



Economic development and prosperity patterns around the world: Structural challenges for a global steady-state economy



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ABSTRACT

Taking a global perspective this paper sets out to theoretically and empirically identify prosperity patterns for four groups of countries at different levels of economic development. It conceptualizes 'prosperity' in terms of ecological sustainability, social inclusion, and the quality of life and contextualizes this definition in global perspective. Subsequently, it operationalizes and measures these dimensions on the basis of data from sources such as the World Bank, the Global Footprint Network and the OECD for 138 countries and by applying dual multiple factor analysis. Building on earlier research that suggested that higher development levels in terms of GDP per capita are capable of providing social and individual prosperity but at the expense of environmental sustainability, we ask whether other interrelations between prosperity indicators exist on other levels of economic development. Empirically distinguishing between 'rich', 'emerging', 'developing' and 'poor countries' the paper finds that social and individual prosperity indicators largely increase with economic development while ecological sustainability indicators worsen. Our analyses further reveal that 'social cohesion' can be established under different economic and institutional conditions, that subjective wellbeing increases with income rises at all levels of economic development and that a decoupling of carbon emissions from the provision of prosperity is, in principle, achievable, while a reduction of the global matter and energy throughput poses a much greater challenge. The paper concludes by highlighting the repercussions of these findings for the trajectories that countries at different levels of economic development would need to undertake.

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1. Introduction

Prosperity is commonly conceptualized in socio-economic terms, highlighting particularly economic development and material welfare in terms of GDP. While this is normally not questioned as a priority in policy making, there is growing evidence that Western production and consumption patterns are not generalizable to the rest of the planet if environmental concerns are considered. The traditional notion and the existing structures of Western prosperity are not only challenged by unprecedented levels of inequality (Piketty, 2014) but also by the fact that the Earth's carrying capacity is being exceeded in relation to at least three planetary boundaries: climate change, the nitrogen cycle, and biodiversity loss (Rockström et al., 2009). Less than ever before can the economy and the associated notion of prosperity be considered as an isolated system. This means taking seriously the environmental limits to economic growth and material prosperity

as well as understanding that there are real thresholds. Ignoring or disrespecting them has fundamental consequences for humans and other species. In addition, there continues to be a lack of evidence for an absolute decoupling of GDP growth, material resource use and carbon emissions (Jackson, 2009; Koch, 2012). This severely diminishes the plausibility of the 'green growth' vision, that economic growth can be combined with environmental sustainability, which is nevertheless almost endlessly reiterated in policy documents, especially in the EU.

Theoretically, we depart from Tim Jackson's 'Prosperity without Growth' (Jackson, 2009) and Fritz and Koch, (2014) and conceptualize prosperity in terms of three dimensions: ecological sustainability, social inclusion as well as individual wellbeing and the quality of life. The added value of the present study is to understand prosperity in a global context. Empirically, we explore the dimensions and relations between the elements of prosperity for groups of countries at different levels of economic development. While existing studies focus on single indicators and intend to find the causes for differences between countries' performances regarding, for example, CO₂ emissions, wellbeing or crime rates, the present study provides a comparative analysis of how

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prosperity indicators are interrelated and whether these relations vary under different economic conditions. In contrast to Fritz and Koch (2014), who studied the advanced capitalist plus selected developing countries and applied correspondence analysis, we now take a global perspective and apply dual multiple factor analysis (DMFA). We have compiled data for 138 countries from different organizations such as the World Bank, the Global Footprint Network, and the OECD and collected information about ten indicators measuring the ecological, social and individual dimensions of prosperity as well as economic development.

In the next section we conceptualize prosperity and its ecological, social and individual dimensions at global scale. Subsequently, we operationalize these prosperity dimensions and empirically analyze them in relation to economic development. How are different levels of economic development associated with social inclusion, quality of life and ecological sustainability? Is there a level of economic development beyond the poorest that is environmentally sustainable? In the conclusion we highlight the implications these associations have for a transition toward a global economy that respects ecological limits.

