ASTIN, AFIR/ERM and IACA Colloquia
Innovation & Invention
23-27 August 2015 | Amora Hotel Jamison Sydney

Actuaries Institute

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Presented to the Actuaries Institute
ASTIN, AFIR/ERM and IACA Colloquia
23-27 August 2015
Sydney

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ENVIRONMENTAL, SOCIAL AND ECONOMIC SUSTAINABILITY: IMPLICATIONS FOR ACTUARIAL SCIENCE

By TL Reddy and RJ Thomson

ABSTRACT
The heart of actuarial science lies in its models. These models form the basis for the advice we provide and for decision-making. The assumptions we use in our models rely on past and current information. Therefore, if there is evidence that the future will not look like the past, we need to ask what the effects will be on what actuaries are doing now and what actuaries should be doing in the future that we are not doing now. Given actuaries' skills and experience in the modelling of the outcomes of entities' activities in the economic domain and the eclectic nature of our discipline, the actuarial profession has a unique position in society relative to other professions to address the challenges of environmental, social and economic sustainability. This paper aims to:
– define what is meant by 'sustainability';
– establish the requirements of accountability for sustainability;
– consider how institutional investors and actuaries can promote sustainability; and
– explore the challenges for the actuarial profession.

KEYWORDS
Sustainability; environmental sustainability; social sustainability; economic sustainability; institutional investors; actuarial science; models; assumptions; triple bottom line

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"The actuary who is only an actuary is not an actuary." F.M. Redington's response to the award of the gold medal of the Institute of Actuaries 1968

1. INTRODUCTION

1.1 The heart of actuarial science lies in its models. These models form the basis for the advice we provide and for decision-making. The assumptions about the future used in these models rely on past and current information. (Thomson, 2013)

1.2 The evidence that the future will not look like the past is increasing and emphasises the burgeoning need for sustainability (Gilding, 2011). 'Sustainability' generally refers to environmental, social and economic sustainability (Giddings, Hopwood & O'Brien, 2002; Van der Vorst, Grafe-Buckens & Sheate, 1999). Other domains of sustainability have been considered. These domains are discussed in section 2. Climate change is now firmly on the agenda of science, the professions and governments worldwide. In addition, as shown by research recently commissioned by the Institute and Faculty of Actuaries (Jones et al., unpublished), resource constraints are going to affect the economy. These effects will include fundamental changes in energy markets due to the end of cheap fossil and nuclear fuels. Also, the capacity of the Earth to accommodate the increase in waste, effluents, pollutants and land-use changes generated by a growth-orientated economic system is limited (Meadows et al., 1972; Daly, 1996). Such changes are already occurring and are having material effects on society. The changes affect environmental sustainability, social sustainability and economic

sustainability. As and when these changes become more serious they will seriously affect the economic assumptions we as actuaries currently use in our models.

1.3 Since the future will not look like the past, we need to ask: what will be the effect on what actuaries are currently doing? and what should actuaries be doing in the future that we are not currently doing? This paper aims to address these questions.

1.4 Jones et al. (op. cit.) concluded that resource constraints would place a limit on future economic growth rates and urged actuaries to "urgently seek to understand the implications of this for their advice, assumptions and models." Apart from that monograph there is a notable absence of actuarial literature specifically focused on sustainability. This paper represents an initial attempt to formalise how unsustainability affects actuarial science and to propose what actuaries should be doing in the future to address these effects. The scope of this research excludes the practicalities and political issues around the implementation process.

1.5 The rest of the paper is organised as follows. Actuaries advise or are employed by institutional investors, which are an integral part of the global financial system. Therefore, before one can understand the implications of unsustainability for actuarial science, one needs to understand concerns about global sustainability in general and, in particular, how institutional investors can promote sustainability. Despite growing concerns about sustainability there is little or no consensus on what it means (Lélé, 1991; Mebratu, 1998; Daly, 1990). In section 2 the use of the word 'sustainability' in the literature is discussed, and from that discussion a definition is suggested. In that section, examples of environmental, social and economic concerns are provided. Requirements of accountability for sustainability are suggested in section 3. An approach for measuring sustainability is proposed in that section. How institutional investors can promote sustainability is dealt with in section 4. How actuaries can promote sustainability is addressed in section 5. Challenges for the actuarial profession in addressing what actuaries should be doing in the future are dealt with in section 6. A summary is set out in section 7 and areas for further research are given in section 8.

2. SUSTAINABILITY CONCERNS

2.1 WHAT IS 'SUSTAINABILITY'?

2.1.1 Despite growing concern about sustainability, there is little or no consensus on what it means.

2.1.2 The most widely used definition of sustainability is the Brundtland report's definition of 'sustainable development' (Mebratu, op. cit.)—"[meeting] the needs of the present [generation] without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987). It is argued that this definition is anthropocentric (Giddings, Hopwood & O'Brien, op. cit.) as it suggests that, although we depend on the environment to meet our needs, it is only our human needs that matter (Hopwood, Mellor & O'Brien, 2005). But it does assume that, at least in terms of human lifetimes, a long-term view needs to be adopted in order for sustainability to be achieved.

2.1.3 'Sustainable development' is often used interchangeably with 'sustainable growth' (Daly, 1996). However, as Goodland (1995) points out, 'sustainability' and 'sustainable development' are not synonymous. He assumes 'sustainable development' to be development that is environmentally, socially and economically sustainable. Daly (1990) defines 'development' as "qualitative improvement" and 'growth' as "quantitative increase in

physical scale". Issues of sustainable development generally relate to the development of poor (or 'developing') countries, whereas issues of sustainability relate to all countries. In fact some authors (e.g. Meyer, 2000) argue that, whilst the poor countries' economies need to grow, the rich countries need to contract, and that 'development' should not relate to GDP growth but to the achievement of an environmentally or socially optimal scale of production. Alternatively, as suggested by Dreby & Lumb (2012), the rich countries can transform to eco-friendly production whilst the poor countries grow by means of such production. As stated by Thomson (op. cit.),"the planet can sustain an ecology without an economy. It cannot sustain an economy without an ecology." In other words, the economy is a subset of the environment and the environment is a "finite global ecosystem" (Daly, 1990). Since the environment can develop but cannot grow, exponential economic growth is therefore not sustainable in the long term (Daly, 1990).

2.1.4 Gray & Milne (2002) define 'sustainability' as the efficient and equitable distribution of resources intra-generationally and inter-generationally over time with the operation of economic activity within the confines of a finite ecosystem. This definition is stronger than the Brundtland report's definition as it recognises that the economy is a subset of the environment and it assumes a long-term view, though the long term is again expressed in terms of human lifetimes. But it relates only to resource constraints and no other, wider environmental issues, for example, the contribution of an entity's activities to climate change.

2.1.5 As stated in ¶1.2, 'sustainability' generally refers to environmental, social and economic sustainability, but the exact relationship between environmental, social and economic sustainability is unclear (Littig & Griebler, 2005). Brown, Dillard & Marshall (unpublished) describe the relationship between the economy, environment and society as follows:

> "natural systems provide the context and sustenance for social systems and, therefore, must be respected, nurtured, and sustained. Social systems provide the context and purpose of economic systems. "

In other words, the economy is a subset of society, which in turn is a subset of the environment. According to Van der Vorst, Grafe-Buckens & Sheate (op. cit.) economic sustainability requires environmental and social sustainability and social sustainability hinges on environmental sustainability. Alternatively, the three domains of sustainability can be treated with parity as suggested by Newton (2003).

2.1.6 The King Report on Corporate Governance in South Africa requires companies to report on the effect of their activities "on the economic life of the community in which it operated during the year under review".[1] The economic life of the community is "categorised as environmental, social and governance issues."[2] Here governance is seen as a separate domain. However, governance should be implemented across all three domains and not just the financial domain (Bennet & van der Lugt, 2004).

