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Is variety the spice of life? India's nutrition experience

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Abstract

This paper departs from an influential study by Deaton and Dreze, in which decline in calorie intake over the past few decades is attributed to lower calorie 'requirements' as a result of improvements in sanitation, health and more sedentary lifestyles, in order to address the central question of whether more diversified diets result in greater consumption of expensive calories and consequently in a reduction of calorie intake. We do so using the National Sample Survey (NSS) consumer expenditure data for 1993–94, 2004–05 and 2011–12. The study was motivated by a classic contribution by Behrman and Deolalikar and its elaboration by Jha et al; the former offer a quantitative explanation of the phenomenon that calorie elasticities are substantially lower than food expenditure elasticities: food variety *per se* is valued so that people purchase increased food variety as their incomes increase, even though this may not alter their calorie intakes much. Our analysis corroborates the fact that dietary diversification is associated with higher costs of calories, mainly because of reliance on more expensive calories (eg through a reduced dependence on cereals, which are the cheapest sources of calories), determined by a taste for variety in both rural and urban areas and across expenditure deciles over the period 1994–2012. Our analysis also confirms that higher costs of calories and greater affluence are associated with a reduction in calorie intake. Hence, closer scrutiny of food preferences and taste for variety is necessary to understand nutritional deprivation better and to design more effective policies to ameliorate it.

Keywords

Calories, diets, taste for variety, cost of calories, reduction in calorie intake, India

JEL Codes

I1, I3, I31

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1. Introduction

That India ranked 100 out of a group of 119 countries in the Global Hunger Index in 2017 is abysmal enough regardless of how steeply it has deteriorated in recent years. The higher the ranking, the worse is the state of hunger. India is currently undergoing a rapid economic and demographic transformation. Since 1980, average living standards have experienced a sustained and rapid rise. Rapid economic growth has been accompanied by rising urbanisation.

A key feature of the economic transformation has been the change in the nature of the Indian diet – a shift away from cereals towards vanaspati (vegetable) oil, eggs, meat, fish and poultry, fruits and vegetables – but with rural–urban variation. Some of the underlying factors in this dietary transition include the expansion of the middle class, higher female labour force participation (though with a reduction in recent years), the emergence of nuclear, two-income families, a sharp age divide in food preferences (with younger age-groups more susceptible to new foods advertised in the media), and a rapid growth of supermarkets and fast food outlets.

What precisely is the impact of dietary diversification on calorie intake is the focus of this study. This is not to suggest that nutrients themselves (such as protein and fat) do not matter. Indeed, they do; but we have restricted much of our analysis to calories. For it is worth emphasising that calorie deficiencies are regarded as the most basic and first-order problem, and often used to characterise widespread malnutrition, although other nutrient inadequacies are also found to be widespread.

In India, *despite* rising incomes, there has been a sustained decline in per capita calorie intake. One of the first examinations of this puzzle, by Deaton and Dreze (2009), shows a decline in average calorie intake in the quarter century preceding 2005. The puzzle is essentially this: per capita calorie consumption is lower at a given level of per capita household expenditure, across the expenditure scale, at low levels of per capita expenditure as well as high. In other words, there is a steady downward shift of the calorie Engel curve in a country which is undernourished! A contentious view offered in this study is that this is not attributable to changes in relative prices, since an aggregate measure of the price of food – treated as an approximation to synonymously the price of calories – changed little during the period in question. Deaton and Dreze are emphatic that, assuming the elasticity of income with respect to nutrition to be positive, the downward shift of the calorie Engel curve is to the result of lower calorie 'requirements', associated mainly with better health and lower activity levels.[1] As the evidence offered is fragmentary and patchy, this explanation is largely conjectural.

Another argument for the declining calorie intake is the lower expenditure on food as a proportion of people's total expenditure, and the voluntary choice of luxuries over food (Banerjee and Duflo, 2011; Basole and Basu, 2015; Sen, 2005). This argument is doubtful, as a

[1] Srinivasan (1992) is deeply sceptical of such 'requirements' on the grounds that energy expenditure adjusts to intake within a range. The question really is what the homeostatic range is within which this adjustment takes place.

reduction in food expenditure (as a proportion of total expenditure), or a food budget squeeze, implies the substitution of more expensive source of calories with a cheaper source of calories to meet energy requirements, and the extant literature suggests that the reverse is actually the case – even the poor are moving away from cheaper sources of calories to more expensive sources (Gaiha et al, 2014; Kaicker et al, 2016). Yet another argument for the lower calorie intake is the underreporting of food consumed, especially of eating out (Smith, 2015). However, this is far from conclusive.

Without rejecting the Deaton–Dreze view as implausible, we focus instead on a growing taste for variety as an important factor in lowering calorie intake during the period 1993–94 to 2011–12. As revealed by the 72nd round of the National Sample Survey (NSS) for 2014–15, there is considerable convergence between urban and rural lifestyles and consumption patterns. Of particular significance is the pervasiveness of eating out in both urban and rural areas. Strong demand for processed and fried foods and for snacks with attractive packaging and rich flavours, as well as for sugary beverages, is fuelled by aggressive advertising in the mass media. The growing 'taste' for variety is exhibited not just by the affluent but also by the lower economic strata.[2]

This study aims to build on two complementary and innovative contributions by Behrman and Deolalikar (1987; 1989). The first, based on estimates for a relatively poor rural south Indian population, indicates that, although income elasticities of food expenditure are large, income elasticities of calorie intakes are much smaller.[3] A number of other recent studies report similar results for a wide range of developing country populations (eg Knudsen and Scandizzo (1979) for Sri Lanka, Morocco and India), with a few notable exceptions. Behrman and Deolalikar's second paper (1989) offers a quantitative explanation of the phenomenon that calorie elasticities are substantially lower than food expenditure elasticities: food variety *per se* is valued such that people purchase increased food variety as their incomes increase, even though that may not greatly alter their calorie intakes.

Variety is directly related to two characteristics of consumer preferences for various foods: the degree of curvature and the centrality (relative to the axes) of location of indifference curves. If concern for low-cost calories dominates food choices at very low incomes, it is expected that the food indifference curves will be relatively flat (so substitution among foods is considerable if relative food prices change) and located close to the axis for the traditional cheapest source of calories. Hence, there is a tendency towards a high concentration on relatively cheap sources of calories. As incomes and food budgets increase, it is posited that food indifference curves across foods may become more sharply curved and centred further away from the axis for the

[2] Fast food consumption in India grew at 12% in current value terms in 2016. This growth was driven by the increasingly fast-paced lives of Indian consumers, which led them to choose a quick fix for their meal requirements. This is especially the case given that the average age of Indian consumers is still below 30 years. Despite a growing awareness of health and wellness among Indian consumers, consumption of fast food has not been affected.

[3] These results appear to be somewhat exaggerated in light of extant studies (Subramanian and Deaton, 1996; Jha et al, 2009).

low-cost calorie source. For preferences characterised by such indifference curves, there will be less concentration on particular (cheap calorie-supplying) foods and a greater variety of foods consumed for given food prices, and less change in food composition in response to changes in relative food prices. This denotes a situation of greater curvature and locational centrality of food indifference curves and a taste for food variety. The cross-country analysis is based on ICP data for 1975 and 1980.[4]

These estimates strongly suggest that, as their incomes and total expenditures on food increase from very low levels, consumers behave as if they increasingly value food variety. They imply that calorie intakes are likely to increase much less than expenditures on food with increased incomes for the poor, because poor people use the additional income to purchase increased food variety. This implication is consistent with income elasticities of calorie intakes that are substantially less than food expenditure elasticities with respect to income at low levels of per capita income.

Based on an analysis of a decline in calorie intake between the 1993 and 1999 NSS rounds, Jha et al (2009) confirm that two sets of relationships are key to this result: one is the relative price effect, depending on the curvature of the food indifference curves for the poor and non-poor; the second is the location of the indifference curves. The decline in calorie intake is thus a consequence of taste for variety associated with increasing curvature of food indifference curves and their increasing centrality. However, the curvature is higher among the non-poor and not substantially so among the poor, although locational differences are pronounced for some food items.

The central question is thus: have more diversified diets resulted in greater consumption of expensive calories and consequently in a reduction in calorie intake? We address this below, using the NSS consumer expenditure data for 1993–94, 2004–05 and 2011–12.

1.1 Scheme

In Section 2, we sketch changes in calorie intake, undernourishment and the costs of calories. We discuss salient features of the NSS data and conversion of food expenditure into nutrient intakes in Section 3. This is followed by a more detailed discussion in Section 4 of changes in calorie, protein and fat intakes and in their distribution during 1994–2012. Section 5 discusses changes in calorie, protein and fat deprivation. Section 6 offers a detailed discussion of the rise in the cost of calories by expenditure decile and over time. Section 7 examines dietary diversification by expenditure decile, and how it evolved over the period 1994–2012. A composite index of dietary diversification is constructed which is an improvement over indices used in earlier studies. Section 8 specifies the model, which is estimated using instrument variable regression with fixed state effects. Section 9 is devoted to a discussion of the

[4] The ICP is a worldwide statistical initiative to collect comparative price data and estimate purchasing power parities of the world's economies. Its main objective is to provide comparable international price and volume measures of GDP and expenditure aggregates among countries.

econometric results. Section 10 discusses the significance of our contribution relative to the pioneering contribution of Behrman and Deolalikar (1989) and its elaboration and validation in India's context by Jha et al (2009), and from a broader policy perspective. Section 11 offers concluding observations on specific policy concerns.

2. Changes in calorie intake, undernourishment and cost of calories

The fact that average calorie intake was slightly higher in 2011–12 than in 2004–05 is seen as a reversal of the declining intake of calories over 1983–2005. We offer a more nuanced view based on a disaggregated analysis that in part refutes this interpretation.

The base year matters. The average calorie intake was lower in 2005 than in 1994 in rural India. It was also lower in 2012 relative to 1994. However, the calorie intake in 2012 was higher than in 2004–05. So, if the comparison is confined to 1994–2012, there was no reversal. A different pattern is revealed for urban India. The average calorie intake was lower in 2005 than in 1994. It rose between 2005–12. However, it declined overall between 1994 and 2012. Thus there was a decline during 1994–2012.

Some related statistics of undernourishment are appalling. The proportion of undernourished people among the rural poor has risen over time and accounted for a larger majority of the poor (about 84% in 2011–12 compared with 75% in 1993–94). The proportion of those undernourished among the urban poor rose but moderately (from 64% in 1993 to 68% in 2011). The poor are thus more likely to be undernourished.

