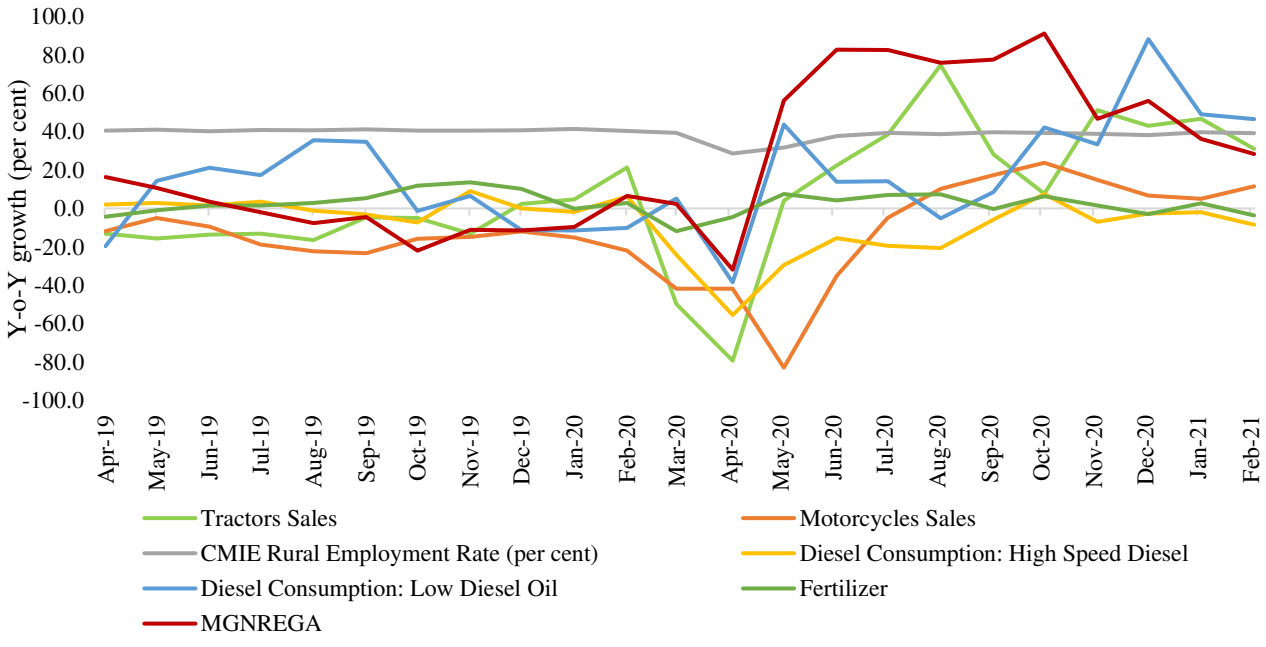
Note: *See Annex Table 1 for sources of data.*

IV. Demand-Side Indicators and Indices

IV.1 Rural Consumption Demand

In the rural sector, all the seven indicators have witnessed an increase or remained at least stable barring diesel consumption in July 2020. Rising tractor sales from April to August period are indicative of a healthy kharif output and an intensive rabi sowing. Furthermore, among rural indicators, MGNREGA work demand increased sharply due to the reverse migration of labourers (Chart 1). Migrant labourers after going back to their home states demanded jobs under MGNREGA or otherwise. The CMIE data also show a concomitant increase in rural employment. In September 2020, except for tractor sales and fertilizer sales, all the indicators displayed an upward trend, implying better recovery. Once the sowing season got over by end-August, sales of tractors and fertilizers witnessed a decline, contributing to a flatter rural demand for September in keeping with the seasonality. However, as can be observed from the Chart, the pace of recovery has been halted by the second wave of covid-19, for which the nation is crippled and the growth process has been adversely affected.