2.1.7 Finally, some authors have suggested stakeholder accountability, ethics, politics and spirituality as further domains. Henriques (2004) argues that the three domains of sustainability do not exhaust the field of sustainability and that stakeholder accountability should be an additional domain. However, stakeholder accountability should be incorporated into all three domains. Similarly, ethics is seen as a separate domain, but ethics "should guide us to what we should do" (Donaldson & Dunfee, 1994) and should also be

[1] King Report on Corporate Governance in South Africa, King Committee, 2009, www.iodsa.co.za
[2] ibid.

implemented across the three domains. Bendell & Kearins (2005) have suggested a political domain. They describe this domain as the influence that corporate entities bring to bear on the public sector to promote sustainability. This definition suggests that such influence is merely a means to the ends of environmental, social and economic sustainability, and therefore not a separate domain of sustainability in itself. Inayatullah (2005) suggests spirituality as the fourth domain. He describes the deepest layer of spirituality as "the mystical alchemy of the self" and concludes that it is impossible to measure. Since spirituality by its nature must inform one's thinking about the environment, society and the economy and is unquantifiable, it is misleading to consider it as a fourth domain. It is also arguably misleading because, if people's spirituality is mature, entities' activities should not be affecting that spirituality.

2.1.8 The major question facing humankind regarding the sustainability of these three domains is whether human activity is sustainable. In other words, can human activity as practised today sustain environmental, social and economic well-being, and if not, how can we change economic activity so that the environment and society can sustain it?

2.1.9 These are global questions; they affect the environment and society in the large. But they also affect environment and society in the small—at the level of individual countries, individual areas, individual entities, individual products and individual investors. The effects of an entity's activities in one area may affect the environment and society in areas far away. (In this paper, an 'entity' is a corporate organisation in the private sector or a government institution. In principle it includes cooperatives, partnerships, self-employed persons and civil-society organisations. In other words, it includes any person or organisation that is engaged in economic activities.)

2.1.10 They are also questions about the future: can the environment and society be sustained both in the short term and in the long? Environmental and social damage can be wrought in the short term, but it may have long-term effects; it can take many years to reverse the damage done by one year's activity.

2.1.11 In the light of the above discussion, for the purposes of this paper, the global economic system—that is, the sum total of human economic activity—is taken to be 'sustainable' if, assuming its indefinite continuance, the effects of that activity will enable the environment, human society and the economic system itself to attain and maintain a state of well-being in every region of the world. The evidence provided in sections 2.2, 2.3 and 2.4 suggests that, in terms of this definition, the global economic system is not sustainable; global sustainability is an objective towards which the global economic system needs to work. For this purpose we need measures of the effects of human activities on each domain. These measures are discussed in ¶¶3.10–13.

2.1.12 The question whether an entity is 'sustainable' will have to be considered in the light of the sustainability of the entire system. Thus, if for example the sustainability of the entire system requires the reduction of the effects on the environment by a certain percentage and the reduction of effects on society by some other percentage then it may be found that some industries, or some entities, need to contract by more than others. Those that need to contract will be those whose contribution to environmental and human well-being is relatively unsustainable in relation to their contribution to the economy. For the purposes of this paper, an entity is considered sustainable if (a) the entire global system is sustainable, or (b) the most efficient way of restoring the system to sustainability would not necessitate any change

in the activities of that entity. The measurement of efficiency is discussed in ¶¶3.14–15 below.

2.2 ENVIRONMENTAL SUSTAINABILITY

2.2.1 The earth system that we depend on is resilient (Ludwig, Walker & Holling, 1997). This means that it is able to maintain its integrity or return to a state of equilibrium after a disturbance (Holling, 1973). However, abrupt shifts in the earth system can cause it to lose its resilience (Scheffer, 2009) and become unsustainable (Lélé, 1998). The earth system has a set of limits or boundaries within which equilibrium is maintained (Rockström et al., 2009). Exponential growth is imposing ever greater demands on the earth system and placing ever greater strain on these limits (Holling, op. cit.). Rockström et al. (op. cit.) identified nine planetary boundaries within which humanity can operate safely. These boundaries describe the fundamental functioning of the earth system (ibid.). They quantified seven of these boundaries. They stated that the transgression of at least one of these boundaries could lead to an abrupt and irreversible change to the global environment. According to their estimations, humanity has already transgressed three of the nine planetary boundaries—climate change (measured by the CO_2 concentration in the atmosphere), rate of biodiversity loss (measured by the rate of extinctions per million species) and changes to the global nitrogen cycle—as a result of exponential growth. Meadows et al. (1972) ask:

> "Is it better to try to live within that limit by accepting a self-imposed restriction on growth? Or is it preferable to go on growing until some other natural limit arises, in the hope that at that time another technological leap will allow growth to continue still longer? For the last several hundred years human society has followed the second course so consistently and successfully that the first choice has been all but forgotten."

For the former question sustainability is imperative (Rockström et al., op. cit.), but for the latter it is assumed that the earth system is resilient and able to withstand any abrupt disruptions and is therefore also sustainable (Gilding, op. cit.). We cannot, however, depend on technological advancement to support continued growth (Ehrlich & Ehrlich, 1990). That would be akin to allowing for embedded values on policies not yet issued and products not yet developed.

2.2.2 On the other hand, the evidence to support concerns about the sustainability of the environment is increasing (Gilding, op. cit.). The effects of climate change provide an obvious argument for the need for environmental sustainability. 'Climate change' refers to the significant and long-lasting changes in the climate system caused by natural climate variability or by human activities (i.e. 'anthropogenic' climate change)[3]. Whilst there is a dissident literature, the mainstream of earth-sciences literature recognises the seriousness of anthropogenic climate change. Since the actuarial profession does not have adequate expertise to enter into this discussion, it is accepted for the purposes of this paper that the mainstream position is correct. In 2013, the Intergovernmental Panel on Climate Change (IPCC) reported that "warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia."[4] These changes include warming of the atmosphere and oceans, diminishing ice levels, rising sea level,

[3] Intergovernmental Panel on Climate Change, Climate Change: A Glossary by the Intergovernmental Panel on Climate Change, 1995. Available: www.ipcc.ch/pdf/glossary/ipcc-glossary.pdf, 19/07/2014

[4] Intergovernmental Panel on Climate Change, Fifth Assessment Report: Summary for Policymakers, 2013. Available: http://www.climatechange2013.org/images/report/WG1AR5_SPM_FINAL.pdf, 15/07/2014

increasing acidification of the oceans and increasing concentrations of greenhouse gases.[5] Climate change has already begun to affect biodiversity. In particular, higher temperatures have affected the timing of reproduction in animal and plant species, migration patterns of animals and species distributions and population sizes.[6] The current rate of biodiversity loss is greater than the natural rate of extinction.[7] The boundaries of the world's biomes are expected to change with climate change as species are expected to shift to higher latitudes and altitudes and as global vegetation cover changes (Peters and Lovejoy (1992) cited in Kappelle, Van Vuuren & Baas (1999)). If species are not able to adjust to unfamiliar geographical distributions, their chances of survival will be reduced (ibid.). It is predicted that, by the year 2080, about 20% of coastal wetlands could be lost due to sea-level rise.

2.3 SOCIAL SUSTAINABILITY

2.3.1 The effects of climate change on health provide evidence that social sustainability hinges on environmental sustainability. According to the World Health Organisation, the net effect of climate change will be negative.[8] Extremely high air temperatures exacerbate cardiovascular and respiratory diseases because they raise the level of pollutants in the air. Urban air pollution causes approximately 1,2 million deaths a year.[9] This is expected to increase as the average air temperature continues to increase. The occurrence of infectious diseases such as malaria is expected to increase as the environment becomes more favourable for transmission (Haines et al., 2006). The prevalence of malnutrition is expected to increase as rising air temperatures and variable rainfall negatively affect crop yields in the poorest regions of the world[10]—by up to 50% by 2020 in some African countries[11]. Rising sea levels are increasing the risk of floods. This increases the risk of water-borne diseases, contamination of water supplies, malaria, drowning, injuries and disruption of health services.[12] Climate change also affects social networks as people have to migrate because of the threat of flooding and sea-level rise, especially from low-lying coastal areas and small island states (Pelling & Uitto, 2001).

