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A happiness Kuznets curve? Using model-based cluster analysis to group countries based on happiness, development, income, and carbon emissions

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Abstract This exploratory study uses model-based cluster analysis to group sixty-one countries based on statistical similarities in terms of happiness, development, income, and carbon emissions. Model-based cluster analysis is appropriate for an initial identification of a pattern that is worthy of further investigation. A key finding is that there may be a Kuznets curve for happiness. The Kuznets curve graphs the proposition that, as an economy develops, economic inequality first increases and then decreases. Similarly, the authors find that clusters of countries at the extremes of the lowest and highest average levels of development and income have the highest self-reported levels of happiness. Clusters of countries in the middle of the development and income spectrum have the comparatively lowest average levels of happiness. Further, carbon emissions are not perfectly associated with happiness. For example, between two clusters with the highest average levels of development, income, and happiness there is a 43 % difference in carbon emissions. A highly developed cluster has roughly the same mean carbon emissions as a cluster with 83 % less income, and the least developed cluster has 93 % of the happiness as the most developed cluster yet 86 % less carbon emissions. Despite limitations of both data and methodology, the overall pattern—that there may be a happiness Kuznets curve and that development, income, and carbon emissions are not associated lockstep with happiness—contributes to the literature on decoupling development from growth in emissions.

Keywords Sustainability · Happiness · Indicators · HDI · Kuznets · Cluster analysis

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1 Introduction

The realms of science, business studies, humanities, and spiritual traditions all contain important observations about what makes people happy. Increasingly, the study of happiness as it relates to business and development appears to be gaining popularity and urgency. Yet, in both the arenas of academic studies and management of organizations, several key challenges exist. Using indicators of happiness—whether in the management of firms or public policy or other contexts—is still in its nascent stages. Most critically, given that individuals, firms, and societies want to both improve their circumstances and reduce their carbon emissions, a better understanding of the relationship between happiness, development, income, and carbon emissions is needed. This article reviews literature and then uses model-based cluster analysis to reveal groups of countries with shared characteristics in terms of self-reported happiness, development, income, and carbon emissions. This exploratory work should provoke further thought and progress on several fronts, including the desire to understand key performance indicators (KPIs) and their integration into the management of human affairs in several contexts, including companies and public policy.

2 Literature review

2.1 Happiness and its connection to business and economics

There is a rich literature dissecting, defining, and discussing methodologies for measuring happiness (Hervás and Vázquez, 2013). Psychologists have established that neither money nor consumption guarantee greater happiness (Csikszentmihalyi 1999). Indeed, Maslow's hierarchy of needs—emphasizing that, for example, self-respect and serving greater purposes gain in importance once basic needs are met—is even a staple of business education (Maslow 1943). Consistent with this theory are observations that, for example, happiness of employees is not correlated with financial performance, but is directly and positively impacted by the extent to which a firm has a green reputation (Walsh and Sulkowski 2010). A review of interdisciplinary research identified common proximal mediators of life satisfaction such as quality of work life, quality of non-work life, and feelings of self-worth, career satisfaction, job performance, turnover intentions, and organizational commitment (Erdogan et al. 2012).

The topic of happiness and satisfaction in the workplace is a vital area in business scholarship, given that these feelings among employees boost all measures of firm performance, including financial results (Edmands 2011, 2012). In terms of practical application, Google has tested and deployed a free meditation course for its employees based on the science of happiness and mindfulness (Tan 2012). As discussed below, aspects of happiness have been identified and specifically defined, but for the present moment, suffice it to summarize that emotional states of individuals clearly have an impact on organizational performance.

Clearly, just as individual and firm-level attitudes and activity cumulatively result in country-level economic conditions, sentiments of individuals and within firms collectively are reflected in national-level surveys of self-reported happiness—the connection between emotional states of people and health of businesses and entire economies has long been observed (Akerlof and Shiller 2009; Shiller 2006).

Strangely, for purposes of both managing people and organizations and in the public policy arena, much more attention has been given to the development, implementation, and maximization of a completely different set of measures than those related to happiness. Indeed, public economics "fails to explain the recent history of human welfare and it ignores some of the key findings of modern psychology" (Layard 2006). An overemphasis on a narrow range of metrics (typically GDP, company revenues and profits, stock returns and indices, income, and other measures of material wealth and consumption) at the individual, firm, and national level, among other widely acknowledged-as-erroneous assumptions at the foundation of economics (Sen 1977) has resulted in real problems. For several decades, other indicators reflect very real, growing, and global crises, particularly with respect to climate change, ecosystem collapse, and related problems (Brown 2009; IPCC 2007; Lovelock 2006, 2010; McKibben 2010). Incredibly, even the creator of GDP warned against using his creation as a gauge of the success of an economy (Kuznets 1934).

