

Temperature, Worker Productivity, and Adaptation

Evidence from Survey Data Production



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Camp Resources 2018

August 13, 2018

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Temperature, Labor Productivity, and Adaptation

- We know temperature has a negative relationship with aggregate output (e.g. Hsiang (2010), Dell et al. (2012)).
- Much less is known about the microeconomic mechanisms of reduced productivity.
 - Previous studies on worker productivity focus on indoor sectors of the economy, single firms.
 - Individuals may make short-term adaptive changes, such as reallocation of time (Zivin and Neidell, 2014)
 - Might productivity fall more on less observable tasks?

Research question

- Do extreme temperatures affect the productivity and job performance of outdoor workers?
- What actions do workers take to minimize the utility loss from extreme temperature?

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Strategy: Study the productivity of survey interviewers in developing countries as workers

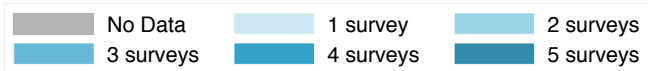
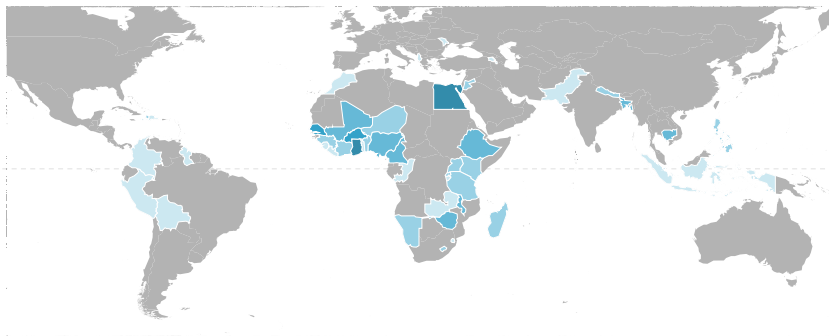
- Interviewers in developing countries conduct interviews in non climate-controlled settings

Daily interviewer productivity data from 46 countries

Study the productivity of interviewers in the Demographic and Health Survey (DHS)

- Reconstruct the daily work schedules of each interviewer and look at quantity and timing of data production
 - Each interview has an interviewer ID, a start time and end time, demographic information on the respondent, and data quality information
 - Quantity of interviews produced is more easily observed by supervisors than quality of data
- Measure data quality as (invalid) missing responses and flags for poor quality dates and measurements.
- Merge each DHS cluster with weather data from the Princeton Meteorological Dataset

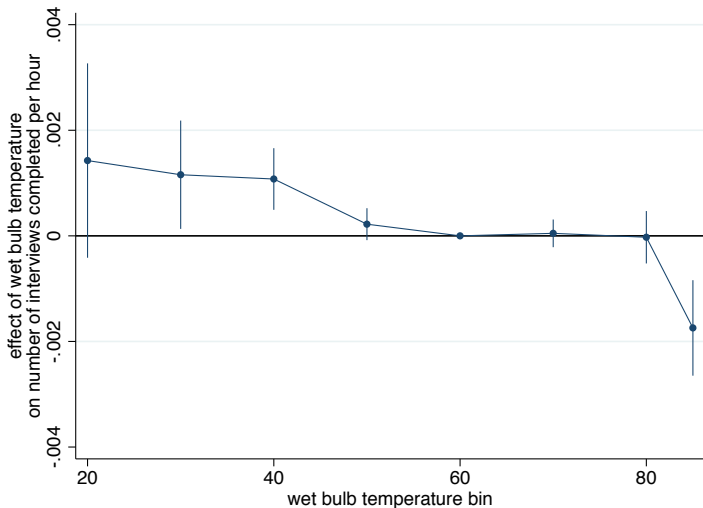
DHS countries span developing world



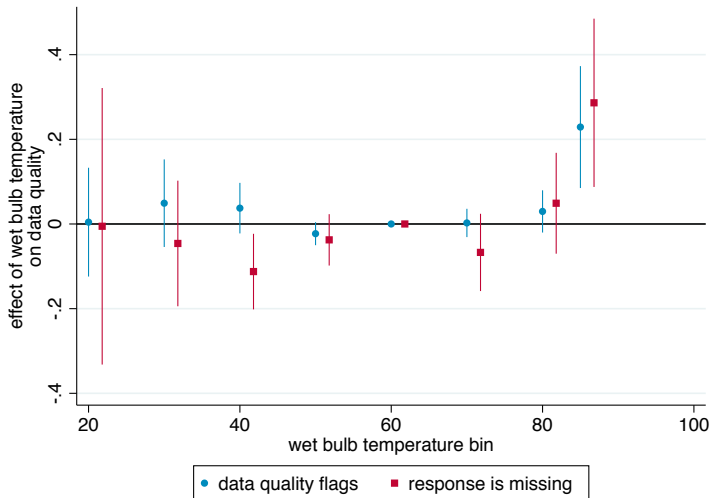
Regression strategy

- Control for region of country fixed effects, usual local climate
- $$Y_{icprd} = \sum_j \beta_j \cdot \text{Exposure}_{cpd}(T_j) + \theta_p + \rho \text{Daylight}_{cpd} + \nu X_{rcpd} + \sigma \text{Expected Temp}_{cpm} + \gamma \text{Day in Round}_{pd} + \epsilon_{icprd}$$
 - An observation is an interviewer/day
 - i: interviewer; r: set of respondents; c: survey cluster (village or city block); p: country-region; d: day of interview
 - Exposure: indicator for daily average wet bulb temperature in bin j
 - Controls for average temperature in cluster/month; number of daylight hours in cluster/date; respondent characteristics; days since beginning of survey round.
 - Cluster standard errors at region of country level

