A central tenet of development policy and discourse is that nations use natural resources, such as fossil fuels, to raise population living standards and enhance well-being. However, research shows that the relationship among human well-being, resource use, and the associated emissions is complex and context specific. To better understand if natural resource use plays a historic role in generating human well-being in the United States, the authors conduct a time-series analysis of greenhouse gas emissions and average life expectancy from 1913 to 2017. The results show that increases in greenhouse gas emissions per capita have an instantaneous, negative effect on life expectancy. The authors also find evidence that income inequality has a long-run negative effect on life expectancy. Additional analyses provide mixed results regarding whether and how the effects of emissions on life expectancy are conditional on income inequality. These findings contradict the assumption that reductions in emissions necessitate trade-offs in human well-being in high-income contexts.
line with other global environmental change scholars (e.g., Roberts et al. 2020), we suggest that country-specific research is urgently needed to better understand the relationships between the burning of fossil fuels (and the associated emissions) and human well-being, particularly among nations that are disproportionately responsible for the climate crisis and other global environmental challenges.

This study investigates if the United States—one of the wealthiest and most economically developed nations in the world—has converted fossil fuel1 use into aggregate gains in human well-being over the past century, as one might expect from the modernization perspective. Building on prior work, we also assess if the relationship is conditional on domestic income inequality. We estimate the instantaneous and long-run effects of greenhouse gas (GHG) emissions per capita and income inequality (measured by the top 10 percent’s share of income) on average life expectancy at birth in the United States for the period from 1913 to 2017. We use average life expectancy as our dependent variable, as it is widely considered a reliable and valid measure of population health that captures many dimensions of human well-being (e.g., Dietz et al. 2015; Jorgenson 2014; Roberts et al. 2020; Steinberger and Roberts 2010).

### National Development and Human and Environmental Well-Being

Despite making up less than 5 percent of the world’s population, the United States contributed more to the global burden of emissions than any other nation over the past century (see Figure 1). Macroeconomic perspectives conceptualize the use of natural resources, combined with other forms of capital, as fundamental to development (Arrow et al. 2004). Therefore, development policies in both national and international contexts commonly position using environmental resources such as fossil fuels as necessary to promote human well-being (Dietz et al. 1990; Rosa and Machlis 1983; WCED 1987).

This understanding of socioenvironmental relations is undergirded by a modernization perspective that conceptualizes economic and social development as progressive processes. Related to this perspective is the Kuznets curve, first advanced by economist Simon Kuznets in the 1950s and 1960s, to explain declining income inequality in England, Germany, and the United States.2 Kuznets proposed that although inequality rises as countries first industrialize, prosperity becomes more equitably shared as nations develop economically because of increased access to education, political pressure for greater public redistribution, lower intersectoral productivity differences, and decreasing returns to capital (Kuznets 1955). Although it was popular for a time, the resurgence of income inequality among high-income nations in the latter half of the twentieth century led many social scientists to challenge the concept3 (e.g., Alderson and Nielsen 2002; Piketty and Saez 2014). Income inequality increased substantially in the United States over the past half century, and by 2017 almost half of pretax income went to those in the top 10 percent of the income distribution (Piketty and Saez 2014; Saez and Zucman 2019). The United States has also witnessed a slight decline in average life expectancy in recent years (see Figure 2) (Arias and Xu 2017).

The modernization perspective and the Kuznets curve concept are also applied widely to scholarship on the relationship between national development and environmental stress (Ayres and Weaver 1998; Dasgupta et al. 2002; Dinda 2004; Mol 2002). For example, ecological modernization theorists propose that over time, nations can lower their environmental impacts through cleaner technologies. Later iterations of the theory also emphasize that ecological rationality emerges among countries with advanced economies. This rationality, and increased reflexivity in national institutions, engenders proenvironmental policies and practices that lead to improved socioenvironmental conditions (Mol 2001, 2002). Likewise, proponents of the “environmental Kuznets curve” (EKC) argue that environmental impacts increase

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1 Fossil fuels (namely, coal, petroleum, and more recently natural gas) have been the primary source of the nation’s energy throughout the entire study period (Fichman 2010).

2 Kuznets was careful to note that the historical trends in those nations might not generalize to future trajectories of inequality (Kuznets 1955, 1979).

3 More recently, some have argued that the global economy is in the midst of a second Kuznets curve, one driven by a technological revolution, a decline in labor organizing, and a shrinking middle class among high-income nations (Milanovic 2016).
with economic development up to a point, after which effects decline with further economic growth (Dasgupta et al. 2002; Grossman and Krueger 1995).

Cross-national analyses of GHG emissions provide limited evidence of an EKC (Dietz and Rosa 1997; Dietz et al. 2012; Roberts and Grimes 1997; York, Rosa, and Dietz 2003). Rather, this research largely suggests that economic development, urbanization, and industrialization increase carbon dioxide (CO₂) and methane emissions (Dietz and Rosa 1997; Jorgenson 2006; Rosa and Dietz 2012; Rosa, York, and Dietz 2004). These findings are consistent with political-economic perspectives that question the long-term sustainability of the growth-oriented socioeconomic system (Givens, Clark, and Jorgenson 2016). Recent evidence suggests the relationship between economic growth and carbon emissions decoupled slightly among high-income nations through time (Jorgenson and Clark 2012; Thombs 2018), while income inequality facilitates a tighter coupling of development and emissions (McGee and Greiner 2018). The desirable environmental effects in cross-national research appear mostly limited to localized measures of environmental harm, such as ground-level air pollution (see Stern 2017).

Results from empirical studies testing for the presence of an EKC in the United States are also mixed (Apergis, Christou, and Gupta 2017; Aslan, Destek, and Okumus 2017). Although some studies present recent reductions in per capita emissions associated with increased use of renewable energy as evidence of an EKC (Bulut 2019; Sarkodie and Strezov 2018), it is important to note that the United States is consistently one of the highest per capita emitters of GHGs in the world, with per capita emissions far higher than for other high-income nations (United Nations Environment Programme 2019).

In the next section, we summarize prior research that identifies income inequality as a driver of increased environmental stress and reduced human well-being in the United States. We propose that the surge in inequality undermines the assumed alignment of energy use and gains in societal well-being through several overlapping mechanisms.

**GHG Emissions, Income Inequality, and Human Well-Being in the United States**

Prior research indicates that income inequality is a significant driver of environmental stress while also undermining human well-being (e.g., Boyce 1994; Jorgenson 2015; Jorgenson, Schor, and Huang 2017; Piketty and Saez 2014). Building on this work, we propose that inequality disrupts the traditional conceptualization of national development...
through several overlapping mechanisms in the context of the United States. These mechanisms include inhibiting energy transitions, promoting unsustainable consumption patterns, eroding social protections, and increasing population exposure to environmental and social hazards.

