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Social Mobility Among Residents of Calcutta

Introduction and Objective of the Study

HUMAN societies are often stratified on the basis of such things as income, occupation, social status or place of residence. Members of such societies move from one class to another. The inherent uncertainty of individual behaviour in these situations implies that the future development of the mobility process cannot be predicted with certainty but only in terms of probabilities.

Social mobility can be defined in terms of changes in social or economic classes over generations. As a result of such changes, the distribution of the total population among the constituent classes changes from one generation to another or from one period of time to another. This distribution, however, will eventually reach a steady state. Distributions obtaining in successive generations are modified by variations in the number of offsprings to different progenitors and by inter-dependence among social groups occupied by the different offsprings of the same progenitor. In order that the analysis of inter-generational social mobility becomes tractable generally the final status of both father and son are considered. Structural mobility is the amount of mobility generated by the fact that the distribution among social strata experienced by the son differ from the distribution of their fathers. This happens due to the changes in social structure over time.

The problem of social mobility measurement was first raised in connection with the needs of empirical research. Primarily measures were developed without considering

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mathematical models by Glass (1954). Rogoff(1953), Bouden (1973) and several other authors. Mukherjee and Chattopadhyay (1986) also developed a few such measures based on measures of association. Prais (1955) was probably the first author to apply chain theory to social mobility. The society is characterised by the transition probability matrix and most of the measures proposed are based on the elements of this matrix. Some examples are listed in Matras (1960). Measures related to occupation changes of a particular individual based on Semi-Markov processes were proposed by Ginsberg (1971), Bartholomew (1982), Mukherjee and Chattopadhyay (1989) and others. When the social classes can be ordered with respect to certain character(s), measures to represent the overall pattern of association and the direction of movement were developed by Mukherjee and Chattopadhyay (1986) and Chattopadhyay (1993).

The objective of the present study is to investigate the inter-generational mobility situation among the residents of Calcutta. The investigation has been done on the basis of the results of a survey undertaken during 1995-96 by the Indian Statistical Institute, Calcutta.

The Survey

The Survey was conducted to study the pattern of migration of persons into Calcutta, their educational and occupational changes over three successive generations (i.e. from fathers to sons and from sons to grandsons) and also the intragenerational changes in occupation of persons in the first generation. Persons in the generation of the heads of the surveyed households have been considered as persons in the first generation. In the study the occupations were classified into 9 groups according to the National Classification of Occupation-1969. The groups were

Group I Professional, Technical and related works
Group II Administrative, Executive and Managerial work
Group III Clerical and related works
Group IV Sales workers
Group V Service workers
Group VI Farmers, Fisherman, Hunters, Loggers and related works
Group VII Production and related workers. Transport equipment operators and Labourers
Group VIII Non-Gainfully Occupied workers Group IX Non-reported and others

Data

Denoting by n_{ij} the frequency in the (ij)th cell, Table 1 shows the number of sons in category j whose father are/were in category i. The raw totals n_{io} show the number of

TABLE 1: OCCUPATIONAL DISTRIBUTION OF SONS BY OCCUPATION OF THEIR FATHERS

5on / *Father*	/	//	*III*	*IV*	*V*	*VI*	*VII*	*VIII*	*IX*	*Total*	% *Values*
I	86	57	56	44	40	0	23	4	3	313	13.08
II	31	39	29	22	11	1	12	5	0	150	6.27
III	48	30	72	39	25	2	25	12	1	254	10.61
IV	41	26	35	172	45	7	73	15	6	420	17.55
V	19	9	32	50	79	0	88	27	6	310	12.95
VI	29	12	24	55	61	73	113	22	9	398	16.63
VII	16	4	37	54	40	13	297	50	10	521	21.77
VIII	1	1	0	0	1	1	1	2	0	7	0.29
IX	1	2	3	3	0	0	7	0	4	20	0.84
Total	272	180	288	439	302	97	639	137	39	2393	
% Values	11.37	7.52	12.04	18.35	12.62	4.05	26.70	5.72	1.63		

sons with their fathers in category *i*. The column totals n_{0j}. show the occupational distribution of sons.

