Mitigating the Davos dilemma: towards a global self-sustainability index

Abstract

The' Davos dilemma' posits a sustainability crisis, provoked by rising human population and intense competitive behaviours, in terms of control and access to depleting natural resources. More broadly understood as an ecological problem, rather than just socio-economic behavioural deficiencies, it calls for better integrated social, natural and business indexed reporting within planetary boundaries. This poses challenges for nationally governed societies to equitably account for self-sustainability performance and their successive government agendas to re-orientate policies and industry investments as innovation towards achieving this in the longer term. We propose and test a Global self-sustainability index for countries across four metrics: economic, environmental, social and innovation. Our tentative findings from a cross-country analysis of twenty-seven countries during 2007-2010 illustrates the approach for wider systematic analysis and as a basis for future large-scale assessments on self-sustainability within and between countries.

Keywords: Davos dilemma; Economic-; Environmental-; Social; Innovation; Global self-sustainability index

Introduction

Sustainable development has been understood as a variety of concepts and indicators that have matured over time (Ciegis et al., 2015; Lopez et al., 2007; Tiwari and Ibrahim, 2012; Joshi et al., 2015, Frugoli et al., 2015). Particularly critical to wide impact is the shared meaning between global and national levels, which underpins much of the collaborative efforts in policy and business decision-making. However, the assessment of sustainability through globally applicable and nationally accountable composite indices (e.g. Skouloudis et. al., 2016; Wilson and Wu, 2016; Wilson and Jianguo, 2016; Shaker and Zubalsky, 2015; Jain and Jain, 2014; Kaivo-oja et al., 2014; Fredericks, 2012; Skouloudis and Evangelinos, 2012) indicates the need for further aggregated approaches. We aim to contribute to this gap by proposing a global self-sustainability index for countries.

The rest of the paper is structured as follows. The next section outlines the rationale for the study, the challenges the Davos dilemma posits as well as prior literature on macro-level sustainability perspectives. The material and methods followed by the study's findings are then presented, before a discussion and concluding remarks on implications emerging from our analysis.

Background

Rationale

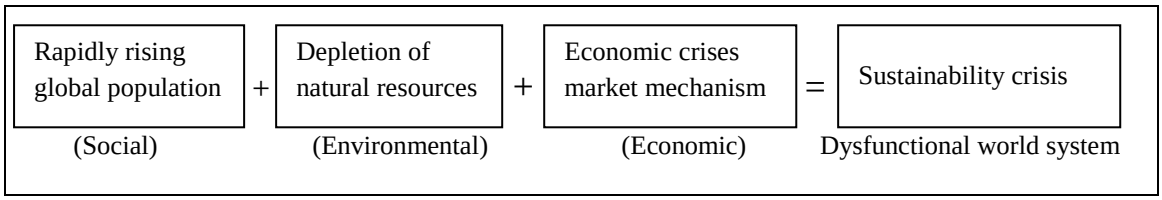
Every year, some 2,500 elite political and business leaders, as members of World Economic Forum[1] (WEF) are invited to Davos, in Switzerland to discuss global affairs. However, the research presented to WEF indicates a widening of the trust gap between businesses and governments (Edelman Trust Barometer, 2014) as well as their respective approaches to sustainability. In this respect, within the most advanced societies, citizen political engagement has deteriorated (Political Info, 2014) which in turn narrows the quality and power of leading governments to influence the 'business priority agenda' of sustainability giving room to an increasing economic gap between the rich and the poor (Scott, 2001; Wall, Burger and Knapp, 2011).

Globally, this economic interpretation of sustainability is transitioning from the G-7 to the highly populated consumer markets such as China[2] and India[3]. Many scholars simply assert the main cause to be that of high world population (Dávila, 2016). However, with a majority of people now living in expanding urbanised cities (Buijs et al., 2010), it is more likely protectionist government policies and competitive consumerism that is exasperating sustainability into a crisis. This has forced the pace of non-renewable resource depletion in some less-developed countries to an alarming rate (Schilling and Chiang, 2011).

The Davos dilemma

The Davos dilemma reflects a scenario whereby the sustainability crisis culminates in a situation where continued and rapidly increasing global population, depleting natural resources or irresponsible market mechanisms will ultimately result in a global collapse:

Figure 1: Davos dilemma



[1] Member based organisation.

[2] Chinese govt. has $4Tn cash (2014) and China has the largest number of millionaires / billionaires globally

[3] Gap between rich (urban) and poor (rural) has increased in 2013 http://www.business-standard.com/article/economy-policy/rich-poor-gap-widens-in-india-113081000072_1.html

Our paper takes a bio-diversified perspective (Hugentobler and Gysi, 2002) where the integrated socio-ecological system (Carpenter et al., 2012) must be corrected or will have to endure a major shock with irreversible consequences. This prognosis is underpinned by major events that took place over the last century which indicate that tensions have arisen between population, natural resources and market mechanisms. Whether in the form of conflicts (Scaruffi, 2009, Leitenberg, 2006), governance crises (Knyght et al., 2011; Patomaki, 2007), natural disasters (McDermott, 2012; Guo, 2010), corporate failures (Herath and Freeman, 2012) or health pandemics (Brown et al., 2005), they all nowadays pose more intense and far-reaching threats on social wellbeing, economic stability and environmental quality which ultimately forms enabling conditions for sustainable development.

Research question

- *How to develop a comprehensive and equitable aggregate global sustainability index that addresses the Davos dilemma?*

Literature review

The 20th century is often characterised by unprecedented industrial growth and individual prosperity (Jackson, 2009; Kotkin 2005). Yet, at the same time, global material consumption has witnessed eight-fold increase up to more than 60 billion tonnes (Gt) per year (Krausmann et al., 2009). This disproportionate usage is stressed by Peters (2011) who notes that the USA consumed more oil per day in 2006 than Germany, China, Japan and Russia combined, of which 60% was imported from the Middle East. In this respect, according to the International Energy Agency (IEA) known oil and gas reserves will fall by 2030. Regardless of immediate economic benefit, half of the projected global GDP for 2050 ($63Tn) is at risk due to flooding, droughts and other environmental shocks as well as food security and indirect conflicts (Caldecott and McDaniels, 2014). It is apparent that these natural resource trajectories are unsustainable (Diamond, 2005).

Technological interconnectedness has facilitated development and control through the expanding economic impacts (Nelson, 2013, Castells, 2012) of local boom and bust cycles from within advanced markets (Shularick and Taylor, 2009; Shleifer and Vishney, 2010, Knyght et al. 2011). Within these markets, societal conflicts and

protests such as the London Riots in 2011, the Occupy Wall Street movement, the Tea Party movement (Williams, 2011; Roosevelt, 2013) have favoured a wave of conservative nationalistic political agendas[4]. Scholarly criticism asserts that such socio-economic patterns are not new (Lane, 2003; Clarke, 2009). This form of 'globalisation' has benefitted greatly the conformance and convergence towards a singular powerful Capitalist model of governance; the Anglo-American (Hall and Soskice, 2001). Yet, the discontinuous nature of this form of capitalism if left alone is ultimately self-destructive, where events such as the financial crisis in 2008 or political conflicts (e.g. Syria, 2016; Ukraine, 2014; Arab Spring, 2011; Iraq war, 2003) become more powerful and undermine global sustainability.