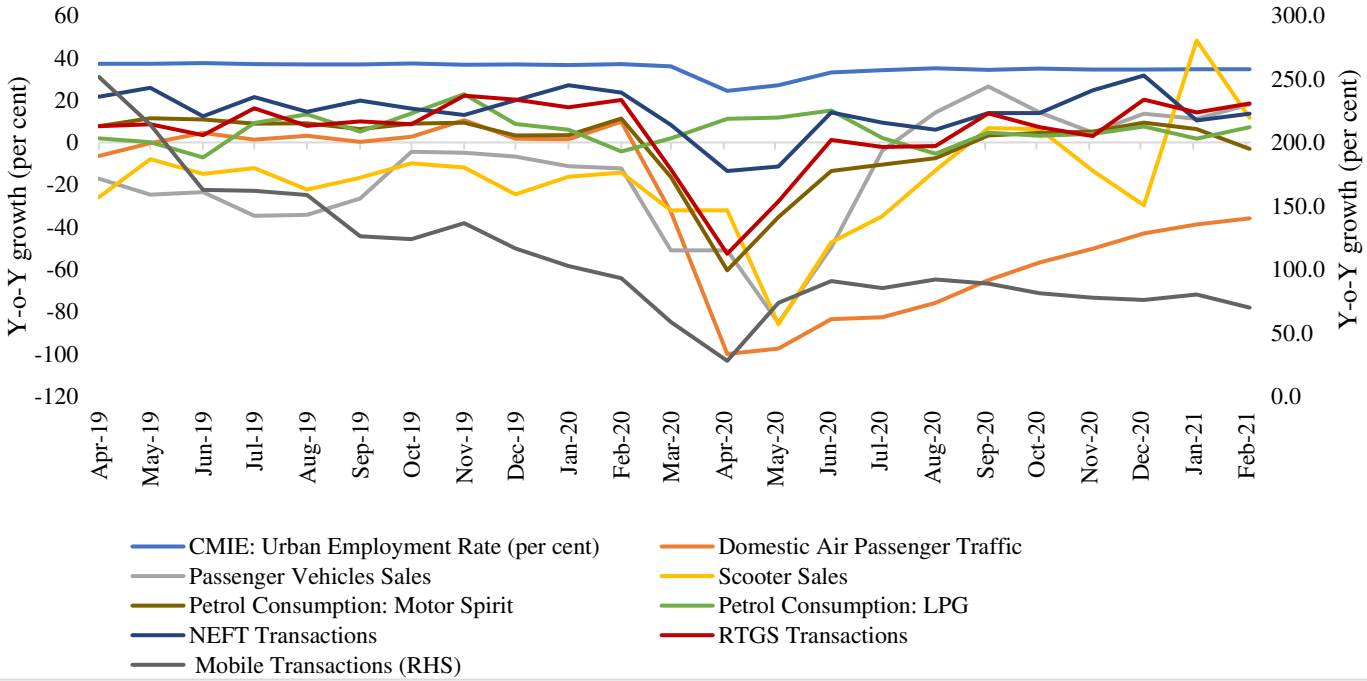
Chart 1: Rural Consumption Demand



IV.2 Urban Consumption Demand

The urban consumption demand remained muted till August 2020. In view of the pandemic, the contact-intensive and/or non-essential services such as transport, hotel and restaurants, and arts and entertainment were most adversely impacted. Particularly, passenger vehicle sales and domestic air traffic were affected severely due to Covid-19. However, passenger vehicle sales, consumption of petrol emerged out of contraction and posted positive growth in September 2020, reflecting largely the pent-up demand being released ahead of the festival season. However, we do not see much improvement in urban employment (Chart 2). However, it is observed that although almost all the indicators of urban demand started showing some improvements after the first wave of covid-19 crisis, condition became grim due to resurgence of covid-19 as a second wave in February 2021. As a result, movement of all the indicators have become either stagnant or declining marginally.

Chart 2: Urban Consumption Demand

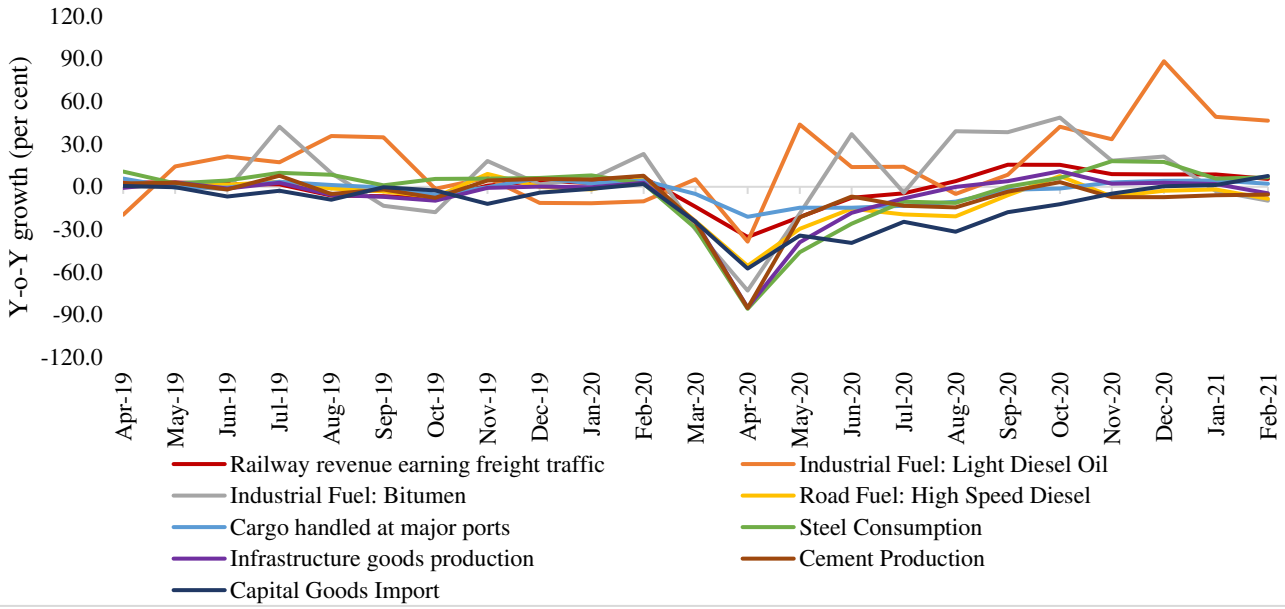


IV.3 Investment Demand

The contraction in gross fixed capital formation (GFCF) was very severe in Q1: 2020-21 by around 47 per cent. Although some of the indicators of investment started showing improvement only in September 2020, most of them were still in the negative zone. Notably, railway freight traffic showed an upward movement in September due to a gradual resumption of

railway services (Chart 3). Indicators of construction activity such as steel consumption and cement production showed a pick-up in September, while IIP infrastructure goods remained flat during July-September, reflecting a delayed pick up. Although some improvements were observed, especially in industrial fuels, steel consumption, cement consumption, revenue earnings from railway freight traffic after the 1st phase of covid-19, they all have witnessed a declining/stagnant trend during the onset of second wave of covid-19.

