



Mercator Research Institute on
Global Commons and Climate Change gGmbH



Environmental migrants in India

Barbora Sedova & Matthias Kalkuhl

sedova@mcc-berlin.net

12.10.2017



Research question

Who are the environmental migrants in India?

Research motivation

Research motivation

Mixed evidence on environmental migration

Evidence of a positive and significant relationship [Beine and Parsons, 2015, Gröger and Zylberberg, 2016, Kubik et al., 2016, Bohra-Mishra et al., 2014, Mueller et al., 2014, Mastrotillo et al., 2016]

However, some research finds ambiguous [Gray and Mueller, 2012b, Bohra-Mishra et al., 2014, Mueller et al., 2014] or negative effects [Carvajal and Medalho Pereira, 2009, Tse, 2012, Chen et al., 2017]

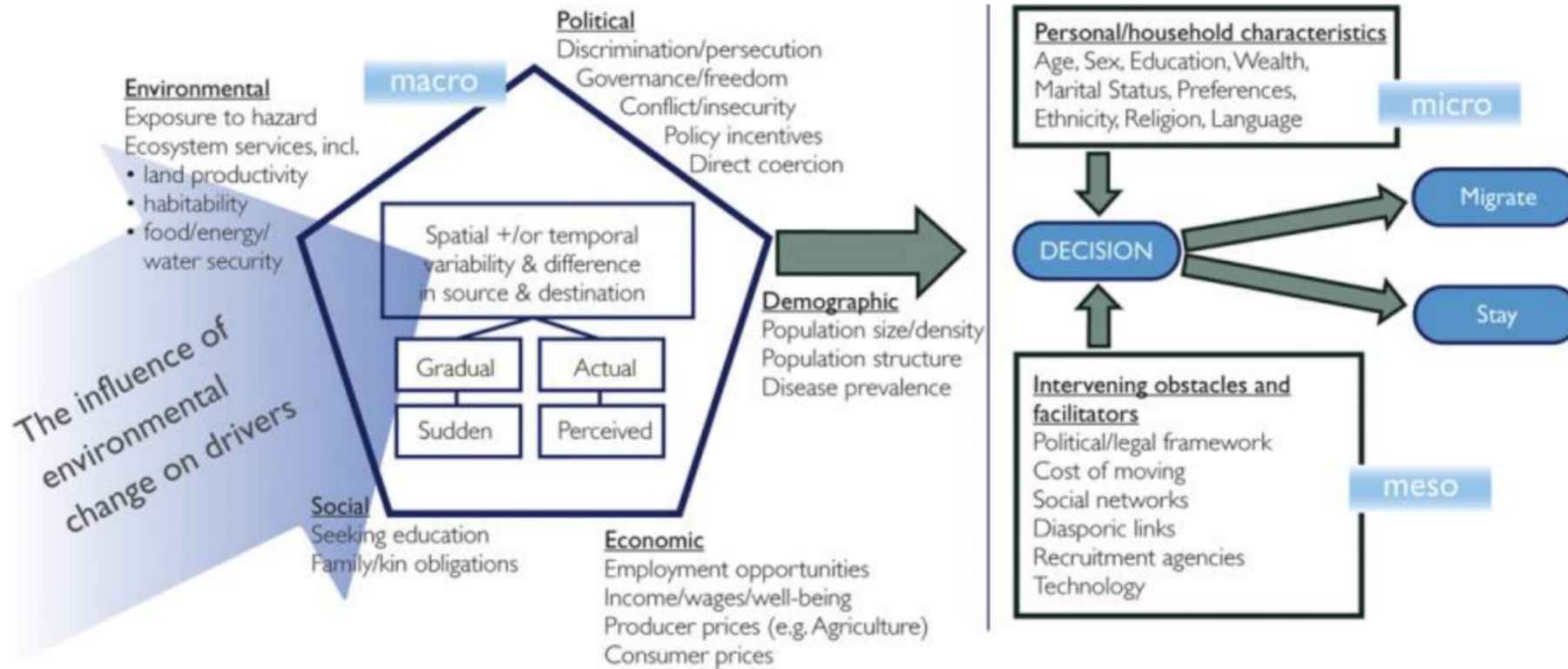
Emerging stream of literature

Acknowledges that this relationship is heterogeneous → more complex [Black et al., 2011, Carr, 2005, Perch-Nielsen et al., 2008, Thiede and Gray, 2017]