The (real) cost of calories rose consistently between 1994 and 2005, and between 2005 and 2011, across per capita expenditure deciles in both rural and urban areas.

3. Data

Our empirical analysis uses household-level data from three recent thick rounds of the quinquennial Consumer Expenditure Survey (CES) conducted by the NSSO: 1993–94 (50th Round), 2004–05 (61st Round) and 2011–12 (68th Round). The thick rounds of the CES are large-scale, nationally representative surveys of households, conducted roughly every five years, which collect detailed data about the level and pattern of consumption expenditure.

Each survey round involves some 80,000 rural households (located in 8,000 villages) and 45,000 urban households (located in 4,500 urban blocks). Survey weights are used to make the sample nationally representative. The surveys record household expenditures and quantities for each food item consumed in the past 30 days (with home grown foods and gifts both valued at the prevailing local prices) or uniform recall period. There are 169 different food items, including 12 products made from rice or wheat, nine types of pulse, seven milk products and many vegetables, spices and types of meat. Their conversion into calories, proteins and fats is done using the Gopalan et al (1971) and ICMR (1990) ratios. Food prices are based on unit values that are aggregated into Primary Sampling Unit averages. Nominal prices are adjusted to the 2004–05 Consumer Price Index for Agricultural Labourers for rural areas and to the Consumer Price Index for Industrial Workers (CPIIW) for urban areas.

4. Changes in intake and distribution of calories, protein and fat

4.1 Aggregate

Table 1 gives comparisons of calorie intake in 1994, 2005 and 2012, using t–tests for significant differences. As both rural and urban comparisons reveal, the intake was significantly lower in 2005 relative to 1994; however, it rose significantly during 2005–12. Nevertheless, between 1994 and 2012 there was a decline.

Table 1: Changes in calorie intake, 1994–2012

	RURAL INDIA			URBAN INDIA		
	1994 and 2005	2005 and 2012	1994 and 2012	1994 and 2005	2005 and 2012	1994 and 2012
1993–94	2284.44		2284.44	2279.18		2279.18
2004–05	2186.46	2186.46		2147.13	2147.13	
2011–12		2220.29	2220.29		2211.84	2211.84
Difference	97.98	-33.83	64.15	132.05	-64.71	67.34
t-statistic	14.96	-5.20	14.66	15.92	-8.19	12.13
p-value	0.00	0.00	0.00	0.00	0.00	0.00

Source: Authors' calculations from various rounds of the NSS.

Thus the inference of a reversal of declining calorie intake based on a comparison of 2005 and 2012 is potentially misleading.

In Table 2, comparisons of protein intake during the corresponding periods are shown, with tests of significance. Average protein intake in rural India declined significantly during 1994–2005; it remained unchanged during 2005–2012; however, it fell significantly during 1994–2012. In urban India, it recorded a significant reduction during 1994–2005 but rose significantly during 2005–2012. However, as in rural India, it fell significantly overall during 1994–2012.

Table 2: Changes in protein intake, 1994–2012

	RURAL INDIA			URBAN INDIA		
	1994 and 2005	2005 and 2012	1994and & 2012	1994 and 2005	2005 and 2012	1994 and 2012
1993–94	63.72		62.07	62.07		62.07
2004–05	59.00	59.00		57.73	57.73	
2011–12		59.10	59.04		59.04	59.04
Difference	4.72	-0.10	3.03	4.34	-1.31	3.03
t-statistic	23.09	-0.53	20.89	19.38	-5.92	20.89
p-value	0.00	0.59	0.00	0.00	0.00	0.00

Source: Authors' calculations from various rounds of the NSS.

The average fat intake was significantly higher in 2005 compared with 1994 in rural India, as also in 2012 relative to 2005, and in 2012 relative to 1994. Thus, in sharp contrast to calorie and protein intakes, fat recorded a consistent rise throughout.

Table 3: Changes in fat intake, 1994–2012

	RURAL INDIA			URBAN INDIA		
	1994 and 2005	2005 and 2012	1994 and 2012	1994 and 2005	2005 and 2012	1994 and 2012
1993–94	34.98		34.98	47.85		47.85
2004–05	40.13	40.13		48.61	48.61	
2011–12		45.28	45.28		53.27	53.27
Difference	-5.14	-5.16	-10.30	-0.75	-4.66	-5.42
t-statistic	-13.64	-12.91	-68.54	-1.20	-7.77	-17.01
p-value	0.00	0.00	0.00	0.23	0.00	0.00

Source: Authors' calculations from various rounds of the NSS.

4.2 Disaggregation by Monthly per Capita Expenditure (MPCE) deciles

In rural India, calorie intake by expenditure decile rose in 1994, 2005 and 2012. To avoid tedious details, our comments are confined to the differences between 1994 and 2012, as shown in Table 4. In the lowest four expenditure deciles in rural India, calorie intake was significantly higher in 2012 relative to 1994. In all higher expenditure deciles, calorie intakes were significantly lower. In urban India, between 1994 and 2012, except for the two lowest expenditure deciles, in which it was significantly higher in 2012, in all higher expenditure deciles calorie intake was significantly lower.

Table 4: Calorie intake by deciles of MPCE

Deciles of MPCE	Mean value			Difference			Wald (F statistic)		
	1993–94	2004–05	2011-12	1994 and 2005	1994 and 2012	2005 and 2012	1994 and 2005	1994 and 2012	2005 and 2012
RURAL									
1	1465.4	1484.7	1679.7	19.30 (1.3%)	214.30 (14.6%)	195.00 (13.1%)	4.0	344.1	279.8
2	1731.3	1681.2	1823.8	-50.10 (-2.9%)	92.50 (5.3%)	142.60 (8.5%)	32.6	56.5	132.3
3	1851.7	1801.9	1915.1	-49.80 (-2.7%)	63.40 (3.4%)	113.20 (6.3%)	12.5	28.2	47.7
4	1975.5	1881.4	1981.6	-94.10 (-4.8%)	6.10 (0.3%)	100.20 (5.3%)	92.3	**0.2 (NS)**	64.1
5	2057.4	1961.7	2041.5	-95.70 (-4.7%)	-15.90 (-0.8%)	79.80 (4.1%)	81.3	**1.7 (NS)**	36.6
6	2165.3	2044.2	2115.8	-121.10 (-5.6%)	-49.50 (-2.3%)	71.60 (3.5%)	126.2	14.8	31.6
7	2276.6	2157.4	2188.6	-119.20 (-5.2%)	-88.00 (-3.9%)	31.20 (1.4%)	44.0	43.2	**2.6 (NS)**
8	2411.5	2291.8	2272.0	-119.70 (-5.0%)	-139.50 (-5.8%)	-19.80 (-0.9%)	13.2	108.6	**0.4 (NS)**
9	2590.0	2377.4	2352.1	-212.60 (-8.2%)	-237.90 (-9.2%)	-25.30 (-1.1%)	229.2	261.8	**2.7 (NS)**
10	3036.9	2791.7	2649.6	-245.20 (-8.1%)	-387.30 (-12.8%)	-142.10 (-5.1%)	76.5	251.9	30.4

URBAN									
Deciles of MPCE	Mean value			Difference			Wald (F statistic)		
	1993–94	2004–05	2011-12	1994 and 2005	1994 and 2012	2005 and 2012	1994 and 2005	1994 and 2012	2005 and 2012
1	1527.3	1512.6	1636.8	-14.70 (-1.0%)	109.50 (7.2%)	124.20 (8.2%)	**1.4 (NS)**	84.5	92.0
2	1759.7	1686.5	1763.2	-73.20 (-4.2%)	3.50 (0.2%)	76.70 (4.5%)	35.4	**0.1 (NS)**	33.9
3	1888.0	1835.7	1858.5	-52.30 (-2.8%)	-29.50 (-1.6%)	22.80 (1.2%)	**1.4 (NS)**	5.0	**0.3 (NS)**
4	1992.3	1856.7	1920.5	-135.60 (-6.8%)	-71.80 (-3.6%)	63.80 (3.4%)	96.2	23.9	17.7
5	2096.1	1945.9	1980.5	-150.20 (-7.2%)	-115.60 (-5.5%)	34.60 (1.8%)	99.9	68.9	4.7
6	2193.7	2021.6	2052.0	-172.10 (-7.8%)	-141.70 (-6.5%)	30.40 (1.5%)	61.2	87.4	**2.0 (NS)**
7	2315.3	2108.5	2129.7	-206.80 (-8.9%)	-185.60 (-8.0%)	21.20 (1.0%)	79.8	107.8	**1.0 (NS)**
8	2450.0	2212.6	2246.5	-237.40 (-9.7%)	-203.50 (-8.3%)	33.90 (1.5%)	123.9	129.8	**2.6 (NS)**
9	2674.0	2338.3	2379.8	-335.70 (-12.6%)	-294.20 (-11.0%)	41.50 (1.8%)	180.2	154.8	**3.2 (NS)**
10	3043.7	2690.7	2608.3	-353.00 (-11.6%)	-435.40 (-14.3%)	-82.40 (-3.1%)	33.3	106.2	**2.3 (NS)**

Source: Authors' calculations from various rounds of the NSS.

Protein

In rural India, protein intake rose by expenditure decile in 1994, 2005 and 2012. Except for the lowest decile, where there was a significant rise, in all higher expenditure deciles there were significant reductions between 1994 and 2012.Urban India witnessed a similar pattern. Except for the lowest expenditure decile, which saw a significant increase, all higher deciles recorded significant reductions.

