

# Measuring the Impact of Supply Chain Disruption on Inflation in India

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October 25, 2024

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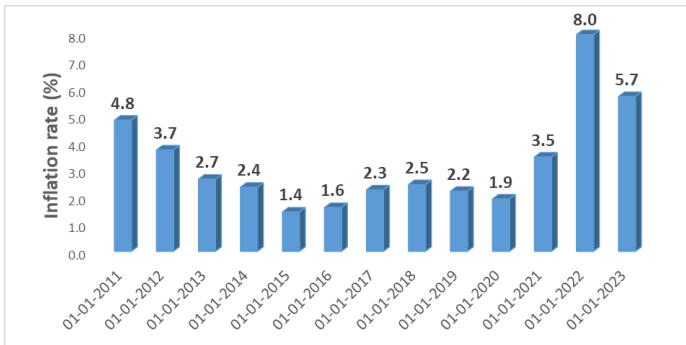
# Outline

- Background
- Alternative measures of supply disruption for India
- Conceptual framework and choice of variables
- Findings
- Conclusion

# Part I

## Background

Average global inflation being stable at 2.5% in the decade of 2011-2020, increased to 5.7% in the beginning of the current decade



Source: World Bank

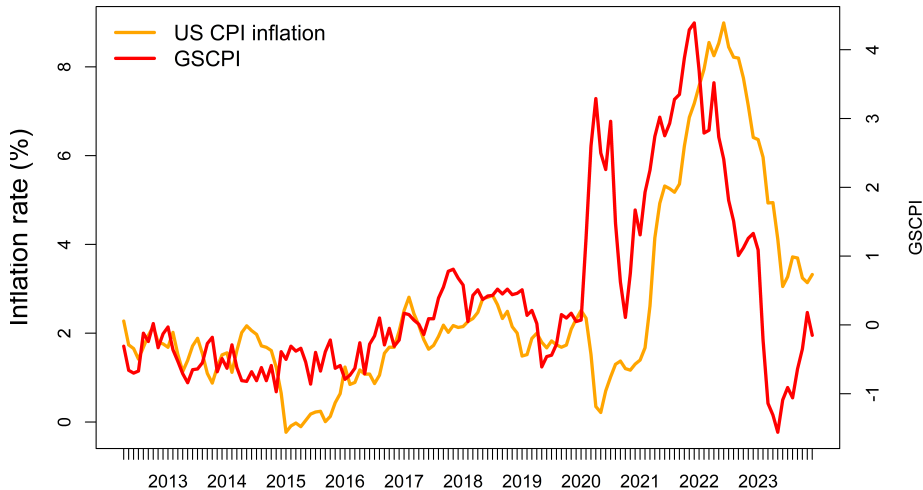
- Global inflation was modest in 2020 due to negative oil price shock
- Inflation paced up from 2021, spiked in 2022 due to pandemic induced supply disruptions across the world

# Expanding literature highlights significant role of supply disruption for surge in inflation since Covid outbreak

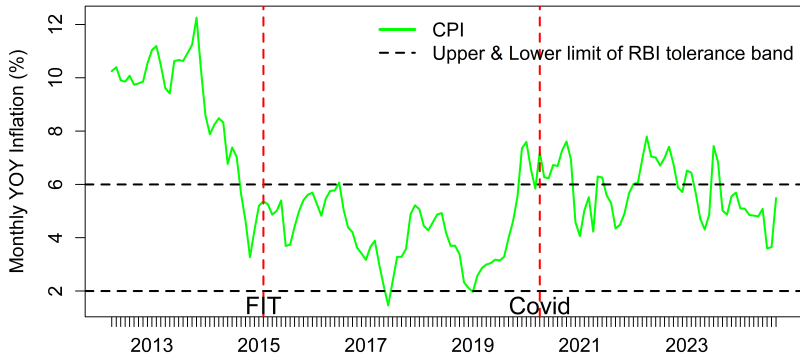
- Giovanni et al. (2022, NBER); Comin et al. (2024, NBER); Ascari et al. (2024, JIMF); Diaz et al. (2024, Economic Modelling); Andriantomanga et al. (2023, IMF), Yousuf (2024, Bangladesh Bank); Ye et al. (2023, Geological Journal)
- Measure of Supply Chain Disruption: **Global Supply Chain Pressure Index (GSCPI)** of Federal Bank of New York
  - Based on information from transportation and manufacturing sector
  - **Baltic Dry Index (BDI)** of Baltic Exchange providing information on average prices paid for the transport of dry bulk materials across more than 20 routes