Following the trigger of 2008 financial crisis, the governments of leading economic countries were attempting to integrate fiscal measures to grapple with rising debts (European Union, 2012), meanwhile transition was that the largest corporations were growing to record levels[5] (Ro, 2014). Since 2010, out of the top 150 global economies, 60% are Transnational Corporations rather than Governments (Keys, Malnight and Stoklund, 2013). For instance, Wal-Mart ranks in 28th positions in the world in GDP, in behind of Norway and ahead of Austria (Fortune, 2015), while Apple had amassed net cash of $130bn and reached market capitalisation of $500bn (Bradshaw, 2014), indicating that control is in the hands of a few (Vitali et al., 2011) and a systemic imbalance between firm, state and society at the bottom line exists (Anderson and Cavangh, 2000).

It is clear that the guiding principles of creative destruction – i.e. innovation (Schumpeter, 1934) - seem to have misplaced the essence of preserving quality and protecting society as the foundations for sustainable development (McKibben, 2007; Sandoz, 1964,). Self-serving global agendas and narrow competitive behaviours are driving misunderstanding. It seems that the notion of self-sustainability understood by Aristotle (384 B.C-322.B.C.) as the households needing to be self-sustainable rather than consumption orientated has been forgotten (Ehnert, 2009).

The knowledge enabling the prudent use of natural resources of our planet to support

[4] Brexit in UK and Donald Trump's win in the 2016 U.S. election.
[5] Top 5 U.S. Corporations have $400bn cash (2014).

economic growth has existed for many years (Veblen 1899; Carson, 1962; Smith 1999). Those in control, claim top-down reform efforts through the World Commission on Environment and Development (1987); 1992-2012 Rio Earth summits culminating in Agenda 21 (Dyllick and Hockerts, 2002). In reality, it is within the social communities of the least developed nations where sustainability for survival is genuinely being practised. Crucially, the wide acceptance of Global Sustainability as equally including economic development, environmental conservation and social equity (Keating, 1993; Division of Sustainable Development, 2012) is not being constructively disseminated to the lower institutional levels (i.e. regional, national or organisational) or supporting the empowerment of bottom-up approaches.

We assert that Innovation can facilitate the restoration of the balance between institutional arrangements and a more holistic understanding of sustainability. Sustainable Innovation for the societal benefit should drive the consumption of income[6] rather than capital accumulation (Ayuso, Angel and Enric Ricart, 1996). Hence, there is a need for more comprehensive sustainability measures that embed innovation into triple-bottom-line and contribute to engaging capital rather than accumulating it - these long-standing accounting principles require better understanding (People, Planet, Profits) (Elkington, 1997).

Given this, a broader solution is needed where the wider benefits need not always be strictly expressed in economic terms (Nidumolu et al. 2009). Hajer (2011) identifies that the solution is premised on society actively reinventing itself by understanding the present for future needs and consequently new markets will form[7]. In practice, this has so far only narrowly translated into increased business competition over increasingly scarce resources (UNEP, 2011). In turn, the spotlight is on the role and function of State (National Government) in better governing for-profit entities towards a fairer distribution of production/consumption needs and given long-term development. Fundamental to this remains the appreciation that innovation needs to preserve quality and protect society (Sandos, 1964).

[6] ICPD Beyond 2014 Review,https://www.unfpa.org/public/home/sitemap/ICPDReport.
[7] The car industry did not exist before the car was invented; it was a problem needing a solution at that time.

Societal challenges

In addressing the Davos dilemma, much of the multiple initiatives across population, resources and market mechanisms towards sustainability remain narrowly focused and conflicted, with projections of a sustainability crisis emerging.

For example, in response to the expected boom in world population, reaching nine billion people by 2050 (United Nations, 2012) the Gates Foundation raised $4.6bn in support of a population control agenda at its London Summit (Guardian, 2012). Critics of this agenda argue that it specifically targets women in less developed countries and further violates the ethics of major religions of the world (Reuters, 2012; Pope Francis, 2013). At the same time, citing examples of China's one-child policy (Weisman, 2007) some scholars such as Sachs (2006: 42) argue that "reducing fertility in the poorest countries of the world would be amongst the smartest investments that rich countries can make for their own wellbeing". In contrast, efforts to save humanity continue. The Integrated Maternal, Newborn Child Health (IMNCH) strategy of Nigeria sought to save 200,000 women and six million children by 2015 through intervention in newborn and maternal deaths in line with Millennium Goals 4 and 5 (PM News, 2011). These efforts seem to serve controlling purpose of the advanced and some niche economies.

Natural Resources

Despite modern farming tools and techniques enabling better registered use of land-40% is being used for agriculture, the future is still not bright as it is forecasted that by 2030 700million people will suffer from hunger (Fischer, 2009). Bogardi et al., (2012) assert that one billion people do not have access to safe drinking water and two billion lack basic sanitation needs. The effect of an immediate inaction will result in greater loss of basic necessities in parts of the world (Westhoek et al., 2010). At the same time that scientists alert us to rising sea levels and melting of the Arctic (The economist, 2012) which is tentatively linked to increased Green House Gas (GHG) emissions due to anthropogenic activity, Rare Earth Metals (REM)[8] are becoming a critical strategic resource (The diplomat, 2013). With the world's increasing

[8]Rare earth metals (REMs) are vital for the production of all high tech products that range from simple electronics, mobile phones, and computers to military weapons markets.

dependency on REMs, China monopolises over 50% of the total reserves and produces 97.4% of the world rare earths. However, these factors are perceived as a threat to business strategies rather than as a call for societal market mechanisms as innovation (Kolk et al., 2008).

Market mechanisms

The ever fiercely contested dominant competitive behaviour of firms seeking purely economic gain, is most acutely evident in unregulated, hyper-competitive and chaotic market environments (Cambridge Symposium on Economic Crime, 2016). While Freidman (2008: 412) recognises that "it is not about the whales anymore, it's about us", a deeper understanding questions the purpose of the firm in giving value to its stakeholders (Freeman, 2012). The elite policy makers and CEOs have increasingly become more aware of the geopolitical competition for resources. Thus, western countries are more than ever before intervening to restore peace and adopt democracy' amongst countries that suddenly have extremist groups in the name of religion, but also happen to be rich in natural resources servicing economic needs of interveners, e.g. Iraq 2003-2014, Libya in 2012 and Algeria in 2013.

There is uneven distribution of source and usage of world resources: 66% of the world's natural resource is concentrated within the developing nations (World Bank, 2011). Europe may have the most globally advanced implementation of sustainability, but in the context of the two hundred plus nations of the world, many of the 43 Least Developed Countries (LDCs) have not and are unable to as yet, engage with international sustainability (Meadowcroft, 2007). Other countries such as Germany are engaging in collaborative urban programmes with nations like Bangladesh (Rooney et al., 2012).

Collaborative diversity

Critical to transformation is a need for highly, medium and low development countries (Nielsen, 2011) to engage more collaboratively with each other for sustained advantage (Hajer, 2011) while respecting the diversity, cultural rights and values within governance frameworks of individual nations (Nidumolu et al., 2009). A holistic and integrated definition of sustainable development coupled with

effective, implementable measures is of paramount importance to mitigate the effects of Davos dilemma.