2.2 An emerging trend: measuring happiness

Over the past few decades, a body of research and literature has flourished around the topic of combining knowledge about happiness and economics to better inform policy-making (Graham 2012). Widely cited literature in the field of positive psychology on subjective well-being (SWB) argues that the components of SWB and their underpinnings in terms of culture and temperament as well as sampling methodologies are advanced enough to produce national indicators of happiness (Diener 2000). Indeed, some believe that the pursuit of happiness rather than constant growth of consumption may be the organizing principle that replaces our current predominant fixation in business and economics. Among these are Peter Senge (Senge 2006; Senge et al. 2008), who argues that a substantial change of mindset, or metanoia, is needed. The Brundtland Commission's definition of sustainability, i.e., 'meeting the needs of the present without compromising the ability of future generations to meet their needs' (Brundtland 1987) somewhat presaged current awareness that humanity may be better served by moving away from pursuit of growth of consumption as an organizing principle.

Several solutions have been proposed and to some extent implemented based on the twin truisms that "we manage what we measure," and that "we are statistically blind to the ecological and societal dimensions of our activities." New types of KPIs, such as the Genuine Progress Indicator, the Gross National Happiness Indicator, the UN's Human Development Indicator, and the Calvert-Henderson Quality of Life Indicators have been developed as ways of focusing attention away from material and financial growth.

Famously, in 1972, the King of Bhutan, Jigme Singye Wangchuck, suggested the development and growth of a Gross National Happiness Index of his country, which is now being applied globally (Bates 2009). In 1990 Mahbub ul Haq and Amartya Sen initiated the U.N. Human Development Index, which reflects average life expectancy, years of education, and income—in ul Haq's words: "just one number which is of the same level of vulgarity as the GNP—but a measure that is not as blind to social aspects of human lives as the GNP is" (Jahan 2004). In 2010, the Inequality-adjusted HDI (IHDI) was introduced, which adjusts down a countries' overall score as inequality increases in each of the three dimensions of the HDI (health, education and income). It similarly has been suggested that the HDI be adjusted for sustainability (Ray 2014).

Since 2000, interest among country governments in full-spectrum evaluations of national well-being has greatly increased. In 2006 China created a green GDP index that adjusts for costs of environmental harm; by this standard, 3 % points of annual GDP

growth should have been subtracted from official statistics (Li and Lang 2010). In 2008 the USA began funding of the State of the USA project to create a "key national indicator system" with new data points to supplement standard GDP measures based on a review of best practices (Government Accountability Office 2011). In 2009 the French government released a report co-authored by Nobel Prize-winning economist Joseph Stiglitz, suggesting an end to "GDP fetishism" (Commission on the Measurement of Economic Performance and Social Progress 2009). By 2010, the UK government announced that surveys of happiness will be taken and considered together with other economic measures.

To summarize, the governments of the UK, France, and the USA have started to catch up with Bhutan in terms of giving serious consideration to tracking happiness as an indicator along with other measures of success. The Bhutanese experiment in defining and implementing a Gross National Happiness (GNH) Index is based in what has been characterized as a Buddhist perspective (that material and spiritual development can complement each other rather than compete), but the Index could be readily applied elsewhere in other cultural contexts. The four essential aspects of the GNH are: (1) conservation of the natural environment; (2) preservation of cultural values; (3) good governance; and (4) ecologically sustainable development (Tideman, 2011). The Center for Bhutan Studies collaborated with empirical researchers to arrive at specific measurable contributors to happiness: physical, mental and spiritual health; time balance; social and community vitality; cultural vitality; education; living standards; good governance; and ecological vitality (Zurick 2006).

2.3 What cross-national comparisons reveal

Two efforts to arrive at national rankings that are related to human happiness are particularly noteworthy: the World Happiness Report (Helliwell et al. 2012, 2013, 2015) and Happy Planet Index, or HPI (New Economics Foundation 2015). The HPI takes a holistic view of well-being, taking into account objective measures such as longevity and environmental footprint as well as happiness and economic activity. The World Happiness Report starts with self-reported emotional state as measured by the Worldwide Independent Network of Market Research/Gallup International Association's End of Year annual global survey—hereinafter Gallup global survey (WIN/Gallup International Association 2015)—and adds layers of interpretation to the raw data.

The World Happiness Report and Happy Planet Index are therefore both useful and valuable, with the caveat that they are not raw, unadulterated reflections of subjective emotional state. One key observation of these reports is that countries can still have happy populations while, on an average per capita basis, exacting much less harm on the natural environment as others, as in the case of the HPI score of Costa Rica.

