The environmental efficiency of well-being: A cross-national analysis

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A B S T R A C T

Recent research has conceptualized sustainability as the environmental efficiency of well-being (EWEB). This concept takes into account the benefits societies are able to produce from their demands on the environment. Research along these lines indicates that countries vary widely in the efficiency with which they transform the Earth's resources into well-being. Here, we take up this finding as a puzzle to be explained. We construct a new measure of EWEB using the ecological footprint per capita (a measure of environmental consumption) and average life satisfaction (a measure of subjective well-being). We draw hypotheses from political economy, modernization, and sustainable consumption theories in the environmental social sciences. Using full information maximum likelihood estimation, we test the effects of climate, political, economic, and social factors on EWEB with a sample of 105 countries. Key findings include a negative quadratic effect of economic development on EWEB, a negative effect of income inequality, and a positive effect of social capital.

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1. Introduction

Definitions of sustainability typically refer, implicitly or explicitly, to striking a balance between societal demands on the environment and social well-being (of current and future generations). For instance, the influential 2005 Millennium Ecosystem Assessment was titled *Ecosystems and Human Well-Being: Synthesis* (Reid et al., 2005). The goal of sustainability is to minimize environmental impacts and maximize human well-being (Dietz et al., 2009; Prescott-Allen, 2001). Chambers et al. (2000, p. 3), argue that, “To make sustainability happen, we need to balance the basic conflict between the two competing goals of ensuring a quality of life and living within the limits of nature." Thus, sustainability is the sustaining of human well-being into the indefinite future by minimizing humanity’s impact on the natural environment upon which that well-being ultimately depends. The goal, as stated in the Brundtland Report, is to “[meet] the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987, p. 8). According to that influential report this is to be achieved by focusing on economic growth, social equity, and environmental protection (WCED, 1987). Much of the debate on sustainability and the means to attain it (i.e., sustainable development) centers on the primacy, and desirability, of each of these three dimensions of sustainability. In particular, a focused debate has ensued over whether economic development or well-being should be the goal. We address this issue in detail below.

Since the landmark Rio Earth Summit and publication of Agenda 21 in 1992, sustainable consumption—how to define it, measure it, and attain it—has become a major topic and policy issue. Here we focus on consumption as the key aspect of sustainability because economics is dominated by the assumption of a strong link between consumption and utility, or well-being, and it is where the issue of well-being has been most researched (see Jackson, 2005; Seyfang, 2009).
There are two main competing views on what sustainable consumption means. The first sees it not as a reduction in consumption, but as ‘consuming differently.’ The focus is on ‘green consumerism,’ market-mechanisms, and production efficiencies (Mol and Spaargaren, 2004; Vincent and Panayotou, 1997). This understanding of sustainable consumption relies on the assumptions of neoclassical economics that equates consumption with utility or well-being and thus does not advocate for lower levels of consumption. According to this view, if sustainability requires reducing consumption levels, then we face a bleak choice between maintaining our own well-being at the expense of future generations or reducing our present well-being (Marks et al., 2007). The route out of this dilemma is to make our consumption more benign or more efficient.

The second approach is critical of the link between consumption and well-being and defines sustainable consumption as ‘consuming less’ in absolute terms. Hence, it is critical of both the environmental costs of high levels of consumption as well as the purported well-being benefits of consumption. This perspective has been marginalized relative to the former in mainstream policy discussions (Seyfang, 2009; Jackson and Michaelis, 2003). In contrast to the continue to consume, but more efficiently, “greening,” view of sustainable consumption, this second view suggests that, because consumption levels and well-being are not tightly coupled, reaching sustainability by reducing consumption will not require reductions in well-being.

A significant body of research has demonstrated that consumption is a major cause of global environmental degradation (Redclift, 1996; Rothman, 1998; Worldwatch Institute, 2004; York et al., 2003). Consumption, therefore, has been attracting increased recognition as an environmental problem in both academic and policy circles (Cohen, 2001; Fuchs and Lorek, 2005; Seyfang, 2009). However, most of the empirical research has focused on consumption as a driver of environmental impacts without regard to the social well-being that consumption may generate. There is a virtual absence of social science research on the social benefits of environmental consumption (for an exception, see Dietz et al., 2009). A number of studies have explored the relationship between natural capital or environmental quality and human well-being (Engelbrecht, 2009; Vemuri and Costanza, 2006); however, these studies have not focused on the role of environmental consumption per se. Some researchers from the world-systems perspective have recently analyzed the direct and indirect influence of environmental consumption on various measures of objective well-being. Specifically, Jorgenson and Burns (2004) have demonstrated a negative indirect effect of environmental consumption on infant mortality while Rice (2008) has found a negative relationship between environmental consumption and maternal mortality rates in less-developed countries. Objective quality of life indicators, such as these, provide the parameters or inputs to well-being and, are, therefore, indirect estimates of well-being (Veenhoven, 1995). Examining the subjective dimension of well-being is a more direct measure of well-being and the natural complement to its objective inputs. Given that conceptualizations of sustainability often encompass both environmental impacts and human well-being, empirical research in this area is essential for a more complete understanding of the dimensions of sustainability.

2. Previous research on consumption and well-being

As noted above, while most research on the relationship between consumption and the environment has neglected the consumption and well-being nexus, several studies have begun to explore the topic. The question posed by these researchers is straightforward: what is the nature of the relationship (if any) between levels of consumption and social well-being?

Conventionally, especially in economics and policy, measures of affluence (i.e., GDP per capita) have typically been used as valid measures of well-being. Based on the axioms of revealed preferences (Samuelson, 1938) and utility maximization, economics equates higher levels of GDP with higher levels of well-being (Royo, 2007). This assumes rather than investigates the equivalence of consumption with well-being. There is good reason to question the use of GDP as a complete proxy for welfare or well-being.3

First, it leaves out natural capital which sustainable well-being depends upon but includes expenditures on positional (i.e., goods that provide satisfaction as a function of comparison) and defensive goods (i.e., goods that protect rather than increase satisfaction) as well as negative externalities none of which contributes to well-being (e.g., the costs of cleaning up pollution add to GDP rather than detract) (Daly and Cobb, 1994; Hirsch, 1977; Jackson, 2009). As Ayres and Martinas (2005, p. 128) note, GDP “is not really a measure of welfare... [it] is a measure of economic activity, nothing more.”

Second, the relationship between affluence and both objective and subjective well-being is curvilinear, with higher levels contributing less and less to well-being (i.e., diminishing marginal returns) (Dietz et al., 2001; Goldstein, 1985; Inglehart and Klingemann, 2000; Layard, 2005; Preston, 1975). Fig. 1 illustrates the curvilinear relationship between GDP per capita and subjective well-being. Furthermore, recent cross-national research has questioned the equating of economic growth with well-being in less-developed countries. Brady et al. (2007, p. 2) criticize the “growth consensus: the conventional wisdom that economic growth should be the primary priority for less-developed countries because it most effectively improves

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1 Not all economists are in agreement that utility and well-being are the same thing (see, for example, Becker and Rayo, 2008).
2 Objective measures of well-being are social indicators that reflect the extent to which human needs are met (e.g., life expectancy, infant mortality, etc.). These measures do not require input from the people they describe. On the other hand, subjective measures of well-being are self-reported levels of well-being (e.g., happiness, life satisfaction, etc.) as perceived by the individual his or herself.
3 This is a transformational point of growing recognition, even among economists. Earlier recognition can be found in Nussbaum and Sen (1993) and very recent refinements are in the influential report commissioned by French President Nicolas Sarkozy in 2008, directed by Nobel Laureates Joseph Stiglitz and Amartya Sen and distinguished French economist Jean-Paul Fitoussi, Report by the Commission on the Measurement of Economic Performance and Social Progress (Stiglitz et al., 2010).
2.1. The economics of subjective well-being

Economist Richard Easterlin (1974, 1995) pioneered the field of the economics of happiness or subjective well-being and arrived at these paradoxical findings: (1) within a society, rich people tend to be much happier than poor people; (2) rich societies tend to be no happier (or not by much) than poor societies, and (3) as countries get richer they do not get happier. Furthermore, some economists, building on the Easterlin findings, have argued for a satiation point—a point where increases in income increase well-being no further (Frey and Stutzer, 2002; Layard, 2005). Easterlin explains his findings, referred to ever since as “the Easterlin paradox,” with two social factors: social comparison and hedonic adaptation. He argued that once basic needs are met, relative income is more important than absolute income in determining subjective well-being. Social comparison refers to the idea that within countries higher income is associated with higher subjective well-being because individuals compare their own consumption to the prevailing norm; those consuming at higher levels feel better off than those consuming at lower levels. But, as an already wealthy nation becomes richer over time, consumption norms undergo an upward shift so that while consumption may be increasing, national average well-being does not change. Easterlin refers to this phenomenon as hedonic adaptation. Recently Easterlin and colleagues (Easterlin and Sawangfa, 2009; Easterlin and Angelescu, 2009) found that economic growth over time does not lead to higher subjective well-being in either developed or developing countries.