Environment may serve as a direct & indirect driver of migration

In econometric studies → interaction terms or regressions for subsamples

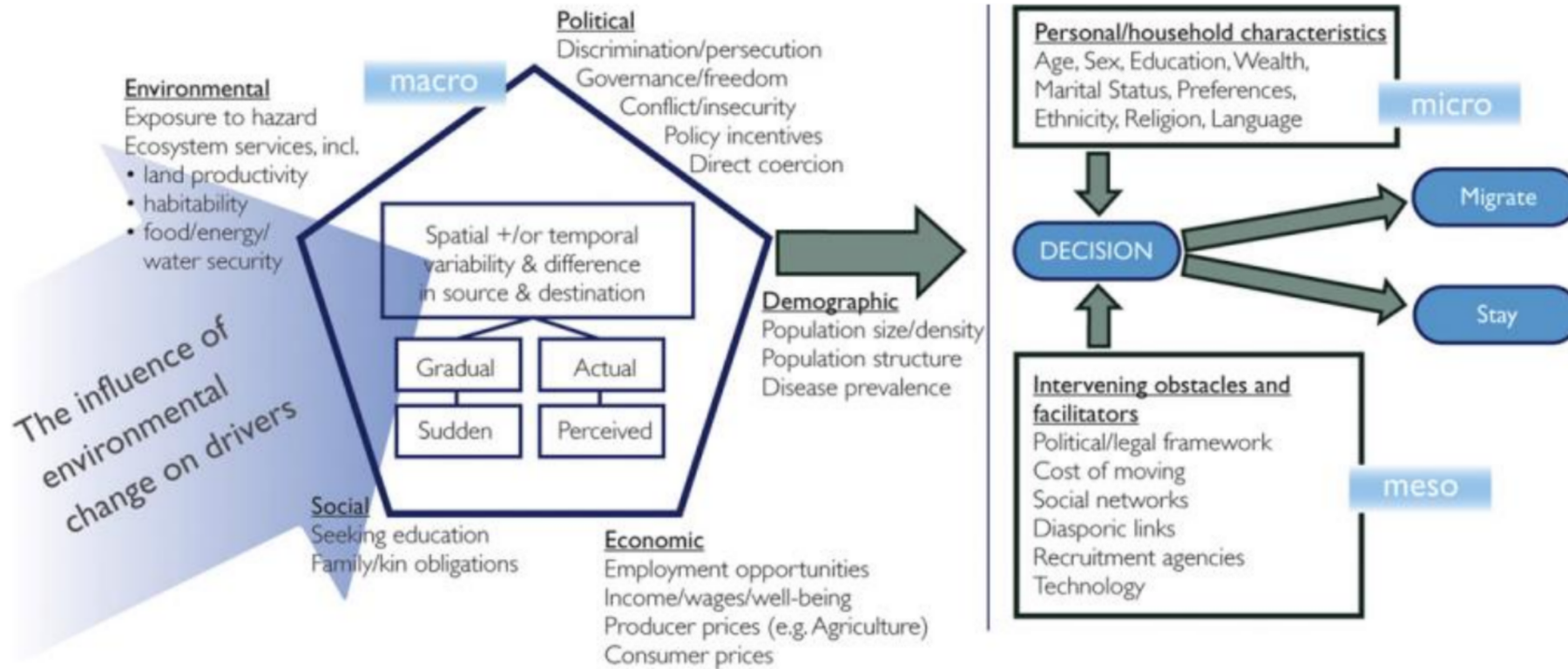
New stream of literature



Black et al. (2011)