Table 5: Protein intake by deciles of MPCE

Deciles of MPCE	Mean value			Difference			Wald (F statistic)		
	1993–94	2004–05	2011–12	1994 and 2005	1994 and 2012	2005 and 2012	1994 and 2005	1994 and 2012	2005 and 2012
RURAL									
1	41.40	39.64	43.67	-1.76 (-4.3%)	2.27 (5.5%)	4.03 (10.2%)	22.24	33.76	113.01
2	47.94	45.13	47.86	-2.81 (-5.9%)	-0.08 (-0.2%)	2.73 (6.0%)	94.61	**0.04 (NS)**	52.91
3	51.03	49.09	50.54	-1.94 (-3.8%)	-0.49 (-1.0%)	1.45 (3.0%)	10.96	**1.61 (NS)**	5.21
4	54.19	51.16	52.98	-3.03 (-5.6%)	-1.21 (-2.2%)	1.82 (3.6%)	80.63	9.42	20.02
5	56.88	53.13	54.41	-3.75 (-6.6%)	-2.47 (-4.3%)	1.28 (2.4%)	128.53	38.31	10.85
6	60.20	56.00	57.16	-4.20 (-7.0%)	-3.04 (-5.0%)	1.16 (2.1%)	104.65	40.84	7.25
7	63.35	58.61	59.28	-4.74 (-7.5%)	-4.07 (-6.4%)	0.67 (1.1%)	153.69	89.98	**2.34 (NS)**
8	67.63	62.04	61.59	-5.59 (-8.3%)	-6.04 (-8.9%)	-0.45 (-0.7%)	132.88	198.99	**0.78 (NS)**
9	73.54	66.18	64.88	-7.36 (-10.0%)	-8.66 (-11.8%)	-1.30 (-2.0%)	136.96	322.03	**3.97 (NS)**
10	86.53	77.33	73.44	-9.20 (-10.6%)	-13.09 (-15.1%)	-3.89 (-5.0%)	159.76	347.36	31.83

URBAN									
Deciles of MPCE	Mean value			Difference			Wald (F statistic)		
	1993–94	2004–05	2011–12	1994 and 2005	1994 and 2012	2005 and 2012	1994 and 2005	1994 and 2012	2005 and 2012
1	42.85	42.07	44.05	-0.78 (-1.8%)	1.20 (2.8%)	1.98 (4.7%)	**3.70 (NS)**	9.94	24.81
2	48.66	46.47	47.82	-2.19 (-4.5%)	-0.84 (-1.7%)	1.35 (2.9%)	28.07	4.22	10.25
3	52.30	51.63	50.26	-0.67 (-1.3%)	-2.04 (-3.9%)	-1.37 (-2.7%)	**0.12 (NS)**	23.78	**0.49 (NS)**
4	55.38	50.83	51.87	-4.55 (-8.2%)	-3.51 (-6.3%)	1.04 (2.0%)	92.20	52.62	4.31
5	57.72	53.76	53.38	-3.96 (-6.9%)	-4.34 (-7.5%)	-0.38 (-0.7%)	55.57	103.28	**0.49 (NS)**
6	60.41	55.03	55.62	-5.38 (-8.9%)	-4.79 (-7.9%)	0.59 (1.1%)	103.80	104.36	**1.37 (NS)**
7	63.64	57.60	57.22	-6.04 (-9.5%)	-6.42 (-10.1%)	-0.38 (-0.7%)	87.33	165.29	**0.38 (NS)**
8	67.59	60.35	60.67	-7.24 (-10.7%)	-6.92 (-10.2%)	0.32 (0.5%)	116.66	164.12	**0.25 (NS)**
9	73.22	63.39	64.47	-9.83 (-13.4%)	-8.75 (-12.0%)	1.08 (1.7%)	204.60	162.43	**2.43 (NS)**
10	83.63	73.05	71.02	-10.58 (-12.7%)	-12.61 (-15.1%)	-2.03 (-2.8%)	40.78	100.62	**2.02 (NS)**

Source: Authors' calculations from various rounds of the NSS.

Fat

As shown in Table 6, in rural India fat intake by expenditure decile rose in each year. Between 1994 and 2012, each decile witnessed a significant increase. In urban India, the pattern was somewhat dissimilar: except for the ninth and 10th deciles, which witnessed reductions in fat intake in 1994–2012, all other expenditure deciles recorded significant increases.

Table 6: Fat intake by deciles of MPCE

Deciles of MPCE	Mean value			Difference			Wald (F statistic)		
	1993–94	2004–05	2011–12	1994 and 2005	1994 and 2012	2005 and 2012	1994 and 2005	1994 and 2012	2005 and 2012
RURAL									
1	14.04	16.14	22.13	2.10 (15.0%)	8.09 (57.6%)	5.99 (37.1%)	62.05	693.44	515.32
2	17.76	21.25	28.05	3.49 (19.7%)	10.29 (57.9%)	6.80 (32.0%)	213.54	1325.03	489.14
3	20.59	25.10	31.78	4.51 (21.9%)	11.19 (54.3%)	6.68 (26.6%)	31.27	1356.47	63.43
4	23.25	27.90	35.63	4.65 (20.0%)	12.38 (53.2%)	7.73 (27.7%)	214.03	1301.57	352.20
5	26.51	30.84	38.30	4.33 (16.3%)	11.79 (44.5%)	7.46 (24.2%)	76.99	1002.94	173.43
6	29.91	34.14	41.92	4.23 (14.1%)	12.01 (40.2%)	7.78 (22.8%)	170.88	935.19	341.81
7	33.51	39.91	45.98	6.40 (19.1%)	12.47 (37.2%)	6.07 (15.2%)	15.38	983.83	13.56
8	38.69	43.39	50.30	4.70 (12.1%)	11.61 (30.0%)	6.91 (15.9%)	24.71	643.76	48.80
9	46.61	48.98	55.65	2.37 (5.1%)	9.04 (19.4%)	6.67 (13.6%)	21.44	310.84	128.63
10	63.82	66.58	68.67	2.76 (4.3%)	4.85 (7.6%)	2.09 (3.1%)	9.39	34.96	5.64

URBAN									
Deciles of MPCE	Mean value			Difference			Wald (F statistic)		
	1993–94	2004–05	2011–12	1994 and 2005	1994 and 2012	2005 and 2012	1994 and 2005	1994 and 2012	2005 and 2012
1	19.41	22.13	28.84	2.72 (14.0%)	9.43 (48.6%)	6.71 (30.3%)	117.75	1154.49	459.39
2	26.48	28.81	36.36	2.33 (8.8%)	9.88 (37.3%)	7.55 (26.2%)	35.67	889.97	294.51
3	31.61	36.53	41.49	4.92 (15.6%)	9.88 (31.3%)	4.96 (13.6%)	**2.92 (NS)**	702.11	**2.96 (NS)**
4	37.30	37.74	45.77	0.44 (1.2%)	8.47 (22.7%)	8.03 (21.3%)	**0.62 (NS)**	219.91	294.53
5	42.21	41.43	49.44	-0.78 (-1.8%)	7.23 (17.1%)	8.01 (19.3%)	**2.49 (NS)**	217.86	218.10
6	47.22	47.53	53.54	0.31 (0.7%)	6.32 (13.4%)	6.01 (12.6%)	**0.05 (NS)**	148.80	18.79
7	53.44	51.90	57.46	-1.54 (-2.9%)	4.02 (7.5%)	5.56 (10.7%)	**2.26 (NS)**	45.07	28.80
8	60.78	57.55	62.55	-3.23 (-5.3%)	1.77 (2.9%)	5.00 (8.7%)	10.14	6.96	22.58
9	71.80	65.12	69.50	-6.68 (-9.3%)	-2.30 (-3.2%)	4.38 (6.7%)	23.06	**3.33 (NS)**	18.23
10	86.72	85.60	80.01	-1.12 (-1.3%)	-6.71 (-7.7%)	-5.59 (-6.5%)	**0.10 (NS)**	19.01	**2.66 (NS)**

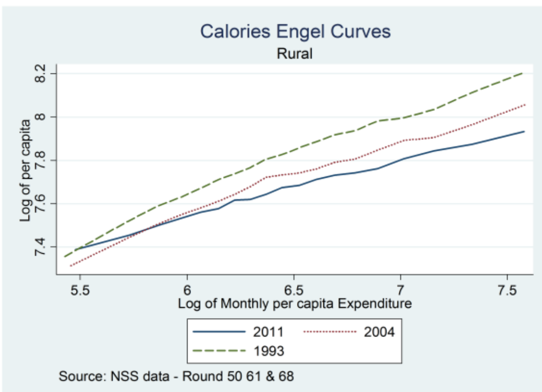
Source: Authors' calculations from various rounds of the NSS.

4.3 Engel curves

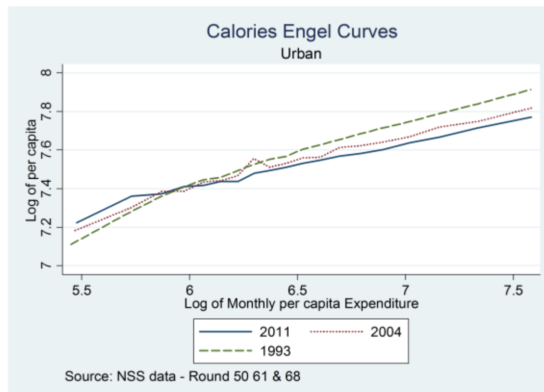
As a supplement to disaggregated analysis of changes in calorie, protein and fat intake by expenditure decile, we examine below how their intakes vary by MPCE, based on Engel curves. These are shown in Figure 1.

