Class matters: Tracking urban inequality in post-liberalization India using a durables-based mixture model

Sudeshna Maitra

Economics Dept., York University,

4700 Keele St., Toronto ON M3J 1P3, Canada

Email: maitra@yorku.ca

Phone: (+1) 416-258-9074

November 21, 2016

Abstract

We identify the (urban) lower, middle and upper classes in India in 1993-94, 1999-00 and 2004-05, using a durables-based mixture model after Maitra (2016). This approach allows a comparison of Indian consumption-inequality in the 1990's, despite the well-documented non-comparability of expenditure data from this period. Shorrock's (1980) inequality index is then used to break up inequality into between-class and within-class components. We find evidence that the interim year 1999-00 was a year of transition (following economic liberalization in 1991), and that between-class inequality became more pronounced in the later years, relative to within-class inequality.

Keywords: inequality, between-group, within-group, durables, mixture model

1. Introduction

What happened to inequality in India over the 1990's, following the economic liberalization of 1991? Owing to different recall periods used in the National Sample Survey questionnaires of 1993-94 and 1999-00, there is widespread concern that the expenditure figures – hence, poverty/inequality indices based on expenditures – may not be comparable over this time (Deaton and Dreze, 2002).

In a recent paper, Maitra (2016) proposed a mixture model using durables ownership – instead of expenditure – to estimate the lower, middle and upper class in urban India in 1993-94 and 1999-00. The goal was to examine poverty in the 1990's and durables ownership is arguably an appropriate consumption standard that is unaffected by different recall periods. Maitra found that while the size of the urban lower class fell over the 1990's, their durables-based well-being also declined over this time.

In this paper, the durables-based mixture approach is used to identify the three urban classes (lower/middle/upper) for the two years already examined (1993-94;1999-00) as well as for an additional year – 2004-05. Using durables ownership allows comparability across the survey years and including the later round provides perspective regarding the nature of changes witnessed in the 1990's viz. transitional or permanent.

We then compute an appropriate inequality index proposed by Shorrocks (1980) which allows the separation of overall consumption inequality into within-class and between-class components. This provides additional insights on the nature of consumption-inequality changes in the 1990's, to better inform our interpretations of existing (often contradictory) reports on inequality (Deaton and Dreze, 2002).

We find evidence that the interim year 1999-2000 is a year of transition and that class distinctions in consumption standards are more pronounced in the later years.

2. Motivation

2.1 Why durables ownership?

Household consumption/wealth is frequently measured using household expenditure (Deaton, 1997). However, for NSS data in particular, the questionnaire altered recall periods for reporting expenditures in the 1999-2000 round, leading to widespread concerns that expenditure data from the later surveys may suffer from a systematic recall bias. Durables ownership data do not suffer from such reporting bias, and hence seem to be a natural choice for comparing household wealth over the 1990s (post liberalization) using NSS data.

Several existing studies have already proposed and used durables ownership as a measure of wealth (Filmer and Pritchett, 2001; Montgomery et al, 2000). Consumer durables are a store of utility and assure the realization of a stream of consumption utility in future periods – hence, they may be considered to represent a permanent sustainable aspect of consumption (Bar-Ilan and Blinder, 1988). Thus, durables ownership is a suitable measure of consumption "standard". Here, the sum of distinct durables owned is used as an indicator of household wealth.

2.2 Why a three-component mixture model?

A mixture model hypothesizes the existence of n classes in the population, which are identified on the basis of their distinct durables-ownership patterns. Maitra argues that $n = 3$ (or 3 classes) is the appropriate number of classes for the data in question, and that the lowest class identified by the model is the class in "relative poverty". The size of the lowest class is thus the measure of relative poverty in each data period[1]. In this paper, we focus not only on the lowest class but examine what the complete mixture-identified class structure – comprising the lower, middle and upper consumption classes – reveals about

[1]Maitra finds that expenditures of the mixture-identified classes are broadly consistent with existing researchers' assumptions about the same.

wealth inequality in post-liberalization India. This is a natural extension of the analysis conducted in Maitra.

