Poverty, Undernutrition and Intra-household Allocation

EC307 Economic Development

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Lecture 7

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READINGS

Tables and figures in this lecture are taken from:

Chapter 8 of Ray (1998)

Chapter 4 of Deaton (1997)

Burgess, R. and Zhuang, J. (2002), Modernisation and Son Preference. mimeo, LSE.

- **Class based on** Subramanian, S. and Deaton, A. (1996): The Demand for Food and Calories. *Journal of Political Economy*, 104 (1).

Introduction

So far: Question of the *welfare of nations* and *households*

Need to tackle the issue of intra-household allocation, i.e., are resources within household fungible?

- If yes, what the welfare implications of that.

Empirical question:

- Are there *biases* in the intra-household allocation of resources?
- If there are *biases* (i.e., imperfect fungibility) – standard household welfare measures (e.g., per capita expenditure or income) may not reflect the welfare of household members.

`Fungible`: mutually interchangeable

Household and Individual Level Data

Welfare, Living Standards, Poverty:

- fundamentally characteristics of individuals not households
- expression at household level is just reflects data limitations.

If all household members not treated equally,

e.g., women get less than men, girls less than boys or if children and the elderly systematically worse off than other household members,

then

social welfare is *overstated* and

inequality is *understated*.

Source of Bias

Where does evidence of biases in intra-household allocation come from? e.g., demography/census data.

- We find significantly more men than women *(relative to what we would expect on biological grounds)* in certain parts of the world. E.g. South Asia, East Asia
- The missing women (Sen etc.) taken as evidence of gender discrimination.

Demographic data: skewed sex ratios may be explained by

- big differences between male & female mortality rates in early life
- lower female life expectancy

BENCHMARK

In unconstrained populations, more males survive early life but have shorter life expectancy.

- This gives us male to female ratio in the overall population of around 0.95 (105 females for every 100 males).
- In contrast, China has a male to female ratio of around 1.18, that is, 10% of women missing during 1990s, which is a major welfare issue.
- This may suggest lower valuation of females relative to males within households (if male-female ratio is endogenous).

Son Preference

Education data: literacy and enrolment rates for females much lower than those for males.

Can *son preference* be viewed as structural feature of developing countries?

Problem: Mechanisms underlying these differences are not fully understood.

One Particular View

- ⇒ Reflects inherited social norms,
  - for e.g., anthropologists (etc.) find that customs relating to inheritance, access to land, outside employment, credit, health and education often biased against women.
  - It reflects a lower valuation of women within certain societies.
  - If gender bias is driven by immutable social norms, the problem is more difficult as policy does not have a role to play in that case.
- Important to not just report the discrimination but isolate the exact mechanism of discrimination
  - Does it vary with structural change in the societies?
  - ⇒ More work on determination of discrimination required.

Detecting Gender Biases

Problem with the literature:

Descriptive, quantitative analysis to date has been largely confined to census data on mortality and enrolment rates differenced by sex

Doesn't allow us to examine driving factors behind gender biases.

The behavioural mechanisms that underlie differential outcomes between the sexes remain not clearly understood.

Modernisation and Son Preference

One approach: Use demand analysis

(i) how does allocation vary according to the *gender* and *age* of the recipient

(ii) even if welfare of household members same, per capita consumption will not provide correct ranking of living standards within household (e.g. because children / elderly need to consume less).

- Equivalence scales
- improve measures of welfare and inequality.

Mainly focussing on (i) but (ii) is also important because it provides insights which allows us to test for presence of gender bias

Unpacking the Demand Equations

Problem: no individual level data.

- Methods rely on detecting gender effects in the aggregate spending patterns of households.

  Unpack demand equations to examine whether the presence of individuals of similar ages but of opposite sexes affect key areas of household spending differently.

To look at these effects:

- Run demand equations (Engel curves) where different age classes n_j have been broken down by gender so that separate γ_{ij} coefficients for males and females can be calculated.

Engle Curves

$$w_i = \alpha_i + \beta_i \ln x + \eta_i \ln n + \sum_{j=1}^{J-1} \gamma_{ij} \left(\frac{n_j}{n} \right) + \delta_i z + u_i$$

where

- w_i is the budget share of the i^{th} commodity,
- x the total household expenditure,
- n the household size,
- n_j is number of household members in sex-age class j.
- z vector of variables which control for location and relevant socio-economic characteristics of the household.

Test of gender bias:

$$\gamma_{ij} = \gamma_{ik},$$

where j and k reflect boys and girls in the same age group.

The hypothesis of equal treatment can be tested in a straightforward manner using an F test.

Engle Curves

Run two types of variables on left hand side:

(i) **Goods** that are considered to be integral to welfare of children (i.e., food, health, education).

→ Differential treatment in these areas may have permanent and irreversible welfare effects.

- The question is does adding a boy relative to a girl lead to lower / higher expenditures on these goods assuming that
  - children are exogenous
    not contributing resources to household and
    not involved in food, health, education allocation decisions.

Engle Curves

Run two types of variables on left hand side:

(ii) **Adult goods** not consumed by children.

Expenditures on these goods (e.g. alcohol, tobacco) can be thought of as indicators of *parental welfare.*

→ Given a fixed household budget, the addition of children can be modelled as a *negative income effect* (i.e., child costs displace adult good consumption) leading to a *reduction of adult good expenditures* and *adult welfare.*

If boys depress adult good consumption more than girls, then this can be taken as an indicator of higher valuation of boys.

Adult Equivalent Ratio

For adult goods, from equation above, we can calculate *"adult equivalent ratio,"*

i.e., *how much would total expenditure have to be reduced to result in a reduction in expenditure on goods i equal to that observed by the addition of a child of type j to the household.*

$$\pi_{ij} = \frac{\left[\frac{\partial p_i q_i}{\partial n_j}\right]}{\left[\frac{\partial p_i q_i}{\partial x}\right]} \cdot \frac{n}{x} = \frac{(\eta_i + \gamma_{ij}) - \Sigma_{J-1}^{j=1} \gamma_{ij} \left(\frac{n_j}{n}\right)}{\beta_i + w_i}$$

Adult Equivalent Ratio

Then can look at three things

(i) whether $\pi_{ij} < 0$.

