Mapping poverty in rural China: how much does the environment matter?[*]

Susan Olivia (Corresponding author), Department of Econometrics and Business Statistics, Monash University, Clayton, Victoria 3800, Australia. Email: susan.olivia@monash.edu

John Gibson,University of Waikato, Hamilton, New Zealand.
Email: jkgibson@mngt.waikato.ac.nz

Scott Rozelle, Stanford University, Stanford, California, USA. Email: rozelle@stanford.edu

Jikun Huang, Chinese Academy of Sciences, Beijing, China.
Email: jkhuang.ccap@igsnrr.ac.cn

Xiangzheng Deng, Chinese Academy of Sciences, Beijing, China.
Email: dengxz.ccap@igsnrr.ac.cn

APPENDIX TABLES

Table A1. Comparisons of survey and census means

	Data Source	Survey (S)		Census (C)		
		Mean	Std. Dev.	Census Mean	Std. Dev.	*p-value*
Welfare Indicator						
Per capita expenditure	S	1,090.68	n.a.	n.a.	n.a.	n.a.
Demographic Characteristics						
Household Size	S & C	4.365	1.222	4.509	1.855	0.900
% of kids	S & C	0.265	0.196	0.253	0.196	0.250
% of adult	S & C	0.735	0.214	0.747	0.214	0.250
Education Characteristics						
# of labor force in HH completed primary school	S & C	0.826	0.943	0.832	0.908	0.862
# of labor force in HH completed junior high school	S & C	1.125	0.910	1.089	1.020	0.361
# of labor force in HH completed senior high school	S & C	0.207	0.391	0.220	0.515	0.404
# of labor force in HH completed vocational school	S & C	0.057	0.334	0.046	0.240	0.252
# of labor force in HH with college degree and above	S & C	0.023	0.218	0.032	0.210	0.125
Dwelling Characteristics						
Housing area (in square meter)	S & C	101.329	56.221	97.070	68.866	0.143
Brick House (dummy = 1; 0 otherwise)	S & C	0.539	0.499	0.560	0.496	0.506
Multi-floors dwelling (dummy=1; 0 otherwise)	S & C	0.162	0.368	0.138	0.344	0.258
Household Economic Activities						
Number of household members engage in non-agriculture activities	S & C	0.576	0.790	0.549	0.646	0.085

Table A2. First-stage regression model of log per capita expenditure

| | Without Environmental Variables | | With Environmental Variables | | | |
| | | | Level | | Interaction | |
	Coeff	s.e.	Coeff	s.e.	Coeff	s.e.
Household Level Characteristics						
Household size	-1.084	0.517	-1.283	0.513	-1.212	0.501
Household size * Housing area			-0.001	0.000	-0.001	0.000
% kids aged 0 - 14 yrs					4.733	0.861
% adults * # HH members completed primary school			-0.074	0.025		
# HH members completed primary	-0.082	0.021				
# HH members completed junior high school					-1.119	0.360
# HH members completed senior high school (square)	0.054	0.019	0.051	0.019		
# HH members completed vocational degree	0.219	0.105	0.220	0.103		
# HH members with college degree and above	-1.331	0.494	-1.209	0.487	-1.057	0.480
# HH members with college degree and above (square)	0.729	0.228	0.668	0.225	0.592	0.223
# HH members engaged in non-agricultural activities	0.116	0.024	0.109	0.024	-2.121	0.621
Housing area (meter square)	0.002	0.000	0.005	0.001	0.033	0.007
House made of brick (dummy = 1; 0 otherwise)			-0.833	0.372		
Multi-floors house (dummy = 1; 0 otherwise)	0.115	0.056	0.140	0.057		
Census Means at Township (T) and County(C) Levels						
# of youths in the household (T)	-7.489	2.936	-8.424	2.937	-7.163	2.862
# of adults in the household (T)	-8.474	2.868	-9.728	2.882	-8.941	2.816
# of elderly in the household (T)	-7.607	2.635	-7.476	2.676	-7.294	2.580
% of HH members who are literate (T)	3.223	1.032	3.573	1.117	3.075	1.111
% of HH members who are still at school (T)			0.843	0.306	0.832	0.302
% of HH members with college degree and above (T)	-2.212	1.022				
House made of brick (dummy = 1; 0 otherwise) (T)			0.182	0.089	0.276	0.086
House has flush toilet (dummy = 1; 0 otherwise) (T)	3.388	1.083	2.758	1.045	3.291	1.034
Female headed household (dummy = 1; 0 otherwise) (C)	-5.609	0.727				
HHs has access to tap water (dummy = 1; 0 otherwise) (C)			0.923	0.224	0.639	0.226
Interaction of Household Level Variables with Census Means						
Household Size * census mean of # of youth	1.359	0.640	1.507	0.633	1.253	0.619
Household size * census mean of # of adults	1.459	0.626	1.589	0.618	1.527	0.603
Household size * census mean of # of elderly	1.386	0.583	1.494	0.579	1.413	0.563
Household size * census mean of % literate households	-0.644	0.223	-0.612	0.231	-0.565	0.228
Household size * census mean of % hh members completed primary			0.113	0.057	0.143	0.056
Household size * census mean of % hh members completed senior	0.139	0.049	0.202	0.072	0.230	0.070

