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Food Price Shocks and the Changing Pattern of Consumption Expenditure across Decile Classes in Rural and Urban India: A Difference-in-Difference Analysis

Against the backdrop of liberalised trade in agricultural commodities in the twenty-first century, world food prices have risen at a faster pace since 2007. Food price volatility is inextricably connected with the problems of food security due to its implications for the availability of food, household incomes and purchasing power, malnutrition, per capita consumption expenditure and the changing patterns of consumption on the part of poor people. In India's case, a declining trend in the availability of food grains in the post-reform period can be explained by the encouragement given to the export of food grains due to India's comparative advantage vis-à-vis the international market in relation to the pricing of food grains. However, the mere availability of food in the country is obviously not sufficient to ensure access to food for all households. In this context, our main objective in this paper is to evaluate the implications of food price volatility on access to food across decile classes in India. Empirical results reveal that consumption expenditure differs in both spatial (rural and urban) and temporal (pre- and post-2008) dimensions; specifically, the relative loss of consumption expenditure is significant in urban regions in comparison to rural regions in post-2008. In fact, difference-in-difference regression results also reinforced our earlier findings that differences in consumption expenditure can be explained by the spatial effect.

Keywords: access to food, availability of food, consumption expenditure, decile classes, food price volatility
JEL classification: Q11, Q18

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Introduction

Since the post-independence, the top priority of Indian policymakers has been to sustain and improve food and nutrition security through food self-sufficiency. Their multi-pronged strategy has helped India to raise levels of food grain production substantially, maintaining a stock of food grains, and increasing the per capita availability of food grains. In fact, the attainment of self-sufficiency in food grains is one of the greatest achievements of the Indian economy in the post-independence period. After remaining a food deficit country for about two decades after independence, India has not only become self-sufficient in food grains but now has a surplus of food grains to export on the world market. The change in per capita net availability of cereals, pulses and food grains[1] since the seventies is presented in Table 1. It is evident that India's policy commitment to ensuring aggregate availability, indicated by the emphasis on food grain production from the 1950s and self-sufficiency from the late 1960s, did lead to per capita net availability of food grain increasing steadily, with some fluctuations, through the period from 1950s to mid-1990s, with the role of imports declining from the late 1960s (Athreya *et al.*, 2008). The decade from 1951 to 1960 saw a rise in food grain availability largely due to various policies of the Government of India, which focused on raising agricultural productivity and thus domestic production of food grains. There was also a significant increase in the area of land under food grains cultivation (Krishnaji and Krishnan, 2003). There were variations in the extent of net availability of food grains per day throughout the seventies and eighties. However, the origin of the emerging crisis in the availability of food grains can be traced back to the second half of the nineties. The per capita availability of food grains was observed to have declined from a peak of 481.92 grams per capita per day in 1991-1995 to 441.04 grams per capita per day in 2006-2010, and to 472.74 grams per capita per day in 2011-15.

Table 1: Per capita Net Availability of Cereals, Pulses and food grains in India (grams per capita per day), 1971-2015.

Year	Cereals		Pulses		Foodgrains (Cereals + Pulses)	
	Average	Percentage change	Average	Percentage change	Average	Percentage change
1971-1975	392.68	-	43.96	-	442.64	-
1976-1980	398.78	1.55	42.98	-2.23	441.76	-0.20
1981-1985	416.82	4.52	39.30	-8.56	456.12	3.25
1986-1990	433.86	4.09	40.00	1.78	473.86	3.89
1991-1995	444.50	2.45	37.42	-6.45	481.92	1.70
1996-2000	434.92	-2.16	34.18	-8.66	469.08	-2.66
2001-2005	414.24	-4.75	32.36	-5.32	446.60	-4.79
2006-2010	404.62	-2.32	36.44	12.61	441.04	-1.24
2011-2015	423.34	4.63	43.64	19.76	472.74	7.19

Source: Authors calculation based on Economic Survey (various years)

The declining trend in the availability of food grains in the post-reform period can be explained by the encouragement by policymakers of the export of food grains due to India's comparative advantage vis-à-vis the international market in the pricing of food grains (i.e. the relative price of food grains[2], as shown by the secondary vertical axis in

[1] Net availability of cereals (or pulses or foodgrains) is a sum total of net production, net imports, and change in government stocks.

[2] Price relatives is estimated by the ratio of international price (FAO food price index) to domestic price (Indian WPI) indicators.