2. Prosperity as a multidimensional concept at global scale

Scholars who systematically consider the existence of ecological limits to economic growth have begun to discuss the feasibility of providing prosperity, the 'good life', 'sustainable welfare' or '21st century socialism' in non-growing economies (Jackson, 2009; Fritz and Koch, 2014; Soper and Emmelin, 2016; Alvarez Lozano, 2012). These research directions are united in their emphasis of those elements of human conviviality that require few, if any, material resources, allowing for a surplus in prosperity for one person or one generation while still leaving room for the development of others. The degrowth research community has furthermore pointed to the link between ecological sustainability, social equity and individual wellbeing (Schneider et al., 2010; Kallis, 2011). Building on these contributions our concept of prosperity includes, on top of environmental sustainability, a social and an individual dimension. In relation to the *social dimension*, previous studies provided the evidence that people in more equal and socially inclusive societies are better-off and report greater amounts of happiness than in more unequal ones where status competition is particularly pronounced (Wilkinson and Pickett, 2010). Concerning the *individual dimension* of prosperity, Steinberger et al. (2012) have demonstrated that high life expectancies are compatible with low carbon emissions but high incomes are not. Wellbeing and quality of life researchers assume that human beings must have certain psychological needs satisfied in order to flourish and experience personal wellbeing. These needs include feeling safe and secure as well as competent and efficient (Kasser, 2009). Similarly, theories of human need (Gough, 2015) argue that the satisfaction of essential needs at global level would require relatively few material resources, allowing for a surplus in welfare and prosperity for one person or one generation without undermining the development of others. While due to planetary limits existing Western welfare systems cannot be generalized to the rest of the world, the issue of whether more than basic human needs can be provided is an empirical one.

While alternative understandings of prosperity in non-growing economies and post-growth societies are moving into the focus of interest, Herman Daly (1991) has developed a model of a non-growing economic system that functions within ecological boundaries. The 'steady-state economy' (SSE) is defined in terms of biophysical limits and material flows designed to keep two factors at constant level: the population of artifacts (stocks of physical wealth) and the number of people. However, the original concept of a SSE was not developed for the global level (Koch,

2015). Yet environmental threats such as climate change are global issues, because it does not matter from which part of the globe greenhouse gases are emitted (IPCC, 2014). It is only at the global level that thresholds for matter and energy throughput and population quota can be determined in order to effectively mitigate global environmental challenges such as climate change. At the same time, these bio-physical terms achieved at the global level would delineate the leeway within which national and local economies and societies could evolve. In other words, there would be space for different national and local paths to post-growth economies and societies that represent different traditions and institutional patterns and that could provide prosperity in different ways. This study contributes toward empirically identifying these different ways by analyzing the interrelations between prosperity indicators on four levels of economic development. Is there a certain level of economic development that is environmentally sustainable? Are there universal patterns of prosperity for all levels or do patterns change in the course of economic development?

3. Operationalizing and comparatively studying prosperity

We operationalize prosperity in a three-dimensional way, as ecological sustainability, social inclusion and quality of life. First, prosperity is concerned with aspects of *ecological sustainability*. We measure the extent to which the relation between society and its natural environment deserves the label 'sustainable' in terms of 'climate friendliness' (low CO₂ emissions), 'clean production' (as a low ecological footprint of production) and clean consumption (as a low ecological footprint of consumption).

Secondly, prosperity involves the social conditions under which people live. We call this second dimension *social inclusion* and suggest a further distinction between two aspects: (a) Social cohesion or the degree to which people can safely live together without excluding or disadvantaging others. We operationalize this subdimension by using the indicators 'security' (measured as low homicides rates) and 'equality' (low values on the Gini index for income inequality). In principle, the combination of social cohesion and ecological sustainability can be provided by authoritarian regimes as well as in more democratic systems. However, only the latter corresponds to a humane understanding of prosperity: freedom and autonomy are, for example, an essential part of the Degrowth declaration (Research and Degrowth, 2010) and a major theme in human needs theory (Doyal and Gough, 1991). Thus, as a second aspect or subdimension of social inclusion (b) 'Political freedom' accounts for the chances that citizens have in participating and shaping their common political and social life by freely expressing their opinions and views. We measure political freedom by the Democracy Index and Freedom House Index, both being indices accounting for political rights and civil liberties.

Third, prosperity refers to individuals and the objective and subjective *quality of life* that individuals are experiencing. For the objective aspect we use life expectancy as an overall indicator for health and literacy rates to measure the degree of education. Literacy rates are a somewhat general indicator for education, as they are similar across the developed countries. However, since we conduct a cross-country analysis with global scope and based on a dataset that includes many developing countries with significant differences in literacy rates, they are a useful source of information in our analyses.

We consider self-reported wellbeing as an indicator for the subjective aspect of the individual quality of life. The debate around the Easterlin paradox (Easterlin, 1974; Easterlin et al., 2010) and the question whether income has relative or absolute value shows that considering objective factors only is not sufficient when evaluating the quality of life. The mechanism of the hedonic treadmill, social comparisons and psychological adaptation

processes interfere with the happiness gains in quality of life that are achieved through economic development (Hagerty and Veenhoven, 2003). In the context of our cross-country study we cannot assess these adaption processes, but explore objective living conditions and subjective well-being simultaneously and study their interrelations at different levels of economic development.

We compiled data for these dimensions and indicators of prosperity from different sources (mainly the Global Footprint Network, the UN and the World Bank) and for one year in the period 2008–2012 in order to minimize lacks through missing data. Since we consider only one point in time per country, we do not, in this paper, follow country's trajectories over time.

