Do social protection programs foster short-term and long-term migration adaptation strategies?

Valerie Mueller[1*], Clark Gray[2], Sudhanshu Handa[2] and David Seidenfeld[3]

[1] Arizona State University, International Food Policy Research Institute, Tempe, Arizona, USA [2] University of North Carolina, Chapel Hill, North Carolina, USA and [3]American Institutes of Research, Washington, DC, USA

*Corresponding author. Email: vmuelle1@asu.edu

ONLINE APPENDIX

Table A1. Household baseline consumption per capita regression, current climate anomalies

	(1)	(2)
Rain	-0.734	-0.068
	(1.820)	(1.557)
Temp	-6.734	-2.554
	(1.801)***	(1.658)
R^2	0.07	0.12
N	2,284	2,284
District FEs?	No	Yes

Notes: Unit of analysis is household. Village-clustered standard errors reported. * $p<0.1$, ** $p<0.05$, *** $p<0.01$.

Table A2. Intent-to-treat and heterogeneous effects of cash transfer on migration, current climate anomalies, village-fixed effects

	Any move		Moves near		Moves far	
	(1)	(2)	(3)	(4)	(5)	(6)
	Men	Women	Men	Women	Men	Women
T	-0.074	-0.005	-0.068	-0.032	-0.015	-0.013
	(0.022)***	(0.012)	(0.016)***	(0.003)***	(0.011)	(0.003)***
T x Rain	0.013	-0.000	0.020	0.009	-0.004	-0.009
	(0.019)	(0.013)	(0.014)	(0.009)	(0.017)	(0.010)
T x Temp	-0.009	0.000	-0.023†	0.001	0.011	0.002
	(0.018)	(0.011)	(0.015)	(0.010)	(0.013)	(0.008)
Rain	0.056	0.005	0.043	-0.004	0.018	0.010
	(0.025)**	(0.011)	(0.015)***	(0.009)	(0.022)	(0.010)
Temp	-0.045	0.003	-0.032	-0.000	-0.019	0.001
	(0.023)*	(0.011)	(0.016)**	(0.009)	(0.017)	(0.010)
R^2	0.10	0.11	0.08	0.07	0.07	0.06
N	6,198	8,208	5,992	8,024	5,941	7,972
F test, p-values						
H_a=Rain + T x Rain; H_a =0	0.003	0.649	0.000	0.558	0.417	0.946
H_b=Temp + T x Temp; H_b =0	0.019	0.757	0.001	0.953	0.610	0.610
H_a (1/3/5)= H_a (2/4/6)		0.014		0.004		0.473
H_b (1/3/5)= H_b (2/4/6)		0.023		0.004		0.519

Notes: Unit of analysis is person-year. T abbreviates treatment. Village-clustered standard errors reported. All specifications include individual and household explanatory variables, as well as village and survey fixed effects. The notation H_a (1/3/5) indicates equation H_a using the estimates from models 1, 3, or 5, respectively, depending on the table column. Thus, H_a (1/3/5)= H_a (2/4/6) is testing whether the expression H_a is equal for men and women using the estimates from models (1/3/5) and (2/4/6), respectively, depending on the table column.
* p<0.1 ** p<0.05; *** p<0.01.

Table A3. Intent-to-treat and heterogeneous effects of cash transfer on migration, current climate anomalies, rainfall-pixel clustered standard errors

	Any move		Moves near		Moves far	
	(1)	(2)	(3)	(4)	(5)	(6)
	Men	Women	Men	Women	Men	Women
T	-0.016	0.006	-0.017	0.005	-0.002	0.003
	(0.012)	(0.009)	(0.008)**	(0.005)	(0.009)	(0.008)
T x Rain	0.008	0.013	0.023	0.020	-0.012	-0.005
	(0.019)	(0.016)	(0.014)	(0.010)**	(0.017)	(0.012)
T x Temp	-0.016	0.001	-0.034	-0.004	0.014	0.007
	(0.017)	(0.013)	(0.013)***	(0.009)	(0.012)	(0.010)
Rain	0.078	0.007	0.048	-0.009	0.034	0.017
	(0.022)***	(0.012)	(0.014)***	(0.008)	(0.018)*	(0.009)**
Temp	-0.059	-0.004	-0.033	0.002	-0.032	-0.009
	(0.018)***	(0.010)	(0.013)**	(0.008)	(0.014)**	(0.007)
R^2	0.07	0.09	0.04	0.06	0.04	0.05
N	6,198	8,208	5,992	8,024	5,941	7,972
F test, p-values						
H_a=Rain + T x Rain; H_a =0	0.000	0.139	0.000	0.231	0.133	0.181
H_b=Temp + T x Temp; H_b =0	0.000	0.867	0.000	0.769	0.255	0.255
H_a (1/3/5)= H_a (2/4/6)		0.009		0.000		0.593
H_b (1/3/5)= H_b (2/4/6)		0.007		0.000		0.460