2.3.2 Health is one component of well-being. Other components include living standards[13], 'social capital' (which includes social networks, social cohesion, the level of trust and the norms and values in a society) (Dempsey et al., 2011), education (ibid.), employment (ibid.), wealth and freedom (Alkire (2002) cited in McGillivray (2007)). (The concept of 'social capital' referred to here, and the similar concepts of 'human capital' and 'environmental capital' are problematic in that they imply a reductionist view of humanity and the environment, i.e. a view that human beings, human society and the global ecosystem are nothing but their value to the global economy.) In 2012, the Happy Planet Index report

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[5] ibid.
[6] Intergovernmental Panel on Climate Change, Climate Change and Biodiversity, 2002, Available: https://www.ipcc.ch/pdf/technical-papers/climate-changes-biodiversity-en.pdf, 30/07/2014
[7] ibid.
[8] World Health Organisation, Climate Change and Health, 2013. Available: http://www.who.int/mediacentre/factsheets/fs266/en/, 19/07/2014
[9] ibid.
[10] ibid.
[11] Intergovernmental Panel on Climate Change, Climate Change 2007: Impacts, Adaptation and Vulnerability, 2007. Available: http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg2_report_impacts_adaptation_and_vulnerability.htm, 19/07/2014
[12] World Health Organisation, Climate Change and Health, 2013. Available: http://www.who.int/mediacentre/factsheets/fs266/en/, 19/07/2014
[13] The Centre for Bhutan Studies, A Short Guide to Gross National Happiness Index, 2012. Available: http://www.grossnationalhappiness.com/wp-content/uploads/2012/04/Short-GNH-Index-edited.pdf, 19/07/2014

revealed that we are still living on an unhappy planet.[14] Here, 'happiness' means sustainable well-being. This index measures "the extent to which countries deliver long, happy, sustainable lives for the people that live in them".[15] It measures the extent of happiness by calculating the number of 'Happy Life Years' (life expectancy adjusted for experienced well-being) achieved per unit of resource use.[16] The report also revealed that happiness does not necessarily have to come at the expense of the environment, since countries with the highest well-being did not necessarily have the highest resource consumption. This provides evidence that social sustainability is affected by environmental sustainability.

2.3.3 The recent global financial crisis has not only become an ongoing crisis affecting global credit markets, debt markets and investment markets, but more importantly it is becoming a social crisis[17]. According to the United Nations report on the world social situation in 2011, the global financial crisis of 2008–2009 and the ongoing global recovery will have long-term social effects.[18] Unemployment rose by 15% between 2007 and 2009. It is estimated that because of the crisis between 47 million and 84 million people fell into, or were trapped in, extreme poverty.[19] As at the beginning of 2014, the World Bank estimated that nearly 75% of the world population live on less than $4 a day.[20] This emphasises that economic sustainability can have significant effects on social sustainability.

2.4 ECONOMIC SUSTAINABILITY

2.4.1 Economic sustainability is inextricably linked to both environmental and social sustainability. This is demonstrated by the limits to growth. Meadows et al. (1972) posit that economies will not be sustainable if natural resources are used beyond the limits and if society continues to depend on phenomena that drove growth in the past. In their book, *The Limits to Growth*, they argued that human demand will exceed nature's supply from the 1980s onwards, with demand exceeding supply by 20% by 2000. At that time, they concluded that, unless special action is taken, population growth coupled with increased resource consumption beyond what the Earth can sustain, will lead to the decline in or the collapse of the environment, economy and society. In their 30-year update the authors concluded that humanity has gone beyond its limits (Meadows et al., 2004). More than ten years later, Turner (unpublished) confirms that the historical trend in non-renewable resources remaining, food per capita, services per capita, population, industrial output per capita and global pollution, has been in line with the trend predicted by the 1972 study, and that population decline is expected by 2030 following economic collapse. More recently, Gilding (op. cit.) stated that humanity has surpassed Earth's capacity to support us. In addition, Thomson (op. cit.) argues that growth in the long term fuelled by cheap oil, debt and information technology is coming to an end. Jones et al. (op. cit.) provide evidence for constraints on resources such as oil, coal, natural gas and uranium and illustrate that growth fuelled by resources is limited.

3. ACCOUNTABILITY FOR SUSTAINABILITY

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[14] New Economics Foundation, The Happy Planet Index: 2012 Report, 2012. Available: http://www.happyplanetindex.org/assets/happy-planet-index-report.pdf, 19/07/2014
[15] Happy Planet Index, www.happyplanetindex.org
[16] New Economics Foundation, The Happy Planet Index: 2012 Report, 2012. Available: http://www.happyplanetindex.org/assets/happy-planet-index-report.pdf, 19/07/2014
[17] The Global Financial Crisis. *The Monthly* (February 2009)
[18] United Nations, The Global Social Crisis: Report on the World Social Situation 2011, 2011. Available: http://www.un.org/esa/socdev/rwss/docs/2011/rwss2011.pdf, 19/07/2014
[19] ibid.
[20] The World Bank, World Development Report, 2014. Available: http://econ.worldbank.org, 19/07/2014

3.1 In order to facilitate the assessment of the sustainability of entities, each entity needs to be accountable to its stakeholders for the effects of its activities (Van der Vorst, Grafe-Buckens & Sheate, op. cit.). Traditionally, accountability refers to the duty of a company to report on the financial results of its activities during a reporting year to its shareholders (Henriques, 2004). In contrast, to achieve sustainability, each entity must be held accountable to all its stakeholders for the effects of its activities on the environment, on society and on the economy (ibid.).

3.2 Secondly, each entity must adopt a long-term view of the effects of its activities on the environment, on society and on the economy (Eccles, Ioannou & Serafeim, 2012). This requirement follows from the definitions in ¶¶2.1.11–12 above. It means that entities must be held accountable not only for the immediate effects of their activities but also for delayed effects as at specified time horizons. On the other hand, reductions of the effects of those activities due to recovery from those effects at the relevant time horizons should also be allowed for.

3.3 Thirdly, each entity must adopt a global view of the effects of its activities (Van der Vost, Grafe-Buckens & Sheate, op. cit.). This requires each entity to recognise that the effects of its activities are not only felt by that entity and its stakeholders, but also have a global effect. Elkington (1994) recognises that sustainability cannot be defined for a single entity but requires system-wide thinking as reflected in the definitions in ¶¶2.1.11–12. As contemplated in ¶2.1.11, this requires that in order for an individual entity to be sustainable, the global environmental, social and economic systems within which it operates need to be sustainable. The principle of proportionality may be applied for this purpose. Thus, for example, if in a particular reporting period an entity emits one-millionth of the greenhouse gases emitted by the global system during that period, then it must be held accountable for one-millionth of the effects. For this purpose, earth science models may be used for the estimation of anthropogenic greenhouse gas emissions and their effects on the biosphere. Similar considerations apply to regional effects; because such effects may be strongly dependent on regional ecosystems, these effects will need to be measured regionally. Thus, for example, if an entity emits one-tenth of the toxins emitted by the regional system into a regional watercourse during that period, then it must be held accountable for one-tenth of the effects. Last but not least, an entity must be accountable for the on-site effects of its activities. Thus, for example, if in a particular reporting period a timber company clear-fells a site and plants alien trees, it must be held accountable for the effects of that activity.

3.4 At this stage we can deduce the requirements of an entity in terms of its accountability to stakeholders for the sustainability of its activities. In order to achieve such accountability, each entity must be held accountable for:

- the effects of its activities during a reporting period on the environment, on society and on the economy as at the end of that period (this satisfies the criterion of immediate accountability for short-term effects);
- the effects of its activities during that reporting period on each of those domains as at future time horizons (this satisfies the criteria of immediate accountability for long-term effects);
- the effects of its activities during future reporting periods on each of those domains as at subsequent time horizons (this satisfies the criteria of accountability for long-term sustainability).

3.5 In order to achieve accountability by and comparability between entities we need measures of the outcomes—i.e. the ultimate effects—of entities' activities on the environment, on society and on the economy (Adams, Frost & Webber, 2004). For example, suppose there are two companies A and B, and that company A pumps more harmful pollutants into a nearby watercourse than company B, whereas company B produces more greenhouse gas emissions than company A. Which company's activities have led to a more adverse environmental effect? This can be determined by measuring the ultimate effects of both activities, in terms of biodiversity for example. The company whose activities led to a higher loss of biodiversity would have the more adverse environmental effect.

