RESERVE BANK OF INDIA

Department of Economic and Policy Research
National Accounts Analysis Division

Real Time Monitoring of the Indian Economy
An Alternative Approach

Presentation in

Meeting of the Group of Experts on National Accounts

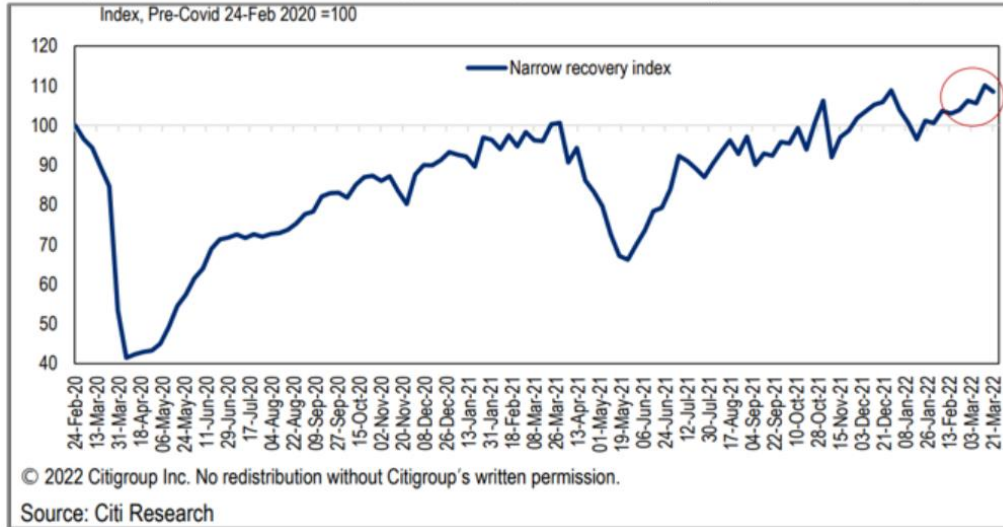United Nations Economic Commission for Europe
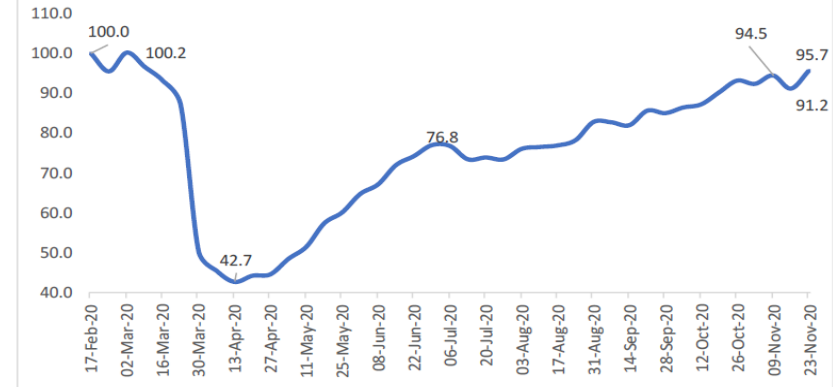
April 25-27, 2023

Outline

Why Weekly Monitoring ? : COVID-19

Fig4: With continued recovery in March, Narrow recovery index is near its peak
Index, Pre-Covid 24-Feb 2020 =100
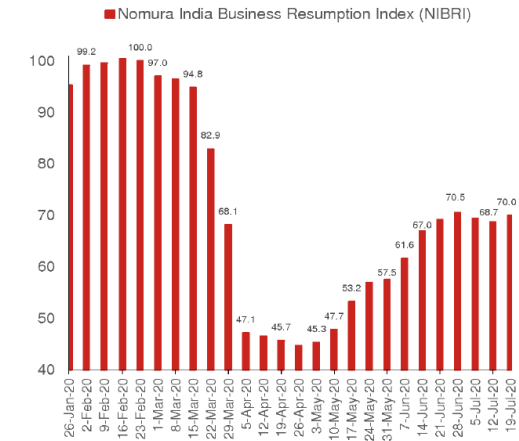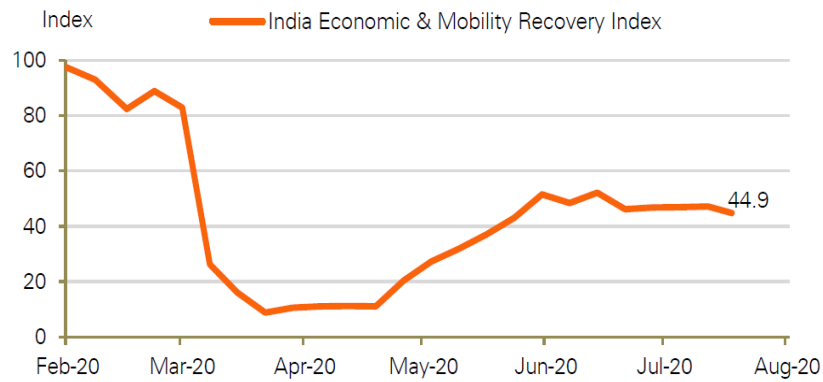
— Narrow recovery index

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Source: Citi Research

Business Activity Index

100.0   100.2   76.8   42.7   94.5   95.7   91.2

Source: SBI Research

Figure 17: DB India Economic and Mobility Recovery Index (DB IEMRI)

Index   — India Economic & Mobility Recovery Index

44.9

Source : POSOCO, CMIE , CEIC , Google Mobility Report and Deutsche Bank. Note: Index has been calculated based on electricity consumption , unemployment rate, E-Way bills and 6 parameters of Google Mobility Report.