Chart 3: Investment Demand

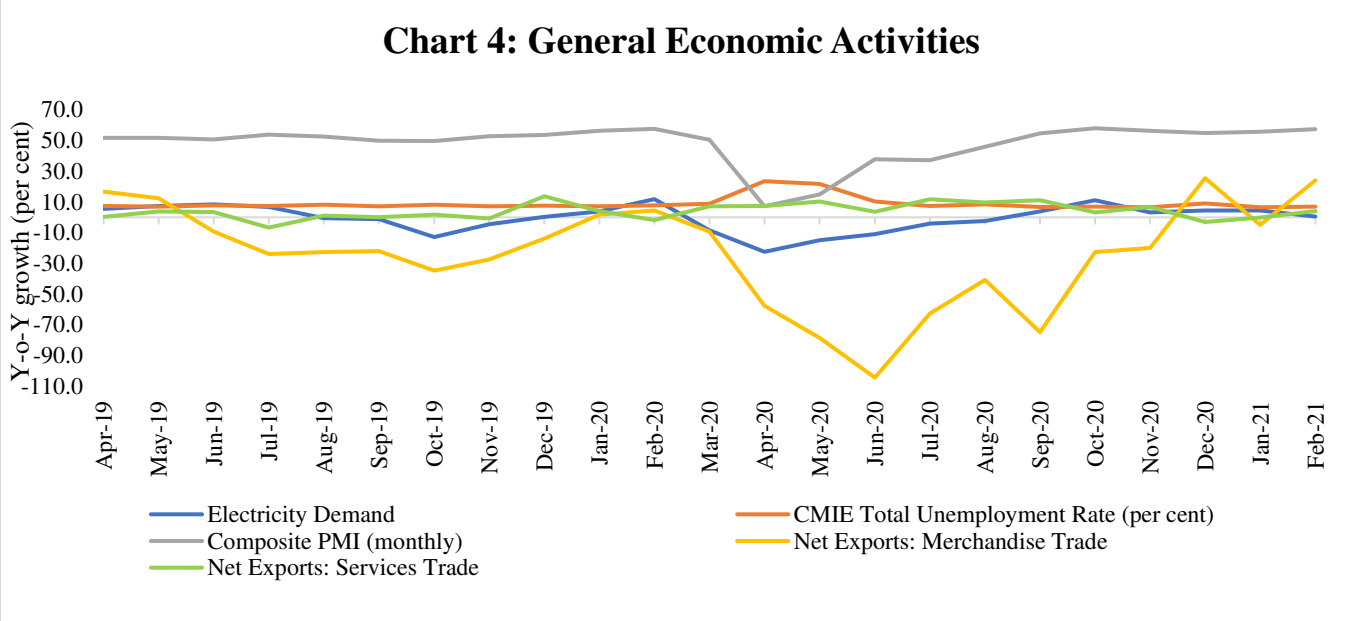


IV.4 General Economic Activities

Among the indicators for general economic activities, all the four indicators have reached closer to their pre-Covid levels in September 2020. E-way bills and electricity demand, which were in the negative zone, have come out of contraction and entered the positive zone (Chart 4). In October, electricity consumption[7] moved up by 11.6 per cent on a y-o-y basis, registering an increase for the second successive month (4.4 per cent in September) after remaining in contraction for the year so far. Inter- and Intra-state movement of goods also caught up speedily as visible from the rebound in the E-Way bills with almost 10 per cent y-o-y growth in September. However,

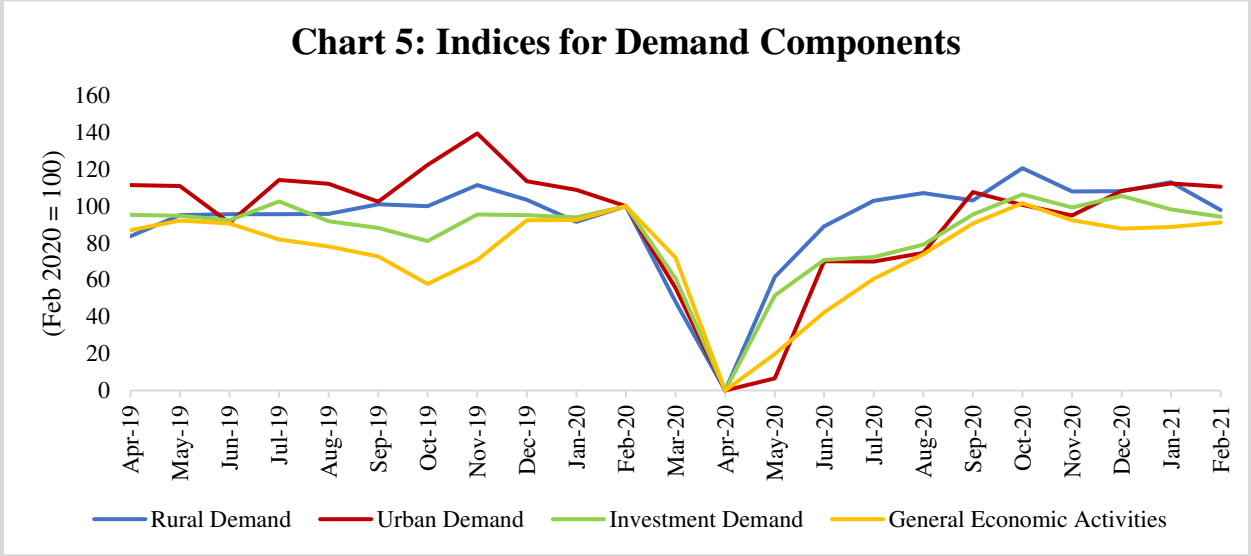
[7] The share of industry in total electricity consumption in 2018-19 was around 42 per cent, while those of domestic consumption and agricultural uses were around 24 per cent and 18 per cent, respectively.

the impact of second wave is also observed in the case general economic activity, as observed in other cases discussed above.



