

## THE INCOME TRANSITION IN RURAL INDIA: EVIDENCE FROM ARIS/REDS SURVEYS

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Measuring changes in inequality helps determine the effectiveness of policies aimed at correcting inequality and generates the data necessary to use inequality as an explanatory variable in policy analysis. Income inequality per period and income mobility across periods can be pooled into one overall measure of multiple period inequality. This paper highlights some aspects of structural changes and examines its impact on economic mobility in Indian rural economy. We have used a unique Additional Rural Income Survey/Rural Economic & Demographic Survey (ARIS/REDS) surveys data set for rural India spanning 3 decades to determine the reasons and magnitude of income mobility. The triggers, that have been identified, include land ownership, affirmative action program and occupation. The income mobility continues to be low. Further, the land reforms and advantages from affirmative action programs have not made any significant impact on the income mobility for the rural households in India over the periods.

*Keywords:* Income Mobility, Measurement Error, Poverty, Primary Survey, Rural India  
*JEL Classification:* D31, I32, D73, O12

### 1. INTRODUCTION

Income inequality is prevalent in India. According to World Inequality Report, (2018), India is the second-most unequal country after Middle East in the world. It is recorded that in 2016, 58.4 percent of India's total wealth owned by only richest 1% Indian population. Further, the richest 10 percent population own 80.7 percent of the India's total wealth against 31 percent in 1980. There is no second opinion that income

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inequality has increased in nearly all countries during the last few decades, but, since 1980, income inequality has been increased drastically in India. Dispersion in income distribution of raises the level of poverty. In 2012, the Indian government stated 22 percent of its population is below its official poverty limit. Although during the period between 1973-74 and 1999-2000, the incidence of poverty has been declined from 54.9 percent to around 26 percent (Reserve Bank of India (RBI), 2012), the rate of reduction in poverty varied considerably during this period. There was a slowdown in the pace of poverty reduction in the early 1990s despite having steep economic growth.

Whereas, the last three decades have been a period of considerable economic growth in the economy; in particular, the spread of new agricultural technologies during the 1970s, the industrial reforms during the 1980s and the extensive structural reforms during the 1990s. It is emphasised that high rate of growth of GDP that was triggered off by economic reforms and has been sustained over the years. However, single minded pursuit of growth rate in planning suffers from serious analytical fallacies which can give erroneous leads. As high growth in Indian economy were accompanied by enlarged disparities in earnings and living standards since 1990s. An exclusive focus on growth rate leaves out the issues relating to structural changes, where, the structural changes are likely to have influenced the pattern of livelihood and income of the households. For instance, the New Industrial Policy of 1991 significantly has modified the requirements regarding the location of industries in rural areas. It can be expected to have an impact on employment and occupational patterns within villages that are relatively well-integrated with the wider economy. Similarly, policies promoting rural non-farm employment or agro-based industries either directly or indirectly (e.g., through the liberalization of inter-state and international agricultural trade) should influence household income through their effects on occupation and activity specialization patterns., There should be a high, and possibly increasing, degree of mobility among households depending on a households' ability to respond to this changing environment. But, income estimates, in reality, has been logged as follows. From 1980 to 2016, the gap between the bottom 50% and the top 0.001% is even less than 110 percent versus more than 3000 percent. Structural transformations in the Indian economy through implementation of deregulation and opening-up reforms affected volume of equity gap. Since the beginning of deregulation policies in the 1980s, the top 0.1 percent earners have captured more growth than all of those in the bottom 50% combined. The middle 40 percent have also seen relatively little growth in their incomes (World Inequality Report, 2018). There was a school of thought in the mid-twentieth century that 'a rising tide lifts all boats' in regard to economic growth. It had been considered that economic growth would bring increasing wealth and higher living standards to all sections of society and eventually makes stable equity. However, latter it became difficult to follow the same logic to defend the reverse phenomenon which had occurred during the post-war period. Since then inequality has been rising rapidly. It raises the need of alternative explanations of inequality. There is a need to judge pattern of growth with reference to the influence of institutional factors and a range of policies that would

impact the economic wellbeing. Although public debates still emphasize on the per capita growth rate to compare economic performance of various countries, tracking income mobility plays a crucial role in shaping distributive pattern of resources and examines capacity of socio economic system to provide equity in opportunities. Income mobility refers the movements of individuals or households on income level over a period of time. It has been stalling progress in education, health and nutrition for large section of the population, thus undermining the very human capabilities needed to achieve a good life. It has been inadequate opportunities and access to economic, social and political resources. Furthermore, inequality has been driving conflict and destabilizing society. Therefore, the assessment of income mobility for a society can infer its long run income inequality and persistence level of poverty in India. This study tries to assess the income transition and economic mobility for Indian rural households.

This paper is organized in six sections. After the brief introduction in Section 1, a quick glimpse of the extant literature is discussed in Section 2. Section 3 covers the methodology of estimating income mobility and Section 4 describes the ARIS/REDS data set for the analysis. Empirical results are presented in the Section 5. Finally, conclusion has been presented in Section 6.

## 2. REVIEW OF LITERATURE

Earlier development thinkers focused on the relationship between economic growth and inequality. After realizing that growth rate fails to generate equity in distribution of opportunity for population, estimating worldwide income inequality plays a more important role in measure for overall development and poverty reduction. Now recent thinkers have taken more robust concept of development by considering multiple dimensions of human development and human well-being. Since the past two decades, there has been renewed attention in estimating the long run progress of income inequality in empirical research during late 1990s, many studies have been carried out to measure year-to-year, intra-country inequality. Studies mostly showed that inter country inequality does not change a large amount (Deininger and Squire, 1998; Gallup et al., 1999; Li et al., 1998; Ravallion, 2001; Roemer and Gugerty, 1997; Timmer, 1997). However, within each region, there are changing trends. While some countries experienced a rise in inequality, others saw a decline. Further, out of 84 developing countries, half of them had showed rising inequality (UNDP, 2013). Atkinson and Bourguignon (1992) viewed the income mobility implies a transition that links an initial distribution to a final distribution and then a mobility index typically describes this transition process. It is generally assumed in literature (Paul, 2009) that a given degree of income inequality in a rigid society in which each individual/ household stays in the same position over a period is more a cause of concern than the same degree of inequality due to mobility as absolute poverty is likely to be persistent in this type of social structure. On the other hand, with high income mobility the absolute poverty is

expected to be of a temporary nature. Therefore, a proper evaluation of income mobility is essential for developing country like India to examine the dynamic aspects of poverty and inequality for proper policy planning.