Fig. 4: Nomura India Business Resumption Index (NIBRI)

■ Nomura India Business Resumption Index (NIBRI)

99.2   100.0   97.0   94.8   82.9   68.1   47.1   45.7   45.3   47.7   53.2   57.5   61.6   67.0   70.5   68.7   70.0

Note: The NIBRI comprises Google mobility indices, driving mobility from Apple, power demand and the labour force participation rate. 1. Google mobility and Apple driving indices are based on a 7-day moving average. 2. 23 February 2020 is considered as the base for all the series and subsequent data entries have been indexed to it. Google mobility data entries prior to 23 Feb are considered to be 100. The readings take into account the latest data for Google mobility indices, which are available with a lag of roughly one week with respect to the other indicators.
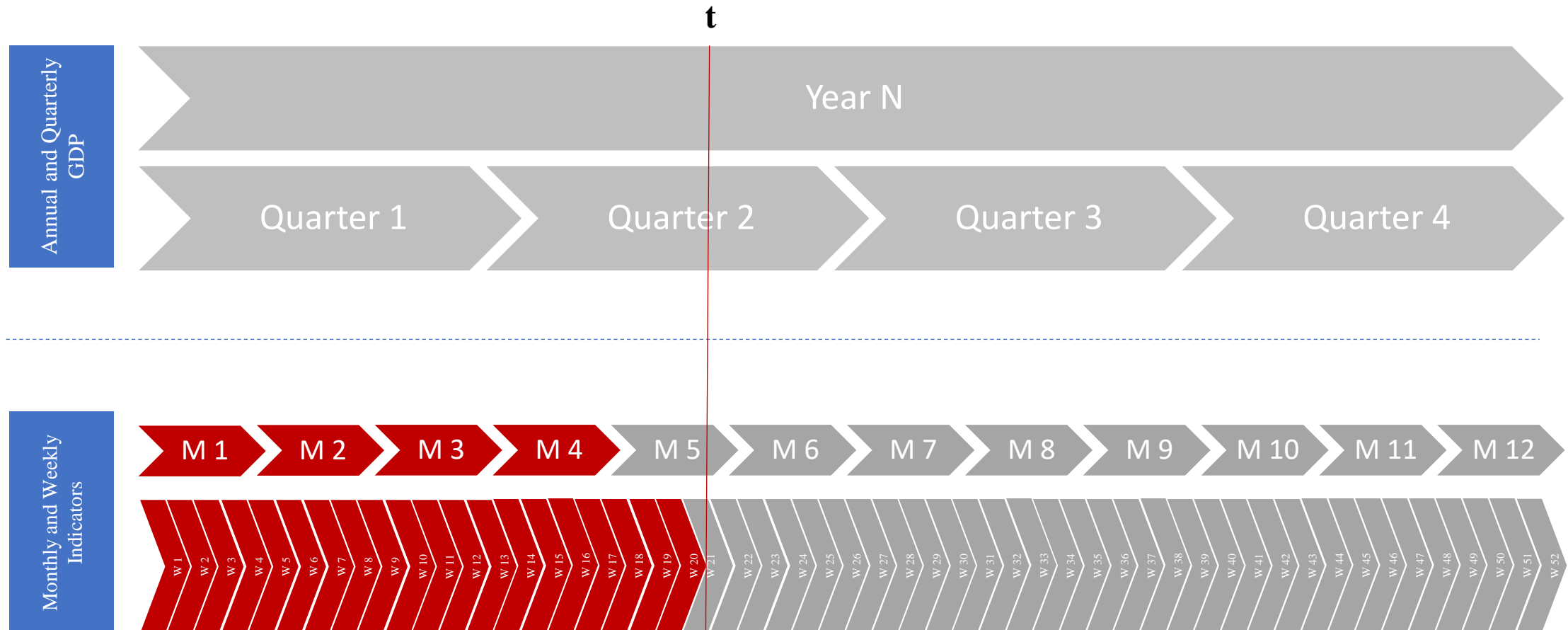Source: Google, Apple, CMIE, Bloomberg and Nomura Global Economics

Why Weekly Monitoring? : Asynchrony in the MPC Information Set

| Round | Reference Quarter | GDP | Indicators Availability | | | Weekly Index (complete up to) |
| | | | Monthly HFIs | | | |
			Complete	Partial	Scant	
April (t)	Q1 (t)	Q3 (t-1)	January	February	March	March
June (t)	Q1 (t)	Q4 (t-1)	-	April	May	May
August (t)	Q2 (t)	Q4 (t-1)	April, May	June	July	July
October (t)	Q3 (t)	Q1 (t)	July	August	September	September
December (t)	Q3 (t)	Q2 (t)	-	October	November	November
February (t)	Q4 (t)	Q2 (t)	October, November	December	January	January

Note: (1) t indicates the current fiscal year. (2) During the April MPC round, the latest GDP estimates are available with a lag of two quarters *i.e.* till Q3 (t-1). However, the availability of the implicit data for Q4 (t-1) estimated using the second advance estimates for the preceding full year reduces the lag to one quarter.

Why Weekly Monitoring?

Till the time period 't', though even the estimate of Q1 is not released, the weekly indicators provide information for the period till the 20th week which effectively covers more than half of the quarter 2 as well.

t

Annual and Quarterly GDP

Year N

| Quarter 1 | Quarter 2 | Quarter 3 | Quarter 4 |

Monthly and Weekly Indicators

M 1 · M 2 · M 3 · M 4 · M 5 · M 6 · M 7 · M 8 · M 9 · M 10 · M 11 · M 12

W 1 · W 2 · W 3 · W 4 · W 5 · W 6 · W 7 · W 8 · W 9 · W 10 · W 11 · W 12 · W 13 · W 14 · W 15 · W 16 · W 17 · W 18 · W 19 · W 20 · W 21 · W 22 · W 23 · W 24 · W 25 · W 26 · W 27 · W 28 · W 29 · W 30 · W 31 · W 32 · W 33 · W 34 · W 35 · W 36 · W 37 · W 38 · W 39 · W 40 · W 41 · W 42 · W 43 · W 44 · W 45 · W 46 · W 47 · W 48 · W 49 · W 50 · W 51 · W 52

Weekly Tracking in Central Banks

Central Bank/ Agency	Description of the Index	Methodologies	Activity Tracking
Federal Reserve Bank of New York	Weekly Economic Index comprising a set of 10 HFIs	Principal Component Analysis (PCA), DFM	Gives weekly picture of the real economic activity based on the latest available dataset at a fixed vintage, used to nowcast quarterly GDP
IMF	Weekly and monthly indicators of the respective economies are aggregated to quarterly frequency to nowcast the GDP	DFM and Machine learning	Nowcasting GDP of European Economies
OECD	Provides an estimate of weekly GDP based on the Google Trends search data and machine learning	Machine learning	Two trackers estimating – i. Weekly GDP relative to the same week in the previous year. ii. GDP level Tracker provides estimates of the level of weekly GDP relative to 2019 Q4
Banque De France	Nowcasting World GDP growth with monthly and weekly indicators	FA-MIDAS	Nowcasting model of annual world GDP growth incorporating weekly data which give weekly forecasts close to IMF and OECD projections, but with a 1 to 3 months lead.
Banca D'Italia	Italian Weekly Economic Index (ITWEI) constructed based on 12 daily/weekly indicators	PCA	Single factor constructed using PCA which is then normalised to match the mean and standar deviation of the Italian GDP
Deutsche Bundesbank	Mixed frequency dataset comprising readily available weekly HFIs along with the monthly industrial output and latest GDP estimate	PCA	Rolling 13-week growth rate index and at the quarter-end, the values of the index can be interpreted approximately as q-o-q rate of change.