Figure 1: Engel curves

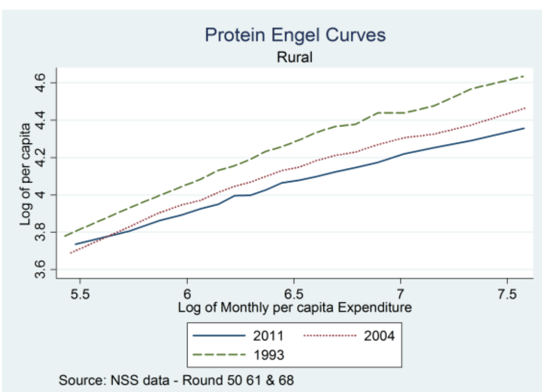
Calorie Engel curve: rural India



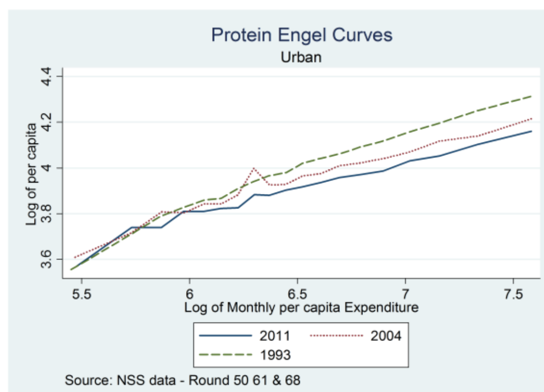
Calorie Engel curve: urban India



Protein Engel curve: rural India

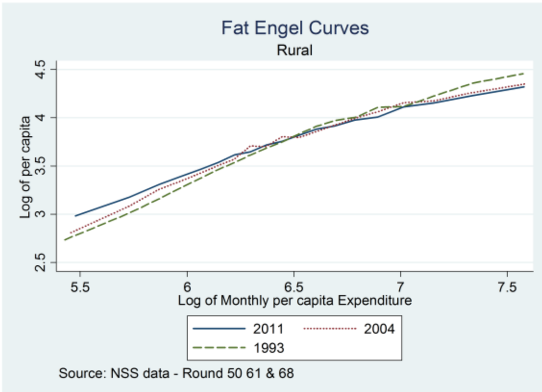


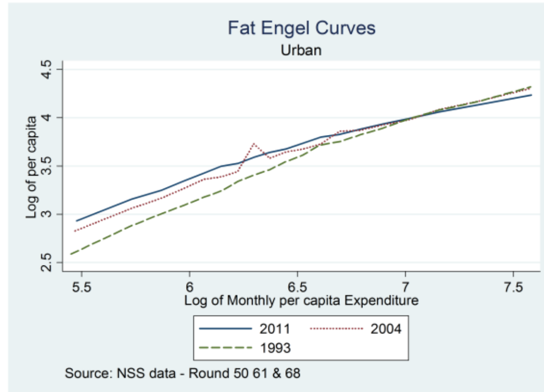
Protein Engel curve: urban India



Fat Engel curve: rural India

Fat Engel curve: urban India





Calories

The Engel curve for Rural India for 1994 lies above that for 2012, further confirming that, at the same level of MPCE, calorie intake was lower in 2012. The gap also widened – especially at higher MPCE. At low MPCE the Engel curve for 1994 rises at a faster rate than the 2012 curve but the former dips at a high MPCE and then rises steadily. In contrast, the 2012 curve at low MPCE rises slowly and dips at high MPCE and rises at a slow rate at higher MPCE. Between 2005 and 12, except for low MPCE, at all other higher MPCEs, the 2012 Engel curve lies below that for 2005.

In urban India, except at low MPCE, the 2012 curve was above the corresponding curves for 1994 and 2005, it is lower at all higher MPCEs. The gap between the 1994 and 2012 curves also widened at higher MPCEs, with a steady but faster rise of the former relative to the latter.

Protein

The protein Engel curve for 2012 in urban India lies consistently below that for 1994, as also below that for 2005, except at low MPCE. This is a striking illustration of the reduction in protein intake between 1994 and 2012. The urban India Engel curves for protein present a contrast. Except for the lowest MPCE, at which the 2012 curve lies above that for 2005 but below the 1994 curve, at higher MPCEs the 2012 curve lies below those for 1994 and 2005.

Fat

The Engel curves for fat are more revealing than the decile-wise analysis. The 2012 curve for rural India lies above those for 1994 and 2005 over a large segment but, at higher MPCEs, it lies just below the 2005 curve and well below the 1994 curve. In urban India, a large segment of the Engel curve for 2012 lies above both the 1994 and 2005 curves but, at higher MPCEs, it overlaps with the 2005 curve but lies below the 1994 curve.

5. Changes in nutritional deprivation

If we take the nutritional norms as valid, the overall picture of nutritional deprivation worsened considerably over the period 1994–2012. Table 7 shows the shares of calorie, protein and fat deficient populations in rural India, and by poverty status (using Tendulkar's state-level poverty lines). For calories, we take the cut-off of 2100 Kcal per capita per day for rural areas and 1800 Kcal per capita per day for urban areas. For proteins we take the cut-off of 60 grams per capita per day and, for fats, we take the cut-off of 30 grams per capita per day. The estimates show that proportions of undernourished and protein-deficient populations rose between 1994 and 2005, but declined subsequently, and the proportion of the fat-deficient population declined consistently during 1994–2012.

Using NSS data and Tendulkar's poverty lines, there was a near halving of poverty. In examining its overlap with undernourishment, two indicators are used. One is the proportion of the undernourished poor or the number of undernourished people who are also poor in the total population. Given the sharp decline in poverty, it is not surprising that this proportion fell from about 4% to about 25% in rural areas. A related but distinct indicator is the proportion of those undernourished among the poor. This has risen over time and accounted for a larger majority of the poor in rural areas (about 84% in 2012 *vis-à-vis* 75% in 1994).

Table 7: Proportion of undernourished, protein- and fat-deficient people in rural India

	RURAL								
	1993–94			2004–05			2011–12		
	Poor	Non-poor	Total	Poor	Non-poor	Total	Poor	Non-poor	Total
Undernourished	41.2%	11.5%	52.7%	40.8%	20.5%	61.3%	24.8%	30.0%	54.8%
Not undernourished	14.1%	33.2%	47.3%	7.7%	31.0%	38.7%	4.9%	40.4%	45.3%
Total	55.3%	44.7%	100%	48.5%	51.5%	100%	29.7%	70.3%	100%
Protein-deficient	41.9%	15.7%	57.6%	41.4%	25.4%	66.9%	26.6%	38.3%	64.9%
Not protein-deficient	13.4%	29.0%	42.4%	7.0%	26.1%	33.1%	3.1%	32.0%	35.1%
Total	55.3%	44.7%	100%	48.5%	51.5%	100%	29.7%	70.3%	100%
Fat-deficient	44.5%	14.9%	59.4%	36.4%	13.4%	49.8%	17.8%	11.9%	29.7%
Not fat-deficient	10.8%	29.9%	40.6%	12.1%	38.1%	50.2%	11.8%	58.4%	70.3%
Total	55.3%	44.7%	100%	48.5%	51.5%	100%	29.7%	70.3%	100%

Source: Authors' calculations from NSS data.

In urban India, as shown in Table 8, the proportion of those undernourished rose between 1994 and 2005 but fell moderately in 2012. The protein-deficient population rose between 1994 and

2005 but fell slightly in 2012. The fat-deficient population fell consistently and was barely one-third of that in 1994.

Table 8: Proportion of undernourished, protein- and fat-deficient people in urban India

	URBAN								
	1993–94			2004–05			2011–12		
	Poor	Non-poor	Total	Poor	Non-poor	Total	Poor	Non-poor	Total
Undernourished	23.2%	12.3%	35.5%	20.8%	17.3%	38.1%	10.9%	21.5%	32.4%
Not undernourished	12.9%	51.7%	64.5%	9.2%	52.7%	61.9%	5.0%	62.6%	67.6%
Total	36.0%	64.0%	100%	29.9%	70.1%	100%	16.0%	84.0%	100%
Protein-deficient	30.9%	31.8%	62.7%	26.9%	41.8%	68.7%	14.9%	52.2%	67.1%
Not protein-deficient	5.2%	32.2%	37.3%	3.0%	28.2%	31.3%	1.1%	31.8%	32.9%
Total	36.0%	64.0%	100%	29.9%	70.1%	100%	16.0%	84.0%	100%
Fat-deficient	26.0%	9.6%	35.6%	18.3%	7.2%	25.4%	7.4%	5.2%	12.5%
Not fat-deficient	10.1%	54.4%	64.4%	11.7%	62.9%	74.6%	8.6%	78.9%	87.5%
Total	36.0%	64.0%	100%	29.9%	70.1%	100%	16.0%	84.0%	100%

Source: Authors' calculations from various rounds of the NSS.

The proportion of undernourished poor reduced from 23% to 11% between 1994 and 2012 thanks to a sharp reduction in the share of the urban poor; but the proportion of poor people who were undernourished rose from 64% in 1994 to 68% in 2012. The poor are thus more likely to be undernourished.

As shown in Table 9, the mean differences in proportion of undernourished populations differed significantly by caste, whether poor or not, in both rural and urban India between 1994–2005, 2005–2012 and 1994–2012.

Table 9: t-tests of differences in mean proportion of undernourished

	Mean value			difference			t-value		
	1993–94	2004–05	2011–12	1994 and 2005	1994 and 2012	2005 and 2012	1994 and 2005	1994 and 2012	2005 and 2012
RURAL									
Total	0.46	0.53	0.47	-0.07	-0.01	0.06	-27.40	-2.81	23.42
SC	0.55	0.60	0.57	-0.05	-0.02	0.03	-8.12	-2.78	5.12
ST	0.54	0.61	0.49	-0.07	0.05	0.11	-11.09	7.10	17.56
Others	0.42	0.49	0.43	-0.08	-0.02	0.06	-24.26	-5.53	17.60
Poor	0.73	0.83	0.82	-0.10	-0.09	0.01	-29.96	-19.84	2.19
Non-poor	0.23	0.36	0.38	-0.13	-0.15	-0.02	-41.28	-46.78	-6.58
URBAN									
Total	0.27	0.34	0.26	-0.07	0.02	0.08	-21.48	5.80	26.68
SC	0.23	0.32	0.27	-0.09	-0.04	0.05	-8.08	-3.44	4.90
ST	0.38	0.43	0.31	-0.05	0.07	0.12	-5.63	7.49	13.46
Others	0.26	0.33	0.25	-0.06	0.02	0.08	-18.56	4.92	22.69
Poor	0.61	0.65	0.62	-0.04	-0.01	0.03	-6.86	-1.99	3.67
Non-poor	0.15	0.20	0.19	-0.05	-0.04	0.01	-17.06	-13.82	3.68

Notes: SC=Scheduled Castes; ST=Scheduled Tribes

The aggregate proportion of undernourished people in rural India rose slightly but significantly during 1994–2012. While it rose slightly but significantly among the SCs, it reduced significantly among the STs. Among 'Others', it rose slightly but significantly during this period. It rose sharply and significantly among the poor, as also among the non-poor.

The aggregate proportion of undernourished people in urban India fell slightly but significantly during 1994–2012. Among the SCs there was a significant increase, while among the STs there was a significant decrease. 'Others' recorded a slight but significant reduction. There was a slight but significant increase among the poor as well as the non-poor.

6. Costs of calories

One of the key hypotheses here is whether individuals and households are switching to more expensive sources of calories driven by a taste for variety. We first look at cross-tabulations of costs of calories by MPCE deciles in Table 10. The (real) cost of calories rose across expenditure deciles in both rural and urban India in 1994, 2005 and 2012 (Table 10). For each decile the cost of calories rose over time, both from 1994 to 2005 and 1994 to 2012. The average cost of calories rose 3.5 times in rural India and 3.6 times in urban India between 1994 and 2012. Whether the mean decile-wise differences are statistically different is tested using the t-test (at the 1% level).