Global sustainability frameworks

Twenty five years ago, the collective concerns of sustainability brought 178 nations together at the Rio 1992 Earth summit, where agreements on climate change and Agenda 21 were signed by attending nations. Over the last twenty years, progress on *Agenda 21*[9] has guided sustainability implementation within divergently governed economies. However, the success varies across countries as reporting remains voluntary and national indicators are only used by some of the member nations (United Nations, 2012). Hence, the call for National indicator profiles by the United Nations remains open (Agenda 21, Chapter 40).

Switzerland and China have adopted frameworks at a national level while Germany and UK are actively engaged in local level endeavours. These government initiatives have been complemented by private sector firm level actions. The World Business Council for Sustainable Development (WBCSD) consisting of 200 CEOs from 35 countries came together to engage in dialogue with politicians (Schmidheiny, 1992). As such, the reporting[10] and practice of Corporate Governance (OECD) has evolved into triple bottom line sustainability (Elkington, 1997) or Corporate Social Responsibility reporting (Carroll, 2008).

Regardless of the increasing efforts by private corporations in the reporting of sustainability and the emergence of global (Bohringer and Jochem, 2007) and national comparative indices such as FTSE4Good, Dow Jones Sustainability Index, there is a widening agenda gap between private and government initiatives with respect to Agenda 21 (Abbott, 2011). Consequently, there appears to be drifting away by private firms from the Rio agreed standards of eco- or socio-efficiency (Dyllick and Hockerts, 2002) towards economic purpose (Freidman, 1962). Furthermore, as this emerges from risk management mitigation rather than innovation (Global Sustainability Institute, 2012) the vision of Corporate Sustainability remains unclear (Yilmas and Flouris, 2010).

[9] Agenda 21 is the UN Action Plan related to Sustainable Development and was the outcome of UN Conference held in Rio 1992.
[10] GRI Framework and ISO26000.

Indeed, Pronk (2011) who was present at the 1992 Rio conference and recalls the spirit of hope at the time, asserts that twenty years later the adoption of sustainability has been taken over by instability and insecurity. In this regard, Pronk (2011) reflects and calls for a more integrated view of the sustainability agenda.

Sustainability concept and measures

Sustainability is perceived as a positive ethical ideal (Dossa et al. 2012). However, collaborative engagement of the concept is low, and the range of indices/metrics measuring progress is rising and disjointed. The Compendium of Sustainable Development Indicator Initiatives refers to 895 sustainability indicator studies of which 94 initiatives are global (IISD, 2013), an 80% rise since the start of this century (IISD, 2000). This has been driven by funded projects linked to global meeting such as the 1992 Rio Earth summit, reports such as the Stern Review on the Economics of Climate Change (Stern, 2006), and impacts of ecological disasters (Indian Ocean Tsunami 2005; Japan Tsunami (2011); Haiti earthquake (2010).

While early studies examined the concept of sustainability from a socio-economic perspective in the form of national wellbeing indicators, the research has moulded into the rise of socio-ecological environmental metrics (see Table 1). Most recently, the concept of sustainability is embracing innovation as a metric. In 2004 the Global Competitiveness Index included a 12th pillar on innovation. INSEAD, Cornell and WIPO have developed the global innovation index (2007-2013). With the global convergence towards transactional capitalism (Kakabadse, 2013), the concept of sustainability was disseminated to include prosperity in societies (Stiglitz, Sen, and Fitoussi, 2009), which induced the emergence of composite indices that include social, economic and environmental metrics.

The problem remains that these sustainability indices differ in measurement purpose (Parris and Kates, 2003) (Table 1) which indicates that there is still a lack of collaborative understanding and integrated measuring of our highlighted three-dimensions (Becker, 2012) underpinning the 'triple bottom line' (Elkington, 1997). Global institutions still lack realities and reliabilities of social datasets, particularly of the least developed nations. Indicators for policy makers remain simplified and non-

subjective (Scobie, 2014). There is a time-lag between national and international datasets. Marin (2014) asserts that dataset profiles can be interpreted differently. For instance, in the UK there are 2.5 times more people who are 'non-employed' rather than unemployed, which increases to five times in the US (Marin, 2014). Gender imbalances based on income are distorting the rights of elder women, and the risk of poverty for elderly is high[11]which are fast emerging paradoxes in Europe. Thus, the need for global comprehensive sustainability measure that captures the multifaceted purposes of sustainability remains a pressing issue(Parris and Kates, 2003).

Table 1- Summary of main sustainability indices

Socio-Economic Indices	•Index of Sustainable Economic Welfare (ISEW) (Cobb, 1989) •Well Being Index (WI) (Prescott-Allen, 2001) •Human Development Index (HDI) (UNDP, 2013)
Socio-Ecological Indices	•Ecological Footprint (EF) (Wackernagel and Rees, 1997) •Living Planet Index (LPI) • WWF (1998-2012) •Environmental Vulnerability Index (EVI) (SOPAC, 2005) •Environmental Sustainability Index (ESI) (Esty et al., 2005) •Environmental Performance Index (EPI) ((Esty, 2006- EPI 2006-2012)
Social-economic and ecological indices	•Better Life Index (OECD, 2007) •The Economist Intelligence Unit's quality of life index (2005) •International Living quality of life Index (2009) •National Commons Product (Dill, 2009)
Innovation Indices	•Global Competitiveness Index (2004) •Global innovation index (2007)

Source: compiled by authors

Sustainability, innovation and normative aspects

In addressing sustainability, responsible governance innovation is professed as a driving force of development for the coming decade (Hajer, 2011). In this respect, we raise two concerns. First, the real motivations and success factors are likely to be different within multi-level structures and for different stakeholder groups of capitalist societies (Freeman, 2007) - the impact of which is that currently success is not factored at each level and remains unclear (Dangelico and Pujari, 2010). Second, scholarly normative concerns of Social Responsibility (Barnard, 1938, Bowen, 1953) have only epistemologically translated into more widely promoted distinctive

[11]http://www.euro.centre.org/.

instrumental categorisations [12] (Carroll, 1979, Sethi, 1975) within a Freidman-preferred framework (1962), which is not practically feasible.

The 'true spirit' of sustainability is underpinned under social, economic and environmental factors which are valid equally and weighted accordingly (Elkington, 1997; Bondy and Starky, 2012). Consequently, despite that a normative dimension of innovation is being a present-day trend, the call remains for ontological indices/metrics which can be collaboratively and efficiently engaged across varieties of governance mechanisms. In this respect, Hajer (2011) denotes that governments must mobilise sustainable innovation within their boundaries, something that necessitates better political engagement and trust which is currently low (Edelman, Trust Barometer, 2014) resulting in unclear policies and low impact or conflicting strategies for sustainability.

Global Sustainable Development as Self Sufficiency

The current quantitative multiple metrics/indices (see Table 1) are in themselves expensive to retain as standalone individual components. It is more a case of lack of integration and actually resolving the challenges being faced, at the right pace that is needed. The qualitative mind argues for prioritising People and Society (Solomon, 1993; Kakabadse and Kakabadse, 2003) over profit - in responsible sustainable development. In this regard, we re-define Global Sustainable Development as: *humanity's responsibility towards the changing relationship with the natural and social world.* In order to address the current definitional deficiencies and integrate sustainability efforts there is an urgent need to incorporate:

a) **Continuity**: Sustainability as the continuously broad changing relationship between humans themselves today that further impacts on future generations and natural environment. Local as being part of a wider global relationship should retain social, environmental and economic factors that endorse continuity.