(ii) test of whether $\pi_{ij} = \pi_{hj}$,

where i and h are different potential adult goods, that is, test of whether they are valid adult goods

(iii) test whether $\pi_{ib} = \pi_{ig}$

where b and g denote boy and girl. Test of gender bias.

- Equivalent to doing an F test on whether $\gamma_{ij} = \gamma_{ik}$,

  where j and k reflect boys and girls in the same age group in regression where adult good share w_i is the left hand side variable.

Empirical Evidence

Deaton (1997): direct comparison by gender of nutrition, health and education reveals gender biases.

For example, excess female mortality amongst girls in China, Bangladesh and India.

Further, enrolment and literacy tend to be higher for boys rather than girls (in cohorts of the same age) in many parts of the developing word.

Empirical Evidence

Mechanisms that underlie these differences are not fully understood.

One suggestion, for example, is that excess female mortality is due to female children receiving less medical attention when they are sick.

Burgess and Zhuang (2001) use household expenditure to try and pry open this black box for China.

Table 3: Health Engel Curves, 1990

	Health goods		Health services	
	Sichuan	Jiangsu	Sichuan	Jiangsu
Constant	-1.108 (1.025)	0.409 (0.339)	-1.885 (-4.691)	-2.072 (-1.959)
ln(x)	0.483 (3.774)	0.300 (2.211)	0.323 (6.434)	0.306 (2.570)
ln(n)	-0.481 (-2.865)	-0.421 (1.884)	-0.181(-2.752)	0.174 (0.888)
M0-4p	2.002 (2.989)	2.710 (3.059)	0.552 (2.104)	2.120 (2.730)
F0-4p	0.419 (0.621)	3.730 (4.172)	0.559 (2.111)	1.646 (2.100)
M5-9p	0.709 (1.049)	1.702 (1.901)	0.287 (1.083)	0.239 (0.304)
F5-9p	0.325 (0.477)	-1.125 (1.198)	-0.240 (-0.902)	1.433 (1.741)
M10-14p	-0.729 (-1.123)	0.558 (0.621)	-0.020 (-0.079)	1.774 (2.254)
F10-14p	-0.959 (-1.481)	0.863 (0.971)	-0.240 (-0.944)	0.816 (1.048)
M15-19p	-1.077 (-1.827)	-0.096 (-0.118)	-0.062 (-0.267)	0.383 (0.532)
F15-19p	-0.413 (-0.697)	0.761 (0.900)	0.029 (0.232)	0.253 (0.341)
M20-29p	-1.282 (-2.363)	-0.379 (-0.519)	-0.022(-0.102)	0.147 (0.230)
F20-29p	0.363 (0.635)	1.045 (1.551)	0.369 (1.953)	0.216 (0.365)
M30-54p	-0.006 (-0.010)	0.391 (0.481)	0.412 (1.810)	0.298 (0.418)
M55+p	0.740 (1.302)	-0.390 (0.514)	0.496 (2.228)	0.567 (0.852)
F55+p	1.233 (2.506)	0.499 (0.793)	0.345 (1.787)	0.529 (0.959)
EDU	0.056 (1.030)	-0.145 (-2.213)	-0.021(-0.986)	-0.089 (-1.553)
OFF	0.223 (1.094)	-0.170 (-0.649)	-0.053(-0.663)	0.117 (0.506)
MIN	-1.252 (-3.686)	-1.347 (-1.660)	-0.342(-2.566)	-1.089 (-1.531)
Adj R^2	0.058	0.026	0.026	0.045
Mean w_i	2.089	1.609	0.424	0.793
F tests:				
0-4	6.07	1.00	0.00	0.33
5-9	0.41	0.43	0.04	2.48
10-14	0.19	0.17	1.10	1.78

Note: t-statistics in parentheses.

Table 4: Education Engel Curves, 1990

	Education goods		Education service	
	Sichuan	Jiangsu	Sichuan	Jiangsu
Constant	0.574 (1.3413)	1.734 (4.233)	-0.232 (-0.239)	2.693 (3.031)
ln(x)	-0.108 (-2.020)	-0.238 (-5.162)	0,083 (0.686)	-0.318 (-3.182)
ln(n)	0.296 (4.222)	0.282 (3.715)	0.323 (2.034)	0.633 (3.844)
M0-4p	-0.605 (-2.162)	-0.021 (-0.071)	-2.145 (-3.385)	-1.293 (-1.983)
F0-4p	-0.562 (-1.992)	-0.344 (-1.134)	-1.696 (-2.654)	-0.722 (-1.097)
M5-9p	2.310 (8.179)	0.900 (2.961)	2.706 (4.231)	2.813 (4.266)
F5-9p	2.294 (8.073)	1.292 (4.056)	3.450 (5.362)	2.962 (4.287)
M10-14p	3.844 (14.181)	2.628 (8.623)	5.565 (9.065)	5.906 (8.936)
F10-14p	3.411 (12.612)	2.859 (9.474)	5.125 (8.367)	5.299 (8.098)
M15-19p	0.770 (3.127)	1.229 (4.413)	1.933 (3.468)	3.292 (5.451)
F15-19p	0.578 (2.339)	0.630 (2.193)	0.361 (0.644)	2.192 (3.521)
M20-29p	-0.758 (-3.346)	-0.208 (-0.837)	-2.297 (-4.476)	-1.397 (-2.599)
F20-29p	-0.515 (-2.553)	-0.339 (-1.483)	-0.531 (-1.163)	-0.872 (-1.757)
M30-54p	-0.362 (-1.494)	-0.125 (-0.452)	-0.950 (-1.730)	-1.236 (-2.067)
M55+p	-0.446 (-1.881)	-0.193 (-0.748)	-1.334 (-2.501)	-0.507 (0.907)
F55+p	-0.366 (-1.778)	-0.059 (-0.275)	-1.184 (-2.544)	-0.789 (-1.702)
EDU	0.419 (6.552)	0.044 (1.992)	0.218 (4.243)	0.168 (3.495)
OFF	0.267 (3.138)	-0.196 (-2.201)	0.304 (1.580)	-0.561 (-2.899)
MIN	-0.201 (-1.415)	-0.045 (-0.162)	-0.230 (0.717)	0.451 (0.754)
Adj R^2	0.264	0.179	0.180	0.231
Mean w_i	0.966	0.521	1.821	1.403
F tests:				
0-4	0.03	1.02	0.55	0.53
5-9	0.00	1.54	1.71	0.04
10-14	3.78	0.62	0.76	1.04
15-19	1.16	6.07	15.33	4.74

Note: t-statistics in parentheses.