	(1) coef	(1) se	(2) coef	(2) se	(3) coef	(3) se
Household size * census mean of #non-ag hh	0.096	0.036	0.098	0.034	0.111	0.035
Household size * census mean of housing area	0.003	0.002				
Household size * census mean of % hhs with access to flush toilet	-0.682	0.259	-0.549	0.256	-0.626	0.252
Brick house * census means of % married household head			0.966	0.415		
Environmental Variables						
Total area of land			0.127	0.053		
% organic matter in soil texture			-0.505	0.076		
Annual rainfall (log)			0.615	0.114		
Temperature			-0.064	0.011		
Density of highway (log)			0.039	0.006		
Interaction of Household Level Variables with Environmental Variables						
% kids * % loam in the soil					-0.027	0.010
% adults * annual rainfall (log)					0.845	0.142
% adults * density of highway (log)					0.026	0.008
% adults * % plain area					0.439	0.148
% adults * temperature					-0.075	0.019
% adults * % organic in the soil					-0.609	0.106
# HH members completed primary * density of highway (log)					0.008	0.002
# HH members completed junior high school * total land available					0.089	0.030
# HH members engaged in non-agriculture * % plain area					0.167	0.061
# HH members engaged in non-agriculture * total land available					0.190	0.052
# HH members engaged in non-agriculture * density of highway (log)					0.012	0.005
Housing area * total land available					-0.002	0.001
Housing area * % plain area					-0.003	0.001
Multi-floors housing * % organic in the soil					-0.555	0.162
Multi-floors housing * total land available					-0.081	0.034
Multi-floors housing * % plain area					0.373	0.158
Multi-floors housing * slope (log)					0.265	0.075
Multi-floors housing * % loam					0.037	0.013
Brick house * % loam					0.018	0.006
Brick house * temperature					-0.075	0.020
Brick house * total land available					0.156	0.043
Brick house * elevation (log)					-0.248	0.072
Constant	13.124	2.372	8.592	2.444	8.157	2.458
R^2	0.249		0.275		0.321	
Adjusted-R^2	0.233		0.257		0.298	

Notes: N=1,360. All coefficients are statistically significant at $p<0.05$.