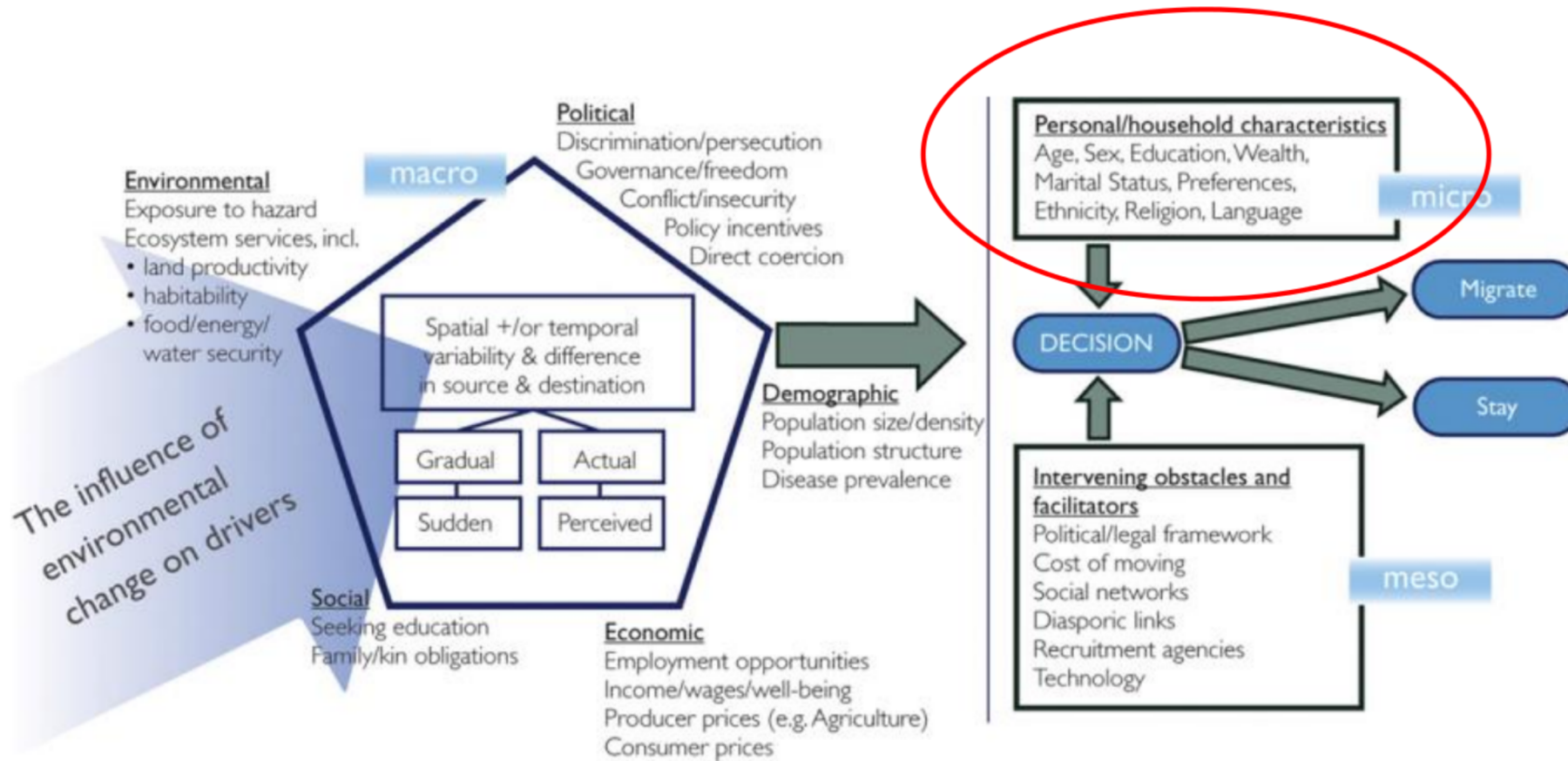
Research focus

Research focus



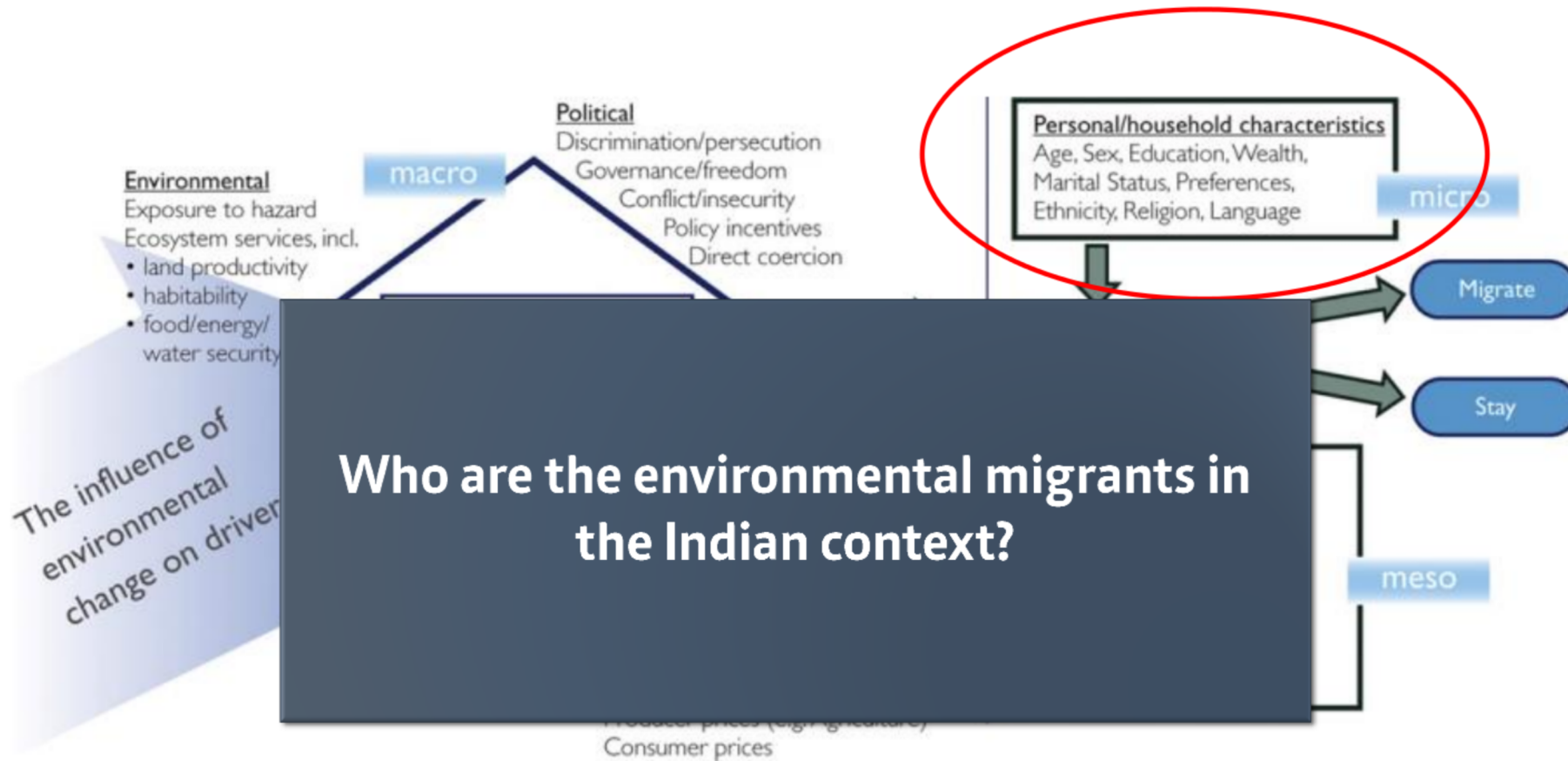
Black et al. (2011)

Research focus



Black et al. (2011)

Research focus



Black et al. (2011)

Contribution

Focus of the research question

Enables consideration of heterogeneous effects at household level

Micro-level nationally representative analysis of environmental migration in India

Usage of dataset (Indian Human Development Survey) that has not been applied in this context yet