Further investigation of the “Easterlin paradox” comes from research demonstrating that economic growth in industrialized countries since WWII has not resulted in substantial increases in subjective well-being (Diener and Oishi, 2000). Recent findings by Diener et al. (2010, p. 61) show “that more than money is needed for quality of life, and the social psychological forms of prosperity correlate only moderately with economic development.” Furthermore, Helliwell (2003) finds that social factors other than affluence are more important in predicting national-level life satisfaction such as low corruption, high levels of mutual trust, and effective social and political institutions. In addition, Inglehart (2009, p. 351) finds that national income per capita “follows a curve of diminishing returns” in relation to subjective well-being.

The Easterlin paradox has attracted its share of critics. The literature on this topic is too vast and growing too rapidly to adequately review here. Nevertheless, it is important to note that several recent articles that have called into question the empirical validity of the Easterlin paradox (e.g., Deaton, 2008; Hagerty and Veenhoven, 2003; Stevenson and Wolfers, 2008). Graham et al. (2009) argue that the national income-subjective well-being relationship is highly complex and that the effects

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4 Thicker description is provided for such cross-national findings by detailed case studies showing that considerably high quality of life can be achieved in poor countries or even regions of countries. The point has been amply demonstrated in the Indian state of Kerala (population 32 million) which, although having one of the lowest GDPs in India, has high literacy rates and life expectancies for both sexes (even higher than African-Americans) and effective health care. These high objective well-being measures can be traced to policies and programs that promote literacy, that expand health care, and are attentive to inequalities (for a descriptive summary see Sen (1993)).

5 Another pioneering economist on this topic was Scitovsky (1976).
of income are sensitive to a number of factors including survey question-framing, the type of well-being analyzed, sample composition, selected time frame, previous levels of economic development, and rates of economic growth.

Despite the limitations in the data, Stevenson and Wolfers (2008), by examining many datasets, provide the most thorough test of the Easterlin hypothesis to date. Their principal test is of the hypotheses that poorer nations are just as happy as rich ones and that there is an income upper bound or satiation point. They find support for neither. Instead they establish a positive link between the log of GDP per capita and subjective well-being and no evidence of a satiation point where wealthier countries have no further increases in well-being.

In sum, the Easterlin paradox is neither definitively confirmed nor disconfirmed by this collection of recent studies. According to Diener et al. (2009b, p. xvi), the debate regarding income and subjective well-being is “best regarded as unsettled.” Resolution of the paradox will require the collection of consistent panel data for many countries, spanning many years. Such data is likely to remain unavailable for the foreseeable future. In the meantime, it appears that the link between income and well-being is clearly a concave, monotonic function, as illustrated in Fig. 1. It apparently takes large increases in income at upper levels to produce modest increases in well-being. The question the relationship poses in the environmental context we are investigating here is about the link between consequential environmental threats and well-being.

2.2. Environmental consumption and well-being

A second body of research with sociological roots avoids the conventional economic assumption of equivalence by investigating the effects of environmental consumption directly on objective and subjective measures of well-being. Early research by Mazur and Rosa (1974) documented the decoupling in the US of energy consumption (a critical natural resource) and various objective measures of quality of life. Rosa (1997) later found that carbon emissions and objective well-being had become decoupled between 1970 and 1985 in a sample of advanced industrial countries. Recent research has found that environmental consumption, measured as the ecological footprint (EF)6, has no direct effect, net of income, on objective well-being measured as life expectancy (Dietz et al., 2009). Furthermore, Knight and Rosa (2009) assessed the direct effect of environmental consumption, measured as EF on subjective well-being measured as average life satisfaction. The findings show that: (1) increased consumption does not lead to higher levels of, and may actually decrease, well-being in high-consumption countries, (2) high consumption levels are not a necessary condition for high levels of well-being, and (3) very large increases in consumption since 1961 have not led to substantial improvements in life satisfaction in the US.

These findings suggest that improvements in well-being may be attainable without escalating the consumption of environmental resources. In short, environmental consumption and well-being are apparently not linearly related. Furthermore, countries with high levels of well-being vary widely in their levels of consumption. For instance, Costa Rica has achieved a level of subjective well-being rivaling that of the US with an EF per capita four times smaller (Abdallah et al., 2009; Knight and Rosa, 2009). Further evidence comes from Marks et al.’s (2006) computation and analysis of the Happy Planet Index, which measured the ratio of well-being to environmental consumption and found wide variation among countries.

Research on the relationship between environmental consumption and well-being led to a key refinement. It refined the idea of sustainability as the maximization of human well-being and minimization of environmental impact by conceptualizing sustainability as environmental efficiency of well-being (EWEB) (Dietz et al., 2009). The EWEB concept takes into account the benefits (alternatively measured as subjective or objective well-being) societies are able to produce from their demands on the environment. EWEB is an important concept and indicator of sustainability because measures of environmental sustainability, like the EF do not measure sustainability per se, but only the ecological and distributional aspects of it (Chambers et al., 2000). By taking into account both well-being and level of environmental consumption, EWEB is more fully consonant with the prevailing definitions of sustainability. It indicates the degree to which a society is achieving a desirable level of well-being without compromising the well-being of future generations by depleting natural capital. As noted above, research along these lines indicates that countries vary widely in the efficiency with which they transform the Earth’s resources into well-being (Dietz et al., 2009; Knight and Rosa, 2009; Marks et al., 2006). This is an especially significant finding, but it begs the question: What social factors influence a country’s environmental efficiency of well-being?

We address this question with a quantitative cross-national analysis in several steps. First, we graphically depict the relationship between environmental consumption and a measure of subjective well-being. Second, we devise and compute a new indicator of the Environmental Efficiency of Well-being (EWEB) using a measure of subjective well-being and a measure of consumption-based environmental pressure, the EF. Third, we examine several factors in the light of prior theorization and findings that may influence EWEB. Fourth, we estimate the effects of social, political, economic, demographic, and climate variables on this new measure of EWEB using Arbuckle’s (1997) full information maximum likelihood estimation (MLE) on a large sample of countries.

3. Measuring EWEB

There have been several attempts to operationalize EWEB in the last decade. First, Dietz et al. (2001) calculated a ratio including infant mortality (transformed into infant survival) as the numerator and a combined index including EF per capita

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6 See Section 3.2 below for a definition and description of the ecological footprint.
(measuring consumption-based environmental impact) and the Environmental Systems Indicator (a subset of the Environmental Sustainability Index measuring environmental quality) as the denominator (Samuel-Johnson, 2001). Second, a similar measure was developed by Prescott-Allen (2001), the Wellbeing/Stress Index, which includes a composite index of objective well-being measures in the numerator and a composite index of ecosystem health (environmental quality) in the denominator. Third, the Happy Planet Index (HPI) (Marks et al., 2006; Abdallah et al., 2009) is the ratio of average life satisfaction multiplied by life expectancy over the EF per capita. A related EWEB measure is Ng’s (2008) Environmentally Responsible Happy Nation Index, which is an attempt to revise conceptually and mathematically the HPI. Fourth, Dietz et al. (2009) estimated the efficiency of well-being using a stochastic frontier production model with ecological footprint, affluence, and education as predictors of life expectancy.

