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Abstract

While a wide range of factors influence rural-rural and rural-urban migration in developing countries, there is significant interest in analyzing the role of agricultural distress and growing inter-regional differences in fuelling such movement. This strand of research acquires importance in the context of climate change adaptation. In the Indian context this analysis gets further complicated due to significant presence of temporary migration. Acknowledging that both temporary and permanent migration in India could be influenced among other things by the weather and its variability, this paper analyses the same using National Sample Survey data for the year 2007-08. The results based on rural Indian migration data suggest that weather has significant role in explaining temporary migration and relatively lesser influence on permanent migration. The study further highlights that both temperature and rainfall are important determinants of temporary migration while the permanent migration is broadly influenced by temperature alone.

Keywords: *Internal Migration; Temporary and Permanent Migration; Developing Countries; Weather Variability*

JEL Codes: *O15; Q54; R11*

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INTRODUCTION

Rural-urban migration in India presents a set of complex and challenging issues for analysis. There are at least three distinct strands of literature that seem relevant in this context: (a) studies on urbanization and the factors facilitating and hindering rural-urban migration; (b) studies on distress migration; and (c) role of climate variability and climate change in accelerating rural-urban migration.

When compared to other parts of the world, the rate of urbanization in India (and South Asia) is relatively slow despite rapid economic growth, with the urbanization rate doubling in almost sixty years (Gupta and Rayadurgam, 2009). Further, about 60 per cent of the urban population growth in South Asia is attributed to the natural growth and the remaining to the rural-urban migration. Ozden and Swadeh (2010) also observe that despite large potential gains, the migration in South Asia is paradoxically low. Through an analysis based on India they argue that socio-cultural and policy induced barriers could be responsible for low rural-urban migration rates. While multiple languages could form part of socio-cultural barriers, the policy induced barriers could include state-specific welfare programs which are not accessible once a household migrates to a different state. Another reason for slow urbanization in India could be slow growth of agricultural productivity leading to inadequate release of agricultural laborers from rural areas. Also, it is often argued that India's industrialization has not been able to absorb unskilled and semi-skilled labor force resulting in too many laborers in the rural areas.

On the other hand, it is also observed that the official statistics focusing on permanent migration often show higher migration rates among better off groups compared to the low income households (Deshingkar and Akter, 2009). Decile-wise incidence of temporary migrants sourced from 64th Round (for the year 2007-08) of National

Sample Survey (NSS) data clearly show that mostly rural men move temporarily for employment. In other words, in the absence of permanent employment options in the destination areas, the low-skilled laborers seem to indulge in circular and seasonal movements. While detailed migration data from the latest census for 2011 in India is not yet available, Sainath (2011) argues that there has been a substantially high migration rate from the rural areas compared to the earlier inter-Census period attributed to distress conditions in agriculture. The temporary as well as the distress driven migration reflects the vulnerable conditions of the food insecure people moving in search of livelihoods.

In developing countries – which are largely dependent on climate sensitive economic activities such as agriculture – climate extremes and changing climatic conditions may accelerate growing levels of rural-to-urban migration (McLeman and Hunter, 2010). Further, climate related migration largely takes place at intra-national and/or intra-regional scales, and it is likely to continue under the climate change conditions (Massey et al., 2010). While people at the upper end of the socioeconomic spectrum may be tied-up with their household/business capital which would also help them resist climate change induced hardships and avoid migration, the people at the lower end of the spectrum (such as landless labourers) may easily be displaced by climate hardships. Though the mechanisms through which climate change would induce migration are not carefully studied, the likely adverse impacts of climate change on agricultural crops may necessitate rural-to-urban and rural-to-rural migration. Cyclical migration for temporary time duration in response to droughts may continue or even grow due to climate change (Deshingkar and Start, 2003). International migration in the context of climate change has largely been studied with reference to sea level rise and inundation of coastal regions. Unlike other causes that force people to migrate, sea-level rise poses a permanent problem, with little or no scope for migrants to return home. Byravan and Chella Rajan (2009) argued that existing institutional arrangements may not be sufficiently

equipped to handle within and across country migration resulting from sea-level rise. Black et al. (2011) and Perch-Nielsen et al. (2008) provide a synthesis of existing literature linking environmental change on human migration. Proposing a new conceptual framework for the drivers of migration, Black et al. (2011) categorize the drivers under the heads of economic, political, demographic, social and environmental. Hassani-Mahmooei and Parris (2012) use agent-based modelling framework to analyse the effects of climate change on internal migration in Bangladesh and predict that depending on the severity of various climate extremes there could be between 3 to 10 million internal migrants over next 40 years. Recently the linkages between weather variability and migration are also analysed through agriculture channel by several studies (Feng et al., 2010, 2012; Barbieri et al., 2010; Dillon et al., 2011; Marchiori et al., 2012; and Viswanathan and Kumar, 2013). These studies point towards existence of such channel through rigorous econometric analysis.

Against this backdrop, acknowledging the specific features of migration in India (including significant presence of temporary migration) and using National Sample Survey (NSS) data the present study attempts to, (a) analyse the broad patterns of temporary and permanent migration in India; and (b) explore the determinants of temporary and permanent migration with special focus on weather and its variability. The analyses presented focuses on rural sector.