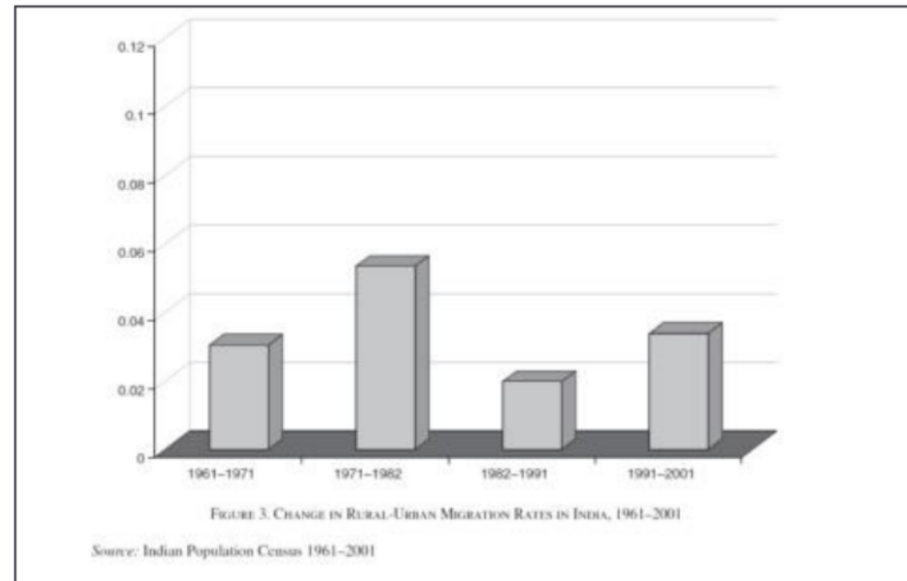
Case of India

Rural-urban migration, 1961-2001

Despite large (real) wage gaps rural-urban migration is low

Explanation

Missing formal insurance
 Strong reliance on rural informal insurance by caste (permanent mobility restriction)



Migration rates of males aged 15-24
 [Munshi and Rosenzweig, 2016]

India & climate change

Heavily dependent on (rain-fed) agriculture

17% GDP : agricultural production

60% of rural population employed in agriculture in 2015 [Worldbank, 2016]

Climate change → increasing exposure to co-variate shocks

Yields fluctuations → income fluctuations

Informal insurance does not function

 *Rural India disproportionately vulnerable to climate change impacts*

Research question

Who are the environmental migrants in India?

- FO
D8 High relevance due to climate change induced increasing frequency and intensity of such shocks
- FO
D8 Identification of segment of population most vulnerable to environmental shocks → policy relevance

Data & methodology

Data

Household data: Indian Human Development Survey

University of Maryland, National Council of Applied Economic Research, New Delhi

Nationally representative household survey

1st round in 2004-2005: 1501 villages

2nd round 2011-12 : 1410 villages

Cross-sectional analysis of 23 601 rural households

Weather data: Climatic Research Unit Timeseries

University of East Anglia

Gridded to 0.5x0.5 → merged to districts

Time span: 1901- 2010

Measures of environmental shock

Main measure of extreme weather events 2006-2010

Self-calibrating Palmer Drought Severity Index (SCPDSI)

Evaluates drought conditions

Based on water balance model → captures the difference between the precipitations required to maintain a normal water-balance level and the actual precipitations

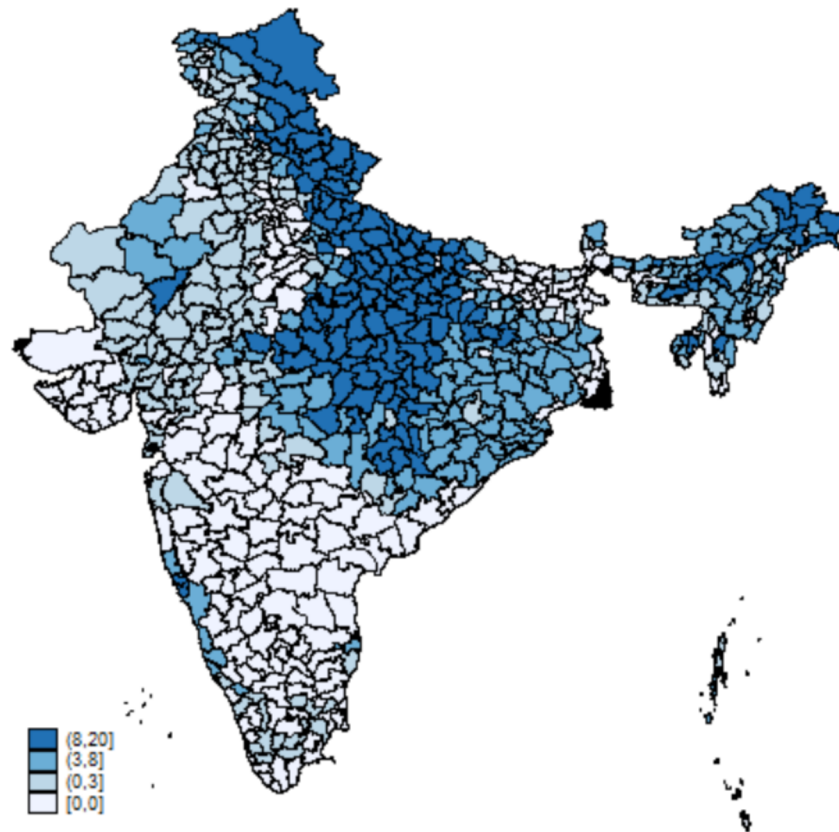
Frequency of droughts and extremely wet conditions based on SCPDSI

Kharif: growing season (June–September) coincides with southwest monsoon → critical for grain production

Variable	Mean	Description	Level
drought	4.77	average number of (at least moderate) drought months during kharif 2006-2010	district
flood	2.72	average number of (at least moderately) wet months during kharif 2006-2010	district
N		23601	