- **Harpex** (Harper Petersen Charter Rates Index) providing information on worldwide price development on charter market for container ships
- **Airfreight cost indices** from the U.S. Bureau of Labor Statistics
- Components of **Purchasing Managers' Index (PMI) Manufacturing**, across seven interconnected economies: China, Euro area, Japan, South Korea, Taiwan, United Kingdom, and United States

# Example: Supply disruption index leads U.S. inflation since 2020



## Headline inflation in India exceeded the upper limit of RBI's tolerance band several times during and post covid period



Source: CSO, MOSPI

- India adopted Flexible Inflation Targeting (FIT) in Feb, 2015
- Average headline inflation high in pre-FIT at 8.8%, stabilised to 4.3% post FIT and till pandemic break out, increased to 5.7% afterwards



# How did supply disruption affect inflation in India?

- India story not yet explored in the literature
- We explore the effect of supply chain disruption in inflation in India
  - Using a Time Varying Parameter VAR (TVP-VAR) model to explore the pattern of the impact over time
  - Develop a small scale DSGE model with cost-push shock to identify relative importance of various shocks, including supply disruption for inflation during and in the post-Covid period

## Part II

# Measures of supply disruption for India

# Three alternative measures of supply chain disruption for India

- 1 **GSCPI**
- 2 **ISPI:** Index of Supply Chain Pressure for India (RBI Bulletin April 2022)
- 3 **Input Cost Index** of HSBC India PMI

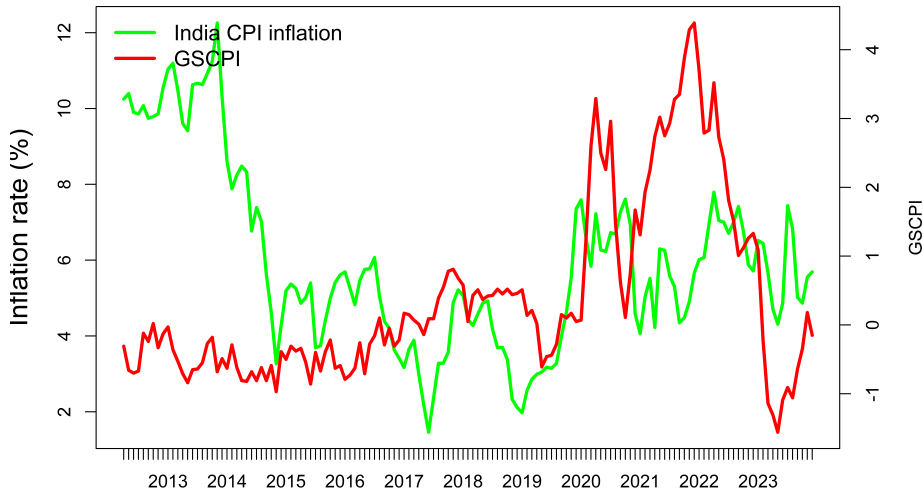
Table: Indicators in ISPI

List of Variable	Item/Sub-item	Source
Inbound Port Traffic	Unloaded, Cargo Traffic at Major Ports	CMIE
Outbound Port Traffic	Loaded, Cargo Traffic at Major Ports	CMIE
Rail Cargo	Railway Goods Traffic	CMIE
Truck Freight	Truck Freight Rates from Delhi to Various Cities in India	CMIE
Domestic Air Cargo	Cargo handled at India's Domestic Airport	CMIE
India SDT	Suppliers' Delivery Times, India Manufacturing PMI	IHS Markit
India Stock Purchases	Stock of Purchases, India Manufacturing PMI	IHS Markit