Our sample is comprised of 138 countries from all world regions. In order to explore prosperity patterns under different economic circumstances we compare four levels of economic development as measured by GDP per capita (constant \$ as purchasing power parity). First, eight countries with exceptionally high GDPs are excluded as outliers. We label these 'overdeveloped' countries due to their extraordinarily high material standard of living. In these countries people have, on average and per year, more than 50,000\$ income at their disposal (Table 1)—an elite that mainly consists of oil-exporting states (e.g. Kuwait and Norway), headquarters of the financial sector (Singapore and Switzerland) and the worlds' largest economy (the U.S.).

The remaining 130 countries are divided into quartiles that represent four levels of economic development. The grouping into quartiles facilitates the comparison of country groups since it leads to sufficient numbers of cases required for the analysis. The four resulting groups largely overlap with the stages of economic development identified and discussed in growth economics (Porter 2005; Sala-i-Martin et al., 2008). In the 32 *poor* countries the annual GDP per capita does not exceed 3200 \$. This group encompasses many African countries such as Zimbabwe, Uganda or Chad but also some Central Asian countries (Afghanistan, Tajikistan) and East and South Asian countries (Bangladesh, Cambodia, and Myanmar). Basically competing 'on their factor endowments, primarily unskilled labor and natural resources' (Sala-i-Martin et al., 2008, 7), so-called 'factor-driven' economies have no alternative but to try to establish the basic requirements for socio-economic development: institutions, functioning legal systems, transport and communication infrastructures, public education and health. Yet since the building of large scale infrastructures and the sale of natural resources are often elements of this development, ecological sustainability may well deteriorate in the process.

In the group of 33 *developing* countries the annual GDP per capita oscillates between 3200 \$ and 11,000 \$. Here 'efficiency-driven' economies can be found that '... begin to develop more efficient production processes and increase product quality.' (Sala-i-Martin et al., 2008, 7) In these countries the material standard of living is slightly higher than in poor countries. The group of developing countries consists of African countries such as Angola, Ghana and Nigeria but also of representatives from the Americas (e.g. Bolivia, Ecuador, Jamaica and Nicaragua) and Eastern Europe (Bosnia, Ukraine). Compared to the first group, we expect an increase in individual and social aspects of prosperity mainly through higher education, better functioning institutions and

higher wages. However, the expansion of consumption, the increased use of electricity, transport etc. is likely to contribute to a worse ecological performance than in the first group.

We call the next group of 33 countries with an annual GDP per capita of between 11,000 and 21,500 \$ *emerging* economies. These are not necessarily growing economies in terms of GDP, but their average material living standard already exceeds that of subsistence levels in advanced Western countries. In Germany, for example, the official subsistence level stood at 8124 € in 2014 (Deutscher Bundestag, 2014).

Our last group of 32 *rich* countries features an annual GDP per capita of between 21,500 and 50,000 \$. Following Sala-i-Martin et al. (2008, 7), these countries have established the status of 'innovation-driven' economies and are 'able to sustain higher wages and the associated standard of living only if their businesses are able to compete with new and unique products. . . .'. This group consists mainly of economically advanced OECD countries located in Europe. Exceptions to this rule include Kazakhstan and Trinidad and Tobago, whose economies are to a huge extent dependent on the extraction of fossil fuels (oil and gas). Social and individual prosperity indicators are expected to peak at this level of economic development since not only basic needs requirements are provided but also a range of possibilities for self-realization, creativity and social activity. While 'green growth' approaches assume that to the extent to which 'green technologies' are applied, innovation-driven economies are not accompanied by further ecological degradation, ecological economists (Jackson, 2009) refer to various rebound effects as a result of which the overall ecological sustainability performance deteriorates despite relative progress in material resource use.

In our analysis, the multidimensionality of prosperity is addressed by investigating the interrelations between prosperity indicators. This requires a statistical method which reduces the complexity of the data set and describes the (joint) variations of the single indicators by means of a reduced number of latent dimensions. In other words: in order to understand and arrive at a clearer picture of all interdependencies between the ten prosperity indicators, a data reduction technique is required that summarizes these interdependencies with a minimal loss of information. Data reduction techniques such as correspondence analysis (for categorical data) or principal component analysis (for continuous data) are not causal analyses but explorative methods of analysis and have a focus on visualizing latent patterns which are hidden in the data. They do not differentiate between dependent and independent variables; instead all variables are regarded as *interdependent*. Moreover, there is no concept of control variables in data reduction techniques. By unfolding the structures which are hidden in the data, all indicators included in the analysis are automatically control variables because all interrelations between them are taken into account.

