WEATHER SHOCKS, DOMESTIC MIGRATION AND HUMAN CAPITAL

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Motivation

- Climate Change: Rise of adverse weather shocks
- Economic Costs of such shocks
  - Agriculture Production, Livelihoods, Displacement, Labor market, human capital formation (health and education)
    - Dell et al 2014, Jessoe et al 2016

- Given the context, this paper explores the link between such shocks (precipitation and temperature) and human capital, *that is mediated through migration flows*
  - In this paper we focus on domestic migration
    - not necessarily forced migration.

This Paper

- Explores the link between adverse weather shocks and human capital through "in"-migration in India
  - Contributes to construction of a 15 year district level panel data (1991-2011) on "in"-migration, weather shocks and human capital (non-trivial)
    - "in" migration- migration within a district (54%), migration into a district from other parts of India.
    - Human capital: primary school completion rates for 12 year olds / middle school completion rates for 15 year olds.
  - Estimates the relationship in two steps:
    - *Causal* impact of weather shocks on migration
    - *Association* of migration and human capital (some evidence that it may be causal)

Context

- Link between Weather shocks and Migration
  - Focus on large environmental refugees-Large (Rigaud et al 2018)
  - Mixed evidence of weather on migration (Cattaneo and Peri 2015)
    - Migration is expensive in areas of liquidity constraints (correlated shocks)
      - Background: Migration is low in India (1 % p.a.)
  - **India evidence**
    - State Level Panel: Drought frequency increases inter-state bilateral migration rates: based on two years: 2001, 1991 (Dallman and Millock 2017)
    - District Level Cross Section: Vishwanathan and Kavi-Kumar (2013)
      - Declines in Agricultural Output
      - Outmigration-low marginal effect
    - Household Level Panel (2 years): Sadova and Kalkuhl (2020)
      - "Low" Weather shocks leads to lower rural-rural migration
      - "High" Weather shocks increases migration to cities.

Context

- Weather Shocks and Human Capital
  - Mixed evidence
    - Rainfall shocks decrease human capital
      - Suggested mechanism: children help households by providing labour (Shah and Steinberg, 2017)-India and other countries

    - Rainfall shocks increases human capital through school enrolment/attendance (Zimmerman 2014)
      - Suggested mechanism: demand for labour falls during droughts-fall in child labour-children in school- India

    - Weather shocks increases human capital by revising expectation of human capital as a viable mitigation strategy, esp for those children near completion –Indonesia (Thomas et al 2004)

Context

- Migration and Human Capital
  - Migration leads to children replacing adults in doing household chores (Jingzhong and Lu 2011): Decline in Human Capital
  - Remittance leads to Higher Human Capital of Children.
  - Migrants often have higher human capital than resident populations-higher human capital of children.

Bottom Line

- Each link in the nexus of Weather Shocks, Migration and Human capital is ambiguous
  - Depends on what type of shocks they are -high, low , temperature, precipitation
  - Depends on the strength of each mechanism

Data

- Construct annual district level data by triangulating different data sets
  - Census of India 1991, 2001 and 2011
  - National Sample Survey (NSS) for 1999-2000 (55^{th} round) and 2007-2008 (64^{th} round)
  - ERA5 re-analysis data (European Centre for Medium range weather forecasts)
  - District Information for school education data (DISE): schooling supply.

- Final Data: 390 districts (district boundaries as of 1991) for the period 1995 to 2001, 2004 to 2011.

Empirical Model

$$logMig_{dt} = \beta_d + \boxed{\Phi Shocks_{dt}} + \theta Demo_{dt} + \sum_d \delta_d D_d * t + \varepsilon_{dt}^m$$

$$HumCap_{dt} = \alpha_d + \Psi Shocks_{dt} + \boxed{\mu logMig_{dt}} + \lambda Demo_{dt} + \phi Schools_{dt} + \sum_d \nu_d D_d * t + \varepsilon_{dt}^h$$