Notes: Unit of analysis is person-year. T abbreviates treatment. Rainfall-pixel clustered standard errors reported. All specifications include individual and household explanatory variables, as well as district and survey fixed effects. The notation H_a (1/3/5) indicates equation H_a using the estimates from models 1, 3, or 5, respectively, depending on the table column. Thus, H_a (1/3/5)= H_a (2/4/6) is testing whether the expression H_a is equal for men and women using the estimates from models (1/3/5) and (2/4/6), respectively, depending on the table column.
* p<0.1 ** p<0.05; *** p<0.01.

Table A4. Intent-to-treat and heterogeneous effects of cash transfer on migration, current climate anomalies, temperature-pixel clustered standard errors

	Any move		Moves near		Moves far	
	(1)	(2)	(3)	(4)	(5)	(6)
	Men	Women	Men	Women	Men	Women
T	-0.016	0.006	-0.017	0.005	-0.002	0.003
	(0.011)	(0.010)	(0.007)**	(0.006)	(0.011)	(0.008)
T x Rain	0.008	0.013	0.023	0.020	-0.012	-0.005
	(0.022)	(0.021)	(0.012)*	(0.011)*	(0.017)	(0.014)
T x Temp	-0.016	0.001	-0.034	-0.004	0.014	0.007
	(0.023)	(0.015)	(0.018)*	(0.012)	(0.014)	(0.009)
Rain	0.078	0.007	0.048	-0.009	0.034	0.017
	(0.021)***	(0.014)	(0.013)***	(0.008)	(0.018)*	(0.010)
Temp	-0.059	-0.004	-0.033	0.002	-0.032	-0.009
	(0.016)***	(0.012)	(0.010)***	(0.008)	(0.013)**	(0.009)
R^2	0.07	0.09	0.04	0.06	0.04	0.05
N	6,198	8,208	5,992	8,024	5,941	7,972
F test, p-values						
H_a=Rain + T x Rain; H_a =0	0.001	0.249	0.002	0.286	0.076	0.303
H_b=Temp + T x Temp; H_b =0	0.007	0.863	0.002	0.797	0.243	0.243
H_a (1/3/5)= H_a (2/4/6)		0.045		0.019		0.630
H_b (1/3/5)= H_b (2/4/6)		0.051		0.016		0.467

Notes: Unit of analysis is person-year. T abbreviates treatment. Temperature-pixel clustered standard errors reported. All specifications include individual and household explanatory variables, as well as district and survey fixed effects. The notation H_a (1/3/5) indicates equation H_a using the estimates from models 1, 3, or 5, respectively, depending on the table column. Thus, H_a (1/3/5)= H_a (2/4/6) is testing whether the expression H_a is equal for men and women using the estimates from models (1/3/5) and (2/4/6), respectively, depending on the table column.
* p<0.1 ** p<0.05; *** p<0.01.

Table A5. Intent-to-treat and heterogeneous effects of cash transfer on migration, lagged climate anomalies