Cowell and Schluter (1998) explained that income mobility can be classified into categories of first-stage and second-stage indices. The first stage indices are constructed using individual/household level panel data on income distribution for two years and the two-stage indices are first transformed into a transition matrix, which is then used to develop summary measures of mobility. With the availability of panel survey data both at the individual and household levels in the recent past, researchers have developed a variety of first-stage indices capturing different facets of mobility (e.g., Shorrocks, 1978a; King, 1983; Fields and Ok, 1996, 1999; Fields, 2009). Shorrocks (1978) popularised the idea that mobility can be measured by the extent to which inequality is reduced by an extension of the income-accounting period (see, for example, Bayaz-Ozturk et al., 2014 and Kopczuk et al., 2010 for recent applications of Shorrocks' approach to the US).

According to Parker and Rougie (2001), mobility can be represented by the transition matrix, which describes the probabilities of persons moving from any one state to another state or remaining where they are. Assessment of mobility allows us to have insights about the working of the economic process over time and to understand the causes of poverty of and be able to interpret the different aspects of economic status. It is important to examine mobility in the context of chronic poverty. Income mobility is an important indicator of the economy by which we can evaluate the transition of households to exit from poverty or re-entry into poverty. Some of literatures (Dardanoni, 1993; Field and Ok, 1996, 1999; and Ding and Wang, 2008) relate mobility measurement to welfare analysis. However, both the transition matrix and welfare analysis approach pay no attention to the measurement error and hence Glewwe (2005) identifies to solve the measurement error in the data.

Kapitany and Molnar (2004) found the stagnation of inequality was coupled with decreasing mobility, which may account for the stabilization of inequality. This process may be observed in every income and expenditure deciles. Immobility was particularly strong at the ends of the income and expenditure scales. The poor had less chance to improve their position, and even the commencement of economic growth could not increase their mobility. The richest families were able to stabilize their position permanently.

Herault (2015) showed how changes in inequality are explained by income mobility and the equalising effect of income growth. It tries to examine how the distributional effect of income growth depends on the distribution of income gains and losses using US data for the 1970/2009 period and it found that most of the equalising effect of income growth occurs through income gains rather than income losses even in times of recession. The analysis also reveals some remarkable trends regarding income mobility and the business cycle.

Another concern is intergenerational mobility within families. A branch of literature

has developed models where primarily, a society is divided in a group of rich and a group of poor people. Rich invests in human capital and therefore has higher labor income within skilled formal sector and bequeaths resources to their descendants' education. With decreasing fertility rates, rich dynasties maintain and perpetuate their status. The poor group invests insufficiently in human capital, works in the unskilled sector and generation after generation leaves less inheritance to their children. Mukund (2001) has explored the dynamics of social mobility in pre-colonial south India. He found that a significant degree of mobility was to be not seen in this society and neither at the individual nor at the corporate level there an acceptance of an immutable caste system and social ranking. The caste system was highly complex, with many intricate strands which linked the social group with their economic base. The interaction of these factors allowed for a degree of intra- and inter-caste mobility which the static understanding of caste does not accommodate.

Jalan and Murgai (2008) examined inequality in opportunities across people when different groups (e.g., caste, gender, or class) have unequal chances of acquiring assets, earn unequal returns to assets (for similar effort), or have unequal access to basic services is of concern for intrinsic reasons and also because it may have an instrumental impact on the development process. It has claimed that society deeply stratified by caste which has historically been associated with poor outcomes and very low mobility and one dimension of inequality of opportunities which is acquisition of human capital and the impact of parents' education on a child's education, to ask whether inequality in human capital in today's generations reflects very unequal opportunities that individuals inherit from their parents. There are three main results. The study claimed that education mobility across generations has increased significantly and consistently. Economic mobility in India has been examined variously by Gaiha (1988), Gaiha and Deolalikar (1993) and Swaminathan (1988) finds limited wealth mobility in a set of Tamil Nadu villages during the period 1977 to 1985. Pal and Kynch (2000) examined the nature and characteristics of occupational change and mobility in rural India. They have shown that success in changing occupation depends crucially on socially constructed 'status' – being older, male, from larger farming families or having higher schooling experience. They also have demonstrated the effects of regional diversity, levels of prosperity and different patterns of employment between agricultural and non-agricultural activities. Mitra (2006) have also shown that the downward mobility are much fewer in number than upward mobility. The duration of migration does not seem to have any significant effect on the expenditure per capita, but it shows a positive influence on the probability to save. Rajeswari and Suhas (2008) found that while caste is not strongly associated with occupational mobility in general, it certainly important for upward mobility through extend of mobility is different among different castes. The maratha-kunbis and dalits are the greatest beneficiaries of upward mobility through there are difference in the mode of their journey. The other backward classes lag behind these two and some castes among them even show stagnation as far as mobility is concerned. Majumder (2010) finds there is a strong intergenerational stickiness in both educational achievement and occupational

distribution among Scheduled Castes (SCs) and Scheduled Tribes (STs) and occupational mobility is lower than educational mobility. Hnatkowska et al. (2013) have shown a significant convergence in the intergenerational mobility from SC/STs to non-SC/ST in both education attainment and wages. Gang, Sen and Yun (2012) find that SCs are able to move out of the occupation which has the highest incidence of poverty and there is an occupational mobility among SCs but not among STs in the period 1983-2004. Desai and Kulkarni (2008) find that there is some equalization of educational achievement across caste groups at the primary level, but at the college level, inequalities are wider. Anirudh (2013) find that there are four socio-economic factors act as significant handicaps to substantial upward mobility – rural upbringing, parents employed in agriculture or as homemakers, relative poverty, and parents' (especially mothers') lack of high school and college education. Therefore, any change in development process in a relatively long term perspective significantly affects other short term policy induced development. Many long term structural changes are taking place through policy induced development in India since last three decades and have seen acceleration or assumed somewhat different qualitative characteristics but have not been received sufficient attention due to an excessive focus on growth rate in policy planning. There are various dimensions in which the impact can be analysed, viz., across sectors and activities, across gender and social groups, locations, skills, expenditure classes, inter-regional, inter-generational. Study of mobility, compare to income inequality, has not been dealt with dept so far for Indian economy. Income mobility allows examining the movements of households or individuals along the income ladder, demographic and structural and economic factors to identify the causes and crucial issues like chronic poverty and may prove to be useful in possible treatments from vulnerable position.