**Inhibiting Energy Transitions**

Fossil fuel combustion accounted for 94 percent of total CO\textsubscript{2} emissions in the United States in 2016 (EPA 2018). The energy industry amassed huge profits from the extraction and trade of these natural resources. Political economy scholarship suggests that those with economic power, such as a high concentration of income, often use their influence in the political sphere to ensure that their interests are protected (Boyce 1994; Dietz and Whitley 2018; Mann 2012). Fossil fuel companies have invested heavily in public misinformation and political lobbying campaigns in the United States to obfuscate the link between fossil fuel use and climate change (Brulle forthcoming; Farrell 2016; Sheehan 2018). These efforts facilitated the growth of conservative-based opposition to environmentalism and climate science (Dunlap and McCright 2011) and stalled the large-scale energy transition away from fossil fuels (Farrell 2019). Furthermore, existing energy efficiency policies in the United States are relatively ineffective. Efficiency improvements are not leading to significant reductions in overall emissions but instead correspond with expanding production and consumption (Adua, Clark, and York 2021; Grant, Jorgenson, and Longhofer 2020; York and McGee 2016).

**Unsustainable Consumption Patterns**

Income and wealth inequality foster unsustainable consumption patterns, which in turn fuel economic growth and environmental degradation but not necessarily enhanced human well-being. For example, streams of sociological research show that income inequality is associated with higher production-based and consumption-based carbon emissions in the United States and other Global North nations (Jorgenson et al. 2017; Knight, Schor, and Jorgenson 2017). One reason for this association is that the lifestyles of the rich are highly resource intensive (Davison 2016) as the wealthy compete for status through overconsumption (Ehrhardt-Martinez et al. 2015; Frank 2020; Schor 1998). Furthermore, larger segments of the population consume mass-produced, nondurable, and highly polluting goods (Claudio 2007; Datta 2014; Wilkinson and Pickett 2010) to emulate the lifestyles of the wealthy (Schor 1998) on smaller budgets. Interdisciplinary research reveals that this overconsumption strains individuals and societies (Frank 2010; McMichael et al. 2007).

**Erosion of Social Protections**

Income inequality is both a cause and consequence of rollbacks in social protections, which disrupts the extent to which ecologically intensive economic expansion creates higher living standards (Wilkinson and Pickett 2010). For example, income inequality is associated with longer working hours (Schor 2010), which is detrimental to both population health and well-being (Bannai and Tamakoshi 2014; Folkard and Lombardi 2006) and environmental outcomes, including increased carbon emissions (Fitzgerald, Schor, and Jorgenson 2018).

Research at the U.S. state level shows that income inequality is also associated with underinvestments in social goods, such as public education and health care (Boyce et al. 1999; Clarkwest 2008; Kawachi and Kennedy 1999; Truesdale and Jencks 2016). Communities of color are particularly affected by this because of the racist legacy of housing segregation (Desmond and Emirbayer 2015). Income inequality is also associated with lower social trust and cohesion among disadvantaged communities (Rüzer and Volker 2016; Wilkinson and Pickett 2010). This trend contributes to community dysfunction (Daly, Wilson, and Vasdev 2001) and inhibits communities’ propensity for collective action for social and environmental reform (Cushing et al. 2015; Ostrom 2008).

**Population Exposure to Environmental and Social Hazards**

Higher income inequality leads to the increased exposure of the structurally disadvantaged to dangerous environmental and social hazards, including hazards associated with GHG emissions (Patz et al. 2005). A primary avenue by which GHG emissions affect population health outcomes is air quality. Emissions make ground-level ozone worse and contribute to fine particulate matter concentration, decreasing lung function and increasing the risk for heart and lung disease (Brook et al. 2010; Lelieveld et al. 2015). Recent research also indicates that exposure to environmental hazards associated with gas and oil production leads to chronic stress and adverse mental health outcomes, such as self-reported depression (Malin 2020).

A related body of research reveals direct associations between income inequality and worsened population health outcomes (e.g., Anderson, Bjorklund, and Rambotti 2019; Mishra and Carleton 2015; Pickett and Rambotti 2015), including reduced life expectancy (e.g., Chetty et al. 2016; Hill and Jorgenson 2018; Thombs et al. 2020). Inequality directly affects population health because relative deprivation in living standards is associated with lower social-emotional outcomes, maladaptive coping mechanisms, and lower subjective well-being (Oishi, Kesebir, and Diener 2011; Payne, Brown-Iannuzzi, and Hannay 2017; Wilkinson and Pickett 2010). These dynamics also contributed to the rise of a phenomenon known as “deaths of despair,” resulting from alcohol abuse, suicide, drug use, and other risky behaviors (Case and Deaton 2020).

In summary, a central premise of development strategies is that nations convert natural resources, such as fossil fuels, into gains in human well-being and that this process becomes...
more efficient over time. In the following analysis, we assess the extent to which GHG emissions from the burning of fossil fuels lead to gains in population well-being by investigating the instantaneous and long-run effects of emissions on average life expectancy in the United States for the period from 1913 to 2017. On the basis of our literature review, we argue that income inequality may disrupt the proposed link between natural resource use and the production of human well-being by inhibiting progress toward more efficient energy production, stimulating unsustainable consumption patterns, limiting the public provision of social goods, and increasing population exposure to social and environmental harms. Therefore, we test if there is a relationship between GHG emissions and life expectancy in the United States and whether the relationship is conditional on income inequality.

Data and Methods

Data

The analyzed sample consists of national-level time series data for the United States for 1913 to 2017 (annual observations). The dependent variable for the study is average life expectancy. Life expectancy data were obtained from Arias and Xu (2019), who are part of the Division of Vital Statistics at the Centers for Disease Control and Prevention. These data represent period life expectancy. Our two independent variables of interest are GHG emissions per capita and income inequality. GHG emissions data were collected from the PRIMAP historical emissions data set from the Potsdam Institute for Climate Impact Research (Gütschow, Jeffery, and Gieseke 2019). They include emissions from CO₂, methane, and nitrous oxide and exclude emissions from land use, land-use change, and forestry (measured in million metric tons). To convert to a per capita measure, we divide the emissions data by historical population size data from the U.S. Census Bureau (2016, 2017, 2020a, 2020b). Income inequality data were obtained from Saez and Zucman (2019) and measure the top 10 percent’s share of pre-tax income for equal-split adults (income is shared equally between couples) aged 20 years and older. The statistics are derived from the national distribution accounts of Piketty, Saez, and Zucman (2018).