These approaches have key limitations for several reasons. First, as recognized by Marks et al. (2006) and Abdallah et al. (2009) in calculating the HPI, ratios are often dominated by either the numerator or denominator depending on which has greater dispersion (in this case the denominator). This means that EWEB indicators measured as ratios are dominated by EF scores and thus can lead to misleading results. The HPI corrects for this by adding a constant to the EF per capita in order to match its coefficient of variation with the numerator; however, this artificial deflation of dispersion in the EF may result in less straightforward interpretation. The adjustment of the EF in the HPI transforms it from an indicator of absolute footprint scores to an indicator of the position of each country in the overall distribution of footprint scores. Thus, the HPI measures the degree to which a country has a higher level of well-being relative to countries with similar levels of environmental consumption. It is important to note that this adjustment has major consequences for the resulting indicator. In order to illustrate this, we calculated an EWEB score by dividing average life satisfaction by the EF per capita and then calculated another score in which the coefficients of variation were matched by adding a constant to the footprint. The two resulting scores were only correlated at .39 ($p < .01$, $N = 105$). Thus, this transformation is not trivial and furthermore, the HPI is not a straightforward ratio. However, as we note below, this is not necessarily a downside of the HPI.

Second, the use of a ratio variable as a dependent variable in regression analyses is statistically questionable, often resulting in spurious correlations (Kronmal, 1993). The major concern here is the inclusion of an independent variable that is the same as or highly correlated with either the numerator or denominator of the ratio in the dependent variable. This can result in a positive or negative effect, respectively, simply because an independent variable is common (or nearly so) to a component of the dependent variable. Furthermore, interpretation of regression coefficients can be difficult because the independent variables may differentially affect the numerator and denominator of the ratio in the dependent variable. This means that regressing a ratio measure of EWEB on several variables would make it difficult to discern the actual effects of each variable and may result in misleading inferences. One solution to this problem would be to treat the EF as an independent variable in a model predicting well-being; however, this is not feasible because level of economic development is a key independent variable of interest and adding the EF as another independent variable would result in excessive multicollinearity and thus unstable parameter estimates.

Third, while Dietz et al. (2001) use a measure of objective well-being, the HPI uses a combined measure of objective and subjective well-being and the Wellbeing/Stress Index (Prescott-Allen, 2001) uses a composite index of objective well-being. Furthermore, Dietz et al. (2001) use a combined measure of environmental impact including both resource consumption and environmental quality while the HPI uses the EF alone and the Wellbeing/Stress Index uses a composite index of environmental quality. The choice of environmental quality or environmental consumption as the denominator of the ratio can affect the results because these are two different types of environmental degradation. As Jorgenson et al. (2009) have noted, countries with higher consumption often face lower levels of degradation within their borders due to the process of ‘ecologically unequal exchange’ by which more-developed countries externalize the environmental costs of their high levels of consumption to less-developed countries; for example, countries with higher resource consumption actually experience lower levels of water pollution and deforestation. Thus, combining such measures in the denominator or numerator results in much less straightforward interpretation. In our view, a simpler approach which selects one type of well-being measure and one type of environmental impact measure is more useful for understanding EWEB at this early stage of research. Here, we focus on environmental consumption measures, particularly the EF.

The approach of Dietz et al. (2009), while useful and innovative, has not been adapted for research on the determinants of cross-national variation in EWEB. Dietz and colleagues estimate countries’ efficiency in enhancing human well-being through the use of economic, natural and human resources, but do not investigate the factors which affect this efficiency. Furthermore, the efficiency measure produced in their approach takes into account economic and human capital inputs in addition to environmental consumption which makes it less amenable to the approach taken here which is concerned with the factors which may affect EWEB alone.

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8 For our sample, this constant was calculated to be 5.89.
9 Both life satisfaction and ecological footprint are described in detail below.
10 In the ecology literature this is referred to as the “Netherlands Fallacy” (York et al., 2003). The term refers to the pattern in some densely populated and economically prosperous nations, such as The Netherlands, which have a relatively clean environment, despite high consumption of resources, because they import a large share of resources they consume and export their wastes, thereby externalizing their environmental impacts.
Ng (2008) offers a critical correction to the HPI. He calculates an alternative Environmentally Responsible Happy Nation Index while criticizing several features of the HPI. Among other changes, Ng advocates for the use of CO₂ per capita as a measure of the external costs of global environmental disruption contributed by a country, which is different from what Marks et al. (2006) claim to be measuring with EF per capita (i.e., the resources consumed by a population). He does so because he views the EF as not “internationally acceptable” for comparing nations’ environmental impacts. Ng’s final measure is computed as adjusted happy life years minus carbon dioxide per capita as a proportion of average world emissions per capita measured in terms of the proportion of the average happy life years of the current generation. Ng provides no comparison of the final scores he calculates with the values of the HPI. Thus, it is not clear how much of a difference or improvement his revisions make. However, as Ng (2008, p. 444) declares, this “estimation is meant to be no more than an illustration.…” Furthermore, Ng (2008, p. 443) relies on numerous assumptions and estimations of variables in calculating his index and acknowledges that “An adequate estimate of these variables is beyond the scope of this paper and probably the capability of any individual researcher.” In view of these limitations we see little grounds suggesting that Ng’s index is an advance on previous EWEB indicators.

To avoid the main limitations of the approaches above we devised a measure of EWEB that takes into account the subjective well-being and EFs of countries without the limitations inherent in a ratio measure. Next, we describe the components of this measure and our calculation of it.

3.1. Life satisfaction

We chose to focus on subjective well-being for several reasons. First, most of the previous research toward developing an EWEB indicator has focused on objective indicators of well-being such as life expectancy and infant mortality or combinations of objective and subjective well-being indicators. Hence, we already have some understanding of the relationship between the quality of living conditions and threats to the environment. By looking at subjective well-being, we move that research into uncharted territory where there is considerable potential for advancing our understanding of this topic. Second, a focus on subjective, as opposed to objective, well-being is more congruent with the sustainable consumption literature (Jackson, 2005; Manno, 2002; Seyfang, 2009). Findings from this study are, therefore, aligned with that literature and hold promise for contributing to it. Third, there is a vertiginously growing literature on subjective well-being in the social sciences. (For a summary of this literature, see Diener et al., 2009a; Dutt and Radcliffe, 2009; Eid and Larsen, 2008; Stevenson and Wolfers, 2008.) Analyzing EWEB in terms of subjective well-being takes this research in a new direction and provides much-needed linkages between environmental social science perspectives and this important and burgeoning literature. Veenhoven (1995, 1996), a pioneer in the social science of subjective well-being, has pointed out that objective well-being indicators are measures of inputs to well-being or quality of life, while subjective measures reflect actual experience of one’s quality of life. He further argued that subjective measures of well-being provide a more comprehensive assessment of overall quality of life (Veenhoven, 2002). We can also recognize that available objective measures of well-being are typically limited to assessing the degree to which basic human needs are met, such as infant mortality, while subjective measures of life satisfaction represent a wider range of life experiences. Helliwell and Putnam go even further, arguing that subjective well-being should be “the ultimate dependent variable in social science” (2004, p. 1435). We are in agreement with Stiglitz et al. (2010) that both objective and subjective measures of well-being provide important information about quality of life. However, addressing both types of well-being as a component of EWEB is beyond the scope of this paper. We suggest that future research operationalize, compute and analyze EWEB scores based on various objective measures of well-being and compare the results to those based on subjective well-being.