Table 8: F-Tests for the Equality of Gender Coefficients

	Alcohol		Tobacco		Tea	
	Sichuan	Jiangsu	Sichuan	Jiangsu	Sichuan	Jiangsu
0-4	0.321	0.072	0.996	0.661	0.001	0.766
5-9	0.653	3.018	0.449	0.014	0.144	2.907
10-14	2.606	1.406	0.788	0.961	0.408	0.075

Table 10: School Enrolment Information for 1990 Census

	RURAL SICHUAN		URBAN SICHUAN		RURAL JIANGSU		URBAN JIANGSU	
Age	Enrolment (per 100 of same sex)		Enrolment (per 100 of same sex)		Enrolment (per 100 of same sex)		Enrolment (per 100 of same sex)	
	Male	Female	Male	Female	Male	Female	Male	Female
6-9	80.1	76.6	79.8	79.8	89.6	87.1	84.7	84.6
10-14	83.1	73.2	89.3	86.9	95.3	88.9	96.9	96.1
15-19	25.7	16.1	38.2	33.9	35.0	22.0	55.4	48.4

Sources: Sichuan 1990 Census, p.1316, p.1394, pp.1535-1537; Jiangsu 1990 Census, pp.470-497, and pp.508-581.

Table 9: Mortality and Sex Ratio Information for 1990 Census

Age		RURAL SICHUAN			URBAN SICHUAN			RURAL JIANGSU			URBAN JIANGSU		
		Mortality rate (per 1000)		Sex ratio	Mortality rate (per 1000)		Sex ratio	Mortality rate (per 1000)		Sex ratio	Mortality rate (per 1000)		Sex ratio
		Male	Female		Male	Female		Male	Female		Male	Female	
At birth	Reverse method			111.9			110.2			115.5			112.2
	Actual reported			115.8			110.2			120.8			116.0
0		25.1	30.0	112.6	29.2	27.8	107.7	15.3	15.5	115.5	12.9	12.6	112.1
1		4.3	5.5	113.7	3.6	3.6	107.2	3.1	2.8	113.7	1.8	2.0	110.8
2		2.7	3.2	111.3	2.6	2.5	105.8	2.5	2.1	111.3	1.6	1.3	108.8
3		1.5	1.7	111.5	1.4	1.5	106.5	1.4	1.3	110.0	1.0	0.8	106.8
4		1.0	1.0	110.4	0.9	0.9	106.2	1.1	0.9	109.3	0.8	0.9	106.8
0-4		10.3	11.8	111.8	7.0	6.7	106.6	5.1	4.8	112.1	3.8	3.6	109.1
5-9		1.2	1.0	109.4	0.9	0.5	106.4	0.7	0.5	108.3	0.6	0.4	106.0
10-14		1.0	0.7	106.4	0.8	0.5	105.4	0.4	0.4	106.6	0.4	0.3	106.8
15-19		1.3	1.1	104.3	1.1	0.7	107.3	0.8	0.8	103.8	0.5	0.4	112.8
Total		7.4	7.2	106.6	8.5	7.5	108.7	6.8	5.9	102.2	5.2	4.8	109.5

Notes: (1) The mortality rate is the number of deaths at each sex-age group between 1st July 1989 and 31st June 1990 per 1000 surviving children at the same sex-age group on 31st June 1990. (2) The sex ratio at birth is the number of male births between 1st July 1989 and 31st June 1990 per 100 female births during the same period. (3) The sex ratio at other age groups is the number of surviving males on 31st June 1990 per 100 surviving females on the same day. Sources: Sichuan 1990 Census, pp.1316-1317, pp.2812-2815, pp.2836-2840, pp.2861-2863, pp.3240-3241; Jiangsu 1990 Census, pp.470-497, pp.1453-1615, pp.1788-1829.

Table 12: F-tests for the Equality of Gender Coefficients: Degree of Diversification Breakdown

	Health Goods		Health Services		Educational Goods		Educational Services	
	Rural Sichuan	Rural Jiangsu	Rural Sichuan	Rural Jiangsu	Rural Sichuan	Rural Jiangsu	Rural Sichuan	Rural Jiangsu
Overall sample								
0-4	6.07	1.00	0.00	0.33	0.03	1.02	0.55	0.53
5-9	0.41	0.43	0.04	2.48	0.00	1.54	1.71	0.04
10-14	0.19	0.17	1.10	1.78	3.78	0.62	0.76	1.04
15-19	-	-	-	-	1.16	6.07	15.33	4.74
Bottom ½ sample								
0-4	6.57	1.54	1.05	0.60	0.16	0.55	0.07	0.90
5-9	0.62	0.12	0.04	1.75	0.00	0.58	0.76	0.00
10-14	0.32	0.83	1.99	3.76	10.81	0.21	6.34	0.08
15-19	-	-	-	-	0.99	3.53	1.73	1.91
Top ½ sample								
0-4	0.76	0.03	0.99	1.72	0.11	0.64	0.40	0.06
5-9	0.21	0.40	0.28	0.72	0.00	0.71	1.16	0.08
10-14	0.02	2.83	0.01	0.00	0.22	0.64	0.97	1.09
15-19	-	-	-	-	0.15	1.46	13.02	1.62

Summary of Results

Burgess and Zhuang (2001) study in China:

The following three key sets of gender bias results emerge:

(i) There is no evidence of discrimination in the allocation of food and calories.