Denoting by m_{ij} the frequency in the (ij)th cell Table 2 shows the number of heads of households in category *j* whose fathers are/were in category *i*. Under this situation, corresponding to each father there was exactly one offspring viz. the head of the household. Table 2 shows the occupational distribution of heads of households by the occupation of their fathers, *m*, values can be used to estimate the occupational transition probabilities *py* given by

TABLE 2 : OCCUPATIONAL DISTRIBUTION OF HEADS OF THE HOUSEHOLDS BY OCCUPATION OF THEIR FATHERS

Son Father	/	//	*III*	*IV*	*V*	*VI*	*VII*	*VIIIQ*	*Total*	% *Values*
I	36	28	23	14	15	0	10	*7*	133	12.15
II	15	20	13	10	5	0	3	*2*	68	6.21
III	20	19	35	16	9	0	11	4	114	10.41
IV	18	13	15	78	21	2	36	14	197	17.99
V	10	4	16	15	51	0	43	9	148	13.52
VI	12	10	10	24	43	0	60	4	163	14.88
VII	9	4	24	29	22	0	161	7	256	23.38
VIII©	2	2	2	3	1	0	3	3	16	1.46
Total	122	100	138	189	167	2	327	50	1095	
%	11.14	9.13	12.60	17.26	15.25	0.18	29.86	4.57		

Here the group VIIIC is constructed by combining the original groups VIII and IX.

p,. = P[Son is in state *j* \ father was in state ;'] assuming that these probabilities are time homogeneous. The estimates are given by *py* = w,./w,o, w,o == £. *m*,.

Table 3 shows the values of the estimated transition probabilities.

TABLE 3 : ESTIMATED TRANSITION PROBABILITY MATRIX FROM FATHER'S CATEGORY TO SON'S CATEGORY

Father \ *Son*	*I*	*II*	*III*	*IV*		*VI*	*VII*	*VIII©*	*Total*
I	.271	.210	.173	.105	.113	0	.075	.053	1
II	.220	.294	.191	.147	.073	0	.044	.031	1
III	.175	.167	.307	.140	.079	0	.096	.036	1
IV	.091	.066	.076	.396	.107	.010	.183	.071	1
v	.068	.027	.108	.101	.345	0	.291	.060	1
VI	.074	.061	.061	.147	.264	0	.368	.025	1
VII	.035	.016	.094	.113	.086	0	.629	.027	1
VIII©	0.125	.125	.125	.188	.063	0	.188	.186	1

Here the group VIII© is constructed by combining the original groups VIII and IX.

Measures of Social Mobility

We have considered measures of social mobility not based on any model, based on mathematical models and also measures developed for ordered categories. Since measures based on mathematical models suffer from many inherent assumptions, we have considered both types of measures. Measures based on ordered categories are used to study the overall pattern of association as well as the direction of movement.

Mobility Measures without Models

Total Mobility: The amount of mobility generated by the movements of the sons from the status of his father. It is measured by

$$TM = N - S_{i}^{K} n_{ii}$$

Structural Mobility

The social or occupational status of a son in a particular generation always differs from the corresponding status of his father in the previous generation due to change in social structure. So, the demand factor is important here and this structured change forces people out of some jobs and into others. The structural or forced out mobility is measured by

$$\text{SM} = N - \Sigma_i \min(n_{i0}, n_{0i})$$

Pure Mobility

Pure of exchange mobility is that part of mobility which is not structural. It is measured by PM = TM − SM

$$= \Sigma_i \min(n_{i0}, n_{0i}) - \Sigma_i n_{ii}$$

On the basis of the above concepts, following immobility indices have been developed by several authors.

1. Glass index (for the *i*th category)

$$I_{G(I)} = Nn_{ii} / n_{i0} \times n_{0i}$$

2. Yasuda Index $I_y = \dfrac{(\Sigma_i n_{ii} - \Sigma_i (n_{i0} \times n_{0i} / N))}{(\Sigma_i \min(n_{i0,} n_{0i}) - \Sigma_i (n_{i0} \times n_{0i} / N))}$

3. Bouden Index $I_B = \dfrac{(\Sigma n_{ii} - \sum_{n_{0i} > \bar{n}_{i0}} (n_{0i} - \bar{n}_{i0}))}{(\Sigma_i \min(n_{i0,} n_{0i}) - \sum_{n_{0i} > \bar{n}_{i0}} (n_{0i} - \bar{n}_{i0}))}$

where $\bar{n}_{i0}$ = number of persons in the first generation who are not in category $i = \Sigma_{j \neq i} n_{j0}$.