Here, we try to examine the income mobility of rural households in India using a unique panel Additional Rural Incomes Survey/Rural Economic & Demographic Survey (ARIS/REDS) data set. The present study examines the income mobility by characterizing the households with affirmative action and landholding. We have estimated the income mobility of rural households in India using three approaches viz. Shorrock's mobility index (1978) which is based on transition matrix approach, Field and Ok (1999) measurement of welfare and Glewwe's (2005) measurement error approach over the periods. This will make a compact measure for income mobility.

### 3. METHODOLOGY

The mobility of households has been measured with respect to time-independence; positional movement, and directional income movement using transition matrices. Transition matrices are most intuitive tools to comprehend mobility and are based on Shorrock's (1978) measures of mobility. These matrices classify the income units into fixed categories in each time period. Income units are defined as quintiles.

Cross-tabulations of the frequency distribution of households in each quintile with the base-year quintile determine the row. A similar cross tabulation with final-year quintile determines the column. Using this methodology, we determine the movement of a family along the income distribution over time. It also determines the existing immobility if any. It also can say that there is a perfect immobility if all households remain in the same quintile in each of these accessible years, i.e., the diagonal elements of the transition matrix. Above triangle of the matrix shows the upward mobility and lower triangle shows the downward mobility. If a significant majority of entries are above the diagonal rather than below the study can conclude that upward mobility is greater than downward mobility between the two years examined.

However, transition matrix measurements are based on the quintile of income, which contains information on how people shift among different classes. However, these transition matrices are not useful because (i) incomes are measured with measurement error and (ii) it does not reveal the impact of the change in an individual's income on the total well-being in the long run. Therefore we propose two alternative measures of income mobility that measure the welfare of the households and simultaneously control the measurement error.

Fields and Ok (1996, 1999) measure of income mobility argues that the change in person's income alters his utility and certainly, has an effect on the welfare of the whole society. The mobility of welfare index of Fields and Ok (1996, 1999) is estimated as follows,

$$M(x) = \frac{1}{N} \sum_{i=1}^N (\log x_i^1 - \log x_i^0), \quad (1)$$

where  $N$  is the number of households in the economy, and  $x_i^0$  and  $x_i^1$  are the initial and final incomes of household  $i$ , respectively. This index is the aggregate of the change in each household's income.

Shorrocks (1978) and Fields and Ok (1996, 1999) measurement of income mobility don't solve the problem of measurement error in the household income. In order to control measurement error we used Glewwe's (2005) measure of income mobility, based on measurement error. Let  $y_1$  be the distribution of income in time period 1 and  $y_2$  be the distribution of income for same households in time period 2.

The simplest mobility measure can be defined as  $1 - \rho(y_1, y_2)$ , where  $\rho(y_1, y_2)$  is the correlation coefficient of  $y_1$  and  $y_2$ . This mobility measures based on the correlation coefficient range from 0 (no mobility) to 1 (full mobility). All measures suffer from a serious problem in that they exaggerate the extent of income mobility when the income variable is measured with error. According to Glewwe (2005), virtually, any measure would overestimate the true mobility because fluctuations in calculated income, that are purely due to measurement error, are mistakenly interpreted as actual income fluctuations.

There is a simple way to estimate  $\rho(y_1, y_2)$  that avoids measurement error bias. We use instrumental variables that are correlated with  $y_1$  and  $y_2$  but uncorrelated with

their error terms. In order to estimate the correlation coefficient  $\rho$  between  $y_1$  and  $y_2$  we, first, regress  $y_1$  on  $y_2$  and,  $y_2$  on  $y_1$  and then take square root of the products of the associated coefficients. If we estimate data on  $y_1$  and  $y_2$  without measurement error then the estimate of mobility  $\rho(y_1, y_2)$  would be the square root of the product of  $\beta_1$  and  $\beta_2$  followed by the following two regressions.

$$y_1 = \alpha_1 + \beta_1 y_2 + \varepsilon_1, \quad (2)$$

$$y_2 = \alpha_2 + \beta_2 y_1 + \varepsilon_2, \quad (3)$$

where  $y_1$  and  $y_2$  denote observed values and  $\varepsilon_1$  and  $\varepsilon_2$  are measurement errors.

Now, if there exist measurement error, we have to estimate (2) and (3) using instrumental variables. In this paper we have identified the following instruments of household income. These include dependency ratio, land ownership and land reform. Certainly, land reform is a dummy that captures the effect of implementation of land reforms in the village. The equations for  $y_1^*$  and  $y_2^*$  are:

$$y_1^* = \gamma_1 + \delta_1 z_2^* + v_1, \quad (4)$$

$$y_2^* = \gamma_2 + \delta_2 z_1^* + v_2, \quad (5)$$

where  $z_1^*$  and  $z_2^*$  denote instrumental variables and  $v_1$  and  $v_2$  are error terms.

#### 4. DATA

The primary source of data is the Additional Rural Incomes Survey/Rural Economic & Demographic Survey (ARIS/REDS) data collected by the National Council of Applied Economic Research (NCAER). These data have been collected for rural households of the major 17 states in India at six points in time, viz. 1968-69, 1969-70, 1970-71, 1981-82, 1998-99 and 2005-06. The objective of the original rounds in 1968-71 was to determine the performance of cultivators of high-yielding varieties relative to cultivators of traditional varieties of crops and the consequences for income inequality. Approximately two-thirds of the entire samples were selected from villages covered by the Intensive Agricultural Development Programme (IADP) or the Intensive Agricultural Area Programme (IAAP). In order to maintain the panel dimension, the same villages were tracked in subsequent survey rounds in 1981-82, 1998-99 and 2005-06.

Each round has three parts. The first part is the 'listing sheet', where information on household income and a few demographic variables is collected. The second part is the 'village questionnaire'. This is the source of information on village-level characteristics such as agricultural production and land use, irrigation facilities, agricultural wage rates, access to markets, social and political structure, land tenure systems and the level of development (including infrastructure, distance from markets etc). The third part is the



‘household questionnaire’ which is used for collecting data on a range of variables relating to household behavior.