IV.5 Indices for Demand Components

The indices for individual demand categories, *viz.*, rural consumption demand, urban consumption demand, investment demand, and general economic activities are plotted in Chart 5. Even though rural consumption demand recovered sharply and immediately in May 2020, the pace of recovery started to wane post June, with each passing month. Although there was some downturn in urban consumption demand in August, the former witnessed an upturn in September, mainly due to the relaxation of Covid-19-related restrictions. Investment demand after showing a V-shaped recovery in May, lost momentum but picked up sharply in September. General economic activities index was the slowest to recover post April and more so beyond June so far. However, as can be seen from the following chart, due to onset of covid -19 in a grave manner the performance of all the indicators have adversely affected. In fact, all the indices have slipped to below 100 during February 2021.



V. Overall Index

The composite index to gauge economic conditions has been arrived at by computing an unweighted mean of the indices of the four components of demand (Chart 6)[8]. Accordingly, economic activities were found to have bottomed out in April 2020 when the overall index went down by around 87 per cent from the pre-Covid-19 level. Subsequently, the index witnessed a V-shaped recovery with the graduated relaxation in lockdowns and resumption of economic activities in various parts of the country. Although the overall index turned flat in August due to localized lockdowns in some of the states (e.g., Assam, West Bengal, Jharkhand, Andhra Pradesh, Tamil Nadu and Delhi), some recovery was witnessed in September, possibly with the flattening of Covid curve for active cases and resumption of economic activities (Chart 7). However, as observed in the case of sector-wise indices, overall index has tripped below 100 in February 2021 due to resurgence of second wave of Covid-19 and consequent lockdown in with varied degree in various parts of the country.

[8] The details of methodology and data are given in the Annex. The exercise was validated, using quarterly data from 2017 onwards.

Chart 6: Overall Index

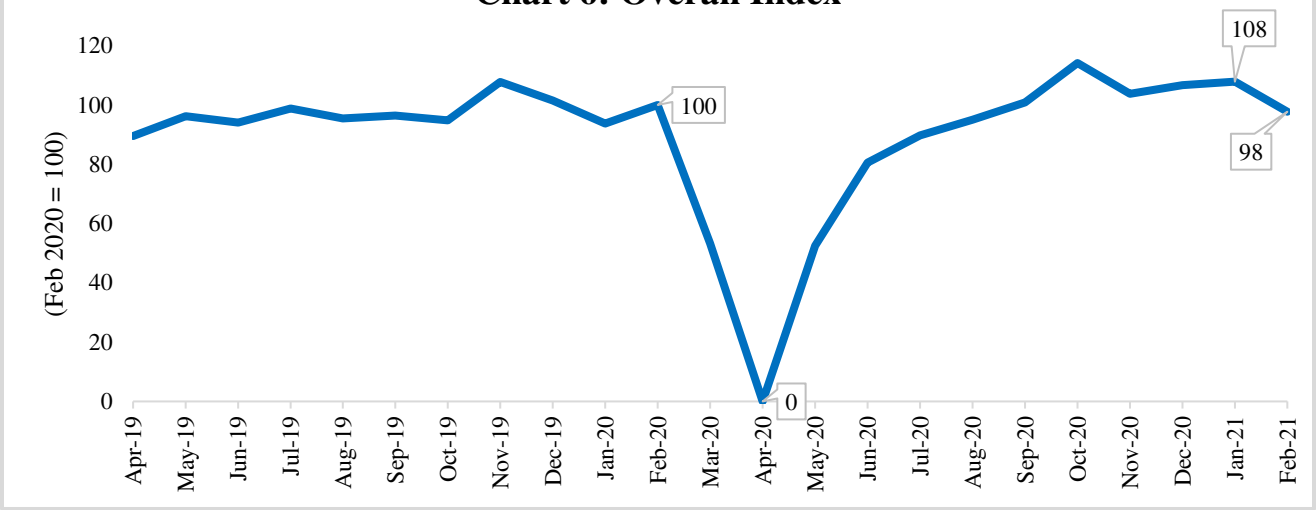
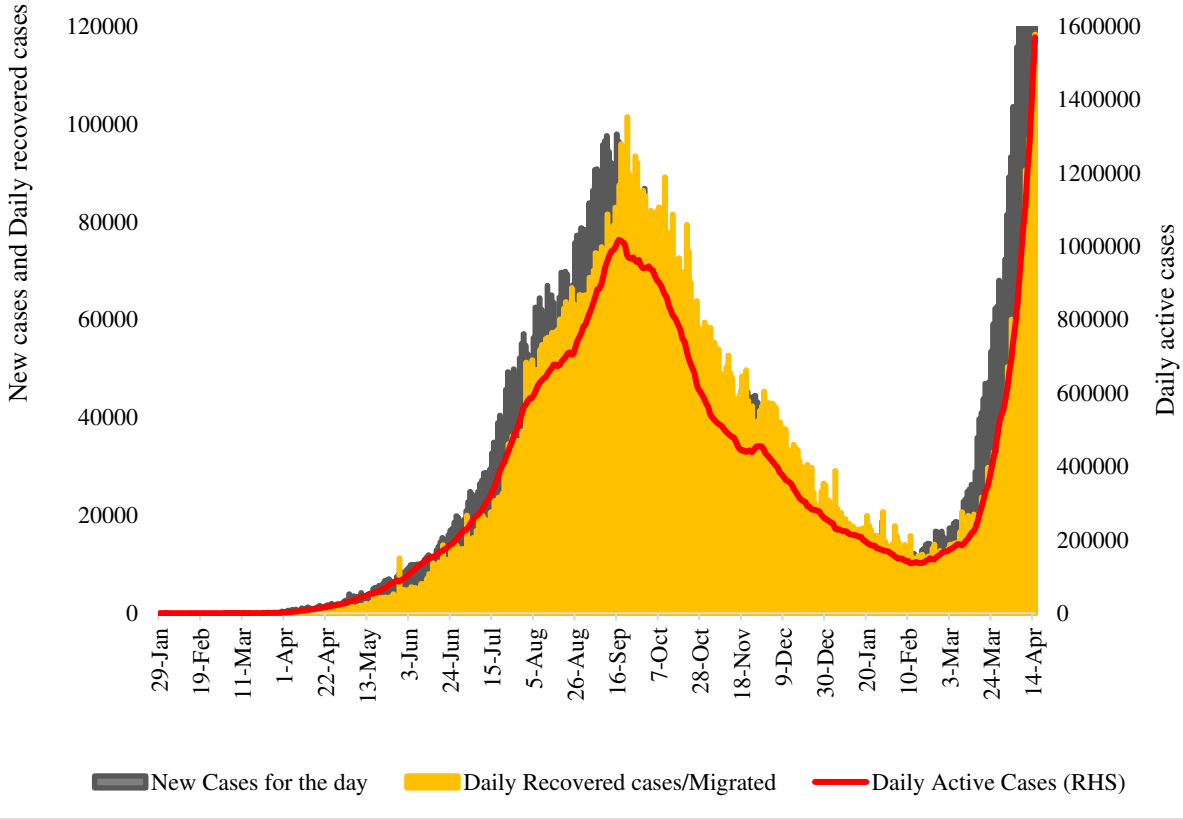