We also include gross domestic product (GDP) per capita as a control in our models. The GDP per capita data are from Bolt et al. (2018), measured in constant 2011 U.S. dollars. The 2017 data point is obtained through extrapolation. The descriptive statistics for life expectancy and the continuous independent variables are reported in Table 1.

Long-Run Multiplier Bounds Approach to Time-Series Analysis

Although sociology relies primarily on cross-sectional and panel data methods to derive inferences between socioecological processes, time-series analysis allows researchers to analyze how processes are related to one another over long periods of time for a single case (Pickup 2014; Thombs, Huang, and Jorgenson 2021). With time-series data, researchers often use dynamic models to derive long-run relationships between variables, which contrasts with static models that estimate only the contemporaneous relationship between them.

Deriving valid long-run inferences has historically relied on unit root tests. However, testing for nonstationarity is complicated because (1) unit root tests suffer from low power; (2) the underlying data-generating process must be correctly identified, and (3) they require the correct lag length (Philips 2018; Webb, Linn, and Lebo 2020). These tests often produce conflicting evidence and leave the researcher taking a “best guess” approach to building their models.

When the series in the model are stationary, the researcher can use the autoregressive distributed lag (ARDL) model, which regresses the dependent variable on its own lags in levels and the levels and lagged levels of the independent variables. To avoid multicollinearity and overfitting, researchers often place restrictions on the model, with \( p \) lags of the dependent variable and \( q \) lags of the independent variables. The most common restriction is to estimate an ARDL(1,1) (one lag of the dependent and independent variables) model:

\[
y_t = \alpha_0 + \alpha_1 y_{t-1} + \beta_0 x_t + \beta_1 x_{t-1} + \epsilon_t, \tag{1}\n\]

where \( \beta_0 \) represents the contemporaneous effect of \( x_t \) on \( y_t \) and the long-run effect is calculated as \( \frac{\beta_0}{1 - \alpha_1} \).

When the series are nonstationary and cointegrated, which is when a linear combination of two series that are nonstationary is stationary (Philips 2018; Pickup 2014), a

| Table 1. Descriptive Statistics. |
|----------------------------------|
| **Variable**                     | **Mean (SD)** | **Minimum** | **Maximum** |
| Life expectancy                  | 68.936 (8.092) | 39.100      | 78.900      |
| GHG emissions per capita         | 25.449 (2.592) | 18.984      | 31.334      |
| Income inequality (top 10 percent share) | 41.231 (4.596) | 34.691      | 48.314      |
| GDP per capita                   | 25,195.930 (14,873.070) | 7,270.000 | 53,439.000 |

Note: \( T = 105 \).
generalized error-correction model (GECM) can be used. The GECM regresses the difference of the dependent variable on the lag(s) of itself in levels and the first differences and lagged levels of the independent variables:

$$\Delta y_t = \alpha_0 + \beta_1 y_{t-1} + \beta_0 \Delta x_t + \beta_1^* x_{t-1} + \varepsilon_t.$$ (2)

Equation 2 is algebraically equivalent to 1, but the interpretations of the coefficients change. $\beta_0$ and $\beta_1^*$ are equivalent to each other and represent the short-run effects of $x_t$. $\alpha_1 - 1 = \alpha_1^*$, where $\alpha_1$ is the autoregressive coefficient, and $\alpha_1^*$ specifies how quickly the model returns to equilibrium following a shock to a variable, which is known as the error-correction rate. Last, $\beta_1 - \beta_0^* = \beta_1$. The long-run effect of $x_t$ in the GECM is calculated as $-\frac{\Delta y_{t-1}}{y_{t-1}}$.

Whenever the researcher has a set of nonstationary variables, it is necessary to test for cointegration before drawing inferences (Philips 2018). If both series are nonstationary, but not cointegrated, then no long-run relationship exists, and the model must be estimated in first-differences (Philips 2018).5

Pesaran, Shin, and Smith (2001) developed the ARDL-bounds approach to cointegration, which does not require the researcher to identify the true order of integration (how many times the variable must be differenced to be made stationary) of the independent variables, only that of the dependent variable. The bounds test relies on fitting an ARDL model in error-correction form, and then using a set of nonstandard critical values to conclude whether cointegration exists (Philips 2018). However, properly identifying the order of integration of the dependent variable can once again leave the researcher taking a best-guess approach.

To address these challenges and limitations, we use the long-run multiplier (LRM) bounds approach to time-series analysis recently developed by Webb, Linn, and Lebo (2019, 2020). Rather than relying on pretesting for unit roots that have low statistical power, the LRM bounds approach draws inferences from the LRM $t$ statistic according to critical value bounds reported by Webb et al. (2019, 2020). This approach avoids the problem of pretesting all together, while accounting for the uncertainty inherent in time-series analysis.

The first step is to estimate a GECM that is white noise (no autocorrelation). The second step is to calculate the LRM, or long-run effect, $-\frac{\Delta y_{t-1}}{y_{t-1}}$, and its standard error, which we estimate using the delta method (the nlcom command in Stata). The third step is to compare the absolute value of the $t$ statistic to the bounds provided by Webb et al. (2020). If the $t$ statistic is above the upper bound, we conclude that there is a long-run relationship. If the $t$ statistic is below the lower bound, we conclude that there is no long-run relationship, and if the $t$ statistic is between the upper and lower bounds, we cannot make substantive conclusions. We use the bounds corresponding to $T = 75$ with three regressors at a level of .05 (lower bound = 1.06, upper bound = 3.65) and .10 (lower bound = .87, upper bound = 2.77). We estimate the following GECM for the main effects:

$$\Delta \text{Life Expectancy}_{t} = \alpha_0 + \alpha_1 \Delta \text{Life Expectancy}_{t-1} + \alpha_2 \Delta \text{Life Expectancy}_{t-1} + \beta_1 \Delta \text{GDP per capita}_{t-1} + \beta_2 \text{GDP per capita}_{t-1} + \beta_3 \Delta \text{Income Inequality}_{t-1} + \beta_4 \text{Income Inequality}_{t-1} + \beta_5 \Delta \text{GHG Emissions per capita}_{t-1} + \beta_6 \text{GHG Emissions per capita}_{t-1}$$ (3)