The listing sheets are typically used to select the households to be surveyed. The income data in these listing sheets is based on total household income from all sources. This data represents a valuable resource in estimating the distribution of household incomes at the village level. In the initial round, we can identify the true income distribution for almost 50% of the villages in which all or at least 80% of resident households (as reported in the Census) have been listed. For some of the larger villages, only a random sample was listed. By 2001 the proportion of villages with over 80% of resident households listed has fallen to about 40%.

The nominal annual household income is converted to real income by deflating to 1971 prices. As the listing sheets are accompanied by a village survey we also have detailed information on village-level characteristics that are rare in cross-country analyses. We also combine the listing sheet and village survey data with the other secondary sources such as the National Census and the NCAER rainfall database in order to investigate the rainfall shocks.

The variables used to explain household income are available in the listing sheets. It also includes household demographic information such as schooling of the head of household, the number of households that have taken advantages of affirmative action, household size and household land for each of the 242 villages.

## 5. EMPIRICAL RESULTS

Here we have examined the income mobility of rural households using different estimations procedures. The mobility index of Shorrocks (1978) has explained in terms of income classes (classified into different quintiles), poor vs. non-poor, land holdings classes and affirmative action program over the periods. The transition matrices of panel households income between the year of 1971 & 1982, 1982 & 1999, 1999 & 2006 and 1971 & 2006 are presented in table 1. An identity matrix as the transition matrix refers perfect immobility and perfect mobility shows matrix with zeros on the diagonal which means everyone has equal probability of winding up in the various possible slots next period, regardless of starting positions. It confirms that the households of 1971-1982 have less income mobility than other periods. The mobility has increased in the year 2006 compared to 1971. It also shows that there is no significant change of income mobility in the periods of 1982 & 1999, 1999 & 2006 and 1971 & 2006 for households. However this measure of income mobility masks the degree of upward and downward mobility. In Table 2, using the same transition matrices we have derived the extent of income immobility and consequently the magnitudes of upward and downward income mobility. The results find that there is a significant degree of downward mobility over the time periods, i.e., decline the magnitude of income mobility. It supports the fact that even after a steady growth during the mentioned period inequality persists in India. A

negative correlation between income mobility and change in inequality has been observed as well. The result finds high persistence upward mobility at the richest 10 percent population but lower persistence at the poorest 10 percent. Higher income group lived with opportunities to secure their well-being.

**Table 1.** Transition Matrices, Based on Income of Households

| 1971 against 1982             |       |       |       |       |       |       |       |       |       |       |        |
|-------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
|                               | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | Total  |
| 1                             | 0.19  | 0.16  | 0.13  | 0.11  | 0.10  | 0.08  | 0.11  | 0.04  | 0.05  | 0.03  | 4,001  |
| 2                             | 0.16  | 0.14  | 0.15  | 0.12  | 0.09  | 0.09  | 0.12  | 0.05  | 0.05  | 0.03  | 3,655  |
| 3                             | 0.15  | 0.13  | 0.12  | 0.14  | 0.09  | 0.09  | 0.12  | 0.05  | 0.07  | 0.04  | 4,381  |
| 4                             | 0.15  | 0.10  | 0.09  | 0.12  | 0.09  | 0.10  | 0.16  | 0.06  | 0.07  | 0.06  | 3,473  |
| 5                             | 0.12  | 0.11  | 0.10  | 0.13  | 0.10  | 0.11  | 0.15  | 0.05  | 0.07  | 0.06  | 3,966  |
| 6                             | 0.12  | 0.09  | 0.06  | 0.11  | 0.09  | 0.12  | 0.17  | 0.06  | 0.09  | 0.07  | 3,714  |
| 7                             | 0.09  | 0.09  | 0.06  | 0.10  | 0.09  | 0.12  | 0.17  | 0.06  | 0.11  | 0.10  | 4,851  |
| 8                             | 0.10  | 0.08  | 0.05  | 0.10  | 0.08  | 0.11  | 0.17  | 0.06  | 0.13  | 0.12  | 3,029  |
| 9                             | 0.07  | 0.05  | 0.03  | 0.07  | 0.06  | 0.10  | 0.18  | 0.07  | 0.18  | 0.19  | 4,415  |
| 10                            | 0.03  | 0.03  | 0.02  | 0.05  | 0.04  | 0.07  | 0.15  | 0.07  | 0.22  | 0.32  | 3,810  |
| Total                         | 4,546 | 3,897 | 3,193 | 4,111 | 3,256 | 3,965 | 5,940 | 2,203 | 4,133 | 4,051 | 39,295 |
| Shorrocks Measure: M(P)=0.943 |       |       |       |       |       |       |       |       |       |       |        |
| 1982 against 1999             |       |       |       |       |       |       |       |       |       |       |        |
|                               | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | Total  |
| 1                             | 0.15  | 0.12  | 0.12  | 0.21  | 0.06  | 0.10  | 0.11  | 0.04  | 0.06  | 0.03  | 4,459  |
| 2                             | 0.11  | 0.12  | 0.11  | 0.21  | 0.07  | 0.10  | 0.12  | 0.06  | 0.06  | 0.04  | 4,173  |
| 3                             | 0.13  | 0.11  | 0.10  | 0.19  | 0.08  | 0.08  | 0.12  | 0.07  | 0.07  | 0.05  | 3,352  |
| 4                             | 0.09  | 0.10  | 0.10  | 0.19  | 0.07  | 0.08  | 0.14  | 0.09  | 0.09  | 0.06  | 4,228  |
| 5                             | 0.11  | 0.11  | 0.08  | 0.19  | 0.06  | 0.07  | 0.13  | 0.08  | 0.10  | 0.07  | 3,428  |
| 6                             | 0.07  | 0.12  | 0.09  | 0.17  | 0.06  | 0.07  | 0.12  | 0.09  | 0.12  | 0.09  | 4,123  |
| 7                             | 0.07  | 0.10  | 0.07  | 0.14  | 0.05  | 0.08  | 0.14  | 0.08  | 0.13  | 0.13  | 6,037  |
| 8                             | 0.07  | 0.09  | 0.06  | 0.12  | 0.04  | 0.08  | 0.14  | 0.11  | 0.15  | 0.15  | 2,319  |
| 9                             | 0.05  | 0.07  | 0.06  | 0.13  | 0.05  | 0.07  | 0.14  | 0.09  | 0.17  | 0.17  | 4,257  |
| 10                            | 0.04  | 0.04  | 0.05  | 0.10  | 0.04  | 0.07  | 0.14  | 0.10  | 0.17  | 0.25  | 4,376  |
| Total                         | 3,575 | 3,927 | 3,361 | 6,714 | 2,383 | 3,260 | 5,261 | 3,325 | 4,655 | 4,291 | 40,752 |
| Shorrocks Measure: M(P)=0.96  |       |       |       |       |       |       |       |       |       |       |        |

