Online Appendix

The Causal Effects of Place on Health and Longevity

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A.1 US Life Expectancy Data

The US life expectancy sample consists of all counties in the US for which life expectancy data is available from the U.S. Small-Area Life Expectancy Estimates Project (USALEEP) (Arias et al., 2018). The USALEEP data report life expectancy at birth for most US census tracts for the period 2010–2015 (National Center for Health Statistics, 2018). We aggregate the tract-level measures to the county level using a weighted average, where the weights are the total population for the census tract, as reported in the 2010 Decennial Census (Manson et al., 2020). We obtain county names and state abbreviations from U.S. Census Bureau (2010*b*) county boundaries from U.S. Census Bureau (2010*a*). The highest and lowest 10 counties, ranked by life expectancy, are reported in Appendix Table A.3.

A.2 European Life Expectancy Data

For the European life expectancy sample, we consider all regions covered by the Nomenclature of Territorial Units for Statistics (NUTS) 2021 classification, a hierarchical system that sequentially divides countries into NUTS 1, NUTS 2, and NUTS 3 regions (Eurostat, 2020*c*). The NUTS system covers 37 European countries, including those in the European Union (EU) and the United Kingdom, EU candidate countries, and European Free Trade Association countries. We obtain NUTS region codes from Eurostat (2020*b*) and boundary files from Eurostat (2020*a*).

We collect data on life expectancy at birth at both the NUTS 2 and NUTS 3 levels. From the European Statistical Office (Eurostat), we obtain life expectancy at birth in 2018 at the NUTS 2 level for all countries covered by NUTS except Albania (Eurostat, 2018). Life expectancy data are not systematically reported at the NUTS 3 level. We compile the data for 1,057 regions in 22 countries from various sources using the most recent period available for each region. We collected total life expectancy at birth, whenever available. In cases where life expectancy was only reported separately for men and women, we defined total life expectancy to be the average of these two measures. Appendix Table A.1 lists the source and time period of NUTS 3 life expectancy data for each of these countries. Appendix Table A.2 summarizes the availability of life expectancy by country at the NUTS 2 and NUTS 3 levels. The highest and lowest 10 NUTS 3 regions, ranked by life expectancy, are reported in Appendix Table A.5.

A.3 Analysis of Regional Variation

To estimate the share of US county-level variation in life expectancy that occurs within versus across states, we run the following regression.

$$[\textit{life expectancy}]_i = [\textit{state fixed effects}] + \epsilon_i, \tag{A–1}$$

where observations, indexed by i, are at the county level. States include all 50 states and the District of Columbia. The R-squared (R^2) from this regression captures the share of the county-level variance in life expectancy that is explained by the state fixed effects, i.e., the share of the variation that occurs across states. The remainder of the variance, given by $1 - R^2$, describes the share of the county-level variation in life expectancy that occurs within states.

Similarly, we estimate the share of European regional life expectancy that occurs across countries using the R^2 from the regression

$$[\textit{life expectancy}]_i = [\textit{country fixed effects}] + \epsilon_i. \tag{A–2}$$

We estimate this regression separately for observations i defined at the NUTS 2 and NUTS 3 levels. The countries included in the NUTS 2 and NUTS 3 life expectancy samples are reported in Appendix Table A.2.

A.4 Local correlates of US county-level life expectancy

To estimate the correlates of US county-level life expectancy, we run the following regression for each local characteristic considered in the analysis:

$$[\textit{life expectancy}]_i = [\textit{local characteristic}]_i + \epsilon_i, \tag{A–3}$$

where observations, indexed by i, are at the county level and local characteristics are those considered by Deryugina and Molitor (2020*b*), Figure 6, except for characteristics derived from Medicare claims. The characteristics are derived from various sources and are intended to capture a broad range of environmental, economic, and public health conditions (Deryugina and Molitor, 2020*a*). Below, we reproduce the list of characteristics from the Online Appendix of Deryugina and Molitor (2020*b*), organized by data source. We also reproduce the description of how each variable was constructed.