Table 10: t-tests of differences in costs of calories by expenditure decile

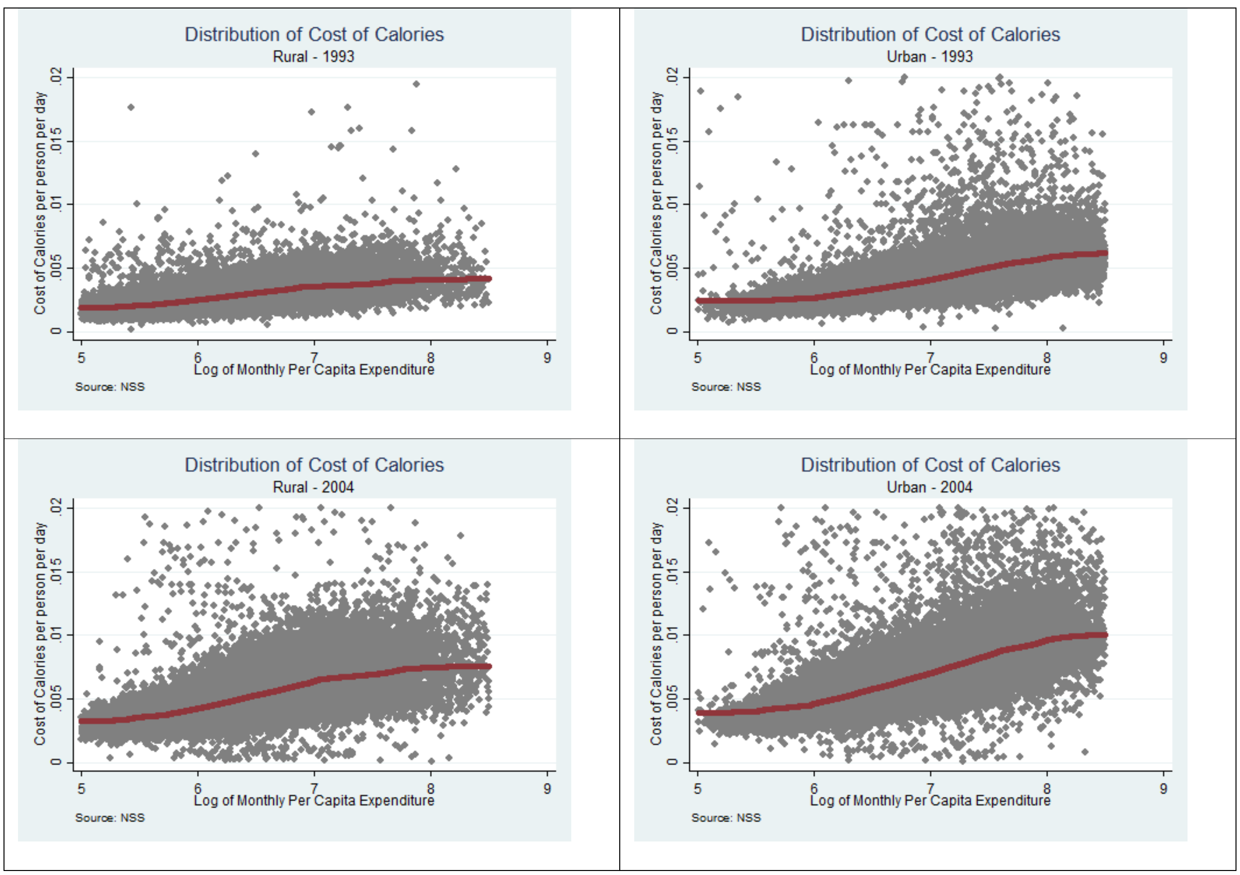
Deciles of MPCE	Mean value			difference			T-value		
	1993–94	2004–05	2011–12	1994 and 2005	1994 and 2012	2005 and 2012	1994 and 2005	1994 and 2012	2005 and 2012
RURAL									
1	2.39	3.79	6.82	-1.40	-4.43	-3.03	-14.55	-22.26	-25.60
2	2.39	4.10	7.52	-1.70	-5.12	-3.42	-34.42	-46.77	-46.81
3	2.55	4.30	8.29	-1.76	-5.75	-3.99	-35.90	-59.42	-56.07
4	2.64	4.52	8.52	-1.88	-5.88	-3.99	-50.18	-78.50	-66.98
5	2.71	4.75	9.03	-2.04	-6.32	-4.28	-62.22	-98.69	-82.51
6	2.86	4.91	9.49	-2.06	-6.63	-4.57	-67.82	-110.00	-93.24
7	3.00	5.26	10.12	-2.27	-7.13	-4.86	-59.46	-120.00	-97.15
8	3.16	5.59	10.66	-2.43	-7.50	-5.07	-78.05	-140.00	-120.00
9	3.39	6.01	11.60	-2.63	-8.21	-5.58	-88.86	-160.00	-130.00
10	3.97	7.22	13.98	-3.25	-10.01	-6.76	-96.96	-160.00	-130.00
URBAN									
1	2.78	4.55	8.35	-1.77	-5.56	-3.80	-44.95	-73.56	-54.10
2	3.03	5.08	9.64	-2.05	-6.61	-4.56	-59.63	-99.92	-75.26
3	3.27	5.55	10.63	-2.28	-7.36	-5.08	-60.67	-120.00	-77.01
4	3.50	6.02	11.41	-2.52	-7.92	-5.39	-41.37	-130.00	-64.13
5	3.74	6.26	12.12	-2.52	-8.38	-5.86	-61.75	-130.00	-80.72
6	3.95	6.79	12.98	-2.84	-9.03	-6.18	-59.02	-130.00	-74.78
7	4.24	7.14	13.92	-2.90	-9.68	-6.78	-71.37	-140.00	-88.67
8	4.59	7.65	14.91	-3.06	-10.32	-7.25	-69.44	-130.00	-94.37
9	5.09	8.38	16.32	-3.30	-11.23	-7.94	-72.15	-130.00	-97.64
10	5.91	9.93	19.04	-4.02	-13.13	-9.11	-62.80	-110.00	-81.50

Using Lowess – a non-parametric data smoothing technique – we further investigate the relationships between cost of calories and MPCE.[5] These are shown in Figure 2.

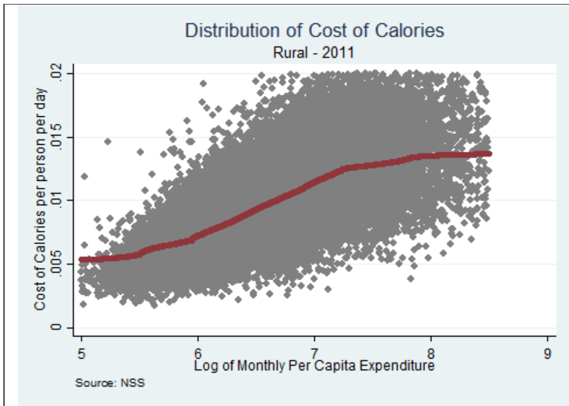
While the cost of calories rose by expenditure decile in both rural and urban India in 1994, the rise was much steeper at high MPCE in the latter. The 2005 graphs show a much steeper rise at high MPCE in both rural and urban India – especially in the latter. The 2012 graphs are distinguishable from the 2005 graphs in two respects: (1) over a large range of MPCE – including the lowest – there was a steep rise in the cost of calories, with a further rise which is nearly flattened in the highest range of MPCE in rural India; and (2) in Urban India, the slope was steeper, with a smaller flat segment at the highest range of MPCE.

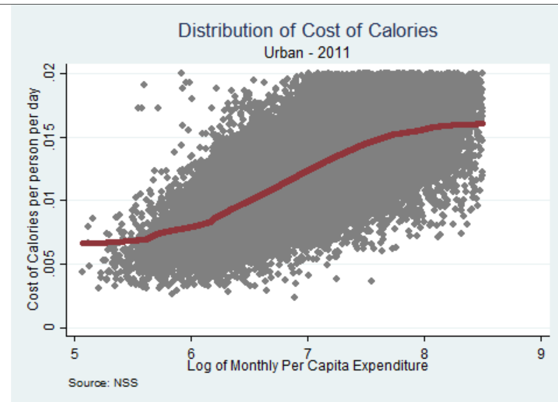
In brief, the Lowess graphs further confirm that the costs of calories rise with higher MPCE, with rates varying between rural and urban India, and over time.

Figure 2: Lowess of cost of calories on MPCE



5 For an admirably clear exposition, see Deaton (1996).





7. Dietary diversification

7.1 Changes in diets

Let us first consider changes in the consumption of various food items in rural and urban areas between 1993–94 and 2011–12, as shown in Figure 3.