3. Data

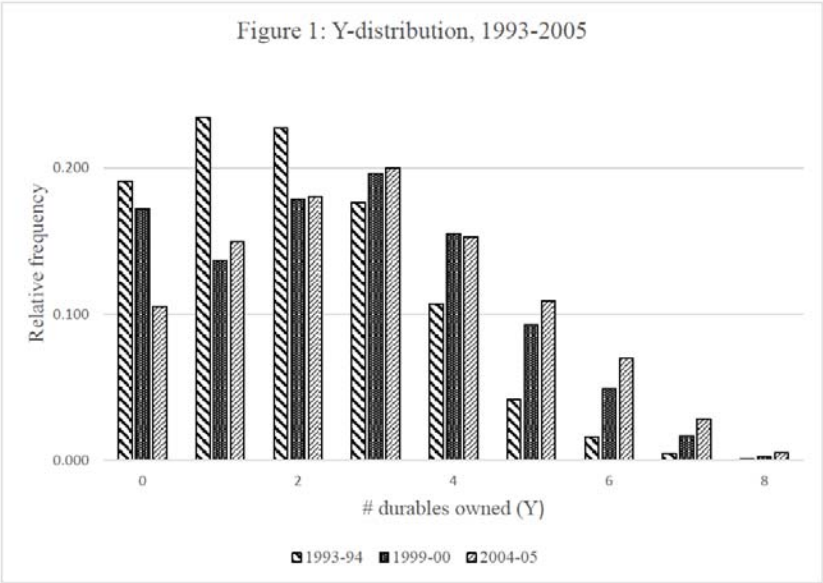
The data come from the urban sub-samples of the 50th (1993-94), 55th (1999-00) and 61st (2004-05) rounds of the Indian National Sample Survey (NSS). Eight durable goods are used in the analysis – radio, television, electric fan, air-conditioner, refrigerator, bicycle, motor bike/scooter, motor car/jeep[2].

For each durable, 'ownership' is defined as an indicator that at least one piece of the durable is in use in the household at the time of interview (note: this variable is not affected by a change in questionnaire recall periods). The variable Y represents the total number of durable goods that a household 'owns' by this definition; $Y \in \{0, 1, 2, ..., 8\}$.

Table 1: Summary statistics

Variable	Year	Mean	Std. Dev.	Coef. Of Var.	Obs.
Total no. of durable goods owned (Y)	1993-94	1.991	1.545	1.289	17239
	1999-00	2.598	1.846	1.407	48924
	2004-05	2.922	1.874	1.559	43356
Per capita monthly expenditure (PCE)	1993-94	629.04	995.76	0.632	"
	1999-00	1018.72	1535.32	0.664	
	2004-05	1258.99	1010.96	1.245	

[2]Comparability across all three rounds necessitates using 8 goods, instead of the 11 used by Maitra (who examines only the 50th and 55th Rounds).



Table/Figure 1 present summary statistics. They indicate overall improvement in durables ownership between 1993-2005, though not necessarily in a monotonic manner. The proportion of households that own 0-2 goods have declined over 1993-2005 despite a slight increase in ownership of 1-2 goods between *1999*-2005.The proportions of households that own 3 or more goods have also increased in 1993-2005. These broad patterns are reflected also in the mixture estimates (Section 3).

The coefficients of variation of Y and per capita expenditure indicate that durables ownership is more dispersed than expenditure, both increasing over time. The inequality measures (Table 3) reiterate this finding (also in Maitra).

4. The Three-Component Mixture Model

Assume households belong to class 1, 2 or 3 and the total number of goods (Y) owned by a class$-i$ household follows a binomial distribution with parameters 8 and p_i[3]. Then the ordering of the p_i's indicates which i $(= 1, 2, 3)$ corresponds to the lower (L), the middle (M) and the upper class (U), respectively, since (by definition) $p_L < p_M < p_U$.

[3]See Maitra for motivations and discussion of all assumptions.

The probability that a household owns y durables is given by:

$$P(y;\pi_1,\pi_2,p_1,p_2,p_3) = \pi_1\phi_1(y;p_1) + \pi_2\phi_2(y;p_2) + (1-\pi_1-\pi_2)\phi_3(y;p_3) \tag{1}$$

where π_i represents the probability that the household belongs to class i and $\phi_i(y;p_i)$ represents the (binomial) probability that a class$-i$ household owns y durables. This is a Three-Component Mixture Model (McLachlan and Peel, 2000).