3.6 Most measures of sustainability focus on entities' performance and practices and not on the ultimate effects of entities activities. Companies reporting in terms of the guidelines of the Global Reporting Initiative (GRI) find themselves having to report numerous such measures. For example, the GRI requires a company to report on the sum of the water effluents it has discharged into nearby watercourses over the reporting period.[21] This is referred to as an 'environmental performance indicator'. On the other hand the ultimate effect, as described in ¶3.5, of these water effluents will, for example, be the loss in biodiversity caused by these effluents. Whilst environmental performance indicators may be interesting, and may constitute explanatory variables for the estimation of outcomes, they fail to allow comparability on the basis of their ultimate effects on the environment. According to Vos & Reddy (unpublished) "performance is the result of practices which are implemented to affect a desired outcome." It is the outcome that is central to accountability and hence sustainability, not performance (Vos & Reddy, op. cit.). Therefore, the effects referred to in ¶3.4 need to be ultimate effects.

3.7 Also, as contemplated in ¶3.3, the effects to be measured should be not only the on-site effects, but also the entity's proportional accountability for regional and global effects.

3.8 Furthermore, for the purposes of the definitions in ¶¶2.1.11–12 we need additive measures; just as we can add up the financial effects of all entities' activities on the world economy, so we need to be able to add up the measures of all entities effects on each of the domains referred to in those definitions.

3.9 We also need measures that we can use to determine the effects of an entity's activities in the respective domains, i.e. to allocate accountability for changes in the measures. Thus the greater the effect of an entity's activities in a particular domain, the greater should be the increase in the measure as a result of that entity's activities. A zero net effect on the domain should be reflected by a zero net effect on the measure used for that domain. Positive and negative effects on the domain should be reflected by positive and negative effect on the measure used for that domain. We refer to the net effect in each domain as the 'bottom line' in that domain.

3.10 The triple bottom line (TBL) framework is an obvious framework to use to measure sustainability. The ultimate aim of the TBL framework is to make entities accountable for the effects that their activities have on the environment, on society and on the economy (Elkington, 1997). The TBL framework is highly criticised, apparently because of the vagueness of its formulation. Based on the argument for measuring ultimate effects presented in ¶3.5, the authors propose that, in order to make entities accountable for the effects of their activities on the environment, on society and on the economy, the ultimate effects of these

[21] Global Reporting Initiative, Version 3.1 Indicators Protocol Set Environment, 2011. Available: https://www.globalreporting.org/reporting/G3andG3-1/g3-1-guidelines/Pages/default.aspx, 27/07/2014

activities on the three domains need to be measured. Based on the authors' specification of the accountability requirements in section 3, they propose a three-fold approach to measuring sustainability. In the first place, as shown in Figure 1, the measurement of the sustainability of entities requires the measurement of the ultimate effects—i.e. the immediate (year-end) outcomes—of an entity's activities on the environment, on society and on the economy (the environmental bottom line, the social bottom line and the economic bottom line respectively) during a reporting period. Secondly, it requires the projection of the ultimate effects at future time horizons of the entity's activities during the reporting period. The purpose of this is to include delayed effects of activities during the reporting year and to allow for reductions of the effects of those activities due to recovery from those effects. Thirdly, in respect of activities during future reporting periods, assuming business as usual, it requires the projection of the ultimate effects of those activities at subsequent time horizons. The purpose of this is to measure the effects of business as usual up to the time horizon. In Figure 1, the rectangles indicate the periods of activity under consideration and the bold vertical lines indicate the time horizons.

3.11 The second requirement provides an explanatory bridge between the first and the third. If the time horizon is taken to be the end of the reporting period then the second requirement collapses to the first. By extending the time horizon year by year into the future, one can see how delayed effects and recoveries change the effects of the entity's activities during the reporting period. This enables a stakeholder to assess how sustainable the activities of the entity were during the reporting year.

3.12 By comparing the second and third requirements a stakeholder can assess how sustainable business as usual will be in comparison with the reporting period. For example, if there are ten reporting periods up to the time horizon and the effects of future activities are the same as those of the activities during the latest reporting year then, all else being equal, the measure of the effects of the future activities will be ten times the measure of the effects during the last reporting period. Of course, all else is unlikely to be equal. The effects of continuance of business as usual may be exponential, or they may reach a critical point beyond which they escalate much more rapidly. By varying the time horizon at which requirements 2 and 3 are measured and compared, the progression of such effects can be analysed. Such comparisons will enable the entity to take timely action to avoid such effects.

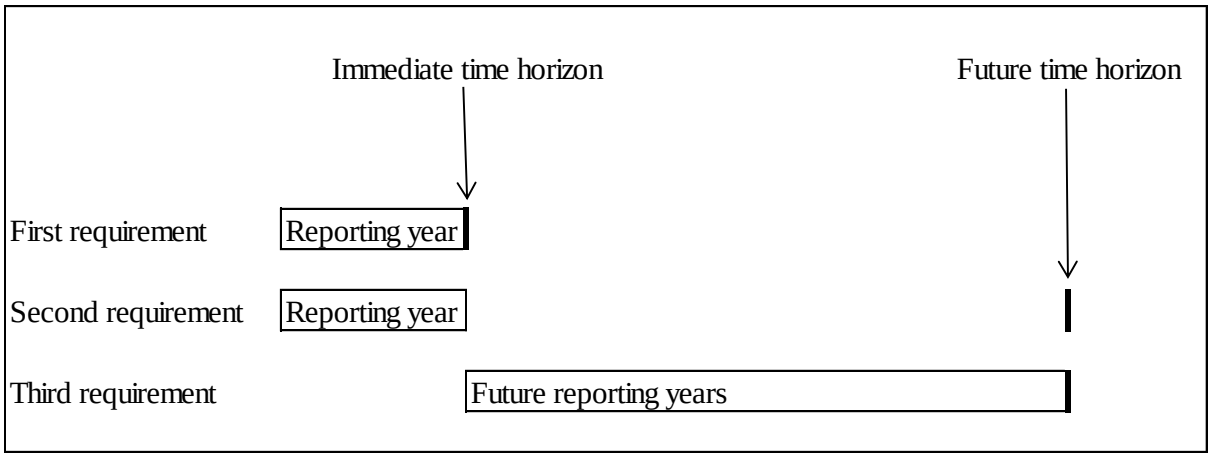

Figure 1. Reporting years and time horizons

3.13 In this paper, the authors have used 'economic' and 'financial' without distinction. For the purposes of measuring sustainability a distinction needs to be drawn between the

economic bottom line and the financial bottom line. The economic bottom line should still be measured in monetary terms, but should incorporate the effects of externalities on profits. Jennings (op. cit.) makes the significant assertion that "while the economic component of the triple bottom line is often assumed to be synonymous with financial performance" they are in fact significantly different. He aptly describes the economic effect on the financial bottom line:

> "Corporate annual reports primarily address the immediate needs of shareholders and financial analysts; but they do not directly account for what is important to stakeholders in economic, as opposed to purely financial, terms. For example, investments made by a company in training and educating employees make an economic contribution beyond the company's boundaries by building national productive capacity in society at large [or] through the provision of employment, the income that employees earn and use and the taxes that they pay, as well as the impact on local suppliers and service providers."

It may at first sight seem that, by deducting environmental, social and economic externalities, we are double-counting effects that will appear as costs in the environmental or social bottom lines. However, if for example a particular activity affects the environment, and via the environment it also affects the economy, then it must be reflected both in the environmental bottom line and in the economic bottom line. The three bottom lines should not be seen as additive; in fact they are measured in three different units of measurement. They constitute three different ways of measuring the effects of an entity's activities. In fact 'bottom line' is a misnomer; what we are interested in is value added, but the expression is now irremediably established in the vocabulary of the public. The distribution of value added is beyond the scope of the 'triple bottom line' of the entity.

3.14 As indicated in ¶2.1.12, the concept of efficiency is required in order to determine whether an entity is sustainable. More particularly, for each entity we need to determine whether it is sustainable in each domain. This may be considered with reference to Figure 1. Since we are considering future sustainability we must consider requirement 3. If the economic bottom line at future time horizons is negative then the entity is economically unsustainable. The following options are then available: the entity could draw up a plan that will make it sustainable; it could be nationalised or subsidised (which may be worthwhile if the environmental and social bottom lines are sufficiently high); or it could be liquidated. Otherwise the environmental efficiency of the entity to a specified time horizon may be taken as the ratio of the environmental bottom line to the economic bottom line and its social efficiency as the ratio of the social bottom line to the economic bottom line.