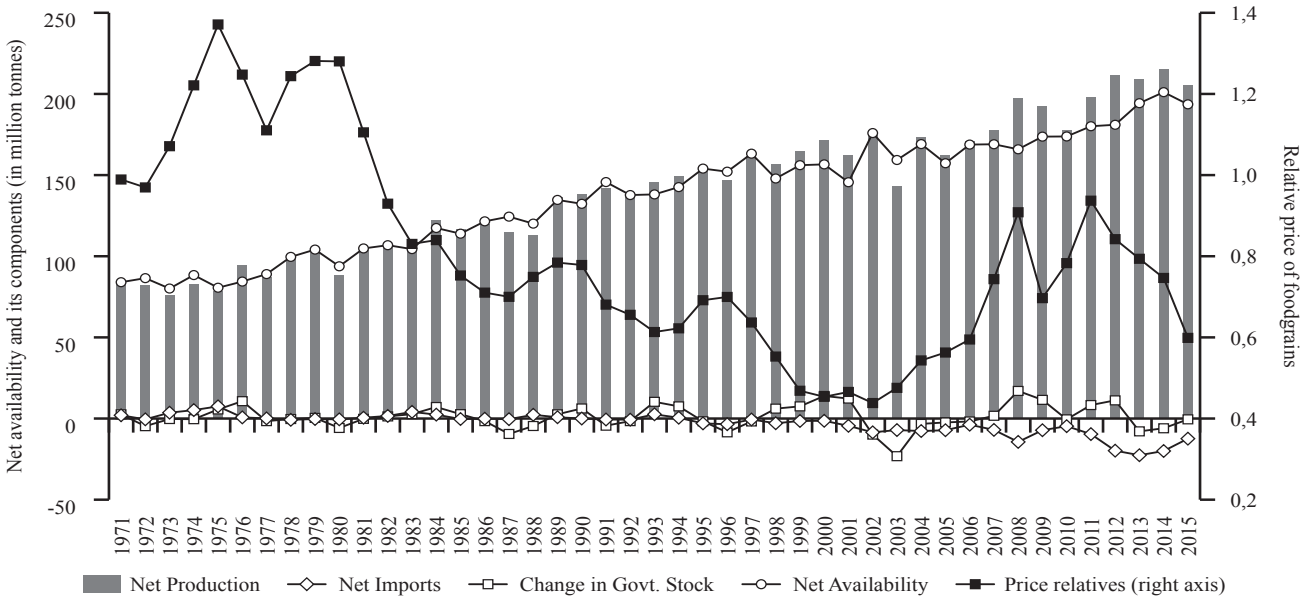

Figure 1: Trend of food price relatives and net availability of foodgrains (& its components).
Source: Authors calculation based on Economic Survey (various years)

Figure 1). It is evident that in the first half of the seventies[3], huge imports of cereals resulted in a higher volume of net availability of cereals in comparison to its net production. The dependence on imports of cereals has reduced significantly over a successive period of time, and India has become a net exporter of cereals since 1995. Thereafter, the production of cereals witnessed a decelerating trend, which ultimately resulted in a declining trend in the per capita availability of cereals. Even though there was substantial progress in the production of cereals during 2006-2010, the declining trend in the availability of cereals exhibits no reversal trend. This is mainly attributable due to the large volume of exports of cereals from India as the domestic price was below international prices. Inappropriate management of the procurement and buffer stock policy of the government is meanwhile considered as another factor explaining the declining availability of cereals for Indian households.

However, the mere availability of food in the country is obviously not sufficient to ensure access to food for all households. In fact, economic access to adequate food depends on the purchasing power of the individual. In this context, the increasing purchasing power of Indian households is reflected in rising monthly per capita consumption over the last 18 years. However, the difference in purchasing power between rural and urban India is reflected in the differential increase in the monthly per capita consumption for rural and urban India. For rural India, real MPCE[4] is seen to have grown from Rs.159.89 in 1993-94 to Rs.220.51 in 2011-12 (i.e. an increase of about 38% over 18 years). In urban India, there has been a substantially higher growth in real MPCE from Rs.264.76 in 1993-94 to Rs.400.54 in 2011-12 (i.e. an increase of 51%). However, in spite of the upward trend of monthly consumption expenditure of households, expenditure on food items reveals a decelerating trend over time. In fact, the share of household consumption expenditure allocated to food can be seen to have declined by nearly 15 percentage points to 48.6% in the rural sector and by about 16 percentage points to 38.5% in the urban sector over an 18-year period. Specifically, cereals have registered the largest decline in share among all the item groups – from 24% to 12% in rural India and from 14% to 7% in urban India over the last 18-year period (NSSO, 2013). The declining demand for food grain (specifically cereals items) reflects the loss of purchasing power on the part of the poor largely due to their deteriorating livelihood security. This view[5] is consistent with the view that declining demand for food grain is due to rising food grain prices arising from the adoption of Structural Adjustment Policies (SAPs) which involved deflationary macroeconomic policies and the opening up of the agricultural sector (Athreya, 2008). Except for 'beverages, etc.', none of the food groups show any noticeable increase in their share of household consumption expenditure, and some of them show a distinct fall (Table 2). The "miscellaneous goods and services" category (including education and medical care) is the group which has grown the most – from 17% of total expenditure in 1993-94 to 26% in 2011-12 in rural India and from 27.5% to nearly 40% in urban India (NSSO, 2013).

Literature Review

Price volatility of agricultural commodities has an important implications for resource allocation as well as consumer and producer welfare (Committee on World Food Security, 2011). However, the implications may not be the same for a producer or a consumer; and while downward price movement may have a negative impact on farm revenue of the

[3] The period from 1961 to 1970 saw a decline in food grain availability, which was partly due to severe droughts in the mid-1960s, leading to wheat imports from the USA under Public Law 480 (Athreya *et al.*, 2008).

[4] Monthly per capita consumption expenditure is measured using a price deflator with 1987-88 as base.

[5] An alternative view argued that declining demand for cereals is due to dietary diversification.

Table 2: Trends in MPCE and Share of Cereals, Food and Non-food in Total Expenditure since 1993-94.