In our case, all indicators are continuous variables with different scale ranges. We first normalized all indicators and then applied a variation of principal component analysis. To analyze and compare four groups of countries on different economic levels we chose DMFA. DMFA considers that our data table containing 130 countries in the rows and 10 indicators in the columns is partitioned row-wise because we have four groups of countries. A regular principal component analysis would analyze the entire data table. A comparison of the four groups would then only be possible afterwards and miss the fact that the correlations between the indicators are not necessarily the same in each of the four groups (Lê et al., 2007). Since it is exactly our purpose to identify these differences, we instead perform DMFA which standardizes the data by group: all variables are standardized according to their respective group means. This procedure facilitates the study of correlations induced by each group (Lê and Pagès 2010). In

Table 1

'Overdeveloped' countries (more than 50 k \$ GDP per capita per year in 2012).

Qatar	131,757.56	United Arab Emirates	58,041.88
Kuwait	85,659.55	Saudi Arabia	53,780.42
Singapore	78,744.13	Switzerland	53,705.28
Norway	65,461.17	United States	53,142.89

addition, DMFA provides the familiar parameters of other data reduction techniques such as Eigenvalues, factor loadings (correlations) and factor scores. These are presented and discussed in the next section.

4. Results

4.1. Univariate description

For most prosperity indicators there is a clear trend associated with the level of economic development: first, the ecological impact rises rather dramatically from one level of economic development to the next (Table 2). While poor countries emit on average just 0.2 tons of CO₂ per capita and year, this amount ascends to 1.7 tons in developing countries, reaches 4.4 tons in emerging economies and more than doubles to 9.8 tons in rich countries. Hence, there is no economic development level beyond the poorest that is at the same time environmentally sustainable.

There are only eight overdeveloped countries in our sample. Means should therefore be interpreted with caution and considered as estimations rather than as exact values. Nevertheless it is noteworthy that people in these eight countries emit the extreme amount of about 18 tons CO₂ every year. Even if a 'decarbonized' economy were to arise in the future, the consideration of ecological footprints reveals that the problem of increasing resource throughput would still need to be addressed as economic activity accelerates. However, the use of resources such as land and sea area, minerals, ore, lumber, fish etc. is at all levels of economic development a threat to ecosystems' resilience, that is regardless of the type of energy production; the greater the extent of economic development the more resources are used to satisfy production and consumption patterns and the greater the environmental damages.

The social inclusion indicators display a similar picture: there is a continuous increase of political freedoms and democratic structures from the economically least developed countries to the rich countries, while this is reversed in the overdeveloped countries. From these eight countries only Norway, Switzerland and the United States are democratic states in the sense that they are providing extensive political and civil rights for their citizens. The same can be observed in relation to income equality. While countries become increasingly equal from one development level to the next, income inequality as measured by the Gini Index is again higher among the overdeveloped countries than in the rich countries. The overdeveloped countries only perform best in terms of security as their world-wide lowest homicide rates indicate. Interestingly, the greatest insecurity does not prevail in poor but in developing countries. Here, conflicts and criminality may be caused by the combination of beginning ecological degradation (Barnett, 2003) and rapid economic change which is often

accompanied by anomie when traditional rules of conduct and social ties are dissolved and new institutional forms of 'solidarity' are not yet established (Durkheim, 1997; Haller and Hadler, 2006; Fritz, 2013).

The indicators for the objective (literacy and life expectancy) and subjective (wellbeing) quality of life show the same pattern of a steady increase and peak at the economic development level of the rich countries. While overdeveloped countries have a slightly lower objective quality of life than rich countries, their well-being is nevertheless higher. Thus we find a clear relation between income and wellbeing in a cross-country perspective. Just as in the case of ecological damages the level of individually perceived wellbeing increases with the material standard of living. The fact that the original Easterlin study could not identify such a pattern is mainly due to the small number of countries for which data were available at that time (Easterlin, 1974). Our results rather confirm more recent studies that came to the conclusion that 'increasing the income of all does increase the happiness of all' (Hagerty and Veenhoven, 2003; see also Diener et al., 2003).

Overall, the comparison of prosperity indicators between the groups of countries demonstrates that economic development enhances social inclusion and the individual quality of life, but at the expense of increasing ecological damages. However, the somewhat self-evident conclusion that, from an environmental perspective, all indicators are related in the worst possible way is merely based on the information provided by univariate descriptions. In the next section we engage in multivariate analyses to fully understand the relationships between all indicators and in relation to economic development.

4.2. Relations between prosperity indicators

In this section we examine the relations between the ten prosperity indicators. We ask whether the data confirm our initial theoretical concept of three dimensions of prosperity and whether their interrelations are similar among the four groups of countries representing the four levels of economic development. For that purpose we use DMFA which allows for an investigation of global prosperity patterns based on 130 countries (due to the small number of cases the overdeveloped countries are excluded from this analysis) as well as separate analyses of each group of countries taking into account that they are nested in the total sample. The most common statistical criterion for deciding on the number of relevant dimensions resulting from a data reduction technique is the Eigenvalue: it specifies how much of the information contained in the indicators is reflected in the resulting dimensions. While all indicators initially have an Eigenvalue of 1, the resulting dimensions have Eigenvalues greater or smaller than 1. An Eigenvalue greater than 1 indicates that this dimension contains more information than one indicator. In this case the data

Table 2
Mean values on prosperity indicators by economic development.