- Census
  - Income per capita
  - Poverty rate, 65+
  - Median home value
  - Urban population share
- Area Resource Files
  - Physicians per capita
  - Hospital beds per capita
- CMS Hospital Compare
  - Hospital quality index
- Behavioral Risk Factor Surveillance System
  - Percent obese
  - Percent smoking
  - Percent exercising
- Chetty and Hendren (2018)
  - Upward income mobility (from p25)
  - Upward income mobility (from p75)
  - Social capital index
  - Crime rate
  - Local government spending per capita
  - Income segregation
- Climate
  - $PM_{2.5}$ concentrations
  - Hot days/year (90°F+)

Census We measure income, poverty, home values, urban population share, and total population for each county using 2000 Decennial Census data, which we obtain from the IPUMS National Historical Geographic Information System (NHGIS) (Manson et al., 2017).[1] The table and dataset names we refer to below are from the NHGIS.

We measure income as per capita income in 1999 (table *NP082A* of dataset *2000_SF3a*). We measure the poverty share among the 65+ population as the number of individuals aged 65 or older with income in 1999 below the poverty level (table *NP087C* of dataset *2000_SF3a*) as a share of the 65+ population for whom poverty status can be determined (table *NP087C* of dataset *2000_SF3a*). We measure median home values as the median value of owner-occupied housing units (table *NH085A* of dataset *2000_SF3a*). Finally, we use the total population of a county (table *NP001A* of dataset *2000_SF1a*) as the denominator for physicians and hospital beds per capita.

Area Resource File (ARF) We obtain the number of physicians and hospital beds for each county in 2004 from the ARF. For the number of physicians, we use variable *F12129-04*, the total number of active MDs (federal and non-federal) in 2004 from the AMA Physician Master File, as provided in the 2005 release of the ARF (U.S. Department of Health and Human Services, 2005). The variable *F08921-04* reports the total number of hospital beds in 2004 from the AHA Survey Database and is provided in the 2009 release of the ARF (U.S. Department of Health and Human Services, 2009).

We calculate the number of physicians per capita by dividing the total number of active MDs by the total population in the county (from census data, described above). Likewise, we calculate hospital beds per capita by dividing the total number of hospital beds by the county population.

Behavioral Risk Factor Surveillance System (BRFSS) We measure obesity, smoking, and exercise behavior using the BRFSS, a telephone survey that collects information on health-related behaviors and chronic conditions (Centers for Disease Control and Prevention, 1995–2004).[2] We pool survey responses for the period 1995–2004.

We calculate percent smoking in each county as the percent of survey respondents for whom the reported smoking status is either "current, daily" or "current, other than daily". We calculate percent obese in each county as the percent of survey respondents who report a body mass index of 30 or greater. We calculate percent exercising in each county as the

[1] Data were downloaded from `https://data2.nhgis.org/main` (accessed October 1, 2019).

[2] Data were downloaded from `https://www.cdc.gov/brfss/annual_data/annual_data.htm` (accessed October 1, 2019).

percent of survey respondents who report participating in any physical activities or exercises other than their regular job in the past month.

CMS Hospital Compare We measure hospital quality within each county using data from the CMS Hospital Compare Process of Care Scores for 2004, which we obtain from Sacarny (2018). We focus on process of care measures for heart attack (AMI), heart failure (HF), and pneumonia (PN), and restrict to metrics that are reported in at least 1,750 counties. This restriction selects a total of 13 metrics, consisting of four AMI metrics (*ami1_share*, *ami2_share*, *ami5_share*, *ami6_share*), three HF metrics (*hf1_share*, *hf2_share*, *hf3_share*), and six PN metrics (*pn1_share*, *pn2_share*, *pn3_share*, *pn4_share*, *pn5_share*, *pn6_share*).