Robust Standard Error Clustered by Districts

Description

	Obs.	Mean	S.D	Min	Max
Total Migrants	5,139	31828	34814	25	547538
Log Migrants	5,139	10.00	0.90	3.26	13.21
Migrants (% of Pop.)	5,139	1.26	0.79	0.00	9.04
Primary School Completion	5,139	0.89	0.09	0.28	1.00
Middle School Completion	3,654	0.76	0.10	0.38	0.99
District High Rain Shock	5,139	0.21	0.40	0.00	1.00
District Low Rain Shock	5,139	0.17	0.37	0.00	1.00
District High Temp. Shock	5,139	0.28	0.45	0.00	1.00
District Low Temp. Shock	5,139	0.07	0.26	0.00	1.00
Prop of Other Districts within State with High Rain Shocks	5,139	0.21	0.27	0.00	1.00
Prop of Other Districts within State with Low Rain Shocks	5,139	0.17	0.24	0.00	1.00
Prop of Other Districts within State with High Temp Shocks	5,139	0.28	0.37	0.00	1.00
Prop of Other Districts within State with Low Temp Shocks	5,139	0.07	0.21	0.00	1.00
Prop of Other State-Districts with High Rain Shocks	5,139	0.16	0.11	0.01	0.38
Prop of Other State-Districts with Low Rain Shocks	5,139	0.21	0.13	0.03	0.53
Prop of Other State-Districts with High Temp Shocks	5,139	0.07	0.15	0.00	0.65
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Rain: Correlation within State= 0.5 ; Correlation of District and out of State=0.2

Temp: Correlation within State=0.7 ; Correlation of District and out of State=0.5

Result-1

- Adverse weather shocks in other states impacts migration into a district
  - Temperature and Rainfall Shocks have different effects

- One standard deviation increase in proportion of “outside of state” districts with *low* rainfall shock leads to a 21 percent fall in migrants for a district

- One standard deviation increase in proportion of “outside of state” districts that have *high* temperature shocks leads to a 6 percent rise in migrants for a district.

Result-2

- Controlling for district level trends and urbanization (that account for desirability of certain districts for in-migration), other controls-including weather shocks, district fixed effects, human capital is positively associated with migration
  - Effect is very small

- Bringing the two results together:
  - A higher proportion of low rainfall shocks in other parts of the country are likely to be associated with lower human capital through a fall in migration
    - One standard deviation more districts with such shocks (13 p.p) leads to 0.5 percent of reduction in primary school completion (rel to mean)
  - A higher proportion of high temperate shocks in other parts of the country are likely to be associated with higher human capital through a rise in migration
    - Very small

Robustness

- Altonji Bounds
- Lewbel Instrumentation
- Drop districts at random
- Drop outlier migration years (high rainfall and low rainfall years)
- Years that potentially contain Short Term migrants (2001/2011) show a different response to rainfall shocks (excluding them same result)

Heterogeneity

- Effects Similar for Boys and Girls
- PRIM results do not depend on urbanization of districts but MIDD results are true only for less urban districts

- More Male Migrants due to droughts -> cause a lowering of human capital further.
    - Male Migrants more likely to compete for jobs-lower wages of domestic workers- reducing incomes and human capital?

Conclusion

- Weather shocks a pan India mechanism-with ripples felt all over
  - Partly due to correlated weather shocks
  - But also due to connectedness due to migration

- Such flows are so far small- but reductions in them (through rainfall shocks) do seem to depress human capital)
- However temperature shocks move the other way-not easy to explain
  - But mechanism due to temperature are not as developed as for rainfall .

Extra slides on Data

Migration

- Census of India 2001 and 2011
  - Data only “in” migrants (within districts and outside district-same state, outside state)
    - Less than 1 year (main workhorse of Dallman and Millock 2017)
    - 1-4 years
    - 5-9 years
    - Above 10 years

- Annualize data for 1-4 and 5-9
  - To do use NSS data sets of retrospective migration history at destination -create equivalent intervals and calculate for each year the prop of the intervals that is attributable for a particular year

- Use the NSS proportion to annualize the census interval data

Human Capital

- No district level annual data set for India
- Use census age-wise educational attainment
  - Use age to impute the year when child was 12 and 15
  - Not valid if a lot of migration: but migration rate for education is 6.8 per thousand persons (Mukhopadhyay and Sharma 2018)
  - We also *condition on passing the previous level of education*
- Some data reported in age groups, not single years-we lose some years (esp for middle school regression)

Weather Shocks

- ERA5 (Sedova and Kalkuhl 2020): rain and temperature
  - Resolution of 31 km –gridded to 0.25 degree lat long
  - Monthly from Jan 1951
- Use 1991 district shape files to extract grids points in districts
  - Small prop have no grid-take data for closest grid point

- High Shock: rainfall or temp for a district-year in the top 20% of district time series (1951-1991)
- Low Shock: bottom 20 percent in rainfall/ temperature.

Weather Shocks

- Shocks elsewhere:
  - For each district , calculate the proportion of other districts within the state that have experienced high/low shocks
  - For each state, calculate the proportion of districts in other states that experience shocks.

Other Controls

- Population, urbanization rates, literacy rates, SC prop, ST prop, prop of rural pop in agriculture
  - 1991, 2001 and 2011: use to annualize by using decadal growth rates.