Material living standard—level of economic development	Ecological Sustainability			Social Inclusion				Quality of Life		
	CO ₂ emissions in tons per capita	Ecological footprint of production in global ha per capita	Ecological footprint of consumption in global ha per capita	Gini index for income inequality	Homicide rates per 100,000 persons	Democracy index	Freedom house index	Life expectancy	Literacy rates	Subjective wellbeing
Poor (n = 32)	0.2	1.2	1.3	41.1	8.3	4.0	2.5	58.9	58.3	4.2
Developing (n = 33)	1.7	1.8	1.8	41.6	13.2	5.1	3.1	68.6	84.8	5.1
Emerging (n = 33)	4.4	2.6	2.8	42.0	9.8	5.4	3.3	73.0	92.6	5.4
Rich (n = 32)	9.8	5.6	5.3	32.2	2.8	7.8	5.5	79.0	98.8	6.5
Overdeveloped (n = 8)	18.2	6.7	7.1	37.2	1.4	5.5	3.2	78.8	95.5	7.0

Table 3

The four dimensions of prosperity: Eigenvalues for a DMFA on ten prosperity indicators and 130 countries (an Eigenvalue greater than 1 indicates a meaningful dimension).

	Eigenvalue	Percentage of variance	Cumulative percentage of variance
Dim. 1	2.68	26.80	26.80
Dim. 2	1.71	17.06	43.86
Dim. 3	1.56	15.64	59.50
Dim. 4	1.21	12.07	71.58
Dim. 5	0.85	8.46	80.03
Dim. 6	0.71	7.11	87.14
Dim. 7	0.45	4.52	91.66
Dim. 8	0.42	4.23	95.89
Dim. 9	0.27	2.72	98.61
Dim. 10	0.14	1.39	100.00

reduction was 'successful' in the sense that the information of two or more indicators is now compressed in one dimension. Consequently, dimensions with Eigenvalues smaller than 1 are not regarded as substantial. The sum of all Eigenvalues equals the number of indicators in the analysis, in our case ten. Last but not least, the ratio of a single Eigenvalue of a dimension to the sum of Eigenvalues is precisely what from other techniques is known as explained variance. In Table 3, for example, the first dimension of prosperity has an Eigenvalue of 2.68. Since the sum of Eigenvalues is 10 this results in an explained variance of 26.8 percent for that dimension.

The Eigenvalues and dimensions produced by DMFA do not fully match our theoretical model of three dimensions of prosperity (ecological sustainability, social inclusion and quality of life). Instead, the analysis yields four dimensions of prosperity that together account for about 72 percent of the total variance (Table 3).

A detailed picture of the interrelationships emerges when the explained variances and correlations of all variables with these four substantial dimensions are calculated (Table 4). Correlations that are greater than 0.2 or smaller than -0.2 are statistically significant with $p < 0.01$. When we conducted the analysis, the software package, which we used to perform the DMFA analysis, the package *factominer* in R, could not directly calculate p -values in a DMFA. However, tests with the same data using regular principal component analysis demonstrated that correlations greater/smaller than $0.2/-0.2$ were highly significant. In the case of the four country clusters, which are discussed in the next section, correlations become highly significant only beyond 0.4 and -0.4 because of the lower number of observations. Hence, the following interpretation of results is based on the most robust and explicit findings, so that the interrelations depicted here are in all likelihood—with more than 99 percent probability—no statistical artifact but do exist in reality.

The first dimension of prosperity is 'political', since the indicators 'democracy' and 'freedom' explain about 20 percent of the variance each. Both variables of political participation correlate positively with the first dimension pointing to the mutual

relationship between the two concepts. In addition, the first dimension is constituted by 'clean consumption' with about 15 percent of explained variance, but here we find a negative correlation (-0.64). Political freedoms are associated with unsustainable consumption patterns and, to a lesser degree, with ecologically harmful production (corr. of -0.55). The quality of life indicators contribute less to this first dimension but correlate moderately positive with it. Hence, this first dimension reflects the mechanisms sometimes referred to as 'modernization', because improvements in the quality of life are accompanied by a liberalization of values and political regimes (Inglehart and Welzel, 2005).

The second dimension is characterized by a very strong connection of the two social cohesion indicators equality and security that together account for over 80 percent of the variance. Consequently, we call this dimension 'social cohesion'. Greater income equality is associated with higher security. This relationship is largely independent from all other indicators including ecological sustainability and political freedom. There is also a positive correlation between 'social cohesion' (including 'security' as measured by low homicide rates) and life expectancy.