Other Nowcasting Studies in RBI

Study	Description
Nowcasting Using a Hybrid Machine Learning Framework	Nowcast growth in Gross Value Added (GVA) using high frequency payment system data for India. The study adopts a hybrid machine learning approach using MIDAS in combination with Support Vector Machine (SVM). .
Real Time Monitoring of Indian Economy	Two different weekly indices – (i) a 7-indicator weekly activity index (WAI) using the dynamic factor model reflecting changes in economic activity on a year-on-year basis; (ii) a 15-indicator weekly diffusion index (WDI) reflecting directional movement on a sequential basis
Nowcasting Global Growth	Bridges the gap between the availability of and the arrival of global GDP estimates and higher frequency indicators of global economic activity.
State of the Economy	27 monthly indicators based **Economic Activity Index** (EAI), representing industry, services, global and misc. activities to gauge underlying state of the economy Provide separate nowcast for Industrial and services sector
Nowcasting Indian GDP growth using a Dynamic Factor Model	Early estimate of current quarter GDP growth, by constructing single-index dynamic factors (DFs) using a sequentially expanding list of 6, 9 and 12 high-frequency indicators.
Nowcasting Real Estate Activity in India	Big Data Analytics to nowcast the sales growth of real estate companies using Google search data. Search intensity information improves precision relative to other benchmark approaches.

Monthly/Quarterly Indicators for Nowcasting

Gross Value Added (Supply Side)	
I. Agriculture	**III. Services**
Tractor Sales	Consumption of Steel
Fertiliser Sales	Sales of Commercial Vehicles
II. Industry	Cargo Handled at Major Sea Ports
Core Eight Industries	Cargo Handled at Airport
Production of Coal	Domestic
Production of Crude oil	International
Production of Cement	Passengers Handled at Airport
Production of Natural Gas	Domestic
IIP	International
Mining	Railways
Manufacturing	Net Tonne Kilometres
Electricity	Passenger Traffic
PMI Manufacturing	PMI Services
	Aggregate Bank Credit and Deposit
	Total Telephone Subscribers

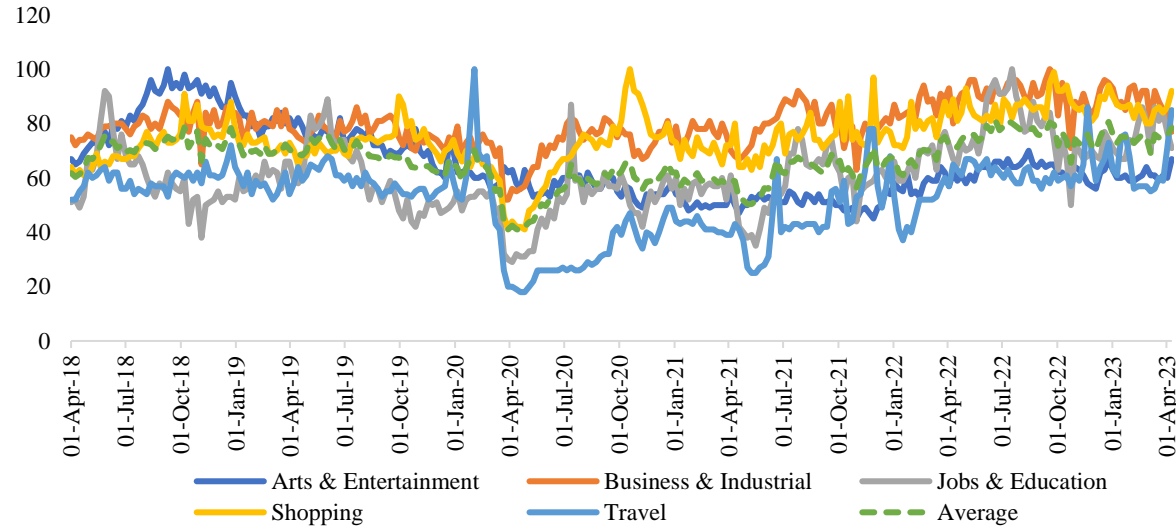| Gross Domestic Product (Demand Side)	
I. Investment Demand	**IV. Consumption Demand**
Cement Production	Fuel Consumption
Steel Consumption	Motor Spirit (Petrol)
IIP	High Speed Diesel
Infra./construction goods	Aviation Turbine Fuel
Capital Goods	Automobile
Import of Capital Goods	Commercial Vehicle Sales
II. Fiscal	Domestic Automobile Sales
Capital Expenditure	Two-wheeler Sales
Central Govt. Revenue Exp. excl. Interest payment & Subsidies	Motor Vehicle Registration
GST Collection	IIP
E-Way Bills	Consumer Durables
III. External Sector	Consumer Non-durables
Merchandise Exports	**V. CPI and WPI**
Merchandise Imports	CPI General
Non-Oil Non-Gold Imports	WPI All, Food, Mineral & Manuf.