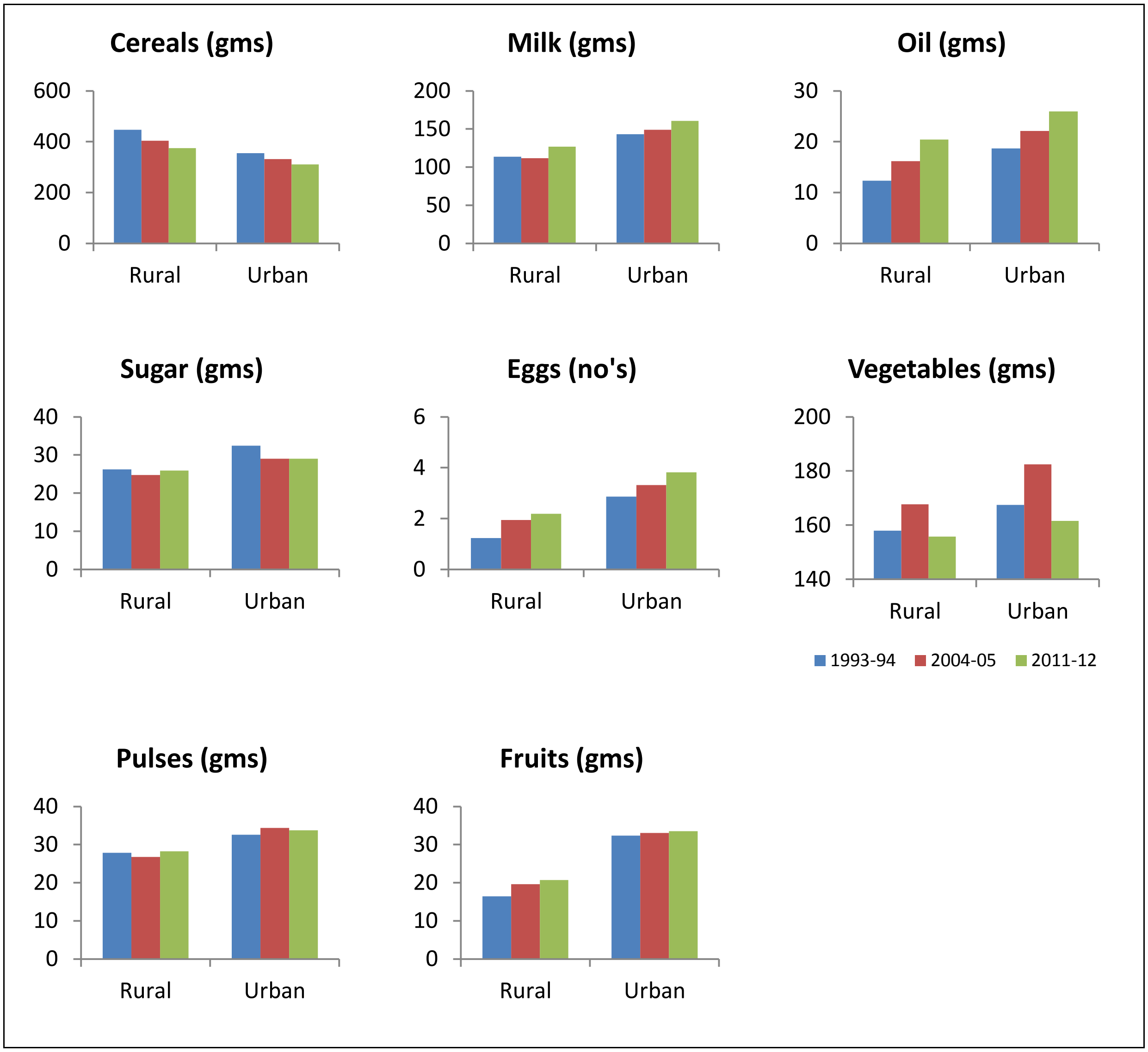
There was a sharp reduction in cereal consumption between 1994 and 2012 – 16% in rural areas and 13% in urban areas. While the reduction was more drastic in the first period (1994 to 2005) in rural areas, in urban areas, the rate of reduction was almost equal in both periods.

In rural areas, pulses, nuts and dried fruits recorded a sharp drop between 1994 and 2005 but their intake increased substantially in the second period. The consumption of sugar decreased too, in both the sectors in the first period, followed by a slight increase. By contrast, intakes of vanaspati oil rose sharply in both rural and urban areas, especially in the first period. The consumption of milk and milk products increased, particularly in urban areas (by about 12% between 1994 and 2012), especially in the second period. Intakes of meat, fish and poultry increased significantly in both rural (19%) and urban (10%) areas between 1994 and 2012. Vegetable intakes increased moderately in the first period in both areas, but declined by a greater amount in the second, leaving a net decline between 1994 and 2012. Fruit consumption increased. There were marked differences in the intakes of various food commodities among various income classes too (Kaicker et al, 2016).

These dietary shifts are linked to intakes of calories, proteins and fats with varying importance, as shown in Kaicker et al (2016).[6]

[6] See Annex 1 for a graphical illustration of changes in sources of calories, protein and fat.

Figure 3: Changes in diets in India (1994–2012), daily per capita consumption



Source: Authors' calculations from various rounds of the NSS

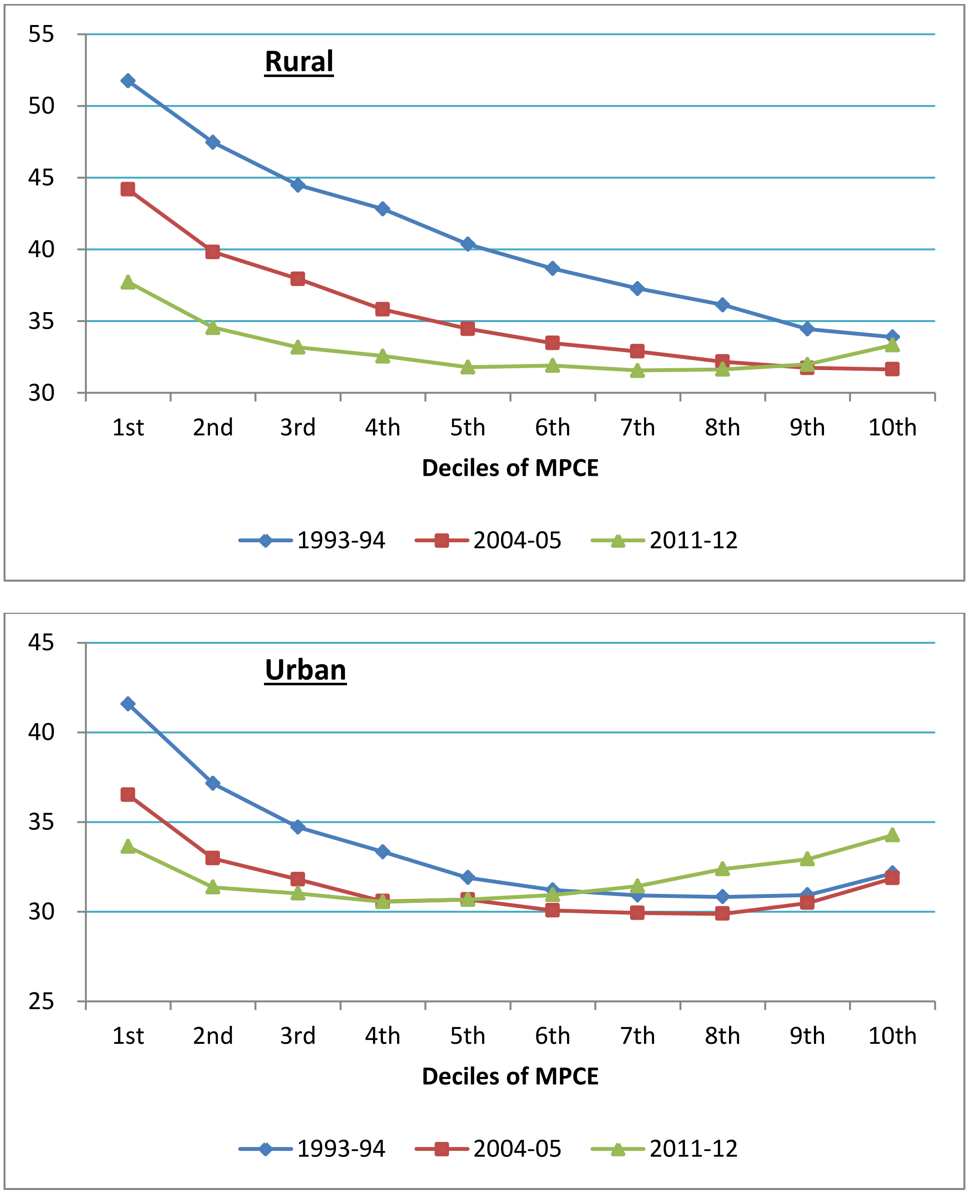
To capture diversification in diets, ie a move from a cereal-dominated diet to more variety in the food consumption basket, we use a Food Diversity Index (FDI). The FDI is calculated as the sum of squares of the shares of the various food items in the food consumption basket,

Algebraically, $FDI_{it} = \sum_1^5 S_{jit}^2$ (1)

Type equation here.

where FDI_{it} is is the food diversity index for household i at time t, S_{jit} is the share of commodity j in the food consumption basket of i^{th} household in time t. This is similar to the Herfindahl Index used to measure the competitiveness of an industry. A high value of the index implies a monopolistic market (or, in our case, a more concentrated food basket), while a low value implies a nearly perfect competitive market (in our case, a more diverse food basket). We use five food groups to construct the FDI: (1) cereals and pulses; (2) milk, milk products, eggs and meat; (3) oil; (4) sugar; and (5) fruits and vegetables. Figure 4 shows the variation in FDI by expenditure decile for rural and urban areas in 1994, 2005 and 2012.

Figure 4: Herfindahl Index for rural and urban India



Source: Authors' calculations based on various rounds of the NSS.

FDI for rural India fell consistently across expenditure deciles in 1994, 2005 and 2012, except for the ninth decile, which saw a rise. The 1994 curve was above that for 2005, and the latter was above that for 2012. There are two implications: first, dietary diversification was greater at successively higher expenditure deciles; and, second, dietary diversification rose between 1994 and 2005, and 2005 and 2012 (except for the ninth and 10th deciles), but with a narrowing of the gap between 2005 and 2012. This implies a slowing of dietary diversification during 2005–12-between the sixth and ninth deciles).

The FDI graphs for urban India differ markedly. FDI curves for 1994 and 2005 fell with expenditure deciles and the latter lay below the former. So the implications are that: (1) dietary diversity was greater at successively higher MPCE; and (2) it was greater in 2005 than in 1994. The 2012 curve lies below the 2005 curve and crosses over at the fourth decile; it also crosses the 1994 curve between the sixth and seventh deciles, pointing to a reduction in dietary diversity above these expenditure deciles.

Often dietary diversity is taken to be synonymous with a diet's quality. In a recent contribution (Rashid et al, 2011), for example, one of the two measures of dietary quality is diversity. The latter is defined as the number of different foods or food groups consumed over a given reference period. It is rationalised that increasing the variety of foods across and within groups ensures an adequate intake of essential nutrients that promote good health. In fact, it is pointed out that there is a strong positive association between dietary diversity and nutrient adequacy (Ruel, 2002). But another study (FAO, 2012) takes a broader view that dietary changes in the past two decades have had both positive and negative impacts on nutrition. On the positive side, the quality of diets at the aggregate global level has improved, and nutritional outcomes have also improved in most parts of the world. On the negative side, diets increasingly contain more energy-dense, semi-processed foods, saturated fats and sugars. These shifts and changes are associated with an increase in over-nutrition and obesity. The latter are causally linked to higher prevalence rates of non-communicable diseases (NCDs) such as diabetes, cardiovascular disease and cancer (Gaiha et al, 2014, 2015). So whether the nutritional implications are positive or negative is essentially an empirical issue.

