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District level poverty estimation: a spatial approach

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Abstract

The paper uses the procedure for estimating regional consumer price index numbers based on the estimation of item-specific region wise Engel curves. Given the problem of unavailability of official district level poverty lines, the same are estimated by multiplying the official state level poverty line by the district level price indices estimated taking state as the base region. The poverty measures adjusted for the district level poverty lines, give a clearer picture for the spatial variations in levels of living across the districts of West Bengal, an eastern state of India.

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1. Introduction

The targeting of spatial anti-poverty policies depends crucially on the ability to identify the characteristics of different areas. Several questions that arise in this context are: do some regions within the states have exceptional rates of poverty compared to other regions? To what extent do state-level poverty studies mask intra-regional variance in levels of poverty within a state? How does a regional focus on poverty affect our current measurement and understanding of economic well-being? Clearly, the choice and size of spatial units fundamentally alters the measurement of poverty. At high levels of *spatial disaggregation*, disparities in levels of income per capita increase. Similarly, at high levels of *aggregation* differences between areas are averaged out. Now, since there is also the possibility of variations in standards for defining poverty across the regions/districts of a state, another important question that arises is: does the poverty line vary spatially according to the costs of the goods in the market basket?

In the context of India, official estimates of state level poverty line are provided by the Planning Commission. Given that there are ample variations in the cost of living conditions across different districts within a state, the official state level poverty line used for estimating poverty at the district level may not be appropriate and requires to be properly adjusted with district price index numbers (with reference to the state) to get the true picture of poverty at the district level. However, non availability of item wise price data at the sub-state level has so far prevented estimation of district specific price index numbers and hence of district specific poverty lines.

This paper uses the procedure suggested in **(Coondoo, Majumder, & Chattopadhyay, 2010)** for estimating regional consumer price index numbers based on the estimation of item-specific region wise Engel curves. Given the problem of unavailability of official district level poverty lines, the same are estimated by multiplying the official state level poverty line by the district level price indices estimated taking state as the base region. The poverty measures adjusted for the district level poverty lines, give a clearer picture for the spatial variations in levels of living across the districts. The methodology in (Coondoo, Majumder, & Chattopadhyay), hereafter referred as *CMC methodology* is followed in this paper. The distinctive feature of the present paper is that statistical precision of the estimated price indices are also found.

The plan of the paper is as follows: Section 2 describes the methodology; Section 3 describes the data and results and finally section 4 concludes.

2. The CMC Methodology

The intuition behind the CMC methodology is that when a consumer expenditure data set covers regions facing different price situations, the region-specific *Engel curves* for individual items estimated from such a data set would contain information about regional price level differentials, which when retrieved should give a set of regional True Cost Of Living Indice's (TCLI's).

The methodology is based on the assumption of a cost function underlying *quadratic logarithmic system* (e.g., Quadratic Almost Ideal Demand System (QUAIDS) of (Banks, Blundell, & Lewbel, 1997) and the *Generalized Almost Ideal Demand System* (GAIDS) of (Lancaster & Ray, 1998)) and is assumed of the following form:

$$C(u,p) = a(p).exp\left(\frac{b(p)}{\frac{1}{ln\,u} - \lambda(p)}\right) \quad ; \quad (1)$$

p being the price vector, $a(p)$ being a homogeneous function of degree one in prices, $b(p)$ and $\lambda(p)$ being homogeneous functions of degree zero in prices, and *u* denoting the level of utility.

The True Cost of Living Index (TCLI) in logarithmic form comparing price situation of the r^{th} region, p^r with price situation of the base region, p^0 is given by

$$ln\,P(p^r, p^0, u^*) = [ln\,a(p^r) - ln\,a(p^0)] + \left[\frac{b(p^r)}{\frac{1}{ln\,u^*} - \lambda(p^r)} - \frac{b(p^0)}{\frac{1}{ln\,u^*} - \lambda(p^0)}\right] \quad ; \quad (2)$$

u^* being the *reference utility* level. The first term of the R.H.S. of (2) is the logarithm of the *basic index* (measuring the cost of living index at some minimum benchmark utility level) which may be interpreted as that component of TCLI that captures the effect of uniform or average inflation on the cost of living and the second term is the logarithm of the *marginal index*, interpreted as the other component of TCLI that captures the effect of a change in the relative price structure. The estimation procedure consists of the following three stages.