3.15 For the purposes of ¶2.1.12 we now need to determine the most efficient way of restoring the global system (which now excludes economically unsustainable entities) to sustainability in the environmental and social domains. For this purpose we sort all entities in descending order of environmental efficiency at a specified time horizon. We then determine the cumulative economic and environmental bottom lines at that time horizon. Where the cumulative environmental bottom line becomes zero we draw a line between the entities above that point and the entities below. The former are sustainable: as contemplated in ¶2.1.11 the most efficient way of restoring the system to sustainability would not necessitate any change in the activities of those entities. The latter are environmentally unsustainable at the specified time horizon. We now determine the environmental efficiency of the last entity in the sustainable category. We refer to this as the 'minimum environmental efficiency' for that time horizon. This exercise is repeated for every time horizon. Once the model has been

developed it can be run it for a range of time horizons and the results can be presented in either tabular or graphic form. A similar process is followed for social sustainability. Every entity that is environmentally or socially unsustainable at any time horizon will need to submit a plan to increase its environmental or social efficiency at each such time horizon to the minimum environmental and social efficiency at that time horizon. Year by year thereafter it will be accountable to its stakeholders for implementing that plan. For this purpose the first requirement in Figure 1 will be used if the entity has previously been found to be unsustainable at the end of the current reporting period and the second requirement will be used for the subsequent time horizons at which the entity has been found to be unsustainable.

4. HOW INSTITUTIONAL INVESTORS CAN PROMOTE SUSTAINABILITY

4.1 Institutional investors are entities that invest money on behalf of other people. They include pension funds, insurance companies, banks, collective investment schemes and companies (Sandberg, 2011). Institutional investors are major players in the global financial market. In the UK, for instance, they control over 84% of total shareholdings (Sandberg, op. cit.). They are so large, and their asset portfolios are so widely diversified, that they virtually "own" the global economy (Kiernan, 2007). They share a common interest in economic sustainability as their investment portfolios are affected more by overall economic performance than by the performance of individual companies (Urwin, 2011). Since environmental, social and economic sustainability are connected, sustainability is affected by the investment choices institutional investors make and it affects the choices they make.

4.2 A recent example of the former effect is the economic and social effects of the global financial crisis. Following the pattern of other crises in the past four hundred years, the recent global crisis was precipitated by short-termism—as banks and companies invested for short-term gains (Kindleberger &Aliber, 2005), because of short-term optimism about the American property market, rather than for productive purposes (Kindleberger & Aliber, 2005; Thomson, op. cit.)—and by poor corporate governance (Croce, Stuart & Yermo, 2011). The effects of this crisis on human well-being were far-reaching.

4.3 An example of the latter effect is that institutional investors' choices are influenced by the wider economic consequences of externalities. For example, it is conceivable to achieve short-term excess returns by investing in a company that avoids the costs of state-of-the-art pollution control systems (Kiernan, op. cit.). But even for a diversified investor, such as an institutional investor, environmental costs are unavoidable as one company's externalities can damage the profitability of other portfolio companies, adversely affecting overall market return.[22] If the entities in which an institutional investor is investing are unsustainable then that investor is unsustainable. Hence, the long-term environmental, social and economic concerns detailed in section 2 present a compelling case for evaluation of how the investment principles of institutional investors might be better aligned to the promotion of sustainability (Hawley, Johnson & Waitzer, 2011).

4.4 There is a growing concern that long-term institutional investors, such as pension funds and life insurance companies, are becoming increasingly "short-termist" (Croce, Stuart & Yermo, op. cit.). Their investment strategies are currently short-termist because: asset

[22] Trucost commissioned by the United Nations Environmental Programme Finance Initiative and the United Nations Principles for Responsible Investment Initiative, Universal Ownership: Why Environmental Externalities Matter to Institutional Investors, 2010. Available: http://www.unepfi.org/fileadmin/documents/universal_ownership_full.pdf, 21/07/2014

managers' incentives are based on their performance against short-term market-related benchmarks (Hawley, Johnson & Waitzer, op. cit.), market values of portfolios are based on current prices (Lydenberg, 2009) and investment holding periods are declining (Croce, Stuart & Yermo, op. cit.). Index-tracker funds and institutional investors that track indices become perpetual short-term investors (Lydenberg, op.cit.) that feed asset price bubbles (Croce, Stuart & Yermo, op. cit.). As mentioned in ¶4.1, the short-termist views of investors negatively affect sustainability. Therefore, true long-term investing is needed. This requires institutional investors to incorporate sustainability issues into investment decisions as sustainability requires entities to adopt a long-term view (see ¶3.2). It also requires a shift in focus from short-term price to long-term value (Lydenberg, op. cit.).

4.5 There have been significant developments to address sustainability concerns with regard to the financial services industry, in which institutional investors operate. The United Nations Environment Programme Finance Initiative, founded in 1992, aims to promote the mainstreaming of sustainability concerns into financial institutions' operations, decision-making and governance and to mobilise capital to foster a more sustainable economy.[23] It has contributed to the launch of the United Nations Principles for Responsible Investment and the Sustainable Stock Exchanges Initiative and has developed the Principles for Sustainable Insurance.[24] The launch of the United Nations Principles for Responsible Investment Initiative in 2006 marked an international commitment from institutional investors to incorporate sustainability issues into their investment decision-making and ownership practices.[25] These principles apply to service providers of institutional investors such as asset managers, and asset owners such as pension funds and insurance companies. As at the end of 2011, the initiative had over 850 signatories, including many of the world's largest pension funds, collectively representing more than USD 25 trillion (Hawley, Johnson and Waitzer, op. cit.). Despite the increasing number of signatories committed to these principles, they are not being adequately integrated into investment strategies due to a lack of expertise on how to integrate them. [26]

4.6 Socially responsible investing (SRI) has grown because of growing concerns of investors, both institutional and individual, about climate change (Lee, Faff & Langfield-Smith, 2009), numerous corporate scandals (Herringer, Firer & Viviers, 2009) and human catastrophes such as Chernobyl (Lee, Faff & Langfield-Smith, op. cit.). SRI governs the manner in which investors invest. It is based on the premise of investing in entities that demonstrate good financial performance and corporate governance and protect the environment (Sethi, 2005) and society (Hartman, Rubin & Dhanda 2007). As at the end of 2012, assets engaged in responsible investing represented 11,3% of total assets under management in the United States of America.[27] Asset management companies have responded to the growing demand for socially responsible investments by offering SRI products (Herringer, Firer & Viviers, op. cit.). Index producers have developed numerous SRI indices. In South Africa, the JSE Socially Responsible Investment Index was established in 2004.[28] The criteria used to select the constituents include environmental, social and

[23] United Nations Environment Programme Finance Initiative, http://www.unepfi.org
[24] ibid.
[25] United Nations Principles for Responsible Investment, http://www.unpri.org
[26] United Nations Environment Programme Finance Initiative, Fiduciary Responsibility, 2009. Available: www.unepfi.org
[27] The Forum for Sustainable and Responsible Investment, Report on Sustainable and Responsible Investing Trends in the United States, 2012. Available: http://www.ussif.org/files/publications/12_trends_exec_summary.pdf, 17/07/2014
[28] Johannesburg Stock Exchange, https://www.jse.co.za

governance (ESG) concerns. SRI is growing but, like the current methodology of the GRI, it focuses on the practices of entities and not on the outcomes of their activities.