**Table 1.** Transition Matrices, Based on Income of Households (Cont')

| 1999 against 2006 |       |       |       |       |       |       |       |       |       |       |        |
|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
|                   | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | Total  |
| 1                 | 0.13  | 0.13  | 0.12  | 0.13  | 0.12  | 0.11  | 0.09  | 0.08  | 0.06  | 0.04  | 4,784  |
| 2                 | 0.13  | 0.13  | 0.12  | 0.13  | 0.10  | 0.10  | 0.08  | 0.07  | 0.07  | 0.05  | 4,296  |
| 3                 | 0.12  | 0.13  | 0.11  | 0.12  | 0.11  | 0.11  | 0.10  | 0.09  | 0.07  | 0.05  | 4,218  |
| 4                 | 0.11  | 0.11  | 0.10  | 0.12  | 0.10  | 0.11  | 0.10  | 0.10  | 0.09  | 0.06  | 7,632  |
| 5                 | 0.11  | 0.09  | 0.10  | 0.10  | 0.10  | 0.13  | 0.10  | 0.10  | 0.10  | 0.07  | 2,678  |
| 6                 | 0.08  | 0.08  | 0.09  | 0.10  | 0.10  | 0.12  | 0.11  | 0.12  | 0.10  | 0.09  | 3,520  |
| 7                 | 0.06  | 0.07  | 0.08  | 0.10  | 0.10  | 0.12  | 0.10  | 0.12  | 0.13  | 0.12  | 5,576  |
| 8                 | 0.05  | 0.05  | 0.07  | 0.10  | 0.09  | 0.11  | 0.11  | 0.14  | 0.14  | 0.14  | 4,076  |
| 9                 | 0.03  | 0.04  | 0.06  | 0.07  | 0.08  | 0.11  | 0.11  | 0.14  | 0.17  | 0.20  | 4,957  |
| 10                | 0.03  | 0.03  | 0.04  | 0.05  | 0.06  | 0.10  | 0.08  | 0.13  | 0.19  | 0.30  | 4,685  |
| Total             | 4,009 | 3,999 | 4,000 | 4,648 | 4,451 | 5,126 | 4,629 | 5,061 | 5,255 | 5,244 | 46,422 |

Shorrocks's Measure: M(P)=0.953

| 1971 against 2006 |       |       |       |       |       |       |       |       |       |       |        |
|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
|                   | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | Total  |
| 1                 | 0.12  | 0.13  | 0.11  | 0.12  | 0.11  | 0.11  | 0.09  | 0.08  | 0.08  | 0.05  | 1,752  |
| 2                 | 0.14  | 0.11  | 0.11  | 0.12  | 0.11  | 0.09  | 0.09  | 0.09  | 0.07  | 0.06  | 1,933  |
| 3                 | 0.14  | 0.13  | 0.10  | 0.11  | 0.11  | 0.10  | 0.09  | 0.09  | 0.08  | 0.06  | 2,471  |
| 4                 | 0.10  | 0.10  | 0.10  | 0.11  | 0.10  | 0.11  | 0.10  | 0.10  | 0.10  | 0.07  | 1,923  |
| 5                 | 0.10  | 0.13  | 0.15  | 0.12  | 0.09  | 0.09  | 0.09  | 0.08  | 0.10  | 0.07  | 2,717  |
| 6                 | 0.08  | 0.08  | 0.08  | 0.11  | 0.09  | 0.12  | 0.10  | 0.13  | 0.11  | 0.11  | 2,358  |
| 7                 | 0.07  | 0.08  | 0.07  | 0.09  | 0.09  | 0.11  | 0.12  | 0.12  | 0.11  | 0.13  | 2,789  |
| 8                 | 0.07  | 0.08  | 0.07  | 0.08  | 0.08  | 0.11  | 0.10  | 0.11  | 0.14  | 0.16  | 1,720  |
| 9                 | 0.05  | 0.05  | 0.06  | 0.08  | 0.07  | 0.09  | 0.11  | 0.13  | 0.17  | 0.20  | 2,688  |
| 10                | 0.03  | 0.03  | 0.03  | 0.05  | 0.06  | 0.07  | 0.08  | 0.13  | 0.19  | 0.33  | 2,402  |
| Total             | 2,000 | 2,042 | 1,996 | 2,218 | 2,031 | 2,282 | 2,202 | 2,428 | 2,656 | 2,898 | 22,753 |

Shorrocks's Measure: M(P)=0.96

**Table 2.** Summary Measures of Income Mobility

|                   | Income  |         |         |         |
|-------------------|---------|---------|---------|---------|
|                   | 1971-82 | 1982-99 | 1999-06 | 1971-06 |
| Immobility ratio  | 0.169   | 0.151   | 0.158   | 0.153   |
| Upward mobility   | 0.466   | 0.499   | 0.509   | 0.509   |
| Downward mobility | 0.473   | 0.462   | 0.449   | 0.454   |

Table 2 provides summary of income mobility over the three benchmark periods and overall mobility from 1971 to 2006. This result develops an aggregate income mobility measure based on estimated income transition matrices. It provides additively decomposable value into upward and downward mobility components which help us in understanding the nature of mobility. It enables that mobility among lower income groups is different from that among higher income groups. It clearly brings out that immobility and downward mobility have been reduced over time. However, the absolute volume of downward mobility remains high.

The transition matrices for poor vs. non-poor<sup>1</sup> have shown in Table 3. In the periods 1982-1999, 1999-2006 and 1971-2006, the sum of probabilities of households remaining poor and becoming poor (the first column) is less than the sum of the probabilities of households becoming non-poor and remaining non-poor (the second column). The results suggest that the number of households below the poverty line has declined over the periods. The measurement of mobility finds that the mobility for poor vs. non-poor has increased over the periods from 1971 to 2006.