Several factors contribute to happiness levels; for example, in developed countries, it has been found to depend on whether respondents live stable relationships, life satisfaction is related to respondents' feelings of control, and social capital of a country is an important predictor of happiness (Gundelach and Kreiner 2004). However, greater levels of wealth and development carry their own set of stresses and miseries. The World Happiness Report dedicates a chapter to mental health problems of depression, anxiety and stress, which persist—or could even be exacerbated by features of economic development such as consumerism and the phenomena of unnatural diets, dislocation and destruction of social connections and connections to nature and traditions and lifestyles and sleeping patterns (Helliwell et al. 2012).

As will be expanded upon in the section below, implications for future research, a larger question is whether human well-being can be decoupled from constant growth in consumption and associated ecological devastation, including carbon emissions (Dietz et al. 2012). Based on Kuznets' hypothesis that economic inequality worsens and then diminishes as countries develop (Kuznets 1955), an environmental Kuznets curve (EKC) has been suggested (Grossman and Krueger 1995; Selden and Song 1994; Shafik 1994; Stern et al. 1996). The EKC holds that environmental conditions worsen as countries begin to develop but eventually improve as countries become more fully developed, a theory that has been tested and critiqued (Stern 2004; White and Sulkowski 2010). An EKC can be substantiated or discredited depending on the variables used and context considered (Apergis and Ozturk 2015; Dietz et al. 2012; Stern 2004; Yang et al. 2015; Yin et al. 2015).

Based on the foregoing research, the authors seek to establish—using an objective statistical test—whether there exist clusters of countries defined by similar levels of average happiness, development, income, and carbon emissions and what kind of comparisons or contrasts can be drawn between them. The novel contribution of this paper to the foregoing literature is the use of model-based cluster analysis.

3 Test

Model-based cluster analysis is a data reduction technique appropriate for identifying relationships that are not readily apparent in a given a data set. It is critical to point out that model-based cluster analysis is used purely as a tool of exploratory research in this context—there is no model proposed nor hypothesis tested in this study. Therefore, while the authors are not testing correlations between any of the variables below, the results do serve as valuable observations about reality that can inform and serve as a foundation for further research.

4 Variable definition

The authors selected variables that reflect happiness, human development, per capita income, and per capita carbon dioxide emissions.

5 Methodology

To determine the extent of similarities and differences between countries, the technique of model-based cluster analysis is employed. The goal of cluster analysis is to identify homogeneous groups in a given population based upon the data being analyzed (Hair et al. 2006). One of the limitations of cluster analysis is, however, that determination of the optimal number of clusters is more art than science (e.g., it depends on researcher interpretation). The technique of model-based cluster analysis addresses this limitation by defining the optimal solution using a multivariate Gaussian mixture (Fraley and Raftery 2002, 2006):

$$f(\mathrm{x}i|\mathrm{K},\theta) = \sum_{\mathrm{k}=1}^{\mathrm{K}} \mathrm{p}k\phi(\mathrm{x}i|\mathrm{m}k,\Sigma k)$$

where the pk's are the mixing proportions and $\phi(.\mid \mathrm{m}k, \Sigma k)$ denotes a Gaussian density with mean mk and variance matrix Σk. This analysis is used in conjunction with a Bayesian criterion (BIC) to determine the optimal model based upon a given dataset. The Bayesian criterion approximates the integrated likelihood of the data:

$\mathrm{p}(\mathrm{x}|\mathrm{m}) = \mathrm{p}(\mathrm{x}|\mathrm{m},\theta\mathrm{m})\pi(\theta\mathrm{m})\mathrm{d}\theta\mathrm{m}$, $\pi(\theta\mathrm{m})$ being a prior distribution for parameter θm.

BIC is calculated as:

$$\mathrm{BIC}(\mathrm{m}) = \log \mathrm{p}\left(\mathrm{x}|\mathrm{m},\hat{\theta}\mathrm{m}\right) - \frac{\mathrm{vm}}{2}\log(\mathrm{n}).$$

A model-based cluster analysis is a useful method for establishing cohorts of entities that are statistically similar to each other (homogeneous groupings). In this case, the method is used to establish cohorts of countries, based on measures of happiness, development, emissions, and income, which are similar to each other. Most importantly, one may examine the countries within a cohort to speculate on what underlying factors explain each cohort's similarities.

6 Data

For a cross-national comparison of happiness—that is, subjective emotional state, unaltered by a formula that includes information about societal conditions or environmental footprint—the basis for the World Happiness Report can be used: the annual Gallup global survey. Among other questions, typically 1000 respondents in each country answer whether they are happy, and Net Happiness is calculated as the percent answering "yes" minus those answering "no" or the equivalent of "don't know" or a failure to respond. Appendix 1 lists the raw data used in the present study, sorted by Net Happiness. One of the most obvious features about the ten countries at the top of the list is that seven are countries that are not high in GNI nor HDI. The Gallup global survey has a 37 years history and, while one might suspect occasional problems in surveying, it is doubtful that this pattern is a result of widespread errors or intentional deception. Country data are generally consistent year-to-year. The average of end-of-year 2011 and 2012 was used (or otherwise the statistic for the available year if only one year of data is public). This approach—using most recently available data from Gallup and averaging the recent results of annual surveys on happiness—was adopted by the authors of the World Happiness Report (Helliwell et al. 2012, 2013, 2015) and others (Ott 2011).