Set of Weekly/Daily Data

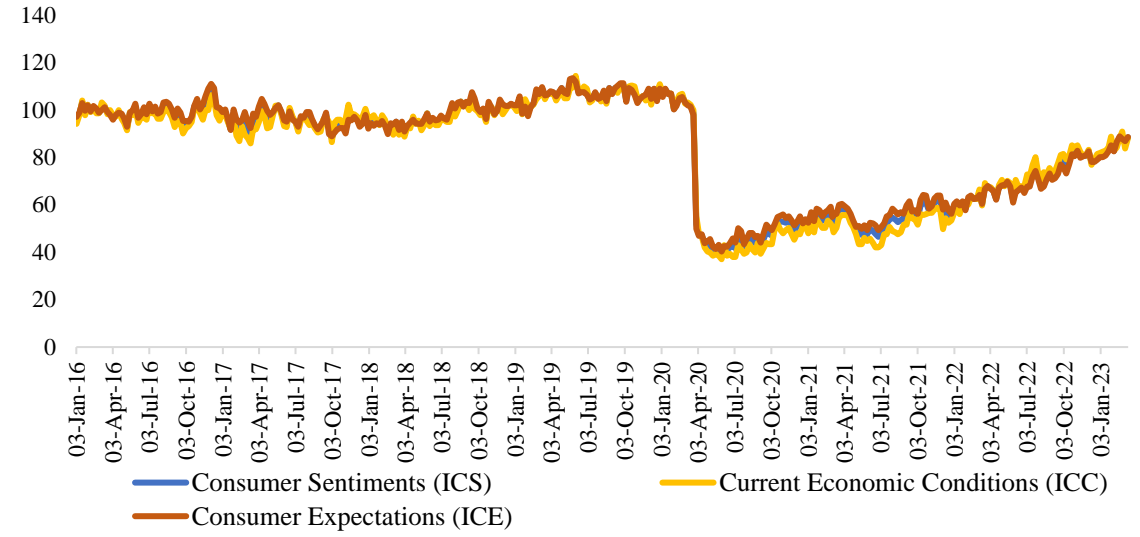| S. No.	Category	Indicators	Frequency	Source
1	Soft (4)	Google Trends	Daily	Google
2		Consumer Sentiment Index	Weekly	CMIE
3		Consumer Expectation Index		
4		Current Economic Conditions Index		
5	Labour (2)	Unemployment Rate (%)	Weekly	
6		Labour Participation Rate (%)		
7	Demand (4)	Electricity Generation	Daily	Power System Operation Corporation Limited
8		Air Cargo Traffic		Airport Authority of India (AAI)
9		Railway Freight Loading		Ministry of Railways
10		Motor Vehicle Registration	Weekly	Ministry of Road Transport and highways
11	Mobility (4)	Railway Passengers	Daily	Ministry of Railways
12		Mobility (Retail, Grocery, Park, Transit & Workplace)		Google
13		Aircraft Traffic		AAI
14		Airport Footfall		AAI
15	Payments (3)	RTGS	Daily	RBI
16		Retail Payments		
17		ATM and AePS Withdrawal		

Note: Retail Payments include NEFT, UPI, IMPS, BBPS, CTS, AePS and NACH.

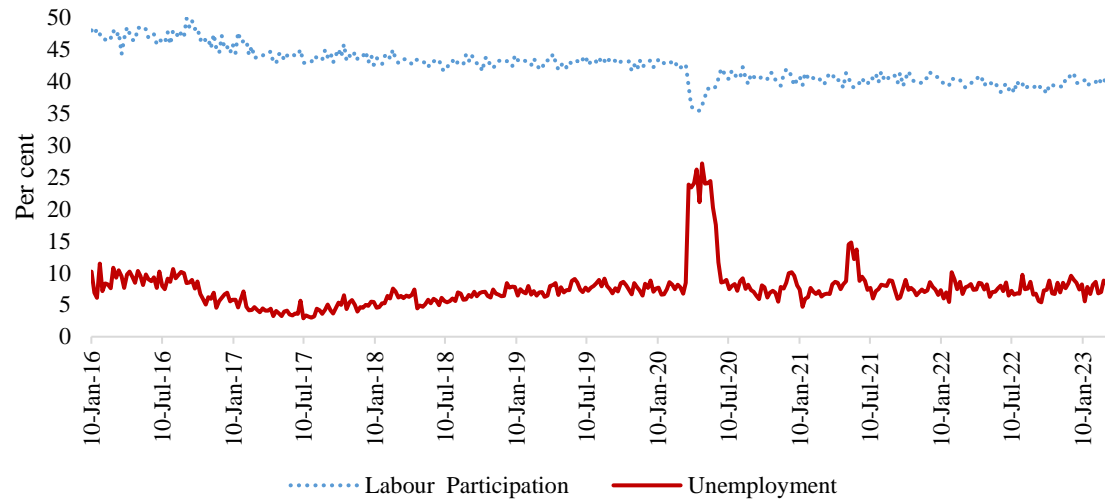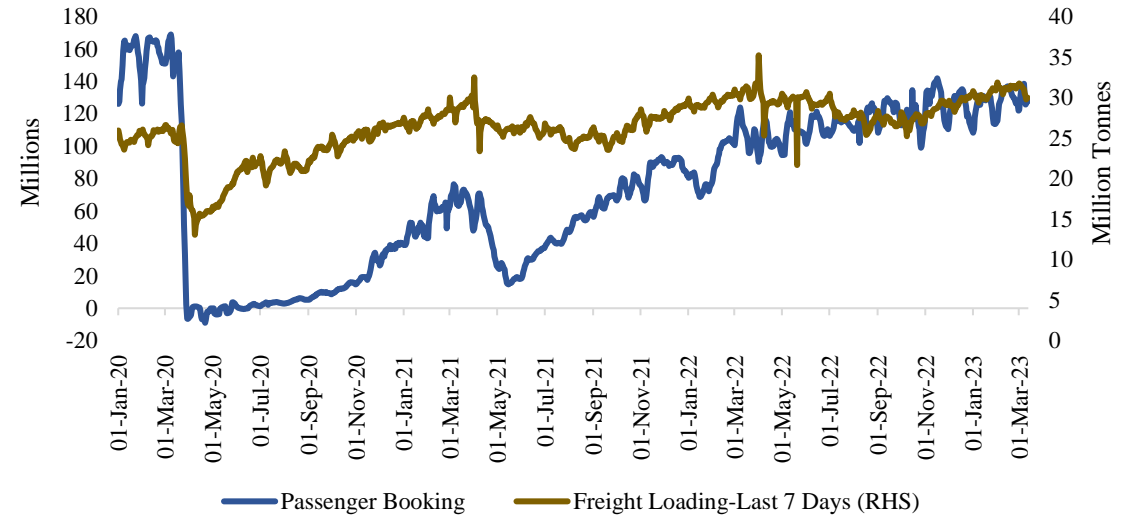# Constituent Indicators: Recent Trends (1/3)

Google Trends

Legend: Arts & Entertainment, Business & Industrial, Jobs & Education, Shopping, Travel, Average

CMIE Sentiment Indices

Legend: Consumer Sentiments (ICS), Current Economic Conditions (ICC), Consumer Expectations (ICE)