**Table 3.** Transition Matrices, Poor vs. Non-Poor

| 1971 against 1982              |        |          |        |
|--------------------------------|--------|----------|--------|
|                                | Poor   | Non poor | Total  |
| Poor                           | 0.76   | 0.24     | 34,580 |
| Non poor                       | 0.46   | 0.54     | 4,715  |
| Total                          | 28,542 | 10,753   | 39,295 |
| Shorrocks's Measure: M(P)=0.70 |        |          |        |
| 1982 against 1999              |        |          |        |
|                                | Poor   | Non poor | Total  |
| Poor                           | 0.58   | 0.42     | 30,293 |
| Non poor                       | 0.37   | 0.63     | 10,459 |
| Total                          | 21,637 | 19,115   | 40,752 |
| Shorrocks's Measure: M(P)=0.79 |        |          |        |
| 1999 against 2006              |        |          |        |
|                                | Poor   | Non poor | Total  |
| Poor                           | 0.32   | 0.68     | 24,900 |
| Non poor                       | 0.18   | 0.82     | 21,522 |
| Total                          | 11,844 | 34,578   | 46,422 |
| Shorrocks's Measure: M(P)=0.85 |        |          |        |
| 1971 against 2006              |        |          |        |
|                                | Poor   | Non poor | Total  |
| Poor                           | 0.30   | 0.70     | 20,048 |
| Non poor                       | 0.14   | 0.86     | 2,705  |
| Total                          | 6,308  | 16,445   | 22,753 |
| Shorrocks's Measure: M(P)=0.85 |        |          |        |

<sup>1</sup> The poor vs. non-poor have defined on the basis of state level poverty line in the corresponding periods.

The importance of economic mobility is further enhanced in the rural economy context because of stratified nature of Indian rural structure based on respective land holdings. In the Table 4, the transition matrices for land holdings classes have explained. The maximum landless farmers are immobile over the periods, which can be seen in Table 5. It has been observed that the income mobility for landless households was very low throughout the study periods. During 1999 to 2006, a steep downward mobility has been recorded for this category. However, it has slightly improved during the last observed period. Further, the marginal and small land holders have also experienced quite similar kind of income mobility during the said periods. Transition was positive for large land holders. It claims that the resource allocation and opportunity distribution have not followed the equity rule.

Also, the results show that the probability of becoming marginal farmers is more in 2006 and the probability of becoming large farmers is less over the periods. The mobility measure finds a significant downward mobility over the periods. The mobility in the period 1999-2006 is very lower than other periods.

**Table 4.** Transition Matrices with Land Holdings Categories

| 1982 against 1999              |          |          |       |        |       |        |
|--------------------------------|----------|----------|-------|--------|-------|--------|
|                                | Landless | Marginal | Small | Medium | Large | Total  |
| Landless                       | 0.73     | 0.19     | 0.04  | 0.03   | 0.01  | 10,434 |
| Marginal                       | 0.40     | 0.49     | 0.07  | 0.03   | 0.01  | 5,852  |
| Small                          | 0.32     | 0.46     | 0.13  | 0.07   | 0.02  | 4,194  |
| Medium                         | 0.27     | 0.43     | 0.14  | 0.12   | 0.04  | 5,458  |
| Large                          | 0.23     | 0.41     | 0.10  | 0.15   | 0.11  | 3,091  |
| Total                          | 13,477   | 10,410   | 2,478 | 1,870  | 794   | 29,029 |
| Shorrocks's Measure: M(P)=0.85 |          |          |       |        |       |        |
| 1999 against 2006              |          |          |       |        |       |        |
|                                | Landless | Marginal | Small | Medium | Large | Total  |
| Landless                       | 0.85     | 0.12     | 0.02  | 0.01   | 0.00  | 23,203 |
| Marginal                       | 0.01     | 0.96     | 0.02  | 0.01   | 0.00  | 15,914 |
| Small                          | 0.01     | 0.10     | 0.87  | 0.03   | 0.00  | 3,669  |
| Medium                         | 0.01     | 0.05     | 0.06  | 0.88   | 0.01  | 2,624  |
| Large                          | 0.00     | 0.04     | 0.10  | 0.15   | 0.70  | 1,012  |
| Total                          | 19,833   | 18,689   | 4,202 | 2,876  | 822   | 46,422 |
| Shorrocks's Measure: M(P)=0.18 |          |          |       |        |       |        |
| 1982 against 2006              |          |          |       |        |       |        |
|                                | Landless | Marginal | Small | Medium | Large | Total  |
| Landless                       | 0.69     | 0.23     | 0.05  | 0.03   | 0.01  | 10,532 |
| Marginal                       | 0.30     | 0.59     | 0.07  | 0.03   | 0.01  | 5,902  |
| Small                          | 0.23     | 0.54     | 0.15  | 0.08   | 0.01  | 4,235  |
| Medium                         | 0.17     | 0.50     | 0.16  | 0.13   | 0.04  | 5,519  |
| Large                          | 0.11     | 0.48     | 0.13  | 0.18   | 0.10  | 3,109  |
| Total                          | 11,309   | 12,390   | 2,873 | 2,093  | 632   | 29,297 |
| Shorrocks's Measure: M(P)=0.83 |          |          |       |        |       |        |

**Table 5.** Summary Measures of Income Mobility with Land Holdings Categories

|                   | Land holdings |         |         |
|-------------------|---------------|---------|---------|
|                   | 1982-99       | 1999-06 | 1982-06 |
| Immobility ratio  | 0.395         | 0.980   | 0.415   |
| Upward mobility   | 0.128         | 0.055   | 0.140   |
| Downward mobility | 0.728         | 0.133   | 0.693   |

Another important perspective of mode of income mobility is change in livelihood through participation in welfare based programme organized by Government for inclusive growth. We have to estimate the degree of income mobility over time due to the positive impact of welfare programme or through policy level intervention. As Government organizes welfare schemes for poor vulnerable section of population and socially and educationally well off do not get any affirmative benefits income mobility should be improved for poor ad vulnerable income group. This measure can capture the effectiveness of existing developmental policies. Tables 6.1, 6.2 and 6.3 explain the transition matrices for the rural households in India who have taken advantages of affirmative action of Government through seeking employment, admission and both i.e. who have taken the benefit of both the employment and admission over the periods. The results of mobility measurement show that there is a significant immobility ratio over the periods and the upward mobility has been increased more than downward mobility. Mobility arises with more and more participation in employment based programme and move away from their initial low level of income. In this approach, mobility is best characterized as an absolute concept.