	Rural					Urban				
	1993-94	**1999-00**	**2004-05**	**2009-10**	**2011-12**	**1993-94**	**1999-00**	**2004-05**	**2009-10**	**2011-12**
	Growth of MPCE at 1987-88 prices									
$MPCE_{URP}$	159.89	-	175.17	187.79	220.51	264.76	-	311.35	355.03	400.54
$MPCE_{MRP}$	162.56	179.39	181.56	192.93	221.93	268.38	306.42	326.8	368.99	413.53
$MPCE_{MMRP}$	-	-	-	213.17	246.54	-	-	-	394.52	439.01
	Share of total consumption expenditure in									
Cereals	24.20	22.20	18.00	15.60	12.00	14.00	12.40	10.10	9.10	7.30
Food total	63.20	59.40	55.00	53.60	48.60	54.70	48.10	42.50	40.70	38.50
Non-food total	36.80	40.60	45.00	46.40	51.40	45.30	51.90	57.50	59.30	61.50

Source: Report of the Key Indicators of Household Consumption Expenditure in India, 2011-12 (NSSO, 68th Round)

producers, it has some favourable impact on food expenditures of the consumers. On a macroeconomic level, price volatility has far-reaching implications for growth and poverty (ADB, 2008; Lustig, 2008; Bidi et al, 2009; Ivanic and Will, 2008; Robles *et al.*, 2010; Martin and Ivanic, 2016; Headey and Martin, 2016), economic crisis (Acemoglu et al, 2003; Aizenman and Pinto, 2005), riots (Van Weezel, 2016); the marketing of agricultural produce, and food security (Rapsomanikis, 2009; Kalkuhl et al, 2016). The risk of food price volatility ultimately damages food security in the form of access to food by the poor. In this context, government policies can mitigate the risk of price volatility through the management of food price stability and thereby insulate their population from the harmful effects of food price variability (Saini and Gulati, 2016; Gouel *et al.*, 2016; Global Panel, 2016).

In fact, price volatility is inextricably connected with the problems of food security via implications on household incomes and purchasing power (Rapsomanikis, 2009; Headey, 2011), malnutrition (Devereux, 2009; Bibi *et al.*, 2009; Action Centre la Faim, 2009; Compton *et al.*, 2010). In most of the studies on the implications of price volatility on food security, simulations exercises are employed to assess the impact in terms of reductions in per capita consumption (Rapsomanikis, 2009), increases in the number of poor people (ADB, 2008; Headey, 2011) and changing patterns of consumption on the part of poor people (ADB, 2008; Bibi *et al.*, 2009). However, the data generation procedure involved in such simulations exercises have been criticised in some studies (Headey, 2011). In marked contrast to some other studies, Headey (ibid.) argued that the number of food-insecure people actually decreased during the period of price volatility, 2005-08. The result was explained by the positive impact of rapid economic growth in emerging countries and the existence of price stabilisation policies. Inadequate social safety nets in some countries can explain the varying impact of the food price shocks on poverty. Ivanic and Will (2008) estimated that at least 105 million people in LDC became poor because of high food price inflation since 2005. The poor people face the worst situation as they spend a larger percentage of their income on food as compared with richer income groups.

Several studies examined the implications of rising world food prices in the nutritional level of the people. In a cross-section study, Devereux (2009) revealed the linkages between maize prices and child nutrition in Malawi. Acute malnutrition increased during 2004-05 due to doubled prices of maize, and started decreasing thereafter when the price stabilized. The prevalence of being underweight and wasting in young children in Bangladesh, Cambodia and Mauritania was explained by the rising food price in those countries. It also led to a widespread reduction in the dietary diversification of the region (Compton *et al.*, 2010). However, literature relating to the differential impact of rising food prices on gender and different social groups is relatively scanty in nature. Nevertheless, approaching the topic from this perspective, Hossain and Green (2011) have argued that small-scale farmers and small traders have been the worst affected, whereas commodity producers and workers in export sectors have improved their situation. Meanwhile, rising food prices in Mali led to a reduction in non-food consumption to absorb the shock of price volatility (Bibi *et al.*, 2009). Finally, in the Philippines and Bangladesh, poorer people depend mainly on a single major staple of their food consumption due to lower possibility of substitution in the event of food prices soaring (ADB, 2008).

Against such a backdrop of existing literature, this study addresses the existing research gap on the following two grounds. Firstly, this study presents a disaggregated analysis on the changing pattern of consumption behaviour of the decile classes of the population in India to address the differential impact of rising food prices on different social groups. Secondly, given the known limitations of the data generation procedure involving the use of a simulation exercise, the study employs a 'quasi-experiments with constructed controls' design. The design basically involves comparing the consumption behaviour between households within a decile group to that of the median group of households across decile classes. This framework is also applicable in comparing change in the consumption expenditure of rural India vis-à-vis urban India. Among the different types of quasi-experimental designs that can be used to assess food price impacts, a 'differences-in-differences' (DID) method is used in this study. Thus, the study tries objectively to examine the changing pattern of consumption expenditure across decile classes of the population in India. Changes in consumption expenditure can be explained by spatial differences (rural vis-à-vis urban) and temporal dynamics (before price shock vis-à-vis after price shock). The extent to which spatial-temporal dynamics can explain the consumption expenditure of households is tested within a difference-in-difference framework.

Table 3: NSSO Methodology of Consumption Estimation at Different Reference Periods.