The dependent and independent variables are transformed into natural logarithms, which make the model equivalent to estimating an elasticity model; that is, the percentage change in the dependent variable associated with a 1 percent increase in the independent variable (e.g., York et al. 2003). For the model including the cross-period interactions, we estimate

$$\Delta \text{Life Expectancy}_{t} = \alpha_0 + \alpha_1 \Delta \text{Life Expectancy}_{t-1} + \alpha_2 \Delta \text{Life Expectancy}_{t-1} + \beta_1 \Delta \text{GDP per capita}_{t-1} + \beta_2 \text{GDP per capita}_{t-1} + \beta_3 \Delta \text{Income Inequality}_{t-1} + \beta_4 \text{Income Inequality}_{t-1} + \beta_5 \Delta \text{GHG Emissions per capita}_{t-1} + \beta_6 \text{GHG Emissions per capita}_{t-1} + \beta_7 \text{GDP per capita}_{t-1} + \beta_8 \text{Income Inequality}_{t-1} + \beta_9 \text{GHG Emissions per capita}_{t-1} + \beta_{10} \text{Income Inequality}_{t-1} + \beta_{11} \text{GHG Emissions per capita}_{t-1} + \beta_{12} \text{Income Inequality}_{t-1} + \beta_{13} \text{GHG Emissions per capita}_{t-1}$$ (4)

To correctly specify our model, we include all cross-period interactions (four interaction terms) (Warner 2019). This model allows us to test whether the short-run and long-run effects of GHG emissions per capita on life expectancy are conditional on the changes and levels of income inequality. Both models are estimated using ordinary least squares in Stata 16.

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4A GECM can be used with stationary variables too (De Boef and Keele 2008).

5This is to ensure equation balance, whereby the order of integration of the independent variables equals the order of integration of the dependent variable (Pickup and Kellstedt 2020).
Results

Instantaneous and Long-Run Effects of GHG Emissions per Capita and Income Inequality on Life Expectancy

Table 2 reports three models of the main effects that account for the uncertainty in modeling long-run relationships with time-series data. Model 1 is equation 3, which estimates the long-run relationship for each variable, calculated as:

\[ \frac{X_{t-1}}{y_{t-1}} \]

GDP per capita is the only variable with an LRM long-run relationship for each variable, calculated as

\[ \frac{\Delta \text{GDP per capita}}{\Delta \text{variable}} \]

The interaction between the changes in GHG emissions and income inequality are marginally statistically significant in model 4 and statistically significant at the .05 \( \alpha \) level in models 5 and 6. In model 4, the interaction between the lag of GHG emissions and the short-run effect of income inequality is statistically significant on the basis of traditional critical values. However, results are not conclusive, because the interaction term is between the lower and upper bounds (\( t \) statistic = 2.48) even at the .10 \( \alpha \) level.

The short-run effects of GHG emissions per capita across the three models are presented in Table 4 at the 10th, 50th, and 90th percentiles of the change in income inequality. In the case of model 4, \( \beta_6 = 0 \), so the marginal effects are estimated as

\[ \beta_5 + (\beta_6 + \beta_7) \Delta \text{Income Inequality} \]

The marginal effect ranges from -1.447 (marginally statistically significant) at the 10th percentile of the change in income inequality (-2.6 percent) to -1.396 (marginally statistically significant) at the 90th percentile (3.2 percent), suggesting that the short-run effect tends toward zero as income inequality increases. In models 5 and 6 (the short-run effect is estimated as \( \beta_5 + \beta_7 \Delta \text{Income Inequality} \) in these models), the opposite is found, whereby the marginal effect becomes more negative as income inequality increases. These results indicate that there is mixed evidence regarding whether and how short-run changes in income inequality moderate the short-run effect of emissions on life expectancy.

A similar phenomenon is observed in model 4 regarding whether the long-run effect of GHG emissions per capita is conditional on the changes and level of income inequality. In the case of model 4 (the only model in which the lag of GHG emissions appears), \( \beta_6 \) and \( \beta_{10} = 0 \), so the long-run effect of GHG emissions per capita is calculated as

\[ (\beta_5 + \beta_7) \Delta \text{Income Inequality} \]

Thus, the long-run effect is conditional only on the change in income inequality. Like the short-run effects, the long-run effect of GHG emissions are reported at the 10th, 50th, and 90th percentiles of the change in income inequality. These results indicate that the emissions long-run effect is largest in absolute terms at the 10th percentile of the change in income inequality (-2.6 percent) and smallest in absolute terms (-1.325) at the 90th percentile (3.2 percent). However, there is considerable overlap in the confidence intervals between the three marginal effects, and the \( t \) statistic for each is between the bounds at the .05 and .10 \( \alpha \) levels. Thus, no conclusive statements should be made about these particular findings.

Discussion and Conclusion

It is widely assumed that nation-states use natural resources, such as fossil fuels, to grow their economies and enhance
Table 2. Main Effects.

| Life Expectancy | Model 1                  | Model 2                  | Model 3                  |
|-----------------|--------------------------|--------------------------|--------------------------|
| yt⁻¹             | -0.361* (.102)           | -0.230* (.084)           | -0.202* (.079)           |
| Δ xt             |                          |                          |                          |
| Income inequality | -0.011 (.155)           | 0.066 (.153)             | 0.076 (.153)             |
| GHG emissions per capita | -0.340* (.126) | -0.268* (.123) | -0.257* (.123) |
| GDP per capita   | -0.024 (.125)            | -0.077 (.124)            | -0.095 (.123)            |
| xt⁻¹             |                          |                          |                          |
| Income inequality | -0.167* (.071)           | -0.038 (.037)            |                          |
| GHG emissions per capita | -0.154* (.072) |                      |                          |
| GDP per capita   | 0.055* (.019)            | 0.033* (.016)            | 0.030* (.015)            |
| Δ yt⁻¹           | -0.221* (.101)           | -0.274* (.099)           | -0.294* (.097)           |

| LRM             | LRM (SE) | t statistic (inference) | LRM (SE) | t statistic (inference) | LRM (SE) | t statistic (inference) |
|-----------------|----------|-------------------------|----------|-------------------------|----------|-------------------------|
| Income inequality | -0.464 (.149) | 3.11 (between/above) | -0.163 (.154) | 1.06 (between/between) |            |                          |
| GHG emissions per capita | -0.427 (.160) | 2.67 (between/between) |            |                          |            |                          |
| GDP per capita   | 0.153 (.018) | 8.54 (above/above)     | 0.144 (.029) | 4.93 (above/above)     | 0.147 (.033) | 4.49 (above/above)     |
| Constant         | 1.329* (.391) |                      | 0.613* (.123) |                      | 0.563* (.201) |                      |
| T               | 103       |                        | 103       |                        | 103       |                        |
| Adjusted R²     | 0.362     |                        | 0.338     |                        | 0.338     |                        |
| Breusch-Godfrey χ² of AR(1) | 0.303 | 0.041                  | 0.052     | 0.101                  | 2.141     |                      |
| AR(2)           | 0.533     |                        | 0.047     | 0.092                  | 2.182     |                      |
| AR(3)           | 1.502     |                        | 2.386     |                        | 2.141     |                      |
| Durbin’s alternative χ² of AR(1) | 0.274 | 0.037                  | 0.047     | 0.092                  | 2.182     |                      |