The third dimension of prosperity mainly depicts the relationship between the ecological indicators 'climate friendliness' and 'clean production'. Both correlate positively and account for about half of the variance. Likewise positively related to this dimension are the two political participation indicators. This is an interesting finding since it appears to contradict the pattern found for the 'modernization' dimension: while political freedoms tend to be accompanied with ecological unsustainability across the globe, in particular concerning consumption, there is also a configuration in the data where ecological sustainability and political freedoms are combined. The findings for the fourth dimension, which is mainly constituted by the interrelation of all quality of life indicators, follow a similar pattern: clean production and consumption also contribute to this dimension and correlate positively with the quality of life indicators.

However, as the lower overall statistical power of the third (15.6 percent explained variance) and fourth dimension

Table 4

Contributions of the indicators to the dimensions (explained variances) and factor loadings (correlations) from a DMFA on the ten prosperity indicators.

	Contributions/explained variance (in %)				Factor loadings (correlations)			
	Dim. 1	Dim. 2	Dim. 3	Dim. 4	Dim. 1	Dim. 2	Dim. 3	Dim. 4
Climate friendliness	0.51	0.01	28.10	3.83	-0.12	-0.01	0.66	-0.22
Clean production	11.33	0.85	20.64	13.44	-0.55	0.12	0.57	0.40
Clean consumption	15.39	1.34	12.85	12.24	-0.64	-0.15	0.45	0.38
Equality	0.25	42.68	0.31	0.28	0.08	0.85	-0.07	0.06
Security	0.55	38.24	3.34	4.54	0.12	0.81	0.23	-0.23
Democracy	22.52	2.74	12.58	1.33	0.78	-0.22	0.44	-0.13
Freedom	19.34	1.70	13.02	5.71	0.72	-0.17	0.45	-0.26
Life expectancy	11.89	7.78	2.97	20.91	0.56	0.36	0.22	0.50
Literacy	7.69	0.25	6.17	16.90	0.45	0.06	-0.31	0.45
Well-being	10.52	4.41	0.01	20.83	0.53	-0.27	0.01	0.50

(12.1 percent explained variance) indicates, this applies to a limited number of countries only. These countries feature low levels of economic development (thus have lower environmental impacts) but have established relatively huge extents of democratic governance (e.g. Costa Rica, Panama in Latin America, Benin and Ghana in Africa and, maybe most importantly given its size and significance in the world economy, India). Together, these dimensions represent a pattern similar to that highlighted in ‘good life beyond growth’ concepts, although, for some of these countries, it may be more appropriate to talk about prosperity ‘before’ rather than ‘beyond’ growth.

In summary, our results suggest that the main pattern of global prosperity consists of the link between social and individual welfare, on the one hand, and ecological damages or ecological ‘unsustainability’, on the other. However, these results also demonstrate that other combinations and patterns are, in principle, possible. In the final step of our analysis we explore whether this pattern is the same for all four groups of economic development or whether there are differences between them. Thus, we now turn to the part of the DMFA that analyses the four groups of countries separately.

4.3. Different patterns of prosperity at different levels of economic development

Fig. 1 visualizes the DMFA results for the four levels of development and groups of countries and indicates that there are both substantially different but also similar relations between our prosperity indicators. There are two main common patterns for all levels of economic development: first, independent from all other prosperity indicators, social cohesion as the second dimension of prosperity is always constituted by a strong link between equality and security. This finding indicates that social cohesion can be established in various contexts: in relatively free and democratic societies but also under authoritarian rule (e.g. in the former ‘real-existing’ socialist countries of Eastern Europe), as well as in ecologically sustainable or unsustainable ways. As a corollary, a plus in social cohesion can be achieved in likewise different ecological, social and political contexts.

Second, the main prosperity dimension ‘modernization’ largely consists of the variables for political freedom plus those for the quality of life. However, there are two interesting exceptions:

