How did Transition to the GST Regime Affect Inflation in India?

No. 405
06-February-2024
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How did Transition to the GST Regime Affect Inflation in India?[1]

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Abstract

Indian indirect tax regime shifted from multiple tax system to a uniform rate value added Goods and Services tax regime on the 1st July 2017. There have been long standing public debate on probable costs and benefits of GST regime replacing long-existed multiple tax regime. In the cost side, while producers and sellers may have to incur some fixed cost at the beginning of the regime to comply with the government rates and structures, shift to GST system is expected to reduce prices via reducing cascading effects of multiple tax layers and increasing efficiency of the logistics and distribution system. Empirical literature on both advanced and developing economies suggest mixed impact of adopting GST system on inflation. This paper contributes to this literature by investigating effects of GST system on CPI, WPI inflation and their major components namely food and core inflation in India. Applying intervention method in a multivariate framework, controlling for other macroeconomic shocks and duration of intervention endogenously identified using structural breaks in inflation series, *we find a positive effect of GST on headline inflation in India via inflationary impact on retail food prices.*

JEL Classification: C54, E31, E65

Keywords: GST, Inflation, Structural breaks, Intervention method, India.

[1] We are grateful to the participants at the NIPFP Conference on Impact of GST on Indian Economy for their valuable and constructive comments that helped in improving the paper. We are indebted to Sacchidananda Mukherjee and Pulapre Balakrishnan for their valuable insights and inputs and critical comments towards enriching the paper.

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1 Introduction

Indian indirect tax regime shifted from multiple tax regime to a Uniform rate value added Goods and Services tax regime on the 1st July 2017. The new regime is a dual VAT system with concurrent taxation power to the union (federal) and state (provincial or sub-national) governments (Mukherjee, 2020). Under this new system, Central GST (CGST), GST accrued to states and UTs (SGST/UTGST) and Integrated GST (IGST) were levied at rates that have been mutually agreed upon by the states and Centre. At the initial implementation phase, GST was levied under the following slabs of 0%, 5%, 12%, 18%, and 28%. In January 2018, the regime was undergone various changes including exemption of central tax on intra-state supplies of selected goods and re-structuring of categories from under 28% to 18%.

There have been long standing public debate on probable costs and benefits of GST regime replacing long-existed multiple indirect tax system. In the cost side, while producers and sellers may have to incur some fixed cost at the beginning of the regime to comply with the government rates and structures, there are a number of potential benefits of the system conducive to reduce cost of production such as (i) promoting uniform tax structure across states, (ii) remove cascading effects of taxes (iii) help in increasing taxpayer base (iv) providing online procedures to increase ease of doing business (v) increasing efficiency of logistics and distribution system and (vi) promoting competitive pricing, consumption and growth. Hence shift to GST system is expected to reduce prices via reducing cascading effects of multiple tax layers and increasing efficiency of logistics and the distribution system.

However empirical literature on both advanced and developing economies suggests mixed impact of adopting GST system on inflation across countries. The limited studies on India, developing since the country's transition to GST regime are also inconclusive regarding the new tax regime's impact on inflation. This study aims to contribute to this literature by investigating effects of GST system on CPI, WPI inflation and their major components namely food and core inflation in India.

The present study contributes to the limited literature on inflationary consequences of GST implementation in emerging economies and proposes two major methodological innovations. First, it applies intervention method in multivariate framework, controlling for other events such as Covid-19 pandemic and various macroeconomic shocks such as weather and oil price shocks. Secondly, it applies structural break test to endogenously identify ex-post intervention dates/major events and duration of their impacts, instead of conventional method of assuming the impact to sustain till five quarters from the date of GST introduction.

We find a positive impact of GST on headline inflation in India via inflationary impact on retail food inflation. The effect persisted for around two years. Under the new regime, GST at a rate of 5% are applicable on food articles and pre-packed labelled food items such as atta, paneer and curd. However, core CPI inflation and

WPI manufacturing inflation are found to be unaffected by the change in indirect tax regime.

The rest of the paper is organised as follows: Section 2 reviews selected cross-country literature on inflationary impact of GST. Section 3 describes the data used in our analysis and Section 4 details the estimation framework. Discussions on results are in Sections 5 and 6. Section 7 discusses findings from robustness analysis and finally Section 8 concludes the paper.

2 Review of selected literature

The cross country evidence on the impact of adopting GST system on inflation are mixed. Bulk of the literature mainly based on evidence from developed economies find transitory increase in inflation following implementation of GST system. For instance Dixon and Lim (2004), while assessing various criteria for underlying inflation measures in Australia, observed temporary rise in the headline inflation accompanying introduction of GST in July 2000.

Valadkhani and Layton (2004) explored impact of GST system on inflation in Australia at the city level. Based on a quarterly panel of 8 major cities in Australia for the period 1948:Q4 to 2003:Q1, and applying intervention method, the authors found an one time 2.8% increase in inflation in Australia as a whole in the quarter of July-September, 2000, ie., the quarter when GST was introduced.

Bolton and Dollery (2005) compared effects of GST on various macroeconomic indicators including price in three developed economies, namely Australia, New Zealand and Canada. These countries adopted GST system in the years 2000, 1986 and 1991 respectively. All the three countries were found to experience an immediate spike in the price level in the respective year of GST introduction, followed by decline in inflation rate in the subsequent year. In a more recent study, while Canada was found to experience a rise in CPI post GST introduction, no significant effect was found for UK replacing Purchase Tax by GST in 1973 (Gelardi, 2014).