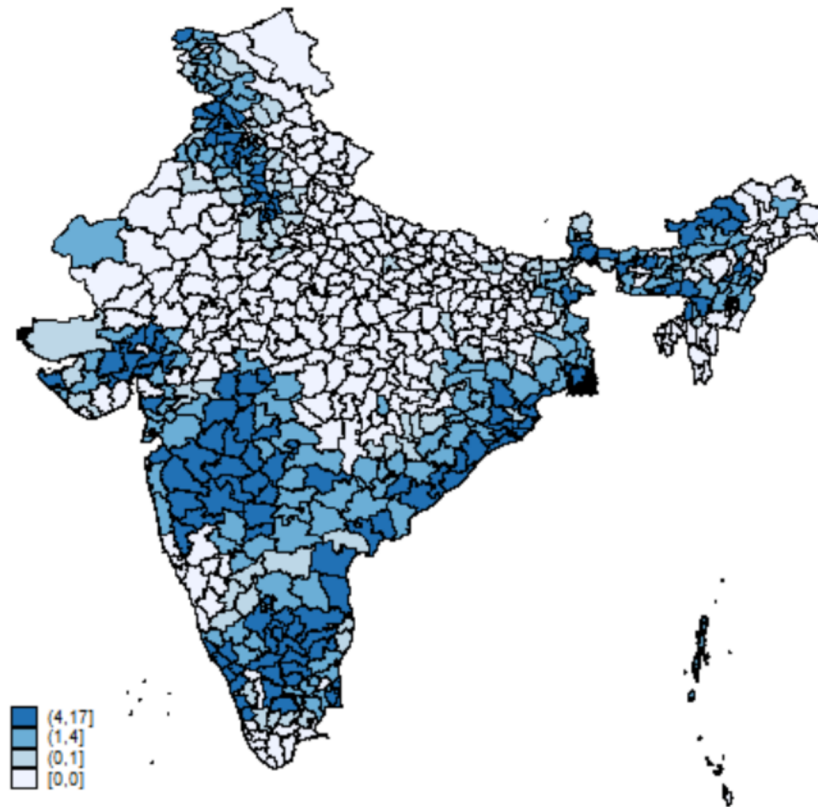
Frequency of droughts based on SCPDSI

Number of months of drought during kharif 2006-2010



Frequency of extremely wet conditions based on SCPDSI

Nr. of months of extremely wet conditions during kharif 2006-2010



Dependent variable

Dependent variable

Dependent variable → binary:

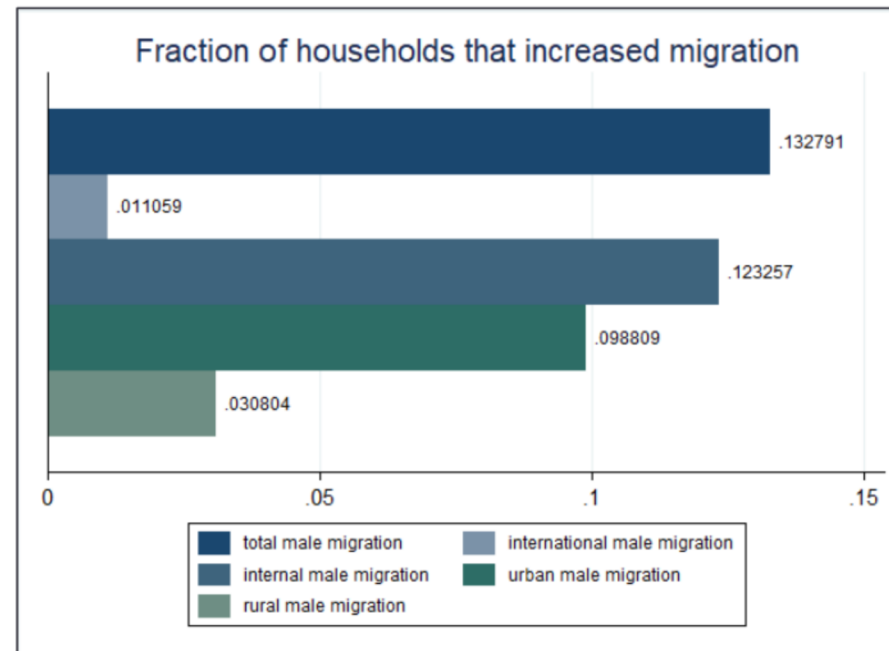
(1) hh increased number of rural out-migrants between IHDS-I and IHDS-II.

(0) else

(Sensitivity analysis with count data)

Permanent migrants:

non-resident male (female) household members in productive age (15-65), who out-migrated from rural areas for work.



Other explanatory variables

Employment of variables follows theory

Micro-level variables

Household structure: nr. of children, nr. of hh members, education, caste, wealth, agricultural dependence

Meso-level variables

Social networks → costs of moving

Macro-level variables

Economic conditions at origin and destination

Social factors: membership in associations

Political factors: crime rate, conflict rate, institutional quality

Environmental factors: drought, extremely wet conditions

Summary statistics

Variable	Mean	Description	Level
Micro-level factors			
Children	2.03	number of children	household
Members	6.05	number of members	household
Education	6.51	years of schooling of an adult with highest education	household
Poor	0.22	binary: (1) under poverty line, else (0)	household
Assets	9.94	number of assets	household
Agriculture	0.6	binary: (1) primary source of income agriculture, else (0)	household
Land	0.62	binary: (1) owns land, else (0)	household
Income	7885.26	yearly income per hh. member (Rupee)	household
Meso-level factors			
Networkhh	0.12	number of non-resident hh. members	household
Macro-level factors			
Crime	0.07	categorical: (1) experienced crime, else (0)	household
Getalong	2.37	categorical: conflict in village (1) a lot , (2) some, (3) get along	household
Income urban caste	14546.58	caste-specific yearly income per hh. member in urban area (Rupee)	caste
Income rural caste	7885.91	caste-specific yearly income per hh. member in rural area (Rupee)	caste
			23601