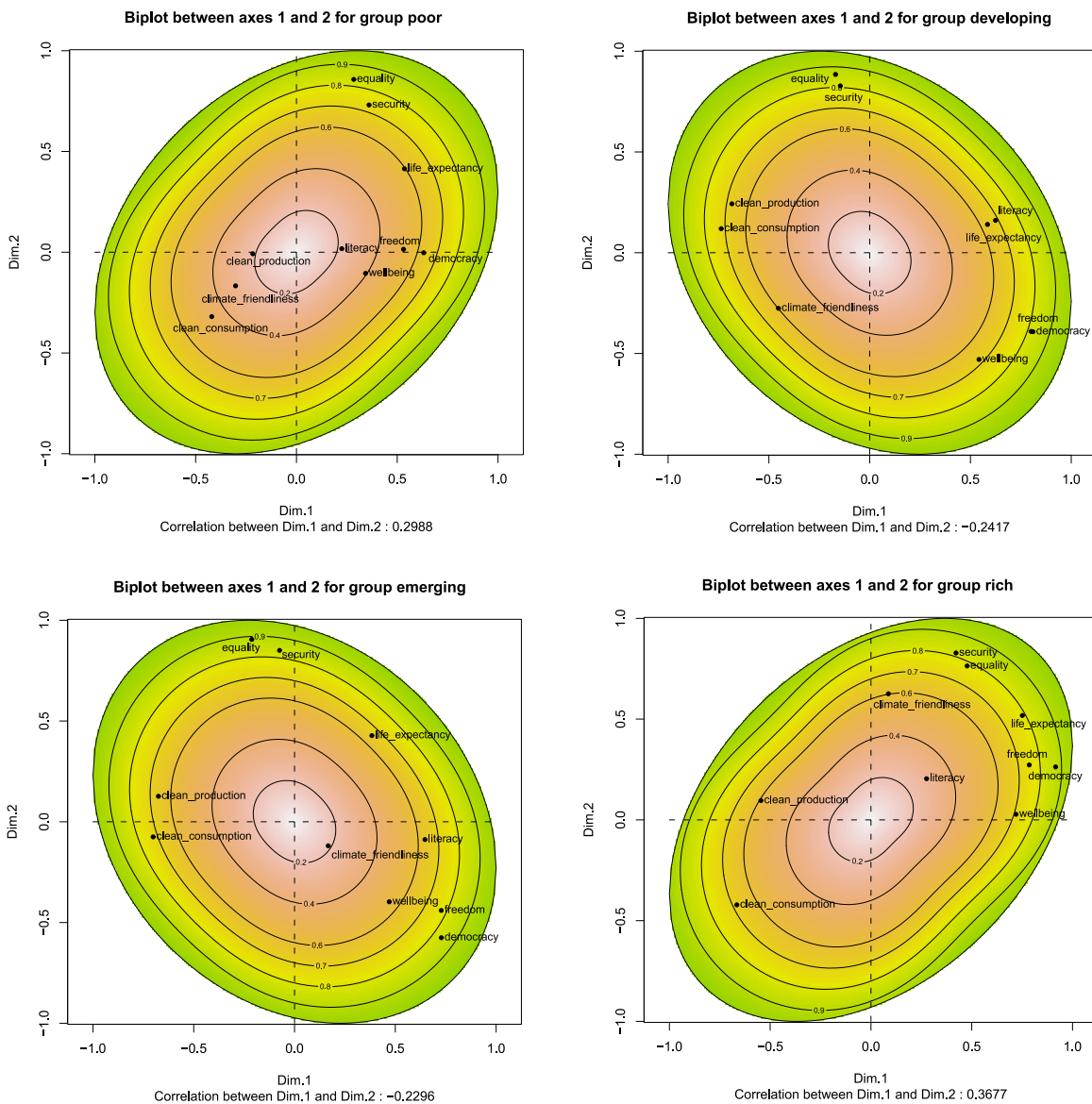


Fig. 1. Correlations of prosperity indicators for the four groups of countries representing four levels of economic development.

literacy rates play a relatively unimportant role both in poor and in rich countries. This is due to the fact that there is lower variation of this indicator in poor and rich than in developing and emerging countries. In poor countries, literacy rates mostly feature rather low values and in rich countries relatively high ones, whereas in the two other groups we find countries of all levels of education as measured by literacy. In addition, subjective wellbeing is less connected to 'modernization' in poor countries than in the other countries. In the countries with the lowest material living standards wellbeing is generally, that is independently from other factors, very low.

It is of particular interest to trace the positional changes of the three indicators for ecological sustainability over the different levels of economic development: in the case of the *poor* countries, these are located closest to the center of the map, especially the variable clean production. This indicates a weak correlation with both the 'modernization' and 'social cohesion' dimension; only in relation to clean consumption a moderate correlation with both dimensions exists. The conclusion is that in poor countries the existence of political freedoms and the level of the quality of life are less linked to environmental impacts than in countries with a higher material living standard.

In *developing* countries we find a strong negative correlation between ecological sustainability, on the one hand, and political freedom and the quality of life, on the other. Hence, in these countries a rise in social and individual welfare is often accompanied by ecological damage. However, this combination applies more for the ecological footprints of production and consumption than for carbon emissions. The same pattern characterizes the group of *emerging economies*, yet with a much clearer separation of production and consumption from 'climate friendliness'. In this cluster the latter actually weakly correlates with the modernization dimension. Already at this level of economic development it is not only possible to relatively decouple CO₂ emissions from prosperity it is actually the case in some countries. Not surprisingly, these are mostly the same countries that also contributed to the constitution of the 'good life' dimensions of prosperity (e.g. Costa Rica, Panama and Colombia).