4.7 The long-term environmental, social and economic concerns detailed in section 2 also present a compelling case for evaluation of how the fiduciary duties of pension-fund trustees might be better aligned to promote sustainability (Hawley, Johnson & Waitzer, op. cit.). The trustees of a pension fund have a duty to act with care and prudence in the management of the fund's assets (Richardson, 2007; Thomson & Reddy, unpublished), a duty to act in accordance with the purpose of the fund (Richardson, 2007) and a duty of impartiality (Hawley, Johnson and Waitzer, op. cit.). Taking ESG considerations into account when investing in companies is considered to follow from the duty of prudence since there is evidence to suggest that the financial performance of companies is affected by their ESG performance.[29] The duty of prudence encourages trustees to follow the strategies of similar pension funds (Galler (2002) cited in Hawley, Johnson and Waitzer (op. cit.)). This herd mentality coupled with the focus on short-term investing discussed in ¶4.4, creates market volatility and distracts trustees from acting in the best interests of the members (Del Guercio (1996) cited in Hawley, Johnson and Waitzer (op. cit)), which may contravene the duty of impartiality and the duty to act in accordance with the purpose of the fund (Sethi, op. cit.). In order for pension funds to deliver sustainable benefits over several generations, the incorporation of sustainability issues into investment decisions may assist trustees in discharging their fiduciary duties more effectively (Hawley, Johnson and Waitzer, op. cit). It is apparent that trustees need regulatory or legal impetus to integrate such issues into investment decisions.[30] South Africa has taken the lead in this respect (Hawley, Johnson and Waitzer, op. cit.) through the amendment to regulation 28 of the Pension Funds Act which states that:

> "Prudent investing should give appropriate consideration to any factor which may materially affect the sustainable long-term performance of a fund's assets, including factors of an environmental, social and governance character. This concept applies across all assets and categories of assets and should promote the interests of a fund in a stable and transparent environment."[31]

4.8 Companies' focus on short-term profits is driven by the primacy of the shareholders' interests over any other stakeholder (Doane, 2004). The pressure by executives to meet quarterly earnings may encourage them to cut costs, for example forego a pollution-control system (Tonello, unpublished), but the environmental, social and economic costs (Jennings, 2004) of increased pollution emitted by the company will be borne by society at large and paid for by future generations (Tonello,op. cit.). And investors in companies need to be held accountable for their share in the environmental, social and economic effects of the companies they invest in. There is evidence to support the argument that the financial performance of companies is affected by their ESG performance because shareholder value can be eroded by externalities, as discussed in ¶4.3. This evidence has signalled the need for business to integrate financial results with ESG concerns. Again, South Africa has taken the

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[29] United Nations Environment Programme Finance Initiative, The Materiality of Social, Environmental and Corporate Governance Issues to Equity Pricing, 2004. Available: http://www.unepfi.org/fileadmin/documents/amwg_materiality_equity_pricing_report_2004.pdf, 17/07/2014

[30] Freshfields Bruckhaus Deringer commissioned by United Nations Environment Programme Finance Initiative, A Legal Framework for the Integration of Environmental, Social and Governance Issues into Institutional Investment, 2005. Available: http://www.unepfi.org/fileadmin/documents/freshfields_legal_resp_20051123.pdf, 15/07/2014

[31] South African Pension Funds Act, Regulation 28, www.fsb.co.za, 08/04/2014

lead in this respect. The establishment of the King Report on Corporate Governance in South Africa in 2009, led to companies' being required to report on ESG issues.

5. HOW ACTUARIES CAN PROMOTE SUSTAINABILITY

In this section we consider two questions: first, how unsustainability affects what actuaries are currently doing, and secondly what actuaries should be doing in the future that we are not currently doing.

5.1 HOW UNSUSTAINABILITY AFFECTS WHAT ACTUARIES ARE CURRENTLY DOING

5.1.1 The sustainability concerns discussed in section 2 will have a material effect on actuarial assumptions, particularly for the modelling and valuation of liabilities. This section reviews actuarial literature on these effects. Despite these material effects, the actuarial literature on this subject is limited to resource constraints and climate change.

5.1.2 As Dr A. Jones points out, the effects of resource constraints on actuarial assumptions relate to both our economic assumptions and our demographic assumptions.[32] Jones et al. (op. cit.) concluded that resource constraints would place a limit on future economic growth rates. They provide evidence, albeit subjective, that our assumptions about future economic growth will be lower, returns on investments will be lower and discount rates will be lower as governments respond to a lower-growth environment. Real wage growth will be lower and life expectancies will decline. Allen et al. (unpublished) provide similar arguments for the effects of climate change and resource depletion. Clearly, actuarial advice on these matters will be affected (ibid.). The net result will be a severe strain on solvency for defined-benefit pension funds, reduced levels of defined-contribution pensions and reduced viability of savings and risk-management products (Jones et al., unpublished). There will be limited or no data to rely on (Jones et al., op. cit.; Allen et al., op. cit.). However, while Jones et al. (op. cit.) serves as an illustration of future scenarios, "it cannot yet form the basis of actuarial modelling in any mechanistic way" (Thomson, op. cit.).

5.1.3 Climate change is considered to be the "greatest strategic threat for the insurance industry".[33] Other issues, such as natural catastrophes, are compounded by climate change (Mills, 2009). It is expected that climate change will significantly affect the liabilities of insurance companies, banks and pension funds (Louis, unpublished). Louis (op. cit.) uses the direct effects of climate change on business according to the IPCC to illustrate the effects of climate change on the insurance industry. For example, higher temperatures would cause increased incidence of deaths and serious illness and reduced cold-related morbidity and mortality. This would affect life- and health-insurance business directly. Higher temperatures would increase the risk of death in livestock and damage to crops and reduce the risk of damage to crops due to cold weather. This would affect general insurance business directly (Louis, op. cit.). Therefore, climate change will increase insurance costs, reduce insurability (The Geneva Association, unpublished) and increase premium rates (Allen et al., op. cit.). Mills (2009) points out that as net liability exposures are expected to increase with climate-change risks, availability and affordability of insurance will become increasingly problematic from an underwriting and asset-management perspective. Resource depletion will affect investment strategies, pricing methodologies, underwriting guidelines and product development used in the insurance industry (Allen et al., op. cit.). Regulation of the financial

[32] Sharing a Finite World. *The Actuary* (January/February 2013)
[33] Ernst and Young, Strategic Business Risk, 2008. Available: http://www.climateneeds.umd.edu/reports, 16/07/2014

service industry will be affected as governments respond to negative effects of climate change and the effects of reduced energy supply (ibid.).

5.1.4 Micro-finance is considered to play a role in poverty alleviation (Zeller & Sharma, 2000). On the other hand, Thomson & Posel (2002), argue with regard to the provision of funeral insurance to burial societies in South Africa, that, "given their divergence in interests, it appears that, without stricter regulation of insurers in general and policing of illegal insurers in particular," micro-insurance cannot be of benefit to burial societies. The main problem facing the provision of micro-insurance is the challenge of minimising the cost of provision so that it can be affordable to poorer households (Ziller & Sharma, op. cit.). But as Thomson & Posel (op. cit.) argue, these are not the only problems; microfinance may in effect undermine social networks and norms of reciprocity by replacing mutual assistance and its associated social networks with commercialised products. From section 2.3, it is evident that economic and environmental concerns will lead to higher levels of poverty and lower levels of food security. Therefore, the provision of micro-insurance is likely to become more expensive.

5.2. WHAT SHOULD ACTUARIES BE DOING IN THE FUTURE THAT WE ARE NOT CURRENTLY DOING?

5.2.1 Through the establishment of interest groups and working groups such as the Resource and Environment Working Group[34], through changes to the guidelines on the advice being given to clients such as the Code for Responsible Investing in South Africa[35] and through the involvement of individual actuaries in sustainability issues, the actuarial profession has made some progress on the issues discussed in section 5.1. Most of the contribution has been in the area of climate change and resource constraints. We shall need to focus on all three dimensions of sustainability—economic, environmental and social—and not just on economic and environmental sustainability. Actuaries have also been actively involved in advising clients on SRI. However, as mentioned in ¶4.6, such investment focuses on the practices of entities and not on the outcomes of their activities. As discussed in ¶3.5, outcomes are important for the measurement of sustainability and for accountability, not practices.

5.2.2 Most actuaries advise or are employed by institutional investors. As the need for institutional investors to adopt a long-term view grows, actuaries will need to provide solutions to how institutional investors can incorporate sustainability issues in their investment decisions. We should include issues of sustainability in addressing the problems that our clients ask us to solve (Allen et al., op. cit.). This requires measuring the sustainability of the entities our clients invest in, measuring the sustainability of our client's activities and measuring the effects of unsustainability on economic returns.