The rest of the paper is organized as follows: The next section provides broad trends of internal migration in India based on the nationally representative sample survey conducted for the period July 2007 to June 2008 by the National Sample Survey Organisation (64th Round of NSS). The subsequent sections describe the data, the modelling framework adopted for identifying the determinants of temporary and permanent migration, and results from different variants of probit model. In particular the analysis explores the role of weather variability in

influencing temporary and permanent migration in rural India. The last section provides concluding observations.

BROAD TRENDS OF INTERNAL MIGRATION IN INDIA

Data on internal migration in India is available through two different sources: Census and National Sample Survey[1]. Bhagat (2008) provides a comprehensive overview on these two data sources highlighting their differences and measurement problems. Bhagat (2008) argues that the Census definition of migration based on both place of birth and place of last residence makes it difficult to distinguish between permanent, semi-permanent and temporary migrants. The NSS definition of migrant is clearer (compared to Census definition) and the sampling weights are used to arrive at macro-level estimates on migration. Main features of migration in India include: (a) significant increase in the absolute number of internal migrants especially in the post-liberalization period (i.e., after 1991); (b) non-monotonic increase in inter-Censal growth rates; (c) marriage remains the dominant reason reported for female migration; and (d) the official statistics show steady decline in incidence (migrants per 100 people) of rural to urban migration partly due to its inability to capture the temporary migration. The rest of this section discusses the broad trends of internal migration in India estimated using the unit record data of the NSS data of 64th round (2007-08). However, it is important to note that temporary migration as per this NSS round pertains to migration for employment. Hence for comparability reasons, permanent migration either due to transfer of jobs or due to marriage has been excluded in the analysis. Thus, reasons for permanent migration would include in addition to employment, migration for 'studies', 'with the family', due to 'natural disasters, conflicts and health related issues' and a residual 'others'.

[1] Since both these sources record information on migration based on place of enumeration, they do not capture the emigration patterns. Further, since emigrants from India are less than one percent of the total migrants, most studies focus on trends in internal migration.

Migration Across Rural and Urban Sectors

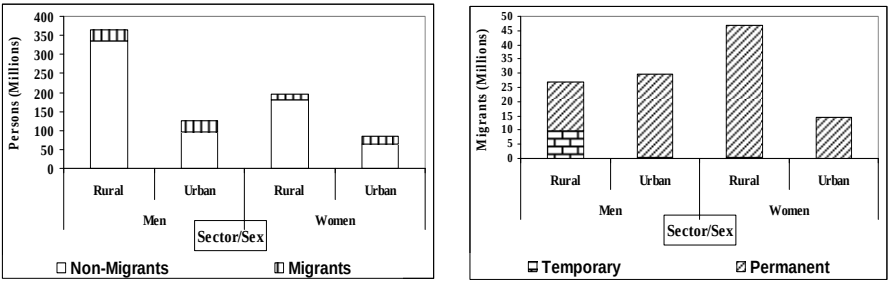
Figure 1 provides an overview of the distribution of different types of migrants across rural and urban sectors and among male and female population groups. Figure 1a shows that there are about 92.4 million internal migrants constituting about 12 per cent of the total population in 2007-08[2]. About 54.5 per cent of the migrants are urban, 61.4 per cent are men and 88.2 per cent are permanent. The migrants constitute about 7.5 per cent of the rural population and about 24.1 per cent of the urban population. Women constitute about 36 per cent of the rural migrants and 41 per cent of the urban migrants.

Figure 1b shows the distribution of temporary and permanent migrants for men and women and within rural and urban areas. It is observed that temporary migrants are about 10.8 million in number which is about 9.2 per cent of the total migrants. The temporary migrants account for 13.9 per cent of rural migrants and 1.3 per cent of the urban migrants. Rural men (about 89 per cent) dominate over other streams of temporary migrants. The share of women among temporary migrants in urban areas is about 8.3 per cent and is higher than their share in rural areas (5.5 per cent). Figure 1b also indicates that 36 per cent of rural male migrants are temporary, while 1.8 per cent of urban male migrants are temporary. In contrast, among rural women migrants 4 per cent and among urban women migrants less than1 per cent resort to temporary migration.

[2] The numbers are population estimates based on the sampling inflation factors available in the NSS data.

Figure 1: Distribution of Migrants and Migrant Types: Rural and Urban for Men and Women: All India, 2007-08

(a) Non-Migrants and Migrants **(b) Migrant Types**



Source: NSS unit record data.

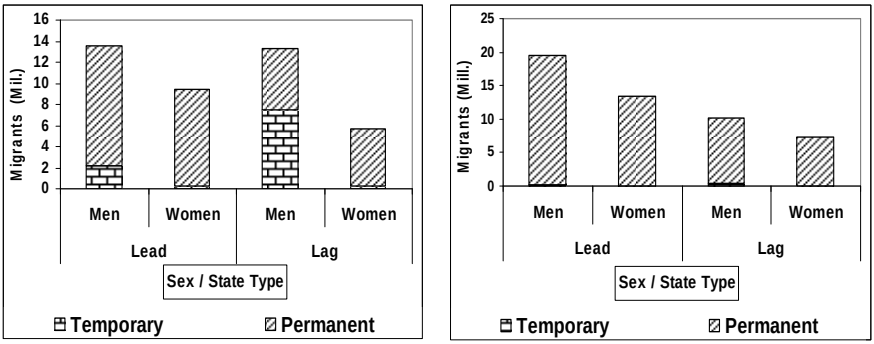
Notes: (i) Temporary refers to migrants who move out for a period within 6 months and come back; (ii) Permanent migrants include all durations of stay; (iii) Migrants who give marriage or transfer from jobs etc. as reason for migration are excluded.