In line with developed economies, empirical evidence on the effect of GST on prices are inconclusive for developing economies as well. Sahoo et al. (2017) studied post-implementation impact of GST on inflation for eleven developing and developed countries. The sample included Australia, Singapore, Japan, Canada, China, Greece, Portugal, Thailand, New Zealand, Maldives and Vietnam. Using intervention framework, no significant effect of GST on inflation was found in the sample countries, except for China, Portugal and New Zealand. In China, significant rise in inflation rate was found as pre-GST spending rush caused inflationary spiral in the country. On the other hand, Portugal and New Zealand experienced significant reduction in inflation following implementation of GST.

Since India entered the GST regime in 2017, a growing literature investigating the effect of GST introduction on inflation in India find mixed evidence in this regard, too. Based on an index of incidence of GST defined as the

percentage change in tax incidence the proposed GST is expected to bring in CPI, Morris et al. (2018) find inflationary impact using dummy for GST introduction and controlling for other macroeconomic indicators, such as expected inflation. However Das (2018) found no significant impact on inflation in non-special category states (treatment group that came under the GST system in 2017) compared to special category states (control group consisting the states exempted from the GST system) using difference-in-differences (DID) framework.

3 The Data

The current inflation rate is assumed to depend on output growth, expected inflation rate, interest rate capturing the monetary policy stance of the central bank, exchange rate capturing its pass-through effect of external shocks, and WPI food articles inflation capturing supply shocks including weather and agricultural wage inflation affecting the food sector. The variables for the analysis are chosen based on existing empirical studies determining factors affecting inflation in India (Bhattacharya and Kapoor (2020); Bhattacharya, Jain and Singh (2019); Bhattacharya and Sen Gupta (2017); Bhattacharya and Patnaik (2014); Bhattacharya, Patnaik and Shah (2011)).

The data set consists of CPI, WPI, and other macroeconomic indicators of monthly frequency for the period April 2011 to July 2022. Along with the headline CPI, two of its major components such as CPI food and CPI core (net of petrol and diesel for conveyance) are considered. Given that wholesale activities in food articles are exempted from GST, among the wholesale prices, WPI manufactured food and WPI non-food manufacturing (henceforth called as WPI core) are included in the analysis. CPI and WPI series are sourced from CSO, MOSPI and the Department of Economic Adviser respectively.

Among other macroeconomic indicators, Crude oil price (Brent, $/bbl) from World Bank captures oil price shock in our analysis. WPI food articles, driven by weather condition, agricultural wages, and MSP, presents a combined indicator of supply side shocks to food commodity prices. Call money rate, sourced from RBI proxies the short term market interest rate. Non-food credit (sourced from RBI) represents a monthly indicator of economic activities.

Reserve Bank of India's survey based households' inflation expectation series captures expected future inflation in the economy. The average three months ahead inflation expectation of the households represents one quarter ahead expected inflation in the analysis. Finally, rupee/dollar exchange rate captures external shocks in the study.[3]

[3] Existence of seasonality in the price series are tested using X13-SEATS Seasonal Adjustment Programme of the U.S. Census Bureau. None of the series showed existence of significant seasonal pattern, and hence non-seasonally adjusted (NSA) price series are used in the analysis.

Under the Augmented Dickey-Fuller (ADF) Unit Root test, we can not reject the null hypothesis of unit root for aggregate CPI, CPI core, WPI manufactured food, WPI core, non-food credit and crude oil prices, all in log level at 5% level of significance (see the first two columns of Table A.1 in Appendix A). The first difference of these series in log levels are found to be stationary. Hence we can conclude that these variables are integrated to order 1, e.g., the variables are I(1). Interest rate and expected inflation are also found to be I(1) at 5% level. The null hypothesis of unit root is found to be rejected for exchange rate, WPI food articles, and CPI food at 5% significance level. However, under the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) Unit Root test, all variables are found to be I(1) (Table A.2 in Appendix A).

Since macroeconomic variables are potentially subject to structural breaks due to policy regime shifts among various reasons, Zivot-Andrews test for unit root controlling for possibility of structural breaks is also conducted. Again, we can not reject the null hypothesis of unit root for aggregate CPI, CPI core, WPI manufactured food, WPI core, non-food credit and crude oil prices, all in log level at 5% level of significance (Table A.3 in Appendix A). We can not reject the null of unit root for interest rate as well. The first difference of each of the series in log levels and interest rate are found to be stationary containing a structural break. The null hypothesis of unit root is found to be rejected for exchange rate, WPI food articles, and CPI food and expected inflation at 5% significance level. These series are stationary but contain structural breaks.

4 Empirical Model

Conceptually, implementation of uniform GST system would affect both demand and supply side of the economy. If it reduces the cascading effects of the existing multiple tax structure, the economy would experience a fiscal easing. It would reduce marginal cost of producers and hence act as a positive supply shock to increase output and reduce price level, causing a onetime decline in inflation rate. On the other hand it will boost consumption. Overall, the economy will experience higher output and lower price level along with initial decline in inflation rate. However, actual impacts of GST implementation depends on institutional structure of the economy.

Cost of compliance with GST norms of the government can initially raise cost of production, reduce output and hence increase price level. In that scenario, implementation of GST would lead to an initial rise in inflation rate.
Eventually, this cost can decline and lead to a decline in inflation rate.

Again if the GST rate is determined in a way such that it just replaces the effective tax incidents under the previous tax regime, the marginal cost conditions of firms will not change. The implementation of GST would not have any significant impact on output, price level and hence inflation rate following the implementation. Hence, the direction, extent, lag and duration of impacts from a GST regime implementation on inflation is an empirical question to investigate and

the results can vary across countries based on their economic and institutional structures.