Category	Item Group	Schedule type I		Schedule type II	
		Method	Reference period	Method	Reference period
I	Clothing, bedding, footwear, education, medical (institutional), durable goods	URP	Last 30 days	MMRP	Last 365 days
		MRP	Last 365 days		
II	Edible oil; egg, fish & meat; vegetables, fruits, spices, beverages and processed foods; pan, tobacco & intoxicants	URP	Last 30 days	MMRP	Last 7 days
		MRP	Last 30 days		
III	All other food, fuel and light, miscellaneous goods and services including non-institutional medical; rents and taxes	URP	Last 30 days	MMRP	Last 30 days
		MRP	Last 30 days		

Source: Author's modification on the original table as found in Key Indicators of Household Consumer Expenditure in India, 2011-12.

Data and Methods

Data on consumption expenditure on different reference period or recall period (URP, MRP, MMRP) has been collected from different rounds of NSS covering the period 1993-94 to 2011-12. Data on consumption expenditure are collected from two types of schedules of NSS enquiry: schedule 1.0 type 1 and schedule 1.0 type 2 (Table 3). Different estimates on consumption expenditure actually depend on the reference period or recall period for reporting consumption: Uniform reference period (URP), Mixed reference period (MRP), and Modified mixed reference period (MMRP).

In a disaggregated analysis, the study examines the changing pattern of consumption expenditure across fractile[6] classes of population in rural and urban India. NSS reports data on consumption expenditure across decile classes: the first decile class comprises the bottom 10% of the population in terms of MPCE and the top (10^{th}) decile class comprises the top 10 percent of the population.

To compare the level of consumption expenditure for different segments of the population in the pre- and post-crisis scenario (or rural-urban division), pairwise t-test is employed in this paper. Test of equality of consumption expenditure determines whether the mean consumption expenditure is statistically different in spatial dimension (rural and urban India) in a given temporal setting or whether the mean consumption expenditure is statistically different in temporal dimension (pre and post-2008) in a given region. For example, in the second case, the hypothesis is given by H_0: CE_1=CE_2, where CE_1 and CE_2 are the means of the consumption expenditure for say, period 1 and 2 respectively. The t-test statistic can be written as:

$$t = \frac{CE_1 - CE_2}{\sqrt{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)}} \approx t_{n_1+n_2-2}, \tag{1}$$

where S_1 and S_2 are the standard deviation of the respective periods. Comparing the calculated and tabulated values of the t statistic necessary conclusions can be made.

Difference-in-difference technique (DID) is used in the study to examine the changing scenario of consumption expenditure in spatial (rural-urban divide) and temporal (pre and post food price inflation) dynamics. DID technique is used in the study to calculate the effect of a food price surge in 2008 (i.e. treatment) on consumption expenditure (i.e. outcome) by comparing the average change in consumption expenditure for rural India (i.e. treatment group), compared to the average change over time for the urban India (i.e. control group). In addition, the change in consumption expenditure of a decile class (i.e. treatment group) is compared with the median class (i.e. control group). In other words, in a panel data structure framework of consumption expenditures across decile classes over time, the study measures the differences, between the treatment and control group, of the changes in the outcome variable that occur over time.

It is to be noted that DID estimator can be numerically calculated by using table 4. In this table the lower right cell itself represents the estimator.

The DID regression technique can provide us the same estimator along with the significance level (Gertler *et al.*, 2010). The empirical specification of the regression can be written as follows:

$$y = \alpha + \beta T + \gamma I + \delta (T.I) + \varepsilon, \tag{2}$$

where T is a time dummy variable (t = 1 for post 2008, t = 0 for pre 2008), and I is a regional variable (i = 1 for rural and i = 0 for urban). The interaction effect (or the composite variable) $T.I$ is a dummy variable ($t = i$ =1 for rural consumption in post 2008).

The estimates in this regression specification can be derived as follows:

$$\begin{aligned}
&\alpha = (yIT = 0, I = 0) = y_{00} \\
&\beta = (yIT = 1, I = 0) - (yIT = 0, I = 0) = y_{10} - y_{00} \\
&\gamma = (yIT = 0, I = 1) - (yIT = 0, I = 0) = y_{01} - y_{00} \\
&\delta = [(yIT = 1, I = 1) - (yIT = 0, I = 1)] - \\
&-[(yIT = 1, I = 0) - (yIT = 0, I = 0)] = \\
&= [(y_{11} - y_{01}) - (y_{10} - y_{00})],
\end{aligned} \tag{3}$$

It is to be noted that the regression technique provides us the same DID estimator.

[6] Fractile is that point below which a stated fraction (or decimal equivalence) of the values lie.

Table 4: Calculation of DID estimator.

y_{it}	$i = 1$ (say Rural)	$i = 0$ (say Urban)	Difference
$t = 1$ (say post 2008)	y_{11}	y_{10}	$y_{10} - y_{11}$
$t = 0$ (say pre 2008)	y_{01}	y_{00}	$y_{00} - y_{01}$
Change	$y_{01} - y_{11}$	$y_{00} - y_{10}$	DID = $(y_{00} - y_{01}) - (y_{10} - y_{11})$

Source: Author's calculation

Table 5: Calculation of DID estimator by using regression coefficients.

y_{it}	$i = 1$ (say Rural)	$i = 0$ (say Urban)	Difference
$t = 1$ (say post 2008)	$\alpha+\beta+\gamma+\delta$	$\alpha+\beta$	$\gamma+\delta$
$t = 0$ (say pre 2008)	$\alpha+\gamma$	α	γ
Change	$\beta+\delta$	β	$\Delta\Delta y = \delta$

Source: Author's calculation

Table 6: Decile Group Wise Comparison of Average MPCE at Constant (1993-94) Prices in 61st and 66th round.