Migration Across 'Lead' and 'Lag' States

Following Ozden and Swadeh (2010) it could be instructive to assess temporary and permanent migration from the 'lead' and 'lag' states across rural and urban sectors. The 'lead' ('lag') states are defined as those with lower (higher) population share in the bottom quintile of monthly per-capita expenditure distribution compared to their share in the all-India population. From figure 2 it can be seen that, lead (lag) states accounts for a smaller (larger) share, i.e., 26 per cent (74 per cent) of temporary migrants when compared to their share among permanent migrants, i.e., 65 per cent. The male-female composition of migrants shows that women constitute about 41 per cent in the lead states and 35 per cent in the lag states. Two main inferences can be made from Figure 2: (a) Lead regions which are wealthier would attract more permanent migrants compared to temporary migrants; (b) Men predominate among temporary migrants in the lag (poorer) regions.

Figure 2: Migrant Types in Lead and Lag States
Men and Women in Rural and Urban Areas: All India, 2007-08

(a) Rural **(b) Urban**



Source: NSS unit record data.

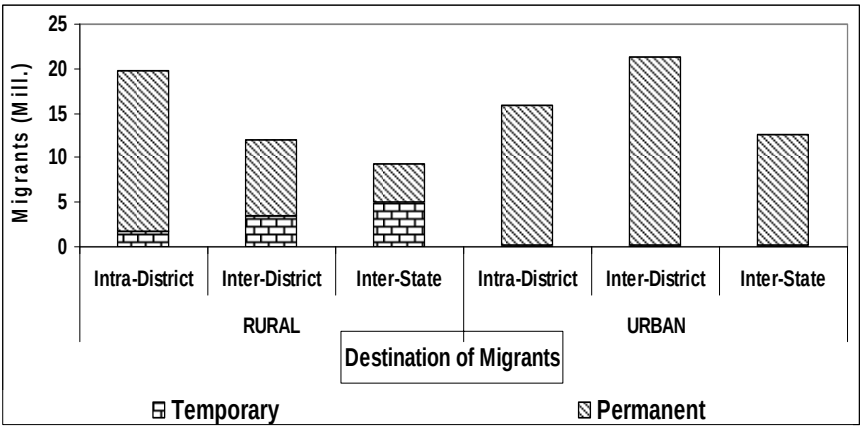
Notes: (i) See figure 1 for definition of migrant types; (ii) Lead and lag states have been classified on the basis of the proportion of people they have in the bottom quintile of the all India MPCE distribution with the lag states having a higher share within the bottom quintile compared to their share in the overall population of the country.

Migration Across Regions

In India, at the sub-national level states constitute one level of administrative jurisdiction formed largely on the basis of linguistic groups while states are further disaggregated into administrative units called districts. In many large states districts vary in terms of their agro-climatic conditions, level of urbanisation and level of development so that inter-district movement of people can be expected. The districts themselves are most often large sometimes in terms of the geographical area or in terms of the population size and as a result are further classified for administrative convenience into *tehsils* and blocks formed by clusters of villages or urban agglomerations. Once again intra-district variation in terms of infrastructure facilities and the social composition of the population (in terms of caste or sub-caste groups) impacts the level of regional development. Hence within district movement that is, moving from one *tehsil* or village to another is also commonly observed. As seen in Figure 3 intra-district movement constitutes the major chunk in rural areas and is also substantial in urban areas. Irrespective of the sector,

the intra-state movement dominates over inter-state movements but is interesting to note that temporary migrants are largely inter-state migrants. Further, temporary migrants are mainly from rural areas. The share of temporary migrants in rural areas varies based on their destinations: 54 per cent are inter-state migrants, 29 per cent are inter-district migrants, and 9 per cent are intra-district migrants.

Figure 3: Migrant Types for Different Levels of Administrative Boundaries Rural and Urban Areas: All India 2007-08



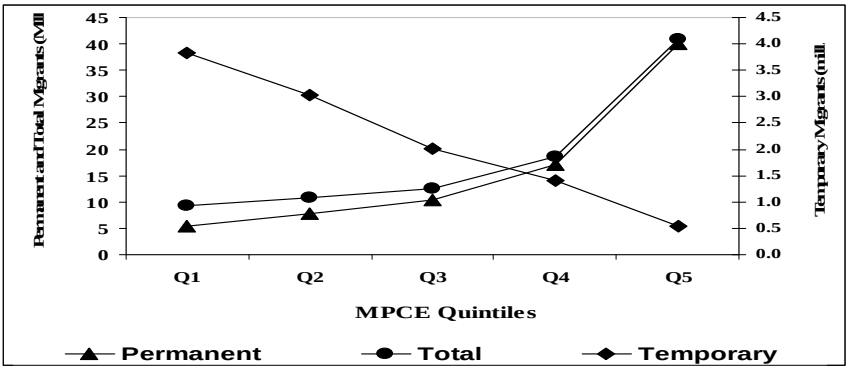
Source: NSS unit record data.

Notes: (i) See figure 1 for definition of migrant types and the text for classification of districts and states in India.