	Any move		Moves near		Moves far	
	(1)	(2)	(3)	(4)	(5)	(6)
	Men	Women	Men	Women	Men	Women
Panel A: Lagged Climate Anomalies						
T	-0.009	0.009	-0.006	0.004	-0.003	0.007
	(0.013)	(0.009)	(0.010)	(0.006)	(0.008)	(0.007)
T x Rain	-0.005	0.002	-0.009	0.001	0.003	0.003
	(0.012)	(0.007)	(0.008)	(0.005)	(0.010)	(0.006)
T x Temp	-0.013	0.018	-0.029	-0.001	0.017	0.024
	(0.031)	(0.020)	(0.023)	(0.013)	(0.022)	(0.017)
Rain	0.003	0.001	-0.000	-0.002	0.001	0.003
	(0.010)	(0.006)	(0.006)	(0.004)	(0.008)	(0.005)
Temp	-0.080	-0.024	-0.051	-0.008	-0.040	-0.021
	(0.035)**	(0.016)	(0.027)*	(0.012)	(0.023)*	(0.013)
R^2	0.07	0.09	0.04	0.06	0.04	0.05
F test, p-values						
H_a=Rain + T x Rain; H_a =0	0.697	0.491	0.099	0.677	0.426	0.170
H_b=Temp + T x Temp; H_b =0	0.006	0.773	0.003	0.467	0.232	0.232
H_a (1/3/5)= H_a (2/4/6)		0.463		0.260		0.823
H_b (1/3/5)= H_b (2/4/6)		0.032		0.018		0.301
Panel B: Positive vs. Negative Lagged Climate Anomalies						
T	0.005	0.002	0.004	0.004	0.002	-0.001
	(0.015)	(0.011)	(0.013)	(0.007)	(0.010)	(0.007)
T x Rain-	-0.065	0.042	-0.031	0.011	-0.040	0.035
	(0.049)	(0.031)	(0.035)	(0.021)	(0.034)	(0.026)
T x Rain+	-0.019	0.009	-0.015	0.003	-0.005	0.008
	(0.017)	(0.009)	(0.011)	(0.006)	(0.015)	(0.008)
T x Temp-	0.018	-0.021	0.025	-0.004	-0.008	-0.022
	(0.040)	(0.024)	(0.029)	(0.015)	(0.029)	(0.020)
T x Temp+	-0.147	0.086	-0.215	-0.087	0.044	0.154

	(0.254)	(0.203)	(0.189)	(0.126)	(0.151)	(0.148)
Rain-	0.028	-0.023	0.002	0.008	0.031	-0.028
	(0.039)	(0.023)	(0.028)	(0.018)	(0.032)	(0.016)*
Rain+	0.009	0.000	-0.001	-0.000	0.009	0.001
	(0.016)	(0.008)	(0.010)	(0.005)	(0.014)	(0.007)
Temp-	0.073	0.010	0.050	0.001	0.034	0.012
	(0.040)*	(0.019)	(0.031)	(0.013)	(0.028)	(0.016)
Temp+	-0.080	-0.281	-0.011	-0.081	-0.043	-0.227
	(0.210)	(0.129)**	(0.158)	(0.087)	(0.119)	(0.080)***
R^2	0.07	0.09	0.04	0.06	0.04	0.05
F test, p-values						
H_a=T+T x Rain-; H_a =0	0.337	0.422	0.371	0.250	0.711	0.774
H_b=T+T x Rain+; H_b =0	0.331	0.210	0.057	0.519	0.686	0.152
H_c=T+T x Temp-; H_c =0	0.016	0.580	0.012	0.829	0.208	0.208
H_d=T+T x Temp+; H_d =0	0.092	0.213	0.027	0.073	0.995	0.995
H_a (1/3/5)= H_a (2/4/6)		0.273		0.179		0.681
H_b (1/3/5)= H_b (2/4/6)		0.150		0.059		0.612
H_c (1/3/5)= H_c (2/4/6)		0.029		0.019		0.198
H_d (1/3/5)= H_d (2/4/6)		0.821		0.576		0.479
N	6,198	8,208	5,992	8,024	5,941	7,972

Notes: Unit of analysis is person-year. T abbreviates treatment. Rain+ and Temp+ use the absolute values of z-scores that are greater than or equal to zero. Rain- and Temp- use the absolute values of z-scores that are less than zero. Village-clustered standard errors reported. All specifications include individual and household explanatory variables, as well as district and survey fixed effects. The notation H_a (1/3/5) indicates equation H_a using the estimates from models 1, 3, or 5, respectively, depending on the table column. Thus, H_a (1/3/5)= H_a (2/4/6) is testing whether the expression H_a is equal for men and women using the estimates from models (1/3/5) and (2/4/6), respectively, depending on the table column.
* p<0.1 ** p<0.05; *** p<0.01.

Table A6. Intent-to-treat and heterogeneous effects of cash transfer on migration, contemporaneous and lagged climate levels