We use a measure of national average life satisfaction as our indicator of subjective well-being. Sometimes happiness and well-being are used interchangeably in the literature. But, there is an important distinction between ‘happiness’ and ‘life satisfaction’ and they are typically measured using different types of survey instruments. As Helliwell and Putnam (2004, p. 1435) point out, “Generally speaking, self-ratings of ‘happiness’ turn out to reflect relatively short-term, situation-dependent expressions of mood, whereas self-ratings of ‘life satisfaction’ appear to measure longer-term, more stable evaluations…” Since we are more concerned with people’s sense of the state of their life experiences rather than fluctuating moods (even if averaged), life satisfaction more likely than happiness taps this dimension. Measures of life satisfaction have been found to be valid, reliable indicators within countries and, for the most part, across countries and cultures (Abdallah et al., 2008; Diener and Suh, 2000; Helliwell and Putnam, 2004). Indeed, compelling recent research has demonstrated that among US states subjective well-being correlates highly with measures based on objective well-being, thus indicating that “subjective well-being data contain genuine information about the quality of human lives” (Oswald and Wu, 2010, p. 579). Furthermore, Helliwell (2007) has demonstrated that both suicide rates and life satisfaction data are similarly well explained by the same statistical model. This suggests that reservations about the use of subjective indicators because of misgivings about their validity compared to objective measures or suggestions that the survey questions of subjective measures may be interpreted differently across cultures are misguided. In our own data, the correlation between our measure of life satisfaction and life expectancy, a common measure of objective well-being, is .83 (n = 105; p < .01). For these reasons we focus our present analysis of EWEB on subjective life satisfaction.

11 Life expectancy data are from World Bank (2007).
Two survey questions in the Gallup World Poll have been repeatedly used to measure life satisfaction in a large number of countries. The first, known as the Cantril self-anchoring ladder, reads as follows:

Please imagine a ladder with steps numbered from 0 at the bottom to 10 at the top. Suppose we say that the top of the ladder (10) represents the best possible life for you and the bottom of the ladder (0) represents the worst possible life for you. If the top step is 10 and the bottom step is 0, on which step of the ladder do you feel you personally stand at the present time?

The second survey question asks respondents to answer the following question on a scale of 0–10:

All things considered, how satisfied are you with your life these days?

Recently, Bjornskov (2008) raised concerns about the comparability of data based on the Cantril ladder with data based on the life satisfaction question. However, Helliwell et al. (2009) have allayed these concerns by determining that an average of the two indicators provides the best measure of life satisfaction. We follow their advice and calculate the mean of these two indicators using country-level mean responses to these questions, as provided by the World Database of Happiness (Veenhoven, 2009).

3.2. Ecological footprint

For our indicator of environmental consumption, we use the per capita ecological footprints (EF) of nations. The EF is a measure of consumption-based pressure on the environment developed by Wackernagel and Rees (1996). It is constructed from five basic forms of human consumption: food, housing, transportation, consumer goods, and services; these categories comprise a more direct measure of consumption than GDP which also includes gross domestic investment, net exports, and government expenditures (BEA, 2009). Further, these categories of consumption are converted into a common metric permitting harmonized comparisons. The footprint is defined by Rees as “the area of land and water ecosystems required on a continuous basis to produce the resources that the population consumes, and to assimilate (some of) the wastes that the population produces, wherever on Earth the relevant land/water may be located” (2006, p. 145). The common metric is, therefore, not based upon market prices like GDP, but the amount of land area at average levels of productivity to replenish the consumption levels at a specific point in time.

We have chosen the EF as the most suitable indicator of environmental threat for assessing EWEB because it is the most comprehensive indicator of the resource demands nations make on the environment. Furthermore, it does not suffer from the same limitations as its competitors, as explained above. Using an indicator of local environmental quality is less desirable because it does not take into account the resources consumed and ecosystems affected that do not originate or are not located within that country.

The (EF) is widely considered to be a reliable indicator of country-level threats to the environment and to sustainability. Indeed, it has become one of the most widely used measure of anthropogenic environmental pressure in the environmental social sciences (e.g., Dietz et al., 2007; Hayden and Shandra, 2009; Jorgenson, 2003; Jorgenson and Burns, 2007; Jorgenson et al., 2009; Özler and Obach, 2009; Rosa et al., 2004; York et al., 2003). However, the EF is not without its critics. Perhaps the single most repeated criticism of the footprint is that it does not measure actual impacts to the environment (Dietz et al., 2010). However, this criticism is misplaced since the EF is not intended to be an impact measure, but a hypothetical measure of threats to the environment. We have been careful here to emphasize the latter interpretation. Indeed, Rees (2006), co-developer of the EF, acknowledges that the EF as a hypothetical concept likely under-estimates the actual anthropogenic impact on the environment.

Another criticism, from the developers of the EF, include its omission of key environmental threats such as water consumption, toxic and hazardous wastes, pollution in general, and greenhouse gases other than carbon dioxide (Wackernagel et al., 2002). One of the earliest and most durable critiques questions the appropriateness of combining various types of resource consumption and land in one single indicator and the large contribution of energy consumption to footprint measurements (Van den Bergh and Verbruggen, 1999). Still others question the lack of consideration given to the environmental space needed for the preservation of non-human species (Özler and Obach, 2009). More recently, Fiala (2008) has criticized the assumption of zero greenhouse gas emissions and national borders as arbitrary, the inadequacy of the footprint in accounting for intensive versus extensive production growth via technological change, and the lack of significant correlation between the footprint and measures of land degradation. Despite all these limitations, Jorgenson and Clark (in press) importantly note that the EF remains a useful indicator for hypothesis testing for a number of reasons: It is comprehensive, yet conservative; the calculations are based on rigorous methodology; it is widely accepted and used throughout the social science disciplines; it has high face validity given its strong correlation with other environmental impact indicators such as carbon dioxide emissions; and it is available for a wide array of nations.12

Because the EF is a comprehensive, consumption-based measure, all the resources consumed by a country, including imports, are attributed to its own footprint while its exports are attributed to the footprints of the importing countries (i.e., consumption = production + imports − exports). This is particularly important because, due to international trade, the

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12 For a more in-depth review of criticisms of the ecological footprint and responses to them, see Rees (2006) and for recent developments in footprint methods see the special section of Ecological Economics, vol. 68, issue 7, 2009.
environmental consequences of consumption often occur far from the site of consumption as noted above (Jorgenson et al., 2009; York et al., 2003).

As already mentioned, one major analytical advantage of the EF is that, like money for economic goods, it combines the consumption of many different types of resources, the use of land for living space, and the production of wastes (currently limited to CO2 emissions due to data limitations) into a single common metric: land. Its specific measure is global hectares. A global hectare is a unit (2.41 acres) of biologically productive land or water adjusted to the world average productivity (Rees, 2006). The EF includes over 200 resource categories as well as the embodied energy in more than 600 categories of products (Kitzes et al., 2007). A considerable advantage of this measure is that it captures tradeoffs between the consumption of different resources (e.g., biomass fuels vs. fossil fuels) (York et al., 2009). For the present analysis, we use the most recent EF data available, which is for 2005 (Global Footprint Network, 2008a).

3.3. Calculating EWEB

Fig. 2 illustrates the relationship between the EF and average life satisfaction. Note the horizontal spread of observations at high levels of life satisfaction (i.e., around seven). This indicates, in line with much of the previous research reviewed here, that among countries with high life satisfaction there is wide variation in environmental consumption. Furthermore, note the observations with life satisfaction around seven near the vertical line at 2.1 global hectares of EF, which is the global biocapacity per capita available in 2005 (Global Footprint Network, 2008b). This indicates that relatively high levels of well-being are achievable with sustainable levels of consumption. Thus, it is clear that countries vary widely in how efficient they are at transforming environmental consumption into human well-being.

In order to calculate our indicator of EWEB we borrow a methodological innovation from the macro-comparative political economy literature on urbanization. Timberlake and Kentor (1983) determined that by regressing urbanization on economic development (GDP per capita) and taking the residuals, they could measure overurbanization without the drawbacks of using a ratio measure (e.g., urbanization/GDP per capita). The residuals represent the level of urbanization relative to the level of GDP per capita. Countries with large positive residuals are overurbanized relative to their level of economic development, while those with large negative residuals are underurbanized. This measure of urbanization has been used in numerous cross-national studies (e.g., Bradshaw, 1985; Walton and Ragan, 1990; Shandra et al., 2003).

We follow the same procedure to calculate our EWEB indicator. We regress average life satisfaction on EF per capita and compute the unstandardized residuals.13 Countries with large positive residuals have high well-being relative to their level of consumption. This means that the environmental efficiency of well-being of the US is quite low, not average.