Stage 1: A set of item-specific Engel curves relating budget shares to the logarithm of income are estimated for each region:

$$w_{irj} = a_{ir} + b_{ir}y^*_{rj} + c_{ir}y^{*2}_{rj} + \varepsilon_{irj} \quad ; \quad (3)$$

y^* denoting the logarithm of income, the subscript *i* denoting the i^{th} item, the subscript $j(j = 1,2, \ldots, H_r)$ denoting the PCE (Per Capita Expenditure) class of a region, ε_{irj} being a random disturbance term and a_{ir}, b_{ir}, c_{ir} being the parameters to be estimated.

Stage 2: The components of the basic index, i.e., $a(p^r)$; $r = 0, 1, 2, \ldots, R$ is estimated at this stage.

Assuming $\pi_0 = \ln a(p_0)$ and $\pi_r = \ln a(p_r); r = 1,2, \ldots, R$; the following *errors-in-variable regression* set-up is obtained using the estimates of the first stage regression parameters:

$$\hat{b}_{ir} - \hat{b}_{i0} = \pi_0(2\hat{c}_{i0}) - \pi_r(2\hat{c}_{ir}) + e_{ir} \;; \quad i = 1, 2, \ldots, n; \; r = 1, 2, \ldots, R; \quad (4)$$

e_{ir} being a composite error term which is a linear combination of the individual errors in estimating parameters in Stage 1.

The consistent estimates of the π_r's are obtained as

$$\hat{\pi} = \frac{1}{2}\left(\hat{C}'\Sigma^{-1}\hat{C} - NE'_C\Sigma^{-1}E_C\right)^{-1}\left(\hat{C}'\Sigma^{-1}\hat{B} - NE'_C\Sigma^{-1}E_B\right); \quad (5)$$

where $\hat{C}$ is the matrix of explanatory variables in (4), $\hat{B}$ is the vector of dependent variables in (4), E_C is the matrix of estimation errors in *C*'s, E_B is the vector of estimation errors in *B* , *N* (= *nR*) is the sample size and Σ is the variance-covariance matrix of the error terms in (4). Asymptotically $E'_C\Sigma^{-1}E_C$ converging to a null matrix and $E'_C\Sigma^{-1}E_B$ converging to a null vector, (5) will yield the usual GLS estimates.

Stage 3: $b(p^r)$ and $\lambda(p^r)$; $r = 1,2, \ldots, R$, i.e., the components of the marginal index are estimated at this stage.

Treat region *r* = 0 as the base region and take the utility levels of the base region as reference utility levels. Using the normalisation $b(p^0) = \lambda(p^0) = 1$, the base region cost function is given by $C(u, p^0) = a(p^0).exp\left(\frac{1}{\frac{1}{ln\,u} - 1}\right)$;[from (1)] (6)

Denoting the money cost of utility level u_0^h at base region prices p^0 by $y_{0h} = C(u^h_{0,} p^0)$; one gets the following from (6):

$$\frac{1}{\ln u_0^h} = \frac{1}{\ln \frac{y_{0h}}{a(p^0)}} + 1 \quad (7)$$

Estimation of $b(p^r)$ and $\lambda(p^r)$ is proposed from the following regression equation

$$\left(\frac{1}{\ln \bar{y}_{rq} - \hat{\pi}_r}\right) = \frac{1}{b(p^r)}\left(\frac{1}{\ln \bar{y}_{oq} - \hat{\pi}_0} + 1\right) - \frac{\lambda(p^r)}{b(p^r)} + error \quad (8)$$

or, $\left(\frac{1}{\ln \bar{y}_{rq} - \hat{\pi}_r}\right) = \psi_r \left(\frac{1}{\ln \bar{y}_{oq} - \hat{\pi}_0} + 1\right) + \tau_r + error$, say, (8.1)

$\hat{\pi}_r$ being the estimate of $\ln a(p^r)$ and $\bar{y}_{rq}$ (q = 1, 2,..,Q) is the q-th quantile of per capita income/total consumer expenditure (PCE). The regression equations are estimated using region-specific data on PCE by quantiles. The underlying assumption is that all the *q-th* quantile households of a given region have comparable utility levels.

Using the parameter estimates of Stage 2 and Stage 3, the TCLI of Region *'r'* is obtained (from equation (2)) with reference to the base Region, i.e., for a given reference utility level of the base region.