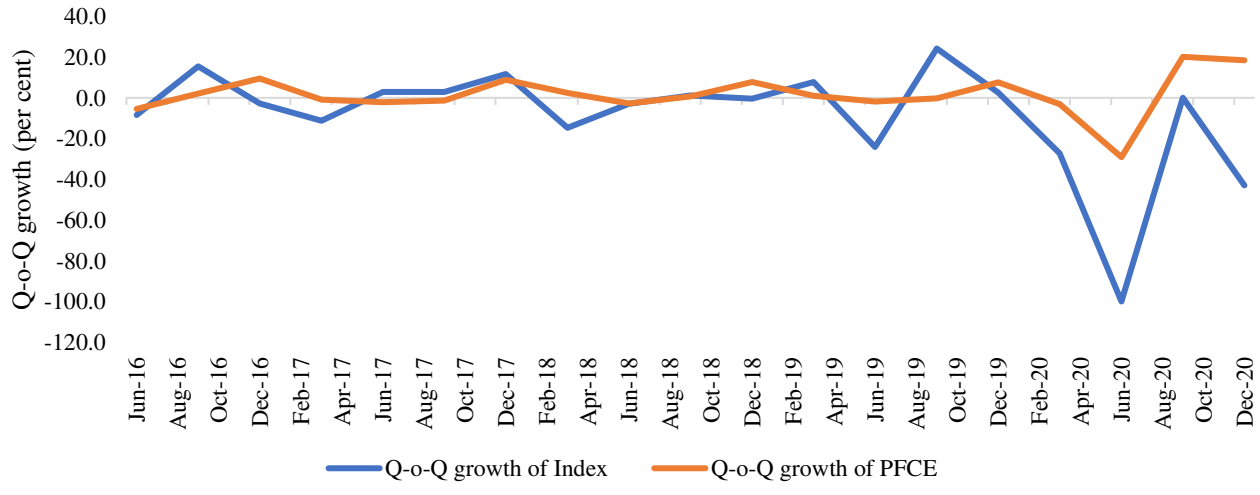
Chart 7: India's Daily Covid 19 Position