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13 We use ecological footprint per capita rather than the log of the footprint because we think that in computing the level of life satisfaction relative to the footprint, the linear scale is more appropriate than the logarithmic. We calculated the EWEB score using both methods and found important differences. For instance, whereas the United States (US) has an EWEB score of −1.31 using our preferred model specification, the alternative model using the log of the footprint produces an EWEB score of −0.57. The latter is misleading because despite its high level of life satisfaction (it is the tenth highest), the US also has the largest footprint in our sample—by far. An EWEB score close to zero gives the impression that the US is about average. On the other hand, our preferred EWEB score indicates that because other countries are able to achieve as high or higher levels of life satisfaction as the US at much lower levels of consumption. This means that the environmental efficiency of well-being of the US is quite low, not average.
environmental consumption while those with large negative residuals have low well-being relative to their level of environmental consumption. Thus, the residuals provide a useful way of measuring EWEB absent the limitations of ratio measures. The equation used to estimate the residuals is presented in Table 1.

Table 2 lists each country and their EWEB scores by World Bank (2009) income classification in 2005 rank ordered within each category. Data necessary for calculating EWEB were available for 105 countries.

We determined that our measure of EWEB is actually quite comparable to the HPI; the two variables are correlated at .89 (p < .001). Furthermore, when we use happy life years (the product of life satisfaction and life expectancy) as our measure of well-being as is the case with the HPI, we find that the HPI and our measure of EWEB, calculated as a residual, correlate at .94 (p < .001). Therefore, the matching of coefficients of variation in the calculation of the HPI makes the EWEB score similar to our EWEB score based on the residuals produced by regression well-being on EF per capita. However, our new measure does have two advantages over the HPI: First, we do not combine objective and subjective measures of well-being. This is important because in order to have analytical clarity, it is important that we determine the correlates of EWEB scores based on each measure of well-being separately before they are combined. Second, our EWEB indicator is not measured as a ratio, which, as discussed above, reduces the risk of spurious findings.

### Table 1

Unstandardized regression coefficients of ecological footprint per capita on average life satisfaction.

<table>
<thead>
<tr>
<th></th>
<th>Ecological footprint, p.c.</th>
<th>Constant</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.490 (.042)***</td>
<td>4.262 (.141)</td>
<td>0.571</td>
</tr>
</tbody>
</table>

*** Notes: p < .01; N = 105.

### Table 2

Environmental efficiency of well-being (EWEB) scores by world bank income classification in 2005.

<table>
<thead>
<tr>
<th>HIGH INCOME</th>
<th></th>
<th>LOWER MIDDLE</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Netherlands</td>
<td>1.25</td>
<td>Turkey</td>
<td>–0.39</td>
<td>Cameroon</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>1.06</td>
<td>Hungary</td>
<td>–0.45</td>
<td>LOW INCOME</td>
</tr>
<tr>
<td>Finland</td>
<td>1.01</td>
<td>Russia</td>
<td>–0.51</td>
<td>Laos</td>
</tr>
<tr>
<td>Sweden</td>
<td>0.9</td>
<td>Latvia</td>
<td>–0.8</td>
<td>India</td>
</tr>
<tr>
<td>Austria</td>
<td>0.78</td>
<td>Lebanon</td>
<td>–0.89</td>
<td>Pakistan</td>
</tr>
<tr>
<td>Belgium</td>
<td>0.59</td>
<td>Botswana</td>
<td>–1.14</td>
<td>Viet Nam</td>
</tr>
<tr>
<td>Germany</td>
<td>0.51</td>
<td>Estonia</td>
<td>–1.86</td>
<td>Uzbekistan</td>
</tr>
<tr>
<td>Ireland</td>
<td>0.45</td>
<td></td>
<td></td>
<td>Bangladesh</td>
</tr>
<tr>
<td>Singapore</td>
<td>0.45</td>
<td>Brazil</td>
<td>1.57</td>
<td>Nepal</td>
</tr>
<tr>
<td>Israel</td>
<td>0.39</td>
<td>Colombia</td>
<td>1.57</td>
<td>Tajikistan</td>
</tr>
<tr>
<td>France</td>
<td>0.36</td>
<td>Dominican Rep.</td>
<td>1.41</td>
<td>Kyrgyzstan</td>
</tr>
<tr>
<td>UK</td>
<td>0.33</td>
<td>Honduras</td>
<td>1.06</td>
<td>Zambia</td>
</tr>
<tr>
<td>Spain</td>
<td>0.33</td>
<td>El Salvador</td>
<td>0.98</td>
<td>Nigeria</td>
</tr>
<tr>
<td>Italy</td>
<td>0.27</td>
<td>Jordan</td>
<td>0.8</td>
<td>Ghana</td>
</tr>
<tr>
<td>Norway</td>
<td>0.16</td>
<td>Thailand</td>
<td>0.76</td>
<td>Cambodia</td>
</tr>
<tr>
<td>Slovenia</td>
<td>0.02</td>
<td>Nicaragua</td>
<td>0.75</td>
<td>Rwanda</td>
</tr>
<tr>
<td>Canada</td>
<td>–0.01</td>
<td>Bolivia</td>
<td>0.62</td>
<td>Senegal</td>
</tr>
<tr>
<td>Japan</td>
<td>–0.11</td>
<td>Morocco</td>
<td>0.59</td>
<td>Mauritania</td>
</tr>
<tr>
<td>South Korea</td>
<td>–0.17</td>
<td>Indonesia</td>
<td>0.55</td>
<td>Afghanistan</td>
</tr>
<tr>
<td>New Zealand</td>
<td>–0.42</td>
<td>Egypt</td>
<td>0.51</td>
<td>Mozambique</td>
</tr>
<tr>
<td>Australia</td>
<td>–0.47</td>
<td>Ecuador</td>
<td>0.47</td>
<td>Chad</td>
</tr>
<tr>
<td>Greece</td>
<td>–0.47</td>
<td>Algeria</td>
<td>0.47</td>
<td>Uganda</td>
</tr>
<tr>
<td>Portugal</td>
<td>–0.8</td>
<td>Peru</td>
<td>0.43</td>
<td>Madagascar</td>
</tr>
<tr>
<td>United States</td>
<td>–1.31</td>
<td>Philippines</td>
<td>0.38</td>
<td>Mongolia</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>2.36</td>
<td>Moldova</td>
<td>0.35</td>
<td>Kenya</td>
</tr>
<tr>
<td>Panama</td>
<td>1.34</td>
<td>Paraguay</td>
<td>0.21</td>
<td>Ethiopia</td>
</tr>
<tr>
<td>Mexico</td>
<td>1.33</td>
<td>Sri Lanka</td>
<td>0.05</td>
<td>Sierra Leone</td>
</tr>
<tr>
<td>Argentina</td>
<td>1.26</td>
<td>Iran</td>
<td>0.16</td>
<td>Mali</td>
</tr>
<tr>
<td>Malaysia</td>
<td>0.92</td>
<td>Armenia</td>
<td>–0.22</td>
<td>Niger</td>
</tr>
<tr>
<td>Chile</td>
<td>0.42</td>
<td>Azerbaijan</td>
<td>–0.33</td>
<td>Burundi</td>
</tr>
<tr>
<td>South Africa</td>
<td>0.18</td>
<td>Angola</td>
<td>–0.41</td>
<td>Benin</td>
</tr>
<tr>
<td>Poland</td>
<td>–0.02</td>
<td>Ukraine</td>
<td>–0.41</td>
<td>Tanzania</td>
</tr>
<tr>
<td>Romania</td>
<td>–0.04</td>
<td>Belarus</td>
<td>–0.51</td>
<td>Burkina Faso</td>
</tr>
<tr>
<td>Lithuania</td>
<td>–0.07</td>
<td>Iraq</td>
<td>–0.58</td>
<td>Zimbabwe</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>–0.1</td>
<td>Georgia</td>
<td>–0.7</td>
<td>Togo</td>
</tr>
</tbody>
</table>
Now that we have devised an indicator of EWEB, we shift our attention to the factors which may affect this variable. In the next section we review empirical and theoretical literatures which explicitly or implicitly offer guidance into what independent variables may be of importance here.