Maitra uses an Expectations-Maximization algorithm (McLachlan and Krishnan, 1996) to obtain estimates of the following parameters (from (1) :

1. π_i : the (unconditional) probability that any household belongs to class$-i(i = 1, 2, 3)$
2. p_i : the probability that a class$-i$ household owns a durable good
3. γ_{ij} : the (conditional) probability that household j belong to class i[4]

The ownership probabilities p_i and class-specific densities $\phi_i(y;p_i)$ identify the classes by their different ownership patterns. Moreover, unconditional probability (π_i) estimates – interpretable as class shares – indicate urban class sizes in India. Finally, the estimated (conditional) probabilities of class membership, γ_{ij}, along with π_i and p_i, enable an assignment of each household into a particular class, albeit with some randomness (Maitra). This enables an examination of other class-specific household characteristics such as per capita monthly expenditures (PCE).

Table 2: Mixture model estimates

Year	π_L	π_M	π_U	p_L	p_M	p_U
1993-94	0.324	0.647	0.029	0.085	0.313	0.644
1999-00	0.200	0.621	0.179	0.035	0.341	0.590
2004-05	0.161	0.603	0.235	0.079	0.340	0.627

Table 2 presents the mixture estimates. The non-monotonic movement of class own-

[4]It is easily shown:

$$\gamma_{ij} = P(class = i/Y = y_j) = \frac{\pi_i\phi_i(y_j;p_i)}{\pi_1\phi_1(y_j;p_1) + \pi_2\phi_2(y_j;p_2) + (1-\pi_1-\pi_2)\phi_3(y_j;p_3)} \tag{2}$$

erships (p_i) suggests that the interim year (1999-00) is a year of transition – in 1993-94 and 2004-05, class-specific durables ownerships are roughly the same, after a deviation in 1999-00. Notably, the size of the lower class halved over the entire time period, while that of the upper class has increased (the middle class is almost the same in size). This presents an overall positive picture of durables-based well-being – in particular a clear reduction in relative poverty – between 1993-2005.

5. Shorrocks' Inequality Index

The objective of this paper is to examine consumption inequality in India, and to ascertain what portion of this inequality is attributable to disparities within and between classes. This necessitates the usage of an inequality index that can be decomposed into within and between-group components.

Shorrocks (1980) presents an inequality index that satisfies the decomposition property[5]. Let I^{Sh} be Shorrocks' inequality index in any variable x. Then,

$$I^{Sh} = \frac{1}{n}\sum_{i=1}^{n}\log(\left(\frac{\mu}{x_i}\right)) \tag{3}$$

where n is the number of observations and μ is the mean of x. I^{Sh} can be expressed as the sum of within-group (WG) and between-group (BG) inequality, given as

$$WG = \sum_{g=1}^{3}(\left(\frac{n_g}{n}\right))I_g^{Sh} \tag{4}$$

$$BG = \sum_{g=1}^{3}(\left(\frac{n_g}{n}\right))\log(\left(\frac{\mu}{\mu_g}\right)) \tag{5}$$

where n_g is the number of observations in class g ($g = 1, 2, 3$), I_g^{Sh} is Shorrocks inequality

[5]True when $c = 0$ in Shorrock's general class of indices, yielding (3) .

index within class g and μ_g is the mean of x in group g.

Shorrocks inequality index is well-suited for decomposing inequality within and between mixture-estimated classes. Notice that the mixture model (1) hypothesizes the very class sizes (π_g) which are used as weights $\frac{n_g}{n}$ in computing WG and BG [(4) − (5)].

However, Shorrock's index is only defined when all observations of x are strictly positive, a condition that is not met by Y. This issue is resolved by defining a new welfare index that is a monotonic transformation of Y. This index, W, is given as

$$W = Y + 1 \tag{6}$$

Clearly, W satisfies the requirement of being strictly positive in value, without affecting households' class memberships in any way[6]. In Section 5, we examine inequality in W instead of Y.

6. Inequality results

We examine inequality in well-being (W) and PCE[7].

Recall that PCE is not comparable across 1993-94 and 1999-00 (Section 1). However, we can still examine and compare the percentage breakups of PCE-inequality into within and between-group components.

[6] An estimated three-component mixture model using W is the same as one using Y.

[7] Note that the classes – with respect to which within-group and between-group inequalities are defined – are estimated based on Y, even when discussing class inequalities in other variables, e.g. W, PCE.