The HDI of each country is included. This serves several purposes. One is to explore whether there is a connection between HDI and happiness. The HDI is determined by not just GNI per capita adjusted for purchasing power, but also life expectancy at birth, mean years of schooling, expected years of schooling, and, since 2010, it is adjusted for income inequality. Therefore, to the extent that health, education, and absence of vast income differences should affect levels of happiness, one might expect to see a closer connection between HDI and happiness than GNI and happiness when characteristics of the clusters are finally compared. Gross National Income per capita data from the World Bank from the year 2010 is included in the analysis. It does not change drastically year-to-year. Carbon

dioxide (CO2) emissions per capita from the year 2010 (also from the World Bank) is included and likewise does not drastically change year-to-year.

7 Results

The data were analyzed using the R statistical package (R Development Core Team 2013) module for model-based cluster analysis. Model-based cluster analysis identified five clusters as the optimal solution for the dataset.

Given the data, model-based cluster analysis identified an EVI (diagonal, equal volume, varying shape) model with five components:

Log likelihood	*n*	df	BIC	ICL
−943.1975	61	40	−2050.83	−2056.657

Clustering summary

Cluster	1	2	3	4	5
Number of countries	21	16	10	10	4

Appendix 2 presents individual results for each of the 61 countries included in the analysis.

Based on the results above, the five clusters and their membership and characteristics are summarized in the following Tables 1 and 2.

The statistical clusters in the two tables above are noteworthy for at least three reasons, all of which are clarified in the table and graph below. First, among wealthy countries, happiness, HDI, and GNI levels are barely distinguishable, despite Cluster 4 (High Development and Income and Happy, but Middle CO2) having a mean of 57 % of the emissions as that of Cluster 3 (High Development and Income and CO2, and Happy). Second, the poorest and

Table 1 Countries, grouped by cluster membership

Cluster	Cluster members
Least Development and Income and CO2, but Happy	Fiji, Nigeria, Colombia, Ghana, Philippines, Uzbekistan, Peru, Ecuador, Armenia, India, Mozambique, Cameroon, Kenya, Vietnam, Tunisia, Moldova, Pakistan, Georgia, Morocco, Iraq, Egypt
Middle Development and Income and CO2, but Least Happy	Brazil, Malaysia, Azerbaijan, Bosnia and Herzegovina, Macedonia, South Africa, Russian Federation, Bulgaria, Ukraine, China, Turkey, Poland, Serbia, Lithuania, Romania, Lebanon
High Development and Income and CO2, and Happy	Netherlands, Finland, Germany, Singapore, Japan, Canada, Belgium, Australia, USA, Ireland
High Development and Income and Happy, but Middle CO2	Switzerland, Denmark, Iceland, Spain, Austria, Sweden, France, Hong Kong, United Kingdom, Italy
Upper Middle Development and Income, but High CO2, and 2nd Least Happy	Saudi Arabia, South Korea, Czech Republic, Portugal

Table 2 Cluster means

	Happiness	CO2 per capita	HDI	GNI per capita	Cluster
High Development and Income and CO2, and Happy	48.0	11.31	0.914	45,086	3
High Development and Income and Happy, but Middle CO2	46.9	6.43	0.897	44,663	4
Upper Middle Development and Income, but high CO2, and 2nd Least Happy	35.5	11.02	0.845	19,830	5
Middle Development and Income and CO2, but Least Happy	29.2	6.22	0.750	7364	2
Least Development and Income and CO2, but Happy	44.8	1.54	0.616	2467	1

least polluting cluster, Cluster 1 (Least Development and Income and CO2, but Happy), while enjoying a mean of 93 % of the happiness of the happiest cluster, has a mean carbon footprint of 14 %—and a mean income of 5 %—of the happiest cluster, Cluster 3 (High Development and Income and CO2, and Happy). Third, the poorest and least polluting cluster has a mean happiness higher than two of its counterparts (Clusters 5 and 2), even though one of these wealthier counterparts contains countries that, on average, emit seven times more CO2 per capita (Upper Middle Development and Income, but High CO2, and 2nd Least Happy). These results would be even more dramatic if Iraq and Egypt had been excluded on the grounds of their having experienced recent violent upheavals.

The key findings emerge most clearly, however, if the characteristics are indexed (Table 3 below) and then illustrated on a chart (Fig. 1 below), with clusters on the horizontal axis, sorted by relative income and development.