CMIE Labour Market

Legend: Labour Participation, Unemployment

Rail Passenger & Freight

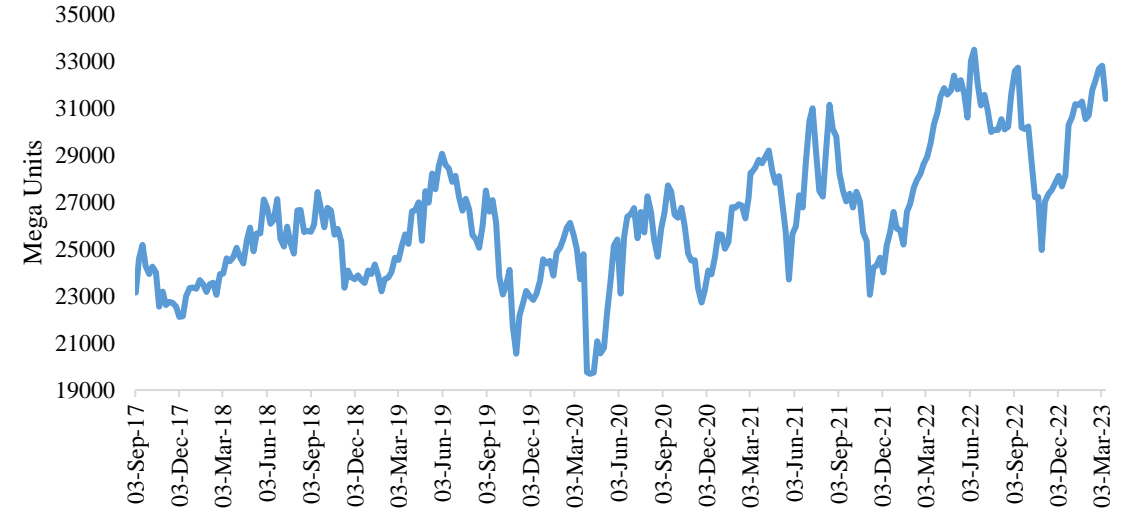Legend: Passenger Booking, Freight Loading-Last 7 Days (RHS)

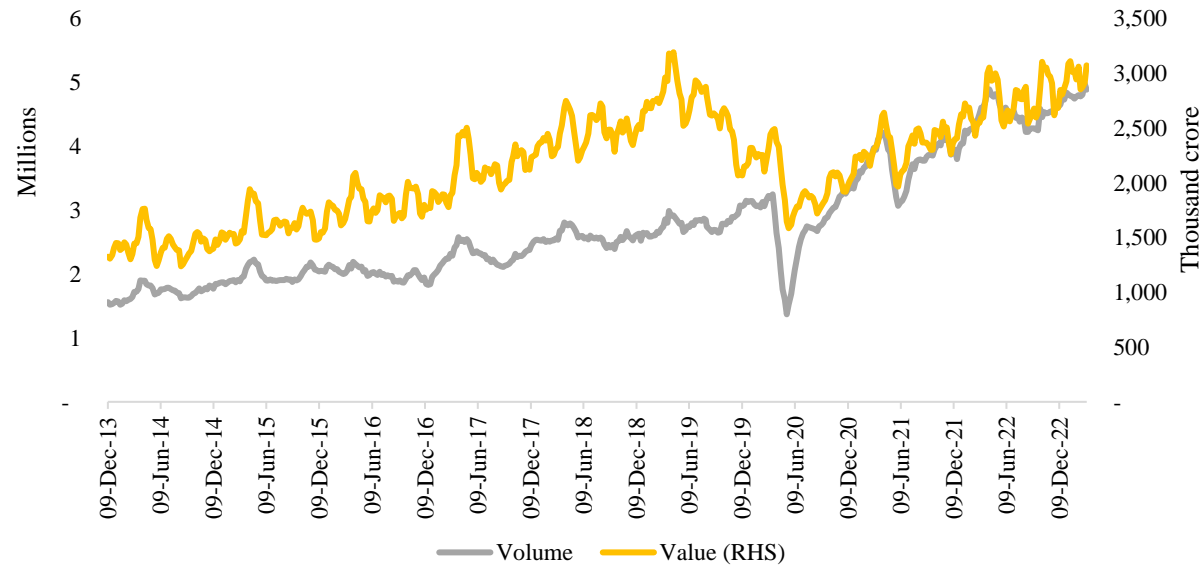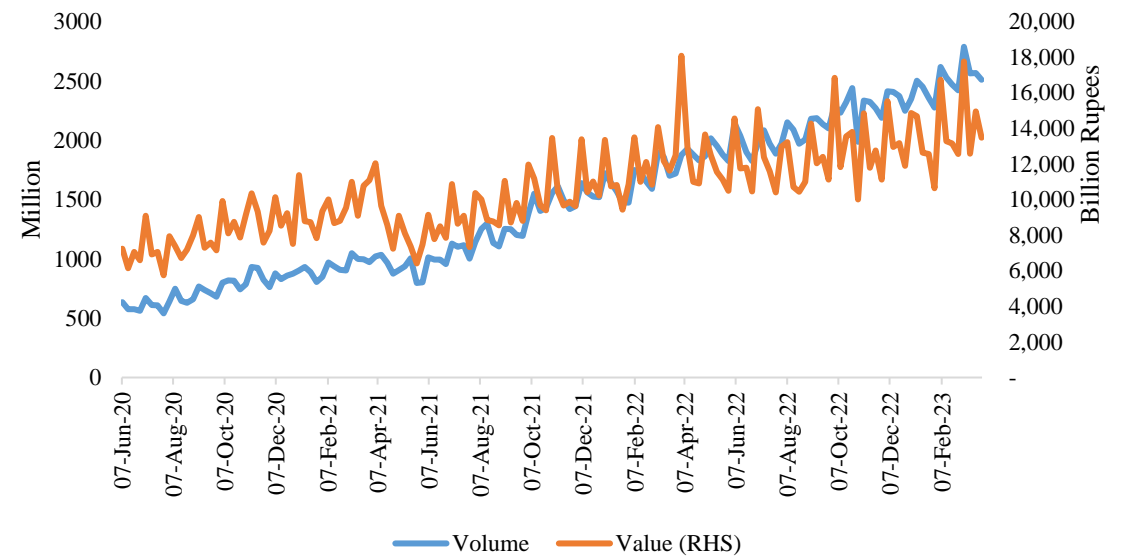# Constituent Indicators: Recent Trends (2/3)