We apply intervention method following Box and Tiao (1975); Valadkhani and Layton (2004) to study the impact of the introduction of GST regime on inflation in India through time. In this framework, dummy variables capture major events of policy changes such as GST implementation and the revision of GST rates. Studies using conventional intervention framework assume that the effect of GST prevails for a period of one year and three months or five quarters (Valadkhani and Layton, 2004). Under this assumption, a univariate Seasonal Auto-Regressive Integrated Moving Average (ARIMA) model for the price level in log is augmented by dummy variables to evaluate the effects of a particular policy change:

$$\phi(L)\Phi(L^s)(1-L)^d(1-L^s)^D \ln y_t = \theta(L)\Theta(L^s)\epsilon_t + \beta DV_t \qquad (1)$$

where $\ln y_t$ denotes a price series in log; L is the lag operator and hence $L\ln y_t = \ln y_{t-1}$; s is the seasonal period and hence $s = 12$ for monthly data; $\varphi(L) = 1 - \varphi_1 L - \varphi_2 L^2 .... - \varphi_p L^p$ is the non-seasonal autoregressive (AR) operator; $\theta(L) = 1 - \theta_1 L - \theta_2 L^2 - ..... - \theta_q L^q$ is the non-seasonal moving average (MA) operator; $\Phi(L) = 1 - \Phi_1 L^s - \varphi_2 L^{2s} - ..... - \Phi_P L^{Ps}$ is the seasonal AR operator; and $\Theta(L) = 1 - \Theta_1 L^s - \Theta_2 L^{2s} - ..... - \Theta_Q L^{Qs}$ is the seasonal MA operator. Here D stands for the number of differencing required to remove seasonal unit root. Similarly, d represents the number of differencing required to remove the non-seasonal unit root. Here ϵ_t is the i.i.d error with zero mean and variance σ^2, and DV_t is a dummy variable capturing the policy regime shift. Equation (1) can also be augmented with causal variables (Bhattacharyya and Layton, 1979; Harvey and Durbin, 1986).

In the present study, we introduce two major innovations to the conventional intervention methodology:

1. The effect of policy intervention may not be instantaneous from the date of policy implementation. Hence we identify ex-post date of policy regime shifts using Bai and Perron (1998, 2003) structural break tests on inflation series. Next, we define dummy variables capturing policy regime shifts as follows: The dummy variable for a particular event takes value 1 from the identified break date, prior to next break identified; otherwise 0. For instance, let two break dates identified for a time series spanning periods 1, 2, ...,T on T_k and T_{k+10} Two dummies D_1 and D_2 associated to break dates T_k and T_{k+10} will be

$$D_1 = 1 \quad for \quad T_k, T_{k+1}, ..., T_{k+9}; \quad otherwise \quad 0 \qquad (2)$$

$$D_2 = 1 \quad for \quad T_{k+10}, T_{k+11}, ..., T; \quad otherwise \quad 0 \qquad (3)$$

2. Inflation can be affected by other macroeconomic shocks, such as weather, fuel price and demand shocks. Macroeconomic indicators capturing these shocks and inflation are generally characterised by enedogeneity among themselves. We address the endogeneity issue by using Vector Auto Regression (VAR) framework. Again, price and other macroeconomic indicators may contain common stochastic trend (in other words these indicators can be cointegrated). Since the ADF and Zivot-Andrews tests find that the variables are of mixed order of integration, we apply the multivariate

intervention method in an Auto Regressive Distributed Lag (ARDL) framework to address the issues of endogeneity and co-integration:

$$\Delta \ln y_t = c - \alpha(\ln y_{t-1} - \Theta X_{t-1}) + \sum_{i=1}^{p-1} \psi_{\ln yi} \Delta y_{t-i} + \sum_{i=1}^{q-1} \psi_{Xi} \Delta X_{t-i} + \gamma DV_t + u_t \quad (4)$$

where $\ln y_t$ is the price series in log, X_t is the vector of other macroeconomic indicators, and DV_t is the vector of dummy variables capturing structural breaks in inflation rate series.

After estimating the ARDL specification, the existence of co-integration among the variables are confirmed using the Bound test. ARDL bounds test developed by Pesaran et al. (2001) tests the presence of the long run co-integration relationship among the variables. The advantage of this test over the conventional Engle-Granger test (1997) and Johansen tests (1991, 1995) is that it does not require all the variables to be non-stationary and integrated to the same order. The bound test allows testing of co-integration among variables with mixed order of integration.

The Bound test involves two tests of co-integration: (i) overall F-test on all the lagged level variables and (ii) t-test on the lagged level of the dependent variable, with the assumption that the dependent variable is integrated to order one. The significance of the overall F-test suggests the lagged level of the variables are jointly significant in the ARDL specification. The significance of the overall F-test can also arise due to only the lagged level of the dependent variable or lagged level of the independent variables. Hence the t-test is conducted on the lagged level of the dependent variable to rule out the degenerate case, when lagged level of the dependent variable is not significant in the ARDL specification, implying non-cointegration.