The novelty of the present analysis is that the **statistical precision of the estimated CMC indices** are also found out. From equation (2), the TCLI for any region is a function of the estimated coefficients at different stages:

i.e., $\hat{P}(p^r, p^0, u^*) = f(\hat{\pi}_r, \hat{\pi}_0, \hat{\psi}_r, \hat{\tau}_r)$.[1]

The variance of the estimated index can, thus be derived using the *delta method* ((Powell L. A., 2007), (Seber, 1982), (Oehlert, 1992), (Xu & Long, 2005))[2] as:

$$V(\hat{P}) = \left(\frac{\partial f}{\partial \hat{\pi}_r}\right)^2 var(\hat{\pi}_r) + \left(\frac{\partial f}{\partial \hat{\pi}_0}\right)^2 var(\hat{\pi}_0) + \left(\frac{\partial f}{\partial \hat{\psi}_r}\right)^2 var(\hat{\psi}_r) + \left(\frac{\partial f}{\partial \hat{\tau}_r}\right)^2 var(\hat{\tau}_r)$$
$$+2cov[(\hat{\pi}_r, \hat{\pi}_0)]\left(\frac{\partial f}{\partial \hat{\pi}_r}\right)\left(\frac{\partial f}{\partial \hat{\pi}_0}\right) + 2cov[(\hat{\psi}_r, \hat{\tau}_r)]\left(\frac{\partial f}{\partial \hat{\psi}_r}\right)\left(\frac{\partial f}{\partial \hat{\tau}_r}\right) \quad (9)$$

The estimates of $var(.)'s$ and $cov(.)'s$ on the R.H.S of equation (9) can be obtained from the respective stages of regression. The covariance terms including second stage and third stage parameters have been dropped since regressions at respective stages are carried out independently.

3. Data and Results

The data used here is 61st round (2004-05) NSS employment-unemployment data for rural West Bengal, an eastern state of India. The base region has been taken to be the state as a whole, which relates to the data for all districts combined. The data set covers 20 item expenditure categories, a number of which contain non-food and service items, jointly comprising total consumer expenditure. Table A1 (Appendix A.1) shows the list of items.

The data have been grouped into twenty quantile classes of total consumption expenditure. The item-specific Engel curves for regions have been estimated by single-equation weighted least squares, using the estimated population proportion of individual PCE classes as weights.

Price indices have been computed using the *CMC method*, first taking the *'districts'* as regions and then considering the *'NSS regions'* as specified in the NSS data structure and

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[1] $\hat{\psi}_r = \frac{1}{b(p^r)}$; $\tau_r = -\frac{\lambda(p^r)}{b(p^r)}$ [see equation (8.1)].

[2] Delta method approximates the variance of any parameter that is a function of one or more random variables, each with its own estimate of variance. Suppose G is the parameter, which is a function of the random variables: $(X_1, X_2, \ldots, X_N)$;

i.e. $G = f(X_1, X_2, \ldots, X_N)$, the variance of G is given by

$$var(G) = \sum_{i=1}^{n} var(X_i)\left[\frac{\partial f}{\partial X_i}\right]^2 + 2\sum_{i=1}^{n}\sum_{j=1}^{n} cov(X_i, X_j)\left[\left(\frac{\partial f}{\partial X_i}\right)\left(\frac{\partial f}{\partial X_j}\right)\right],$$

where $\frac{\partial f}{\partial X_i}$ is the partial derivative of G with respect to X_i.

treating the corresponding district price indices within a region to be the same. The listing of districts and NSS regions has been given in Table A2 (Appendix A.2). The reference utility level has been taken to be the utility value (obtained from equation (7)) at the median level of expenditure for the reference region. Using the estimated price index numbers two sets of *district specific* poverty lines have been estimated from the official state level poverty line.
Estimated price indices with their associated standard errors have been reported in Table 1. Standard errors have been estimated using equation (9) involving parameter estimates and variance and covariance terms of the stages of regression. The parameter estimates and their corresponding standard errors of the second and third stage regressions have been reported in Table A3 (Appendix A.3).

It is noted that there is ample variation in values of the estimated price indices across the districts as well as across definitions of 'region'. It is also observed that in the rural sector, taking 'West Bengal' as numeraire, the Northern districts have lower price levels and the Southern districts have higher price levels. It is interesting to note that except for few districts (Kochbihar, Birbhum and Purulia) this segregation largely coincides with the traditional (geographical) division of North and South Bengal with respect to the River Hooghly[3].