In the *rich* countries the positions of ecological indicators are further apart than in the poorer countries. While 'climate friendliness' is again moderately positively associated with the modernization dimension, it is now also strongly positively related to 'social cohesion', the second dimension. Among the rich countries, the more equal and secure countries tend to emit less CO₂ than the more unequal and insecure ones. Yet the establishment of truly 'clean' production processes remains an unrealistic perspective, since the link between clean production and other prosperity indicators is negative. Moreover, the position of 'clean consumption' lies at the negative pole of social cohesion. Citizens of countries with relative high income equality tend to consume more and in more unsustainable ways than those of countries with lower levels of equality. The dialectic of the welfare state, which is a core institutional feature of these countries, appears to lie in the fact that the same mechanisms that ensure a minimum of income equality and social cohesion also allow that a huge percentage of the population lead environmentally harmful lifestyles (Koch and Fritz, 2014).

Finally, our analysis yields the somewhat surprising result that prosperity patterns are similar in poor and rich countries, on the one hand, and in developing and emerging countries, on the other: regarding the former two groups, social cohesion, welfare and individual wellbeing indicators (political freedoms and quality of life) are positively related. By contrast, in the two latter groups (developing and emerging countries) the political freedom and social cohesion indicators have a moderately negative correlation. Hence, there is a sizeable amount of rather

authoritarian countries that provide few political rights in combination with a significant extent of equality, where the latter may emanate from top-down conformity pressure rather than from bottom-up solidarity.

5. Conclusion

Taking a global perspective we theoretically and empirically studied prosperity patterns at different levels of economic development. We conceptualized 'prosperity' in terms of ecological sustainability, social inclusion, and the quality of life and measured these dimensions on the basis of data from sources such as the World Bank, the Global Footprint Network and the OECD and by applying DMFA. Building on earlier research that suggested that higher development levels in terms of GDP per capita are capable of providing social and individual prosperity but at the expense of environmental sustainability, our research question were whether a certain level of economic development can be empirically identified, which is environmentally sustainable, and whether interrelations between prosperity indicators vary with different levels of economic development.

The univariate description of the data indicated a clear trend toward rising ecological impacts from one level of economic development to the next. In fact, there is no economic development level beyond the poorest that would at the same time be environmentally sustainable. While ecological sustainability indicators worsen with economic development, social and individual prosperity indicators largely increase.

Our DMFA revealed further significant similarities and differences in prosperity patterns across the four country groups of economic development. *First*, the originally proposed 'social inclusion' dimension turned out to be empirically subdivided into the two different dimensions of political freedom and social cohesion. The fact that the latter is independent from all other prosperity indicators means that 'social cohesion' can be established under different socio-economic, ecological and more or less democratic conditions. This also indicates that the degrowth-research community's claim that a transition toward a sustainable economy and society would need to come with a plus in democracy and equality is, in principle, achievable.

Second, in 'poor' and 'rich' countries the modernization dimension and the social cohesion dimension are positively related, that is, individual quality of life is associated with equality and security. However, in 'developing countries' and 'emerging economies' this relationship is negative. The fact that in these countries homicide rates and inequality increase in parallel with the level of modernization may from a Durkheimian perspective be explained by pointing to the rapid speed of socio-economic change accompanied by the temporary absence of moral and institutional regulation as a result of which anomie increases.

Third, rich countries succeed to some extent in achieving a relative decoupling of CO₂ emissions from social and individual welfare. However, there is as yet no evidence for an absolute decoupling of these parameters which would be necessary to meet IPCC targets.

Fourth, the establishment of environmentally sustainable production processes is an even greater challenge than that of climate change, because a surplus in our three dimensions of prosperity is at all levels of economic development accompanied by an increase in the ecological footprint of production. While this relation is least strong in the poorest group of countries, it is identifiable already at the level of 'developing countries' and remains stable in 'emerging economies' and 'rich countries'.

Fifth and finally, unsustainable consumption is mainly a problem for the rich countries, where all other prosperity indicators correlate negatively with 'clean consumption'.

In the event an introduction of a global SSE was politically decided, our empirical results have repercussions for the trajectories that countries at different levels of economic development would need to undertake in order to achieve a surplus in prosperity in all three dimensions. Aiming at the provision of a maximum of prosperity within ecological limits, the policy challenge for the 'poor' countries of our sample would be to enhance the quality of life and social inclusion while maintaining low ecological footprints and carbon emissions; 'developing' and 'emerging' countries would face the double challenge of combining individual wellbeing with social welfare, while preserving relatively low ecological footprints and carbon emissions; 'rich' and especially the 'over-developed' countries would need to consume differently so that lesser amounts of material resources and fossil energy are used and to make production processes more environmentally sustainable. Both transitions would include issues of redistribution of wealth, labor, time and natural resources. Future in-depth studies of the four country groups could help identify best practices in the provision of prosperity so that other countries at similar development levels could engage in institutional learning processes. Finally, the consideration of country-specific data of different points in time would allow for an analysis of the structural changes of the relationships between economic, ecological and social conditions of prosperity within countries.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.gloenvcha.2016.02.007>.

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