5 Major Macroeconomic Events and Structural Breaks in Indian Inflation Series

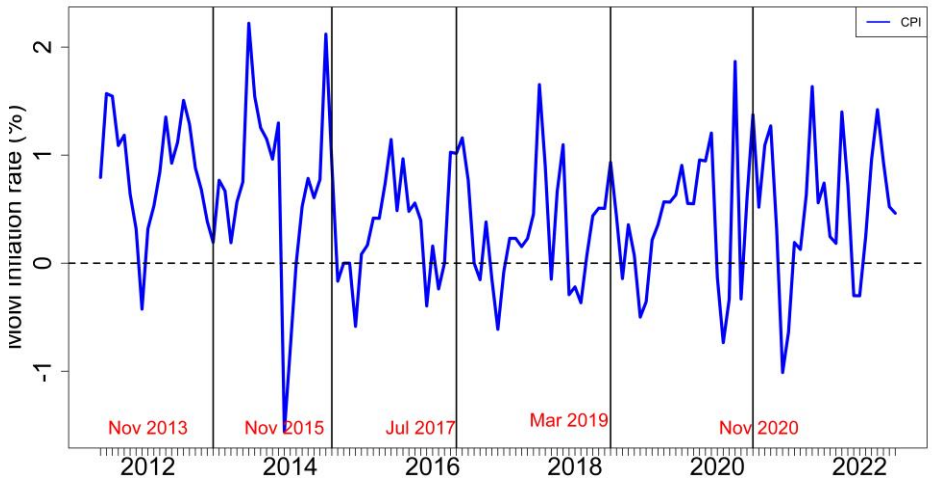
Since 2011, there have been quite a few major changes in the macroeconomic policy space in India. In February 2015, India adopted Flexible Inflation Targeting (FIT) monetary policy regime formally, where RBI in an agreement with the Ministry of Finance, set to target 4±2% CPI inflation over medium to long run. In July 2017, CGST, IGST, and SGST/UTGST were levied at rates that have been mutually agreed upon by the states and Centre. In this new indirect tax regime, GST implemented under the following slabs of 0%, 5%, 12%, 18%, 28%. In January 2018, the GST rate structure went through a revision where intra-state supplies of selected goods were exempted from central taxation, and there was re-structuring

of categories from under 28% to 18%. In April 2020, a nation-wide lockdown was imposed to fight the Covid-19 pandemic.

Table 1 summarises dates of structural breaks in retail and wholesale inflation in India during the period April 2012 to July 2022. These structural breaks are associated with various domestic and global events during this period. Headline inflation and various components of CPI and WPI inflation responded to these events heterogeneously. For instance, the headline CPI inflation experienced five structural breaks in this decade related to the following events (Figure 1):

- **Nov 2013:** Easing of food inflation from double digit number for almost two years (12.4% on average during April 2012 to November 2013)

Figure 1: Structural break associated with GST roll out and other major events in headline CPI inflation



Source: Author's estimates

to a persistently moderate 4% rate on average for the next six years (during December 2013 to August 2019).

- **Nov 2015:** India entered formal inflation targeting regime on February 20, 2015.
- **Jul 2017:** Roll out of GST regime.
- **Mar 2019:** Negative investment shock: GFCF recorded 1.6% growth in year 2019-20 vis a vis 11.2 % in the year 2018-19 capturing a negative demand shock for the economy.
- **Nov 2020:** National lockdown was imposed in March 2020 as a consequence of the Covid-19 pandemic.

Structural breaks at the same dates as in CPI inflation are also found in CPI food inflation. Since food items constitute 39% of the CPI basket, it is indeed the structural breaks in the food components inflation resulted in same break dates in the headline CPI inflation. Structural breaks in CPI core inflation are associated to events such as adoption of inflation targeting regime in 2015, implementation of

GST in 2017, revision of GST rates in 2018, beginning of Covid-19 outbreak and the post-covid period of demand revival.

WPI manufactured food products inflation is subject to structural breaks related to events such as persistently low WPI food articles inflation since

Table 1: Structural breaks in retail and wholesale inflation in India: April 2012–July 2022

Inflation indicator (MoM)	Break date	Break date	Break date	Break date	Break date
CPI	**Nov 2013:** Easing of food inflation after 2 years	**Nov 2015:** Shift to inflation targeting	**Jul 2017:** GST roll out	**Mar 2019:** Negative investment shock	**Nov 2020:** Covid lockdown
CPI food	**Nov 2013**	**Nov 2015**	**Jul 2017**	**Mar 2019**	**Nov 2020**
CPI core	Oct 2015: Inflation targeting	**Jun 2017: GST, forward looking**	**Oct 2018:** GST rate revised	**Jan 2020:** Covid beginning	**Apr 2021:** Covid: demand revival in face of supply distortion
WPI manufactured food	**Nov 2013**	**Jul 2015:** Inflation targeting regime	**Jan 2017:** GST	**Mar 2019**	**Oct 2020:** Covid
WPI non-food manufacturing	**Nov 2013**	**May 2015:** Inflation targeting	**Dec 2016:** Demonetisation	**Nov 2018:** GST rate re-vision	**August 2020:** covid

Source: Author's estimates

2014 for the next six years, adoption of inflation targeting and GST, negative investment shock and first wave of the pandemic. WPI core inflation, measured by the WPI non-food manufacturing inflation also experienced structural breaks related to events such as inflation targeting in 2015, demonetisation in 2016, GST rate revision in 2018 and the first wave of the pandemic in 2020.

6 Impacts of GST implementation on inflation rates

We find that GST had heterogeneous impact on various components of CPI and WPI inflation. Tables 2 and 3 summarise these findings.

6.1 Impact on headline CPI inflation

There exists a long run co-integrating relation among headline CPI, exchange rate, non-food credit, WPI food articles prices in level, and interest rate estimated with the ARDL specification.