Percentile group of population	Rural				Urban			
	61st 2004-05 (U30)	61st 2004-05 (M)	66th 2009-10 (U30)	66th 2009-10 (M)	61st 2004-05 (U30)	61st 2004-05 (M)	66th 2009-10 (U30)	66th 2009-10 (M)
10%-20%	169.00	193.00	143.37	153.84	223.00	248.00	177.32	188.67
20%-30%	195.00	220.00	188.52	200.00	269.00	294.00	245.68	260.46
30%-40%	221.00	245.00	218.89	230.84	316.00	342.00	295.79	313.97
40%-50%	246.00	271.00	246.86	259.30	368.00	396.00	349.64	370.12
50%-60%	275.00	299.00	275.29	289.05	433.00	461.00	410.78	435.14
60%-70%	310.00	333.00	307.35	321.78	512.00	545.00	483.02	511.50
70%-80%	359.00	380.00	346.06	361.66	619.00	657.00	574.06	609.45
80%-90%	442.00	455.00	400.49	415.52	804.00	854.00	697.77	744.55
90%-95%	570.00	569.00	490.03	505.52	1,088.00	1,144.00	911.74	971.76
95%-100%	1,116.00	938.00	910.52	886.16	2,137.00	1,985.00	1,929.65	1,907.55
All	**319.00**	**331.00**	**352.74**	**362.38**	**531.00**	**555.00**	**607.42**	**631.30**
Median	**292.50**	**316.00**	**291.32**	**305.41**	**472.50**	**503.00**	**446.90**	**473.32**

Source: Data on 61st round has been collected from Report on Consumption Expenditure, 2004-05 (p.19), and data on 66th round has been deflated by using suitable price indices.

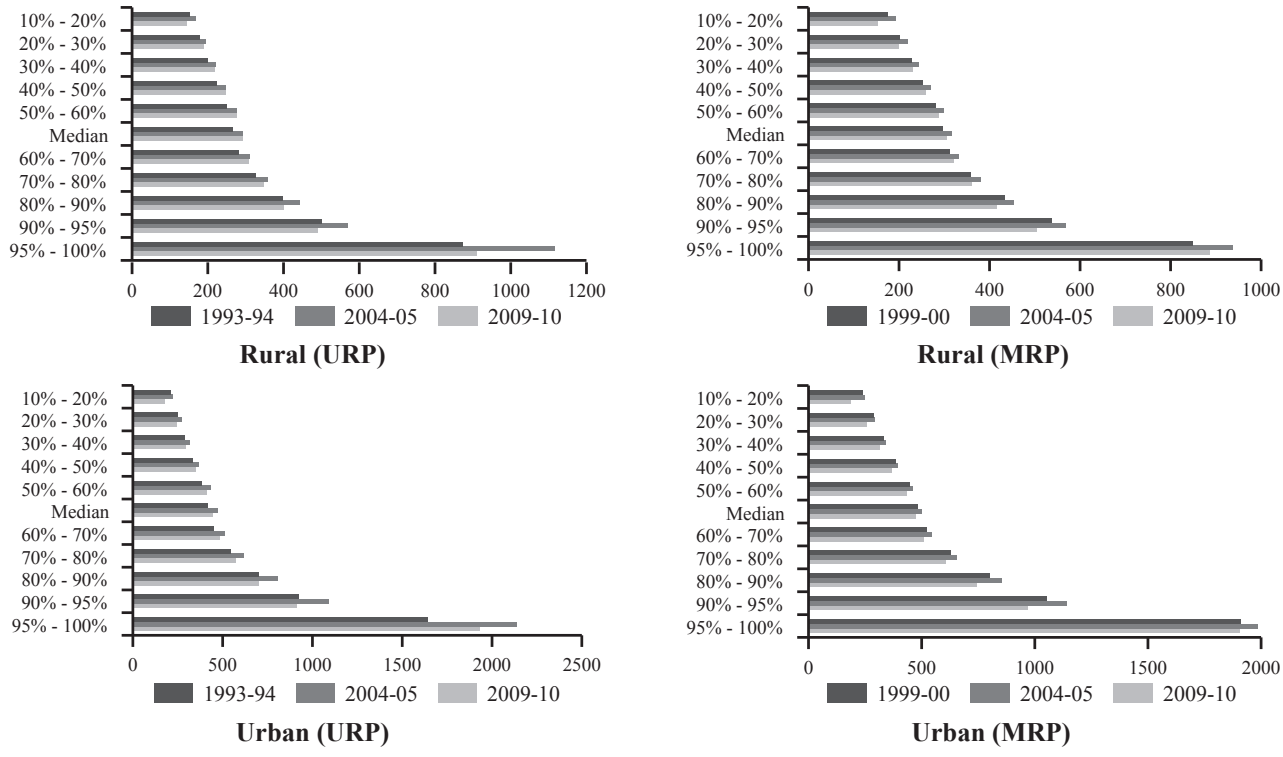

Figure 2: Change in MPCE across Decile Classes.

Source: own calculations

Table 7: Tests of Equality of Mean Consumption Expenditure in Rural and Urban India.