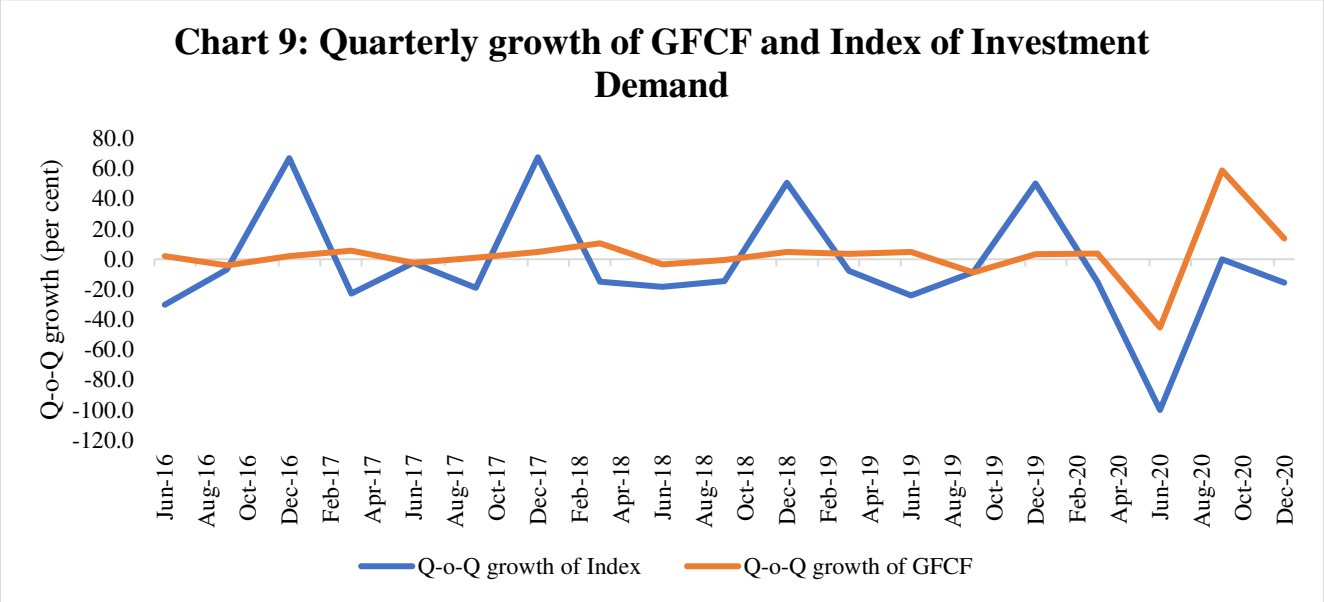


Robustness of the Results

After construction of the index, the next step is to examine its forecasting accuracy and efficiency in tracing and tracking the behaviour of actual series of aggregate demand at an aggregated level as also at a disaggregated level. While the index has been constructed as a monthly series, GDP estimates are available on a quarterly basis. Therefore, we have first constructed a quarterly series on the indices taking the quarterly data from June 2016 to December 2020. One popular test of reliability runs on sign accuracy in the quarterly growth rate of the constructed series against the actual series. If such accuracy crosses the mark of 50 per cent, the constructed series is assumed to be a reliable one (Mohanty, Hansda and Jain, 2003). In the present case, the sign of quarterly growth of the constructed index for consumption demand is observed to be the same as that of the actual series for 11 out of 19 quarters under consideration (Chart 8 and Table 3.A). In other words, the sign accuracy of the constructed index has turned out to be more than 58 per cent. Similarly, the index of investment demand also marched past the sign accuracy test (Chart 9 and Table 3.B). The sign accuracy of the constructed overall index has turned out to be 53 per cent (Chart 10 and Table 3.C). Finally, the correlation coefficient of the growth rates of the two series at the aggregate level as also at the component level was found to be very high at 0.56. The major objective of the exercise is to predict the direction of the economic condition, and therefore, RMSE may not be very relevant in this context.

Chart 8: Quarterly growth of PFCE and Index of Consumption Demand (Rural + Urban)





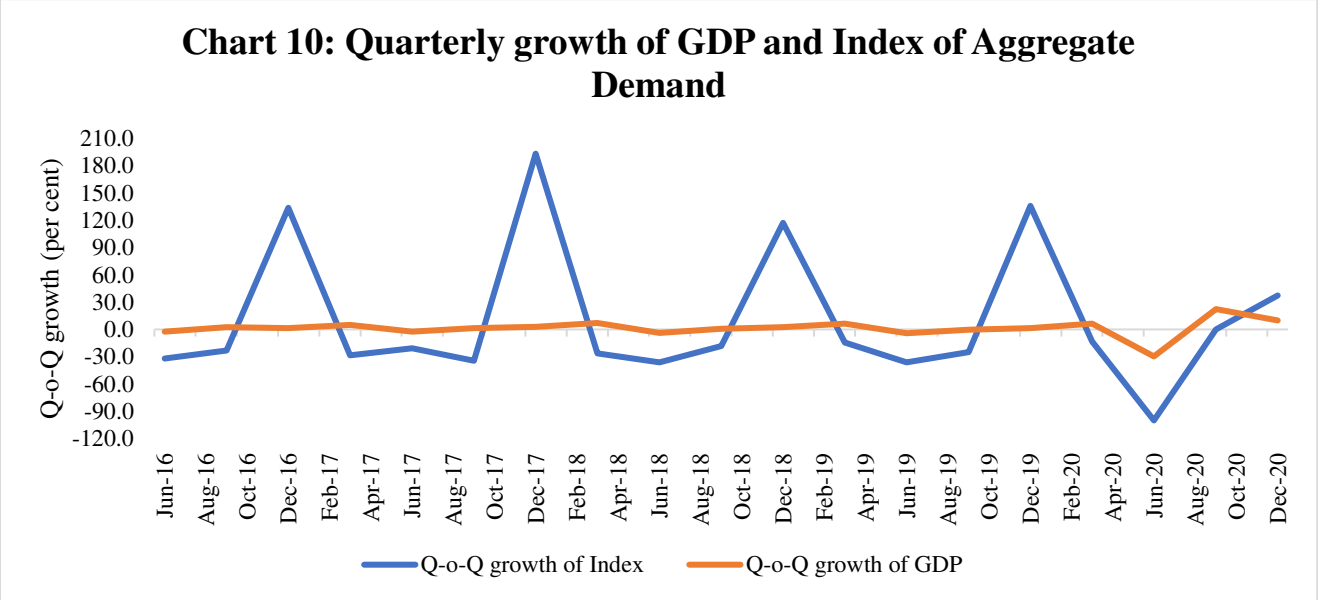


Table 3.A: Quarterly Growth of PFCE and of the Index of Consumption Demand (Rural + Urban)

(Per cent)

Quarter	Q-o-Q growth of Index	Q-o-Q growth of PFCE
Jun-16	-8.5	-5.4
Sep-16	15.4	2.1
Dec-16	-2.8	9.5