Summary statistics

Variable	Mean	Description	Level
Micro-level factors			
Children	2.03	number of children	household
Members	6.05	number of members	household
Education	6.51	years of schooling of an adult with highest education	household
Poor	0.22	binary: (1) under poverty line, else (0)	household
Assets	9.94	number of assets	household
Agriculture	0.6	binary: (1) primary source of income agriculture, else (0)	household
Land	0.62	binary: (1) owns land, else (0)	household
Income	7885.26	yearly income per hh. member (Rupee)	household
Meso-level factors			
Networkhh	0.12	number of non-resident hh. members	household
Macro-level factors			
Crime	0.07	categorical: (1) experienced crime, else (0)	household
Getalong	2.37	categorical: conflict in village (1) a lot , (2) some, (3) get along	household
Income urban caste	14546.58	caste-specific yearly income per hh. member in urban area (Rupee)	caste
Income rural caste	7885.91	caste-specific yearly income per hh. member in rural area (Rupee)	caste
			23601

Summary statistics

Variable	Mean	Description	Level
Micro-level factors			
Children	2.03	number of children	household
Members	6.05	number of members	household
Education	6.51	years of schooling of an adult with highest education	household
Poor	0.22	binary: (1) under poverty line, else (0)	household
Assets	9.94	number of assets	household
Agriculture	0.6	binary: (1) primary source of income agriculture, else (0)	household
Land	0.62	binary: (1) owns land, else (0)	household
Income	7885.26	yearly income per hh. member (Rupee)	household
Meso-level factors			
Networkhh	0.12	number of non-resident hh. members	household
Macro-level factors			
Crime	0.07	categorical: (1) experienced crime, else (0)	household
Getalong	2.37	categorical: conflict in village (1) a lot , (2) some, (3) get along	household
Income urban caste	14546.58	caste-specific yearly income per hh. member in urban area (Rupee)	caste
Income rural caste	7885.91	caste-specific yearly income per hh. member in rural area (Rupee)	caste
			23601

Summary statistics

Variable	Mean	Description	Level
Micro-level factors			
Children	2.03	number of children	household
Members	6.05	number of members	household
Education	6.51	years of schooling of an adult with highest education	household
Poor	0.22	binary: (1) under poverty line, else (0)	household
Assets	9.94	number of assets	household
Agriculture	0.6	binary: (1) primary source of income agriculture, else (0)	household
Land	0.62	binary: (1) owns land, else (0)	household
Income	7885.26	yearly income per hh. member (Rupee)	household
Meso-level factors			
Networkhh	0.12	number of non-resident hh. members	household
Macro-level factors			
Crime	0.07	categorical: (1) experienced crime, else (0)	household
Getalong	2.37	categorical: conflict in village (1) a lot , (2) some, (3) get along	household
Income urban caste	14546.58	caste-specific yearly income per hh. member in urban area (Rupee)	caste
Income rural caste	7885.91	caste-specific yearly income per hh. member in rural area (Rupee)	caste
23601			

Models

Model

Linear probability model

$$\Delta \text{피}_{\text{팻}} = \text{회}_0 + \text{회}_1 \text{팻} + \text{회}_2 \text{필}_{\text{팻}1} + \text{회}_3 \text{필}_{\text{팻}1} * \text{팻} + \text{회}_4 \text{필}_{\text{팻}2} + \text{회}_5 + \text{회}_6 + \text{회}_7$$

Sensitivity analysis

Negative binomial model

Dependent variable change in number of migrants

$\Delta \text{피}_{\text{팻}}$	Change in migration (1/0) between 2006-2010
팻	Environmental shock at district level 팻
$\text{필}_{\text{팻}1}$	Household characteristics at micro level
$\text{필}_{\text{팻}2}$	Meso- and macro-level factors
회_5	Village fixed effects
회_6	State fixed effects

Outcomes

Extremely wet conditions

Wet conditions & male migration

Household composition & education do not matter for migration of affected households.

	All	Internal	International	Urban	Rural
drought	-0.115*** (0.00860)	-0.0313*** (0.00845)	-0.0656*** (0.00248)	-0.0324*** (0.00810)	0.00314 (0.00403)
Children	-0.0202*** (0.00366)	-0.0197*** (0.00361)	0.0000631 (0.00102)	-0.0170*** (0.00327)	-0.00350** (0.00157)
flood	0.227*** (0.0174)	0.0177 (0.0168)	0.160*** (0.00462)	0.0208 (0.0162)	-0.00730 (0.00799)
Children*flood	0.000515 (0.000866)	0.000723 (0.000855)	-0.000434 (0.000312)	0.000689 (0.000719)	0.0000911 (0.000422)
Members	0.00917*** (0.00202)	0.00826*** (0.00196)	0.000740 (0.000902)	0.00664*** (0.00180)	0.00245** (0.000945)
Members*flood	-0.000770 (0.000488)	-0.000684 (0.000458)	0.0000299 (0.000212)	-0.000571 (0.000384)	-0.000258 (0.000239)
Education	-0.00243*** (0.000845)	-0.00224*** (0.000818)	-0.000244 (0.000245)	-0.00237*** (0.000772)	-0.000721 (0.000439)
Education*flood	0.000138 (0.000201)	0.000163 (0.000179)	-0.0000223 (0.0000917)	0.000229 (0.000172)	0.0000688 (0.0000917)
Caste	-0.0139** (0.00566)	-0.0137** (0.00552)	-0.0000910 (0.00142)	-0.00953* (0.00549)	-0.00312 (0.00234)
Caste*flood	0.00150* (0.000864)	0.00167** (0.000807)	-0.000223 (0.000268)	0.00106 (0.000752)	0.000567 (0.000427)
Poor	-0.00143 (0.00860)	-0.000177 (0.00883)	-0.000626 (0.00266)	0.00293 (0.00826)	-0.00525 (0.00561)
Poor*flood	0.00149 (0.00216)	0.000730 (0.00205)	0.000920 (0.000881)	-0.000338 (0.00209)	0.00159 (0.00109)
<i>N</i>	23601	23601	23601	23601	23601
<i>R</i> ²	0.157	0.154	0.172	0.156	0.093
Fixed effects	Yes	Yes	Yes	Yes	Yes

Clustered standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

Only heterogeneous effects reported.