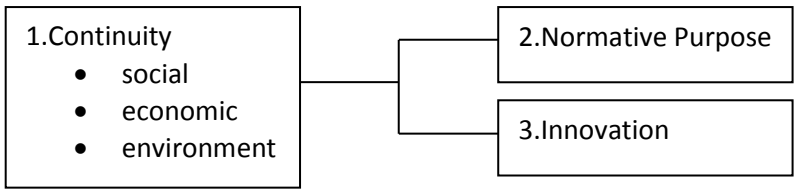
[12] Economic, legal, ethical and philanthropic.

b) **Innovation**: To mitigate the Davos Dilemma there is a need for innovation to return to origins of self-sufficiency within a national context. Major shift in political thinking of market mechanisms is essential.

c) **Normative understanding**: The current array of quantitative metrics/indices seem to have lost normative purpose in definition. Normative purpose derived from religious; cultural; or atheist reference points can establish better collective framing for collaborations between societies; and allow for diverse needs of societies.

In this regard, a comprehensive Global Sustainability Index (GSI) requires each nation to take responsibility and accountability of its tangible and intangible assets – with the overarching role of the government to oversee policy implementation towards achieving self-sustainability. Our future vision would then translate into co-evolving nations (Volberda and Lewin, 2003) being able to have trade-offs with other nations while the role of global institutions (UN) would be to facilitate the balance between countries.

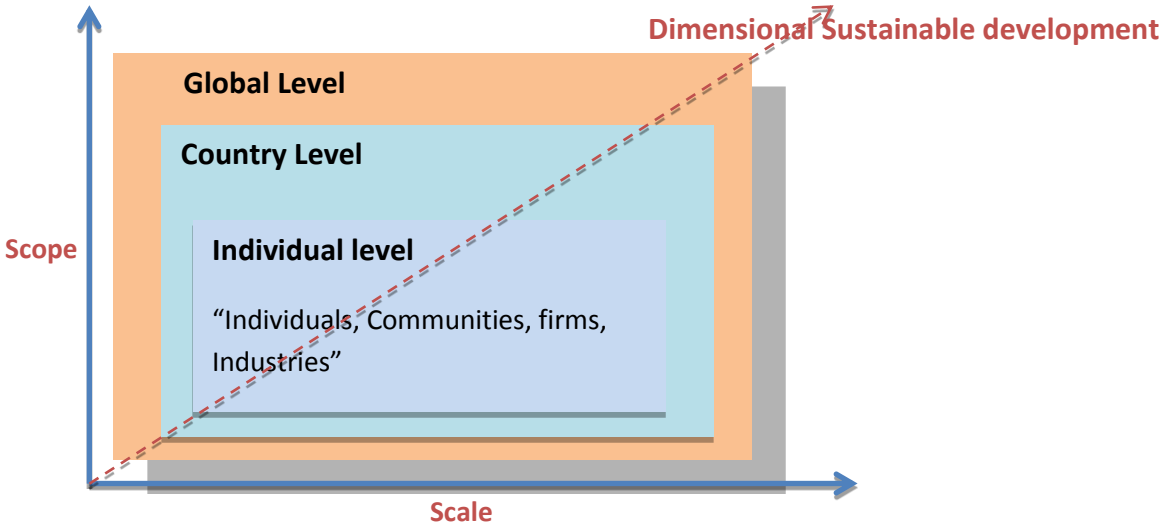
Framework 1 – Dimensions of Sustainability for Self Sufficiency



Source: compiled by authors

Under these conceptualizations, sustainable development can be identified as the continuity of patterns of change which occur over time between the three dimensions of sustainability (Framework 1). This reflects dynamics of shifting powers between the normative and innovation dimensions to suit the state of socio-economic or socio-ecological challenges which are in the unique position to rebalance the system. In this context, the Global Sustainable Development (Framework 2) is about the continuance of the sustainable development for the longer run and across all levels to restore Humanity's responsibility towards the changing relationship with the natural and social world. Thus, a pressing call remains for concepts to be derived ontologically to enable better strategic focus on shared responsibility and true accountability over the common good.

Framework 2: Global Sustainable Development



Source: compiled by the author

Towards a holistic measure of Global Sustainability

The indices/metrics of Table 1 have been developed to assess sustainability from different perspectives (socio-economic, socio-ecological or aspects of innovative capacity). However no single measure has attempted to integrate such aspects, and, in doing so to include all Social; Economic and Environmental attributes. While the Global Competitiveness Index - GCI (2012) also includes socio and ecological elements, its purpose serves national competitiveness dynamics - as opposed to self-sufficiency or integration - and it relies on datasets pertaining to GDP proxies, which do not reflect robust sustainability-related orientations. We adopt our broader definition to capture these attributes by recognising that current measures lack normative integrating qualities - taking into account data availability constraints. We avoid the measure of GDP, as the rationale of this measure does not fully reflect realities (Dill, 2009; Frugoli et al., 2015). Thus, our proposed Global Sustainability Index is presented in the following expression:

Figure 2: Global Sustainability Index (GSI)

Source: compiled by authors

Construction of GSI

The proposed GSI index focuses on the most prominent problems pertaining to society, environment, economy and innovation. Our Social measure places focuses on the individual capacity for sustaining human living needs and individual well-being. Our Environmental metric refers to ecological considerations and biodiversity through the lens of SEDAC[13] developed a version of Environment Performance Index (EPI, 2010-2012). In addition, we employ the stability of energy supply based on reserves as well as imported stocks of natural resources (US Energy Information Administration, 2013a,b). Our Economic metric seeks to capture effects of the sovereign debt crisis which has affected global markets along with the associated broader economic problems. Finally, as a separate measure, we include Innovation to capture government, collaborative private sector and educational institutional entrepreneurialism efforts derived from GCI's related component. Table 2 details the configuration of our GSI:

Table 2: GSI Configuration

	Metric weighting		Measures weighting		Source
GSI	**30%**	**Social Metric**	Heath and Education	7.5%	United Nation Development Program (2013)
			Net food (% of net merchandise)	7.5%	Complied by the authors from World Bank Data (2013)[14]
			Unemployment rate	7.5%	Euromonitor International (2013)
			Global Peace Index Scores	7.5%	Global Peace Index (2007-2010)
	30%	**Environmental metric**	EPI scores	7.5%	Pilot EPI -Yale (2000-2012)
			Alternative and Nuclear energy (% of total energy use)	7.5%	World Bank Data (2013)
			Energy imports, net (% of energy use)	7.5%	World Bank Data (2013)
			Proved Natural Gas Reserves (Trillion Cubic Feet)	3.75%	US Energy Information Administration (2013a)
			Proved Petroleum Reserves (Billion Barrels)	3.75%	US Energy Information Administration (2013b)
	30%	**Economic**	Current Account Balance	7.5%	Euromonitor International

[13] NASA Socioeconomic Data and Applications Center - Pilot EPI Trend http://sedac.ciesin.columbia.edu/data/set/epi-environmental-performance-index-pilot-trend-2012.