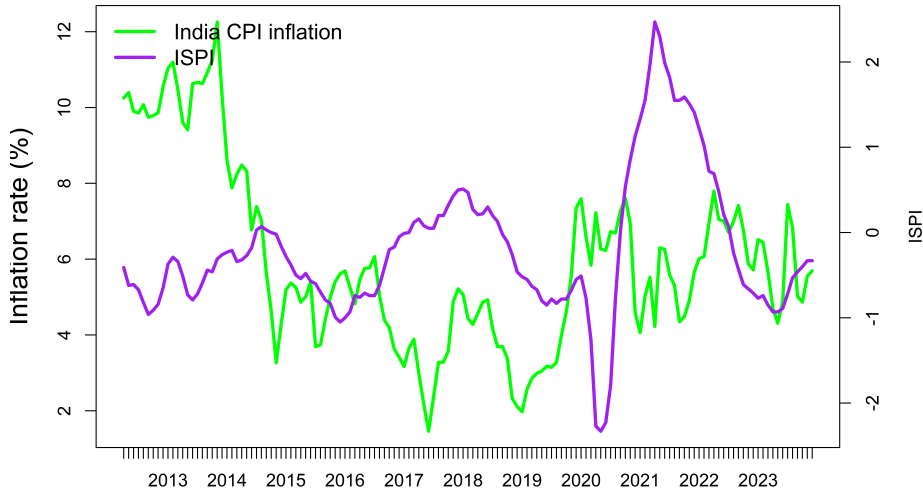
List of Variable	Item/Sub-item	Source
India Backlog	Backlogs of Work, India Manufacturing PMI	IHS Markit
China SDT	Suppliers' Delivery Times, China Manufacturing PMI	IHS Markit
China Backlog	Backlogs of Work, China Manufacturing PMI	IHS Markit
Manufacturing SDT	Suppliers' Delivery Time, Global Manufacturing PMI	IHS Markit
Electronics SDT	Suppliers' Delivery Time, Global Electronics PMI	IHS Markit
US Backlog	Backlogs of Orders, US Manufacturing PMI	Institute for Supply Management (ISM)
US SDT	Suppliers' Delivery Time, US Manufacturing PMI	Institute for Supply Management (ISM)

List of Variable	Item/Sub-item	Source
Harpex	Harpex Index	Refinitiv
Baltic Dry Index	Baltic Dry Index	Refinitiv
Semiconductor	PHLX Semiconductor Sector Index	Refinitiv
Asia to US Air Freight	Inbound Price Index (International Services): Air Freight for Asia	U.S. Bureau of Labor Statistics
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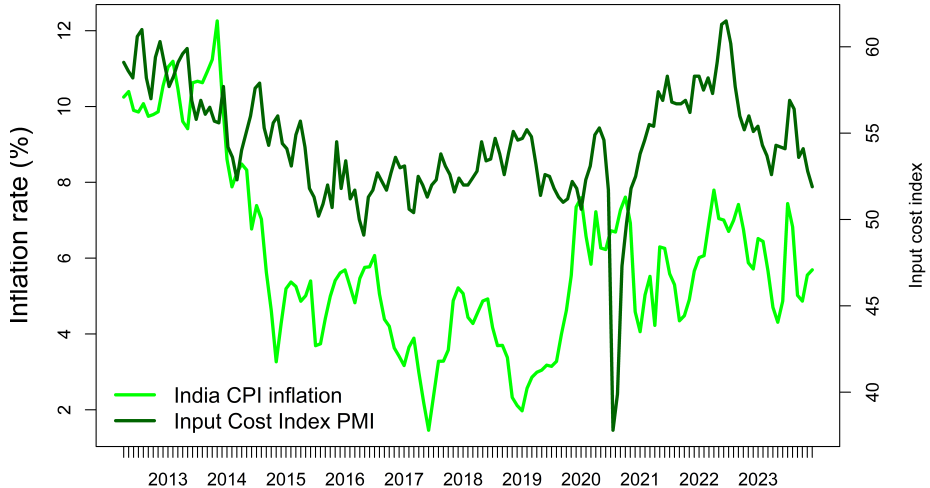
# CPI inflation mildly followed GSCPI during 2020-2023



# CPI inflation and ISPI moved in opposite directions during the sample period



# Input cost index lead CPI inflation during and post pandemic periods





## Choice of rest of variables based on a basic reduced form neo-Keynesian structure, and existing empirical literature

- **Aggregate demand:** Dynamic IS curve

$$\tilde{y}_t = \alpha_1 \tilde{y}_{t-1} - \alpha_2 E_t \pi_{t+1} + \alpha_3 i_t - \alpha_4 \hat{e}_t + \epsilon_t^y$$