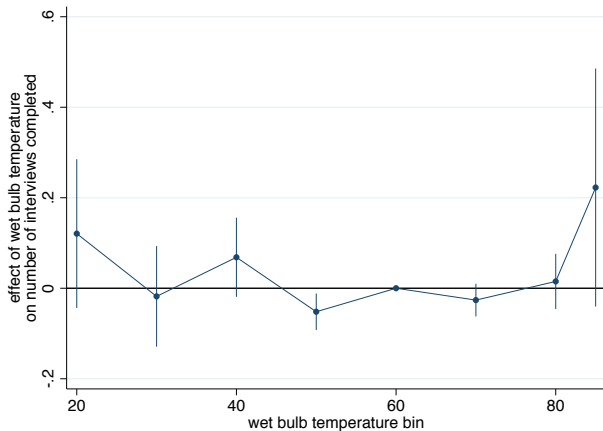
Number of interviews per hour declines on hot days



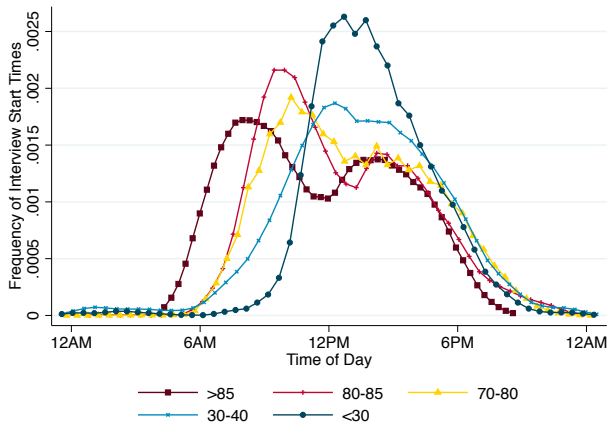
More data quality issues arise on hot days...



...but number of completed interviews does not decrease



Interviewers allocate work time to more pleasant temps



Discussion & Conclusion

Strategy: Study the productivity of survey interviewers as workers

- Main effect on production efficiency of an 85 degree wet bulb day is 10 percent.
- Results also suggest that certain contracts might be less effective in hot places.
- There may be negative utility and efficiency consequences from certain adaptive behaviors.

How to generalize this effect?

- Not necessarily a rare occupation: 1 in 4 Malawians in capital city with a secondary education have worked as an interviewer (1 in 10 overall) (Chinkhumba et al., 2014).
- Production targets, difficulty observing quality, and outdoor work are common.

Interviewers are paid per day, work full time

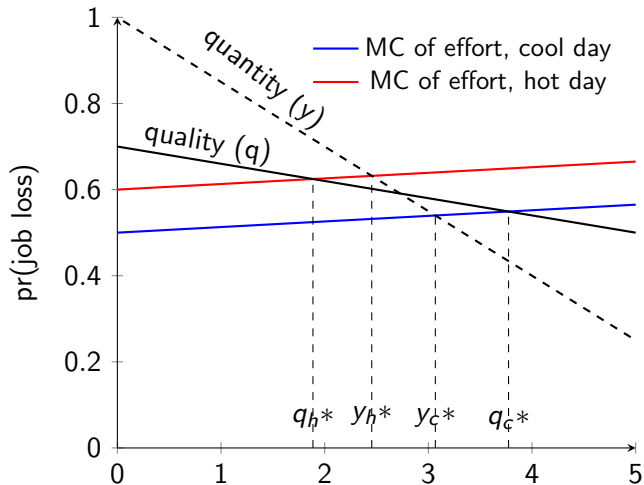
- Interviewers paid a flat rate per day, not per hour or piece rate.
- Incentive to perform well comes from continuation value of having the job.
 - Do not observe terminations, but DHS practice is to hire reserve interviewers to fill gaps after separations.
 - About 3/4 of interviewers in recent surveys had worked for another interview before.
- Interviewers must be available full time, including nights and weekends.
- Receive household assignments at beginning of the day, but assignments are adjusted based on needs throughout the day.