Note: Standard errors are in parentheses. The LRM standard errors are calculated using the delta method. The first reported inference for the LRM corresponds to the .05 α level, and the second is the .10 α level. “Below” refers to |t| < 1.06, “between” refers to 1.06 < |t| < 3.65, and “above” refers to |t| > 3.65 at the .05 α level, and “below” refers to |t| < .87, “between” refers to .87 < |t| < 2.77, and “above” refers to |t| > 2.77 at the .10 α level. Asterisks are not given to the LRM s, because inference relies on nonstandard critical values. AR(1) = first-order autoregressive process; AR(2) = second-order autoregressive process; AR(3) = third-order autoregressive process; GDP = gross domestic product; GHG = greenhouse gas; LRM = long-run multiplier.

*p < .10. **p < .05.
Table 3. Interaction Results.

| Life Expectancy Model 4 | Model 5 | Model 6 |
|-------------------------|---------|---------|
| Life expectancy         | $-0.300^* (0.100)$ | $-0.167^# (0.084)$ | $-0.145^# (0.080)$ |
| Interactions            |         |         |         |
| $\Delta$ GHG emissions per capita $\times \Delta$ income inequality | $-4.313^* (2.541)$ | $-7.008^* (2.617)$ | $-6.364^* (2.506)$ |
| $\Delta$ GHG emissions per capita $\times$ income inequality $t_{-1}$ | $-1.318 (856)$ | $-1.350 (884)$ |         |
| $\Delta$ GHG emissions per capita $t_{-1} \times \Delta$ income inequality | $5.217^* (2.101)$ |         |         |
| $\Delta x_t$            |         |         |         |
| GDP per capita          | $-0.076 (1.121)$ | $0.001 (1.126)$ | $-0.585 (1.123)$ |
| Income inequality       | $-16.804^* (6.799)$ | $0.042 (1.563)$ | $0.093 (1.152)$ |
| GHG emissions per capita | $-1.423^# (0.745)$ | $-1.467^# (0.777)$ | $-0.279^* (0.121)$ |
| $\Delta y_{t-p}$        |         |         |         |
| $\Delta$ $\Delta$ GDP per capita | $-1.318 (856)$ |         |         |
| $\Delta$ $\Delta$ income inequality | $1.304 (1.153)$ | $-0.049 (0.037)$ |         |
| $\Delta$ $\Delta$ GHG emissions per capita | $-5.64^# (304)$ |         |         |
| Constant                | $2.468 (1.060)$ | $0.417^# (2.141)$ | $0.385^# (2.208)$ |
| $T$                     | 103     | 103     | 103     |
| Adjusted $R^2$          | .433    | .383    | .377    |
| Breusch-Godfrey $\chi^2$ of AR(1) | .762 | 2.586 | 1.583 |
| AR(2)                   | 1.246   | 3.467   | 2.622   |
| AR(3)                   | 1.257   | 3.585   | 2.687   |
| Durbin's alternative $\chi^2$ of AR(1) | .663 | 2.318 | 1.452 |
| AR(2)                   | 1.078   | 3.100   | 2.404   |
| AR(3)                   | 1.075   | 3.174   | 2.437   |

Note: Standard errors are in parentheses. AR(1) = first-order autoregressive process; AR(2) = second-order autoregressive process; AR(3) = third-order autoregressive process; GDP = gross domestic product; GHG = greenhouse gas.

# $p < .10$. * $p < .05$.

Table 4. Short-Run and Long-Run Effects of GHG Emissions per Capita on Life Expectancy Conditional on Income Inequality.

| $\Delta$ Income Inequality | −2.6% (10th Percentile) | .2% (50th Percentile) | 3.2% (90th Percentile) |
|-----------------------------|-------------------------|----------------------|------------------------|
| GHG emissions per capita short-run effect |         |         |         |
| Model 4                     | $-1.447^# (7.41)$ | $-1.422^# (7.46)$ | $-1.396^# (7.66)$ |
| Model 5                     | $-1.283^# (7.70)$ | $-1.473^# (7.78)$ | $-1.677^# (7.93)$ |
| Model 6                     | $-1.111 (1.39)$ | $-1.300^# (1.25)$ | $-1.487^# (1.50)$ |
| GHG emissions per capita long-run effect | $-2.333 (1.156)$ | $-1.852 (1.050)$ | $-1.325 (0.998)$ |
| LRM t statistic (inference) | 2.02 (between/between) | 1.76 (between/between) | 1.33 (between/between) |

Note: Standard errors are in parentheses. The LRM standard errors are calculated using the delta method. The first reported inference for the LRM corresponds to the .05 $\alpha$ level, and the second is the .10 $\alpha$ level. “Below” refers to $|t| < 1.06$, “between” refers to $1.06 < |t| < 3.65$, and “above” refers to $|t| > 3.65$ at the .05 $\alpha$ level, and “below” refers to $|t| < .87$, “between” refers to $.87 < |t| < 2.77$, and “above” refers to $|t| > 2.77$ at the .10 $\alpha$ level. Asterisks are not given to the LRMs, because inference relies on nonstandard critical values. GHG = greenhouse gas; LRM = long-run multiplier.

# $p < .10$. * $p < .05$.

population well-being. However, our time-series analysis indicates that in the short run, increases in GHG emissions are associated with lower life expectancy in the United States. These findings support a growing literature that reveals complex associations between primary energy use and GHG emissions and life expectancy (Mazur and Rosa 1974; Steinberger, Lamb, and Sakai 2020; Steinberger and Roberts 2010; Vita et al. 2019). These results also lend support to calls from other social scientists and population health scientists to better integrate our understanding of human
well-being and planetary health in the Anthropocene epoch (Boström et al. 2018; Dietz and Jorgenson 2014; Longo et al. 2016; Whitmee et al. 2015). Moreover, our findings contradict the assumption that emissions reductions will necessitate trade-offs in human well-being in wealthy nations. The need to challenge the widely promoted misconception about the alignment between energy use and human well-being in the high-income context (Brulle 2019; Sheehan 2018) becomes more pressing as everyday societal functioning is increasingly at risk because of ecological breakdown and climate change (Fisher and Jorgenson 2019).