Time	Method	Mean CE_Rural	Mean CE_Urban	t-statistic	P-value at two-tail test
2004-05	URP	390.30	676.90	-3.066	0.013
2009-10	MRP	352.74	607.54	-2.741	0.022
2004-05	URP	390.30	692.60	-3.104	0.012
2009-10	MRP	362.37	631.32	-2.873	0.018
Region	**Method**	**Mean CE_Pre 2008**	**Mean CE_Post 2008**	**t-statistic**	**P-value at two-tail test**
Rural	URP	390.3	352.74	1.849	0.097
Rural	MRP	390.3	362.37	4.608	0.001
Urban	URP	676.9	607.54	3.137	0.011
Urban	MRP	692.6	631.32	4.086	0.002

Source: own calculations

Table 8: Decile Class wise difference-in-difference estimates of MPCE before and after 2008 in Rural India (URP & MRP).

Decile class	Rural		Change	Rural		Change
	2004-05 (U30)	2009-10 (U30)		2004-05 (M)	2009-10 (M)	
10% -20%	169.00	143.37	-25.63	193.00	153.84	-39.16
Median	292.50	291.32	-1.18	316.00	305.41	-10.59
Difference	-123.50	-147.95	-24.45	-123.00	-151.57	-28.57
20%-30%	195.00	188.52	-6.48	220.00	200.00	-20.00
Median	292.50	291.32	-1.18	316.00	305.41	-10.59
Difference	-97.50	-102.80	-5.30	-96.00	-105.41	-9.41
30%-40%	221.00	218.89	-2.11	245.00	230.84	-14.16
Median	292.50	291.32	-1.18	316.00	305.41	-10.59
Difference	-71.50	-72.43	-0.93	-71.00	-74.57	-3.57
40%-50%	246.00	246.86	0.86	271.00	259.30	-11.70
Median	292.50	291.32	-1.18	316.00	305.41	-10.59
Difference	-46.50	-44.46	2.04	-45.00	-46.11	-1.11
50%-60%	275.00	275.29	0.29	299.00	289.05	-9.95
Median	292.50	291.32	-1.18	316.00	305.41	-10.59
Difference	-17.50	-16.03	1.47	-17.00	-16.37	0.63
60%-70%	310.00	307.35	-2.65	333.00	321.78	-11.22
Median	292.50	291.32	-1.18	316.00	305.41	-10.59
Difference	17.50	16.03	-1.47	17.00	16.37	-0.63
70%-80%	359.00	346.06	-12.94	380.00	361.66	-18.34
Median	292.50	291.32	-1.18	316.00	305.41	-10.59
Difference	66.50	54.74	-11.76	64.00	56.25	-7.75
80%-90%	442.00	400.49	-41.51	455.00	415.52	-39.48
Median	292.50	291.32	-1.18	316.00	305.41	-10.59
Difference	149.50	109.17	-40.33	139.00	110.10	-28.90
90%-95%	570.00	490.03	-79.97	569.00	505.52	-63.48
Median	292.50	291.32	-1.18	316.00	305.41	-10.59
Difference	277.50	198.71	-78.79	253.00	200.10	-52.90
95%-100%	1,116.00	910.52	-205.48	938.00	886.16	-51.84
Median	292.50	291.32	-1.18	316.00	305.41	-10.59
Difference	823.50	619.19	-204.31	622.00	580.75	-41.25

Source: own calculations

Changing Pattern of Consumption Expenditure across Decile Classes

To have a deeper insight into the trend in consumption expenditure for the different segments of population, this paper utilises secondary data on MPCE (measured in uniform and mixed reference periods) for different percentile groups of population in rural and urban India from 50th (1993-94) to 66th (2009-10) rounds of consumption expenditure surveys. In presenting the trend of consumption expenditure behavior, estimates of MPCE is deflated by suitable price indices (CPI-AL price indices for rural and the CPI-UNME for urban sector) and expressed at 1993-94 prices. In general, consumption expenditure across decile classes' at first exhibited an upward trend during the 1990's and then decelerated in the post-2008 scenario (Figure 2). Table 6 presents the MPCE data on 61st and 66th rounds of consumption expenditure surveys to explore the change in consumption expenditure in the pre and post food crisis scenario across percentile groups of the population.

Empirical results from the mean equality test suggest that mean levels of consumption expenditure in rural and urban differ significantly at a 5 per cent level of significance

Table 9: Decile Class wise difference-in-difference estimates of MPCE before and after 2008 in Urban India (URP & MRP).