5.2.3 Based on the authors' specification of the accountability requirements, they propose a three-fold approach to measuring sustainability based on the TBL framework (discussed in ¶¶3.10–3.13). For the purposes of determining the sustainability of an entity they propose to measure the environmental and social 'efficiency' of that entity relative to its economic bottom line (discussed in ¶3.14). They also propose the formulation of plans for achieving minimum levels of sustainability and for accountability for the implementation of such plans (discussed in ¶3.15).

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[34] Resource and Environment Working Group, http://www.actuaries.org

[35] Institute of Directors Southern Africa, Code for Responsible Investing in South Africa, 2011. Available: http://c.ymcdn.com/sites/www.iodsa.co.za/resource/resmgr/crisa/crisa_19_july_2011.pdf, 08/04/2014

5.2.4 To determine how unsustainability affects economic returns, projections of investment returns need to be extended to include the effects of environmental, social and economic externalities in the economic domain.[36] Furthermore, actuaries should be able to report to clients about the environmental and social returns on their investments.

5.2.5 To address the effects of unsustainability on actuarial models, actuaries will need to model the effects of unsustainability on actuarial assumptions in general and on the valuation of liabilities in particular. For example, Jones et al. (op. cit.) envisage rates of return on the market portfolio ranging from zero to 3% a year, depending on four scenarios. These rates need to be used, at least for illustration based on those scenarios. The scenarios relate to the sensitivity of governments and markets to resource limitations. Whilst the quantitative effects suggested by Jones et al. (op. cit.) for the scenarios that they use are interesting—and in fact suggest quite substantial departures from the typical assumptions currently being made by actuaries—they are not adequate for this purpose. In the first place they are quite subjective. They merely illustrate what the authors envisage under the scenarios they describe. The challenge to actuaries is to model those effects.

5.2.6 Actuaries can promote sustainability by getting involved in the development and application of the methodology of TBL reporting discussed in ¶¶3.10–3.15. This will enable actuaries to advise clients in the financial-services industry not only on their financial returns but also on their environmental, social and economic returns. Furthermore, it will enable us to advise clients in other sectors on TBL measurement, modelling and reporting.

6. CHALLENGES FOR THE ACTUARIAL PROFESSION

6.1 The accounting profession has developed most of the framework for reporting on the TBL (Adams, Frost & Webber, op. cit.), so why not leave the job of measuring and modelling the triple bottom line to the accountants?

6.2 Firstly, as observed in ¶3.6, the current reporting framework focuses on practices, not on ultimate effects. Where environmental outcomes are calculated, they tend to be expressed in financial terms—typically the cost of avoiding adverse environmental effects before they occur or of restoring the environment after they occur (Howes, 2004). The use of monetary measures of the environmental bottom line is reductionist (Jacobs, 1991). Either one is valuing the environment merely in terms of its use to human society or one is valuing it merely in terms of the cost of restoring it if it were damaged. Both approaches reduce the environment to merely a part of the economy. In recent years some actuaries have fallen into the same trap. For example, Carroll et al. (unpublished) uses three categories of methods to value 'ecosystem goods and services' in monetary terms. The first category involves the determination of the market value of the goods and services provided by the ecosystem. The second involves surveys of respondents to assess their 'stated preferences' and the third involved the determination of 'revealed preferences'; i.e. the effects of the ecosystem on prices and costs. Such approaches are useful in determining the externalities that need to be included in economic value of an ecosystem. They are therefore useful in determining the economic value added (or subtracted) by an entity that positively (or negatively) affects the economic value of that ecosystem. However, for the purposes of determining the effects of

[36] Trucost commissioned by the United Nations Environmental Programme Finance Initiative and the United Nations Principles for Responsible Investment Initiative, Universal Ownership: Why Environmental Externalities Matter to Institutional Investors, 2010. Available: http://www.unepfi.org/fileadmin/documents/universal_ownership_full.pdf, 21/07/2014

an entity's activities on the ecosystem per se they would be economistic; they would suggest that the environment may be entirely expressed in terms of money—that there is nothing in the environment that money cannot buy. Besides being economistic, a monetary measure of the environmental bottom line would also be anthropocentric; it would suggest that the environment is nothing but its use to human society.

6.3 Similar arguments apply to the measurement of the social bottom line. A monetary measure of the social bottom line would be economistic (Jacobs, 1991).

6.4 As discussed in section 2.1, we cannot have an economy without human society and there can be no human society without an environment. In each domain we need a measure that is meaningful in that domain. The environmental domain needs to be measured in terms of variables that are meaningful to the environment, such as biomass and biodiversity. The social domain needs to be measured in terms of variables that are meaningful to society, such as human well-being. In each domain the measure should be defined so as to facilitate the determination of the effects of an entity's activities on that domain. The use of one-dimensional measures will inevitably be reductionist, as they inevitably reduce a number of components to one scalar value. But a measure that is meaningful will avoid unnecessary reductionism. To date the accounting profession has not addressed these principles.

6.5 Secondly, there is a lack of commitment to the expert auditing of reporting that does not pertain to the financial bottom line, making the quality of expert attestation applied to such reports significantly weaker than that applied to financial reports (Gray & Milne, 2002).

6.6 Finally, and most importantly, actuaries are more orientated towards the modelling of measures of entities' bottom lines and have the experience and the necessary skill set to formulate mathematically defined variables and to develop models of those variables based on specified assumptions about the relationships between them and about future uncertainties. Mr C. Gingell, a general-insurance actuary, describes the role of actuaries in modelling sustainability as follows[37]:

> "…quantifying downside scenarios has been the realm of engineers or economists, who often rely on point estimates and worst-case scenarios. The stochastic modelling skills actuaries can deploy allow organisations a far deeper understanding by showing the relative likelihood of different scenarios occurring."

In the context of resource constraints, Allen et al. (op. cit.) state that actuaries "with our deep and practical understanding of financial modelling and communicating long-term risk, are ideally placed to help global efforts to face [the challenges of resource depletion] and to adapt to this changing world." Actuaries should be "at the forefront" of a full exploration of the effects of resource depletion on the global financial system (ibid.).

6.7 One might also question whether actuaries have the expertise to model the environmental and social bottom lines. It may be considered more sensible to have each profession deal with the bottom line in which it has the expertise Thus, for example, the environmental scientists could develop the environmental bottom line. Which discipline would be responsible for the social bottom line would be a little more difficult; a measure of human well-being would require expertise from sociology, psychology, statistics, health science and demography. Actuarial science already uses knowledge from the three latter

[37] The Green Guardians. *The Actuary* (June 2013)

disciplines. As Ms C. Jones, a pensions actuary and sustainability and economics manager at the Institute of Chartered Accountants in England and Wales puts it[38]:

> "Sustainability issues are too often seen as concerns for other people. Part of the problem is caused by gaps in background knowledge. For example, business and finance specialists may know little about ecology, so they often do not appreciate just how much businesses and society generally depend on the natural environment."

Therefore, we need to respect the eclectic nature of our discipline and recognise that to develop outcomes-based measures, to achieve sustainability, we shall need to work with other disciplines and draw knowledge from them. But the development and modelling of measures in the three domains of the TBL will necessitate an integrated approach: the criteria adopted for the definition of the measure to be used in each domain must be consistent with those adopted in each of the other domains. Also, feedback from one domain to another will have to be consistently allowed for.

