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Natural Shocks and Internal Labor Migration: Evidence from Pakistan

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Abstract
Pakistan is among the hardest hit countries by natural disasters, particularly floods, earthquakes, and droughts. The study examines the impact of floods, earthquakes, and droughts on Pakistan's internal labor migration. Using the probit model, we determine whether the labor migration decision will differ in shock-affected and other districts in Pakistan. The findings show that internal labor migration likely decreases in shock-affected districts compared to other districts. We analyze the data separately for the rural and urban, male and female, and employed, unemployed and not-in-labor force for the robustness check. Urban region evidence is consistent with baseline results. However, for rural regions, the coefficient of natural shocks is statistically insignificant in the whole sample and across subsamples meaning that natural shocks have no significant impact on internal labor migration in the rural region.

Keywords: Droughts, Earthquake, Floods, Labor Migration, Natural Shocks, Pakistan

Introduction
Climate change-driven natural disasters – storms, floods, earthquakes, droughts, and extreme temperatures – have increased globally over the past fifty years, with more than 11000 disasters causing US$ 3.64 trillion in economic losses and claiming two million lives[1]. Over the years, Pakistan has also faced severe weather events, a trend that persists. In 2010, Pakistan was hit by devastating floods, impacting over 20 million people and causing damage to more than 20 percent of the land area.[2] However, the floods in 2022 were even more catastrophic. The country experienced an extraordinary amount of rainfall during the month of July, surpassing the average by a significant 180 percent causing significant damage and affecting 3.3 million in 81 districts[3]. This study evaluates the impact of medium to severe natural shocks — floods, earthquakes, and droughts — from 2001 to 2015 in Pakistan on internal labor migration. Past studies have addressed the effects of natural disasters on GDP growth[45], income, wealth, assets[6], local labor market[7], and aggregate productivity[8]. In recent literature, researchers have explored different forms of migration as a potential strategy for adapting to natural disasters. As natural disasters vary in severity, resulting in differing degrees of damage and distinct effects on household risk preferences, local amenities, and market conditions[9]. Hence, establishing a definitive connection between natural disasters and migration patterns has proven elusive. Also, labor migration, as an adaptation mechanism following a disaster, can assist individuals in recovering from income losses and seeking better employment opportunities[10]. Conversely, individuals affected by these shocks may choose to remain in their homes, driven by prospects of disaster-induced employment within their home region, particularly during the rehabilitation and rebuilding phase[11]. To test these conflicting hypotheses, this study examines plausible exogenous variations. While the study by Mueller et al. is the first to examine the impact of floods and heat stress on internal migration in Pakistan, its findings are limited to five districts, making them less

generalizable to other districts[12]. Consequently, there is a need to provide micro-level evidence of the impact of natural disasters on internal migration across all districts of Pakistan. Our study has three objectives: firstly, to examine whether labor migration decisions differ in shock-affected and other districts; second, to separately estimate the impact of natural shocks on internal migration for gender, region, and employment status wise; and the third is to map all natural shocks district wise in the last two decades. We have used the probit model and collected data on floods, earthquakes, and droughts, declared disasters by the government of Pakistan, from different authentic published sources. We must mention that we used data on economic and social migration, not displaced or forced migration, from Pakistan Labor Surveys. Shakya et al. have conducted a similar study examining the impact of Nepal's earthquake on international labor migration. The contribution of our study is to provide evidence on migration from Pakistan[13].

Drivers of Migration: Theory and Evidence

Labor migration is an investment to seek better employment opportunities and earn a good livelihood[14]. Similarly, Todaro suggests that changing location offer more employment opportunities[15]. Migration depends on age, distance, and education. Migration has a negative relationship with age[16] and a positive with distance, and education[17].

Natural disasters can affect labor migration in numerous ways. The first mechanism is by augmenting push factors. Natural disasters hamper economic activities by destroying productive capital and displacing labor, resulting in wage reduction and consequently income reduction[18] [19]. Evidence supports that natural disasters put long-term negative impacts on living standards[20] and regional and national economic growth trends[21]. Many studies found no migration or negative migration effects of natural disasters[22] [23]. The evidence is similar for internal migration[24]. The possible reason is that liquidity constraints hinder migration post-disaster[25]. The second mechanism is the push factor. After a disaster, labor demand may increase and cause no migration or a negative effect. Also, self-employment can be created to reconstruct or rebuild their property. Halliday evidence suggests that El Salvador earthquakes negatively affect migration to the United States[26] and as a result, construction wages increased. Additionally, remittances and other financial flows fuel reconstruction efforts in the affected regions[27]. Studies have investigated one type of natural disaster on migration. This necessitates the need to provide evidence at the district level on the numerous disasters on the labor decision to migrate.