Using the district price indices, the *district specific* poverty lines are estimated as follows:
District specific poverty line, Z_d *=district price index* $\times$ *state poverty line, Z.*
A class of sub-group decomposable measures of poverty proposed by (Foster, Greer, & Thorbecke, 1984), has been used in the present empirical exercise. In its continuous form, the measure is given by: $F_\alpha = \int_0^z \left(\frac{z-x}{z}\right)^\alpha dx$; x and z being the individual income level and the state-level poverty line, respectively. Depending on the value of the parameter α, three different poverty measures are obtained; viz., $\alpha = 0$, $\alpha = 1$ and $\alpha = 2$ give the *head count ratio*, the *poverty gap measure* and the *squared poverty gap* measure, respectively. Henceforth, we shall refer to these measures as FGT0, FGT1 and FGT2, respectively. The measure in discrete form is written as: $F_\alpha = \frac{1}{N}\sum_{x_{i\le z}} \left(\frac{z-x_i}{z}\right)^\alpha$; x_i and N being the income of the i^{th} person and the number of persons in the society, respectively. To use these poverty measures for estimation of poverty from unit level household survey data on per capita income/consumer expenditure, the sample design of which is not *self-weighting*, the following *multiplier-adjusted* discrete form of the measure has been used :
$P_\alpha = F_\alpha = \frac{1}{\sum_{j=1}^{n} m_j}\sum_{x_{i\le z}} m_i \left(\frac{z-x_i}{z}\right)^\alpha$;where n is the sample size and m_i is the *multiplier* associated with the i^{th} sample household.

The state level rural poverty line of Rs.382.82 per capita per month has been used in the present analysis[4]. Using this state level poverty line, Z to estimate the district level estimates of poverty, it is noted from Tables 2 and 3 that there is plenty of variations in the incidences of poverty across the districts and that poverty is much higher in the northern districts compared to the southern districts. Now using Z_d in place of Z, it is observed that largely, the incidences of poverty adjusted for the spatial variations in the estimate of poverty line, i.e., the adjusted FGT measures gets reduced for the northern districts and gets enhanced for the southern districts (compared to the unadjusted FGT measures). A comparison of the adjusted FGT estimates with the unadjusted FGT estimates thus shows that, largely, poverty is overestimated in the districts of North Bengal and underestimated in the districts of South

[3] See Appendix A.4 for the map of West Bengal at the end of this paper. The river flows through the middle of Mursidabad district. Figures A. 2 and A.3 show in the map the spatial variations in the cost of living indices across the districts.

[4] (Source: http://www.cbhidghs.nic.in/writereaddata/mainlinkFile/Socio-Economic%20Indicators.pdf).

Bengal when the conventional state level poverty line is used for estimating poverty at the district level.

4. Conclusion

The use of an official state level poverty line may bias the district level poverty estimates, when there are variations in the cost of living across the districts within a state. The paper deals with the issue of poverty measurement incorporating the intra regional heterogeneity in the price structure. Using the CMC methodology, it finds out estimates of district specific price indices, using which district specific poverty lines are estimated. The distinctive feature of the present analysis is that statistical precision of the estimated price indices are also found out.

Estimates of district level price indices reveal that districts in rural North Bengal have lower price levels compared to those in rural South Bengal. As a consequence, it is also observed that poverty is overestimated in the districts of North Bengal and underestimated in the districts of South Bengal when the conventional state level poverty line is used in place of district level poverty lines for estimating poverty at the district level.

An important finding is that the demarcation of West Bengal by price levels coincides with the natural geographical demarcation. This provides a basis for exploration of the poverty situation in the two parts of West Bengal separately. The spatial variation in the incidences of poverty across the districts may be properly explored incorporating the intrinsic characterization of these two parts in a *spatial regression* framework.[5]

[5] The geographical segmentation of west Bengal has important socio-political implications. There is a debate in terms of inequitable distribution of aid and welfare measures against the Northern part (See (Barma, 2007), (Ganguly, 2005))

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TABLES

Table 1 Estimate of Price Indices (Rural West Bengal: 2004-2005)

District		Price indices using the proposed method			
		Districts taken as Regions		NSS Regions taken as Regions	
		Estimate	Standard Error	Estimate	Standard Error
(1)	(2)	(3)	(4)	(5)	(6)
North Bengal	Darjiling	0.9802	0.1199	0.9392	0.3445
	Jalpaiguri	0.9081	0.2039	0.9392	0.3445
	Kochbihar	1.0276	0.2319	0.9392	0.3445
	Uttar dinajpur	0.7759	0.2169	0.8763	0.2568
	Dakshin dinajpur	0.9370	0.2032	0.8763	0.2568
	Maldah	0.8425	0.1753	0.8763	0.2568
	Murshidabad	0.7775	0.1385	0.8763	0.2568
South Bengal	Birbhum	0.8394	0.0876	0.8763	0.2568
	Bardhaman	1.0974	0.1660	1.1047	0.3075
	Nadia	1.0682	0.1868	0.8763	0.2568
	North 24 Paraganas	1.0910	0.2465	1.1047	0.3075
	Hugli	1.3329	0.3767	1.1047	0.3075
	Bankura	1.0081	0.1777	1.0363	0.2600
	Purulia	0.7547	0.1668	1.0363	0.2600
	Medinipur	1.1239	0.1767	1.0363	0.2600
	Howrah	1.0522	0.1656	1.1047	0.3075
	South 24 Paraganas	1.0492	0.1747	1.1047	0.3075
	West Bengal	**1.0000**		**1.0000**	