6.8 Paradigm shifts are needed for a sustainable future. Elkington (1997) calls for seven revolutions in order for companies to deliver against the TBL and to transition into 'sustainable capitalism'. The seven revolutions focus on markets, values, transparency, life-cycle technology, partnerships, time and corporate governance (Elkington, 1997). The first revolution, in markets, will be that markets will be driven by competition rather than compliance. As a result, business will shift from using competition as an excuse not to address the TBL to using it as part of business strategy. The second revolution, in values, involves a shift from commercial values to human and societal values. He states that the worst blind-spot that business suffers from is that the purpose of business is about the creation of economic value and not about social or ethical values. The third revolution, in transparency, requires business to increase the level of disclosure to stakeholders and increase the information disclosed to stakeholders, as stakeholders increasingly demand information on what business is doing and planning to do. The information disclosed is being used to benchmark, compare and rank the performance of competitive companies. Companies are increasingly operating in a global goldfish bowl as entire value chains, linking suppliers and customers, are becoming more transparent. The fourth revolution relates to a shift to life-cycle technology. Companies that assume that their responsibility ends at the point of sale will be required to consider the TBL effects of their operations and products from the point of sale to disposal. The fifth revolution, in partnerships, requires partnerships to emerge between companies and other organisations such as activist groups, and to align sustainability goals. The sixth revolution, in time, requires business to shift their focus from the short-term to the long-term to deal with the longer-term problems of sustainability. Finally, the seventh revolution in corporate governance, requires the TBL agenda to be the responsibility of an entity's board of directors. Corporate governance permeates the other six revolutions. (ibid.)

6.9 Shah (2004) draws on Kuhn's (1996) arguments on how paradigm shifts occur, to describe the paradigm shift needed for a sustainable future, as follows:

> "It requires something more than pictures of businessmen assuming new ways of controlling the ecological and social conditions of life. These problems are more than a call for simply solving the next puzzle since they also require culturally oriented transformations in our current ways of thinking, being and knowing. They involve changing how we look at puzzle-solving and changing the puzzles that we are interested in solving."

[38] ibid.

6.10 The TBL has the potential to redefine the dominant paradigm of actuarial science. Our quantitative approach will be challenged, as we shall need to embrace the qualitative and philosophical before positing the models, and we shall need to accept that our modelling is only part of the solution. The modelling of the TBL will require us to shift from "making financial sense of the future" to "making sustainable sense of the future" where 'sustainability' refers to economic, environmental and social sustainability.

6.11 Finally, we need to recognise that, if we do not embrace the TBL and recognise our clients' accountability for the sustainability of their activities in all three domains, we shall be consigning ourselves to a minor role in the greater scheme of things. Already companies are accepting accountability in the social and environmental domains by including practice-based measures of their activities in their annual accounts as specified by the GRI and sustainability reporting on that basis is becoming standard practice (Vos & Reddy, unpublished).

6.12 As a result of our membership of and involvement in the actuarial profession, our perspectives as the authors of this paper are inevitably influenced by those of the profession. We make no apology for those perspectives.

6.13 As Elkington's (1997) revolutions unfold, and as accountability for the TBL becomes embedded in the practice of human, corporate and governmental activity, all participants in that activity will need to come on board. Furthermore, we cannot afford to give primacy to the economic bottom line, let alone the financial bottom line. Each domain needs to be taken as seriously as the others. As Elkington argues, "to refuse the challenge implied by the triple bottom line is to risk extinction." (ibid.)

7. SUMMARY

7.1 Concerns about sustainability, such as the effects of climate change and limits to growth, are well known. Despite the growing concerns about sustainability, there is little or no consensus on what it means. For the purposes of this paper, the global economic system—that is, the sum total of human economic activity—is taken to be 'sustainable' if, assuming its indefinite continuance, the effects of that activity will enable the environment, human society and the economic system itself to attain and maintain a state of well-being in every region of the world. An entity is considered sustainable if (a) the entire global system is sustainable, or (b) the most efficient way of restoring the system to sustainability would not necessitate any change in the activities of that entity.

7.2 In order to facilitate the assessment of the sustainability of entities, each entity needs to be accountable to its stakeholders for the effects of its activities. It is argued in this paper that, in order to achieve such accountability for sustainability, each entity must be held accountable for:

- the effects of its activities during a reporting period on the environment, on society and on the economy as at the end of that period;
- the effects of its activities during that reporting period on each of those domains as at future time horizons; and
- the effects of its activities during future reporting periods on each of those domains as at subsequent time horizons.

In order to achieve accountability by and comparability between entities we need measures of the outcomes—i.e. the ultimate effects, of entities' activities on the environment, on society and the on economy. Therefore, the effects referred to in this definition need to be ultimate effects. They must include not only on-site effects but also the entity's proportional accountability for regional and global effects. The measures of those effects must be additive. Based on the authors' specification of the accountability requirements, they propose a three-fold approach to measuring sustainability based on the TBL framework. For the purposes of determining the sustainability of an entity they propose to measure the environmental and social 'efficiency' of that entity relative to its economic bottom line. They also propose the formulation of plans for achieving minimum levels of sustainability and for accountability for the implementation of such plans.

7.3 Since institutional investors virtually "own" the global economy, economic sustainability—and hence environmental and social sustainability—is affected by the investment choices institutional investors make and in return it affects the choices they make. Therefore, long-term environmental, social and economic concerns present a compelling case for evaluation of how the investment principles of institutional investors might be better aligned to promote sustainability. For this purpose, an evaluation of the current short-term view of institutional investors' investment strategies, the fiduciary duties of trustees and the focus on short-term profit of companies is provided in this paper.

7.4 Sustainability concerns will have a material effect on actuarial assumptions and future liabilities and on the advice provided to clients. Despite these material effects, the actuarial literature on this subject is limited to resource constraints and climate change. Actuaries advise or are employed by institutional investors. As the need for institutional investors to promote sustainability grows, actuaries need to provide solutions to how institutional investors can incorporate sustainability issues in their investment decisions. This requires measuring the sustainability of the entities our clients invest in, measuring the sustainability of our client's activities and measuring the effect of sustainability on economic returns. To address the effects of unsustainability on actuarial models, actuaries will need to model the effect of sustainability on actuarial assumptions in general and on liabilities in particular.

7.5 Given our skills and experience in the modelling of the outcomes of entities' activities in the economic domain, we have a unique position in society relative to other professions to measure sustainability and model the effects of unsustainability on our assumptions and in the modelling and valuation of the liabilities of financial institutions. We need to respect the eclectic nature of our discipline and recognise that to develop outcomes-based measures, to achieve sustainability, we shall need to work with other disciplines and draw knowledge from them.

8. FURTHER RESEARCH

8.1 The measures discussed in this paper will need to be specified. For that purpose, the criteria for the specification of those measures will need to be established and alternative specifications will need to be discussed with reference to those criteria. For the purposes of practical application it will not be feasible to measure the effects of each entity on every element of the global environment, nor on every human being. Regression models expressed in terms of explanatory variables will be required. Some of these explanatory variables may be the practice-based variables currently used by the GRI. Alternative definitions of the explanatory variables will need to be explored. The structure of the models required for the

projection of the explanatory variables to future time horizons, and therefore of the measures themselves at those time horizons, will need to be specified.

8.2 The measures and models contemplated in this paper relate to the activities of entities. Investors' accountability for their proportional share in the environmental, social and economic value add of the entities they invest in will need to addressed.

8.3 Similarly, brandholders' accountability for the environmental, social and economic effects of the processes of production and consumption of their brands of goods and services will need to addressed.

8.4 The models of the environment produced by earth scientists generally allow for alternative policies with regard to greenhouse gas emissions, land-use change etc.. For the purposes of the modelling required for accountability, projection will be required of the effects of economic activity. These effects will be measured as the difference between the measures assuming no economic activity and the measures assuming business as usual. The environmental models will need to be specified to produce projections on such assumptions.

8.5 Similarly, the demographic effects of economic activity will have to be modelled for the purpose of measuring the effects of economic activity on human well-being as required for the social bottom line.

8.6 The regression models of the required measures, and the time-series models required for projections to future time horizons will need to be parameterised. This will be a very costly exercise. A scoping study, which itself will be a substantial project, will be required in order to assess the costs and benefits of implementing the measurement, modelling and accountability processes required and to ensure that the parameterisation of the models is undertaken cost-effectively.

8.7 The implementation of the proposed process will be controversial, and many vested interests are involved. Whilst this matter is not essentially a matter for research, it will require careful planning and professional advice will be required.

8.8 In each of these areas, individual actuaries, or the actuarial profession as a whole, should be able to play a part.

ACKNOWLEDGEMENT

We the authors are members of the project group on the TBL established by the Resources and Environment Working Group of the International Actuarial Association. We appreciate the support given to our research by that Working Group. However, the opinion and commentary in this paper should not be construed as that of the International Actuarial Association.

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