We also find some evidence of a long-run negative effect of inequality, and we investigated if income inequality moderates the relationship between emissions and life expectancy. Consistent with the results of prior research (Chetty et al. 2016; Hill et al. 2019; Kaplan et al. 1996; Thombs et al. 2020), in two of three models we find that the effect of GHG on life expectancy becomes more negative as income inequality increases. However, these findings are somewhat inconsistent across the analysis. We suggest that future research should closely investigate this question across different social contexts and temporal dimensions.

Amplifying the call by Roberts et al. (2020), the results of our time-series analysis of the United States indicate that addressing the nation’s surge in income inequality could provide a multidividend return to efforts to mitigate this risk and shift toward a low-carbon, high well-being society. Addressing this challenge will likely require investment in redistributive policies, which are pivotal to fostering an equitable, sustainable, and just future (Büchs and Koch 2017; Gough 2017). We hope this study will encourage researchers to conduct similar analyses of other nations, which could further increase our understanding of these complex socioenvironmental relationships and fundamental sustainability challenges. Furthermore, additional research along these lines will help identify the structural factors that facilitate or undermine national efforts to achieve enhanced human well-being with reduced stress on the environment.

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References

Adua, Lazarus, Brett Clark, and Richard York. 2021. “The Ineffectiveness of Efficiency: The Paradoxical Effects of State Policy on Energy Consumption in the United States.” Energy Research & Social Science 71:101806.

Alderson, Arthur S., and François Nielsen. 2002. “Globalization and the Great U-Turn: Income Inequality Trends in 16 OECD Countries.” American Journal of Sociology 107(5):1244–99.

Anderson, Kathryn Freeman, Eric Bjorklund, and Simone Rambotti. 2019. “Income Inequality and Chronic Health Conditions: A Multilevel Analysis of the U.S. States.” Sociological Focus 52(1):65–85.

Ayperis, Nicholas, Christina Christou, and Rangan Gupta. 2017. “Are There Environmental Kuznets Curves for US State-Level CO₂ Emissions?” Renewable and Sustainable Energy Reviews 69:551–58.

Arias, Elizabeth, and Jiaquan Xu. 2017. “United States Life Tables, 2017.” National Vital Statistics Reports 68(7):66.

Arias, Elizabeth, and Jiaquan Xu. 2019. “United States Life Tables, 2017.” National Vital Statistics Reports 68(4):10

Arrow, Kenneth, Partha Dasgupta, Lawrence Goulder, Gretchen Daily, Paul Ehrlich, Geoffrey Heal, and Simon Levin, et al. 2004. “Are We Consuming Too Much?” Journal of Economic Perspectives 18(3):147–72.

Aslan, Alper, Mehmet Akif Destek, and Ilyas Okumus. 2018. “Bootstrap Rolling Window Estimation Approach to Analysis of the Environment Kuznets Curve Hypothesis: Evidence from the USA.” Environmental Science and Pollution Research 25(3):2402–8.

Ayres, Robert U., and Paul Michael Weaver. 1998. Eco-restructuring: Implications for Sustainable Development. Tokyo: United Nations University Press.

Bannai, Akira, and Akiko Tamakoshi. 2014. “The Association between Long Working Hours and Health: A Systematic Review of Epidemiological Evidence.” Scandinavian Journal of Work, Environment & Health 40(1):5–18.

Bolt, Jutta, Robert Inklhaar, Herman de Jong, and Jan Luiten van Zanden. 2018. “Rebasing ‘Maddison’: New Income Comparisons and the Shape of Long-Run Economic Development.” Maddison Project Working Paper 10. Groningen, the Netherlands: University of Groningen.

Boström, Magnus, Erik Andersson, Monika Berg, Karin Gustafsson, Eva Gustavsson, Erik Hysing, and Rolf Lidskog, et al. 2018. “Conditions for Transformative Learning for Sustainable Development: A Theoretical Review and Approach.” Sustainability 10(12):4479.

Boyce, James K. 1994. “Inequality as a Cause of Environmental Degradation.” Ecological Economics 11(3):169–78.

Boyce, James K., Andrew R. Klemer, Paul H. Templet, and Cleve E. Willis. 1999. “Power Distribution, the Environment, and Public Health: A State-Level Analysis.” Ecological Economics 29(1):127–40.

Brook, Robert D., Sanjay Rajagopalan, C. Arden Pope III, Jeffrey R. Brook, Aruni Bhatnagar, Ana V. Diez-Roux, and Fernando Holguin, et al. 2010. “Particulate Matter Air Pollution and Cardiovascular Disease: An Update to the Scientific Statement from the American Heart Association.” Circulation 121(21):2331–78.

Brulle, Robert J. Forthcoming. “Networks of Opposition: A Structural Analysis of US Climate Change Countermovement Coalitions 1989–2015.” Sociological Inquiry.
Chetty, Raj, Michael Stepner, Sarah Abraham, Shelby Lin, Benjamin Scuder, Nicholas Turner, and Augustin Bergeron, et al. 2016. “The Association between Income and Life Expectancy in the United States, 2001–2014.” *JAMA* 315(16):1750–66.

Clarkwest, Andrew. 2008. “Neo-materialist Theory and the Temporal Relationship between Income Inequality and Longevity Change.” *Social Science & Medicine* 66(9):1871–81.

Claudio, Luz. 2007. “Waste Couture: Environmental Impact of the Clothing Industry.” Rockville, MD: National Institute of Environmental Health Sciences.

Cushing, Lara, Rachel Morello-Frosch, Madeline Wander, and Manuel Pastor. 2015. “The Haves, the Have-Not, and the Health of Everyone: The Relationship between Social Inequality and Environmental Quality.” *Annual Review of Public Health* 36:193–209.

Daly, Martin, Margo Wilson, and Shawn Vasdev. 2001. “Income Inequality and Homicide Rates in Canada and the United States.” *Canadian Journal of Criminology* 43(2):219–36.

Dasgupta, Susmita, Benoit Laplante, Hua Wang, and David Wheeler. 2002. “Confronting the Environmental Kuznets Curve.” *Journal of Economic Perspectives* 16(1):147–68.

Datta, Y. 2014. “Rising Economic Inequality and Class Divisions in America: A Socio-economic Class Lifestyle Profile.” *Oxford Journal: An International Journal of Business & Economics* 8(2).

Davison, Aidan. 2016. “The Luxury of Nature: The Environmental Consequences of Super-Rich Lives.” Pp. 339–60 in *Handbook on Wealth and the Super-Rich*, edited by J. Hay, and J. V. Beaverstock. London: Elgar.

De Boef, Suzanna, and Luke Keele. 2008. “Taking Time Seriously.” *American Journal of Political Science* 52(1):184–200.