Table A3. Predicted county-level poverty and inequality rates

County Name	$\hat{P}_0$	s.e.$(\hat{P}_0)$	$\hat{P}_2$	s.e.$(\hat{P}_2)$	$\hat{G}E(0)$	s.e. $(\hat{G}E(0))$
Xincheng Qu	0.052	0.038	0.010	0.010	0.503	0.315
Beilin Qu	0.067	0.045	0.012	0.011	0.583	0.283
Lianhu Qu	0.061	0.035	0.010	0.008	0.651	0.240
Baqiao Qu	0.287	0.044	0.059	0.016	0.592	0.181
Weiyang Qu	0.142	0.041	0.025	0.011	0.700	0.299
Yanta Qu	0.162	0.048	0.035	0.014	0.968	0.446
Yanliang Qu	0.301	0.051	0.058	0.017	0.558	0.167
Lintong Qu	0.312	0.046	0.054	0.014	0.483	0.158
Chang'an Xian	0.222	0.043	0.031	0.008	0.277	0.035
Lantian Xian	0.287	0.029	0.043	0.007	0.279	0.030
Zhouzhi Xian	0.321	0.040	0.044	0.009	0.261	0.032
Hu Xian	0.233	0.033	0.031	0.007	0.301	0.056
Gaoling Xian	0.337	0.048	0.083	0.019	0.436	0.116
Wangyi Qu	0.159	0.061	0.019	0.011	0.287	0.088
Yintai Qu	0.236	0.057	0.034	0.012	0.471	0.187
Yao Xian	0.324	0.045	0.046	0.011	0.374	0.083
Yijun Xian	0.434	0.052	0.074	0.017	0.333	0.130
Weibin Qu	0.268	0.063	0.054	0.019	0.350	0.079
Jintai Qu	0.264	0.073	0.059	0.024	0.567	0.199
Baoji Xian	0.161	0.036	0.028	0.011	0.780	0.256
Fengxiang Xian	0.444	0.038	0.087	0.014	0.327	0.050
Qishan Xian	0.163	0.041	0.023	0.008	0.384	0.085
Fufeng Xian	0.486	0.058	0.103	0.022	0.427	0.082
Mei Xian	0.353	0.047	0.055	0.012	0.374	0.071
Long Xian	0.782	0.066	0.200	0.037	0.189	0.031
Qianyang Xian	0.705	0.060	0.198	0.032	0.312	0.066
Linyou Xian	0.403	0.057	0.069	0.018	0.296	0.051
Feng Xian	0.440	0.070	0.073	0.018	0.242	0.040
Taibai Xian	0.324	0.073	0.054	0.020	0.363	0.116
Qindu Qu	0.318	0.044	0.067	0.015	0.898	0.526
Yangling Qu	0.322	0.063	0.069	0.024	0.566	0.220
Weicheng Qu	0.322	0.054	0.074	0.021	0.562	0.158
Sanyuan Xian	0.394	0.052	0.081	0.017	0.512	0.152
Jingyang Xian	0.374	0.042	0.068	0.014	0.385	0.062
Qian Xian	0.804	0.052	0.253	0.032	0.318	0.096
Liquan Xian	0.827	0.045	0.284	0.035	0.305	0.064
Yongshou Xian	0.792	0.048	0.255	0.034	0.316	0.088
Bin Xian	0.683	0.070	0.166	0.032	0.236	0.034
Changwu Xian	0.746	0.057	0.232	0.031	0.413	0.166
Xunyi Xian	0.623	0.062	0.127	0.023	0.231	0.030
Chunhua Xian	0.707	0.059	0.176	0.028	0.249	0.043
Wugong Xian	0.390	0.056	0.097	0.025	0.530	0.129
Xingping Shi	0.420	0.055	0.096	0.022	0.504	0.114
Linwei Qu	0.265	0.048	0.042	0.012	0.447	0.141
Hua Xian	0.110	0.030	0.014	0.006	0.445	0.125
Tongguan Xian	0.223	0.065	0.048	0.019	0.421	0.079
Dali Xian	0.378	0.043	0.062	0.012	0.255	0.039