4. Factors influencing EWEB

4.1. Modernization theories

Modernization theories, including ecological modernization theory from sociology and economic modernization theory from economics have emphasized the positive role of economic growth and development in achieving sustainability. Ecological modernization theory (EMT), in particular, argues that when it comes to sustainable consumption, the focus should not be on ‘how much,’ and derisively labels those who would focus on ecological limits to consumption as Malthusian (Mol and Spaargaren, 2004). EMT characterizes approaches that advocate for “less or limits to consumption” as taking up a “demodernization” position, implicitly suggesting that reducing consumption is tantamount to reversing historical gains in well-being (Mol and Spaargaren, 2004, p. 263). The modernization path to sustainability relies heavily on the assumptions of neo-classical economics and therefore eschews limits to absolute consumption and assumes a strong link between consumption and well-being.

In addition, economic growth in this view is seen not as an environmental problem, but as a solution. Researchers in this tradition have also suggested the existence of an ‘environmental Kuznets curve’ which purportedly demonstrates that environmental impacts increase with economic development up to a point after which impacts decline with further economic growth (Grossman and Krueger, 1995). However, many studies have failed to corroborate the existence of the Kuznets, inverted-U relationship; with most indicating that environmental impacts actually continue to rise with economic growth (York et al., 2003, 2009). Nevertheless, it is appropriate to examine from this perspective the prediction of a linear, positive relationship between economic development and EWEB, since this is the relationship consistent with modernization theories.

Furthermore, EMT emphasizes the importance of democracy in making states responsive to extra-institutional environmental politics, suggesting that more democratic countries will have lower environmental impacts (Mol and Sonnenfeld, 2000; Murphy, 2000). This may be especially important in predicting EWEB because previous research has determined that democracy is positively related to life satisfaction (Layard, 2005; Inglehart and Klingemann, 2000). Thus, the theoretical expectation is that democracy will be positively related to EWEB.

4.2. Political economy

Political economy perspectives are critical of the link between sustainability and economic growth. The treadmill of production theory, in particular, argues that economic growth is the main driver of environmental degradation (Gould et al., 2004; Schnaiberg, 1980). Proponents of this view argue that in advanced industrial countries, economic growth is driven by investments in resource-intensive and highly polluting production technologies which displace labor resulting in the need for more economic growth to absorb the displaced labor.

The treadmill of production theory describes high income countries as encountering “decreased social efficiency of natural resource utilization” (Gould et al., 2004, p. 297). That is, because of the capitalist political economy, economic growth in these countries results in each consumer dollar generating more environmental damage and less welfare for individuals than it did at lower levels of development (Schnaiberg, 1991). This suggests that EWEB may be highest at intermediate levels of development; thus, the relationship between economic development and EWEB may follow an inverted-U shape—similar in shape to the environmental Kuznets curve (Grossman and Krueger, 1995) but with a drastically different interpretation of the consequences of economic growth for sustainability. Partial evidence for this view comes from Rice (2008) who, in examining bivariate correlations, found fundamental differences in the correlation of environmental consumption with well-being between low and high-income nations. Among low income countries several indicators of objective well-being improve substantially with increased environmental consumption. In sharp contrast, among high income countries increased environmental consumption has deleterious effects on several objective well-being indicators. Overall, Rice (2008) argues that this suggests that the marginal utility of environmental consumption is substantially higher among developing countries compared to those countries at high levels of economic development. Knight and Rosa (2009) demonstrated a similar relationship between environmental consumption and subjective well-being as illustrated here in Fig. 2.

In addition, income inequality may be an important factor affecting EWEB. In the treadmill of production theory and other political economy theories, inequality is an important component of the social systems’ effects on the environment (Gould et al., 2004). Inequality may affect EWEB by disproportionately distributing consumption and whatever well-being benefits it entails, so that, among marginalized groups and the poor, consumption is restricted while the privileged enjoy high levels of consumption. Among the former, higher consumption may actually result in higher well-being, but among the latter, the

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14 As previously noted, the environmental Kuznets curve predicts that further economic development will lead to environmental sustainability. In contrast, if economic development and EWEB have a similar inverted U-shaped relationship, then further economic development may impede, rather than contribute to, sustainability.
effect is likely to be small or non-existent (Diener and Biswas-Diener, 2002). Higher levels of inequality may also spur status-based competitive consumption which would increase environmental impacts without increasing overall societal well-being (Jackson, 2009). Furthermore, Jorgenson (2004) found that among high income core countries, greater inequality increases environmental consumption. In view of Knight and Rosa’s (2009) and Rice’s (2008) findings discussed above, this suggests that inequality may be negatively associated with EWEB.

4.3. Sustainable consumption, community, and social capital

The relationship between environmental consumption and subjective well-being has been most explicitly theorized in the sustainable consumption literature. For instance, Manno (2002) developed the concept of ‘consumption efficiency’ which is the ratio of personal and social well-being to material consumption. He argues that the goal of sustainable development should be to increase consumption efficiency but that doing so is difficult within a society dominated by “commoditization.” Focusing, not on commodities, but on nurturing the ability of social relationships and communities to meet needs would not only result in lower levels of consumption but also higher well-being. This idea of consumption efficiency is congruent with Jackson’s (2005) concept of the ‘double-dividend,’ which refers to the possibility that we might be able to achieve higher well-being while simultaneously reducing environmental consumption. In this view, more effective needs-satisfaction, and thus higher well-being, may be achieved through the dematerialization of satisfiers (i.e., various ways of satisfying needs) by meeting needs through social relationships. For example, Seyfang (2009) describes local provisioning (e.g., farmers’ markets, cooperatives), mutual aid programs, sharing, and local currencies as examples of community building and social capital which promote sustainable consumption. Furthermore, research on subjective well-being has found that one of the strongest predictors of national-level life satisfaction is high levels of social capital (Helliwell, 2003; Helliwell and Putnam, 2004; Layard, 2005; Veenhoven, 2008). Countries with high levels of social capital may be able to meet some needs through social relationships and community thereby reducing material consumption and boosting life satisfaction by reinforcing social participation. Thus, this literature would lead us to expect a positive relationship between social capital and EWEB.

4.4. Climate

Van de Vliert (2009) identified climate as an important factor influencing life satisfaction, arguing that populations in harsher climates experience lower levels of subjective well-being. Van de Vliert (2009) argues that while colder climate is negatively correlated with happiness, this relationship is mediated by affluence so that among rich countries colder climate is associated with high levels of happiness (e.g., the Scandinavian countries) while among poor countries colder climate is associated with low levels of happiness. Rehdanz and Maddison (2005) similarly find that colder winters are associated with lower average happiness. In addition, research in human ecology has found that countries in colder climates exhibit higher levels of environmental consumption (York et al., 2003). Therefore, we include climate as a control in our model because it may have a significant effect on EWEB.

4.5. Region

A consistent finding in the subjective well-being literature is that two regions of the world stand out. Latin American countries tend to have higher life satisfaction than countries at similar levels of development, while Former Soviet Union (FSU) countries tend to have lower life satisfaction (Engelbrecht, 2009; Helliwell et al., 2009; Inglehart and Klingemann, 2000; Inglehart et al., 2008). The Latin American effect may be due to a particular cultural or social context while the ex-Soviet effect may be due to the lasting social effects of the breakdown of the Soviet Union (Helliwell et al., 2009; Inglehart and Klingemann, 2000). Because we produce our EWEB score by regressing life satisfaction on EF, it is likely that these unusually high or low values show up in the residuals that make up our dependent variable. Therefore, we include two dummy variables in our model to control for these regional effects.

5. Variables and data sources

5.1. Dependent variable

The environmental efficiency of well-being (EWEB), as described above, is measured as the unstandardized residual produced by regressing the average of two measures of average life satisfaction on EF per capita. Life satisfaction data are from

15 Jorgenson (2003), working from an ecostructural world-systems approach, found that, in a sample of countries in all three zones of the world system (i.e., core, semiperiphery, and periphery), income inequality is negatively associated with environmental consumption measured as the ecological footprint. However, further research (Jorgenson, 2004) indicated that the effect is positive in the core and negative in the other zones. According to this research, world-system position influences level of inequality and ecological footprint as well as the relationship between the two.