Princeton Weather Data Details

Combines reanalysis data from the National Centers for Environmental Prediction-National Center for Atmospheric Research (NCEP-NCAR) with observational data

- Reanalysis data: observational data combined with physics-based weather models to improve coverage in observationally sparse regions.
- Biases in the reanalysis data are corrected using observational data on precipitation, temperature, and radiation
- Upper air temperature and wind are more strongly influenced by observational data; humidity and surface temperature are more modeled.
- Observational data from the Climactic Research Unit (CRU) dataset and the Global Precipitation Climatology Project (GPCP)

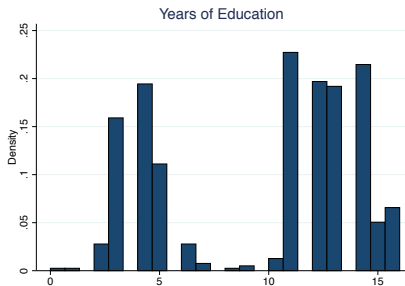
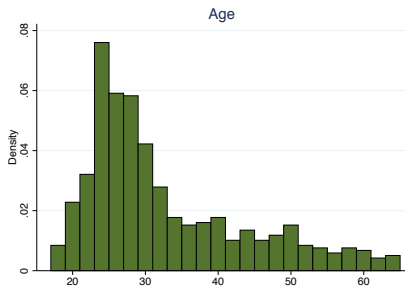
Effect of temperature may be larger on quality than quantity



Daylight Hours Do Not Mediate Relationship Between Temp and Start Time

	Start Time		
Wet Bulb Bin			
<30 Degrees	105.489*** (4.193)	111.552*** (4.298)	
30-40 Degrees	59.637*** (2.489)	63.555*** (2.563)	
40-50 Degrees	17.653*** (1.252)	19.935*** (1.301)	
50-60 Degrees	-4.091*** (0.769)	-2.649*** (0.801)	
70-80 Degrees	-14.239*** (0.664)	-14.421*** (0.664)	
80-85 Degrees	-52.843*** (1.407)	-53.644*** (1.412)	
>85 Degrees	-163.049*** (10.657)	-166.374*** (10.669)	
Daylight	-0.099*** (0.006)		0.042 (0.006)
Observations	413,417	413,417	413,417

Interviewer Characteristics



◀ Back

Role of the respondent

- Productivity results may include an effect on the respondent

There are two ways that the respondent could drive the results

- An effect on nonresponse: 10 percent of interviews require more than one attempt
 - Potential selection effect into the sample is an issue if easier respondents are less likely to be present on hot days
 - Nonresponse could also cause interviewers' work to take longer
- Respondent could behave differently during the interview
 - Might expect this to differ for different types of respondents

There is a small amount of selection on respondents...

Wet Bulb Bin	Number of Children Aged								
	Age	Works	<5	Formal House	Illiterate	Electricity	Married	Asset Index	Sex
<30 Degrees	0.349 (0.266)	-0.000588 (0.0281)	0.0406 (0.0470)	-0.0256 (0.0306)	-0.0236 (0.0244)	-0.0113 (0.0291)	-0.00447 (0.0169)	-0.0339 (0.138)	-0.0319** (0.0132)
30-40 Degrees	-0.00992 (0.183)	-0.0193 (0.0179)	0.121** (0.0522)	-0.0574* (0.0314)	-0.00324 (0.0195)	-0.0147 (0.0278)	-0.00583 (0.0113)	-0.155 (0.140)	-0.00769 (0.00575)
40-50 Degrees	-0.0790 (0.0986)	-0.00642 (0.00959)	0.0367 (0.0245)	-0.0291** (0.0145)	0.00242 (0.00984)	-0.00551 (0.0141)	-0.00139 (0.00590)	-0.0969 (0.0623)	-0.00175 (0.00284)
50-60 Degrees	-0.0628 (0.0573)	-0.00734 (0.00611)	0.0238 (0.0165)	-0.00377 (0.00892)	-0.00943 (0.00680)	-0.00782 (0.00905)	-0.000949 (0.00362)	-0.0151 (0.0388)	0.00232 (0.00199)
70-80 Degrees	0.0277 (0.0684)	0.0165*** (0.00565)	0.0119 (0.0152)	0.00241 (0.00919)	-0.00668 (0.00542)	0.00440 (0.00863)	-0.000674 (0.00464)	0.0168 (0.0384)	-0.000141 (0.00182)
80-85 Degrees	-0.0194 (0.102)	0.0161* (0.00852)	0.0359 (0.0246)	-0.0147 (0.0152)	-0.00803 (0.00852)	-0.00229 (0.0154)	0.00357 (0.00743)	0.000432 (0.0719)	-0.00120 (0.00288)
>85 Degrees	0.428 (0.264)	-0.0820 (0.0508)	0.127* (0.0677)	0.0129 (0.0981)	-0.0215 (0.0871)	0.0720 (0.0929)	0.0380 (0.0254)	0.433 (0.324)	-0.00622 (0.0341)
Observations	962,443	962,443	962,443	962,443	962,443	962,443	962,443	962,443	1,221,516
R-squared	0.036	0.177	0.166	0.395	0.414	0.505	0.242	0.436	0.146

Robust standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

...but respondent controls don't affect main results