County Name	$\hat{P}_0$	s.e.$(\hat{P}_0)$	$\hat{P}_2$	s.e.$(\hat{P}_2)$	$\hat{G}E(0)$	s.e. $(\hat{G}E(0))$
Heyang Xian	0.473	0.045	0.086	0.017	0.256	0.043
Chengcheng Xian	0.511	0.054	0.094	0.018	0.257	0.042
Pucheng Xian	0.379	0.045	0.062	0.013	0.314	0.044
Baishui Xian	0.568	0.052	0.120	0.021	0.269	0.040
Fuping Xian	0.435	0.044	0.064	0.011	0.225	0.030
Hancheng Shi	0.449	0.046	0.079	0.016	0.310	0.069
Huayin Shi	0.209	0.055	0.035	0.013	0.478	0.124
Baota Qu	0.315	0.039	0.038	0.008	0.232	0.033
Yanchang Xian	0.706	0.066	0.128	0.025	0.143	0.019
Yanchuan Xian	0.530	0.057	0.088	0.017	0.204	0.032
Zichang Xian	0.223	0.045	0.024	0.007	0.186	0.028
Ansai Xian	0.256	0.045	0.031	0.008	0.204	0.033
Zhidan Xian	0.382	0.065	0.052	0.016	0.222	0.040
Wuqi Xian	0.398	0.058	0.057	0.015	0.206	0.035
Ganquan Xian	0.285	0.052	0.038	0.011	0.230	0.037
Fu Xian	0.478	0.054	0.077	0.016	0.211	0.033
Luochuan Xian	0.504	0.057	0.077	0.017	0.214	0.023
Yichuan Xian	0.767	0.055	0.170	0.029	0.171	0.030
Huanglong Xian	0.474	0.061	0.094	0.022	0.314	0.060
Huangling Xian	0.363	0.057	0.051	0.012	0.226	0.030
Hantai Qu	0.233	0.048	0.049	0.016	0.335	0.060
Nanzheng Xian	0.435	0.036	0.080	0.011	0.359	0.048
Chenggu Xian	0.572	0.054	0.124	0.019	0.305	0.046
Yang Xian	0.688	0.059	0.144	0.023	0.212	0.033
Xixiang Xian	0.758	0.060	0.186	0.029	0.225	0.032
Mian Xian	0.289	0.031	0.045	0.008	0.406	0.102
Ningqiang Xian	0.534	0.060	0.089	0.016	0.198	0.028
Lueyang Xian	0.513	0.056	0.080	0.014	0.208	0.048
Zhenba Xian	0.735	0.066	0.202	0.032	0.291	0.054
Liuba Xian	0.513	0.077	0.097	0.024	0.312	0.064
Foping Xian	0.385	0.093	0.067	0.024	0.327	0.086
Yuyang Qu	0.359	0.068	0.038	0.010	0.175	0.041
Shenmu Xian	0.293	0.048	0.031	0.008	0.230	0.063
Fugu Xian	0.541	0.069	0.085	0.019	0.198	0.026
Hengshan Xian	0.342	0.055	0.038	0.009	0.164	0.029
Jingbian Xian	0.330	0.041	0.051	0.011	0.297	0.053
Dingbian Xian	0.466	0.048	0.086	0.014	0.330	0.077
Suide Xian	0.506	0.055	0.077	0.013	0.174	0.024
Mizhi Xian	0.312	0.063	0.051	0.014	0.244	0.047
Jia Xian	0.468	0.051	0.067	0.012	0.186	0.023
Wubao Xian	0.567	0.071	0.190	0.034	0.536	0.167
Qingjian Xian	0.596	0.062	0.110	0.019	0.243	0.029
Zizhou Xian	0.365	0.047	0.046	0.010	0.177	0.022
Hanbin Qu	0.631	0.044	0.108	0.016	0.198	0.024
Hanyin Xian	0.573	0.068	0.099	0.021	0.312	0.144
Shiquan Xian	0.800	0.053	0.184	0.034	0.169	0.022
Ningshan Xian	0.355	0.059	0.055	0.014	0.326	0.070
Ziyang Xian	0.668	0.059	0.122	0.021	0.177	0.024
Langao Xian	0.314	0.064	0.046	0.013	0.304	0.081

County Name	$\hat{P}_0$	s.e.$(\hat{P}_0)$	$\hat{P}_2$	s.e.$(\hat{P}_2)$	$\hat{G}E(0)$	s.e. $(\hat{G}E(0))$
Pingli Xian	0.509	0.059	0.075	0.015	0.198	0.031
Zhenping Xian	0.209	0.058	0.031	0.015	0.414	0.151
Xunyang Xian	0.640	0.053	0.119	0.019	0.197	0.028
Baihe Xian	0.454	0.069	0.074	0.018	0.252	0.061
Shangzhou Shi	0.446	0.040	0.068	0.010	0.220	0.022
Luonan Xian	0.190	0.043	0.021	0.006	0.318	0.069
Danfeng Xian	0.405	0.038	0.058	0.010	0.226	0.028
Shangnan Xian	0.607	0.057	0.099	0.018	0.181	0.023
Shanyang Xian	0.635	0.051	0.119	0.019	0.221	0.084
Zhen'an Xian	0.569	0.054	0.092	0.016	0.202	0.028
Zhashui Xian	0.402	0.056	0.058	0.013	0.236	0.048

Note: Estimates are from the model with environment variables interacted with household variables.
 Counties are arrayed by administrative code.