**Table 6.1.** Transition Matrices of Households that have taken Advantages of Affirmative Action Program for seeking Employment

| Seeking Employment (1999) | Seeking Employment (2006) |          |         |
|---------------------------|---------------------------|----------|---------|
|                           | Yes                       | No       | Total   |
| Yes                       | 0.327152                  | 0.672848 | 9,222   |
| No                        | 0.029265                  | 0.970735 | 150,420 |
| Total                     | 7,419                     | 152,223  | 159,642 |

Shorrocks's Measure:  $M(P) = 0.702112$

**Table 6.2.** Transition Matrices of Households that have taken Advantages of Affirmative Action Program for seeking Admission

| Seeking Admission (1999) | Seeking Admission (2006) |          |         |
|--------------------------|--------------------------|----------|---------|
|                          | Yes                      | No       | Total   |
| Yes                      | 0.402871                 | 0.597129 | 9,405   |
| No                       | 0.018804                 | 0.981196 | 150,237 |
| Total                    | 6,614                    | 153,028  | 159,642 |

Shorrocks's Measure:  $M(P) = 0.615933$

**Table 6.3.** Transition Matrices of Households that have taken Advantages of Affirmative Action Program for seeking Employment and Admission

| Both Seeking Employment and Admission (1999) | Both Seeking Employment and Admission (2006) |          |         |
|--|--|----------|---------|
|  | Yes  | No       | Total   |
| Yes  | 0.398498                                     | 0.601502 | 3,596   |
| No   | 0.008087                                     | 0.991913 | 156,046 |
| Total  | 2,695  | 156,947  | 159,642 |

Shorrocks's Measure:  $M(P) = 0.609589$

Table 7 indicates the household's relative income mobility (using Fields and Ok, 1999) which is also known as measurement of welfare of the households over the periods. It measures the income mobility in the long term (i.e., 1971-2006) and the short term (i.e., 1972-82, 1982-1999 and 1999-2006). From the results, we find that the long term income mobility is more than short term income mobility i.e. the welfare of the households has increased in the long run for almost all the states. During the period 1971-82, negative mobility has been recorded for Bihar, Gujarat, Haryana, Uttar Pradesh and Orissa. However, next two decades these states performed effectively and secured upward mobility. Rajasthan has secured highest long run mobility during 1971 to 2006.

**Table 7.** Measure of State wise Income Mobility Rate

|                  | 1971-82 | 1982-99 | 1999-2006 | 1971-2006 |
|------------------|---------|---------|-----------|-----------|
| Andhra Pradesh   | 0.0154  | -0.0057 | 0.0218    | 0.0223    |
| Bihar            | -0.0032 | 0.013   | 0.0046    | 0.0106    |
| Chhattisgarh     | -       | -       | 0.0301    | -         |
| Gujarat          | -0.0269 | 0.0371  | 0.0353    | 0.0481    |
| Haryana          | -0.007  | 0.0054  | 0.0444    | 0.0726    |
| Himachal Pradesh | 0.0049  | 0.0007  | 0.0031    | 0.0133    |
| Jharkhand        | -0.0034 | 0.0154  | 0.0063    | 0.023     |
| Karnataka        | -0.0287 | 0.0155  | 0.0133    | 0.0035    |
| Kerala           | 0.0152  | 0.0292  | -0.0142   | 0.0213    |
| Madhya Pradesh   | -       | -       | 0.0285    | -         |
| Maharashtra      | -       | -0.0131 | 0.0372    | -         |
| Orissa           | -0.0093 | 0.018   | 0.0146    | 0.0399    |
| Punjab           | -0.0038 | 0.0243  | 0.0138    | 0.0481    |
| Rajasthan        | 0.0165  | 0.1116  | -0.0284   | 0.1215    |
| Tamil Nadu       | 0.0242  | 0.0271  | 0.0195    | 0.0415    |
| Uttar Pradesh    | -0.0236 | 0.0588  | 0.0706    | 0.0971    |
| West Bengal      | 0.0176  | 0.009   | -0.0021   | 0.0347    |

This paper analyses income mobility of Glewwe (2005) using correlation coefficients ignoring measurement error. The income mobility is 0.725, 0.753 and 0.738 over the selected periods in the Table 8.1. Both the correlation based mobility measure and the Shorrocks's mobility index have shown the high income mobility of households

over the periods. It almost certainly overestimated the income mobility because it ignores measurement error. Before analyzing the measurement error, it is needed to demonstrate the regression approach is in fact an alternative way to estimate the correlation coefficient. In the Table 8.2, the regression based mobility has presented. The regression based mobility with ignoring measurement error overestimates the income mobility.

**Table 8.1.** Estimated Mobility in Household Income, Ignoring Measurement Error

| Sample periods    | Glewwe's Mobility Index:<br>[1 - P(ln(x), ln(y))] | Shorrocks's mobility index |
|-------------------|---|----------------------------|
| 1982 against 1999 | 0.725   | 0.96                       |
| 1982 against 2006 | 0.753   | -                          |
| 1999 against 2006 | 0.738   | 0.953                      |

**Table 8.2.** Regression based Estimates of Mobility, Ignoring Measurement Error

| Sample Periods    | $\beta_1$            | $\beta_2$             | $\sqrt{\beta_1\beta_2}$ | $m(x, y)$ |
|-------------------|----------------------|-----------------------|-------------------------|-----------|
| 1982 against 1999 | 0.15169<br>(0.00326) | 0.279301<br>(0.0060)  | 0.205833                | 0.794167  |
| 1982 against 2006 | 0.189772<br>(0.0037) | 0.328096<br>(0.00635) | 0.249527                | 0.750473  |
| 1999 against 2006 | 0.295244<br>(0.0047) | 0.246877<br>(0.0039)  | 0.269979                | 0.730021  |

Following Glewwe (2005) we have estimated the income mobility by correcting for measurement error using instrumental variable method. We selected suitable instrumental variables to estimate the income mobility with correcting the measurement errors in the regression model. We have taken the instruments not related with public policy (dependency ratio<sup>2</sup> land ownership) and policy instruments (land reforms, affirmative action and rainfall shocks)<sup>3</sup>, which may reduce the possibility that random errors in the income of the households over the periods. The combination of policy and non-policy instrumental variables have used for regressing income of the households. The instrumental variables are likely to be measured with random errors as well, but as long as those errors are unrelated to the errors in the income variables. The results are reported in Tables 9.1, 9.2, 9.3, 9.4 and 9.5. Overall, the results show that there is only one to two percent income mobility of households in 2006. These findings suggest that the earlier measured mobility is spurious, which overestimates the true mobility of households over the periods.