Decile class	Urban		Change	Urban		Change
	2004-05 (U30)	2009-10 (U30)		2004-05 (M)	2009-10 (M)	
10% -20%	223.00	177.32	-45.68	248.00	188.67	-59.33
Median	472.50	446.90	-25.60	503.00	473.32	-29.68
Difference	-249.50	-269.58	-20.08	-255.00	-284.65	-29.65
20%-30%	269.00	245.68	-23.32	294.00	260.46	-33.54
Median	472.50	446.90	-25.60	503.00	473.32	-29.68
Difference	-203.50	-201.21	2.29	-209.00	-212.86	-3.86
30%-40%	316.00	295.79	-20.21	342.00	313.97	-28.03
Median	472.50	446.90	-25.60	503.00	473.32	-29.68
Difference	-156.50	-151.11	5.39	-161.00	-159.35	1.65
40%-50%	368.00	349.64	-18.36	396.00	370.12	-25.88
Median	472.50	446.90	-25.60	503.00	473.32	-29.68
Difference	-104.50	-97.26	7.24	-107.00	-103.20	3.80
50%-60%	433.00	410.78	-22.22	461.00	435.14	-25.86
Median	472.50	446.90	-25.60	503.00	473.32	-29.68
Difference	-39.50	-36.12	3.38	-42.00	-38.18	3.82
60%-70%	512.00	483.02	-28.98	545.00	511.50	-33.50
Median	472.50	446.90	-25.60	503.00	473.32	-29.68
Difference	39.50	36.12	-3.38	42.00	38.18	-3.82
70%-80%	619.00	574.06	-44.94	657.00	609.45	-47.55
Median	472.50	446.90	-25.60	503.00	473.32	-29.68
Difference	146.50	127.16	-19.34	154.00	136.13	-17.87
80%-90%	804.00	697.77	-106.23	854.00	744.55	-109.45
Median	472.50	446.90	-25.60	503.00	473.32	-29.68
Difference	331.50	250.87	-80.63	351.00	271.23	-79.77
90%-95%	1088.00	911.74	-176.26	1144.00	971.76	-172.24
Median	472.50	446.90	-25.60	503.00	473.32	-29.68
Difference	615.50	464.84	-150.66	641.00	498.44	-142.56
95%-100%	2,137.00	1,929.65	-207.35	1,985.00	1,907.55	-77.45
Median	472.50	446.90	-25.60	503.00	473.32	-29.68
Difference	1,664.50	1,482.75	-181.75	1,482.00	1,434.23	-47.77

Source: own calculations

(Table 7). A negative estimate of t-statistic suggests that rural consumption expenditure is lower than the urban region, while positive estimates of t-statistic suggest that consumption expenditure in the second period (i.e. post-2008), in fact, declines in comparison to the first period. Spatial variation in consumption expenditure is also statistically significant in a particular time period. The findings remain the same irrespective of the measures of consumption expenditure (uniform or mixed reference period) used.

Spatial-temporal Difference in Consumption Expenditure: Difference-in-difference

Table 8 summarises the change in MPCE across decile classes in the pre- and post-2008 scenario. Differences in the average consumption expenditures are also noted across decile classes by considering the median class as the control group of the population. A general trend of declining consumption expenditure across decile classes is noticeable after the rise in food prices in 2008. Change in consumption expenditure of a particular decile class (e.g. expenditure decline by Rs. 25.63 for 10%-20% class) is compared with the change in consumption expenditure of the median class (e.g. expenditure decline by only Rs. 1.18 for median class) by calculating the difference-in-difference estimator. The relative loss (the difference-in-difference of the changes in consumption expenditure) is Rs. 24.45. Inspection of the relative changes across decile classes indicates that the food price surge in 2008 had far-reaching implications on the consumption expenditure of most of the classes (especially higher decile class from 70%-80% and lowest decile class) in comparison to the median class. Middle decile classes (e.g. 40%-50% and 50%-60%) do not exhibit the same trend. The relative change in MPCE measured by using URP is seen as more prominent for the lower-income group (10%-20% to 50%-60%) than considering MRP as the measurement reference. For the higher-income class (from 60%-70%), MRP measurement provides larger relative change than URP.

The overall conclusion remains the same for urban India: the higher decile classes (from 80%-90%) and the lowest ones (10%-20%) are worse affected than the median class of the population. However, the magnitude of relative loss is lower in urban areas than in their rural counterparts. As with rural India, measurement of relative change by using a

Table 10: Decile class and region-wise difference-in-difference estimates of MPCE before and after 2008.

Decile class	Region	2004-05 (U30)	2009-10 (U30)	Change	2004-05 (M)	2009-10 (M)	Change
10%-20%	Rural	169.00	143.37	-25.63	193.00	153.84	-39.16
	Urban	223.00	177.32	-45.68	248.00	188.67	-59.33
	Difference	-54.00	-33.95	20.05	-55.00	-34.83	20.17
20%-30%	Rural	195.00	188.52	-6.48	220.00	200.00	-20.00
	Urban	269.00	245.68	-23.32	294.00	260.46	-33.54
	Difference	-74.00	-57.16	16.84	-74.00	-60.46	13.54
30%-40%	Rural	221.00	218.89	-2.11	245.00	230.84	-14.16
	Urban	316.00	295.79	-20.21	342.00	313.97	-28.03
	Difference	-95.00	-76.90	18.10	-97.00	-83.13	13.87
40%-50%	Rural	246.00	246.86	0.86	271.00	259.30	-11.70
	Urban	368.00	349.64	-18.36	396.00	370.12	-25.88
	Difference	-122.00	-102.77	19.23	-125.00	-110.81	14.19
50%-60%	Rural	275.00	275.29	0.29	299.00	289.05	-9.95
	Urban	433.00	410.78	-22.22	461.00	435.14	-25.86
	Difference	-158.00	-135.49	22.51	-162.00	-146.09	15.91
60%-70%	Rural	310.00	307.35	-2.65	333.00	321.78	-11.22
	Urban	512.00	483.02	-28.98	545.00	511.50	-33.50
	Difference	-202.00	-175.66	26.34	-212.00	-189.72	22.28
70%-80%	Rural	359.00	346.06	-12.94	380.00	361.66	-18.34
	Urban	619.00	574.06	-44.94	657.00	609.45	-47.55
	Difference	-260.00	-228.00	32.00	-277.00	-247.79	29.21
80%-90%	Rural	442.00	400.49	-41.51	455.00	415.52	-39.48
	Urban	804.00	697.77	-106.23	854.00	744.55	-109.45
	Difference	-362.00	-297.28	64.72	-399.00	-329.03	69.97
90%-95%	Rural	570.00	490.03	-79.97	569.00	505.52	-63.48
	Urban	1088.00	911.74	-176.26	1144.00	971.76	-172.24
	Difference	-518.00	-421.71	96.29	-575.00	-466.24	108.76
95%-100%	Rural	1,116.00	910.52	-205.48	938.00	886.16	-51.84
	Urban	2,137.00	1,929.65	-207.35	1,985.00	1,907.55	-77.45
	Difference	-1,021.00	-1,019.13	1.87	-1,047.00	-1,021.38	25.62