Data Descriptive Statistics

Data for Natural Shocks in Pakistan

To empirically investigate the impact of natural shocks on internal migration, three factors - demographic, social, and economic - are considered in this study. To declare flood, earthquake, and drought as disaster/shock, the paper has used the benchmark given by Emergency Event Disaster Database (EM-DAT)[1]. According to EM-DAT, to declare a natural event as disaster/shock, at least one of the following conditions should be fulfilled; (1) at least 10 people deaths are reported, (2) at least 100 people affected are reported, (3) state declaration as emergency, and (4) state called assistance for international aid. Under the conditions of EM-DAT, a dummy variable of natural shocks at a district level has been created, which indicates that either shock hit the district in a year or not. If shock hit the district, it is taken equal to 1 and otherwise 0. Similarly, dummies are created for 93 districts of Pakistan, namely, Punjab, Sindh, Khyber Pakhtunkhwa (KPK), and Baluchistan. To capture the district level shocks, the paper has used the exposed districts from the reports of the National Disaster Management Authority (NDMA), Provincial Disaster Management Authority (PDMA), Earthquake Reconstruction and Rehabilitation Authority (ERRA), and Relief web.

[1] Emergency Event Disaster Database (EM-DAT) is the database launched by the Center for Research on the Epidemiology of Disaster (CRED). EM-DAT contains the data of over 22,000 disasters from 1900 to present day in the world. The database is obtained from numerous sources, include UN agencies, insurance companies, non-governmental organization, press agencies, and research institutes.

Data on Internal Migration in Pakistan

The data on migration is taken from the Labor Force Survey collected by the Pakistan Bureau of Statistics (PBS)[2]. The PBS conducted 12 surveys between 2001 and 2014. For this study, ten-year micro-level cross-sectional data includes years 2001, 2003, 2005, 2006, 2007, 2009, 2010, 2012, 2013, and 2014. The data represents all rural and urban regions of four provinces of Pakistan, excluding Northern Areas, Azad, Jammu Kashmir, and Federal Administrative Tribal Areas. Excluded regions contain only 2% of the total population. These surveys are based on two-stage stratified sampling[28]. The urban domains and villages/tehsils/mouzens in rural areas, as enumeration blocks, are taken as Primary Sampling Unit (PSU). The recorded household sample of PSUs is taken as a Secondary Sampling Unit (SSU). A sample of 36400 households is considered at the National/Provincial level in each survey. The questionnaire of the Labor Force Survey (LFS) covered a broad set of questions about demographic, social, and economic conditions of active as well as inactive population. The respondent was asked three questions related to migration; the first question is, "how long … has been living in this district?". If he/she is living since birth, then it means no migration, and if he/she is living at least less than one year or more than one year in a district, it indicates the status of the migration. The other two questions are; "was …. the previous residence in rural or urban?" and "what was the main reason for migration?" The reasons include both economic and non-economic factors responsible for migrations. The paper linked the individual demographic characteristics and socio-economic status to the vulnerable districts hit by the natural shock(s) across Pakistan. Similarly, any household member who moved from one administrative district to another administrative district, at any point in his/her life, is considered internal migration, excluded one move within the district. The paper uses the data of migrants, age 12 and above, who are living in a new place for less than one year.