8 Key findings explained: a happiness Kuznets curve and differences in carbon emissions

Figure 1 illustrates the pattern that emerged from the model-based cluster analysis. The vertical bars indicate relative development, income, and carbon emissions. The line tracing mean happiness from cluster-to-cluster shows that the happiest clusters are at the extremes

Table 3 Indexed average of indicators in each country cluster, displayed as a percent of the highest value for each indicator

	Happiness (%)	CO2 pc (%)	HDI (%)	GNI pc (%)	Cluster
High Development and Income and CO2, and Happy	100	100	100	100	3
High Development and Income and Happy, but Middle CO2	98	57	98	99	4
Upper Middle Development and Income, but High CO2, and 2nd Least Happy	74	97	92	44	5
Middle Development and Income and CO2, but Least Happy	61	55	82	16	2
Least Development and Income and CO2, but Happy	93	14	67	5	1

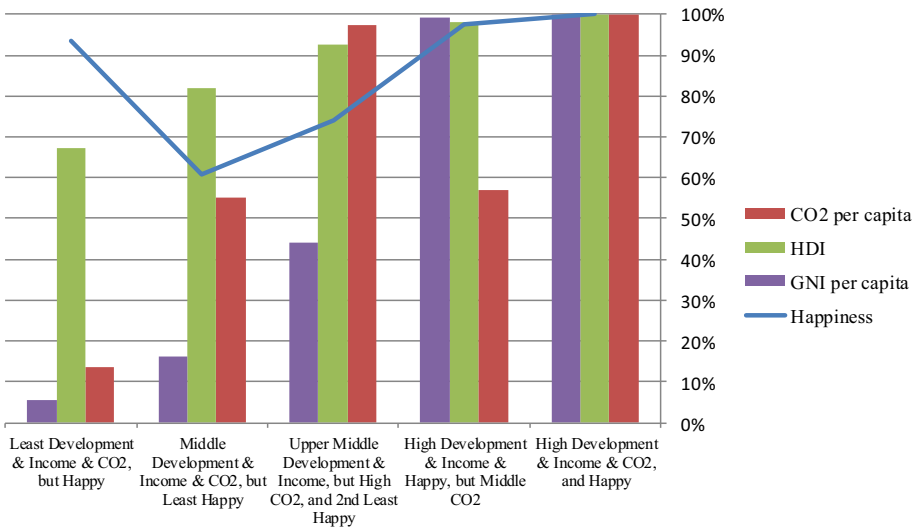

Fig. 1 Indexed average of indicators in each country cluster, displayed as a percent of the highest value for each indicator

of most and least developed country clusters. Happiness is lowest in the two clusters of medium-developed, medium-income countries. It is important to clarify that no causality is implied or tested by the analysis or this representation. Instead, the pattern is simply highlighted that middle-developed country clusters have the lowest mean happiness.

The finding that mean happiness was markedly lower in the middle-developed two clusters of countries and highest in the least and most developed clusters is evocative of the Kuznets curve (albeit inverted in shape)—the theory positing that economic inequality is exacerbated as countries start developing, but then is reduced as countries become more developed (Kuznets 1955).

The results indicate that a variation of the Kuznets curve—a happiness Kuznets curve (HKC)—may exist, whereby average happiness may first decline as companies move from being undeveloped to medium developed and then rises as countries move from being medium developed to developed. While, as elaborated upon below, a Kuznets curve for economic inequality and environmental degradation have been hypothesized and tested in various ways, it appears that so far the notion of a Kuznets curve for happiness has not been posited.

The second key takeaway is that carbon emissions do not track perfectly with either development or happiness. Of particular interest is the second most developed cluster with the second highest mean income, yet with roughly 40 % less carbon emissions than both the most developed and one of the middle-developed clusters. Its mean emissions per capita approximate the second least developed cluster, whose mean income is 86 % lower. Visualized this way, the results of the cluster analysis beg further investigation as to whether and how other countries could emulate the outcome of having development and high incomes with low carbon emissions. Again, such speculation is outside the bounds of this study, but these results do provide direction for new research questions.

9 Implications for future research

An environmental Kuznets curve (EKC) has been posited (Grossman and Krueger 1995; Selden and Song 1994; Shafik 1994; Stern et al. 1996) and tested and critiqued (Babcicky 2013; Stern 2004; White and Sulkowski 2010). This hypothesis holds that environmental conditions worsen as countries begin to develop but eventually improve as countries become more fully developed. One study tested environmental intensity of human well-being (EIWB), represented as the ratio of a nation's per capita ecological footprint to its average life expectancy at birth (Dietz et al. 2009), finding an inverse of the Kuznets curve.