Desmond, Matthew, and Mustafa Emirbayer. 2015. *Race in America*. New York: Norton.

Dietz, Thomas, Tom R. Burns, and Federick H. Buttel. 1990. “Evolutionary Theory in Sociology: An Examination of Current Thinking.” *Sociological Forum* 5(2):155–71.

Dietz, Thomas, Kenneth A. Frank, Cameron T. Whitley, Jennifer Kelly, and Rachel Kelly. 2015. “Political Influences on Greenhouse Gas Emissions from US States.” *Proceedings of the National Academy of Sciences* 112(27):8254–59.

Dietz, Thomas, and Andrew Jorgenson. 2014. “Towards a New View of Sustainable Development: Human Well-Being and Environmental Stress.” *Environmental Research Letters* 9(3):031001.

Dietz, Thomas, and Eugene A. Rosa. 1997. “Effects of Population and Affluence on CO2 Emissions.” *Proceedings of the National Academy of Sciences* 94(1):175–79.

Dietz, Thomas, Eugene A. Rosa, and Richard York. 2009. “Environmentally Efficient Well-Being: Rethinking Sustainability as the Relationship between Human Well-Being and Environmental Impacts.” *Human Ecology Review* 16(1):114–23.

Dietz, Thomas, Eugene A. Rosa, and Richard York. 2012. “Environmentally Efficient Well-Being: Is There a Kuznets Curve?” *Applied Geography* 32(1):21–28.

Dietz, Thomas, and Cameron T. Whitley. 2018. “Inequality, Decisions, and Altruism.” *Sociology of Development* 4(3):282–303.

Dinda, Soumyananda. 2004. “Environmental Kuznets Curve Hypothesis: A Survey.” *Ecological Economics* 49(4):431–55.

Dunlap, Riley E., and Aaron M. McCright. 2011. “Organized Climate Denial.” Pp. 144–60 in *The Oxford Handbook of Climate Change and Society*. New York: Oxford University Press.

Ehrhardt-Martinez, Karen, Juliet B. Schor, Wokie Abrahamse, Alison Hope Alkon, Jonn Axsom, Keith Brown, and R. L. Schwom, et al. 2015. “Consumption and Climate Change.” *Climate Change and Society: Sociological Perspectives* 93:126.

EPA (U.S. Environmental Protection Agency). 2018. “U.S. Inventory of Greenhouse Gas Emissions and Sinks.” EPA-430-R-18-003. Washington, DC: U.S. Environmental Protection Agency.

Farrell, Justin. 2016. “Corporate Funding and Ideological Polarization about Climate Change.” *Proceedings of the National Academy of Sciences* 113(1):92–97.

Farrell, Justin. 2019. “The Growth of Climate Change Misinformation in US Philanthropy: Evidence from Natural Language Processing.” *Environmental Research Letters* 14(3):034013.

Fichman, B. T. 2010. “Annual Energy Review 2009.” No. DOE/EIA-0384. Washington, DC: U.S. Department of Energy, Energy Information Administration, Office of Energy Markets and End Use.

Fisher, Dana, and Andrew Jorgenson. 2019. “Ending the Stalemate: Toward a Theory of Anthro-Shift.” *Sociological Theory* 37(4):342–62.

Fitzgerald, Jared, Juliet Schor, and Andrew Jorgenson. 2018. “Working Hours and Carbon Dioxide Emissions in the United States, 2007–2013.” *Social Forces* 96(4):1851–74.

Folkard, Simon, and David A. Lombardi. 2006. “Modeling the Impact of the Components of Long Work Hours on Injuries and Accidents.” *American Journal of Industrial Medicine* 49(11):953–63.

Foster, John Bellamy. 1999. “Marx’s Theory of Metabolic Rift: Classical Foundations for Environmental Sociology.” *American Journal of Sociology* 105(2):366–405.

Frank, Robert H. 2010. *Luxury Fever: Weighing the Cost of Excess*. Princeton, NJ: Princeton University Press.

Frank, Robert H. 2020. *Under the Influence: Putting Peer Pressure to Work*. Princeton, NJ: Princeton University Press.

Givens, Jennifer E. 2017. “World Society, World Polity, and the Carbon Intensity of Well-Being, 1990–2011.” *Sociology of Development* 3(4):403–35.

Givens, Jennifer E. 2018. “Ecologically Unequal Exchange and the Carbon Intensity of Well-Being, 1990–2011.” *Environmental Sociology* 4(3):311–24.

Givens, Jennifer E. 2018. “Ecologically Unequal Exchange and the Carbon Intensity of Well-Being, 1990–2011.” *Environmental Sociology* 4(3):311–24.

Givens, Jennifer, Brett Clark, and Andrew Jorgenson. 2016. “Strengthening the Ties between Environmental Sociology and the Sociology of Development.” Pp. 69–94 in *The Sociology of Development Handbook*, edited by P. Almeida, D. Brown, S. Cohn, S. Curran, R. Emigh, G. Hooks, and H. Hung, et al. Berkeley: University of California Press.

Gough, Ian. 2017. *Heat, Greed and Human Need: Climate Change, Capitalism and Sustainable Wellbeing*. London: Edward Elgar.

Grant, Don, Andrew Jorgenson, and Wesley Longhofer. 2020. *Super Polluters: Tackling the World’s Largest Sites of Climate-Disrupting Emissions*. New York: Columbia University Press.
Gütschow, Johannes, Louise Jeffery, and Robert Gieseke. 2019. “Economic Growth and the Environment.” Quarterly Journal of Economics 110(2):353–77.

Gitschow, Johannes, Louise Jeffery, and Robert Gieseke. 2019. “The PRIMAP-Hist National Historical Emissions Time Series (1850–2016).” Version 2.0. Retrieved May 19, 2021. http://dataservices.gfz-potsdam.de/pik/showshort.php?id=escidoc:3842934.

Hill, Terrence D., and Andrew Jorgenson. 2018. “Bring Out Your Dead! A Study of Income Inequality and Life Expectancy in the United States, 2000–2010.” Health & Place 49:1–6. doi: 10.1016/j.healthplace.2017.11.001.

Hill, Terrence D., Andrew Jorgenson, Peter Ore, Kelly S. Balistreri, and Brett Clark. 2019. “Air Quality and Life Expectancy in the United States: An Analysis of the Moderating Effect of Income Inequality.” Socius: Sociological Research for a Dynamic World 5(3):277–82.

Jorgenson, Andrew. 2006. “Global Warming and the Neglected Greenhouse Gas: A Cross-National Study of Methane Emissions Intensity, 1995.” Social Forces 84(3):1777–96.