The Bound test of Pesaran et al. (2001) shows evidence for strong co-integrating relationships among the variables. We reject the null hypothesis of no level relation as the value of F-statistic (6.243) exceeds the upper bound of 3.61 at 5% level and the value of t-statistic (-5.961) falls below the lower bound of -2.86 at 5% level. Columns 2 and 3 in the upper panel of Table 2 suggest in the long run, 10% exchange rate depreciation will lead to 1% CPI inflation at 10% level of significance. A 100 basis points interest rate hike will cause 0.012% deflation in headline CPI. The effect is significant at 1% level. A 10% growth in non-food credit and a 10% WPI food articles inflation will respectively cause 3.04% and 3.34% headline inflation at 1% level of significance. Expected inflation and crude oil prices do not affect headline CPI in the long run. The estimated adjustment parameter suggests following a 100% deviation in the long run relation, the CPI inflation will adjust at a speed of 25.7% to restore the long run equilibrium.

The implementation of GST in July 2017 seems to have a weak positive effect on headline CPI inflation in the short run as shown in the second and third column of the lower panel. *With other factors unchanged, CPI inflation was 0.76% higher following the shift to GST system, compared to the pre-GST regime. However,* the impact was marginally significant at 10% level, *and it lasted during mid-2017 to the beginning of 2019.* The GST dummy interacted with other macroeconomic indicators did not seem to have any significant effect on CPI inflation. *Negative investment shock of 2019-20 worked as a negative demand shock and reduced CPI inflation significantly.*

6.2 Impact on CPI food inflation

A long run co-integrating relationship is found among CPI food prices, non-food credit, WPI food articles prices, global crude oil price in level, interest rate and expected inflation estimated under ARDL specification. We reject the null hypothesis of no level relation as the value of F-statistic (6.774) exceeds the upper bound of 3.61 at 5% level and the value of t-statistic (-6.661) falls below the lower bound of -2.86 at 5% level.

Columns 4 and 5 of Table 2 suggest, a 100 basis point increase in interest rate seems to reduce food price in India by 0.011% in the long run. A 10% non-food credit growth, capturing rise in demand, leads to 1.08% increase in CPI food prices in the long run. A 10% rise in WPI food articles prices increases CPI food by 7.54%, while crude oil inflation reduces food prices. [4]

[4] Although it is a counter-intuitive result, but it is driven by the fact that the second round effect of crude oil inflation on food inflation is found to be insignificant (Bhattacharya, Jain and Singh, 2019) and during the sample period, there have been many occasions when CPI food and crude oil inflation moved in the opposite direction persistently.

Table 2: Impact of GST on headline CPI inflation and its major components

Regressors	CPI Infl.		CPI food Infl.		CPI core Infl.	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
Adjustment parameter	**-0.257**	**0.000**	**-0.386**	**0.000**		
Long run **Log Price$_i$(-1)** ***i* ∈ (*CPI, CPI food, CPI core*)** **Log Exrate(-1)**	0.101	0.074	0.090	0.210		
Interest rate(-1)	-0.012	0.000	-0.011	0.003		
Log NF Credit(-1)	0.304	0.000	0.108	0.038		
Infl. Exp.(-1)	0.002	0.196	0.005	0.031		
Log WPI food. art.(-1)	0.334	0.000	0.754	0.000		
Log Crude oil(-1)	0.006	0.404	-0.020	0.023		
Short run **Constant**	-0.506	0.001	-0.309	0.135	-0.209	0.131
Δ*CPI*(−1)	0.144	0.025				
Δ*CPIfood*(−1)			0.152	0.006		
Δ*CPIcore*(−1)					-0.120	0.221
ΔExrate	0.026	0.089	0.035	0.229	0.057	0.000
ΔInterest	-0.002	0.181	-0.004	0.007	-0.0003	0.332
ΔInterest(−1)	0.003	0.023				
ΔNF Credit	-0.006	0.809	0.042	0.052	0.025	0.082
ΔNF Credit(−1)	-0.049	0.058				
ΔInfl. exp.	0.001	0.210	0.002	0.040	0.0002	0.511
ΔWPI food art.	0.206	0.000	0.519	0.000		
ΔCrude oil	0.002	0.408	-0.008	0.026	-0.002	0.345
Dum IT 2015	-0.002	0.250	-0.003	0.261		
Dum GST 2017	0.759	0.121	2.287	0.018	0.003	0.851
Dum GST rev. 2018					-0.027	0.640
Dum Investment shock	-0.007	0.035	-0.015	0.019		
Dum Covid 1st. wave	-0.004	0.301	-0.011	0.145	0.0001	0.971
Dum post Covid					-0.001	0.554
Dum GST × Exrate	-0.085	0.256	-0.172	0.239	0.001	0.988
Dum GST × Interest	0.009	0.462	0.014	0.526	-0.001	0.754
Dum GST × NF Credit	-0.032	0.319	-0.081	0.192	0.013	0.903
Dum GST × Exp. Infl.	0.0002	0.946	0.003	0.609	0.0002	0.754

Dum GST × WPI food art.		-0.001	0.990	-0.010	0.185		
Dum GST × Crude oil		0.013	0.275	0.026	0.275	0.00001	0.997
Dum GST rev.	× Exrate					-0.036	0.616
Dum GST rev.	× Interest					0.003	0.860
Dum GST rev.	× NF credit					-0.043	0.194
Dum GST rev.	× Exp. Infl.					0.0002	0.797
Dum GST rev.	× Crude oil					0.002	0.836

Source: Author's estimates

in the long run. The estimated adjustment parameter suggests following a 100% deviation in the long run relation, the CPI food inflation will adjust at a speed of 38.6% to restore the long run equilibrium.