[14] Net food (% of net merchandise) is calculated as follows:
Net Food (% of net merchandise) = Food exports (% of merchandise exports) - Food imports (% of merchandise exports).

		Metric	- US$ mn		(2013)
			Public Debt - US$ mn - Current Prices - Year-on-Year Exchange Rates	7.5%	Euromonitor International (2013)[15]
			Government Revenue US$ mn- Current Prices - Year-on-Year Exchange Rates	7.5%	Euromonitor International (2013)[16]
			Index of Consumer Prices	7.5%	Euromonitor International (2013)
	10%	**Innovation Metric**	Innovation scores	10%	Global Competitiveness Index (2013)

Source: compiled by authors

Data sources

The construction of metrics in Table 2 is guided by an extensive research and selective assessment of currently available metrics/measures as sources of data. In developing the Social metric we considered amongst others, International living quality of life (2005) (International Living, 2013); Economist Intelligence Unit's quality of life (2005); HDI (Ul-Haq, 1990) and Better Life (OECD, 2013) indices. Likewise, we considered a political stability index for which our review included: Bertelsmann Stiftung's Transformation (BTI, 2013); Political Instability (The Economist Intelligence Unit, 2009); Worldwide Governance Indicators (WGI) (Kaufmann et al. 2011); and Freedom House (FH, 2012). For our Environmental metric we considered Ecological Footprint (Wackernagel and Rees, 1997), Living Planet (WWF, 1998), Environmental Vulnerability (EVI) (SOPAC, 2005) and Environmental Performance (EPI) (Esty et al., 2006) which was classified as the most prominent but has new iterations[17] wherein 2014 the index uses 9 issues and 20 indicators. This index is only produced every two years. Therefore we use Pilot Trend EPI (2012) that offers a decade cross-country comparison. The 12thpillar of innovation within WEF's GCI is retained as the single measure for our innovation metric. Several other metrics were considered such as Boston Consulting Group / National Association of Manufacturers (2009), Innovation Union Scoreboard (European Commission, 2011), the Global Innovation Index (Economist Intelligence Unit, 2009) and the WEF's Global Innovation Index (2007-2013). However, most of

[15]Public debt for Bangladesh has been compiled from the economist (2013).
[16] Public debt for Bangladesh has been compiled from the economist (2013).
[17] 2006;2008;2010;2012;2014.

these metric sources had to be discarded for various reasons, including the use of GDP which we argue is a weak indicator; some sources internally combine more than one aspect of economic, social, political which causes overlapping; in some cases full set of all countries data was unavailable; or longitudinal datasets were not available for the desired period of our assessment.

Weightings and Standardisation of GSI

We followed a weighting of metrics that aligns with our definition of Sustainability as a dynamic state that equally balances social; environmental and economic attributes (30% each) for Continuity. We posit that, regardless that regulations underpin and are endogenous within each metric, Innovation needs its own attention as a driver of change and, hence, we allocate 10% weighting to Innovation. Each single element within the three Continuity categories is given each a 7.5% weighting (total 30%). We further sub-divide Resource metrics into Proven Gas (3.75%) and Petrol (3.75%) reserves (total 7.5%).

To facilitate aggregation of all single measure into metrics, the raw data are standardised into a single comparable scale. While some measures are customised to allow such cross-country comparability, others require appropriate denominator to be scaled. In the case of this study, the total country population was used to scale the data (i.e. Current Account Balance, Government Revenue, and Public Debt).

Critical investigation of GSI

The GSI and underlying Global sustainability development theoretical framework is tested for the following five propositions:

Proposition 1:	Higher development countries are most vulnerable to social crises.
Preposition 2:	Population density has an impact on country social and environmental scores
Proposition 3:	Developed countries are more innovative and are environmentally most sustainable.

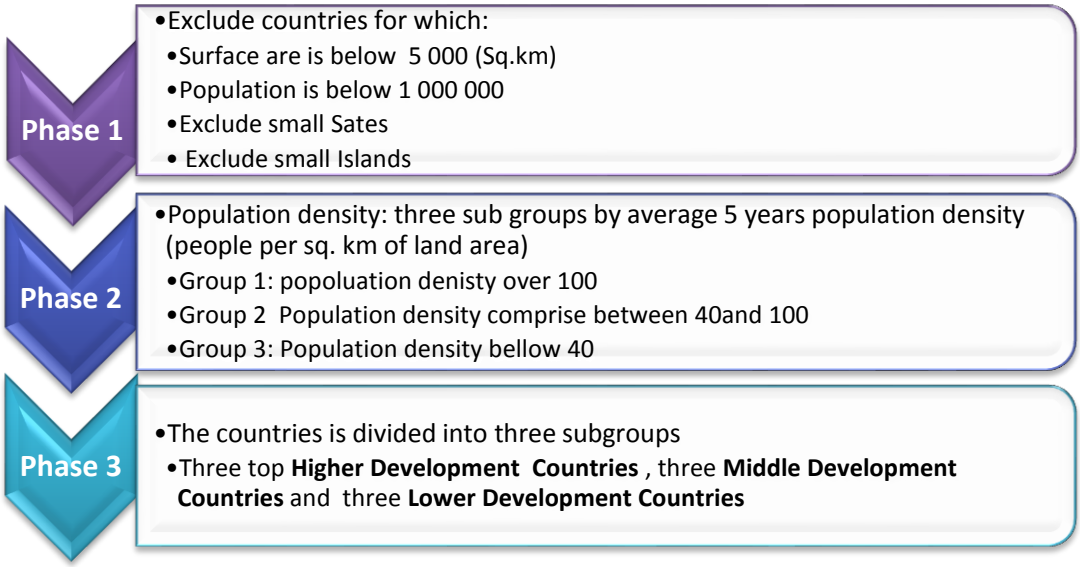
Proposition 4: Countries with low macroeconomic performance are more sustainable.

Proposition 5: Countries with more efficient national economies, usage of resources and social performance scores achieve higher sustainability.

Methodology and sample identification

The study tests the GSI using a small cross-country comparative assessment of twenty-seven countries across three population groups for the period 2007-2010 which consists of 9 high-, 9 middle- and 9 low-developed. These were selected by listing all 200+ countries and reducing the sample in three consecutive phases outlined in Figure 3.

Figure 3-Country Selection Criteria



Source: Compiled by authors

In phase 1 of the country selection smaller countries are removed - a criterion adopted by previous studies (e.g. ESI, 2005). In addition, countries with a population below 1 million and small states (World Bank, 2013) are delisted, an approach similar to EPI's approach (EPI, 2012). Finally, small islands are eliminated (e.g. see United Nations, 2013). A list of 137 countries moves to Phase 2.

Then in Phase 2, 137 countries are divided into three groups based on population density – over populated, mid populated and low populated. Group 1: over 100 people per sq.km; Group 2: 40 to 100 people per sq.km; and Group 3: less than 40 people per sq.km.