Table 2 Poverty Estimates Based on State and District Level Poverty Lines (Rural West Bengal: 2004-2005): State poverty line=Rs 382.82

District		Estimated district poverty line (Rs.) (Using Col (2) of Table 1)	Poverty estimate					
			FGT0		FGT1		FGT2	
			Using Col (3)	Using WB Poverty line (Rs. 382.82)	Using Col (3)	Using WB Poverty line (Rs. 382.82)	Using Col (3)	Using WB Poverty line (Rs. 382.82)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
North Bengal	Darjiling	375.2450	0.2177	0.2464	0.0399	0.0439	0.0106	0.0118
	Jalpaiguri	347.6227	0.2400	0.3231	0.0426	0.0647	0.0111	0.0185
	Kochbihar	393.3720	0.1537	0.1290	0.0234	0.0199	0.0059	0.0050
	Uttar dinajpur	297.0313	0.2135	0.5158	0.0261	0.1012	0.0046	0.0276
	Dakshin dinajpur	358.7115	0.1740	0.2304	0.0296	0.0406	0.0070	0.0104
	Maldah	322.5208	0.2088	0.4175	0.0328	0.0772	0.0075	0.0210
	Murshidabad	297.6502	0.1726	0.4877	0.0234	0.0904	0.0055	0.0249
South Bengal	Birbhum	321.3266	0.1661	0.3583	0.0245	0.0630	0.0057	0.0166
	Bardhaman	420.0930	0.1999	0.1162	0.0299	0.0170	0.0072	0.0039
	Nadia	408.9210	0.2355	0.1876	0.0385	0.0265	0.0089	0.0056
	North 24 Paraganas	417.6744	0.2052	0.1371	0.0330	0.0201	0.0082	0.0048
	Hugli	510.2699	0.3986	0.1324	0.0790	0.0242	0.0255	0.0073
	Bankura	385.9318	0.2519	0.2495	0.0381	0.0364	0.0103	0.0099
	Purulia	288.9282	0.1627	0.5074	0.0251	0.1035	0.0048	0.0290
	Medinipur	430.2520	0.2286	0.1493	0.0430	0.0243	0.0128	0.0074
	Howrah	402.7885	0.1642	0.1295	0.0206	0.0142	0.0038	0.0024
	South 24 Paraganas	401.6521	0.2038	0.1595	0.0267	0.0191	0.0060	0.0043

Table 3 Poverty Estimates Based on State and Region Level Poverty Lines (Rural West Bengal: 2004-2005): State poverty line=Rs 382.82

District		Estimated district poverty line (Rs.) (Using Col (4.) of Table 1)	Poverty estimate					
			FGT0		FGT1		FGT2	
			Using Col (2)	Using WB Poverty line (Rs. 382.82)	Using Col (2)	Using WB Poverty line (Rs. 382.82)	Using Col (2)	Using WB Poverty line (Rs. 382.82)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
North Bengal	Darjiling	359.5470	0.2008	0.2464	0.0326	0.0439	0.0083	0.0118
	Jalpaiguri	359.5470	0.2761	0.3231	0.0495	0.0647	0.0134	0.0185
	Kochbihar	359.5470	0.0865	0.1290	0.0145	0.0199	0.0034	0.0050
	Uttar dinajpur	335.4723	0.3267	0.5158	0.0560	0.1012	0.0124	0.0276
	Dakshin dinajpur	335.4723	0.1343	0.2304	0.0203	0.0406	0.0044	0.0104
	Maldah	335.4723	0.2444	0.4175	0.0405	0.0772	0.0097	0.0210
	Murshidabad	335.4723	0.3207	0.4877	0.0474	0.0904	0.0117	0.0249
South Bengal	Birbhum	335.4723	0.2214	0.3583	0.0317	0.0630	0.0075	0.0166
	Bardhaman	422.8859	0.2056	0.1162	0.0311	0.0170	0.0075	0.0039
	Nadia	335.4723	0.1034	0.1876	0.0096	0.0265	0.0019	0.0056
	North 24 Paraganas	422.8859	0.2205	0.1371	0.0353	0.0201	0.0089	0.0048
	Hugli	422.8859	0.1935	0.1324	0.0366	0.0242	0.0114	0.0073
	Bankura	396.7284	0.2718	0.2495	0.0442	0.0364	0.0119	0.0099
	Purulia	396.7284	0.5494	0.5074	0.1183	0.1035	0.0346	0.0290
	Medinipur	396.7284	0.1778	0.1493	0.0292	0.0243	0.0087	0.0074
	Howrah	422.8859	0.1970	0.1295	0.0280	0.0142	0.0057	0.0024
	South 24 Paraganas	422.8859	0.2608	0.1595	0.0370	0.0191	0.0085	0.0043