The implementation of GST in July 2017 had a significant positive effect on CPI food inflation. With other factors unchanged, CPI food inflation was 2.3% higher following the shift to GST system, compared to the pre-GST regime. The effect is significant at 5% level and it lasted during mid-2017 to the beginning of 2019. The GST dummy interacted with other macroeconomic indicators did not seem to have any significant effect on CPI food inflation. *Negative investment shock of 2019-20 worked as a negative demand shock and reduced CPI food inflation significantly.* In the short run, increase in non-food credit growth, inflation expectation, WPI food articles inflation increase CPI food inflation, while interest rate hike at a faster rate and rise in crude oil inflation reduce it.

6.3 Impact on CPI core inflation

For modelling CPI core inflation, all explanatory variables discussed in Section 3, except for WPI food inflation are included. We can not reject the null hypothesis of no level relation as the value of F-statistic (2.436) is less than the upper bound of 3.79 at 5% level and the value of t-statistic (-2.117) is higher than the lower bound of -2.86 at 5% level. Since there is no evidence of long run relation among CPI core and other macroeconomic indicators, we estimate the model in a Vector Auto-Regression (VAR) framework in first difference of the variables. The sixth and seventh columns of Table 2 report the estimated coefficients and the associated p-values. *GST implementation in 2017 and revision of rate structure in 2018 did not seem to significantly affect CPI core inflation.*

6.4 Impact on WPI manufactured food inflation

There exists a long run co-integrating relation among WPI manufactured food products, exchange rate, non-food credit, crude oil price in level, and interest rate estimated with the ARDL specification. We reject the null hypothesis of no level relation as the value of F-statistic (7.626) exceeds the upper bound of 3.79 at

5% level and the value of t-statistic (-6.235) falls below the lower bound of -2.62 at 5% level.

The second and third columns of Table 3 suggest a 10% depreciation in exchange rate increases WPI manufacturing food products by 3.85%. A 10% non-food credit growth and crude oil inflation increase this component of WPI by 2.77% and 1.29% respectively. A 100 basis point rise in interest rate reduces WPI food products by 0.037%. The estimated adjustment parameter suggests following a 100% deviation in the long run relation, the WPI food products inflation will adjust at a speed of 22.7% to restore the long run equilibrium.

While GST implementation in 2017 did not induce any significant effect on WPI food products inflation, it declined as a fallout of the negative investment shock in 2019-20. Increase in the rate of exchange rate depreciation, WPI food articles inflation and crude oil inflation lead to rise in WPI food products inflation in the short run. Rise in interest rate a faster rate moderates this component of WPI inflation in the short run.

6.5 Impact on WPI core (non-food manufacturing) inflation

We find a long run co-integrating relation among WPI core, crude oil price in level and interest rate. We reject the null hypothesis of no level relation as the value of F-statistic (6.472) exceeds the upper bound of 4.01 at 5% level and the value of t-statistic (-3.861) falls below the lower bound of -2.86 at 5% level.

A 100 basis point increase in interest rate reduces WPI core prices by 0.046% in the long run. A 10% rise in crude oil leads to a 1.4% increase in WPI core inflation. The estimated adjustment parameter suggests following a 100% deviation in the long run relation, the WPI core inflation will adjust at a speed of 9.6% to restore the long run equilibrium relation.

Revision of GST rate structure in 2018 did not have any significant impact on WPI core inflation. However, during the first wave of Covid-19 pandemic, WPI core inflation declined as massive job and income loss caused by nationwide lockdown acted as a negative demand shock. Increase in the rate of growth of non-food credit, and crude oil inflation lead to a rise in WPI core inflation in the short run. Rise in interest rate a faster rate moderates WPI core inflation in the short run.

6.6 Discussion of the results

Overall, GST implementation in 2017 induced a significant positive but transitory effect on CPI food inflation, while CPI core inflation, wholesale manufactured food and non-food prices remained unaffected. Our results for the CPI core inflation and WPI non-food manufacturing are similar as found for UK where GST implementation did not affect CPI inflation significantly as it replaced the existing Purchase Tax system (Gelardi, 2014). The new GST system effectively inflicted similar tax incidence on manufacturing wholesale and retail activities as well as on the services, as the effective tax incidence under pre-GST system in India. Hence we do not find significant impact of GST on prices of these items.

On the other hand, while wholesaling of food items are exempted from GST, pre-packaged and pre-labelled food items with weight less than 25 kg weight are brought under 5% GST rate. This implies non-branded retailing of food items, which were not taxed earlier, now taxed at the same rate as branded food items. This has inflicted an overall inflationary impact of retail food prices. Hence we find a significant positive impact if GST on CPI food inflation. Since food basket constitute 39% of the CPI basket, overall CPI inflation suffers a weak positive impact of the new indirect tax regime implemented in 2017, mainly driven by its impact on the retail food inflation.

Table 3: Impact of GST on WPI manufactured food products and WPI core inflation

Regressors	WPI manuf. food infl.		WPI core Infl.	
	Coeff.	p-value	Coeff.	p-value
Adjustment parameter	**-0.227**	**0.000**	**-0.096**	**0.000**
Long run **Log Price$_i$(-1)** ***i* ∈ (*WPI manuf. food, core*)** **Log Exrate(-1)**	0.385	0.006	0.328	0.216
Interest rate(-1)	-0.037	0.000	-0.046	0.005
Log NF Credit(-1)	0.277	0.004	0.178	0.351
Log WPI food. art.(-1)	-0.145	0.222		
Log Crude oil(-1)	0.129	0.000	0.144	0.000
Short run **Constant**	-0.168	0.441	0.025	0.906
Δ*WPImanuf.food*(−1)	0.287	0.000		
Δ*WPIcore*(−1)			0.190	0.031
ΔExrate	0.087	0.007	0.032	0.209
ΔInterest	-0.013	0.000	-0.004	0.000
ΔInterest(−1)	0.008	0.006		
ΔNF Credit	0.063	0.007	0.125	0.003
ΔNF Credit(−1)			0.088	0.044
ΔWPI food art.	0.048	0.208		
ΔCrude oil	0.029	0.000	0.014	0.000
Dum IT 2015	-0.004	0.349	-0.0001	0.968
Dum Demonetisation 2016			-0.008	0.120
Dum GST 2017	1.530	0.342		
Dum GST rev. 2018			0.475	0.267
Dum Investment shock	-0.015	0.048		
Dum Covid 1st. wave	-0.011	0.263	-0.020	0.034
Dum GST × Exrate	-0.028	0.826		