However, to date, it seems that no one has explicitly articulated the existence of a happiness Kuznets curve (HKC). Ott (2011) came closest: in a cross-country comparison of governance quality and happiness, the study found a curve showing that happiness *inequality* increased as countries moved from lowest governance quality to medium governance quality and then decreased as among countries with highest governance quality. Ott noted the similarity of this bell curve to the Kuznets curve. However, this study has revealed that an HKC may exist, with happiness decreasing and then increasing as countries move through stages of development. This should provoke further studies that test for causality. For example, it may be that indicators of human development, income, or some other factor cause average happiness to improve as a country moves through phases of development.

To a greater degree extant literature has explored how carbon emissions do not track perfectly with greater development, prosperity, and well-being (Steinberger and Roberts 2010). The second key finding builds upon those findings. The key next questions remain how countries—and by extension, the economic and societal units that comprise countries—can further the goals of happiness and prosperity while further decoupling these aims from environmental degradation.

One vital implication for scholars and policy-makers in wealthy, developed countries is that role models, best practices, and good ideas should not chauvinistically be assumed to be found exclusively in their own countries. Less wealthy countries where there are high levels of happiness and well-being could be a source of ideas worthy of emulation or adaptation.

The corollary for developing or undeveloped countries is not to imitate blindly the practices—nor unquestioningly to follow the advice—of authorities in more developed countries. To some extent this has occurred, and the clusters described here may hint at this: An example of this is the "leap-frogging" of stages of development in telecommunications infrastructure, with developing countries adopting cellular phone and data networks rather than building the physical infrastructure of transmission lines. The result is advancement in connectivity with a comparably lower amount of negative environmental externalities (relative to imitating the stages of development of historically wealthier countries).

As suggested elsewhere (Dietz et al. 2012), it is appropriate to consider whether national-level trends and comparisons hold any implications or raise questions for sub-national units of analysis such as firms. Just as the environmental footprint of a country cannot be divorced from the environmental footprint of commerce, neither can we separate the happiness of a society from the happiness of employees of businesses. Therefore, there are several implications for managers, policy-makers, and management scholars in the results of this study.

A critical question—though obviously a provocative one in the realms of both public policy and management—is what is either an optimal level of compensation and consumption, and development, or else what are the tipping points of the factors that contribute to happiness? If governments decide to cease treating constantly increasing consumption of material goods and GDP growth as policy goals, then understanding alternative KPIs will continue to gain importance. If the trend of dematerialization continues to take hold, beyond emphasis on renewability and supply loops and servicing (Reiskin et al. 2008; Rothenberg 2007; White et al. 1999) to a fundamental downsizing of possessions and materially consumptive lifestyle, what will be the KPIs of successful organizations and economies?

Besides joining others who have called for development and adoption and use of an expanded range of KPIs for both firms and economies, the authors believe that there is a need to specifically focus on measures of happiness and using them in the management. Potentially, the annual publication of statistics on the happiness of employees may become as commonplace as reporting on environmental and societal impacts and governance (ESG or sustainability reporting). Ninety-five percent of the Global Fortune 250 now engage in this practice, along with thousands of other organizations (KPMG 2011). Inasmuch as it has been established that financial performance of firms is positively impacted by having happier employees, it is logical that not only employees and clients, but also investors would gain from including company happiness indicators in annual reporting practices.

10 Limitations

The first possible critique is the choices of data used. Arguably the methodology by which happiness data from sixty-one countries was gathered may have had imperfections, with no guarantee that samples were demographically representative. This concern is ameliorated, however, by the fact that the dataset resulting from the Gallup surveys roughly corroborates with the findings of scholarly studies. On a mood happiness scale ranging from 0 to 100 with an overall mean of 75 (Cummins et al. 2014), developed countries tended to have means in the range of 70–80 points (Cummins 1995), while less developed countries had a mean mood happiness of between 60 and 80 points (Cummins 1998). In the present study using Gallup data, the least developed cluster had a mean self-reported happiness of 89 % or roughly what one would expect based on these earlier studies. Studies that have explored differences in methodologies for gauging happiness have found that they ultimately do not yield vastly varying results (Ferrer-i-Carbonell and Frijters 2004).

A related weakness in the data is the potential that the question "are you happy" may be interpreted differently across cultures and in different languages. If so, should (at the firm level and country level) we further develop baseline definitions, methods, metrics, and databases of this vital measure? This question has been investigated to some extent and cultural differences tend not to be a significant obstacle to international comparisons of happiness (Diener and Oishi 2000).

Conceivably more countries could be included, as well as more variables, such as measures of average daylight-hours-per-day, mean temperature, and average leisure time, but these are more fairly viewed as ideas for further studies rather than critical weaknesses in this study. It bears repeating that the goal of this study is just to test for interesting aspects of reality; it is not to propose and test specific hypotheses. An inherent limitation,

therefore, is that correlation or causality between variables is not being tested at this stage. There could be a variety of causal relationships proposed and tested moving forward.