Deaton (1997) also finds mixed results for food in Maharashtra (India).

→ Parents may not change their food buying or production decisions if they have a boy or a girl but they allot different portions or higher quality foods to sons rather daughters.

→ These effects will not necessarily show up in tests which focus on the allocation of total food or calories.

Summary of Results

(ii) there is *evidence of discrimination* against young girls (0-4 years) in the allocation of health goods in

the poorer, less diversified province (Sichuan) but

not

in the richer, more diversified province (Jiangsu).

(iii) there is evidence in *both provinces* of a *pro-boy bias* spending of goods and services associated with secondary and tertiary *education.*

CONTRIBUTION

Two extensions from standard literature:

(i) Match household and census data.

Shows that biases in household spending on health and education correspond to observed biases in age specific mortality and enrollment.

Gender biases in spending within particular age groups seem to correspond fairly exactly to gender biases in outcomes in the same age groups.

Suggests that *gender biases* in the intra-household allocation of resources at least partly underlie observed differences in *outcomes*

CONTRIBUTION

Two extensions from standard literature:

(ii) Comparisons across and within (rural and urban) samples confirm that discrimination in health good spending against girls 0-4 years of age, associated with poorer, less diversified households.

→ Same pattern of results is also found for spending on education goods.

Results suggest that income and the composition of income enter into the parental decision rule.

→ Discrimination is not driven entirely by cultural factors.

CONTRIBUTION

This points to a potential serole for public policy in counteracting gender discrimination.

As regards excess female mortality in the 0-5 age group, it would appear that policies which *promote growth* and *diversification* will reduce this form of gender discrimination.

Households in rural Jiangsu, which do not show evidence of excess female mortality in the 0-5 age range, however, appear to *adjust sex composition prior to birth,* most probably through screening and selective abortion.

CONTRIBUTION

As a result, though the workings of these distinct methods of discrimination, similar sex ratios are observed at age 2 in both provinces.

Blocking of ultrasound and other screening techniques, if implementable, represents an obvious policy to counteract pre-birth discrimination.

However, this raises the distinct possibility that expression of son preference will simply be pushed forward in time and become manifested in pro-boy health spending resulting in excess female mortality. Thus, it could lead to other kinds of complications.

CONTRIBUTION

Education: broad suggestion that *growth* and *diversification* helps erode these forms of *discrimination.*

It may reflect *both* the roles these processes have to play in equalising returns to males and females (e.g., in off-farm employment) and in *eroding cultural beliefs,* which favour focussing secondary and tertiary education on males.

This paper cannot discriminate between these two effects - both are likely to be going on.

PROBLEMS

Adult goods: It is difficult to find any results even when census indicates presence of discrimination. See Deaton (1997) for a review.

Problems:

(i) difficult to identify adults goods

(ii) they constitute small part of total expenditure

(iii) children may actually contribute resources to household

(iv) children may change tastes of adults

Introduction to Nutrition

- Development economics' objective: Improve human welfare.

  However, welfare is multidimensional,

  - e.g., income and nutrition have many dimensions
  - being poor and being undernourished are not the same thing.

  Big question: Will rising economic welfare *(associated, for example, with economic diversification and the green revolution)* lead to reductions in calorific undernutrition?

  Until recently, it was widely accepted in international policy circles that *income growth* has an important role to play in *improving the nutrition of the poor*.

Income Nutrition Link

- Recent studies like Behrman and Deolalikar has questioned the strength of the association between income and nutrition.

  Changes in income $\rightarrow$ small impact on nutrient intake

- **Policy implication:** *Income mediated policies will have limited impact on nutritional goals.*
- Governments will have to supplement income generation programmes with alternative strategies
  - i.e., price subsidies, rationing, feeding programmes, nutrition and education to limit hunger and malnutrition.

Two Views

There is also common ground between two distinct views

One View

Treats household *welfare* (including nutrition) as synonymous with *household income*

Other View

Views household *welfare* in terms the *capability to avoid basic deprivations,* including undernutrition, which is

View *eroded* if income growth is not associated with improvements in nutrition.

Shrinking ground makes it difficult to think of *household income* as a convenient shorthand for *household welfare.*

For public policy, nutritional welfare and economic welfare would have to be considered separately.

Two versions of *"revisionist"* positions:

i. **Strong version:** No association between *income growth* and *improvements in nutrition*, or at least none that is statistically discernible (Behrman and Deolalikar, 1987).

ii. **Weak version:** *Response of nutrition to income among the poor is statistically significant but small*. The hypothesis does not deny the role of income growth in improving nutrition, it emphasizes its weakness.

Linking Income to Nutrition

Size of the calorie response is an an empirical question, which can, in principle, be determined with reference to relevant data.

Households in developing countries typically spend a large proportion of their income on food

e.g., 50%-70%

Elasticity of demand for food with respect to income (rather expenditure) is therefore quite *high* for a substantial proportion of the population and may even be close to one for the poorest households.

Linking Income to Nutrition

This does not necessarily imply an equally high elasticity of demand for calories.

As expenditure rises, households *switch* towards more expensive foods, which involves both:

i. *substitution within* broad food groups towards higher quality foods ("*superior*" cereals like rice in place of 'coarse' cereals like sorghum or maize), *and*

ii. *substitution between* food groups (meat, dairy products or fats in place of cereals).

Price per unit calorie is thus an increasing function of income.

Elasticity of calories therefore lies below the elasticity of food.