APPENDICES

Appendix A.1 Table A1 Showing List of Items

1. Cereals	9. Sugar	15. Rent etc
2. Pulses and products	10. Salt and spices	16. Medical expense
3. Milk	11. Beverages etc	17. Educational Expense
4. Milk products	12. Betel leaf, tobacco, intoxicants	18. Clothing
5. Edible oils	13. Fuel and light	19. Footwear
6. Vegetables	14. Miscellaneous goods and services	20. Durable goods
7. Fruits and nuts		
8. Meat, egg and fish		

Appendix A.2 Table A2 NSS Regions and Districts of West Bengal (2004-2005)

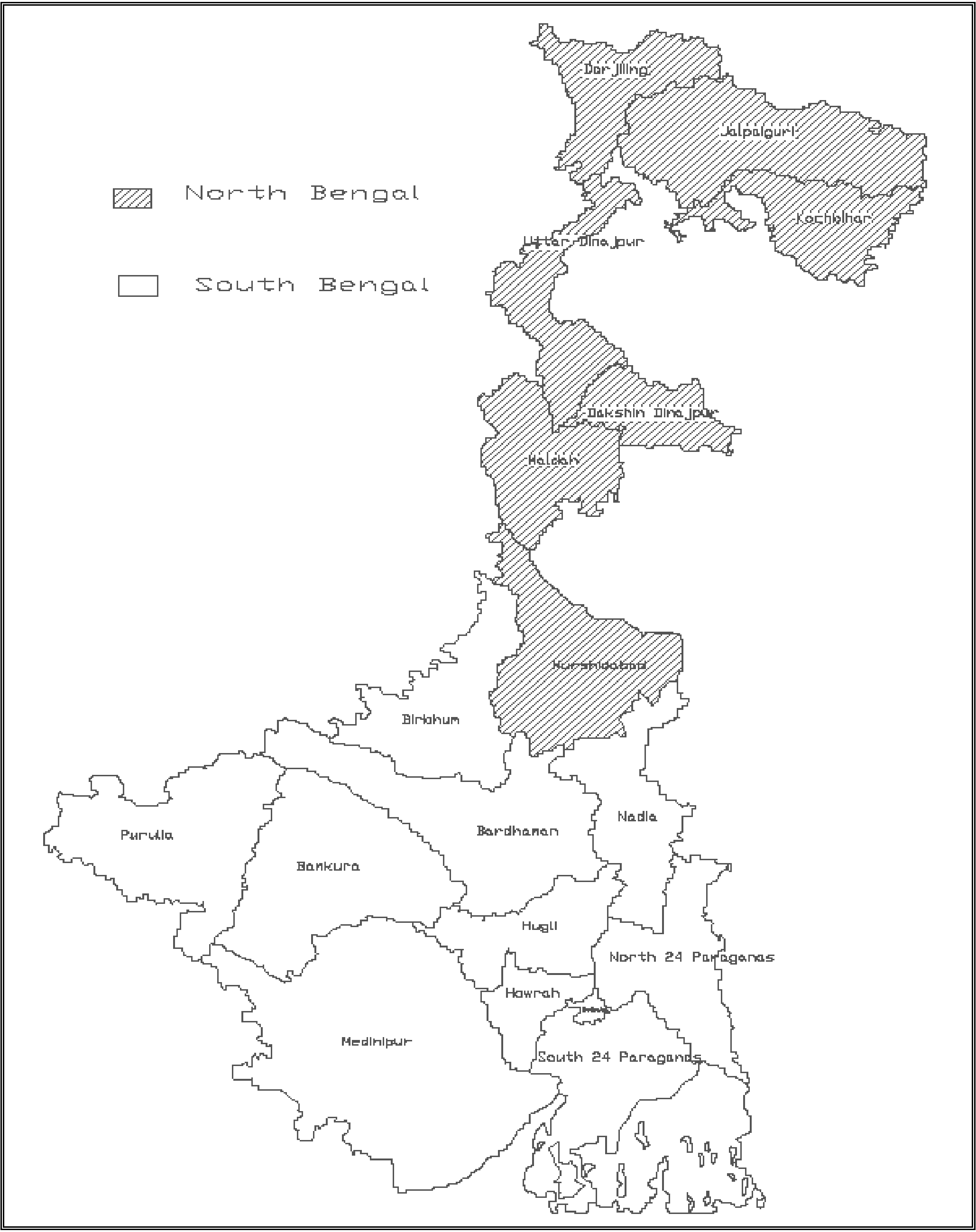
Districts	District Code	NSS Regions of West Bengal	
		Region Code	Name of Region
Darjiling	1	1	Himalayan
Jalpaiguri	2	1	
Kochbihar	3	1	
Uttar dinajpur	4	2	Eastern Plains
Dakshin dinajpur	5	2	
Maldah	6	2	
Murshidabad	7	2	
Birbhum	8	2	
Bardhaman	9	3	Central Plains
Nadia	10	2	Eastern Plains
North 24 Paraganas	11	3	Central Plains
Hugli	12	3	
Bankura	13	4	Western Plains
Purulia	14	4	
Medinipur	15	4	
Howrah	16	3	Central Plains
South 24 Paraganas	18	3	