Dum GST × Interest		-0.005	0.641		
Dum GST × NF Credit		-0.097	0.200		
Dum GST × WPI food art.		0.043	0.473		
Dum GST × Crude oil		-0.011	0.579		
Dum GST rev.	× Exrate			-0.010	0.903
Dum GST rev.	× Interest			0.002	0.850
Dum GST rev.	× NF credit			-0.032	0.390
Dum GST rev.	× Crude oil			0.013	0.357

Source: Author's estimates

7 Robustness analysis

We test for the robustness of our findings for CPI inflation using two alternative modelling framework. First we estimate a standard univariate intervention method as in Valadkhani and Layton (2004). Secondly, since KPSS tests of unit root find all variable are I(1), we estimate Vector Error Correction Model (VECM) or VAR model based on existence of co-integrating relations among price indicators and other macroeconomic variables augmented by event dummies identified in Table 1. The robustness check using VECM/VAR is tested for all the components of CPI and WPI inflation considered in the analysis.

7.1 Conventional Intervention Method

In this framework, generally it is assumed that the effect of GST regime persists for one year and three months (five quarters) from the month of GST implementation. Hence we investigate the effect of GST implementation on prices for the next 15 months. These effects are captured by 15 month dummies, although we include 14 dummies to avoid multi-colinearity problem with the intercept. Log of CPI is assumed to follow Seasonal ARIMA (SARIMA) $(p,d,q)(P,D,Q)$ specifications as in Equation (1). No significant effect of GST is found even after 14 months of implementation (Table 4). This result closely resembles with our findings from ARDL model which finds a weak positive effect of GST implementation in 2017 on CPI inflation.

Table 4: Results of robustness analysis for CPI inflation using conventional intervention method

	CPI inflation Coef. of GST dummy	p-value
Aug 2017	-0.0004	0.660
Sep 2017	-0.0012	0.184
Oct 2017	0.0001	0.912
Nov 2017	0.0011	0.222
Dec 2017	-0.0012	0.184
Jan 2018	-0.0005	0.582
Feb 2018	-0.0002	0.826
Mar 2018	0.0002	0.826
Apr 2018	-0.0016	0.075
May 2018	0.0003	0.741
Jun 2018	-0.0006	0.509
Jul 2018	-0.0003	0.714
Aug 2018	0.0001	0.912
Sep 2018	-0.0001	0.912

Source: Author's estimates

7.2 VECM/VAR framework

Table 5 summarises findings from alternative modelling framework. Overall, results from the alternative models are similar to those found from ARDL framework. GST implementation is found to increase CPI food and headline CPI inflation significantly. No significant impact found for CPI core inflation, WPI manufactured food product inflation and WPI core inflation.

Table 5: Results from robustness analysis using VECM/VAR framework

Price indicator	Controls	Model	Findings
CPI	Crude oil, WPI food articles, Non-food credit, Rs./Dollar exchange rate, interest rate, household inflation expectation, dummies associated to structural breaks	VECM: No of co-integration relations: 2	GST implementation in 2017 increased CPI inflation significantly in the short run. Under GST regime, effect of nonfood credit growth on CPI inflation reduced significantly. Inflation targeting, negative investment shock in 2019 and the 1st wave of covid-19 pandemic reduced CPI inflation significantly in the short run.
CPI Food	Crude oil, WPI food articles, Non-food credit, Rs./Dollar exchange rate, interest rate, household inflation expectation, dummies associated to structural breaks	VECM: No of co-integration relations: 2	GST implementation in 2017 increased CPI food inflation significantly in the short run. Under GST regime, effect of nonfood credit growth on CPI food inflation reduced significantly. Inflation targeting, negative investment shock in 2019 and the 1st wave of covid-19 pandemic reduced CPI food inflation significantly in the short run.
CPI core	Crude oil, Non-food credit, Rs./Dollar exchange rate, interest rate, household inflation expectation, dummies associated to structural breaks	VECM: No of co-integration relations: 1	No significant effect of GST implementation in 2017 and revision of rate structure in 2018 on CPI core inflation
WPI manuf. food	Crude oil, WPI food articles, Non-food credit, Rs./Dollar exchange rate, interest rate, dummies associated to structural breaks	VECM: No of co-integration relations: 1	No significant effect of GST implementation in 2017 on WPI manufactured food products inflation
WPI non-food manuf.	Crude oil, Non-food credit, Rs./Dollar exchange rate, interest rate, dummies associated to structural breaks	VAR in first difference	No significant effect of GST rate revision in 2018 on WPI core inflation

Source: Author's estimates

8 Conclusion

Indian indirect tax regime shifted from multiple tax regime to a Uniform rate value added Goods and Services tax regime in July 2017. There have been long standing public debate on probable costs and benefits of GST regime replacing long-existed multiple tax regime. In the cost side, while producers and sellers may have to incur some fixed cost at the beginning of the regime to comply with the government rates and structures, shift to GST system is expected to reduce prices

via reducing cascading effects of multiple tax layers and increasing efficiency of the logistics and distribution system.