TABLE 1

EXPENDITURE PATTERNS, CALORIE CONSUMPTION, AND PRICES PER CALORIE, RURAL MAHARASHTRA, 1983

	EXPENDITURE SHARES (%)			CALORIE SHARES (%)			PRICE PER CALORIE (Rupees per 1,000 Calories)		
	Mean (1)	Bottom 10% (2)	Top 10% (3)	Mean (4)	Bottom 10% (5)	Top 10% (6)	Mean (7)	Bottom 10% (8)	Top 10% (9)
					A. Food Groups				
Cereals	40.7	46.0	31.0	70.8	77.3	57.3	.64	.51	.79
Pulses	8.9	10.2	7.8	6.6	6.2	7.2	1.51	1.44	1.60
Dairy	8.1	4.9	11.8	2.8	1.3	4.9	3.69	3.59	3.92
Oils and fats	9.0	9.2	9.2	5.9	4.8	7.6	1.74	1.67	1.81
Meat	5.1	3.4	6.4	.7	.4	1.0	11.7	11.0	12.2
Fruits and vegetables	10.5	8.5	12.0	3.5	2.3	5.4	3.90	3.83	3.85
Sugar	6.5	7.4	5.9	7.2	7.0	8.0	1.01	.94	1.09
Other food	11.3	10.4	16.1	2.5	0.8	8.6	17.4	16.8	15.9
					B. Cereals				
Rice	11.6	9.0	10.9	15.2	10.1	16.5	.95	.89	1.02
Wheat	5.6	3.8	7.9	8.5	4.7	14.4	.79	.73	.82
Jowar	18.2	27.4	9.3	37.8	52.9	21.6	.50	.43	.55
Bajra	3.0	2.7	1.3	6.6	4.9	3.2	.48	.48	.50
Other coarse cereal	1.2	2.8	.3	2.2	4.5	.6	.66	.58	.99
Cereal substitutes	1.1	.5	1.3	.6	.2	.8	2.23	2.22	2.22
Total food (or total calories)	67.4	73.4	54.1	2,120 2,098	1,385 1,429	3,382 3,167	1.14	.88	1.50

NOTE.—Mean refers to mean over the whole sample, bottom 10% to mean over households in the bottom decile of per capita household expenditure, and top 10% to mean over households in the top decile of per capita household expenditure. The figures in the last row of panel B are unadjusted and adjusted total calories, respectively, where the adjustment corrects for meals given to others or not received from others; see the text for a full description. Shares of calories and of expenditures are calculated on an individual household basis and are averaged over all appropriate households. Calorie prices are averages over consuming households.

Food and Calorie Elasticity

Substitution towards higher priced calories drives a *wedge* between *food elasticity* and *calorie elasticity.*

The size of this wedge depends on household preferences for *quality* and *variety* at the margin.

Expect the switch to expensive foods to be more pronounced at high levels of per-capita expenditure.

Calorie-expenditure elasticity will therefore tend to *decline* towards *zero* as *expenditure rises.*

Whether the elasticity is as low as 0.10 (or even 0.0) at low intakes is what is in dispute.

- Estimates range from around 0.5 on the one hand to near zero on the other.

Calorie Response

Problem: Elasticity *evaluated at mean* as opposed to in the lower end of distribution. However, controversy is over the *size of the calorie response* in poor households.

Benchmark: *Reutlinger and Selowsky (1976):* calorie elasticities of around **0.3 – 0.4** in the poorest households, which falls as calorie availability increases.

- High estimates reported in the literature broadly reinforce the benchmark values.

Revisionist: Calorie response is considerably *smaller,* even in poor households – closer to a third or a quarter of what was previously assumed.

Extreme view: Calorie–expenditure curve is essentially *flat* over the whole range of per-capita expenditure.

Biased Calorie Elasticities: Measurement Error

Variation in size of calorie elasticities is in part due to differences in the method of data collection.

Estimates obtained from nutritional surveys based on 24-hour observation or recall of food consumption tend to be lower than those based on household expenditure surveys. *Why?*

i. *Measurement error in expenditure surveys: Food quantities* typically figure in the construction of both calories and household expenditure.

   Any *error in the measurement of food is transmitted by construction to both variables* (e.g., in imputation of home produced consumption).

Biased Calorie Elasticities: Measurement Error

Spurious positive correlation between calorie availability and household expenditure, which would tend to bias the estimated elasticity upwards.

Solution: *Instrumental Variables* – Variables used as instruments must be correlated with household expenditure and arguably uncorrelated with its measurement error.
E.g., income if independently measured, proxies of long-term income or wealth are other candidates.

Use of *instrumental variables leads to a small fall* in the estimated elasticity. Fall is not sufficient to place the estimated elasticity in the 'revisionist' camp (e.g. Subramanian and Deaton, 1998).

Difference between estimates cannot be ascribed to methodological differences alone.

Biased Calorie Elasticities: Misreporting

ii. *Misreporting of food consumption:* May be more pronounced in the case of expenditure surveys as opposed to 24-hour nutrition surveys.

Food intakes are not directly measured in expenditure surveys,

Food may be given to guests, agricultural labourers, servants or even animals but nonetheless recorded as household consumption.

Food consumption by non-members is systematically related to household expenditure (*richer households have more servants, hire more labour, feed more guests and own more livestock*).

This will lead to an *overstatement* (understatement) of calorie availability in *richer* (poorer) households. Impart an upward bias to calorie elasticities.

Biased Calorie Elasticities

Solution: Don't *look* at mean elasticity but rather at *specific parts of the distribution.*

Non-parametric regression within narrow income band (e.g., bottom quintile). Scope for this being a problem limited within a narrow income band.

Deaton (1997): Warns against presuming that nutrition surveys provide superior data. *Increased accuracy from observation could be offset by the artificial and intrusive nature of the survey.*

To avoid embarrassment, poor households may consume more on the day of observation than is average. Similarly, people may report better diets than actually consumed. These factors would compress the lower extreme and lead to a *downward bias in the calorie elasticity.*

The Demand for Food and Calories

Methodology: Three distinct methods to get calorie elasticity estimates

i. Non-parametric regression

ii. Ordinary least squares (OLS) regression

iii. Instrumental variable (IV) regression

Non-Parametric Estimates

Work with regression of the form:

$$m(x) = E(y \mid x))$$

where

x is the logarithm of per-capita total household expenditure and

y is logarithm of per-capita calorie availability.