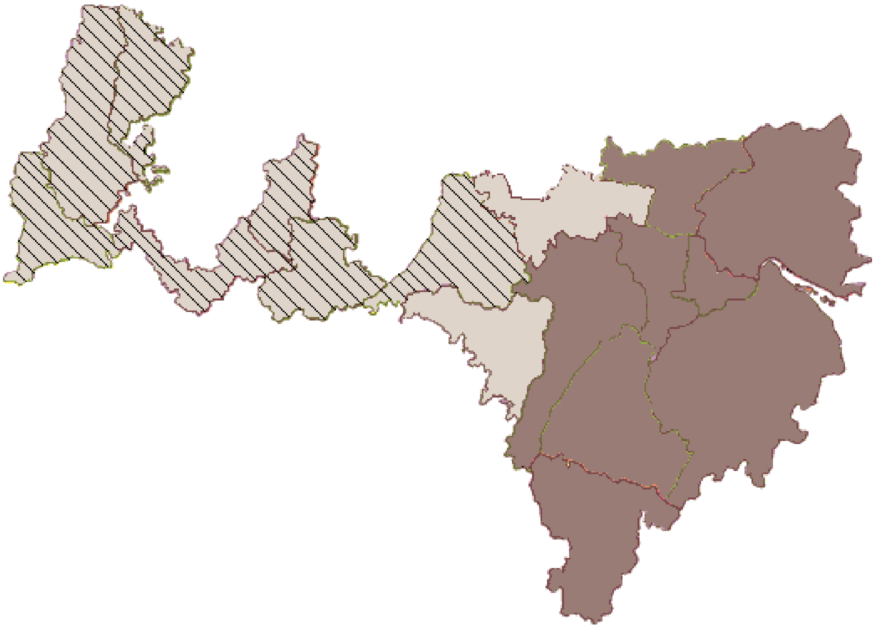
Appendix A.3 Table A3 Estimates of Parameters of Equation (7)