Jorgenson, Andrew. 2014. “Economic Development and the Carbon Intensity of Human Well-Being.” Nature Climate Change 4(3):186–89.

Jorgenson, Andrew. 2015. “Inequality and the Carbon Intensity of Human Well-Being.” Journal of Environmental Studies and Sciences 5(3):277–82.

Jorgenson, Andrew, and Brett Clark. 2012. “Are the Economy and the Environment Decoupling? A Comparative International Study, 1960–2005.” American Journal of Sociology 118(1):1–44.

Jorgenson, Andrew, Juliet Schor, and Xiaorui Huang. 2017. “Income Inequality and Carbon Emissions in the United States: A State-Level Analysis, 1997–2012.” Ecological Economics 134:40–48.

Kaplan, George A., Elsie R. Pamyuk, John W. Lynch, Richard D. Cohen, and Jennifer L. Balfour. 1996. “Inequality in Income and Mortality in the United States: Analysis of Mortality and Potential Pathways.” BMJ 312(7037):999–1003.

Kawachi, Ihiro, and Bruce P. Kennedy. 1999. “Income Inequality and Health: Pathways and Mechanisms.” Health Services Research 34(1 Pt 2):215.

Kelly, Orla. 2020. “The Silver Bullet? Assessing the Role of Education for Sustainability.” Social Forces 99(1):178–204.

Knight, Kyle, Juliet Schor, and Andrew Jorgenson. 2017. “Wealth Inequality and Carbon Emissions in High-Income Countries.” Social Currents 4(5):403–12.

Kuznets, Simon. 1955. “Economic Growth and Income Inequality.” American Economic Review 45(1):1–28.

Kuznets, Simon. 1979. Growth, Population and Income Distribution: Selected Essays, Vol. 45. New York: Norton

Lamb, William F. 2016. “Which Countries Avoid Carbon-Intensive Development?” Journal of Cleaner Production 131:523–533.

Lelieveld, Jos, John S. Evans, Mohammed Fnais, Despina Giannadaki, and Andrea Pozzer. 2015. “The Contribution of Outdoor Air Pollution Sources to Premature Mortality on a Global Scale.” Nature 525(7569):367–71.

Longo, Stefano B., Brett Clark, Thomas E. Shriver, and Rebecca Clausen. 2016. “Sustainability and Environmental Sociology: Putting the Economy in Its Place and Moving toward an Integrative Socio-ecology.” Sustainability 8(5):437.

Malin, Stephanie A. 2020. “Depressed Democracy, Environmental Injustice: Exploring the Negative Mental Health Implications of Unconventional Oil and Gas Production in the United States.” Energy Research & Social Science 70:101720.

Mann, Michael. 2012. The Sources of Social Power, Volume 4: Globalizations, 1945–2011. Cambridge, UK: Cambridge University Press.

Mazur, Allan, and Eugene Rosa. 1974. “Energy and Lifestyle.” Science 186(4164):607–10.

Mcgee, Julius Alexander, and Patrick Trent Greiner. 2018. “Can Reducing Income Inequality Decouple Economic Growth from CO2 Emissions?” Socius 4. Retrieved May 19, 2021. https://journals.sagepub.com/doi/10.1177/2378023118772716.

McMichael, Anthony J., John W. Powles, Colin D. Butler, and Ricardo Uauy. 2007. “Food, Livestock Production, Energy, Climate Change, and Health.” The Lancet 370(9594):1253–63.

Milanovic, Branko. 2016. Global Inequality: A New Approach for the Age of Globalization. Cambridge, MA: Harvard University Press.

Mishra, Sandeep, and R. Nicholas Carleton. 2015. “Subjective Relative Deprivation Is Associated with Poorer Physical and Mental Health.” Social Science & Medicine 147:144–49.

Mol, Arthur P. J. 2001. Globalization and Environmental Reform: The Ecological Modernization of the Global Economy. Cambridge, MA: MIT Press.

Mol, Arthur P. J. 2002. “Ecological Modernization and the Global Economy.” Global Environmental Politics 2(2):92–115.

Neumayer, Eric. 2003. Weak versus Strong Sustainability: Exploring the Limits of Two Opposing Paradigms. London: Edward Elgar.

Oishi, Shigehiro, Selin Kesebir, and Ed Diener. 2011. “Income Inequality and Happiness.” Psychological Science 22(9):1095–1100.

O’Neill, Daniel W., Andrew L. Fanning, William F. Lamb, and Julia K. Steinberger. 2018. “A Good Life for All within Planetary Boundaries.” Nature Sustainability 1(2):88–95.

Ostrom, Elinor. 2008. “Frameworks and Theories of Environmental Change.” Global Environmental Change 18(2):249–52.

Patz, Jonathan A., Diarmid Campbell-Lendrum, Tracey Holloway, and Jonathan A. Foley. 2005. “Impact of Regional Climate Change on Human Health.” Nature 438(7066):310–17.

Payne, B. Keith, Jazmin L. Brown-Iannuzzi, and Jason W. Hannay. 2017. “Economic Inequality Increases Risk Taking.” Proceedings of the National Academy of Sciences 114(18):4643–48.

Pesaran, M. Hashem, Yongcheol Shin, and Richard J. Smith. 2001. “Bounds Testing Approaches to the Analysis of Level Relationships.” Journal of Applied Econometrics 16(3):289–326.

Philips, Andrew Q. 2018. “Have Your Cake and Eat It Too? Cointegration and Dynamic Inference from Autoregressive Distributed Lag Models.” American Journal of Political Science 62(1):230–44.

Pickup, Mark. 2014. Introduction to Time Series Analysis. Thousand Oaks, CA: Sage.

Pickup, Mark, and Paul Kellstedt. 2020. “Equation Balance in Time Series Analysis: What It Is and How to Apply It.” Working
Anthropocene Epoch: Report of the Rockefeller Foundation–Lancet Commission on Planetary Health.” The Lancet 386(10007):1973–2028.

Wilkinson, Richard, and Kate Pickett. 2010. The Spirit Level: Why Equality Is Better for Everyone. London: Penguin UK.

Xu, Zhenci, Sophia N. Chau, Xiuzhi Chen, Jian Zhang, Yingjie Li, Thomas Dietz, and Jinyan Wang, et al. 2020. “Assessing Progress towards Sustainable Development over Space and Time.” Nature 577(7788):74–78.

York, Richard, and Julius Alexander McGee. 2016. “Understanding the Jevons Paradox.” Environmental Sociology 2(1):77–87.

York, Richard, Eugene A. Rosa, and Thomas Dietz. 2003. “Footprints on the Earth: The Environmental Consequences of Modernity.” American Sociological Review 68(2):279–300.

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