Source: own calculations

particular referencing period (URP or MRP) provides similar findings also in the context of urban India (Table 9).

Considering the urban region as the control group, the change in consumption expenditure of the rural region (i.e. treatment group) is also examined. Overall, it has been seen that change in consumption expenditure post-2008 is distinctly marked in comparison to the expenditure in urban area in change in rural areas. It has been reflected by the positive DID estimator in all cases. The findings suggest that urban area faces challenges in the wake of food price inflation in 2008 due to their dependence on non-wage goods (especially food grains) from rural areas (Table 10).

In the specification of DID regression, we have included a treatment effect (*i*, for rural or urban area), time effect (t, for pre and post-2008) and the interaction effect of time and treatment (*ti*). The coefficient of the treatment effect (δ) indicates the estimated average treatment effect. All coefficients have their expected signs. Time effects suggest that mean consumption expenditure is, in fact, declines in post 2008. However, the result is not found to be significant. Treatment effects suggest that mean consumption expenditure in rural is lower than urban region, and the result is found significant. In other words, significant coefficients of treatment effect in both the regressions (URP or MRP) imply the influence of spatial effect in determining the average MPCE across decile classes of the population. This supports our earlier findings of significant differences in mean MPCE in rural-urban differences in consumption expenditure (Table 11).

Sophisticated statistical software also reports average MPCE levels in urban and rural India in pre and post 2008 (table 12). The difference-in-difference coefficients (31.6 in URP and 33.4 in MRP) as shown in table 12 is similar to the coefficients of interaction effects in difference-in-difference regressions (Table 11).

Conclusions and Policy Implications

The main objective of this paper was to examine the implications of food price volatility on the changing pattern of consumption expenditure across decile classes in India. The background of the study suggests that the declining trend in the availability of food grains in the post-reform period can be explained by the encouragement of the export of food grains due to the comparative advantage of India vis-à-vis the international market in the pricing of food grains.

Consumption expenditure differs in both spatial (rural and urban) and temporal (pre- and post-2008) dimensions. Empirical results reveal that the relative loss of consumption expenditure (or difference-in-difference of the changes

Table 11: Results of difference-in-difference regression (URP and MRP).

	Uniform Reference Period		Mixed Reference Period	
	Coefficients	**t Stat**	**Coefficients**	**t Stat**
Constant	676.9	5.01***	692.6	5.49***
t	-69.3	-0.36	-61.2	-0.34
i	-286.6	-1.50*	-302.3	-1.69**
ti	31.7	0.11	33.3	0.13
	Observations: 40 Unadjusted R-squared = 0.367207, Adjusted R-squared = 0.333002		Observations: 40 Unadjusted R-squared = 0.104473, Adjusted R-squared = 0.0298452	

Note: ***, **, * implies significant at 1%, 10% and 15% level
Source: Author's calculation

Table 12: Results of Average MPCE (URP and MRP).

	Uniform Reference Period			Mixed Reference Period		
	i = 1 (Rural)	**i = 0 (Urban)**	**Difference**	**i = 1 (Rural)**	**i = 0 (Urban)**	**Difference**
t = 1 (post2008)	352.7	607.7	255.0	362.4	631.3	268.9
t = 0 (pre 2008)	390.3	676.9	286.6	390.3	692.6	302.3
Change	37.6	69.2	DID = 31.6	27.9	61.3	DID = 33.4

Source: Author's calculation

in consumption expenditure) in the urban regions is higher in comparison to the expenditure change in rural areas after the food price shock of 2008. Also, difference-in-difference regression has reinforced our earlier findings that differences in consumption expenditure can be explained by the interplay of spatial and temporal factors and the effects of their interaction.

In the backdrop of the relative loss of consumption expenditure in urban regions than rural regions after 2008, there is a need for a provision of social safety nets in urban India. The implementation of targeted promotional social protection policies through a combination of buffer stock operations and a public distribution system is expected simultaneously to address both the problem of access to food and the stabilisation of food prices.

As a limitation, the study considers only one dimension of food security (i.e. access to food as measured by the estimates of consumption expenditure). Any sweeping generalisation on the basis of this dimension may not capture the overall impact on nutrition food security. Adequate attention needs to be given to dietary diversification away from cereals and increasing consumption of horticulture and livestock products, which may compensate for calorie and protein losses arising from the declining per capita availability of cereal consumption. Macro evidence should be supplemented by micro empirical observations to provide a holistic overview of the impact of food price volatility on nutrition security.

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