Registered Motor Vehicles
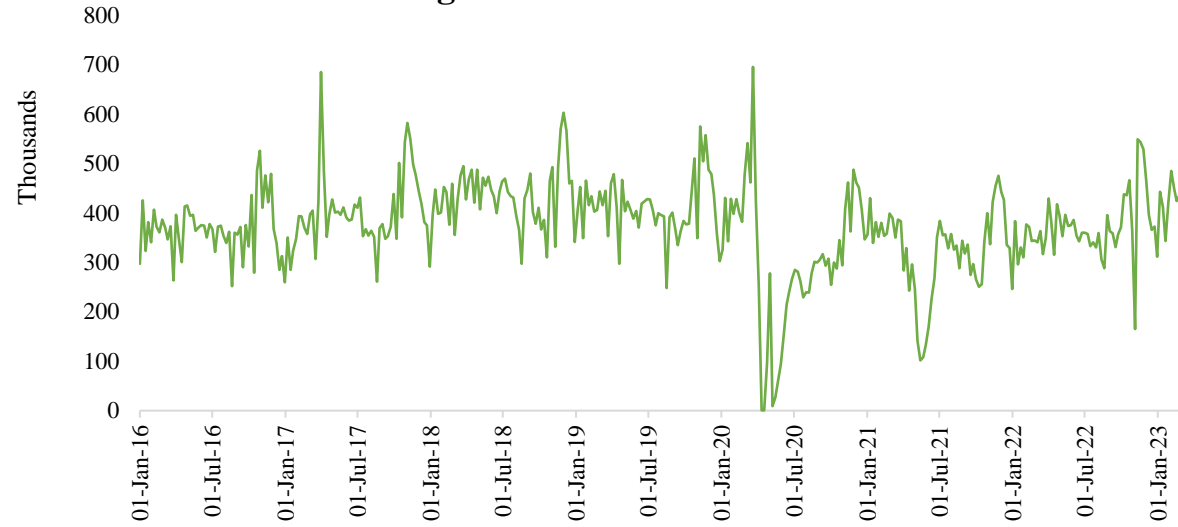
Electricity Generation

RTGS (Customer and Interbank)

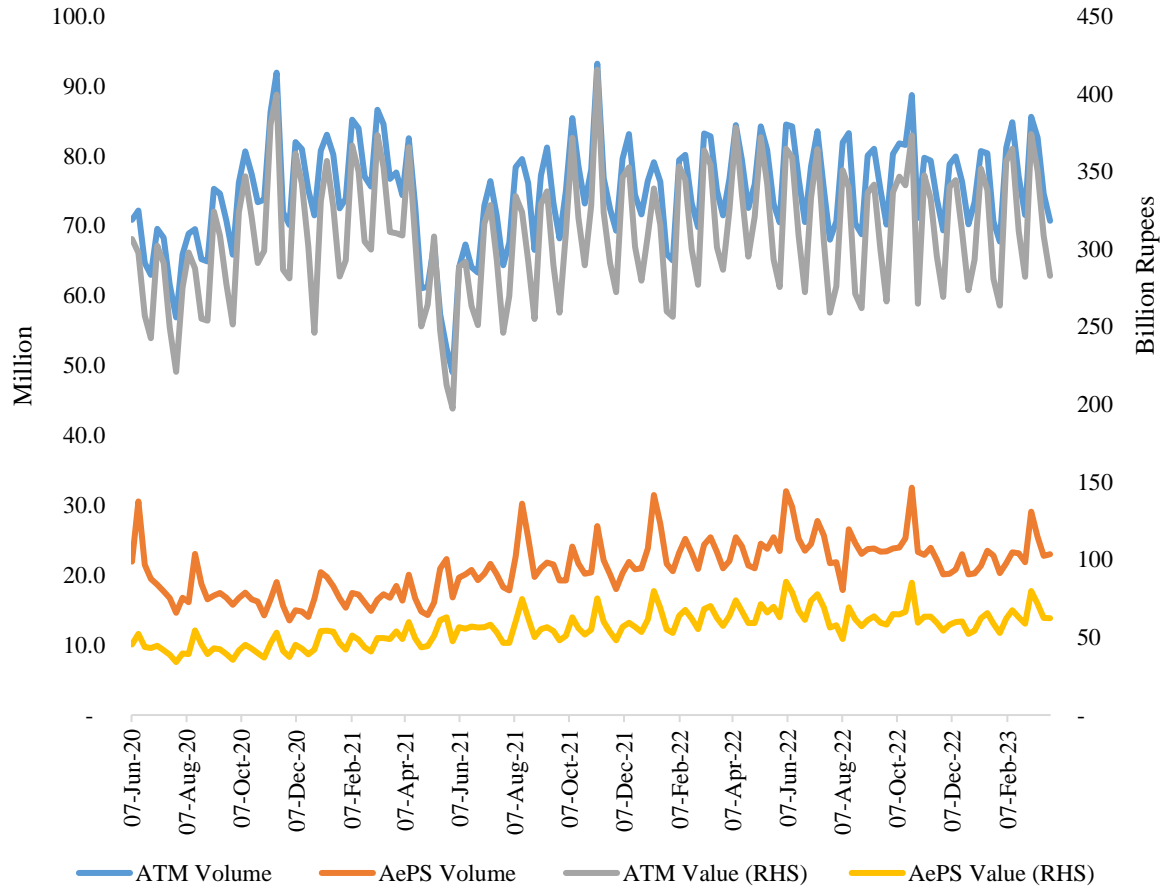**Retail Payments**

Constituent Indicators: Recent Trends (3/3)

Cash Withdrawals

Legend: ATM Volume, AePS Volume, ATM Value (RHS), AePS Value (RHS)