For each process of care metric, we calculate the share of patients in each county who receive appropriate care according to that metric, among hospitals for whom the metric is reported. We combine these 13 process of care metrics into a single hospital quality index, defined as the county-level mean across all metrics (this mean will be missing if any of the underlying metrics are missing for that county). Thus, this hospital quality index can be loosely interpreted as the share of AMI/HF/PN patients receiving appropriate care in the county.

Chetty and Hendren (2018) We obtain county-level measures of upward income mobility, social capital, crime, local government spending, and income segregation from Chetty and Hendren (2018). For measuring upward income mobility, we use the variables *pct_causal_p25_kr26* and *pct_causal_p75_kr26* from Online Data Table 2, "Preferred Estimates of Causal Place Effects by County."[3] The measures of upward income mobility capture the percentage change in income at age 26 from spending one more year of childhood in the county, for children whose parents were at the 25th or 75th percentiles, respectively, of the US household income distribution.

The measures of social capital, crime, local government spending, and income segregation come from Online Data Table 4, "Complete County-Level Dataset: Causal Effects and Covariates." Specifically, we use the variables *scap_ski90pcm*, *crime_total*, *subcty_total_expend_pc*, and *cs00_seg_inc*.[4]

[3] A description of the variables in Online Data Table 2 can be found at https://opportunityinsights.org/wp-content/uploads/2018/04/online_table2-2.pdf (accessed October 1, 2019).

[4] A description of the variables in Online Data Table 4 can be found at https://opportunityinsights.org/wp-content/uploads/2018/04/online_table4-2.pdf (accessed October 1, 2019).

Climate We measure fine particulate ($PM_{2.5}$) air pollution concentrations and the number of extremely hot days using data recorded by ground monitor stations. We measure the average $PM_{2.5}$ concentration in a county for the period 2006–2013. We obtain $PM_{2.5}$ air pollution data from EPA's Air Quality System database, which provides hourly data at the pollution-monitor level for pollutants that are regulated by the Clean Air Act (U.S. Environmental Protection Agency, 2006–2013). We aggregate monitor readings to the daily level by averaging across hourly observations and then construct daily ZIP code level pollution measures by calculating the inverse distance-weighted average across all monitors located within 20 miles of the ZIP code centroid. We then average these daily values over the period 2006–2013. Finally, we aggregate ZIP code level average pollution concentrations to the county level by averaging across all ZIP codes matched to a county based on the county recorded for the plurality of Medicare beneficiaries living in that ZIP code.

Our source for daily temperature variables is the Global Historical Climatology Network GHCN-Daily database, which provides weather measurements from land surface stations across the United States (National Oceanic and Atmospheric Administration, 2006–2013). For the period 2006–2013, we calculate daily high and low temperatures for each ZIP code as the inverse distance-weighted average of all available daily maximum and minimum temperatures, respectively, for GHCN stations within a 20-mile radius of the ZIP code centroid. The daily average temperature for a ZIP code is calculated as the midpoint of the daily high and low temperatures. We calculate the number of days per year in which the average daily temperature exceeded 90°F in a ZIP code, and then aggregate to the county level using the same ZIP code to county crosswalk used to construct the pollution measure.

Table A.1: Sources of life expectancy at NUTS 3 level by country

Country	NUTS 3 Data Source	NUTS 3 Data Report Year
Austria	Statistics Austria (2019)	2019
Bulgaria	Republic of Bulgaria National Statistical Institute (2019)	2019
Cyprus	Statistical Service of Cyprus (2019)	2019
Denmark	Statistics Denmark (2019)	2019
Finland	Statistics Finland (2019)	2019
France	French National Institute of Statistics and Economic Studies (2019)	2019
Germany	Rau and Schmertmann (2020)	2015–2017
Hungary	Hungarian Central Statistical Office (2019)	2019
Italy	Italian National Institute of Statistics (2019)	2019
Latvia	Central Statistical Bureau of Latvia (2019)	2019
Liechtenstein	World Bank Open Data (2018)	2018
Lithuania	Statistics Lithuania (2019)	2019
Luxembourg	World Bank Open Data (2018)	2018
Montenegro	World Bank Open Data (2018)	2018
Norway	Statistics Norway (2015)	2011–2015
Poland	Statistics Poland (2019)	2019
Portugal	Statistics Portugal (2019)	2017–2019
Romania	Romania National Institute of Statistics (2019)	2019
Slovenia	Statistical Office of the Republic of Slovenia (2019)	2019
Spain	Spain National Statistics Institute (2018)	2018
Sweden	Statistics Sweden (2019)	2015–2019
Turkey	Turkish Statistical Institute (2017)	2017