Migration Across MPCE Quintiles

To supplement the migration patterns observed above it will be useful to study the pattern of the temporary and permanent migrants for different economic strata. Figure 4 shows such trend across monthly per-capita expenditure (MPCE) quintiles. It can be seen from the figure that the permanent migrants are among the richer segments, while the temporary migrants are mainly among the poorer segments of the society.

Figure 4: Number of Migrants (millions) across MPCE Quintiles Temporary, Permanent and Total Migrants: All India, 2007-08



Source: NSS unit record data.

Notes: (i) Q1-Q5 are the five Monthly per Capita Expenditure (MPCE) quintiles with Q1 as bottom 20 per cent and Q5 as top 20 per cent of the population in the MPCE distribution. (ii) The left y-axis represents permanent and total migrants and the right y-axis represents temporary migrants.

Distribution of Migrants across Economic Activities

A final pattern worth examining will be the distribution of migrants across economic activities. In the NSS data the migrants are asked about the type of economic activity they engaged in prior to and post migration. One would of course expect that agriculture would dominate as the primary activity before migration and table 1 corroborates this expectation. The patterns presented in table 1 show that the movement out of agriculture sector (10.8 millions) is mainly noticed among temporary migrants who predominantly move to work in the industrial sector. Among permanent migrants moving out of agriculture sector, though the largest proportion of migrants is to the same sector the other two sectors also have substantial shares. The service sector (6.2 millions) acts as the main pull sector for the permanent migrants. Further the table also shows that a substantial number of people who were not economically active before migration have availed livelihood opportunities in the service sector after migration. Mostly women who migrate with families belong to this category.

Table 1: Distribution of Non-Migrants, Temporary and Permanent Migrants Across Sectors of Economic Activities

(in Millions)

Before Migration	After Migration				
	Agriculture	**Industry**	**Services**	**Not Working**	**Total**
Non-Migrants					
Agriculture	140	-	-	-	140
Industry	-	47	-	-	47
Services	-	-	63	-	63
Not Working	-	-	-	427	427
Total	140	47	63	427	677
Temporary					
Agriculture	1.8	2.9	0.7	-	5.4
Industry	0.1	2.9	0.1	-	3.0
Services	0.0	0.2	0.9	-	1.1
Not Working	0.1	0.2	0.1	-	0.4
Total	2.1	6.1	1.8		10.0
Permanent					
Agriculture	3.8	2.8	2.6	1.6	10.8
Industry	0.5	4.0	0.8	0.6	5.9
Services	0.5	0.6	6.2	1.2	8.4
Not Working	2.1	5.0	7.5	40.8	55.4
Total	6.9	12.4	17.1	44.2	80.5

Source: NSS unit record data.

Note: (i) The category 'Not Working' refers to all those who are not in the labour market like students, elderly and very young children and home-makers. (ii) For non-migrants the off-diagonal elements are obviously empty sets. Since all temporary migrants by definition as per the data source migrate for employment hence the 'Not Working' column after migration is empty.

DATA AND METHODOLOGY

The influence of weather variability on migration can be analysed in a number of ways. The focus is on assessing influence of weather variability on migration in rural areas presumably operating through the agriculture channel. While both the Census and the NSS data provide scope for undertaking such analysis there are relative merits and

demerits. Since the Census data does not provide satisfactory evidence on temporary migration and since weather variability induced distress migration from agriculture could largely manifest in the temporary migration, this study focuses on migration data sourced from the NSS. The analysis presented assesses if weather acts as an important determinant of (both temporary and permanent) migration. The analysis is based on a discrete choice model for the likelihood of migration - separately for temporary and permanent, and for different administrative/geographic classifications - in rural India using the NSS unit record data.

Data

For the analysis two main sources of data are used: (i) migrant status of individuals and their socio-economic characteristics from NSS unit record data; and (ii) district level weather data from India Meteorological Department.

The NSS data provides information at the household level about individual's migrant status and their socio-economic characteristics. The migrant status is classified on the basis of duration of migration: (a) temporary, when the person declares that he/she has gone out of the place of enumeration for less than six months in search of livelihood; (b) permanent, when the person has moved to the place of enumeration and has been staying there for more than six months. In other words, NSS collects information such that temporary migrants would be referred as 'out-migrants' while the permanent migrants would be referred as 'in-migrants' at the place of enumeration. NSS data provides greater details on before and after migration status for the temporary migrants, while it gives largely post migration details for the permanent migrants.

As mentioned earlier, in case of permanent migrants the NSS data provides various reasons for migration that include marriage, employment, transfer of jobs, education, accompanying the family etc.

However, by definition the reason for migration in case of temporary migration is always employment related. Hence for ensuring comparability, the analysis here excludes the permanent migrants who cite marriage or transfer of jobs as reason for migration. The permanent migrants giving other reasons have not been excluded from the analysis since such reasons may also influence decision for permanent settlement[3]. While the permanent migrants would include all those migrants who could have migrated into the place of enumeration anytime, for the sake of comparability with the temporary migrants the analysis here focuses on migrants who have migrated in the past one year from the date of enumeration. It is difficult to perceive how weather would have influenced the migration related decisions taken by the permanent migrants who have migrated into the region of enumeration over the last fifty or more years. However, it could be expected that more recent permanent migrants would have considered the influence of weather in their decisions[4]. From this perspective also the focus on permanent migrants who report their duration of stay as one year or less is justifiable. For both temporary and permanent migration the analysis is carried out for men and women aged 15 years and above.