Air Traffic

Legend: Cargo Traffic, Aircraft Traffic, Airport Footfall (RHS)
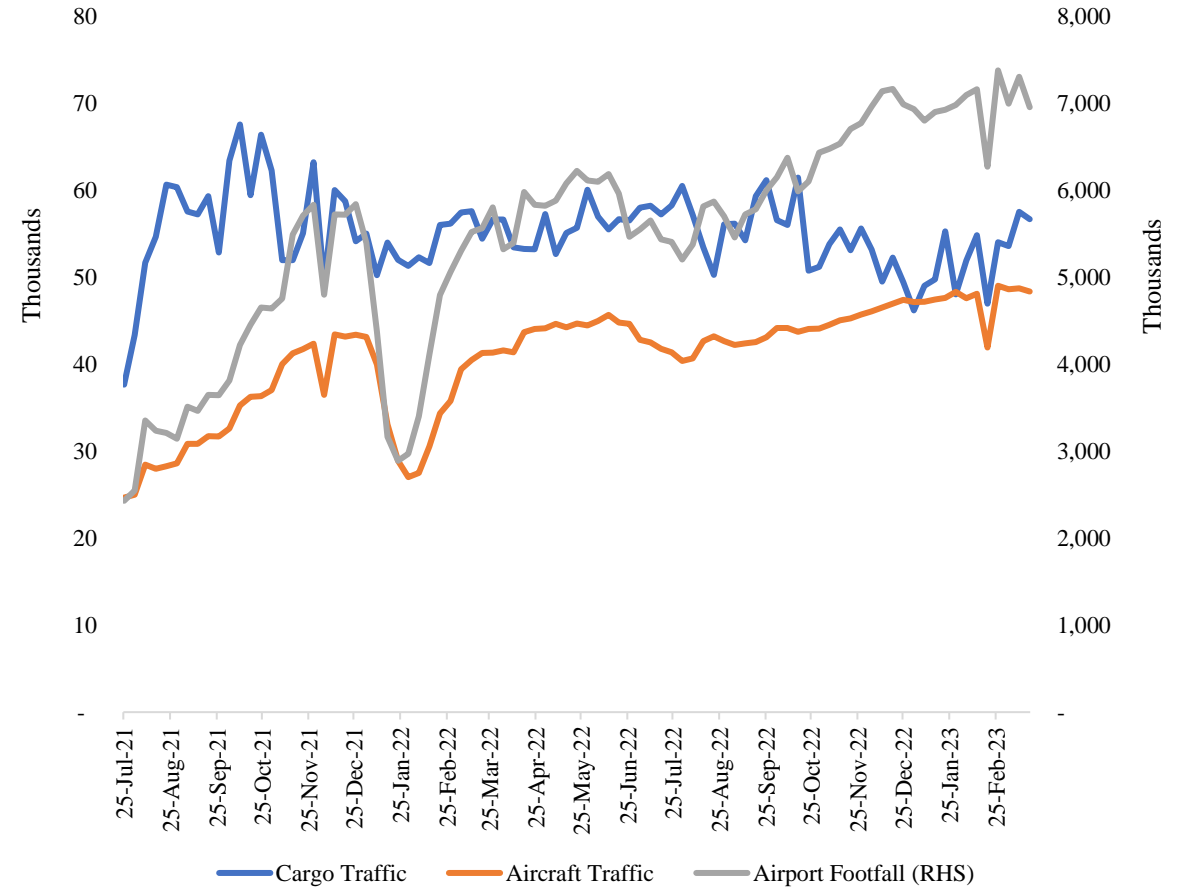
Indicator Selection

Table 4a: Correlation Matrix with Quarterly GDP growth

	CSENT	LFPR	Un Rate	ElecGen	MVReg	RTGS	Google Trend
CSENT	1.00						
LFPR	0.82***	1.00					
Un Rate	0.33	0.37	1.00				
ElecGen	0.46*	0.61**	0.49*	1.00			
MVReg	0.21	0.55**	-0.29	0.46*	1.00		
RTGS	0.55**	0.75*	0.30	0.83***	0.64**	1.00	
Google Trend	0.70***	0.56**	0.54**	0.80***	0.24	0.60**	1.00
GDP	**0.78***	**0.90***	**0.55**	**0.86***	**0.48*	**0.86***	**0.81***

Note: ***$p < 0.01$; **$p<0.05$; *$p < 0.1$.

Table 4b: Correlation Matrix with IIP Growth

	CSENT	LFPR	Un Rate	ElecGen	MVReg	RTGS	Google Trend
CSENT	1.00						
LFPR	0.74***	1.00					
Un Rate	0.33**	0.40***	1.00				
ElecGen	0.40***	0.66***	0.51***	1.00			
MVReg	0.13	0.53***	-0.01	0.56***	1.00		
RTGS	0.51***	0.68***	0.28*	0.72***	0.36**	1.00	
Google Trend	0.67***	0.57***	0.54***	0.76***	0.25*	0.53***	1.00
IIP	**0.40***	**0.79***	**0.34**	**0.87***	**0.83***	**0.69***	**0.59***

Note: ***$p < 0.01$; **$p<0.05$; *$p < 0.1$.

Evolving Nowcasting Models

Dynamic Factor Model
Monthly Indicators

Constructed using only the monthly indicators

Monthly Factor

Factor Augmented MIDAS

Weekly Activity Index (WAI)
7 Indicators

Weekly Diffusion Index (WDI)
15 Indicators

WAI reflects changes in economic activity on a year-on-year basis

WDI Reflects directional movement on a sequential basis which compliments the model-based WAI

Weekly Factor

Contribution of this study where the monthly DFM is augmented by factor based on weekly indicators

Nowcast Results : FA-MIDAS Best Performing

- Performance of the benchmark Seasonal ARIMA (SARIMA) model is compared with the DFM with only monthly indicators and the FA-MIDAS model which comprises factors from a set of both monthly as well as weekly indicators

- Including the weekly information is found to be useful in terms of lower forecast error than the monthly DFM as well as SARIMA model

Out of Sample Nowcast of GDP Growth
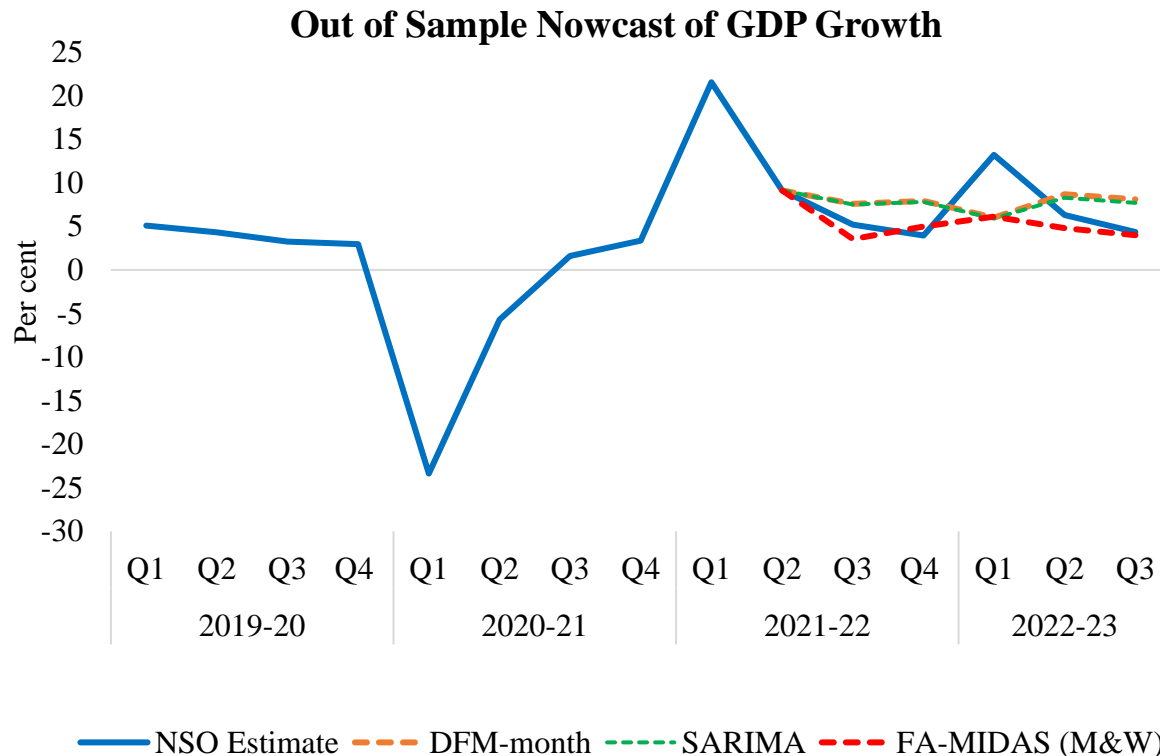
Performance of Nowcast Models			
Out of Sample (Q3:FY22 - Q3:FY23)	**RMSE**	**MAE**	**Theil's U**
FA-MIDAS (M&W)	**3.37**	**2.35**	0.74
SARIMA	3.90	3.43	0.79
DFM-month	4.01	3.54	0.80
Pre-pandemic (Q1:FY06 - Q4:FY20)			
SARIMA	1.35	0.98	0.52
DFM-month	0.96	0.41	0.44