Smooth local regression technique: For any x (or band of x) run a *weighted linear regression* of logarithm of per-capita calorie availability (y) on the logarithm of per-capita total household expenditure (x). Don't impose a structure on the error, let the data speak for itself.

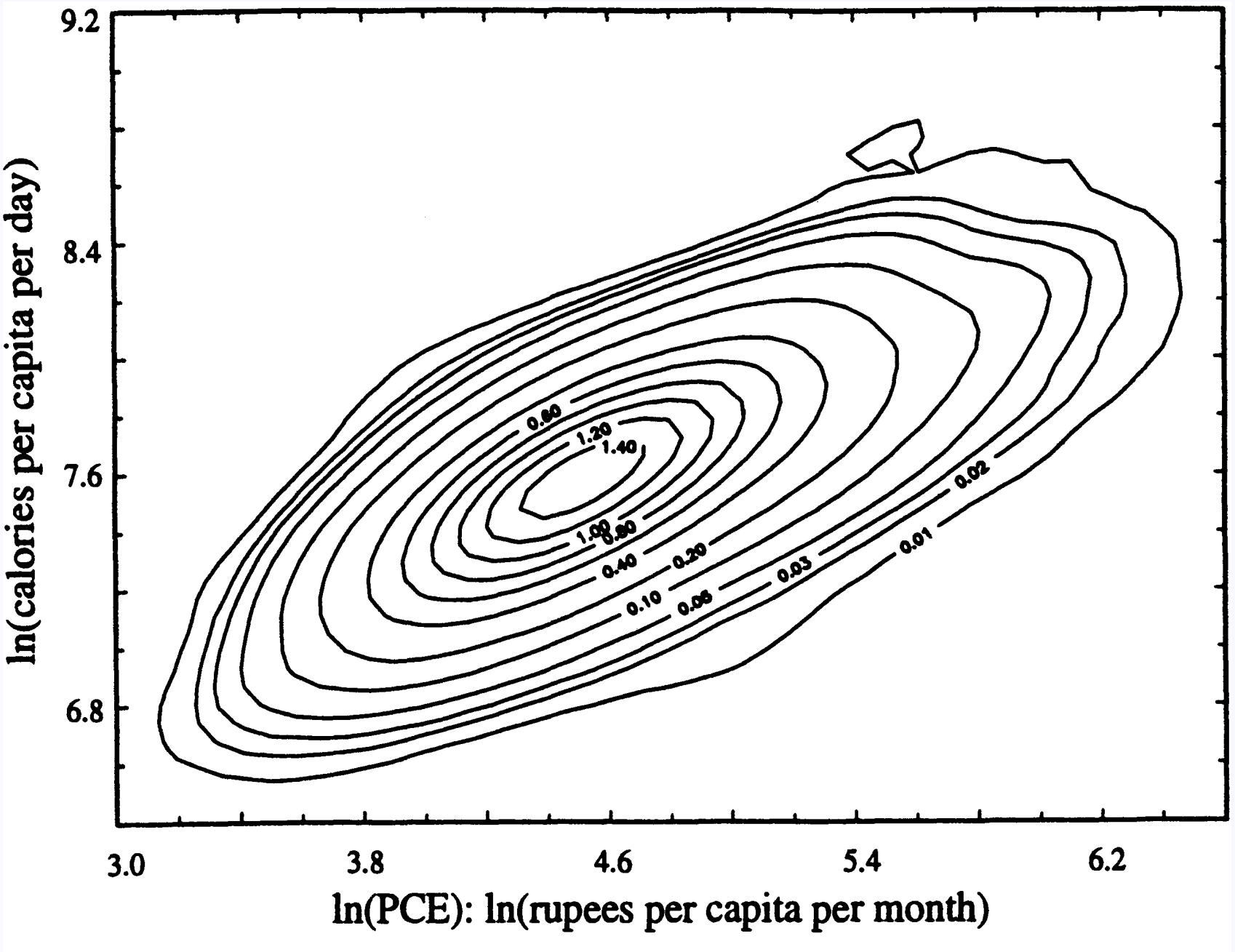
Non-Parametric Regressions

Non-parametric regression: Useful for examining bi-variate relationships, which are potentially non-linear. Look at the shape of relationship – *is there flattening with increasing income?*

→ Use average derivative estimators to calculate the slopes within different bands of x. Allows us to graph out calorie elasticities. Look for two things:

i. Is there a *decline in elasticity* with *increasing income.*

ii. Are *calorie elasticity estimates* significantly different from *zero,* in particular for the poor. Calculate the confidence intervals to check this.