Empirical literature on both advanced and developing economies suggest mixed impact of adopting GST system on inflation. This paper contributes to this literature by investigate effects of GST system on CPI, WPI inflation and their major components namely food and core inflation in India. In a multivariate intervention framework, controlling for other macroeconomic shocks and endogenously identified duration of intervention, we find a positive impact of GST on headline inflation in India via inflationary impact on retail food prices. The effect persisted for around two years. However, core CPI inflation and WPI manufacturing inflation are found to be unaffected by the change in indirect tax regime.

Under the new regime, GST at a rate of 5% are applicable on retail food articles and pre-packed labelled food items such as atta, paneer and curd. Consequently, per unit price of these items payable by the consumers experienced a rise, leading to a rise in retail food inflation given their high share in the CPI basket.

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A Appendix A

Table A.1: Augmented Dickey-Fuller Test Results

Variable	Test statistic	Variable	Test statistic
Log CPI	-3.29	Δ Log CPI	-7.02
Log CPI food	-3.47	Δ Log CPI food	-7.33
Log CPI core	-1.18	Δ Log CPI core	-8.60
Log WPI food arts.	-3.66	Δ Log WPI food arts.	-7.60
Log WPI manuf. food	-2.04	Δ Log WPI manuf. food	-6.66
Log WPI core	-0.38	Δ Log WPI core	-5.63
Log exchange rate	-3.61	Δ Log exchange rate	-7.75
Log non-food credit	-2.54	Δ Log non-food credit	-10.23
Log crude oil	-2.12	Δ Log crude oil	-8.62
Interest rate	-1.13	Δ Interest rate	-8.126
Expected inflation	-2.14	Δ Expected inflation	-7.83

Source: Author's estimates

Log of CPI, CPI food, exchange rate, non-food credit, WPI food articles, WPI manufactured food, WPI core, crude oil price are tested with the null hypothesis of unit root with drift and trend. The critical values under this null hypothesis are -3.99, -3.43 and -3.13 at 1%, 5% and 10% level of significance respectively.

The first difference of Log of CPI, CPI food, exchange rate, non-food credit, WPI food articles, WPI manufactured food, WPI core, crude oil price, interest rate and expected inflation are tested with the null hypothesis of unit root with drift. The critical values under this null hypothesis are -3.46, -2.88 and -2.57 at 1%, 5% and 10% level of significance respectively.

Table A.2: KPSS Test Results

Variable	Test statistic	Variable	Test statistic
Log CPI	0.449	Δ Log CPI	0.328
Log CPI food	0.392	Δ Log CPI food	0.135
Log CPI core	0.218	Δ Log CPI core	0.237
Log WPI food arts.	0.334	Δ Log WPI food arts.	0.047
Log WPI manuf. food	0.281	Δ Log WPI manuf. food	0.153
Log WPI core	0.317	Δ Log WPI core	0.405
Log exchange rate	0.373	Δ Log exchange rate	0.228
Log non-food credit	0.472	Δ Log non-food credit	0.264
Log crude oil	0.379	Δ Log crude oil	0.230
Interest rate	0.239	Δ Interest rate	0.161
Expected inflation	0.509	Δ Expected inflation	0.081

Source: Author's estimates

Log of CPI, CPI food, exchange rate, non-food credit, WPI food articles, WPI manufactured food, WPI core, crude oil price are tested with the null hypothesis that the series is stationary around a trend. The critical values under this null hypothesis are 0.216, 0.146 and 0.119 at 1%, 5% and 10% level of significance respectively.

The first difference of Log of CPI, CPI food, exchange rate, non-food credit, WPI food articles, WPI manufactured food, WPI core, crude oil price, interest rate and expected inflation are tested with the null hypothesis that the series is stationary around a drift. The critical values under this null hypothesis are 0.739, 0.463 and 0.347 at 1%, 5% and 10% level of significance respectively.

Table A.3: Zivot-Andrews Test Results

Variable	Test statistic	Variable	Test statistic
Log CPI	-4.97	Δ Log CPI	-7.93
Log CPI food	-5.14	Δ Log CPI food	-7.76
Log CPI core	-3.47	Δ Log CPI core	-9.48
Log WPI food arts.	-5.84	Δ Log WPI food arts.	-7.82
Log WPI manuf. food	-3.63	Δ Log WPI manuf. food	-6.98
Log WPI core	-2.78	Δ Log WPI core	-6.88
Log exchange rate	-4.87	Δ Log exchange rate	-8.28
Log non-food credit	-3.71	Δ Log non-food credit	-10.98
Log crude oil	-4.09	Δ Log crude oil	-9.30
Interest rate	-4.16	Δ Interest rate	-8.73
Expected inflation	-5.46	Δ Expected inflation	-7.97

Source: Author's estimates

Log of CPI, CPI food, exchange rate, non-food credit, WPI food articles, WPI manufactured food, WPI core, crude oil price are tested with the null hypothesis that the series is stationary around a trend. The critical values under this null hypothesis are -5.57, -5.08 and -4.82 at 1%, 5% and 10% level of significance respectively.

The first difference of Log of CPI, CPI food, exchange rate, non-food credit, WPI food articles, WPI manufactured food, WPI core, crude oil price, interest rate and expected inflation are tested with the null hypothesis that the series is stationary around a drift. The critical values under this null hypothesis are -5.34, -4.80 and -4.58 at 1%, 5% and 10% level of significance respectively.

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