16 Karl Marx, of course, introduced the concept of commodification, namely the transformation of all goods and services into commercial commodities; Manno (2002) adopts the conceptually similar term “commoditization” in order to emphasize that this process is active rather than passive.
the Gallup World Poll and were made available in Veenhoven's (2009) World Database of Happiness. These data cover the years 2006–2009. The EF data are for 2005 and are from Global Footprint Network (2008a).17

5.2. Independent variables

Economic development is measured by the GDP per capita in 2005 in US dollars. We take the natural log to correct for skewness. We also include the quadratic of GDP per capita in the model. A linear relationship between economic development and EWEB would indicate support for modernization theories. A negative quadratic relationship would support the political economy perspective of Schnaiberg (1980) and colleagues (e.g., Gould et al., 2004). The variable in the quadratic was centered before squaring, by subtracting the mean, in order to reduce collinearity with the linear term. These data are from the World Bank (2007).

Our measure of democracy is for 2005 and is from the 2008 version of the Polity IV dataset (Marshall et al., 2008). We use the “Polity Score” which conceptualizes types of regime authority as a spectrum ranging from fully institutionalized autocracies to fully institutionalized democracies and is measured on a scale from −10 to +10, where −10 is a hereditary monarchy and +10 is a consolidated democracy.

Inequality is measured as the GINI coefficient for net income in 2000. We use this year of data because it has the widest coverage of countries.18 The GINI coefficient is a measure of income inequality which ranges from 0 to 100 where 0 is the most equal and 100 is the most unequal. These data are from Solt's (2009) Standardized World Income Inequality Database (SWIID). Cross-national GINI coefficient data typically present a tradeoff between coverage and comparability (i.e., income definitions and reference units); the more countries covered the less comparable the measure for each country. Solt's SWIID database maximizes comparability for the largest possible number of countries and years. It does so by standardizing and augmenting the United Nation University's World Income Inequality Database through the use of data from the Luxembourg Income Study and a custom algorithm. While this dataset is quite new, it is already being employed in research published in top social science journals such as American Political Science Review (Baldwin and Huber, 2010).

The idea of social capital comprises reciprocity, membership in voluntary organizations, and trust (Putnam, 1995). Based upon data availability, we use the level of trust as our rough indicator of social capital. Previous research has used trust as a proxy for social capital because it has relatively wide coverage among countries (e.g., Engelbrecht, 2009; Helliwell, 2007). Trust is measured with the survey question:

Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?

This question was asked in wave 4 of the World Values Survey between 1999 and 2001. Trust is measured as the percentage of people answering ‘most people can be trusted.’ These data are from World Values Survey Association (2009).

We measure climate with a variable developed and calculated by Van de Vliert (2009). His variable, “Winters,” is the sum of absolute deviations from 22 °C (72 °F) for the average lowest and highest temperatures in the coldest month. This measures the harshness of a country’s winters and is an improvement over average temperature or latitude as a measure of climate.

As noted above, we include two dummy variables to control for possible regional effects of Latin American and Former Soviet Union countries. These variables are coded 1 if a country is in that region and 0 if not. Descriptive statistics for all variables are presented in Table 3.

6. Model estimation

Because of a large amount of missing data on a key variable, trust, we decided to estimate our multivariate regression model with Arbuckle’s (1997) full information maximum likelihood (MLE) routine with AMOS software. Dealing with missing data by using listwise deletion would have resulted in sample of less than 50 countries. By allowing us to include all countries for which we have data on the dependent variable, MLE estimation makes it possible to include 105 countries in our analysis. Furthermore, this estimation procedure provides more consistent and less biased results than listwise or pairwise deletion in OLS regression (Arbuckle, 1997; Jorgenson, 2004). This method has been used by a number of macro-comparative researchers, including Hayden and Shanda (2009), Jorgenson (2004), and Kentor (2001). In order to assess the reliability of our results, we also computed OLS regression models using listwise deletion (see Appendix). We estimate two MLE models: Model 1 includes all independent variables and Model 2 includes only the variables that were significant in

17 While longitudinal ecological footprint data are available for a large number of countries between 1960 and 2005, life satisfaction data are much sparser. The Gallup World Poll, which provides the widest coverage of life satisfaction data (more than 130 countries) only began in 2006. Abdallah et al. (2009) recently released a rather lengthy longitudinal data set (1961–2005) of the Happy Planet Index for 25 OECD countries, based heavily on estimates of life satisfaction, and a shorter three time-point (1990–2005) dataset including components for 36 countries, both of which may prove useful for future research. However, we suggest that a cross-sectional analysis that includes a large number of geographically diverse countries at varying levels of development is more suitable and appropriate for assessing the effects on EWEB at this early stage of research.

18 Levels of income inequality have been found to be relatively stable over time, thus the choice of year for these data are not a concern in relation to the other variables in our analysis (Bergesen and Bata, 2002; Jorgenson, 2003).
the full model. Standardized MLE coefficients, unstandardized MLE coefficients, and standard errors are reported in Table 4. The R-square for the models are moderately strong, with 50% of the variation in EWEB explained in the full model (Model 1) and 48.5% in the reduced model (Model 2). Variance inflation factors (based on the listwise analysis) indicate no serious problems with multicollinearity for the models reported in Table 4.

7. Results and discussion

The regression results show that economic development has a negative quadratic relationship with EWEB. The coefficient of the linear term of GDP per capita is positive and significant while the quadratic is negative and significant. This suggests that the environmental efficiency with which well-being is produced increases with affluence at low to moderate levels of economic development but declines at high levels. This supports the treadmill of production theory which suggests that the social efficiency of natural resource utilization declines at high levels of economic development. This is counter to modernization theories (both ecological modernization theory and economic modernization theory). These theories, by equating consumption with well-being and arguing that sustainability can only be achieved through higher economic growth, predict
a linear, monotonically increasing relationship between economic development and EWEB. That prediction is called into question by these findings.

The coefficient for democracy is not significant. Hence, the type of regime authority is apparently unrelated to EWEB. This finding is counter to EMT and other modernization theories which suggest that sustainability is intimately linked with liberal democracy. Alternative measures of democracy and political freedom were tested in models not reported here. These indicators included indexes of political rights and civil liberties, a score based on these two indexes, and a dummy variable indicating whether a country is an electoral democracy (all data are from Freedom House, 2010). The results from the Marshall et al. (2008) Polity Score were sustained; democracy had no significant effect on EWEB. This non-finding is consistent with other research results. First, recent research indicates that the effect of democracy on life satisfaction is positive and significant only for countries with higher levels of economic development and also, we would expect, larger EFs (Helliwell and Huang, 2008). Second, the relationship between democracy and EF, contrary to prediction, has been found to be either non-significant or positive (York et al., 2003; Marquart-Pyatt, 2010).

Inequality has a negative, significant effect on EWEB. The prediction from political economy that countries with high inequality produce well-being less efficiently than more egalitarian countries is supported by our analysis. We find support for the link between economic equality and sustainability measured as EWEB. As argued by Jackson (2009) and Wilkinson and Pickett (2009) inequality may increase status-based consumption (a constant push to keep up with others) which does not add to overall well-being while also resulting in lower levels of overall social health and well-being.

Trust, our single measure of social capital, has a positive, significant relationship to EWEB. This supports recent findings showing that social capital is an important factor in explaining cross-national variation in life satisfaction (Helliwell, 2007). Furthermore, it reaffirms the nature of humans as social creatures whose well-being is tied to the relationships with their fellow humans. The finding also supports claims in the sustainable consumption literature that there may be a ‘double-dividend’ in reducing consumption, whereby increased community and social capital increase well-being while reducing consumption levels (Jackson, 2005; Manno, 2002).

Climate, measured as the harshness of winters, has a significant, negative effect on EWEB. This likely occurs because colder climates reduce well-being while increasing resource consumption demands. For example, heating demands place an additional burden on energy supplies.

We found that there is a significant regional effect for Latin American countries. Net of other factors, Latin American countries tend to have higher EWEB. This is consistent with previous research that has showed that Latin American countries have higher life satisfaction compared to countries at similar levels of development and may be due to particular features of Latin American societies and culture (Helliwell et al., 2009). The Former Soviet Union dummy variable had no significant effect on EWEB.