	Any move		Moves near		Moves far	
	(1)	(2)	(3)	(4)	(5)	(6)
	Men	Women	Men	Women	Men	Women
Panel A: Contemporaneous Climate Levels						
T	0.040	-0.027	0.112	0.039	-0.057	-0.142
	(0.409)	(0.274)	(0.335)	(0.196)	(0.244)	(0.170)
T x Rain	-0.000	0.000	0.001	0.000	-0.001	0.000
	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
T x Temp	-0.002	0.001	-0.007	-0.002	0.004	0.006
	(0.018)	(0.012)	(0.015)	(0.008)	(0.010)	(0.007)
Rain	0.002	0.000	0.001	-0.000	0.001	0.000
	(0.001)***	(0.000)	(0.000)	(0.000)	(0.000)***	(0.000)
Temp	-0.000	0.015	0.006	0.006	-0.006	0.009
	(0.011)	(0.005)***	(0.007)	(0.003)*	(0.007)	(0.004)**
R^2	0.07	0.09	0.04	0.06	0.05	0.05
F test, p-values						
H_a=Rain + T x Rain; H_a =0	0.036	0.842	0.119	0.871	0.040	0.702
H_b=Temp + T x Temp; H_b =0	0.888	0.142	0.969	0.540	0.795	0.795
H_a (1/3/5)= H_a (2/4/6)		0.104		0.162		0.177
H_b (1/3/5)= H_b (2/4/6)		0.242		0.672		0.124
Panel B: Lagged Climate Levels						
T	-0.378	-0.011	-0.366	0.097	-0.068	-0.175
	(0.433)	(0.293)	(0.338)	(0.201)	(0.257)	(0.194)
T x Rain	-0.000	-0.000	0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
T x Temp	0.017	0.001	0.015	-0.003	0.004	0.008
	(0.018)	(0.012)	(0.014)	(0.008)	(0.011)	(0.008)
Rain	0.001	0.000	-0.000	0.000	0.001	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)**	(0.000)
Temp	-0.005	0.013	-0.000	0.006	-0.005	0.007

	(0.014)	(0.005)**	(0.008)	(0.003)*	(0.009)	(0.005)
R^2	0.07	0.09	0.04	0.06	0.04	0.05
F test, p-values						
H_a=Rain + T x Rain; H_a =0	0.269	0.995	0.934	0.464	0.105	0.397
H_b=Temp + T x Temp; H_b =0	0.331	0.207	0.172	0.707	0.812	0.812
H_a (1/3/5)= H_a (2/4/6)		0.185		0.617		0.096
H_b (1/3/5)= H_b (2/4/6)		0.727		0.155		0.100
N	6,198	8,208	5,992	8,024	5,941	7,972

Notes: Unit of analysis is person-year. T abbreviates treatment. All specifications include individual and household explanatory variables, as well as district and survey fixed effects. The notation H_a (1/3/5) indicates equation H_a using the estimates from models 1, 3, or 5, respectively, depending on the table column. Thus, H_a (1/3/5)= H_a (2/4/6) is testing whether the expression H_a is equal for men and women using the estimates from models (1/3/5) and (2/4/6), respectively, depending on the table column.

* p<0.1 ** p<0.05; *** p<0.01.

Table A7. Pearson correlation coefficients

Variable	R_t	T_t	R_{t-1}	T_{t-1}
R_t	1.00			
T_t	0.44	1.00		
R_{t-1}	0.16	0.34	1.00	
T_{t-1}	0.18	-0.08	-0.59	1.00

Notes: R and T refer to rainfall and temperature z-scores, respectively. The subscripts t and t-1 denote 0- and 1-year lagged variables.

Table A8. Intent-to-treat and climate heterogeneous effects of cash transfer on male migration, by temporal differences in climate exposure

	(1) Moves near one-year lag
T	-0.028
	(0.013)**
T x Rain	0.029
	(0.018)
T x Temp	-0.036
	(0.016)**
T x Lagged Rain	-0.002
	(0.010)
T x Lagged Temp	-0.036
	(0.026)
Rain	0.056
	(0.016)***
Temp	-0.016
	(0.016)
Lagged Rain	-0.019
	(0.010)*
Lagged Temp	-0.041
	(0.025)
R^2	0.05
F statistic, p-values	
H_a=Rain + T x Rain; H_a =0	0.000
H_b=Temp + T x Temp; H_b =0	0.001
H_c=Lagged Rain + T x Lagged Rain; H_c =0	0.020
H_d=Lagged Temp + T x Lagged Temp; H_d =0	0.001
N	5,992

Notes: Unit of analysis is person-year. T abbreviates treatment. Village-clustered standard errors reported. All specifications include individual and household explanatory variables, as well as district and survey fixed effects.
* p<0.1 ** p<0.05 *** p<0.01.