11 Conclusions

This exploratory study used a novel approach in its field—model-based cluster analysis—to evaluate data on happiness, development, income, and carbon emissions. This data reduction technique identifies clusters of statistically similar entities. The intent is to identify patterns that may previously have been underappreciated or not noticed. The model-based cluster analysis indicated that there are five distinct groups of similar countries.

Two key patterns are identified. When country clusters are distributed on a horizontal axis by level of income and development and happiness is charted on the vertical axis, a happiness Kuznets curve (HKC) emerges, whereby the average happiness of countries appears to decline as they transition from less-developed to medium-developed, and then rises as they become highly developed. Second, carbon emissions do not track perfectly with development and income. A particularly interesting cluster is one where happiness, income, and development are all second highest and near parity with the most developed cluster, but carbon emissions are roughly 40 % below that of the most developed and a middle-developed cluster of companies, and roughly the same as the second least developed cluster.

The authors underscore that this analysis does not suggest causality between variables. Rather, it contributes to extant literature on the topics of happiness and sustainable development by deploying a novel tool and finding that a happiness Kuznets curve may exist and that carbon emissions do not perfectly track with indicators of income, development, and happiness.

Appendix 1

Country data, listed by level of happiness

Country	Net Happiness	Happiness (% of max)	CO2	CO2 (% of max)	HDI	HDI (% of max)	GNI	GNI (% of max)
Fiji	85	100	1.5	9	0.70	75	3670	5
Nigeria	84	99	0.5	3	0.47	50	1240	2
Netherlands	77	91	11.0	62	0.92	98	48,530	66
Colombia	73	86	1.6	9	0.72	77	5460	7
Ghana	72	85	0.4	2	0.56	59	1260	2
Switzerland	69.5	82	5.0	28	0.91	97	73,680	100
Finland	69	81	11.5	66	0.89	95	47,140	64
Philippines	69	81	0.9	5	0.65	70	2060	3
Brazil	68.5	81	2.2	12	0.73	78	9520	13
Malaysia	68	80	7.7	44	0.77	82	8150	11
Saudi Arabia	66	78	17.0	97	0.78	83	19,360	26
Denmark	64	75	8.3	48	0.90	96	59,590	81

Country	Net Happiness	Happiness (% of max)	CO2	CO2 (% of max)	HDI	HDI (% of max)	GNI	GNI (% of max)
Iceland	63.5	75	6.2	35	0.91	97	33,900	46
Uzbekistan	62	73	3.7	21	0.65	70	1300	2
Azerbaijan	60	71	5.1	29	0.73	78	5370	7
Peru	59.5	70	2.0	11	0.74	79	4720	6
Ecuador	58.5	69	2.2	12	0.72	77	4330	6
Spain	55	65	5.9	33	0.89	94	31,420	43
Armenia	53	62	1.4	8	0.73	78	3330	5
Germany	52.5	62	9.1	52	0.92	98	43,300	59
Austria	51	60	8.0	45	0.90	95	47,060	64
Singapore	50	59	2.7	15	0.90	95	42,530	58
Sweden	50	59	5.6	32	0.92	98	50,860	69
Japan	49	58	9.2	52	0.91	97	42,190	57
Canada	47.5	56	16.2	92	0.91	97	43,250	59
Belgium	44	52	10.0	57	0.90	96	45,840	62
Korea, Rep (South)	43.5	51	11.5	65	0.91	97	19,720	27
India	40.5	48	1.7	9	0.55	59	1290	2
Bosnia and Herzegovina	39.5	46	8.1	46	0.74	78	4640	6
Australia	39	46	16.9	96	0.94	100	46,310	63
Mozambique	39	46	0.1	1	0.33	35	430	1
France	38	45	5.6	32	0.89	95	42,280	57
Cameroon	36	42	0.4	2	0.50	53	1130	2
Macedonia	35.5	42	5.2	29	0.74	79	4580	6
South Africa	35	41	9.2	52	0.63	67	6100	8
USA	33.5	39	17.6	100	0.94	100	48,960	66
Kenya	32.5	38	0.3	2	0.52	55	800	1
Russian Federation	31.5	37	12.2	70	0.79	84	10,000	14
Vietnam	30.5	36	1.7	10	0.62	66	1270	2
Bulgaria	29.5	35	5.9	34	0.78	83	6320	9
Tunisia	29.5	35	2.5	14	0.71	76	4150	6
Ukraine	29	34	6.6	38	0.74	79	2990	4
Moldava	28	33	1.4	8	0.66	70	1820	2
Pakistan	28	33	0.9	5	0.52	55	1060	1
Hong Kong	27.5	32	5.2	29	0.91	97	33,630	46
China	27	32	6.2	35	0.70	75	4240	6
UK	27	32	7.9	45	0.88	93	38,690	53
Georgia	25	29	1.4	8	0.75	79	2680	4
Czech Republic	24.5	29	10.6	60	0.87	93	18,370	25
Turkey	24.5	29	4.1	24	0.72	77	9980	14
Morocco	24	28	1.6	9	0.59	63	2880	4
Italy	23	27	6.7	38	0.88	94	35,520	48
Ireland	18	21	8.9	51	0.92	98	42,810	58