Mar-17	-11.3	-0.8
Jun-17	2.9	-2.1
Sep-17	2.9	-1.4
Dec-17	11.6	8.8
Mar-18	-14.8	2.4
Jun-18	-2.9	-2.8
Sep-18	1.2	0.8
Dec-18	-0.4	7.7
Mar-19	7.7	1
Jun-19	-24.2	-1.9
Sep-19	24.2	-0.2
Dec-19	2.6	7.6
Mar-20	-27.3	-3.2
Jun-20	-100.0	-29.1
Sep-20	-	20.1
Dec-20	-43.0	18.4
Coefficient of Correlation between PFCE growth and growth of the Index of consumption demand	0.558	
Sign Accuracy of quarterly growth Index of real economic indicators	58%	
RMSE	25.17	

Table 3.B: Quarterly Growth of GFCF and of the Index of Investment Demand

(Per cent)

Quarter	Q-o-Q growth of Index	Q-o-Q growth of GFCF
Jun-16	-30.3	2.0
Sep-16	-6.8	-4.2
Dec-16	67.0	2.1
Mar-17	-22.8	5.8
Jun-17	-2.4	-2.4
Sep-17	-18.9	0.9
Dec-17	67.6	4.8
Mar-18	-14.8	10.5
Jun-18	-18.3	-3.4
Sep-18	-14.4	-0.5
Dec-18	50.7	4.9
Mar-19	-7.8	3.6
Jun-19	-24.1	4.7
Sep-19	-8.6	-8.7
Dec-19	50.2	3.4
Mar-20	-15.2	3.7

Jun-20	-100.0	-45.3
Sep-20	-	58.9
Dec-20	-15.6	13.7
Coefficient of Correlation between GFCF growth and growth of the Index of Investment demand	0.565	
Sign Accuracy of quarterly growth Index of real economic indicators	53%	
RMSE	34.11	

Table 3.C: Quarterly Growth of GDP and of the Index of Aggregate Demand

(Per cent)

Quarter	Q-o-Q growth of Index	Q-o-Q growth of GDP
Jun-16	-32.0	-2.4
Sep-16	-23.1	2.4
Dec-16	133.8	1.4
Mar-17	-28.4	4.8
Jun-17	-20.7	-2.5
Sep-17	-34.4	1.6
Dec-17	193.2	2.7
Mar-18	-26.3	7.0
Jun-18	-36.3	-3.8
Sep-18	-18.3	0.6
Dec-18	117.1	2.6
Mar-19	-14.3	6.5
Jun-19	-36.3	-4.2
Sep-19	-24.8	-0.1
Dec-19	135.8	1.3
Mar-20	-13.5	6.3
Jun-20	-100.0	-29.6
Sep-20	-	22.4
Dec-20	37.3	9.8
Coefficient of Correlation between GDP growth and growth of the Index of Aggregate demand	0.381	
Sign Accuracy of quarterly growth Index of real economic indicators	58%	
RMSE	74.53	

VI. Concluding Observations

The purpose of this study was to construct a composite coincident index of economic activities based on real-time indicators as carried out by the Federal Reserve for assessment of economic activity. Apart from the current crisis when this kind of exercise could be very helpful,

this is also useful during normal times as well when there is a time gap in the official release of GDP data. The delay in data releases of the key macroeconomic variables poses a challenge to the policy-makers. For instance, India's monetary policy is announced six times a year (i.e. bi-monthly), while the GDP data are released quarterly. Under such conditions, having a composite index based on real economic activities would be of great help for the policymakers. In this backdrop, we have considered 30 indicators of high-frequency (monthly) and classified them into four categories, *viz*., rural consumption demand, urban consumption demand, investment demand, and general economic activities. By applying the principal component analysis, we have calculated the index for each category and then combined them to get the overall index. Thus, the indices so constructed help to assess on the current economic situation for each component of aggregate demand as also at the aggregate level. We have carried out the sign accuracy-test on the indices on a quarterly basis, excepting general economic activities index due to the unavailability of a consensus fix on the sector. From the constructed indices, both sector-wise and also the overall, we observe that although the economy started recovering after August 2020, due to resurgence of Covid-19 pandemic in February 2021, i.e. second wave of the pandemic, the pace of recovery has halted, which hints at a higher uncertainty in the economy going forward.

Annex Table 1: Sources of data

Sl No	Parameter	Data Source
1	Core Eight Industries	Department for Promotion of Industry and Internal Trade; Office of Economic Advisor
2	Cement Production (mn tonnes)	Ministry of Commerce and Industry
3	Steel Consumption ('000 tonnes)	Joint Plant Committee (JPC) jpcindiasteel. nic. in
4	GST Revenue Collection	Goods and Services Tax Network, CEIC
5	Tourist arrivals ('000 tourists)	Ministry of Tourism
6	**Automobile Sales (in '000 numbers)**	Society of Indian Automobile Manufacturers (SIAM)
	a) Commercial Vehicles	-do-
	b) Passenger Vehicles	-do-
	c) Two Wheelers	-do-
	d) Motorcycles	
	e) Tractors	Tractors Manufacturing Association
7	Railway revenue earning freight traffic (mn tonnes)	Indian Railways
8	Cargo handled at major ports ('000 tonnes)	Indian Port Association
9	**Civil aviation**	Centre for Monitoring Indian Economy (CMIE)
	a) Domestic cargo Traffic ('000 tonnes)	
	b) International cargo Traffic ('000 tonnes)	
	c) International Passenger Traffic (lakh)	
	d) Domestic Passenger Traffic (lakh)	
10	**Petroleum: Consumption**	CEIC
	High Speed Diesel	
	Motor Spirit	
	Liquified Petroleum Gas	
	Light Diesel Oil	
	Total	
11	Indian Basket of Crude Oil Price	Petroleum Planning and Analysis Cell
12	**Bank Aggregates**	DBIE
	Aggregate deposits	
	Aggregate bank credit	DBIE
	SCB's Non Food Credit	DBIE
13	Central Government Revenue	
14	**Trade**	
	Merchandise Trade	Ministry of Commerce and Industry; Department of Commerce