In order to determine if there are other important regional effects, and as a sensitivity test, we estimated a MLE model including dummy variables for major regions of the globe: Asia, Africa, Latin America, and the Former Soviet Union countries, with the affluent nations—Europe (including the US, Canada, Australia, and New Zealand) as the comparison category (see Model 7 in the Appendix). The results differed substantially with income inequality and the effect of the linear term of GDP per capita dropping below statistical significance while all other variables were substantively the same. The Africa dummy variable was the only regional variable besides Latin America to come up significant (and negative), but model fit was not substantially improved with the addition of the regional variables. In contrast to the results presented in Table 4, an insignificant coefficient for GDP per capita and negative coefficient for the squared term suggest that economic development may not affect EWEB until high levels of development at which further growth decreases EWEB. However, we must interpret these results with caution because the variance inflation factors (for the unreported listwise analysis) indicate there may be problems of multicollinearity in this model (VIFs near and above 5). Thus, we have more confidence in the results based on the more parsimonious model.

As noted above, we also computed OLS regression models employing listwise deletion as a check on the reliability of the MLE results reported in Table 4 (Model 1). We specified two models: (1) a model which excludes the variable with the most missing data (i.e., Trust); and (2) a model including all variables. All of these models are reported in the Appendix. The first model (N = 90) has one major discrepancy in that the quadratic of GDP per capita is not significant; otherwise, the findings are not different from the results in Table 4 (see Model 3). However, further analysis indicated that GDP per capita is only significant in this model when log-transformed, suggesting that the relationship is not linear but rather curvilinear, perhaps demonstrating diminishing marginal returns (see Models 4 and 5). The listwise model including trust (N = 50) is substantially different (see Model 6). Only two variables are significant in this model: the Latin American dummy variable and Trust. We suggest that this is an artifact due to the drastic decrease in sample size. However, it is telling that even with fewer than half the cases as in the full MLE model, the variable trust is statistically significant. With regard to the linear rather than inverted U-shaped relationship between GDP per capita and EWEB found in the first listwise model, we suggest that because MLE estimates are based on a larger sample and are more consistent and efficient than those produced with listwise deletion (Arbuckle, 1997), more weight should be given to these results. However, we do acknowledge that the OLS results do question the robustness of this finding of a negative quadratic relationship and therefore force us to interpret the findings in the

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19 There is no universally agreed upon single VIF standard to judge multicollinearity. VIF cutoff points range from 2.5 (Allison 1999) to 10 (see O’Brien, 2007 for a summary). We have, following Greene (2000) chosen a VIF of 5 as a reasonable compromise between those extremes.
MLE models (Table 4) more cautiously. However, all models indicated that the relationship was non-linear and thus in opposition to modernization theories. Nevertheless, further investigation is needed on the relationship between economic development and EWEB.

8. Conclusion

A variety of sources have conceptualized sustainability as the level of human well-being relative to environmental threats and impacts. Researchers have found that measures of this concept indicate that countries vary widely in the environmental efficiency with which they produce well-being (Dietz et al., 2009; Knight and Rosa, 2009; Marks et al., 2006). Here, we took up this finding as a puzzle to be explained. We devised and computed a new measure of environmental efficiency of well-being (EWEB) based on the residuals produced by regressing average life satisfaction on EF per capita. Then, we performed a multivariate analysis of the effects of various factors, identified by previous research and theorization, on EWEB.

Ruut Veenhoven, the most prominent sociologist studying subjective well-being, has advanced the idea that average life satisfaction in a society depends on the extent to which that society is “livable” (1995). In this conceptualization, the better a society meets the needs of its population and advances a high objective quality of life, the happier that population will be. We observe that research on EWEB furthers our understanding of these issues by conceptualizing social well-being in relation to environmental sustainability. EWEB underscores the importance of meeting the needs of society without compromising future generations by depleting natural capital and services. A focus on consumption, as Princen (2005) argues, shifts the question of achieving sustainability from production efficiency to consumption ‘sufficiency’. Sufficiency “is the sense that, as one does more and more of an activity, there can be enough and there can be too much” (Princen, 2005, p. 6). In these terms, our analysis identifies key factors that could contribute to the ability of societies to become more sufficient in terms of achieving livable societies with high levels of well-being but without high levels of consumption. Research on EWEB seeks to contribute to bridging the current divide between the subjective well-being literature and the environmental social science literature on sustainability and consumption.

Political economy theories question the utility of economic development in achieving sustainability while modernization theorists argue that it is the primary means. Our test of these theories indicates support for the former. Indeed, the most striking finding is that economic development has an inverted U-shaped relationship to EWEB—consistent with the predictions of political economy but diametrically opposite to those of modernization theories. The results show that efficiency increases at low to moderate levels of consumption, but reaches a turning point and then declines. Additional analyses with OLS models using listwise deletion and an MLE model including additional regional dummies produced discrepant results. However, in both of these models, the relationship was non-linear, suggesting in the former that the relationship is curvilinear with increases at high levels of economic development increasing EWEB less and less while the latter model suggested no relationship until high levels of development at which point further increases negatively impacted EWEB. Taken together, the results suggest that the path to sustainability is not necessarily, as economic and ecological modernization theories suggest, paved by economic growth. The policy implications of this are clear: If governments focused more on improving well-being directly, rather than indirectly through increasing incomes and consumption, sustainability and high levels of well-being might become more realistic goals. Furthermore, policies designed to alleviate economic inequality may help to move countries toward sustainability because more egalitarian countries are able to achieve higher levels of well-being with lower levels of environmental consumption.

In addition, our findings suggest that countries with higher social capital (measured as trust) transform environmental consumption into well-being more efficiently. This supports sustainable consumption scholars who argue that community and social capital are important factors in achieving the ‘double-dividend’ of lower consumption and higher well-being (Jackson, 2005). As Manno (2002) has argued, meeting needs through social relationships and community ties rather than commodities decreases material consumption and increases well-being. Thus, policies aimed at increasing social participation and community cohesion may be a key factor in achieving sustainability.

In sum, our findings offer an encouraging alternative to the sustainability strategy dependent on unbounded economic growth. Our analyses suggest a more important role for decreasing inequality and increasing social capital in achieving sustainability. However, this analysis is only a starting point for further research on EWEB. The present analysis has not exhausted the list of potential correlates of EWEB. Future investigation should be undertaken of other factors influencing cross-national variation in environmental efficiency of well-being (EWEB). We have focused on factors internal to nations, such as economic development, social capital, and domestic inequality that have been identified by major theoretical perspectives in the environmental social sciences, but scholars may wish to identify the external and relational factors involved as is common from the world-systems perspective of sociology. We recognize the limitations inherent in using cross-sectional data, but suggest that given the lack of previous research on EWEB and the lack of longitudinal data with sufficient coverage, our chosen analysis is appropriate. However, longitudinal analyses should be encouraged when appropriate data become available. Finally, as is apparent from our discussion of operationalizing EWEB, alternative indicators of well-being or environmental impacts may be used for measuring EWEB. We suggest that future research should refine and extend this concept, explore alternative indicators, and seek to refine its measurement. A promising line of research would be to
compute and compare EWEB indicators based on various measures of subjective well-being, objective well-being, and perhaps a combination of the two.

Further understanding of the link between human use of the environment and well-being can provide empirical guidance on the path to sustainability by identifying possible social structural changes that can preserve, and maybe enhance, human well-being while reducing environmental threats and impacts.

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Appendix A

See Table A1.

Table A1
Sensitivity analyses of alternative specifications and techniques.

<table>
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<tr>
<th></th>
<th>OLS Model 3</th>
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<td>.121**</td>
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<td>.119/.059</td>
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<td>(.060)</td>
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<td>(lnGDP per capita)^2</td>
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Notes: In Models 1–4, OLS coefficients are presented with standard errors in parentheses. In Model 5, standardized MLE coefficients are in bold, MLE coefficients are in italics, standard errors are in parentheses. 

* $p < .10$ (two-tailed tests).  
** $p < .05$ (two-tailed tests).  
*** $p < .01$ (two-tailed tests).

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