Table A9. Intent-to-treat and heterogeneous effects of cash transfer on migration, current wet season climate anomalies

	Any move		Moves near		Moves far	
	(1)	(2)	(3)	(4)	(5)	(6)
	Men	Women	Men	Women	Men	Women
T	-0.021	0.003	-0.028	-0.003	0.003	0.007
	(0.016)	(0.009)	(0.010)***	(0.008)	(0.013)	(0.007)
T x Rain	0.002	0.005	0.009	0.008	-0.005	-0.002
	(0.011)	(0.008)	(0.008)	(0.005)	(0.010)	(0.006)
T x Temp	-0.027	0.002	-0.050	-0.007	0.017	0.012
	(0.026)	(0.015)	(0.020)**	(0.012)	(0.020)	(0.011)
Rain	0.045	0.007	0.028	-0.001	0.019	0.009
	(0.013)***	(0.008)	(0.010)***	(0.005)	(0.011)	(0.006)
Temp	-0.067	-0.010	-0.035	-0.002	-0.036	-0.013
	(0.028)**	(0.013)	(0.020)*	(0.010)	(0.022)	(0.009)
R^2	0.07	0.09	0.04	0.06	0.04	0.05
N	6,198	8,208	5,992	8,024	5,941	7,972
F statistic, p-values						
H_a=Rain + T x Rain; H_a =0	0.000	0.139	0.000	0.191	0.077	0.196
H_b=Temp + T x Temp; H_b =0	0.000	0.637	0.000	0.420	0.176	0.176
H_a (1/3/5)= H_a (2/4/6)		0.021		0.005		0.541
H_b (1/3/5)= H_b (2/4/6)		0.006		0.001		0.369

Notes: Unit of analysis is person-year. Village-clustered standard errors reported. * p<0.1 ** p<0.05; *** p<0.01. District and survey fixed effects included. The wet season is defined as December through March.

Table A10. Average individual and household baseline characteristics for males by treatment and wealth status

	Poor			Less Poor		
	Control	Treated	Difference	Control	Treated	Difference
Age is 19 to 35 years old	0.451	0.496	0.05	0.590	0.567	-0.02
	(0.022)	(0.023)	[0.16]	(0.022)	(0.021)	[0.51]
Age is 36 to 55 years old	0.333	0.291	-0.04	0.262	0.292	0.03
	(0.021)	(0.020)	[0.11]	(0.020)	(0.019)	[0.26]
Age is greater than 55 years old	0.023	0.026	0.00	0.026	0.013	-0.01
	(0.007)	(0.007)	[0.71]	(0.007)	(0.005)	[0.13]
Number of people ages 6 - 12	1.725	1.652	-0.07	1.221	1.325	0.10
	(0.052)	(0.052)	[0.53]	(0.051)	(0.052)	[0.43]
Number of people ages 13 - 18	0.946	0.961	0.02	0.626	0.792	0.17
	(0.048)	(0.046)	[0.88]	(0.041)	(0.041)	[0.08]
Number of people ages 19 - 35	1.315	1.539	0.22	1.600	1.558	-0.04
	(0.038)	(0.039)	[0.01]	(0.046)	(0.041)	[0.71]
Number of people ages 36 - 55	0.845	0.754	-0.09	0.646	0.690	0.04
	(0.036)	(0.035)	[0.20]	(0.036)	(0.035)	[0.51]
Number of people ages 56 - 69	0.060	0.083	0.02	0.097	0.054	-0.04
	(0.012)	(0.014)	[0.47]	(0.014)	(0.011)	[0.14]
Mean of 12-month rainfall, 1981-2009	74.688	76.189	1.50	75.916	77.646	1.73
	(0.478)	(0.594)	[0.59]	(0.525)	(0.531)	[0.52]
SD of 12-month rainfall, 1981-2009	15.187	15.632	0.44	16.910	16.828	-0.08
	(0.161)	(0.177)	[0.58]	(0.172)	(0.186)	[0.93]
Mean of 12 month-temperatures, 1981-2009	23.517	23.579	0.06	23.518	23.591	0.07
	(0.023)	(0.018)	[0.54]	(0.024)	(0.017)	[0.48]
SD of 12 month-temperatures, 1981-2009	0.501	0.507	0.01	0.535	0.522	-0.01
	(0.005)	(0.005)	[0.81]	(0.004)	(0.004)	[0.53]
Kaputa	0.445	0.421	-0.02	0.264	0.327	0.06
	(0.022)	(0.022)	[0.84]	(0.020)	(0.020)	[0.54]
Shangombo	0.412	0.429	0.02	0.364	0.321	-0.04
	(0.022)	(0.022)	[0.89]	(0.021)	(0.020)	[0.70]
N	517	492		503	554	

Notes: P values in brackets for t tests of difference in means. F statistic testing joint significance of all variables for poor sample is 1.35 (p-value=0.20). F statistic testing joint significance of all variables for less poor sample is 1.12 (p-value=0.35).