Notes: The table reports the source and report year, by country, for the NUTS 3 life expectancy sample.

Table A.2: Availability of life expectancy data by European country

	(1)	(2)	(3)	(4)
Country	# NUTS 2	# NUTS 2 with life expectancy data	# NUTS 3	# NUTS 3 with life expectancy data
Albania	3	0	12	0
Austria	9	9	35	35
Belgium	11	11	44	0
Bulgaria	6	6	28	28
Croatia	4	4	21	0
Cyprus	1	1	1	1
Czech Republic	8	8	14	0
Denmark	5	5	11	11
Estonia	1	1	5	0
Finland	5	5	19	19
France	27	24	101	101
Germany	38	38	401	397
Greece	13	13	52	0
Hungary	8	8	20	20
Iceland	1	1	2	0
Ireland	3	3	8	0
Italy	21	21	107	107
Latvia	1	1	6	6
Liechtenstein	1	1	1	1
Lithuania	2	2	10	10
Luxembourg	1	1	1	1
Malta	1	1	2	0
Montenegro	1	1	1	1
Netherlands	12	12	40	0
North Macedonia	1	1	8	0
Norway	7	6	13	11
Poland	17	17	73	73
Portugal	7	7	25	25
Romania	8	8	42	42
Serbia	4	4	25	0
Slovakia	4	4	8	0
Slovenia	2	2	12	12
Spain	19	19	59	54
Sweden	8	8	21	21
Switzerland	7	7	26	0
Turkey	26	25	81	81
United Kingdom	41	41	179	0
Total	334	326	1,514	1,057

Notes: Columns (1) and (3) report the number of NUTS 2 and NUTS 3 regions, respectively, in the NUTS 2021 classification system. Columns (2) and (4) report the number of NUTS 2 and NUTS 3 regions, respectively, for which we have life expectancy data. Maps of life expectancy by NUTS 2 and NUTS 3 region are shown in Online Appendix Figures A.1 and A.2, respectively.

Table A.3: US counties with the highest and lowest life expectancy

	(1)	(2)	(3)	(4)
County name	County FIPS code	State	Life expectancy at birth	Rank
Regions with the highest life expectancy				
Cheyenne County	08017	CO	89.5	1
Wayne County	49055	UT	89.3	2
Haskell County	20081	KS	88.6	3
Stanton County	20187	KS	87.9	4
Custer County	16037	ID	87.7	5
Sherman County	48421	TX	87.3	6
Crook County	56011	WY	87.1	7
Granite County	30039	MT	87.0	8
Aleutians East Borough	02013	AK	86.9	9
Concho County	48095	TX	86.8	10
Regions with the lowest life expectancy				
Walker County	01127	AL	71.4	3,099
Madison Parish	22065	LA	71.4	3,100
Emporia city	51595	VA	71.4	3,101
Estill County	21065	KY	71.3	3,102
Sussex County	51183	VA	71.0	3,103
Tallahatchie County	28135	MS	70.8	3,104
Powell County	21197	KY	70.8	3,105
Breathitt County	21025	KY	70.2	3,106
McIntosh County	40091	OK	69.7	3,107
East Carroll Parish	22035	LA	69.1	3,108

Notes: The table reports the top 10 and bottom 10 counties in the US county life expectancy sample ($N = 3,108$), ranked by life expectancy at birth.