As discussed in the previous section, the nature of movement in the NSS data has also been classified based on the administrative jurisdictions as inter-state, inter-district and intra-district. The analysis to assess the determinants of temporary and permanent migration is carried out at these three levels of spatial disaggregation.

Given that the focus of analysis is on rural areas, the temporary migrant could move to either an urban or a rural area from his/her rural residence, whereas the permanent migrant could have moved from rural or urban area into a rural area.

[3] For example, when older children migrate with family and acquire human capital (education) they may subsequently settle as permanent migrants.

[4] It is worth reiterating here that the analysis excludes migrants into urban areas.

The weather data for all the districts of India over the past twenty years preceding the year 2007-08 (the year to which the NSS data corresponds) is based on the gridded data of $1^{o}x1^{o}$ latitude/longitude resolution for temperature and rainfall released recently by the India Meteorological Department (Rajeevan et al., 2005; Srivastava et al., 2009). The weather variables constructed include mean and standard deviation of annual temperature, mean and standard deviation of total annual rainfall, and mean and standard deviation of monsoon (June to September) rainfall. The rationale for including several weather variables in the empirical analysis is to understand the effect of each weather variable on migration after controlling for other weather variables; and also to assess the differential impact between the mean and the standard deviation of each weather variable.

Methodology

The migrant status is a binary variable taking on value 1 if the respondent is a migrant and 0 otherwise. The discrete choice model for the probability of migration is specified as follows:

$$Y_i = \Phi(\boldsymbol{X_i\beta}) + u_i$$

where, Y_i = 1 when the i^{th} individual undertakes migration;

Y_i = 0 when the individual is a non-migrant;

$\boldsymbol{X_i}$ = set of independent variables including, individual characteristics (like sex, age, employment status, sector of economic activity), household characteristics (like monthly per-capita expenditure, household size, religion, caste, landholding class), regional characteristics (like weather variables as mentioned above in the data section; dummy variable representing the 'lagging' states);

$\boldsymbol{\beta}$ = coefficient vector associated with the independent variables; and u_i the random error term.

The temporary migrant as mentioned above is an 'out-migrant' while the permanent migrant is an 'in-migrant'. Consequently the

coefficient interpretations would be different in both the models and hence separate models are estimated for temporary and permanent migrants. In each of these migrant classifications the probit estimations are carried out for different geographic/administrative locations including inter-state, inter-district and intra-district. As shown below these different variants of the model do provide differing interpretations of the effect of weather on migration.

Table 2 presents the descriptive statistics of the variables used for the estimation. A few points are worth noticing from the table: (i) close to 70 per cent of the temporary migrants are less educated ('Not Literate' and 'Literate & Primary'), whereas 45 per cent of the permanent migrants are relatively more educated ('Middle & Secondary' and 'Higher Secondary and Above'); (ii) while about 57 per cent of the temporary migrants are labourers ('Agricultural Labour' or 'Other Labour'); only 20 per cent of permanent migrants are labourers; (iii) the permanent migrants typically move with families as reflected in the large percentage of 'Not in Labour Force' category under the employment status of these migrants; (iv) temporary migrants typically have large household size and are from poorer families compared to the permanent migrants; (v) people belonging to Scheduled Castes and Tribes constitute higher (about 41) percentage of the temporary migrants compared to the permanent migrants (about 26 per cent); and (vi) a large majority (close to 74 per cent) of temporary migrants are from 'lagging' states.

Table 2: Mean of Variables

Variables	Non-Migrant	Temporary	Permanent	All
Migrant Type (proportion)	0.890	0.034	0.076	1.000
Females (proportion)	0.247	0.052	0.468	0.257
Average Age	35.2	30.2	38.6	35.3
Average Household Size	5.6	5.8	4.6	5.5
Average Log (MPCE)	6.433	6.259	6.738	6.451
Level of Education (proportions- distribution within each migrant type)				
Not Literate	0.315	0.348	0.322	0.316
Literate & Primary	0.263	0.345	0.231	0.263
Middle & Secondary	0.325	0.249	0.292	0.320
Higher Secondary and Above	0.097	0.058	0.155	0.100
Employment Status (before migration)				
Self Employed in Agriculture	0.285	0.220	0.072	0.266
Self Employed in Non-Agriculture	0.096	0.094	0.075	0.094
Agricultural Labour	0.187	0.326	0.142	0.188
Other Labour	0.063	0.250	0.068	0.070
Unemployed	0.016	0.028	0.034	0.018
Regular Wages	0.056	0.053	0.089	0.058
Not in Labour Force	0.297	0.028	0.520	0.305
Landholding Class (proportion- distribution within each migrant type)				
Less than 0.4 ha	0.568	0.668	0.764	0.587
0.4-1 ha	0.194	0.182	0.106	0.186
1.01-4 ha	0.209	0.137	0.107	0.199
> 4 ha	0.029	0.012	0.023	0.028
Religious Groups (proportion- distribution within each migrant type)				
Hindus	0.849	0.837	0.850	0.849
Muslims	0.108	0.140	0.086	0.107
Christians	0.017	0.010	0.034	0.018
Other Religions	0.026	0.013	0.030	0.026
Caste groups (proportion- distribution within each migrant type)				
Other Castes	0.241	0.176	0.309	0.244
Schedule Castes and Tribes	0.310	0.414	0.266	0.310
Other Backward Castes	0.449	0.410	0.426	0.446
Lagging States	0.576	0.742	0.349	0.565
Weather Variables				
Average Annual Temperature	25.52			
Std. Dev. of Annual Avg. Temp.	0.342			
Average Monsoon Rainfall	939.91			
Std. Dev. of Monsoon Rainfall	227.8			

Note: All figures correspond to mean values of the variables. For categorical variables they represent proportions.