Then in Phase 3, the groups from phase 2 are compounded into nine countries. Each group comprises three higher development, three middle development and three low development countries. The country classification criterion follows Nielsen's (2011) taxonomy of lifetime income by population-weighted distribution. Countries are listed in descending order and where possible, the highest ranked countries from different regions are taken. Once the country is selected, a pilot study was run to check the availability of all GSI aggregate single measures. Countries that were missing any of the 14 single measures needed were then removed.

Table 3: Country Selection

	High Development Countries (HDC)	**Middle Development Countries (MDC)**	**Low Development Countries (LDC)**
Group 1 Highly Populated (Over Pop)	Netherland Japan United Kingdom	South Korea Czech Republic El Salvador	Bangladesh India Philippines
Group 2 Medium Populated (Medium Pop)	Spain Greece United Arab Emirates	Slovenia Turkey Costa Rica	Ukraine Ethiopia Egypt
Group 3 Least Populated (Least Pop)	United States Sweden New Zealand	Latvia Venezuela Chile	Cameroon Paraguay Bolivia

Source: compiled by authors

The GSI proposed framework is then applied to measure self-sustainability of the sample countries over the four-year period (2007-2010) across patterns of different population densities, regions and country categories. Table 2 metrics are applied to each of the countries to establish the Self-Sustainability scores at Country level.

Results and discussion

Tables 4-7 present the results of the GSI for the country groups included in the study.

Social Scores

Table 4- Social Scores

		2007	2008	2009	2010	CAGR 07/10	% change 07/10	Average 07/10
HDC	Over Pop	-0.34	-0.36	-0.49	-0.47			-0.41
		% of change	-5%	-37%	4%	-11%	-38%	
	Medium Pop	-0.14	-0.16	-0.17	-0.30			-0.19
		% of change	-16%	-4%	-80%	-30%	-119%	
	Least Pop	0.94	0.91	0.71	0.72			0.82
		% of change	-3%	-21%	1%	-8%	-23%	
MDC	Over Pop	-0.18	-0.15	-0.35	-0.35			-0.26
		% of change	15%	-126%	0%	-25%	-94%	
	Medium Pop	0.30	0.29	-0.02	0.24			0.20
		% of change	-4%	107%	1192 %	-8%	-22%	
	Least Pop	-0.24	-0.39	-0.78	-0.79			-0.55
		% of change	-65%	-98%	-2%	-49%	-233%	
LDC	Over Pop	-0.58	-0.20	-0.33	-0.31			-0.36
		% of change	65%	-62%	7%	19%	47%	
	Medium Pop	0.93	1.30	1.64	1.56			1.36
		% of change	40%	26%	-5%	19%	67%	
	Least Pop	1.55	1.97	2.24	1.24			1.75
		% of change	27%	13%	-45%	-7%	20%	

Source: compiled by authors

Whereas the CAGR social scores for Higher and Medium Development Countries largely deteriorated (2007- 2010) for all population groups, the Compound Annual Growth Rate (CAGR) scores of LDCs contrastingly overall improved. Therefore, the overall average social score improves as population decreases amongst all groups, except for Least Populated group in the MDC - this could be related to the selection of countries.

The average change (%) for both HDC and MDC deteriorated over the period 2007-2010. The positive social score of Medium developed as well as populated countries is related to the fluctuations in social scores of Costa Rica in this group. Costa Rica experienced a sudden drop in its score in 2009 followed by a return to its current state in 2010.This was mainly due to a drop in Net food and increase in its unemployment figure. Amongst the HDCs, Spain registered a significant decline of 130% in its CAGR, followed by the USA which registered a 187% drop in its social scores. These findings are aligned with deteriorating social structure, with increasing unemployment levels and social conflicts, across developed nations and in particular within Spain and the USA (Roosevelt, 2013; Telegraph, 2009-2010) which culminated in a debate over increasing income inequality at the World Economic Forum in Davos (Bloomberg, 2014). The only country within this group with a marked increase in

CAGR is the UAE (+44%). This is mainly related to UAE's oil revenues which strongly support its social structures. However, the social scores do not take into consideration disparities between native UAE's, highly-skilled immigrants-expatriates and the poor low-skilled immigrants for which the social situation is alarming and catastrophic (Forstenlechner and Rutledge, 2011). In the MDC category (2007-2010) El Salvador recorded a decrease of 232% in CAGR followed by Latvia (-155%). This is attributed to political unrest in El Salvador (Seelke, 2013), and the implications of the global financial crisis on Latvian's economic and social structures (World Bank, 2011). Social scores of LDCs recorded an upward trend, with Paraguay (1) and Ethiopia (2) topping the rankings. The findings suggest that the social scores of LDCs are far better than those of HDCs and MDCs. The social scores are quite similar for all the group of over populated countries (Table 4). These findings suggest that HDCs are more at risk of social crisis and that overpopulated countries all three groups (HDCs, MDCs and LDCs) do face similar social challenges and pressures.

The implication being, that reimaging social structures through restructuring health and education systems, and promoting cultural integrity and healthy eating is critical to achieving social self-sustainability at all levels.

Environmental scores

Table 5-Environmetal scores

		2007	2008	2009	2010	CAGR 07/10	% of c	Average 07/10
HDC	Over Pop	3.41	3.45	3.54	3.37	0%	1%	3.44
		% of change	1%	3%	-5%			
	Medium Pop	11.30	10.45	9.55	9.78	5%	13%	10.27
		% of change	8%	9%	-2%			
	Least Pop	7.77	8.31	8.53	8.98	5%	16%	8.40
		% of change	7%	3%	5%			
MDC	Over Pop	2.00	2.23	2.22	2.15	-2%	-7%	2.15
		% of change	-11%	0%	-3%			
	Medium Pop	1.50	1.66	1.96	1.98	10%	32%	1.78
		% of change	11%	18%	-1%			
	Least Pop	10.31	9.95	10.31	9.52	3%	8%	10.02
		% of change	4%	-4%	-8%			
LDC	Over Pop	2.63	2.65	2.73	2.59	0%	1%	2.65
		% of change	-1%	-3%	5%			
	Medium Pop	4.97	5.15	5.36	5.03	0%	1%	5.13
		% of change	4%	4%	-6%			
	Least Pop	14.64	14.26	12.39	11.71	-7%	20%	13.25
		% of change	27%	13%	-45%			

Source: Compiled by the authors

The CAGR trend for environmental scores remained relatively stable over the years, but the rate of change does vary across the population groups (Table 6). HDCs are the most environmentally friendly. This is mainly because the selected countries either have plentiful natural resources (the UAE leading in energy exports, 1st in oil reserves and 2nd in gas reserves, and the USA 1st in natural gas reserves) or are strong in the adoption of alternative energies and EPI scores – as is the case for Sweden (2nd-4th) and New Zealand (5th for both).

Although the UAE leads the list in natural resources, it scores zero in alternative energies. The UAE ranks in 23rd position within EPI scores. This is mainly because the UAE has not resolved the challenge of managing its waste (Al-Hajj & Hamani, 2011). Besides, the UAE are one of the world's highest users of water per capita, which is spurring the depletion of domestic natural water resources coming mostly from desalination plants. (Gleick, 2011). The USA is also in a similar position: it is rich in natural resources but relies heavily on oil reserves as its consumption reached on average 23% of the world oil production between 2007-2010 (BP, 2011). As per the results, the USA is less engaged in developing alternative energies being in 13th place, this justified by the USA refusal to be part of the Kyoto protocol, however, this has changed as the USA adhered to Paris COP21 (US Department of state 2016).