Mobility Measures based on Stochastic Models

For measures based on stochastic models, a simple Markov Model can be used to explain the mobility situation. The transition probability matrix at time point t is given by

$$P^{(t)} = ((p_{ij})) \qquad i = 1 \ldots k, j = 1 \ldots k$$

where k = total number of occupational categories and $p_{ij} = P$ [son is in category j at time point $(t + 1)$ | father was in category i at the time point t].

We also define

$$\pi^{(t)} = (\pi^{(t)}, \pi^{(t)}, \ldots, \pi^{(t)})'$$

where $\pi^{(t)}$ = proportion of total population at time t belonging to category i.

Assuming that $P^{(t)} = P$ is independent of time we have

$$\pi^{(t+1)} = P' \pi^{(t)} \tag{1}$$

where P' is the transpose of P

A repeated application of (1) gives

$$\pi^{(t)} = (P')^t \pi^{(0)} \tag{2}$$

where $\pi^{(0)}$ gives the initial population proportions

$$\Sigma_{j=1}^{k} p_{ij} = 1 \text{ (since } P \text{ is stochastic matrix)}$$

Depending on the values of P, three special situations of mobility can be identified.

Perfectly Mobile Society (PMS): In such a society son's choice of occupational category is independent of that of his father. Hence the rows of the transition probability matrix will be identical i.e. $p_{ij} = r_i \ \forall\ j = 1 \ldots k$. So, under this situation

$$P\ ((r_i)) \qquad i = 1 \ldots k, j = 1 \ldots k \tag{3}$$

In particular, one can choose $r_i = 1/k$ (4)

$$\Sigma_1^k r_i = 1$$

Perfectly Immobile Society (PIS): In such a society a son belongs to the same category as that of his father and thus we have

$$P = I^{k \times k} \tag{5}$$

where I is the diagonal matrix with diagonal elements equal to one.

Extreme Movement: In such a society a son can have any occupation except that of his father. Thus all the diagonal elements of the transition probability matrix will be zero. In particular, one can choose

$$p_{ij} = \frac{1}{(k-1)} \ \forall\ i \neq j \tag{6}$$

A number of measures of mobility had been proposed on the basis of the above model. Some of the measures are as follows :

(a) $\cos \Delta \ = \Sigma_{i=1}^{k} \sqrt{(\pi_i^{(t)} \pi_i^{(t+1)})}$ (1979)

(b) $J(1, 2) = \Sigma_{i=1}^{k} (\pi_i^{(t)} - \pi_i^{(t+1)}) \ln (\pi_i^{(t)} / \pi_i^{(t+1)})$ (1986)

(c) $M_2 = \Sigma_{i=1}^{k} (\pi_i^{(t)} - \pi_i^{(t+1)})^2 / \pi_i^{(t+1)}$ (1994)

(d) $E = |\Sigma_{i=1}^{k} \pi_i^{(t)} \ln \pi_i^{(t)} - \Sigma_{i=1}^{k} \pi_i^{(t+1)} \ln \pi_i^{(t+1)}|$ (1994)

The values of the above measures under the special situations like perfectly mobility and perfectly immobility can be computed.

For a perfectly Immobile Society from (1), (3) and (4)

$$\pi_i^{(t+1)} = r_j = \frac{1}{k} \ \forall \ \ j$$

Hence $$\cos\,\Delta = \left(\frac{1}{\sqrt{k}}\right)\Sigma_1^k \sqrt{\pi_i^{(t)}}$$

$$J(1,\,2) = \Sigma_1^k\, \pi_i^{(t)} \ln \pi_i^{(t)} - \frac{1}{k}\Sigma_1^k \ln \pi_i^{(t)}$$

$$M_2 = \frac{1}{k^2}\,\Sigma_1^k\left(\frac{1}{\pi_i^{(t)}}\right) - 1$$

$$E = \left|\,\ln\left(\frac{1}{k}\right) - \Sigma\pi_i^{(t)} \ln \pi_i^{(t)}\,\right|$$

For a perfectly Immobile Society from (1) and (5)

$$\pi_i^{(t+1)} = \pi_i^{(t)} \quad \forall \;\; i$$

Hence $\cos\,\Delta = 1$, $J(1,\,2) = 0$, $M_2 = 0$, $E = 0$.

To judge the mobility situation of a particular society the values of the above measures can be computed and compared with their values under Perfect mobility and Perfect immobility.

Measures under Ordered Categories

When the occupational categories can be ordered in some sense, measures can be developed in different ways.