Country	Net Happiness	Happiness (% of max)	CO2	CO2 (% of max)	HDI	HDI (% of max)	GNI	GNI (% of max)
Poland	18	21	8.3	47	0.82	88	12,400	17
Serbia	14.5	17	6.3	36	0.77	82	5550	8
Iraq	12	14	3.7	21	0.59	63	4380	6
Lithuania	9	11	4.1	23	0.82	87	11,620	16
Portugal	8	9	4.9	28	0.82	87	21,870	30
Egypt	0	0	2.6	15	0.66	71	2550	3
Romania	−10	−12	3.7	21	0.79	84	8010	11
Lebanon	−12.5	−15	4.7	27	0.75	79	8360	11

Appendix 2

Countries and associated data listed by cluster

Country	Happiness	CO2 per capita	HDI	GNI per capita	Cluster
Fiji	85	1.499937	0.702	3670	1
Nigeria	84	0.494091	0.471	1240	1
Colombia	73	1.629452	0.719	5460	1
Ghana	72	0.370888	0.558	1260	1
Philippines	69	0.873148	0.654	2060	1
Uzbekistan	62	3.656678	0.654	1300	1
Peru	59.5	1.967658	0.741	4720	1
Ecuador	58.5	2.175598	0.724	4330	1
Armenia	53	1.424236	0.729	3330	1
India	40.5	1.666209	0.554	1290	1
Mozambique	39	0.120258	0.327	430	1
Cameroon	36	0.350799	0.495	1130	1
Kenya	32.5	0.303782	0.519	800	1
Vietnam	30.5	1.728118	0.617	1270	1
Tunisia	29.5	2.453102	0.712	4150	1
Moldova	28	1.363005	0.66	1820	1
Pakistan	28	0.932118	0.515	1060	1
Georgia	25	1.401643	0.745	2680	1
Morocco	24	1.599383	0.591	2880	1
Iraq	12	3.703433	0.59	4380	1
Egypt	0	2.622791	0.662	2550	1
Brazil	68.5	2.150268	0.73	9520	2
Malaysia	68	7.667467	0.769	8150	2
Azerbaijan	60	5.050749	0.734	5370	2
Bosnia and Herzegovina	39.5	8.093102	0.735	4640	2
Macedonia	35.5	5.171997	0.74	4580	2
South Africa	35	9.204085	0.629	6100	2

Country	Happiness	CO2 per capita	HDI	GNI per capita	Cluster
Russian Federation	31.5	12.2255	0.788	10,000	2
Bulgaria	29.5	5.930052	0.782	6320	2
Ukraine	29	6.644867	0.74	2990	2
China	27	6.194858	0.699	4240	2
Turkey	24.5	4.131031	0.722	9980	2
Poland	18	8.308632	0.821	12,400	2
Serbia	14.5	6.303584	0.769	5550	2
Lithuania	9	4.12574	0.818	11,620	2
Romania	−10	3.673158	0.786	8010	2
Lebanon	−12.5	4.700013	0.745	8360	2
Netherlands	77	10.95836	0.921	48,530	3
Finland	69	11.53084	0.892	47,140	3
Germany	52.5	9.114842	0.92	43,300	3
Singapore	50	2.663192	0.895	42,530	3
Japan	49	9.185651	0.912	42,190	3
Canada	47.5	16.22	0.911	43,250	3
Belgium	44	9.999147	0.897	45,840	3
Australia	39	16.90802	0.938	46,310	3
USA	33.5	17.56416	0.937	48,960	3
Ireland	18	8.939753	0.916	42,810	3
Switzerland	69.5	4.952968	0.913	73,680	4
Denmark	64	8.346405	0.901	59,590	4
Iceland	63.5	6.168529	0.906	33,900	4
Spain	55	5.853466	0.885	31,420	4
Austria	51	7.973648	0.895	47,060	4
Sweden	50	5.599744	0.916	50,860	4
France	38	5.555374	0.893	42,280	4
Hong Kong	27.5	5.16623	0.906	33,630	4
UK	27	7.925093	0.875	38,690	4
Italy	23	6.717667	0.881	35,520	4
Saudi Arabia	66	17.03991	0.782	19,360	5
Korea, Rep (South)	43.5	11.48689	0.909	19,720	5
Czech Republic	24.5	10.62301	0.873	18,370	5

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