Table A.4: European NUTS 3 regions with the highest and lowest life expectancy

	(1)	(2)	(3)	(4)
NUTS 3 region name	NUTS 3 code	Country	Life expectancy at birth	Rank
Regions with the highest life expectancy				
Madrid	ES300	Spain	84.8	1
Salamanca	ES415	Spain	84.7	2
Soria	ES417	Spain	84.6	3
Hauts-de-Seine	FR105	France	84.5	4
Prato	ITI15	Italy	84.5	5
Perugia	ITI21	Italy	84.5	6
Paris	FR101	France	84.5	7
Pordenone	ITH41	Italy	84.4	8
Firenze	ITI14	Italy	84.4	9
Araba/Álava	ES211	Spain	84.3	10
Regions with the lowest life expectancy				
Разград	BG324	Bulgaria	73.1	1,048
Добрич	BG332	Bulgaria	73.1	1,049
Vidzeme	LV008	Latvia	73.0	1,050
Монтана	BG312	Bulgaria	73.0	1,051
Видин	BG311	Bulgaria	73.0	1,052
Сливен	BG342	Bulgaria	72.8	1,053
Враца	BG313	Bulgaria	72.8	1,054
Kurzeme	LV003	Latvia	72.7	1,055
Zemgale	LV009	Latvia	72.3	1,056
Latgale	LV005	Latvia	70.4	1,057

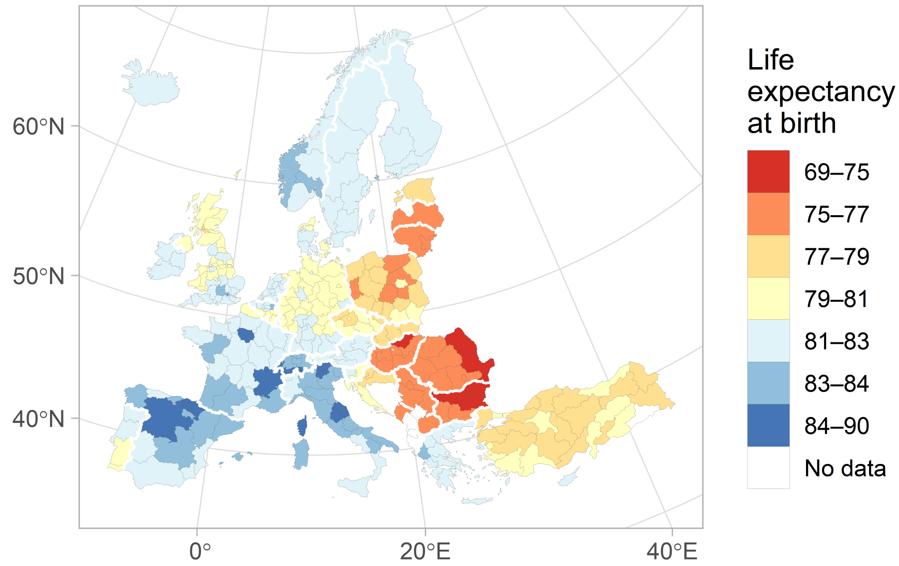
Notes: The table reports the top 10 and bottom 10 regions in the European NUTS 3 life expectancy sample ($N = 1,057$), ranked by life expectancy at birth.