	Districts Taken as Regions			NSS Regions Taken as Regions		
District	π_r	$\frac{1}{b(p^r)}$	$\frac{\lambda(p^r)}{b(p^r)}$	π_r	$\frac{1}{b(p^r)}$	$\frac{\lambda(p^r)}{b(p^r)}$
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Darjiling	7.64 (0.04)**	1.33 (0.03)	1.12 (0.02)	8.42 (0.13)	0.33 (0.02)	0.59 (0.01)
Jalpaiguri	7.61 (0.10)	0.60 (0.03)	0.88 (0.02)	8.42 (0.13)	0.33 (0.02)	0.59 (0.01)
Kochbihar	7.76 (0.10)	0.35 (0.03)	0.79 (0.02)	8.42 (0.13)	0.33 (0.02)	0.59 (0.01)
Uttar dinajpur	7.58 (0.13)	0.67 (0.01)	0.84 (0.01)	7.83 (0.08)	1.04 (0.01)	1.02 (0.004)
Dakshin dinajpur	7.47 (0.06)	-11.29 (1.08)	-2.64 (0.64)	7.83 (0.08)	1.04 (0.01)	1.02 (0.004)
Maldah	7.61 (0.10)	0.73 (0.01)	0.88 (0.01)	7.83 (0.08)	1.04 (0.01)	1.02 (0.004)
Murshidabad	7.63 (0.07)	1.24 (0.05)	0.99 (0.03)	7.83 (0.08)	1.04 (0.01)	1.02 (0.004)
Birbhum	7.60 (0.03)	0.35 (0.03)	0.77 (0.02)	7.83 (0.08)	1.04 (0.01)	1.02 (0.004)
Bardhaman	7.74 (0.07)	0.76 (0.02)	0.95 (0.01)	7.98 (0.09)	1.06 (0.01)	1.05 (0.002)
Nadia	7.67 (0.08)	0.99 (0.02)	1.04 (0.01)	7.83 (0.08)	1.04 (0.01)	1.02 (0.004)
North 24 Paraganas	7.70 (0.11)	1.22 (0.01)	1.11 (0.01)	7.98 (0.09)	1.06 (0.01)	1.05 (0.002)
Hugli	7.69 (0.14)	3.36 (0.11)	1.90 (0.06)	7.98 (0.09)	1.06 (0.01)	1.05 (0.002)
Bankura	7.80 (0.08)	0.96 (0.01)	0.95 (0.01)	8.07 (0.07)	0.83 (0.01)	0.90 (0.005)
Purulia	7.41 (0.10)	0.42 (0.03)	0.83 (0.01)	8.07 (0.07)	0.83 (0.01)	0.90 (0.005)
Medinipur	7.85 (0.07)	0.72 (0.02)	0.90 (0.01)	8.07 (0.07)	0.83 (0.01)	0.90 (0.005)
Howrah	7.86 (0.07)	0.48 (0.02)	0.79 (0.01)	7.98 (0.09)	1.06 (0.01)	1.05 (0.002)
South 24 Paraganas	7.82 (0.07)	1.06 (0.02)	0.98 (0.01)	7.98 (0.09)	1.06 (0.01)	1.05 (0.002)

** Figures in parentheses are the standard errors.

Appendix A.4 Figure A.1 Map of West Bengal





FigureA.2
Estimated Price Indices Constructed on the Basis of NSS Regions

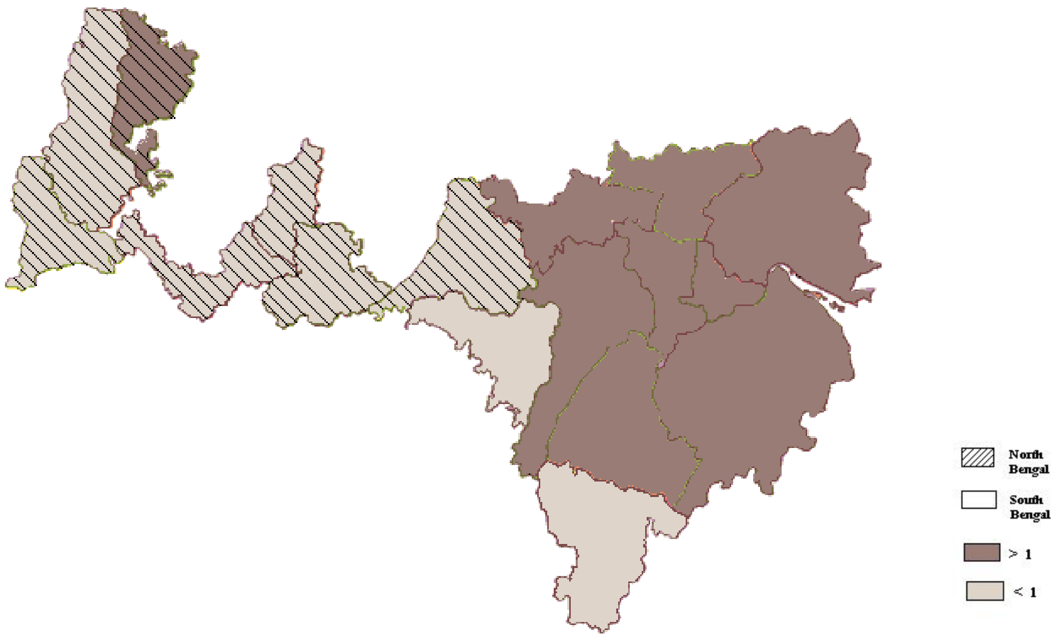


Figure A.3
Estimated Price indices Constructed Taking Districts as Regions.