Descriptive Analysis

In Pakistan, droughts, earthquakes, floods, land sliding, cyclones, and sea hazards have made life vulnerable to people during or after its occurrence. The country has experienced extreme droughts in Baluchistan and Sindh's regions from 1997 to 2002. During 1997-2001, the draught caused death to 143 people, and 2.5 million livestock had died, and the year 2001 was the worst drought reported in the history of Pakistan (Qureshi and Akhter, 2005). In 2004, the earthquake disordered some regions of Khyber Pakhtunkhwa (KPK), including Manshera and Batagram, and at least death of 12 people and around 9000 houses were reported damaged or demolished. In the next year, another earthquake discontinued the tranquillity of the people in Northern Pakistan and Kashmir. The devastating calamity left a legacy in the form of 100,000 fatalities, including 19,000 children. Overall, 500,000 families were affected. In 2011, the monsoon rains washed had 23 districts, mostly lying along the Indus River in Pakistan. According to NDMA figures, the flood caused deaths to more than 520 people, 1180 people injured, and the floods affected the lives of 9.3 million people. Along with extreme natural shocks, Pakistan has faced minor natural shocks every year, except for 2008, that damaged lives, limbs, livestock, property, and other people/regions. Table 1 provides descriptive statistics of selected variables from the survey data. The data shows that 22 percent of districts hit by disasters and 56 percent of the population live in Pakistan's rural regions. , In a rural subsample, 22 districts are hit by disasters, 51 percent are female migrants, and people with 29 is the average age of migrants due to disasters in rural Pakistan. In the urban subsample, 28 is the average age of the disaster-hit migrants in 22 percent hot districts that have 52 percent are female migrants in Pakistan. The control variables data include demographic, social, and economic variables and dummies of origins of the migrants. Demographic controls are age, gender, marital status, and region of origin. Education level is taken as one of the social variables. Economic variables include principle activities (like,

[2] Pakistan Bureau of Statistics (PBS) is one of the departments of the Government of Pakistan whose main concern is to provide national statistical services and comprehensive statistical research. PBS helps to produced and compiled data to better understand Pakistan, its population, economy, resources, culture, and society.

employed, unemployed, or not in the labor force) and monthly income of the disaster-hit people across this study sample.

Table 1: Descriptive Statistics
Source: Authors' calculation

	Observations	Mean	Std. Dev.	Min	Max
Whole sample					
Migration	1,132,693	0.004	0.064	0	1
Natural shocks	1,215,125	0.224	0.417	0	1
Gender	1,217,801	0.487	0.500	0	1
Age	1,217,801	29.337	16.061	10	84
Education	1,217,713	1.932	1.057	1	5
Origin region	1,217,801	1.730	0.444	1	2
Principal activities	1,217,633	2.128	0.962	1	3
Monthly income	1,217,801	915.442	4778.974	0	500000
Rural sample					
Migration	823,693	0.004	0.063	0	1
Natural shocks	888,430	0.224	0.417	0	1
Gender	888,430	0.491	0.500	0	1
Age	888,430	29.497	16.213	10	84
Education	888,369	1.793	0.976	1	5
Origin region	888,430	2.000	0.000	2	2
Principal activities	888,305	2.089	0.968	1	4
Monthly income	888,430	684.253	3759.302	0	475000
Urban sample					
Migration	309,000	0.005	0.067	0	1
Natural shocks	326,695	0.224	0.417	0	1
Gender	329,371	0.478	0.499	0	1
Age	329,371	28.907	15.635	10	84
Education	329,344	2.305	1.172	1	5
Origin region	329,371	1.000	0.000	1	1
Principal activities	329,328	2.232	0.936	1	3
Monthly income	329,371	1539.042	6766.791	0	500000

Empirical Model Specification

To investigate the impact of natural shocks on internal migration. Given the cross-section data described in the above section, our baseline model is specified by the following equation.

$$\boldsymbol{Y_{it} = \alpha + \beta\, D_{it} + \pi X_{it} + \gamma E_{it} + \emptyset_p + £_t + \varepsilon_{it}}$$

Where Y_{it} is the dependent variable, and it is taken as a dummy variable for migration of individual i in time t. The dependent variable is taken as 1 if the respondent has decided on migration, and 0 otherwise. In the set of independent variables, the D_{it} is dummy variable of natural shocks in district i at time t. X_{it} denotes the set of demographic and social characteristics of the individual i at time t to analyze the decision of migration. Explicitly, we include gender, age, marital status (categorized as married, unmarried, divorce), and education level (classified as no schooling, primary, secondary, higher secondary, and degree level). E_{it} is the vector of economic variables representing the status of current employment activities (categorized as employed, unemployed, or not in the labor force) and total monthly income in Pakistani Rupees. The province fixed effect $\emptyset_p$ allow us to the explanation of unobserved characteristics of the population in the province p. The year fixed effect $£_t$ lets us account for unnoticed characteristics of the population changes with time.

Due to the nature of the binary dependent variable, the probit model is used as an estimation technique to estimate the binary outcome. Under the assumption(s), errors are normally distributed. Our estimates may be affected by omitted factors due to the absence of panel data on potential internal migration determinants, resulting in an omitted variable bias. However, using two-way fixed effects permits the absorption of unobserved heterogeneity that is constant across districts and years. In other words, controlling for year- and district-specific fixed effects is critical for absorbing shocks whose influence is limited to a given year and district. Unobserved heterogeneity that varies with time is one of the major obstacles in our research. Hence, the logic of errors normal distribution is somewhat validated by specifying the model (1) by including the year fixed effect and origin fixed effects. Similarly, the standard errors are clustered across the origin districts of migrants in this study.