- **Aggregate supply:** Expectations-augmented Phillips curve

$$\pi_t = \beta_1 \pi_{t-1} + \beta_2 E_t \pi_{t+1} + \beta_3 \tilde{y}_t + \beta_4 \hat{e}_t + \beta_5 \Psi_{t-1} + \epsilon_t^\pi \quad (1)$$

Where  $\Psi_t$  includes global food inflation, WPI inflation, and supply disruption

- **Monetary policy response of central bank:** Taylor-type rule

$$i_t = \delta_1 i_{t-1} + \delta_2 E_t \pi_{t+1} + \delta_3 \tilde{y}_t + \epsilon_t^i \quad (2)$$

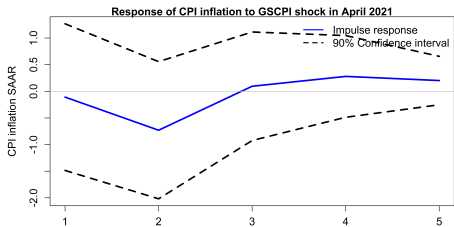
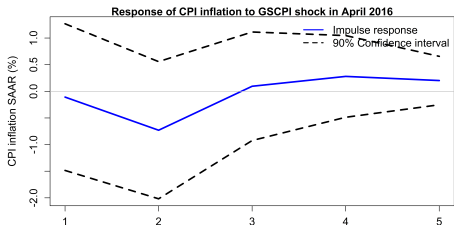
# Data

- Monthly macroeconomic indicators of India for period April 2011 to December 2023
- Real non-food credit for capturing demand pressure (RBI, CSO, MOSPI)
- CPI 2012 base (CSO, MOSPI)
- Three months ahead average expected inflation of households (RBI's survey based households' inflation expectation)
- Repo rate (RBI)
- Re/\$ Exchange Rate (RBI)
- Global food prices (World Bank, Pink Sheet)
- WPI food articles price (Office of Economic Adviser)

# Part III

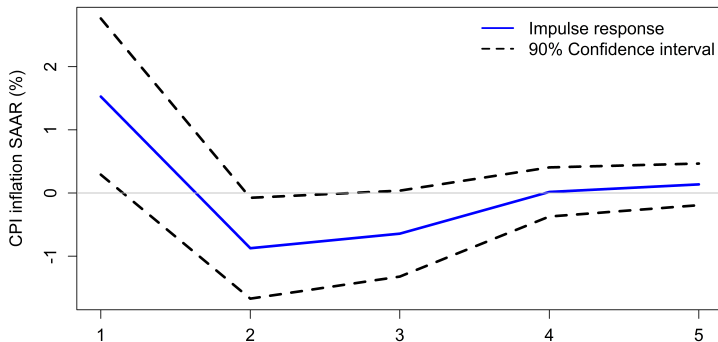
## Role of GSCPI

# No significant impact of GSCPI on CPI inflation



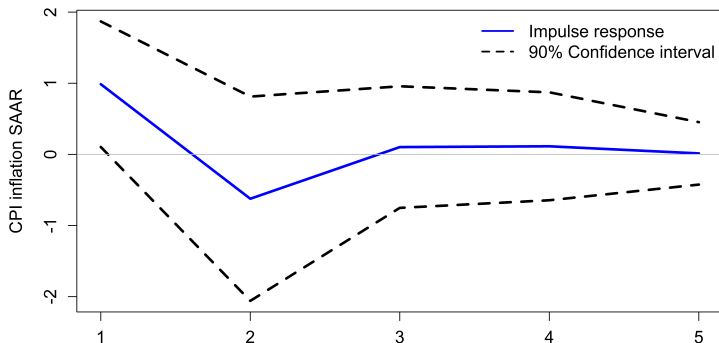
# An increase in WPI food articles inflation increases CPI inflation significantly after one month of the shock, the impact subsides afterwards