RESULTS

Tables 3 and 4 provide the estimates for the probit model for temporary and permanent migrants, respectively. Given that the data on weather variables corresponds to the district level, the role of weather variables in explaining temporary and permanent migration decision is analysed along with other determinants primarily to explain the inter-state and inter-district migrant categories. However, given that both temporary and permanent migrants are substantial in the intra-district migration category, it is useful to explore the influence of weather on the sample that includes all categories of migration. Thus, table 3 reports the estimated coefficients for four different probit model variants explaining probability of temporary migration: (i) determinants of inter-state and inter-district migration; (ii) determinants of inter-state migration; (iii) determinants of inter-district migration; and (iv) determinants of intra-district migration. Table 4 reports the estimated coefficients for two different probit model variants explaining probability of permanent migration: (i) determinants of inter-state and inter-district migration; and (ii) determinants of inter-state, inter-district and intra-district migration. The estimated coefficients corresponding to various control variables representing the household and individual characteristics are discussed first, followed by the coefficients associated with various weather variables.

Role of Individual and Household Characteristics

The role of various individual and household characteristics in explaining the probability of temporary and permanent migration is discussed with the help of the direction of the estimated coefficients and their significance reported in the second and third columns of tables 3 and 4, respectively.

The results show that women are less likely to be temporary migrants compared to men. In contrast women are more likely than men

to be permanent migrants as they tend to move from their natal home after marriage[5]. Temporary migrants are more likely to be younger in age and one could expect a reverse pattern in case of permanent migrants, but results suggest that younger individuals are more likely to be permanent migrants. This could be due to the fact that the analysis is based on permanent migrants who have migrated in the last one year from the date of enumeration.

Less educated people are more likely to be temporary migrants compared to those with middle level education. The probability of temporary migration is highest among not-literate category. In contrast, people with more education are more likely to be permanent migrants, even though less educated people also have positive probability to undertake permanent migration.

With regard to the employment status, casual labour (agricultural and non-agricultural) and unemployed are more likely to be temporary migrants compared to those who are not in labour force. Individuals from households with lower monthly per capita expenditure (after controlling for education, employment status etc.) are more likely to undertake temporary migration. This is in congruence with the pattern observed earlier (refer Figure 4 above). Individuals with lower as well as higher land holding are less likely (compared to those in households with 0.4 to 1.0 hectare land) to be temporary migrants. Overall, individuals with very small amount of land holding or even no land, after controlling for other variables, seem to be constrained to undertake temporary migration. The individuals from households with larger land holdings of course do not see the need for temporary migration[6]. Thus the results show that

[5] It may be noted that even though the respondents who state their reason for migration as marriage are not included in the analysis, a number of respondents have not specified their reason for migration.

[6] However, individuals from such households have greater probability to undertake permanent migration.

individuals with some resources – but not adequate resources – undertake temporary migration to supplement their livelihoods.

The corresponding coefficients of the variables for employment status, income and land possessed are difficult to interpret for a permanent migrant as the NSS collects information on these variables after a person has undertaken migration. Thus, it will be difficult to assess the influence of such characteristics in shaping an individuals' decision before he/she migrated.

As expected individuals from larger households have higher probability to go for temporary migration, whereas the probability to undertake permanent migration decreases as household size increases. Clearly availability of surplus labour within the household enables a member of the family to move out for a short period to supplement the family's income. On the other hand, since a long term migrant moves in permanently, moving with a smaller family would involve lesser costs.

Individuals belonging to scheduled caste and tribes (SC/ST) and other backward classes (OBC) have positive probability to be temporary migrants. Caste status has insignificant influence on decision for permanent migration. Individuals belonging to 'lagging' state are more likely to be temporary migrants while such states are less likely to be the destination for the permanent migrants.

Role of Weather Variables

As mentioned above, weather is represented through annual temperature and monsoon rainfall. Both average and standard deviation over the last twenty years prior to 2007-08 (the year of NSS survey) are considered. While increase in mean temperature could increase migration, increase in monsoon rainfall would decrease migration. Since the temporary migration in the analysis captures out-migration, the corresponding coefficient is expected to be positive for mean temperature and negative

for monsoon rainfall, keeping everything else as same. In contrast as the permanent migration is captured through in-migration, the signs on temperature and monsoon rainfall coefficients are expected to be the opposite. The effect of increase in temperature variability is difficult to predict given that the temperature changes may not be perceived directly. Increase in rainfall variability is expected to increase temporary (out) migration and decrease permanent (in) migration.

The estimated coefficients of the weather variables in case of temporary migration involving inter-state and inter-district categories are broadly on expected lines (see columns 2 to 7 in table 3). The results show that increase in the standard deviation of temperature, keeping mean temperature fixed, reduces temporary migration. One possible explanation is that with higher standard deviation, above average deviations could be moderated by the below average deviations, resulting in lower likelihood of individual undertaking temporary migration.