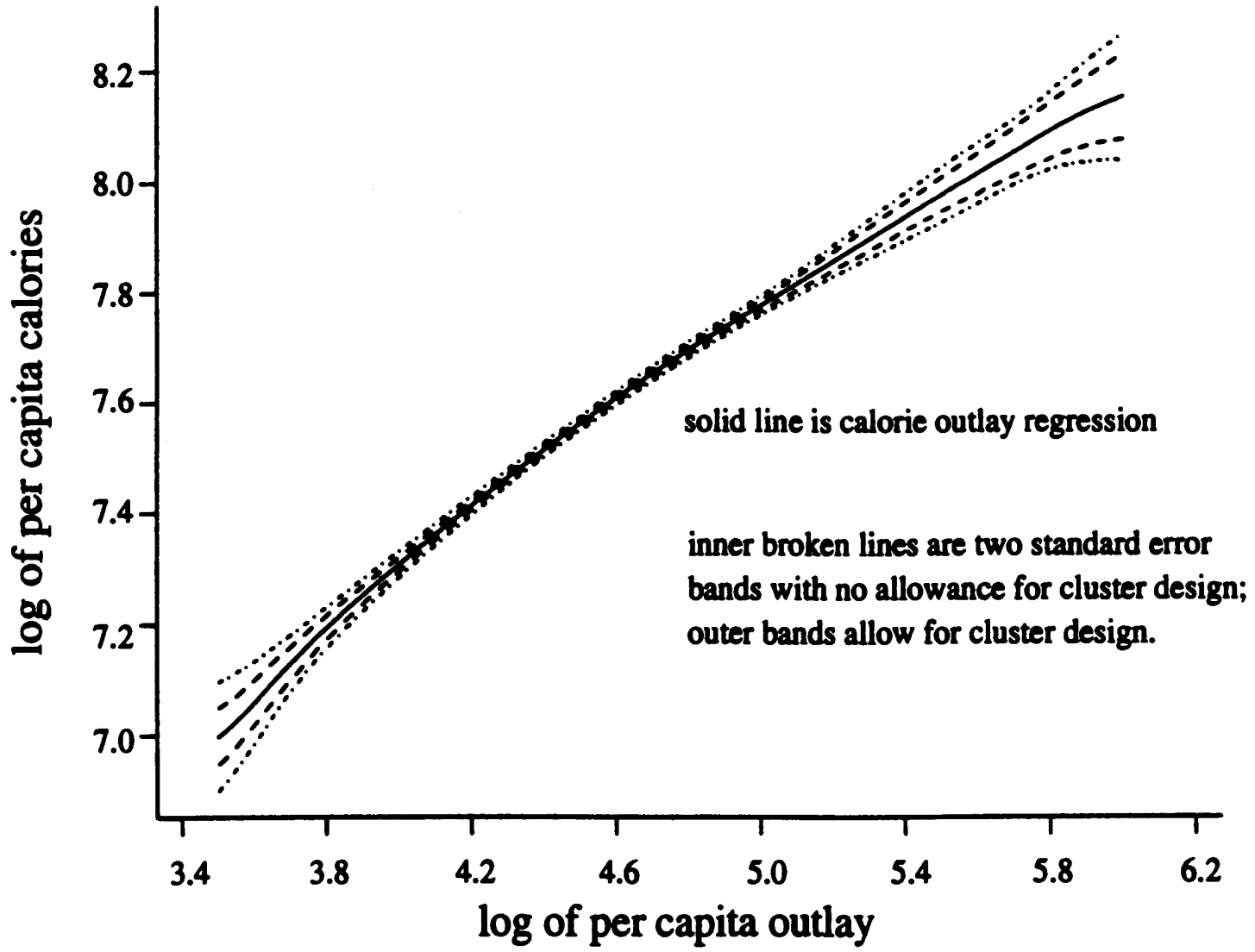


FIG. 2.—Regression function for log calories and log per capita expenditure, Maharashtra, India, 1983.

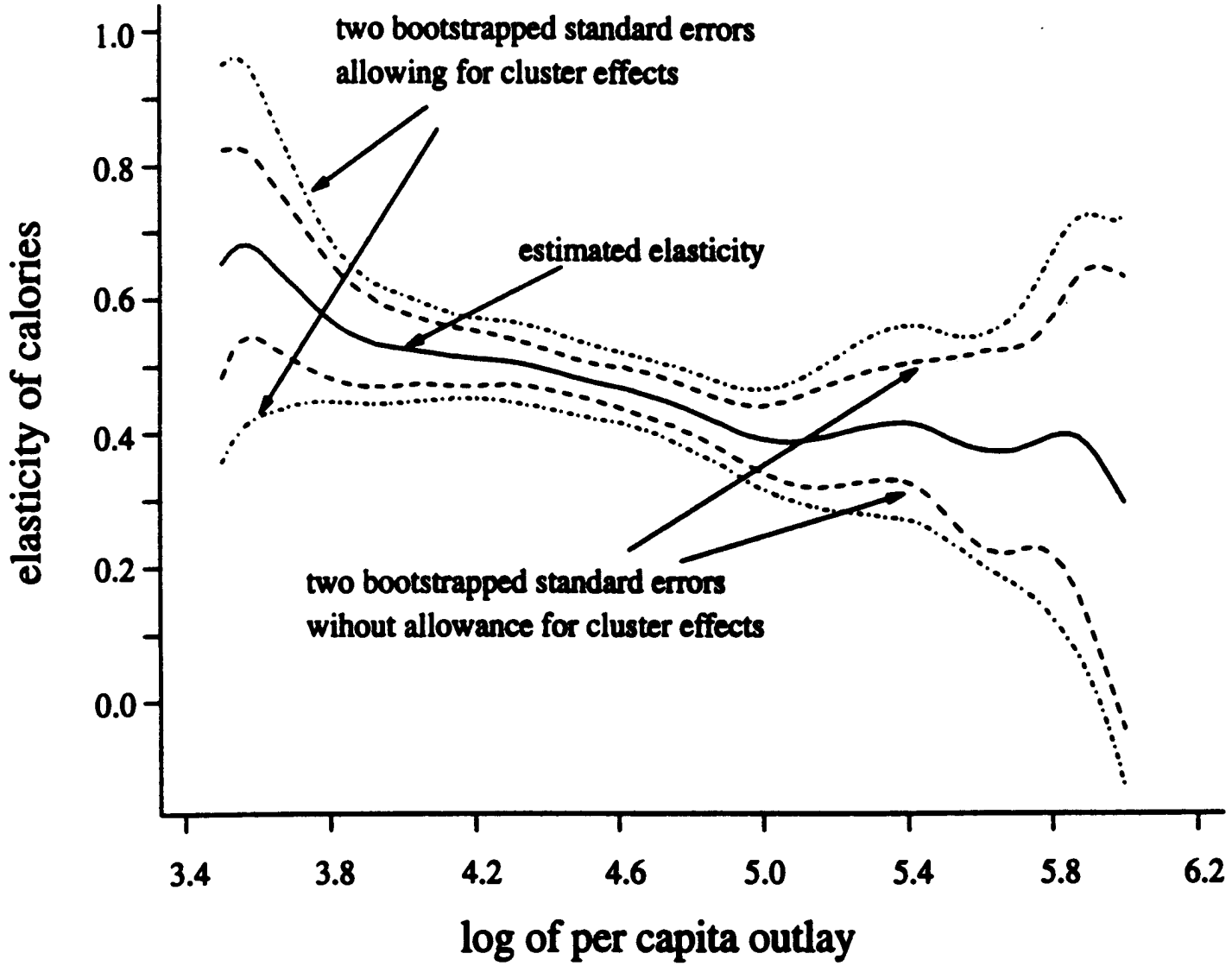


FIG. 3.—Elasticity of per capita calories to per capita expenditure, Maharashtra, India, 1983.