## Impulse response of CPI inflation to a shock to WPI food articles inflation in April 2016



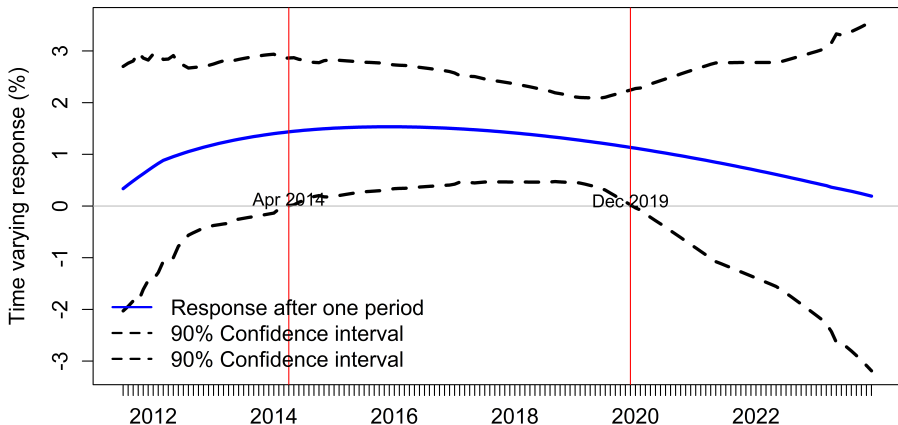
# An increase in global food inflation increases CPI inflation significantly after one month of the shock, the impact subsides afterwards

## Impulse response of CPI inflation to a shock to global food inflation in Jun 2020



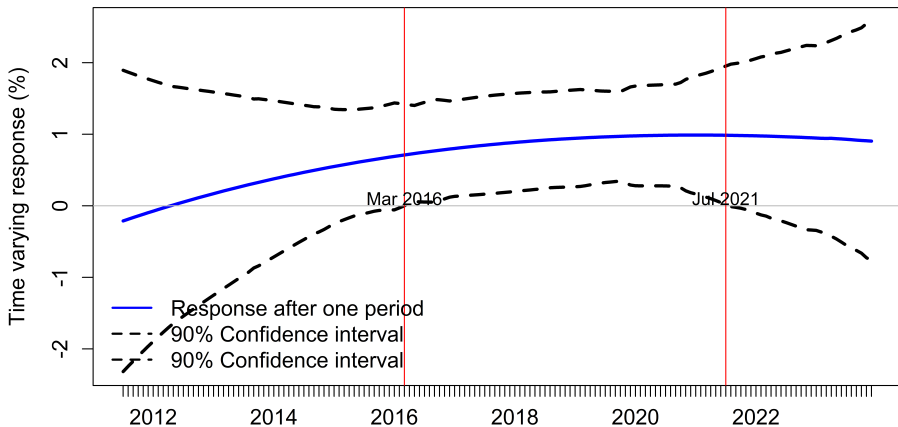
# WPI food articles inflation was a significant driver of headline inflation during April 2014- Dec 2019

Time varying impulse response of CPI inflation after one period of a WPI food articles inflation shock



# Global food inflation was a significant driver of headline inflation during March 2016- July 2021

Time varying impulse response of CPI inflation after one period of a global food inflation shock

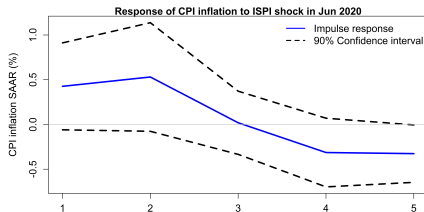
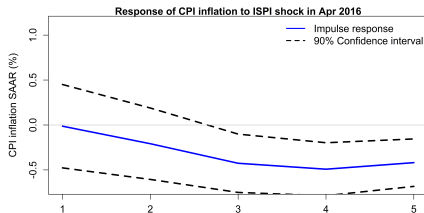