2

Wet conditions & male migration

Migration is costly. Extent of wealth is not a significant driver of affected households.

	All	Internal	International	Urban	Rural
Assets	0.00444*** (0.00107)	0.00357*** (0.000991)	0.00121*** (0.000419)	0.00381*** (0.000901)	0.000178 (0.000563)
Assets*flood	-0.000125 (0.000208)	-0.000209 (0.000176)	0.0000254 (0.000102)	-0.000192 (0.000160)	-0.0000629 (0.0000948)
Agriculture	-0.0183** (0.00794)	-0.0170** (0.00775)	-0.00256 (0.00258)	-0.0121 (0.00763)	-0.00724* (0.00383)
Agriculture*flood	0.000518 (0.00215)	-0.00123 (0.00194)	0.00211*** (0.000808)	-0.000999 (0.00162)	-0.000385 (0.000992)
Land	0.00938 (0.00843)	0.00949 (0.00829)	-0.00147 (0.00228)	0.00817 (0.00753)	0.00306 (0.00422)
Land*flood	0.00149 (0.00176)	0.000989 (0.00172)	0.000622 (0.000547)	0.000553 (0.00160)	0.000555 (0.000770)
_cons	0.0968 (0.0978)	0.110 (0.0933)	-0.00820 (0.0283)	0.0519 (0.0889)	0.0751 (0.0476)
<i>N</i>	23601	23601	23601	23601	23601
<i>R</i> ²	0.157	0.154	0.172	0.156	0.093
Fixed effects	Yes	Yes	Yes	Yes	Yes

Clustered standard errors in parentheses 2
 * p<0.10, ** p<0.05, *** p<0.01
 Only heterogeneous effects reported.

Droughts

Droughts & male migration

Household composition & education do not matter for migration of affected households.

	All	Internal	International	Urban	Rural
flood	0.227*** (0.0148)	0.0243* (0.0138)	0.150*** (0.00522)	0.0260** (0.0132)	-0.000860 (0.00574)
Children	-0.0197*** (0.00321)	-0.0179*** (0.00312)	-0.00213** (0.00105)	-0.0148*** (0.00277)	-0.00247 (0.00152)
drought	-0.112*** (0.00801)	-0.0330*** (0.00777)	-0.0599*** (0.00285)	-0.0369*** (0.00742)	0.00174 (0.00375)
Children*drought	0.000160 (0.000449)	-0.0000577 (0.000467)	0.000222** (0.0000888)	-0.0000976 (0.000448)	-0.000162 (0.000204)
Members	0.00507*** (0.00188)	0.00437** (0.00174)	0.00121 (0.000883)	0.00334** (0.00159)	0.000546 (0.000825)
Members*drought	0.000395 (0.000247)	0.000395 (0.000251)	-0.0000749 (0.0000581)	0.000333 (0.000235)	0.000250** (0.000120)
Education	-0.00188** (0.000732)	-0.00153** (0.000675)	-0.000342 (0.000244)	-0.00129** (0.000637)	-0.000372 (0.000359)
Education*drought	-0.0000444 (0.000110)	-0.0000638 (0.000107)	0.0000103 (0.0000216)	-0.000102 (0.000105)	-0.0000338 (0.0000643)
Caste	-0.00618 (0.00485)	-0.00444 (0.00440)	-0.00174 (0.00186)	-0.00416 (0.00412)	0.0000624 (0.00220)
Caste*drought	-0.000618 (0.000662)	-0.000829 (0.000660)	0.000205* (0.000117)	-0.000380 (0.000659)	-0.000356 (0.000264)
Poor	0.0173* (0.00906)	0.0125 (0.00892)	0.00566 (0.00343)	0.00869 (0.00822)	0.00217 (0.00514)
Poor*drought	-0.00265** (0.00107)	-0.00187* (0.00108)	-0.000760** (0.000308)	-0.00107 (0.00106)	-0.000655 (0.000682)
<i>N</i>	23601	23601	23601	23601	23601
<i>R</i> ²	0.158	0.155	0.171	0.157	0.094
rep dummies	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses
 * p<0.10, ** p<0.05, *** p<0.01
 Only heterogeneous effects reported.