8. Econometric methodology

An IV regression model with fixed effects is estimated as specified below:

$$CC_{it} = \alpha_0 + \alpha_1 FDI_{kt} + \boldsymbol{P_{jkt}}\boldsymbol{\beta} + \boldsymbol{X_{it}}\boldsymbol{\gamma} + u_{\boldsymbol{i}} + \varepsilon_{it} \text{ ....(1)}$$

$$CL_{\boldsymbol{it}} = c_0 + c_1 \widehat{CC}_{it} + \boldsymbol{X_{it}}\boldsymbol{\theta} + \pi_{\boldsymbol{i}} + \boldsymbol{e_{it}} \qquad \textbf{(2)}$$

In the first-stage regression (or the reduced form), the dependent variable is the cost of calories for the I th household in year t, FDI denotes the food diversity index constructed at the PSU level for the k th PSU, $\boldsymbol{P}$ denotes a vector of food prices (jfood commodity price relative to cereal price at the kth PSU level),

$\boldsymbol{X}$ household characteristics that vary over time (such as household size, number of male adults with education above middle level, adult females with education above middle level, MPCE, and u denoting a state dummy, and the error term, ε. In the second stage (structural equation), the dependent variable is calorie intake per capita in ith household and year t, and the explanatory variables include the predicted cost of calories from the first equation and all household characteristics, excluding the relative food prices and FDI (at the PSU level) as instruments in the first equation. The identification strategy relies on the direct effect of relative food prices and dietary diversity on the cost of calories, which in turn affects calorie intake.[7]Two features are noteworthy: (1) to circumvent the endogeneity of relative food prices and dietary diversification at the household level, these variables are constructed at the PSU level; and (2) in order to capture the unobserved heterogeneity (say, cultural diversity leading to dietary diversity), we have used states as fixed effects.[8]

9. Results

The results are given in Table 11. Let us first consider the reduced-form results.

Since FDI and dietary diversification are inversely related, the negative coefficient of FDI implies that less diversified diets are associated with lower costs of calories. Or, in other words, households more dependent on, say, cereals have a weaker taste for variety, and tend to rely on cheaper sources of calories. The effect of MPCE is significantly positive but the magnitude is negligible. All (relative) food prices (relative to the price of cereals) have significant effects, with two negative (milk to cereals and oil to cereals) and the rest positive. Household characteristics matter too. The larger the household, the lower is the cost of calories, presumably because of economies of scale in buying food.

Table 10: Fixed effect IV regression results

	First stage dep variable: cost of calories			**Second stage dep variable: log calorie intake**		
Number of observations	**315874**					
	F (48, 315825) = 3271.47			**F(40,315825)=761.36**		
	Adj R – Squared = 0.332					
	Coef	t-values	P>t	Coef	z	P>z
Cost of calories				-23.37	-25.10	0.000
Dietary diversification	-2.13	-16.98	0.000			
Price ratios	0.00	2.69	0.010			
(Milk to cereal)	-1.13	-153.21	0.000			

[7] An important insight from Subramanian and Deaton (1996) is that, when food prices change, there are more significant shifts between different grades of food commodities (eg different grades of rice) than between food commodities themselves. We are grateful to K Imai for raising this point.

[8] For an exposition of the merits of fixed effects in panel data at the state level, see Wooldridge (2013).

(Oil to cereal)	-0.25	-11.42	0.000			
(Sugar to cereal)	0.02	15.14	0.000			
(Eggs to cereal)	0.11	46.91	0.000			
(Meat to cereal)	0.70	135.38	0.000			
(Pulses to cereal)	0.25	35.93	0.000			
(Fruits to cereal)	2.17	76.82	0.000			
(Vegetables to cereal)	0.00	2.69	0.000			
Household size	-0.29	-81.14	0.000	-102.96	-106.92	0.000
Number of male adults with education above middle level	0.33	35.33	0.000	123.33	50.51	0.000
Number of female adults with education above middle level	0.52	44.90	0.000	44.93	14.72	0.000
MPCE	0.00	87.81	0.000	0.15	98.91	0.000
Sector (0=rural, 1=urban)	0.86	48.20	0.000	-134.26	-30.74	0.000
Constant	9.00	107.86	0.000	2944.16	188.92	0.000
Test of excluded instruments	F (9,315825)=8261.09					
Sargan statistic	518.738; Chi-2 (P Value) = 0.000					

The larger the numbers of adult males and females, the higher are the costs. Location also makes a difference. The costs of calories were higher in urban areas relative to rural areas. The joint significance of multiple instruments (dietary diversification and relative food prices, both at PSU level) is confirmed by the F-test at the 1% level. So the relevance of these instruments is validated. As there are multiple instruments, we tested for over-identifying restrictions using the Sargan test. The Chi-square statistics reject the null that all IVs are uncorrelated with the error term. This implies that some of the IVs are not exogenous and therefore the results must be interpreted with caution.

In the structural equation, the dependent variable is the log of per capita calorie intake. For expositional convenience, we will refer to it as calorie intake, since the two are monotonically related. The higher the MPCE, the larger the calorie intake. The effect is significant and large. The higher the cost of calories, the lower the calorie intake. This effect is also significant and large. The larger the household size, the lower the calorie intake. It is puzzling that the lower cost of calories among larger households doesn't translate into higher calorie intake. Whether there is greater food waste in such households needs investigation. That more educated adult males and females are better aware of healthier diets is consistent with significant positive coefficients of these two variables. Further, it is confirmed that urban areas are more likely to consume tastier, better flavoured and packaged food, fried meats and vegetables which are low in calorific content.

In brief, the results validate the central hypothesis that dietary diversification and affluence – especially the former – are significantly linked to higher costs of calories and that these in turn lower calorie intake.

10. Discussion

An influential study by Deaton and Dreze (2009) shows that, despite rising incomes in India, there has been a sustained decline in per capita calorie intake over the period 1983–2004, primarily thanks to lower calorie 'requirements'. The reduction in calorie requirements is attributed mainly to a better health environment and less strenuous activity levels. Departing from this focus but encompassing it in an alternative demand theory-based explanation of dietary changes, Gaiha et al (2014) analysed, first, the factors associated with dietary diversification and, in the second stage, the effect of dietary diversification on calorie intake. Dietary diversification is associated with food prices, income/expenditure, household characteristics – especially whether a household falls within the middle classes – and location, and with time-related changes transmitted through prices and expenditure. Residually it is associated with lifestyle, activity patterns and the epidemiology of disease environment. The more important result, however, is the lowering of calorie intake as a result of dietary diversification, controlling for the effects of food prices, expenditure, household characteristics (other than middle class affiliation), urban location, and time-related changes. The latter adds an important dimension to food and health policies.

In a classic study, Behrman and Deolalikar (1989) offer a quantifiable explanation of the phenomenon that calorie elasticities are substantially less than food expenditure elasticities: specifically, food variety *per se* is valued such that people purchase an increased variety of food as their incomes increase, even though this may not greatly alter their calorie intakes. The decline in calorie intake is thus a consequence of a taste for variety associated with an increasing curvature of food indifference curves and their increasing centrality. However, the curvature is higher among the non-poor and less so among the poor, although locational differences are pronounced for some food items (Jha et al, 2009).

In this study – the first of its kind in so far as it relies on three rounds of the NSS for 1993–94, 2004–05 and 2011–12 with detailed cost of calorie estimates – we build on these previous studies.[9] Our central question is whether more diversified diets resulted in greater consumption of expensive calories and consequently in a reduction of calorie intake.

[9] In an earlier study, Kaicker et al (2016) examine the role of dietary diversification in lowering the calorie intake over the period 1994–2012 but without taking into account the role of the rising cost of calories.

The main findings are that dietary diversification is associated with higher costs of calories mainly as a result of reliance on more expensive calories (eg through reduced dependence on cereals, which are the cheapest sources of calories), determined by a taste for variety in both rural and urban areas and across expenditure deciles over the period 1994–2012. Our analysis also confirms that higher costs of calories and greater affluence are associated with a reduction in calorie intake. These findings have considerable significance from a policy perspective.

Drawing upon an earlier analysis (Gaiha et al, 2015), based on the *India Human Development Survey* for 2005, eating out appears pervasive: about 30% of the households did it. Eating out is a feature not just of the metro or urban areas, but also of urban slums and rural areas, although it is less pervasive in the last two. In the six largest metro areas (Mumbai, Delhi, Kolkata, Chennai, Bangalore and Hyderabad), about 34% of the households ate out, as compared with about 27% elsewhere. Eating out was thus more pervasive among the metro residents, who also spent larger amounts on doing so.

About 25% of the SCs, 27% of the STs), and about 31% of the Other Backward Castes (OBCs), and Others ate out. Even some of the most deprived and socially excluded groups – especially the SCs and STs – have switched from traditional staples to fast foods and opted for greater variety in food consumption. This is further corroborated when the sample is split into poor and non-poor households using the official poverty line. While a much larger proportion of non-poor households (about 32%) ate out, those eating out among the poor (about 12.5%) were far from negligible. A more disaggregated classification of the households into four MPCE classes (less than Rs300, between Rs300 and Rs500, between Rs 500 and Rs1000, and greater than Rs1000) further dispels any doubts that eating out as a manifestation of dietary transition is mostly a middle-class phenomenon[10]. Our (preliminary) analysis with more recent (2015) India Human Development Ssurvey IHDS data for 2011–12 not only confirms a rapid growth in eating out but also larger (real) expenditures.

The health implications of the changes in dietary patterns are not clear-cut. There is a trade-off: while a nutritionally balanced diet is associated with better health, processed and fried foods are responsible for a higher prevalence of NCDs such as heart disease, cancer and diabetes. Since there are signs of an epidemiological transition in India – higher mortality from these diseases compensating for a decline in mortality from infectious diseases – enhancing awareness of healthy diets is important from a policy perspective (Gaiha et al, 2014, 2015). As consumer preferences for flavour, packaging and variety evolve in complex ways in a context of rapidly integrating food markets, a careful scrutiny of policy interventions (eg labelling of food quality, consumer awareness campaigns through the media and other channels) may help us understand better how to influence food choices.