Table 3: Shorrock's Inequality Index

		Overall, I^{Sh}	Within-group, WG	Between-group, BG (% betwn.)
W	1993-94	0.149	0.086	0.063 (42.4%)
	1999-00	0.166	0.065	0.101 (60.8%)
	2004-05	0.141	0.068	0.073 (51.9%)
PCE	1993-94	0.250	0.243	0.007 (2.7 %)
	1999-00	0.208	0.196	0.013 (6.0%)
	2004-05	0.243	0.187	0.057 (23.3%)

Table 3 – which reports inequality estimates – suggests also that 1999-00 is a year of transition. Overall W-inequality increases initially but decreases in 2004-05 to close to its initial value. However, W-inequality in 2004-05 has a higher between-group component than that in 1993-94 (albeit lower than in 1999-00). In other words, class-based disparities in durables-based well-being became more pronounced, relative to those within-class.

The proportion of PCE-inequality attributable to between-group disparities is very small compared with that of W. Thus the classes identified by Y do not seem very different in terms of their PCE in 1993-94. Over time, however, the between-group component does increase, i.e. class-based differences in PCE do become more pronounced, although it is still only 23% in 2004-05.

7. Conclusion

A durables-based mixture approach enables a comparison of poverty and inequality in the 1990s, despite the well-documented non-comparability of NSS expenditure data from this period.

Two main features emerge. First, 1999-00 may represent a year of transition. Second, class-based differences in W/PCE are more pronounced in 2004-05 than in 1993-94. It remains for future research to ascertain if these patterns continue, and to examine their implications for long-term well-being..

References

Bar-Ilan, A., Blinder, A. S. (1988). "The Life Cycle Permanent-Income Model of Consumer Durables." Annals of Economics and Statistics 9: 71-91.

Deaton, A. (1997). The Analysis of Household Surveys. Washington D.C., John Hopkins University Press.

FP Deaton, A., Dreze J. (2002). "Poverty and Inequality in India: A Re-Examination." Economic and Political Weekly 37(36): 3729-3748.

Maitra, S. (2016). "The poor get poorer: Tracking relative poverty in India using a durables-based mixture model." Journal of Development Economics 119(Complete): 110-120.

Filmer, D., Pritchett, E. (2001). "Estimating Wealth Effects Without Expenditure Data – or Tears: An Application to Educational Enrolment in States of India." Demography 38(1): 115-132.

McLachlan, G. J., Krishnan, T. (1996). The EM Algorithm and Extensions. Wiley Series in Probability and Statistics.

McLachlan, G. J., Peel, D. (2000). Finite Mixture Models. Wiley Series in Probability and Statistics.

Montgomery, M.R. et al. (2000). "Measuring Living Standards With Proxy Variables." Demography 27: 155-74.

Shorrocks, A.F. (1980). "The Class of Additively Decomposable Inequality Measures." Econometrica 48(3): 613-625.

Appendix: Table 3, detailed

Appendix: Table 3' (detailed): Shorrock's Inequality Index[a]

	1993-94			1999-00			2004-05		
	Inequality[b]	Within-group contribution[c]	Between-group contribution[d]	Inequality[b]	Within-group contribution[c]	Between-group contribution[d]	Inequality[b]	Within-group contribution[c]	Between-group contribution[d]
Var: W									
Overall	0.149			0.166			0.141		
Lower	0.100	0.033	0.187	0.062	0.012	0.206	0.097	0.016	0.142
Middle	0.081	0.052	-0.103	0.075	0.047	-0.022	0.075	0.045	0.032
Upper	0.027	0.001	-0.021	0.033	0.006	-0.083	0.029	0.007	-0.101
		0.086	0.063		0.065	0.101		0.068	0.073
		total within	total betwn.		total within	total betwn.		total within	total betwn.
(% betwn.)			(42.4%)			(60.8%)			(51.9%)
Var: PCE									
Overall	0.250			0.208			0.243		
Lower	0.231	0.075	0.042	0.202	0.040	0.047	0.213	0.034	0.103
Middle	0.250	0.162	-0.021	0.195	0.121	0.015	0.188	0.113	0.059
Upper	0.222	0.006	-0.014	0.190	0.034	-0.049	0.165	0.039	-0.105
		0.243	0.007		0.196	0.013		0.187	0.057
		total within	total betwn.		total within	total betwn.		total within	total betwn.
(% betwn.)			(2.7 %)			(6.0%)			(23.3%)

[a] A dicussion of how these estimates compare with those in the literature was omitted due to word constraints, but could be appended upon request.

[b] I^{Sh}/I_g^{Sh}

[c] From (4)

[d] From (5)