Table A.5: Local correlates of US county-level life expectancy

	(1)	(2)	(3)
County characteristic	Characteristic mean [sd]	OLS coeficient (se)	R-squared
A. Health and environmental characteristics			
Percent smoking	22.83	-0.23	0.258
	[5.20]	(0.01)	
Percent obese	22.80	-0.19	0.228
	[5.92]	(0.02)	
Percent exercising	72.95	0.23	0.444
	[6.84]	(0.01)	
Physicians per 1,000 capita	1.33	0.16	0.011
	[1.69]	(0.03)	
PM 2.5 concentrations	10.08	-0.47	0.153
	[2.01]	(0.03)	
Hospital beds per 1,000 capita	3.77	0.02	0.001
	[5.39]	(0.01)	
Hot days/year (90°F+)	0.90	-0.03	0.002
	[3.78]	(0.01)	
Hospital quality index	0.76	5.07	0.033
	[0.08]	(0.69)	
B. Economic characteristics			
Median home value ($1,000s)	81.64	0.02	0.154
	[42.26]	(0.00)	
Income per capita ($1,000s)	17.53	0.27	0.173
	[3.94]	(0.01)	
Poverty rate, 65+	0.12	-21.18	0.244
	[0.06]	(0.80)	
Upward income mobility (from p25)	0.23	2.27	0.236
	[0.53]	(0.07)	
Urban population share	0.41	0.12	0.000
	[0.31]	(0.16)	
Crime rate per 1,000	5.78	-0.15	0.046
	[3.83]	(0.01)	
Local gov. spending per capita	2.15	0.39	0.049
	[1.45]	(0.18)	
Upward income mobility (from p75)	0.14	0.95	0.007
	[0.21]	(0.23)	
Social capital index	-0.01	0.84	0.192
	[1.34]	(0.03)	
Income segregation	0.02	0.15	0.000
	[0.03]	(1.48)	
C. Multivariate comparisons			
All health and environmental characteristics			0.649
All economic characteristics			0.539
All characteristics			0.774

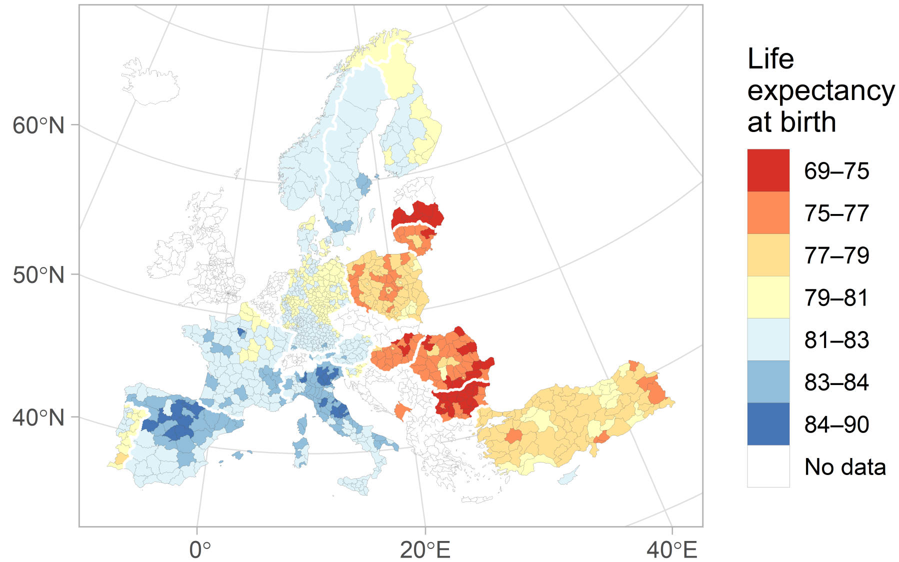
Notes: The table reports results from regressing US county-level life expectancy on local characteristics. Each row in the table corresponds to a separate regression, where the included local characteristic(s) are indicated by the row labels. Observations are unweighted. Column (1) shows the mean and standard deviation (in brackets) of the local characteristic. Column (2) reports regression coefficients and robust standard errors (in parentheses). Column (3) reports the R-squared from the regression. Online Appendix Section A.4 provides more details on the data and regressions.

Figure A.1: European Life Expectancy by NUTS 2 Region



Notes: The figure shows life expectancy at birth in Europe at the NUTS 2 level, based on the NUTS 2 life expectancy sample described in Online Appendix Table A.2.

Figure A.2: European Life Expectancy by NUTS 3 Region



Notes: The figure shows life expectancy at birth in Europe at the NUTS 3 level, based on the NUTS 3 life expectancy sample described in Online Appendix Table A.2.

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