	Capital Goods Imports	Department of Internation Trade
	Services Trade	
15	**PMI**	
	PMI Manufacturing	
	PMI Services	
	PMI Composite	
18	**Payment Transaction Volume Data**	Payment Systems Indicator, Table No 43, DBIE
19	Non-Financial Corporate Real GVA	
20	E-Way Bills	
21	**CMIE Indices**	
	Consumer Sentiment Index	CMIE
	Consumer Expectation Index	CMIE
	Current Economic Conditions	CMIE
22	Electricity Generation: Energy Met	National Load Dispatch Centre: Power System Operation Corporation Limited
23	Electricity Demand, Supply, and Deficit	Central Electricity Authority; CEIC
24	Vehicle Registration Data: Vahan	Ministry of Road Transport and Highways, Vahan4 Dashboard

Annex Table 2(i): Correlation Matrix, KMO and Bartlett's Test for Rural Demand (7 Indicators)

	Tractors Sales	Motorcycles Sales	CMIE: Rural Emp.	Diesel Con. (HSD)	Diesel Con. (LSD)	Fertilizer	MGNREGA
Tractors Sales	1						
Motorcycles Sales	.584**	1					
CMIE: Rural Emp.	.304*	.549**	1				
Diesel Con. (HSD)	.290*	.583**	.745**	1			
Diesel Con.(LDO)	.339**	.290*	-0.006145317	.273*	1		
Fertilizer	0.055	-0.051	0.020	0.119	0.094	1	
MGNREGA	0.197	0.114	-0.084	-0.003	0.050	0.128	1

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	KMO Measure	0.604
Bartlett's Test of Sphericity	Approx. Chi-Square	125.92
	Df	21
	sig	0.00

Note: *** 1% level of significance; ** 5% level of significance; *10% level of significance.

Annex Table 2. (ii): Correlation Matrix, KMO and Bartlett's Test for Urban Demand (9 Indicators)

	CMIE: Urban Employment	Domestic Air Passenger Traffic	Passenger Vehicle Sales	Scooter Sales	Petrol Consumption: Motor Spirit	Petrol Consumption: LPG	NEFT	RTGS	Mobile Transactions
Urban Employment	1								
Domestic Air Passenger Traffic	.896**	1							
Passenger Vehicle Sales	.593**	.440**	1						
Scooter Sales	.623**	.563**	.717**	1					
Petrol Consumption: Motor Spirit	.796**	.731**	.569**	.545**	1				
Petrol Consumption: LPG	0.106	0.184	-0.011	0.000	0.019	1			
NEFT	.645**	.544**	.401**	.269*	.510**	0.035	1		
RTGS	.617**	.538**	.572**	.495**	.692**	-0.046	.527**	1	
Mobile Transactions	.321*	.420**	0.049	0.017	.328**	-0.045	0.191	0.147	1

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	KMO Measure	0.801034964
Bartlett's Test of Sphericity	Approx. Chi-Square	340.5119925
	Df	36.000
	sig	0.000

Note: *** 1% level of significance; ** 5% level of significance; *10% level of significance.

Annex Table 2(iii): Correlation Matrix, KMO and Bartlett's Test for Investment Demand (9 Indicators)

	Railway revenue earning freight traffic	Industrial Fuel: Light Diesel Oil	Industrial Fuel: Bitumen	Road Fuel: High Speed Diesel	Cargo handled at major ports	Steel Consumption	Infrastructure goods production	Cement Production	Capital Goods Import
Railway revenue earning freight traffic	1								
Industrial Fuel: Light Diesel Oil	0.233	1							
Industrial Fuel: Bitumen	.594**	.333**	1						
Road Fuel: High Speed Diesel	.670**	.273*	.486**	1					
Cargo handled at	.542**	0.1712872	.255*	.739**	1				
Steel Consumption	.814**	.251*	.482**	.803**	.707**	1			
Infrastructure goods production	.825**	0.2422729	.585**	.837**	.716**	.918**	1		
Cement Production	.677**	.284*	.594**	.822**	.635**	.798**	.883**	1	
Capital Goods Import	.590**	0.1582844	0.139368421	.677**	.686**	.693**	.679**	.610**	1

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling	KMO Measure	0.886
Bartlett's Test of Sphericity	Approx. Chi-Square	501.65
	Df	36.000
	sig	0.000

Note: *** 1% level of significance; ** 5% level of significance; *10% level of significance.

Annex Table 2(iv): Correlation Matrix, KMO and Bartlett's Test for General Economic Activity (5 Indicators)

	Electricity Demand	CMIE: Total Unemployment Rate	Composite PMI	Net Exports: Merchandise Trade	Net Exports: Services Trade
Electricity Demand	1				
CMIE: Total Unemployment Rate	-.615**	1			
Composite PMI	.690**	-.788**	1		
Net Exports: Merchandise Trade	.354**	-.575**	.301*	1	
Net Exports: Services Trade	-0.049	-0.096	-0.076	0.213	1

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	KMO Measure	0.649
Bartlett's Test of Sphericity	Approx. Chi-Square	131.74
	Df	10.000
	sig	0.000

Note: *** 1% level of significance; ** 5% level of significance; *10% level of significance.

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