<sup>2</sup> The dependency ratio (DR) calculated for each family as: DR=(Family Size/Number of earners).

<sup>3</sup> The land reforms dummy has defined as 1 for who are benefited and 0 for who are not benefited. The dummy for affirmative action has defined as 1 for who have taken advantages and 0 for who have not taken advantages. The dummy for positive/negative rainfall shocks is 1 and 0 simultaneously.



**Table 9.1.** Regression based Income Mobility, using Instrumental Variable as Dependency Ratio

| Sample Periods    | $\beta_1$             | $\beta_2$             | $\sqrt{\beta_1\beta_2}$ | $m(x, y)$ |
|-------------------|-----------------------|-----------------------|-------------------------|-----------|
| 1982 against 1999 | 0.957878<br>(0.00099) | 1.014944<br>(0.00119) | 0.98599834              | 0.014002  |
| 1982 against 2006 | 0.898503<br>(0.00065) | 1.074334<br>(0.00116) | 0.98249308              | 0.017507  |
| 1999 against 2006 | 0.918403<br>(0.00072) | 1.064492<br>(0.00109) | 0.98875297              | 0.011247  |

**Table 9.2.** Regression based Income Mobility, using Instrumental Variable as Land Ownership

| Sample Periods    | $\beta_1$             | $\beta_2$             | $\sqrt{\beta_1\beta_2}$ | $m(x, y)$ |
|-------------------|-----------------------|-----------------------|-------------------------|-----------|
| 1982 against 1999 | 0.952979<br>(0.00234) | 1.006482<br>(0.00093) | 0.979365                | 0.020635  |
| 1982 against 2006 | 0.856006<br>(0.00382) | 1.062619<br>(0.00089) | 0.953734                | 0.046266  |
| 1999 against 2006 | 0.89318<br>(0.00462)  | 1.095701<br>(0.00659) | 0.989271                | 0.010729  |

**Table 9.3.** Regression based Estimates of Mobility, using Instrumental Variable as Land Reforms

| Sample Periods    | $\beta_1$              | $\beta_2$             | $\sqrt{\beta_1\beta_2}$ | $m(x, y)$ |
|-------------------|------------------------|-----------------------|-------------------------|-----------|
| 1982 against 1999 | 0.875362<br>(0.004059) | 1.092385<br>(0.00529) | 0.9778712               | 0.022129  |
| 1982 against 2006 | 0.896549<br>(0.00278)  | 1.05388<br>(0.00346)  | 0.9720365               | 0.027964  |
| 1999 against 2006 | 0.96874<br>(0.00269)   | 1.011389<br>(0.00275) | 0.9898345               | 0.010165  |

**Table 9.4.** Regression based Estimates of Mobility, using Instrumental Variable as Affirmative Actions

| Sample Periods    | $\beta_1$             | $\beta_2$             | $\sqrt{\beta_1\beta_2}$ | $m(x, y)$ |
|-------------------|-----------------------|-----------------------|-------------------------|-----------|
| 1999 against 2006 | 0.963497<br>(0.00199) | 1.019123<br>(0.00219) | 0.99092                 | 0.00908   |

**Table 9.5.** Regression based Estimates of Mobility, using Instrumental Variable as Rainfall Shocks

| Sample Periods    | $\beta_1$             | $\beta_2$             | $\sqrt{\beta_1\beta_2}$ | $m(x, y)$ |
|-------------------|-----------------------|-----------------------|-------------------------|-----------|
| 1982 against 1999 | 0.976854<br>(0.00116) | 1.016581<br>(0.0009)  | 0.99652                 | 0.00348   |
| 1982 against 2006 | 0.91437<br>(0.00096)  | 1.073725<br>(0.00082) | 0.990849                | 0.009151  |
| 1999 against 2006 | 0.915978<br>(0.0012)  | 1.080797<br>(0.00125) | 0.99498                 | 0.00502   |

Notes: 1. All results set  $F(x) = \ln(x)$ , so the mobility index is  $1 - \rho(\ln(x), \ln(y))$ .

2. Numbers in parentheses are standard errors.

Results displayed in Tables 9.1 to 9.5 provide the decomposed effectiveness of policy related instruments and general household characteristics instruments on income mobility for 3 different periods. There exists high persistence positive income mobility after having benefit of self-targeting welfare programmes and land holdings for all the benchmark periods. However, land reform influences income mobility for the period 1999 to 2006. Also, mobility in the lower income distribution could be due to shocks caused by weather and other factors. Therefore, income transition might not always be seen in a positive direction.

## 6. CONCLUSION

Our analysis has provided a set of interesting findings. From the above discussion, it is quite clear that the income mobility based on Glewwe's measure is much lower than correlation based income mobility and Shorrocks' mobility measure. The mobility measure based on welfare of the society claimed that the percentage of welfare of the households have been increased very less over the periods. Estimated transition matrix claims that the number of households below the poverty line has declined over the periods. The measurement of mobility finds that the mobility for poor vs. non-poor has increased over the periods. Increasing asymmetry in income, employment share and participation in welfare programs or distribution of public good is likely to pose a serious problem for growth as well as livelihoods.

Overall results also explain that the land reforms and advantages from affirmative action have not made any significant impact on the income mobility of the rural households over the periods. We should stress the process of financial inclusion and give more importance to implementation process of poverty eradication program and monitor the delivery mechanism so that it can effectively generate upward income mobility through effective participation in implemented program by targeted vulnerable population of the society. Since the outcomes from different indices are wide and broaden the horizons in different direction and vary across states we need to take up a proper disaggregated estimation of income mobility, evaluation of state wise disparity to examine the sustainability of the program before implementing any unique policy level decision regarding poverty eradication through welfare enhancing programs.

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