Results and Discussion

In the table 2, we shows how the trend of internal labor migration among districts severaly affected by the natural shocks is different from the other remaining unaffected districts (comparison group). Table 2 presents the probit estimates of Eq. (1). Column 1 includes only natural shock as a dummy variable, which is captured at the district level. If shock hit the district, then it is equal to 1 and 0 otherwise. The shock coefficient is statistically significant at 5 percent level and shows a negative correlation with internal migration. Column 2 includes only demographic, social and economic control variables, namely gender, age, marital status, region, education level, principal employment activities, and monthly income. These control variables are used to capture the demographic, social, and economic factors of migration. The estimations show that most of the coefficients have statistically significant impacts on internal migration in Pakistan. Some estimated coefficients are essential to elaborate. The calculated results suggest that migration is higher for the unemployed and not in the labor force. The reason is that unemployed person changes his origin district to another where employment opportunities are available. Moreover, those not in the labor force include those who are still investing in education and skills to get a lucrative job in the future, and they are also moving to enroll in a reputed institution or a place near where he gives his quality time. Furthermore, higher monthly income positively and statistically significantly impacts Pakistan's internal migration as such higher income people can afford cost of migration. Column 3 in Table 2 includes demographic, social, and economic characteristics of individuals and the dummy variable of natural shock at the district level. The data shows that a labor who lives in an area hit by any shock, namely flood, earthquake, and drought may likely decrease his migration. The results indicate that people take fewer migrations in Pakistan where shocks hit, moderate and severe, the districts during 2001 and 2014. The natural shock coefficient is obtained under the control variables of demographic and socio-economic characteristics of individuals. The control variable coefficients are also statistically significant except that of the rural region, thus meaning that in a rural area, the natural shocks have no significant impact on labor migration.

Modified Groups Results

This section presents findings on the association of natural shocks with internal migration across the subgroups. Column 1 Table 3 includes the estimates of the sample distributed among rural and urban regions, respectively. Column 2-7 consists of the subsamples of rural and urban migrations of the individuals having attributes of males, females, literate, illiterate, employed, unemployed, and not in the labor force. In the rural region sample, natural shocks are shown to have no statistically significant association with internal migration. In contrast, socioeconomic variables are shown to significantly determine the occurrence of internal migration for this study's rural sample. In all subsamples, the coefficients of natural shock are statistically insignificant. In all specifications (Colum 2-7) of the urban region sample, the coefficients of natural shock are statistically significant and have a negative association with internal migration. The baseline results show that the occurrence of natural shocks has the likelihood of decreasing internal migration. The results suggest that natural shocks have significant impacts on reducing

internal migration for only urban regions. Natural shocks are statistically insignificant, shown in rural region samples for separately estimated rural and urban areas. For urban, all subsamples coefficients have significant negative impacts of natural shocks on internal migration across Pakistan. The results also indicate that natural shocks have the likelihood to discourage urban migration in Pakistan (Table 3).

Discussion

Black et al. have introduced a theoretical framework composed of five migration drivers that include demographic, economic, social, political, and environmental aspects of migration[29]. Directly and indirectly, sudden natural disasters might force population to relocate. Internal migration of labour can be a post-disaster adaptation method for recovering from disaster-caused revenue loss and seeking better work prospects[30]. However, places hit by natural disasters may see an influx of new job and income prospects as a result. More jobs, particularly in the relief, rehabilitation, and rebuilding phases, would be created as a result of these chances, decreasing the need for people to travel great distances to find work[31]. Below, we discuss some other factors that, in addition to natural disasters, might have prompted people not to move into another district. First and foremost, the economic cost is a significant consideration. Internal labor migration can be expensive for the common citizen due to transportation, lodging, and other everyday expenses. Especially after a period of shock, families attempting to recover from considerable economic loss may place migration investments low on their list of priorities[32]. Natural shocks disorder the socio-economic activities; in such situations, people cannot afford the cost of migration[33]; in such situations, affected people face liquidity constraints and obstacles to moving, such as the cost of moving and the means of transportation; Instead people prefer to live with family until their theya are rehabilited and may spend their liquidity on smoothing consumption[34]. Secondly, there is a possibility that urban people have easy access to government and organizations that provide social protection in a disastrous situation fulfilling basic needs of affected people. Hence, they are less likely to migrate to other places as their destinations. Thirdly, in the urban region, most labor employed in such organization where social protection is available to them such as in government, semi-government, multinational organizations, and international NGOs. If any shock hits the urban region, they may be less likely to be affected economically and socially. Moreover, in an urban region, even low-income people are more economically and socially secured having well-developed infrastructure and the government facilities are available to quick response in the effect of any shock.