The role of weather variables in explaining the intra-district temporary migration is slightly different compared to other categories of temporary migration. In general, if a district has favourable weather then it should observe lower within district movement. Thus, the results show that keeping everything same, districts with higher average monsoon rainfall have lower intra-district temporary migration, and increase in any of the other weather variables leads to increase in the intra-district mobility.

In case of permanent migration, the results show that (refer columns 2 to 5 in table 4) the weather variables have no significant impact. Perhaps this could be due to relatively weak influence that weather variables (available at district level) could have on permanent migration decision and the difficulty in capturing the same using a dataset with disaggregated individual level data.

The results reported in columns 4 and 5 in table 4 show negative influence of temperature variables on permanent migration for the model involving all categories of migrants which is perhaps driven by the intra-district migration. The results from a model involving intra-district permanent migration alone (results not reported here), it is observed that increase in mean temperature or its standard deviation of a district reduces the probability of permanent migration within that district. This is similar to the pattern observed in case of intra-district temporary migration. Further, the intra-district migration is fairly dominant over other categories of permanent migration.

Table 3: Estimated Coefficients of Probit Models for Determinants of Temporary Migration

Probability of Migration →	Inter-District/State		Inter-District		Inter-State		Intra-District	
Variables	**Coeff**	**p-value**	**Coeff**	**p-value**	**Coeff**	**p-value**	**Coeff**	**p-value**
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Female=1	-0.486***	0.000	-0.356***	0.000	-0.560***	0.000	-0.248***	0.000
Age	-0.018***	0.000	-0.015***	0.000	-0.018***	0.000	-0.008***	0.000
Education Level –Reference Group is 'Middle+Secondary'								
Not literate	0.178***	0.000	0.221***	0.000	0.092***	0.001	0.107***	0.003
Literate + Primary	0.125***	0.000	0.138***	0.000	0.085***	0.001	0.100***	0.004
Higher Secondary and Above	0.030	0.575	0.099	0.152	-0.050	0.282	0.011	0.836
Employment Status – Reference Group is 'not in labour force'								
Self Employed in Agriculture	0.825***	0.000	0.643***	0.000	0.915***	0.000	0.364***	0.000
Self Employed in Non-Agriculture	0.864***	0.000	0.673***	0.000	0.974***	0.000	0.519***	0.000
Casual Labour in Agriculture	1.097***	0.000	0.930***	0.000	1.141***	0.000	0.698***	0.000
Casual Labour in Non-Agriculture	1.491***	0.000	1.267***	0.000	1.543***	0.000	0.866***	0.000
Unemployed	1.041***	0.000	0.742***	0.000	1.201***	0.000	0.637***	0.000
Regular Wage Earners	0.949***	0.000	0.747***	0.000	1.076***	0.000	0.608***	0.000
Household Size	0.019***	0.000	0.029***	0.000	0.005	0.210	-0.003	0.549
Logarithm of MPCE	-0.179***	0.008	-0.011	0.900	-0.321***	0.000	-0.045	0.244
Land Possessed – Reference Group is '0.4 to 1.0 ha'								
< 0.4 ha	-0.053**	0.059	-0.175***	0.000	0.063**	0.039	-0.102***	0.009
1-.01-4ha	-0.106***	0.000	-0.157***	0.000	-0.012	0.741	0.012	0.772
>4 ha	-0.204***	0.004	-0.132	0.127	-0.271***	0.005	-0.030	0.738
Religion – Reference Group is 'Hindu'								
Muslim	0.041	0.140	0.107***	0.005	0.002	0.939	0.020	0.661
Christian	0.021	0.802	0.021	0.808	0.001	0.997	-0.111	0.129
Others	-0.014	0.851	-0.039	0.688	0.069	0.370	-0.140*	0.091
Caste – Reference Group is 'Other Castes'								
SC/ST	0.035	0.224	0.105***	0.005	-0.040	0.235	0.201***	0.000
OBC	0.026	0.356	-0.049	0.203	0.077*	0.010	0.107***	0.003

(Contd… Table No.3)

Probability of (Migration)→	Inter-District/State		Inter-District		Inter-State		Intra-District	
Variables	**Coeff**	**p-value**	**Coeff**	**p-value**	**Coeff**	**p-value**	**Coeff**	**p-value**
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Weather Variables								
Average Annual Temperature	0.034***	0.000	0.056***	0.000	-0.002	0.817	0.053***	0.000
Std. Dev. of Annual Avg. Temp.	-0.798***	0.000	-0.622***	0.003	-0.955***	0.000	0.668***	0.002
Average Monsoon Rainfall	-0.0003***	0.000	-0.0001***	0.003	-0.0004***	0.000	-0.0001**	0.039
Std. Dev. of Monsoon Rainfall	0.0017***	0.000	0.0010***	0.000	0.0019***	0.000	0.0010***	0.000
Lag state=1	0.464***	0.000	0.052*	0.075	0.859***	0.000	0.073**	0.023
Intercept	-2.19***	0.000	-3.91***	0.000	-0.85**	0.041	-4.24***	0.000
No. of Observations	122536		116920		118495		115502	
Pseudo R^2	0.1604		0.1173		0.1961		0.0722	

Note: (1) Dependent Variable is 1 for temporary migrant type and 0 for non-migrants;
(2) *** denotes significance at 1 per cent level, ** denotes significance at 5 per cent level, * denotes significance at 10 per cent level.