Droughts & male migration

	All	Internal	International	Urban	Rural
flood	0.227*** (0.0148)	0.0243* (0.0138)	0.150*** (0.00522)	0.0260** (0.0132)	-0.000860 (0.00574)
Children	-0.0197*** (0.00321)	-0.0179*** (0.00312)	-0.00213** (0.00105)	-0.0148*** (0.00277)	-0.00247 (0.00152)
drought	-0.112*** (0.00801)	-0.0330*** (0.00777)	-0.0599*** (0.00285)	-0.0369*** (0.00742)	0.00174 (0.00375)
Children*drought	0.000160 (0.000449)	-0.0000577 (0.000467)	0.000222** (0.0000888)	-0.0000976 (0.000448)	-0.000162 (0.000204)
Members	0.00507*** (0.00188)	0.00437** (0.00174)	0.00121 (0.000883)	0.00334** (0.00159)	0.000546 (0.000825)
Members*drought	0.000395 (0.000247)	0.000395 (0.000251)	-0.0000749 (0.0000581)	0.000333 (0.000235)	0.000250** (0.000120)
Education	-0.00188** (0.000732)	-0.00153** (0.000675)	-0.000342 (0.000244)	-0.00129** (0.000637)	-0.000372 (0.000359)
Education*drought	-0.0000444 (0.000110)	-0.0000638 (0.000107)	0.0000103 (0.0000216)	-0.000102 (0.000105)	-0.0000338 (0.0000643)
Caste	-0.00618 (0.00485)	-0.00444 (0.00440)	-0.00174 (0.00186)	-0.00416 (0.00412)	0.0000624 (0.00220)
Caste*drought	-0.000618 (0.000662)	-0.000829 (0.000660)	0.000205* (0.000117)	-0.000380 (0.000659)	-0.000356 (0.000264)
Poor	0.0173* (0.00906)	0.0125 (0.00892)	0.00566 (0.00343)	0.00869 (0.00822)	0.00217 (0.00514)
Poor*drought	-0.00265** (0.00107)	-0.00187* (0.00108)	-0.000760** (0.000308)	-0.00107 (0.00106)	-0.000655 (0.000682)
N	23601	23601	23601	23601	23601
R ²	0.158	0.155	0.171	0.157	0.094
rep dummies	Yes	Yes	Yes	Yes	Yes

Affected households living under poverty line have a lower probability of sending out migrants.

Standard errors in parentheses
 * p<0.10, ** p<0.05, *** p<0.01
 Only heterogeneous effects reported.

Droughts & male migration

Migration is costly. Extent of wealth is not a significant driver of affected households.

	All	Internal	International	Urban	Rural
Assets	0.00394*** (0.000948)	0.00251*** (0.000842)	0.00155*** (0.000376)	0.00246*** (0.000742)	0.000214 (0.000432)
Assets*drought	0.0000520 (0.000145)	0.000124 (0.000137)	-0.0000603** (0.0000299)	0.000203 (0.000131)	-0.0000504 (0.0000807)
Agriculture	-0.00967 (0.00724)	-0.0160** (0.00671)	0.00648** (0.00321)	-0.0118* (0.00632)	-0.00638* (0.00354)
Agriculture*drought	-0.00148 (0.00113)	-0.000860 (0.00111)	-0.000699** (0.000281)	-0.000617 (0.00110)	-0.000338 (0.000533)
Land	0.00896 (0.00718)	0.00698 (0.00692)	0.000503 (0.00246)	0.00526 (0.00681)	0.00327 (0.00364)
Land*drought	0.000958 (0.00114)	0.00114 (0.00113)	-0.0000816 (0.000241)	0.000978 (0.00106)	0.000243 (0.000610)
_cons	0.0743 (0.0968)	0.0647 (0.0893)	0.0315 (0.0346)	0.0289 (0.0835)	0.0508 (0.0430)
<i>N</i>	23601	23601	23601	23601	23601
<i>R</i> ²	0.158	0.155	0.171	0.157	0.094
rep dummies	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses
 * p<0.10, ** p<0.05, *** p<0.01
 Only heterogeneous effects reported.

4

Conclusion

Conclusion

Male migration → household strategy to cope with pressures at the origin

- ▣ No significant response in adaptation of female migration

Droughts decrease costly migration & may trap vulnerable segments of society at the origin

- ▣ Affected households living under poverty line have a lower probability of sending out migrants
- ▣ Households do not respond to environmental pressures by adjusting female migration

Extremely wet conditions increase rural out-migration of males

- ▣ Lower damages than droughts → migration still affordable

Conclusion

Environmental migrants in India ...

- ☐ Tend to be male
- ☐ Sufficient means to afford migration → do not live under poverty line
- ☐ Compared to other migrants → not specific in their households structure



Thank you for your attention!

Appendix

Other explanatory variables

Appendix

	All	Internal	International	Urban	Rural
Income	0.000000369 (0.000000225)	0.000000340 (0.000000211)	4.09e-08 (5.75e-08)	0.000000201 (0.000000156)	6.24e-08 (0.000000118)
Networkhh	-0.0695*** (0.00721)	-0.0576*** (0.00702)	-0.00188 (0.00385)	-0.0333*** (0.00685)	0.00339 (0.00392)
Crime	-0.0124 (0.0114)	-0.0129 (0.0113)	0.00444 (0.00287)	-0.0173 (0.0107)	0.00297 (0.00539)
Getalong	0.00244 (0.00493)	0.00173 (0.00459)	0.00149 (0.00152)	0.00553 (0.00453)	-0.00369 (0.00265)
Incomeu_caste	-0.000000383 (0.00000184)	0.000000138 (0.00000186)	-0.000000672* (0.000000384)	-5.44e-08 (0.00000168)	-0.000000174 (0.000000944)
Incomer_caste	0.000000735 (0.00000441)	-0.00000110 (0.00000428)	0.00000227* (0.00000137)	0.000000614 (0.00000375)	-0.00000123 (0.00000192)
Richerhh	0.000452*** (0.0000980)	0.000440*** (0.0000966)	0.0000260 (0.0000302)	0.000479*** (0.0000918)	-0.0000235 (0.0000431)
Electricity	-0.000968 (0.000951)	-0.000921 (0.000901)	-0.000171 (0.000265)	-0.000712 (0.000796)	-0.000379 (0.000452)
_cons	0.0968 (0.0978)	0.110 (0.0933)	-0.00820 (0.0283)	0.0519 (0.0889)	0.0751 (0.0476)
<i>N</i>	23601	23601	23601	23601	23601
<i>R</i> ²	0.157	0.154	0.172	0.156	0.093
rep dummies	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Only heterogeneous effects reported.