Parametric Estimates

In addition to expenditure, calorie availability is likely to depend on other factors, e.g., *household composition.*

- As *children* are likely to consume less than adults, we would expect to observe lower calorie availability in households with a greater proportion of children after controlling for *household size.*
- Another important determinant of calorie intakes is *occupation*. Other things being equal, we can expect to observe higher intakes in households, where a greater proportion of members are engaged in physically demanding occupations (e.g. farming).
- A third source of variation is *location.* Location may affect calorie intake due to the influence of variations in price, eating habits, public policy or even climate between localities.

Engle Curve

While non-parametric regression techniques give us the shape of the curve in two dimensions, they become cumbersome in a multivariate context. Run a regression of the form:

$$\ln\left[\frac{y}{n}\right] = \alpha + \beta \ln\left[\frac{x}{n}\right] + \eta \ln(n) + \sum_{j=1}^{J-1} \gamma_j \left(\frac{n_j}{n}\right) + \delta z + u$$

- y is calorie availability and
- x is total household expenditure.
- z is a vector of variables reflecting *occupation* and *location* (e.g., village dummies).

Demographics enter through household size term (n) and through proportions of household members in the age groups 0–4, 5–14, 15–54 and 55+ stratified by sex ($\frac{n_j}{n}$).

OLS Estimate

OLS estimates may be *biased* as food consumption data may be subject to random error that feeds into the construction of both household expenditure and calorie availability.

This form of measurement error may be corrected for using *income* as an *instrument* for *expenditure* if this is available and collected independently of expenditure, for e.g., non-food expenditure. (Deaton, 1997)

TABLE 2

OLS Estimates of Double Log Calorie and Calorie Price Regressions with Other Covariates

	Log Calorie Availability				Log Price per Calorie			
	All Data (1)		Within Village (2)		All Data (3)		Within Village (4)	
	β	|t|	β	|t|	β	|t|	β	|t|
Constant	6.028	(78)			−1.5934	(18)		
ln PCE	.3655	(29)	.3407	(27)	.3799	(25)	.3217	(23)
ln household size	−.1572	(14)	−.1630	(21)	.0839	(6.8)	.0661	(8.4)
rm04	−.0967	(2.2)	−.1461	(4.1)	.1024	(2.3)	.1008	(3.3)
rm59	.0488	(1.2)	.0321	(1.0)	−.0467	(1.2)	−.0331	(1.2)
rm1014	.0891	(1.9)	.0612	(1.9)	−.1120	(2.3)	−.0842	(2.9)
rm1555	.1636	(5.1)	.1634	(5.9)	−.1700	(4.3)	−.1347	(5.0)
rm55+	.1406	(3.0)	.1213	(2.8)	−.1565	(3.6)	−.1074	(2.9)
rf04	−.1359	(3.1)	−.1869	(4.9)	.0460	(1.1)	.0742	(2.2)
rf59	.0176	(.4)	−.0040	(.1)	−.0643	(1.4)	−.0476	(1.4)
rf1014	.1140	(2.8)	.0679	(2.0)	−.1108	(2.7)	−.0873	(3.0)
rf1555	.0420	(1.6)	.0514	(2.1)	.0085	(.3)	−.0021	(.1)
Scheduled caste	−.0083	(.8)	−.0179	(2.0)	.0020	(.2)	−.0071	(.8)
Hindu	.0114	(.7)	.0302	(2.1)	−.0562	(2.6)	−.0605	(4.4)
Buddhist	.0237	(1.1)	.0400	(2.0)	−.1080	(4.0)	−.0760	(4.0)
Self-employed nonagriculture	.0187	(1.0)	.0064	(.4)	−.0270	(1.1)	.0079	(.5)
Agricultural labor	.0433	(2.2)	.0222	(1.4)	−.0837	(3.4)	−.0418	(2.7)
Nonagricultural labor	.0275	(1.1)	.0293	(1.5)	−.0210	(.8)	−.0315	(1.7)
Self-employed agriculture	.0618	(3.5)	.0389	(2.7)	−.0610	(2.8)	−.0118	(.8)
R^2	.5532		.6706		.4254		.6414	

Note.—Variables beginning with *r* are demographic ratios, so that, e.g., rf59 is the ratio of females aged 5–9 to total household members, and rm55+ is the ratio of males older than 55. There are four labor type dummies, self-employed or employed, in agriculture or not. The omitted category is "other labor." The omitted religion/caste variable is Jain and other. The within regressions contain 563 dummy variables for the villages and do not contain a constant term. The (uncorrected) *F*-tests for the exclusion of the village effects are 3.19 with 562 and 5,043 degrees of freedom for the calorie regression and 5.39 with 562 and 5,042 degrees of freedom for the calorie price regression. The reported absolute *t*-values are corrected for heteroskedasticity and, in the case of the all-data regressions, for the cluster structure of the sample.

SUMMARY

Calorie availability is strongly associated with household economic welfare.

- *Subramaniam and Deaton (1996)* observe high calorie elasticities of around **0.55** for the poor in rural Maharashtra which is well outside the *revisionist range.*
- Findings clearly refute the extreme view that, "increases in income ... will not result in substantial improvements in nutrient intakes?" (Behrman and Deolalikar ,1987, page 505)

- *Economic development,* as proxied by rising *household expenditure,* will lead to *reductions* in *calorific undernutrition,* which is an *important finding from the perspective of public policy.*