11. Concluding observations

While concerns over poverty and hunger must dominate the policy agenda, the options for dealing with obesity and the upsurge in NCDs can only be neglected at the peril of millions of

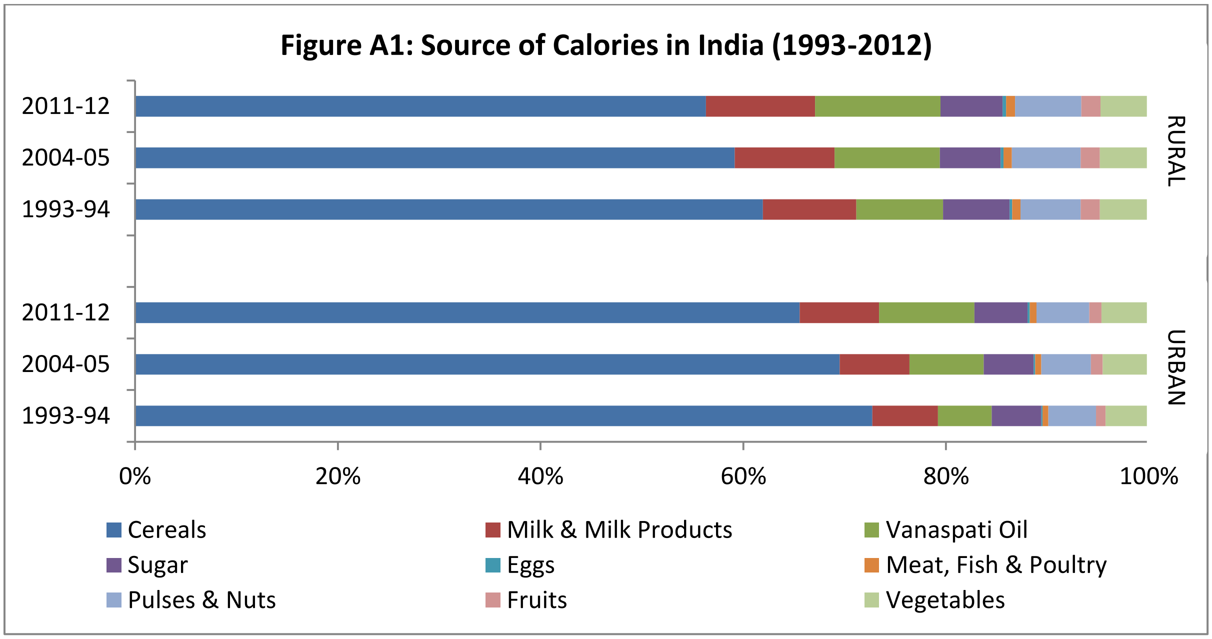
[10] These expenditure estimates are based on 2004–05 prices.

lives that may suffer their worst consequences. Although shifts in diet and physical activities are desirable in many ways – arguably varied and pleasurable – it will be a mistake to overlook the potential onerous nutritional and health effects and the tragic but avoidable loss of wellbeing.

A challenge is to raise awareness of the health implications of the dietary transition despite its slowing down in more recent years. As growing affluence, lifestyle changes and urbanisation are irreversible, the focus must shift to provision of public goods (eg rural infrastructure) to facilitate the participation of smallholders in high-value chains; regulation of food safety standards; nutrition labelling; food and nutritional supplementation; stringent restrictions on tobacco and alcohol consumption; nutritional education – especially of women – and active involvement of the private sector in adhering to regulatory standards and nutritional norms. The latter is largely a question of designing appropriate incentives for the private sector to collaborate better with the public sector. Whether these regulatory measures and norms alone will suffice is unclear, as food preferences are shaped in complex ways by some irreversible changes taking place.

Annex 1

Food composition changes are associated with the decline in nutrient intakes. Figures A.1 to A.3 show the distribution of calorie, protein and fat intake by food commodities for rural and urban areas between 1994 and 2012.



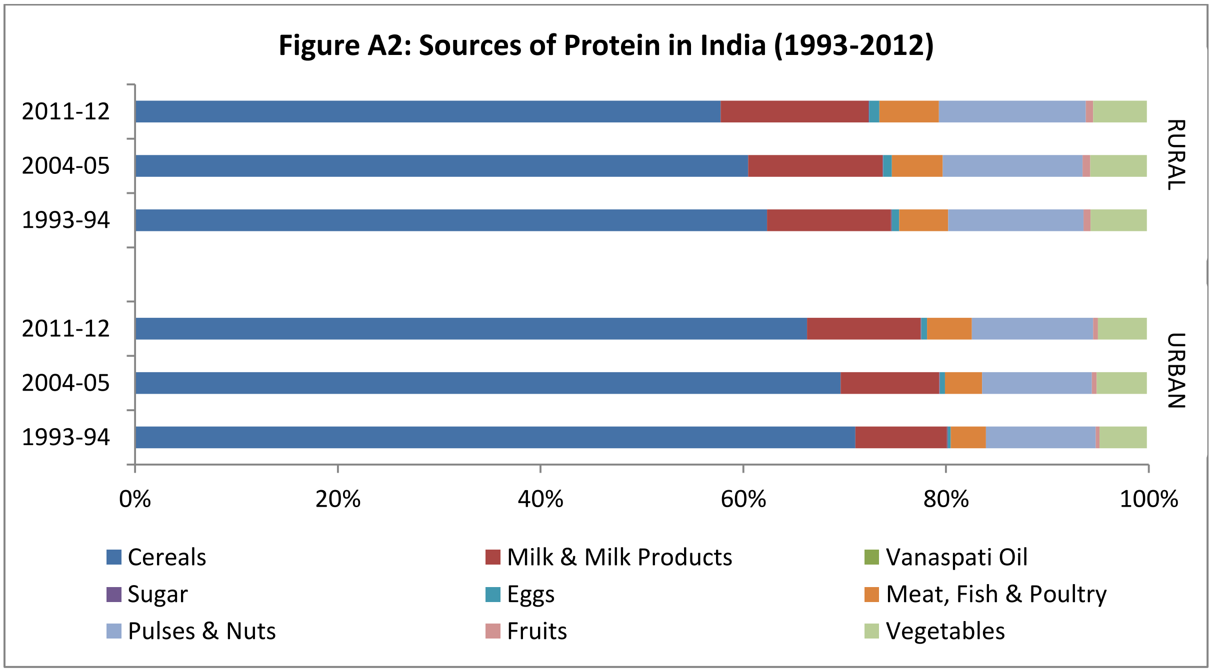
Source: Authors' calculations based on NSS Rounds 50, 61 and 68

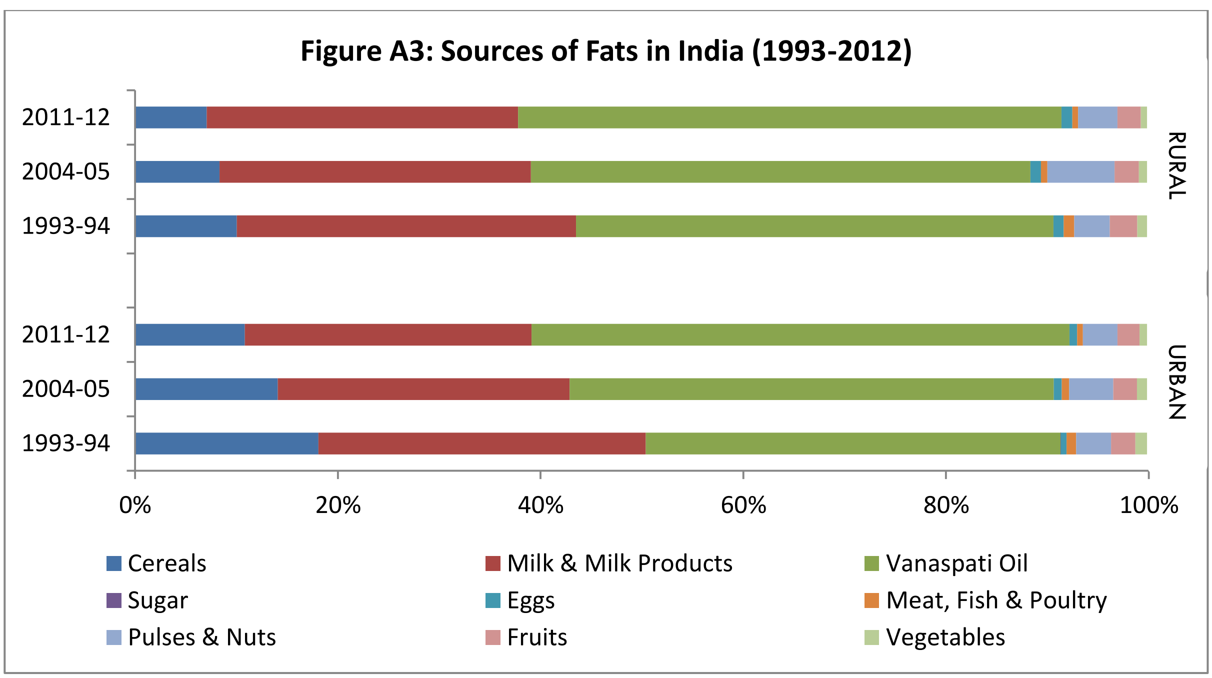
In rural India, as discussed earlier, calorie intakes declined between 1994 and 2012. Most of this is attributable to the decline in calories from cereals. Calories from cereals reduced from 1530 in 1993 to 1383 in 2004 and 1282 in 2011. The contribution of milk and milk products, sugar, pulses, fruits and vegetables remained largely unchanged between 1993 and 2011. The contribution of vanaspati oil to calorie intake increased substantially. Calories obtained from oil increased from 111 in 1994 to 145 in 2004 and 184 in 2012. Similar results are found for urban India.

In both rural and urban India, protein intakes declined between 1994 and 2005, and slightly increased thereafter. Much of the initial decline is reflected in a reduction in protein intake from cereals and slightly from pulses. In rural India, the protein intake from cereals decreased from 42 gm in 1994 to 38 gm in 2005 and to 35 gm in 2012. The corresponding numbers for urban India are 34 gm (1994), 32 gm (2005) and 30 gm (2012). Intake from dairy products (milk, eggs and meat) increased moderately. Proteins from other sources are a very small fraction and largely remained unchanged between 1994 and 2012.

Between 1994 and 2012, fat intake rose in both rural and urban areas. Vanaspati oil has the maximum share in total fat intakes, and its contribution rose over the period 1993 to 2011. In rural India, fat intake from vanaspati oil rose from 12 gm in 1994 to 16 gm in 2005 and 20 gm in

2012. In urban India, the share of vanaspati oil rose from 19 gm in 1994 to 22 gm in 2005 and 26 gm in 2012. The other significant contributors to fat intake are cereals, pulses and milk products (including ghee and butter), but their contribution reduced between 1993 and 2011. Declining intake of fats from these commodities were more than offset by the increased intake of fat from vanaspati oil (Kaicker et al, 2016).





Source: Authors Calculations based on NSS Rounds 50th, 61st and 68th

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