Conclusion

This study evaluated the economic impact of the natural shocks that hit districts of Pakistan in ten years on internal labor migration. We employed the probit model to measure changes in internal migration between affected and unaffected districts. Our empirical research design controlled for the possibility of unobserved heterogeneity, bias from omitted variables, and national temporal patterns. Additionally, we conducted additional robustness checks to demonstrate that our model estimates are accurate and statistically significant. This paper has empirically linked natural shocks with internal migration in the case of Pakistan. This study shed empirical light on the set hypotheses that an individual who lives in a district hit by a natural shock, severe and moderate, has a higher risk of affecting their migration(s) compared to individuals who live in other districts. The study concludes that people took less financial and non-migration in shock-affected districts than in non-affected districts across Pakistan. This study has the following limitations: firstly, only those migrants are considered who lived for one year in a new district and those who were living less than one year in a new district are not considered; secondly, migrants within districts are not considered; thirdly, the intensity of natural shocks is not captured in the study to evaluate changes in migrations by correlating with the intensity of a natural shock. In the future using data on intensity of natural shocks can be used for more robust analysis.

Table 2: Impact of natural shocks on internal labor migration

	(1)	(2)	(3)
Natural shocks	-0.142**		-0.143**
	(0.0706)		(0.0716)
Female		-0.0796***	-0.0795***
		(0.0213)	(0.0213)
Age		-0.0132***	-0.0132***
		(0.00121)	(0.00122)
Married		0.521***	0.521***
		(0.0327)	(0.0329)
Divorced		0.578***	0.579***
		(0.0479)	(0.0480)
Primary		-0.0143	-0.0137
		(0.0238)	(0.0238)
Secondary		0.0969***	0.0988***
		(0.0337)	(0.0331)
Higher		0.186***	0.189***
		(0.0425)	(0.0413)
Degree		0.303***	0.307***
		(0.0491)	(0.0480)
Rural		-0.0559	-0.0551
		(0.0974)	(0.0978)
Unemployed		0.0784**	0.0808**
		(0.0391)	(0.0390)
Not in labor force		0.0891***	0.0904***
		(0.0259)	(0.0260)
Income (log)		0.00000537***	0.00000548***
		(0.00000119)	(0.00000123)
Constant	-2.440***	-2.394***	-2.382***
	(0.0543)	(0.0911)	(0.0939)
Observations	1,130,017	1,132,437	1,129,762

Note: In each specification, include year fixed effect and origin province fixed effects. The standard errors are clustered across the origin district. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3: Impact of *Natural Shocks on Internal Labor Migration* in *the Rural* and *Urban Region Respectively*

	Whole Sample	Male	Female	Literate	Illiterate	Employed	Unemployed	Not in Labor force
				Rural Region				
Natural shocks	-0.0274	-0.0259	-0.0186	-0.0132	-0.0392	-0.0778	-0.0082	0.0166
	-0.0651	-0.0765	-0.0653	-0.0723	-0.0637	-0.0803	-0.1178	-0.0696
Observations	823,500	425,986	397,514	395,606	427,953	353,575	46,352	423,573
				Urban Region				
Natural Shocks	-0.351***	-0.327***	-0.389***	-0.316***	-0.403***	-0.284***	-0.3200**	-0.411***
	-0.128	-0.116	-0.151	-0.116	-0.143	-0.0995	0.1471	-0.159
Observations	306,262	161,232	145,030	209,707	96,578	106,190	21,770	177,722
Demographic controls	Y	Y	Y	Y	Y	Y	Y	Y
Economic controls	Y	Y	Y	Y	Y	Y	Y	Y
Province fixed effect	Y	Y	Y	Y	Y	Y	Y	Y
Year fixed effect	Y	Y	Y	Y	Y	Y	Y	Y

Note: Standard errors are clustered across origin districts. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0

Notes

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