The findings suggest that although Spain and Japan have limited stocks of natural resources their engagement with renewable energy sources is limited indicating a need to redefine their energy and sustainability strategies. Such redefinition of policy design applies to Japan, with on-going nuclear spills in the aftermath of Fukushima 2011 nuclear disaster (Buesseler, 2012).

The MDCs (Table 5) include countries which rank highly on renewable energy sources - Costa Rica (3rd), El Salvador (4th) and Slovenia (6th) and EPI scores- Latvia (1st), Costa Rica (2nd) and Czech Republic (6th). The only country within this group that is exporting energy and is rich in natural resources is Venezuela. Venezuela ranks 2nd amongst the country grouping, ranks 14th in Alternatives and 15th in the EPI ranking. Countries like Costa Rica compensate for the lack of natural resources through the development of alternative energies. This is similar to New

Zealand and Sweden. Whereas Korea and Turkey are in a similar position to Spain and Japan.

Unlike HDC and MDC countries, it is the LDCs that are collectively leading in exporting energy: Bolivia (3rd), Paraguay (4th), Cameroon(5th) and Egypt (6th). Yet, they have minimal natural resources, and they are less engaged in developing alternative resources. The exception is Paraguay which ranks first amongst the 27 countries in the development of alternative energies.

Countries in Latin America are the leading countries in alternative forms of energy: Paraguay, followed by Costa Rica and El Salvador (Global Energy Network Institute, 2009; Scientific American, 2013). While the LDCs countries are leading in the Low pop, the HDCs are leading in the Medium-pop group (Table 5). Regardless of the level of development of countries, all highly-populated countries within the selected sample face higher environmental and social pressures.

This implies that being beyond an optimum population density, the urbanisation of mega-cities is fuelling deeper social and environmental problems.

Economic scores

Table 6 - Economic scores

		2007	2008	2009	2010	CAGR 07/10	% change 07/10	Average 07/10
HDC	Over Pop	-0.10	-0.19	-0.05	-0.10	0%	1%	-0.11
		% of change	-87%	71%	-83%			
	Medium Pop	-0.42	-0.52	-0.06	-0.19	24%	56%	-0.30
		% of change	-23%	**88%**	-193%			
	Least Pop	-0.19	-0.28	-0.03	-0.13	12%	32%	-0.16
		% of change	-49%	**88%**	-288%			
MDC	Over Pop	-0.25	-0.45	-0.12	-0.14	17%	43%	-0.24
		% of change	-78%	**72%**	-16%			
	Medium Pop	-0.54	-0.74	-0.38	-0.40	10%	26%	-0.52
		% of change	-35%	**49%**	-7%			
	Least Pop	-0.83	-1.39	-0.81	-0.71	5%	14%	-0.94
		% of change	-67%	**42%**	12%			
LDC	Over Pop	-0.46	-0.64	-0.52	-0.61	9%	-30%	-0.56
		% of change	-38%	**19%**	-17%			
	Medium Pop	-0.99	-2.20	-0.91	-0.72	10%	27%	-1.20
		% of change	-123%	**59%**	21%			
	Least Pop	-0.44	-0.74	-0.22	-0.21	22%	52%	-0.40
		% of change	-67%	**70%**	4%			

Source: Compiled by the authors

Following the global financial crisis, overall the economic scores for all countries across all categories have all registered a positive change in 2009. However, the scores plummeted back in 2010 (Table 6). This mainly was due to a reduction in the level of debts by countries. However, this trend was not a long-term one - as countries borrowing increased again in 2010. On the other hand, countries have been in general more conscious about reducing their BoPs and increasing their government Revenues, which explains the increases in CAGR and % of change across categories.

The average Economic score for the LDC group is the lowest (-0.72) partially explained by the high levels of debt of Bangladesh (1st) and India (5th). The HDCs received an average score of -0.56. Although all countries within this group have lower inflation rate and a very high government revenue, most countries are in a very critical financial position or reaching bankruptcy this is mainly because countries within this group suffer from high levels of debt and/or deficient Balance of Payments (Table 7). The Debt of HDC country group is 3.4 times their revenues (Revenue+ Balance of payment) (Table 7). The USA is at the top of this group with $11.702 Trillion US Debt (2nd most indebted country within the selection) and $557 Trillion USD deficit in BoP (1st rank), follow by Japan with 9.933 Trillion US$. The UK is in a slightly better position (4th) in debt and 3rd in BoP and while this country has a lot more debts from countries like Greece which was bailed out by the European Union (Betz, 2016; Dawood et al., 2016).

Table 7- Average economic metrics by categories

	HDC	MDC	LDC
Total Debt/ group US$mn	2769728	88946	37453
Total BoP/Group US$mn	-53339	-868	-128
Total Gov Revenue/ Group US$mn	878496	76855	22760
Debt/ Revenue ratio	**3.4**	**1.2**	**1.7**
Average inflation/ group	2	8	10

Source: Compiled by the authors

The finding suggests that MDCs are ranking as a group highest. This is mainly because all countries within this category have an even debt to revenue of 1.2 times.

Thus these countries can be considered as the most economically sustainable countries (Table 7).

Overall, Japan leads in economic terms as it manages to generate high levels of revenue to sustain a high level of debt. The results suggest the level of the population has no significant impact on the country's economic scores.

Innovation scores

Table 8- Average Innovation metrics by categories

		2007	2008	2009	2010	CAGR 07/10	% change 07/10	Average 07/10
HDC	Over Pop	0.51	0.50	0.50	0.50	**-1%**	**2%**	0.50
		% of change	-2%	-1%	0%			
	Medium Pop	0.34	0.34	0.35	0.35	**1%**	**-2%**	0.34
		% of change	0%	3%	-2%			
	Least Pop	0.51	0.51	0.51	0.50	**-1%**	**2%**	0.51
		% of change	-1%	0%	-1%			
MDC	Over Pop	0.40	0.39	0.38	0.37	**-2%**	**6%**	0.39
		% of change	-2%	-2%	-2%			
	Medium Pop	0.36	0.35	0.35	0.35	**-1%**	**2%**	0.35
		% of change	-2%	1%	-1%			
	Least Pop	0.31	0.30	0.30	0.30	**-1%**	**3%**	0.30
		% of change	-5%	0%	2%			
LDC	Over Pop	0.32	0.31	0.30	0.30	**-2%**	**6%**	0.31
		% of change	-2%	-2%	-1%			
	Medium Pop	0.30	0.31	0.30	0.29	**-1%**	**2%**	0.30
		% of change	3%	-3%	-1%			
	Least Pop	0.23	0.23	0.24	0.25	**3%**	**-8%**	0.24
		% of change	-1%	3%	6%			

Source: Compiled by the authors

Overall there are no significant changes in countries Innovation policies the CAGR and % change remained stable between 2007-2010 (Table 8). With the USA leading innovation in developed, the innovation scores for HDCs on average, surpasses the MDC and LDCs, except for the medium populated countries. This is attributed to the high number of patent registration and increased related protection within these countries, especially in the USA. The results show that the Innovation scores, deteriorate with the decreasing country level of development (Table 8). Thus the lower the country level of development the less likely they are to be innovative. Seo, et al. (2016) demonstrated that the science and technology innovation within developed nations remains weaker than their actual capabilities and the relevant regulatory authorities within these countries may not exist. Our results indicate that a broader cross-country regulatory framework for innovation is imperative and that

there is an underlying lack of best-practice sharing and technological /innovation transfer that hampers transnational sustainability.