Table 4: Estimated Coefficients of Probit Models for Determinants of Permanent Migration

Probability of Migration →	Inter-District/State		Inter- District/State and Intra-District	
Variables	**Coeff**	**p-value**	**Coeff**	**p-value**
(1)	**(2)**	**(3)**	**(4)**	**(5)**
Female=1	0.294***	0.000	0.206***	0.000
Age	-0.006***	0.000	-0.004***	0.005
Education Level –Reference Group is 'Middle+Secondary'				
Not literate	0.183***	0.000	0.225***	0.001
Literate + Primary	0.095**	0.017	0.129**	0.015
Higher Secondary and Above	0.096**	0.038	0.123*	0.065
Employment Status – Reference Group is 'not in labour force'				
Self Employed in Agriculture	-0.452***	0.000	-0.434***	0.000
Self Employed in Non-Agriculture	-0.109*	0.058	-0.217**	0.010
Casual Labour in Agriculture	-0.245***	0.000	-0.163**	0.033
Casual Labour in Non-Agriculture	0.307***	0.000	0.458***	0.000
Unemployed	0.314***	0.000	0.482***	0.000
Regular Wage Earners	0.188***	0.001	0.329***	0.000
Household Size	-0.044***	0.000	-0.047***	0.000
Logarithm of MPCE	0.484***	0.000	0.531***	0.000
Land Possessed – Reference Group is '0.4 to 1.0 ha'				
< 0.4 ha	0.297***	0.000	0.215***	0.001
1-.01-4ha	0.051	0.399	-0.036	0.644
>4 ha	0.243*	0.008	0.133	0.263
Religion – Reference Group is 'Hindu'				
Muslim	0.022	0.616	-0.060	0.354
Christian	-0.102	0.244	-0.202*	0.092
Others	-0.199**	0.034	-0.333**	0.012
Caste – Reference Group is 'Other Castes'				
SC/ST	0.011	0.791	-0.140**	0.010
OBC	-0.013	0.701	-0.058	0.213
Weather Variables				
Average Annual Temperature	0.005	0.606	-0.043***	0.000
Std. Dev. of Annual Avg. Temp.	-0.256	0.250	-0.714**	0.013
Average Monsoon Rainfall	0.00005	0.345	-0.0001	0.205
Std. Dev. of Monsoon Rainfall	-0.00010	0.659	1.05E-08	0.950
Lag state=1	-0.284***	0.000	-0.211***	0.000
Intercept	-5.268***	0.000	-4.370***	0.000
No. of Observations	116088		114299	
Pseudo R^2	0.1346		0.1548	

Note: (1) Dependent Variable is 1 for permanent migrant type and 0 for non-migrants; (2) *** denotes significance at 1 per cent level, ** denotes significance at 5 per cent level, * denotes significance at 10 per cent level.

CONCLUSIONS

Internal migration in India is a complex issue with multiple factors affecting it. While on one hand there are concerns that the economic growth in India is not contributing significantly to foster rapid urbanization in-line with the mainstream development arguments, there are also concerns that agricultural distress could be forcing migration of people (attached to agriculture) to other economic sectors and regions in the short to medium term. In the latter context, the role of weather variability in reducing agricultural productivity and hence contributing to migration is fast acquiring great importance as such evidence may provide insights about the scope for migration as an adaptation strategy in the event of climate change. This paper contributes to this strand of literature with its focus on India.

The paper uses household level migration data for the year 2007-08 collected by the NSS Organization. Focusing on both temporary and permanent migration in the rural areas, the study uses econometric analysis to assess to assess the influence of weather variability on migration. The historic weather data at the district level is used for the analysis hypothesizing that adverse weather conditions would lead to increased mobility among the rural households for availing better and/or additional livelihood opportunities.

The results based on probit regression model suggest that unskilled and semi-skilled agricultural labourers have higher probability of migration. The men among the poorer households, from larger households and from the 'lagging' states have higher probability to undertake temporary migration out of rural areas. On the other hand permanent migrants are attracted towards 'leading' states and are on average wealthier than the non-migrants in these regions. The study results suggest that weather has significant role in explaining temporary migration and relatively lesser influence on permanent migration. The

study further highlights that temperature, rainfall and their variability are important determinants of temporary migration while the permanent migration is broadly influenced by temperature and its variability alone.

From a policy perspective it may be useful to explicitly estimate the elasticity of migration to weather changes. A fairly disaggregated regional (district) level analysis using data on migration rate, weather and agriculture would provide scope for such elasticity estimation. Recent contributions in this direction include the studies based on internal migration in the US (Feng et al., 2012), migration between Mexico and the US (Nawrotzki et al., 2012), migration in sub-Saharan Africa (Marchiori et al., 2012), and internal migration in India (Dallman and Millock, 2012; Viswanathan and Kumar, 2013). However, all these studies focus mainly on permanent migration which may give pointers towards the potential role of migration as adaptation strategy. By using household level data, albeit without explicitly modelling the three-way linkage between weather, agriculture and migration, this study demonstrates that temporary migration can serve as coping strategy now and in future for the households facing adverse weather conditions.

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