(a) *Measures based on Placketts' coefficient:* A contingency table (of the transition probabilities) with ordered categories can be considered as sample from bivariate distributions. We have used a class of bivariate distributions proposed by Plackett (1965) and characterised by a measure of association (ψ) based on global odd ratios (Mukherjee and Chattopadhyay (1986)). In case of $k \times k$ contingency table ψ can be estimated in $(k-1)$ ways by considering the association between the marginal distributions in a 2×2 table where we pool classes in the two generations in various possible ways.

$$\psi_{ij} = \frac{(\Sigma_{\alpha=1}^{i}\,\Sigma_{\beta=1}^{j}\, p_{\alpha\beta} \times \Sigma_{\alpha=i+1}^{k}\,\Sigma_{\beta=j+1}^{k}\, p_{\alpha\beta})}{(\Sigma_{\alpha=1}^{i}\,\Sigma_{\beta=j+1}^{k}\, p_{\alpha\beta} \times \Sigma_{\alpha=i+1}^{k}\,\Sigma_{\beta=j+1}^{j}\, p_{\alpha\beta})}$$

where $\psi_{11} = \psi_{k-1,k-1} = 0$

$$\psi_{ii} = \psi_{k-i,k-i}$$

$$\psi_{ij} = \psi_{k-i,k-j}$$

(b) Another Measure (Chattopadhyay (1993)) is given by

$$W = W^+ - W^-$$

Where $W^+ = \frac{(\sum_{i=1}^{k} \sum_{j>i} h(i, j)\, p_{ij})}{(\sum_{i=1}^{k} \sum_{j>i} p_{ij})}$

$$W^- = \frac{(\sum_{i=1}^{k} \sum_{j<i} h(j, i)\, p_{ij})}{(\sum_{i=1}^{k} \sum_{j>i} p_{ij})}$$

Where $h(i, j) > 0$ for $j > i$
$= 0$ for $j = i$
< 0 for $j < i$

Assume particular choices of $h(i, j)$ are

$h(i, j) = (j - i)$
$= e^{(j - 1)}$
$= \text{Sign}\ (j - i)$

$W > 0 \Rightarrow$ Society is moving towards higher categories
$W < 0 \Rightarrow$ Society is moving towards lower categories.

Analysis

The inferences drawn by the analysis of data collected through the survey are discussed below.

Regarding total, structural and pure mobility, the following values have been computed from Table 1.

TABLE 4

Mobility	*Total*	*Structural*	*Pure*
Value	65.56%	14.62%	50.94%

From the above table it can be inferred on the basis of the survey that 65.56 per cent sons are totally mobile with respect to their fathers, 14.62 per cent changes from father to son is due to structural change in the society and 50.94 per cent mobility can be explained as pure mobility.

On the basis of the figures shown in the Table 1, the values of the indices are given below.

TABLE 5

I	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*	*IX*
$I_{G(I)}$	2.417	3.456	2.355	2.232	2.018	4.525	2.135	4.99	12.272

$I_y=0.2929,\ I_B=0.4033$

The values of the above indices show that there was a fair degree of mobility in the choice of occupation of the sons from that of their fathers.

For the survey under consideration, the values of the following measures can be computed on the basis of the figures shown in Table 2 and Table 3.The computed values are given below.

TABLE 6

Measure	*Observed values*	*Values under*	
		*Perfect Mobility**	*Imperfect Mobility*
Cos Δ	.9323849	.9555726	1
J(1, 2)	.7190153	.378	0
M	.2511	.97477	0
E	.10097	.15411	0

*Special Case (5).

On the basis of the values of the above measures it can be inferred that movements in terms of occupational categories over general! on among the residents of Calcutta were quite significant. But from the values of the above measures it is difficult to explain the direction of the movement of the society.

To identify the direction of movement the following measures based on ordered categories have been computed.

On the basis of the values of Table 3, the values of the Ψij coefficients are shown below:

2.93	3.27	3.39	2.75	3.22	3.19	1.19
3.11	4.78	4.94	4.47	5.01	4.98	1.65
3.23	5.04	6.76	5.54	5.47	5.43	1.91
2.86	3.89	4.27	5.38	4.52	4.61	1.61
2.33	2.74	3.05	3.15	3.85	3.90	1.63
2.03	2.27	1.92	1.92	3.26	3.29	2.47
1.08	1.02	1.10	0.96	1.49	1.51	5.05

corresponding to the choice $h(i, j) = (j - i)$, the value $W = -0.237$. From the values Ψij coefficients and w, it can be inferred that the society has a downward movement.

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