Sustainability Scores

Table 9- Average Sustainability metrics by categories

		2007	2008	2009	2010	CAGR 07/10	%Change 07/10	Average 07/10
HDC	Over Pop	3.48	3.41	3.50	3.30	-1.8%	-5.4%	3.42
		% of change	-0.02	0.03	-0.06			
	Medium Pop	11.08	10.12	9.67	9.64	-4.5%	-13.0%	10.13
		% of change	-0.09	-0.04	0.00			
	Less Pop	9.03	9.45	9.72	10.07	3.7%	11.6%	9.57
		% of change	0.05	0.03	0.04			
MDC	Over Pop	1.97	2.02	2.13	2.04	1.1%	3.3%	2.04
		% of change	0.02	0.06	-0.04			
	Medium Pop	1.62	1.57	1.91	2.17	10.3%	34.1%	1.82
		% of change	-0.03	0.22	0.13			
	Less Pop	9.56	8.46	9.01	8.31	-4.5%	-13.0%	8.84
		% of change	-0.11	0.06	-0.08			
LDC	Over Pop	1.90	2.11	2.18	1.98	1.4%	4.1%	2.04
		% of change	0.11	0.03	-0.09			
	Medium Pop	5.22	4.56	6.39	6.17	5.7%	18.2%	5.58
		% of change	-0.13	0.40	-0.03			
	Less Pop	15.98	15.73	14.65	12.99	-6.7%	-18.7%	14.84
		% of change	-0.02	-0.07	-0.11			

Source: Compiled by the authors

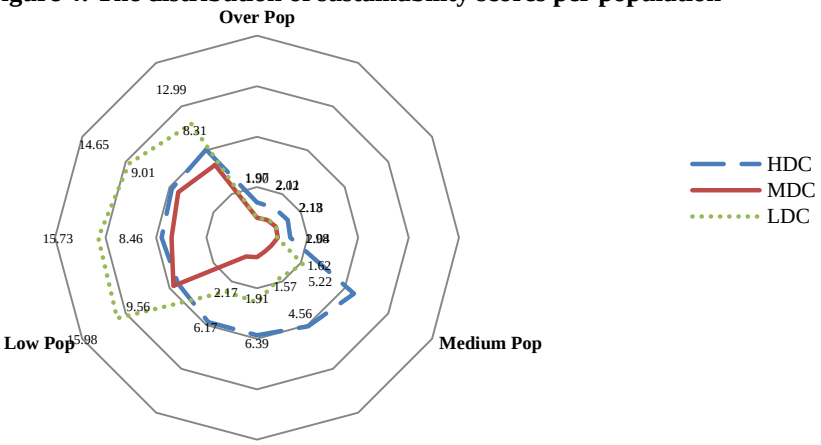
Except for the Less Pop, the results show a reverse trend in the sustainability amongst the Over Pop and the Medium Pop of the HDC countries. An opposite trend has been observed in the percentage of change for the Less Pop amongst the MDC and LDC countries; this is related to the choice of Less Pop countries for the HDC. The Medium Pop and Over Pop amongst the MDC and LDC have realised a steady increase; a similar trend is registered for the GARI.

The results reveal that the lower is the level of the development of the countries and the less populated they are, the more sustainable they are. The HDC score is mainly high because countries within this group (the Netherlands and the UK) rank high in sustainability; this is mainly linked to EU initiatives (European Commission, 2015).

The results in Figure 3, regardless of the country level of population, show that the HDC are the worst countries amongst all groups. There are differences between the

other two groups, mainly because of the South American countries Venezuela, Paraguay, and Bolivia which rank respectively in 2nd , 3rd and 4th positions. This is mainly due to their Environment scores as explained previously. The USA ranks 5th which was surprising. However, this is related to the leading position of the country in Environmental and Innovation.

Figure 4: The distribution of sustainability scores per population



Concluding remarks

The findings confirm that no single country is leading across all the four identified metrics. Thus different countries are at different level of development to attaining self-sustainability. The UAE are found to be the most sustainable country in our sample, a country identified with increased levels of development in socioeconomic terms. However UAE needs to improve its EPI (environment health and ecosystem Vitality-22nd position on average) and Net food in social scores in 18th positions on average, this is in line with Jain and Jain (2013). Also, UAE has to work to improve the situation for its low-class immigrants. Saying that UAE is now more than ever before committed to improving its position (Asif, 2016). Our GSI index revealed that over populated nations face even sustainability challenges while. Also, the results reveal that the level of country sustainability depends upon the concentration of population and the country level of development. Furthermore, the results found increased variability among country in social, economic, environment as well as innovative scores, which reiterates the need for combined usage of environmental and socioeconomic metrics through innovation in monitoring progress towards sustainable development.

Utilising a time series of data we attempted to establish trends and, in this respect, the composite macro-level indices such as the one proposed in this paper can offer fruitful

insights and guidance in global governance over related strategic agendas for action and what to avoid in pursuing sustainability. Although the study relies on a small sample of countries, the tentative findings illustrate an approach for systematic analysis and successful planning as the basis for future large-scale research on sustainability governance at both the national and supranational level. The finding supports the guiding Global Sustainability development theoretical framework (Framework 2) concept by fostering the need for normative guidance for innovation to rebalance the three continuity dimensions (economic, social and economic) of sustainability for self-sufficiency highlighted in framework 1.

In addition the outcomes of this study address three major concerns: firstly to aid the proliferation of responsible capitalism (Rok & de Arruda, 2016) through fostering the need for creative economy (Denning, 2014), secondly to realign goals between global institutions such as UN; WHO; WTO and firms; and thirdly to guide countries towards self-sustainability through innovation.

Yet, as already pointed out in the literature (e.g. Shaker and Zubalsky, 2015; Wilson and Wu, 2016), findings such as those presented here are not meant to rule out other approaches in measuring patterns of (un)sustainable development. On the contrary, it potentially serves as an additional proxy of interrelated development dynamics, indicating current trends and new directions in assessing global sustainability under the scope of the innovative capacity of nations. With the goal of sustainability being an end state for international development and the overarching challenge of our time, the study encapsulates policy implications as it underscores the need for interdisciplinary models in global decision-making towards long-term societal well-being within the planetary boundaries.

Such synergistic models at the institutional level, supported by experts from technological innovation, ecology, economics and social science backgrounds can utilise data from constructs such as the GSI in making informed decisions regarding development options and the respective distributive and intergenerational allocation of resources. Future research can employ sensitivity analysis and increase the rigour of proposed weighting criteria in an attempt to provide a more comprehensive picture of global sustainability trends and developments which ultimately can materially inform global governance towards a more balanced international development.

Likewise, focusing on regional (disaggregated) scales through relevant indexes could foster detailed monitoring of sustainability dynamics and the longevity of socioeconomic and biophysical systems.

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