# Part IV

## Role of ISPI (RBI)

# Initially, a negative relation between CPI inflation and ISPI found, however, pattern of response changed during Covid

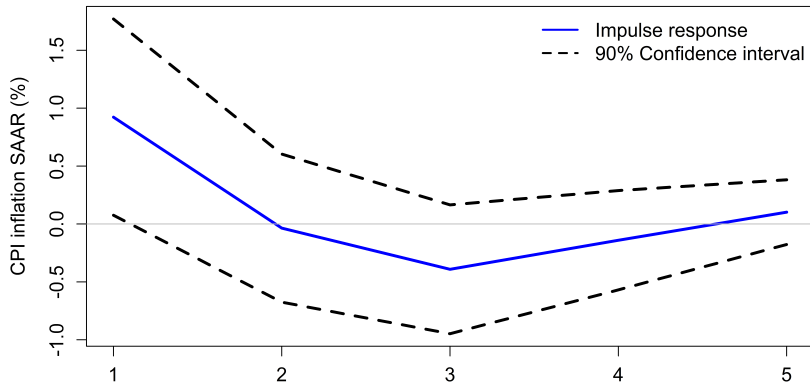


# Part V

## Role of Input Cost Index

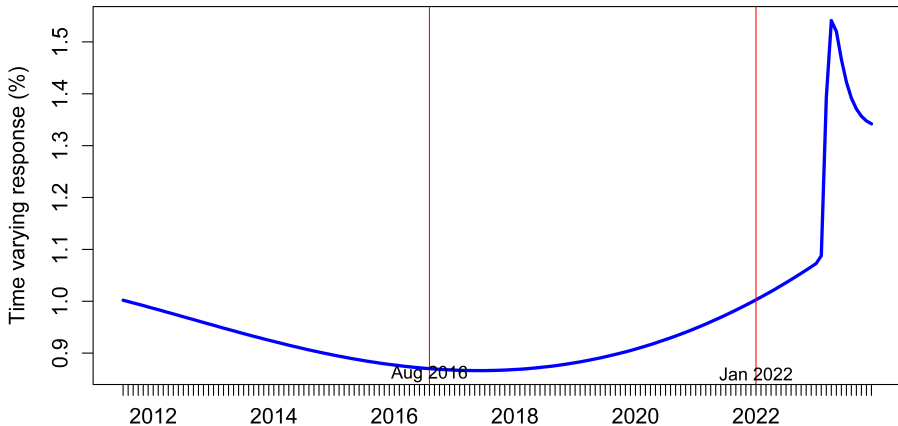
# During covid, input cost pressure had a significant positive impact on inflation

## Impulse response of CPI inflation to a shock to Input cost index in Apr 2020



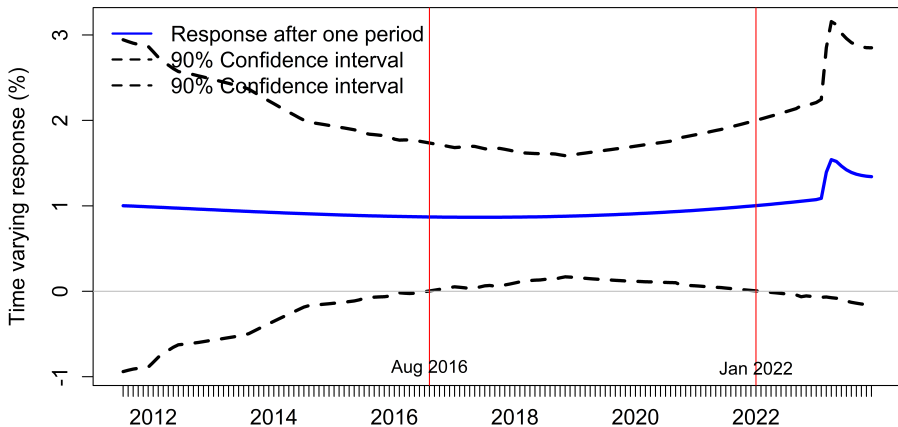
# Impact of input cost pressure was rising since August 2016, with highest impact observed in April 2023

Time varying impulse response of CPI inflation after one period of a input cost pressure shock



# Input cost pressure was a significant driver of headline inflation during August 2016- January 2022

Time varying impulse response of CPI inflation after one period of a input cost pressure shock



# Conclusion

- Different factors driving Headline inflation with their significance changing over time
- Supply disruption moderately contributed to inflation in India via input cost channel during and post pandemic period
- WPI food articles inflation, capturing domestic supply shocks in food sector was a major driver of food inflation till 2019
- Global food inflation also contributed to CPI inflation till mid 2021
- **To assess the role of supply disruption in inflation dynamics of India, a suitable measure of supply disruption for India including information on supply pressure in food commodity market is essential**

Thank you