Weekly Activity Index (WAI) and Weekly Diffusion Index (WDI)

Weekly Activity Index
(52 week percentage change)

Weekly Diffusion Index
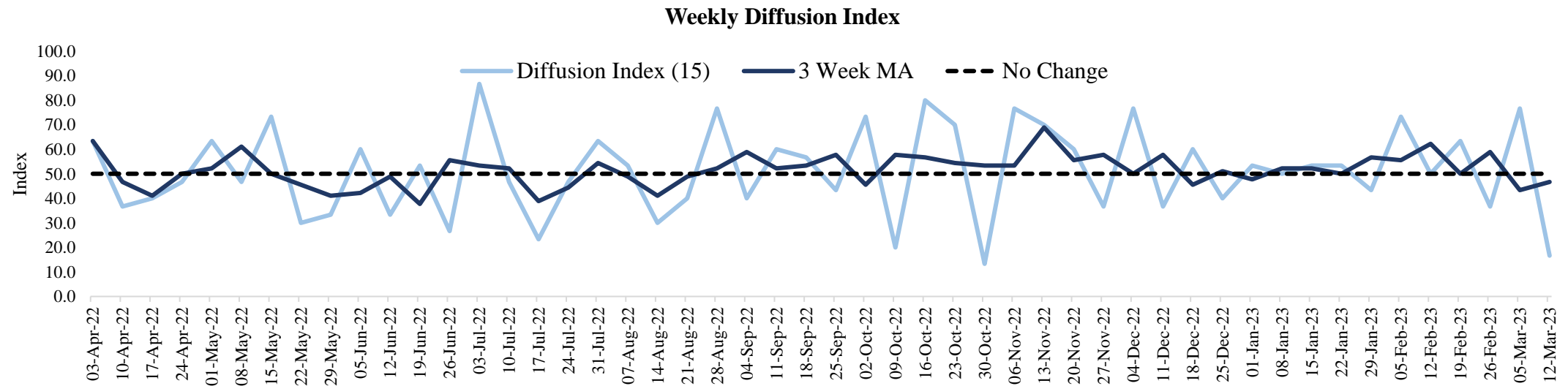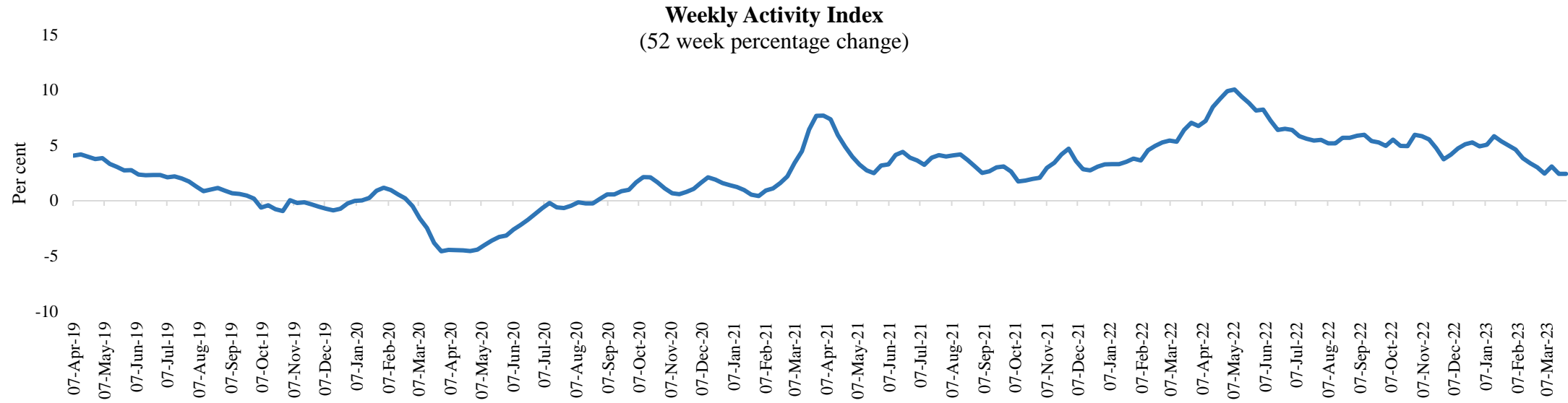
Conclusion and Way Forward

- Motivation was to adapt and upscale our pre-existing nowcasting models which appear inadequate in reflecting the atypical changes in the economy.

- With more frequent and up to date dataflow, the daily/weekly indicators allow model-based monitoring of economic activity to be more real time, thus enhancing their relevance for policy making

- FA-MIDAS model by integrating two composite indices – at monthly and weekly frequency, respectively, constructed using the dynamic factor model for the purpose of nowcasting quarterly GDP. It exhibits the lowest nowcast errors in the post pandemic period,

- Presently, the set of daily and weekly high frequency indicators is limited but growing at a fast pace since the outbreak of the pandemic.

Thank you !