How Should a ‘Sustainable Corporation’ Account for Natural Capital?

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Abstract

Corporate activity promotes economic growth. This has obvious benefits for society, yet by placing unsustainable demands on natural resources, it also poses serious problems. Part of the response to this should be clarity over corporate responsibility and accountability towards the environment, including in regard to the design and implementation of an appropriate system of accounting. In this paper we propose a reinterpretation of financial accounting in which it is argued that existing systems should not be viewed as independent of natural capital accounting; instead, financial accounting should be extended to record profit as a surplus with respect to financial capital once physical capital maintenance of (critical) natural capital has been recorded. Such an approach draws a clean distinction between stocks and flows that are financially and sustainability relevant, while incorporating both within an integrated accounting system. This mitigates the tension that conventionally exists between corporate responsibility towards shareholders and stakeholders.

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How Should a ‘Sustainable Corporation’ Account for Natural Capital?

This paper addresses the intrinsic limitations of current (financial) accounting practice with respect to corporate sustainability and the natural environment (‘natural capital’). Building on the extant literature, whilst also addressing some of its limitations, the aim of the paper is to demonstrate how existing accounting systems should be adjusted to align them more closely with the information needs of sustainable corporations.

The paper is structured as follows. Section 1 sets the context for the analysis by exploring the meaning of a ‘sustainable’ corporation. It is argued that financial viability is a necessary but not sufficient condition for sustainability and that, in addition, a sustainable corporation is one whose activities are sustainable with respect to natural capital. This raises a normative question, explored in Section 2, of whether a corporation should engage in environmentally-sustainable activities of this type, and, if so, what role accounting should play in encouraging this.

Moving to issues of accounting system design, Section 3 reviews the approaches that have been identified in the literature, and describes their limitations. Section 4 considers how the depletion of natural capital should be conceptualized and argues that this is necessarily context-specific, being closer to a “strong” notion of sustainability in some contexts but not others.

Section 5 compares the concept of natural capital with that of financial capital, identifying ways in which financial accounting systems fail to measure and report the profitability of a sustainable corporation. Section 6 brings the analysis together in a framework for accounting practice that takes the form of income-statements and balance-sheets which incorporate both conventional financial accounting and proposed adjustments for sustainability accounting. Section 7 concludes the paper, noting the limitations of the analysis and opportunities for further research.
1. What is accounting for a ‘sustainable corporation’?

The notion of sustainability is contested (Hueting and Reijnders, 1998; Neumayer, 2013), and a source of analytical imprecision in the literature, with definitions often too vague to support the arguments advanced for them (Norman and MacDonald, 2004; Milne and Gray, 2013; Deegan, 2017). We do not attempt to ‘resolve’ this ambiguity around what sustainability ought to mean in a corporate context but instead merely define what a ‘sustainable corporation’ is taken to mean in this paper.

Our specific concern is with natural capital and the meaning of ‘sustainable’ in that context. While much of our analysis generalises to other issues in the corporate sustainability agenda – for example, corporate impact on social and human capital – we do not specifically consider these issues. Instead, we seek to understand what is distinctive about a ‘sustainable’ corporation from a natural capital perspective, and what issues therefore arise in establishing a suitable system of accounting for it. In this regard, if ‘sustainable’ is to have any meaning then it should serve to constrain the scope of corporate activities to some degree. It can therefore be seen as having normative implications for the stakeholders to whom the corporation is accountable. And it is with this accountability that both the role of accounting and the central issue of this paper are concerned.

Our starting point is that a corporation is sustainable if, at a minimum, it is financially viable. This could mean simply that the corporation is solvent, and so able to meet its financial obligations over time, as they fall due. Somewhat more ambitiously, sustainability might be associated with profitability and growth. In this case, the corporation’s capacity to generate value for its customers exceeds the value expended on its various input resources, and the surplus so created can be reinvested to increase its capital and its expected future levels of revenue and profit. Either way, the notion of sustainability is one of financial viability.

The notion of sustainability seems also, however, to imply that the financial viability of the company is not just current but also ongoing. Consider, for example, a corporation which is set up to (profitably) extract minerals from a mine, and which is then closed down once the mine in exhausted; such a company is never in a position of being financially unviable, but it is not sustainable either. Likewise, consider a corporation in the fossil fuel industry. It is reasonable to argue that the corporation can remain financially profitable for decades to
come but in the process contributes to carbon emissions beyond levels that are regarded as safe for continuing human existence on the planet (IPCC, 2014). The fundamental issue here is whether the underlying activities of the corporation are sustainable. In the context of natural capital, if the planet has finite capacity and natural resources, which corporate activity serves progressively to diminish, then the criterion for a sustainable corporate sector is not met (Pearce, 1988).

The conceptual issues at stake here can summarised briefly by exploring the following matrix of possible states.

<table>
<thead>
<tr>
<th>Natural Capital Maintained</th>
<th>Natural Capital Diminished</th>
</tr>
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<tbody>
<tr>
<td>Financially Viable</td>
<td>Sustainable</td>
</tr>
<tr>
<td></td>
<td>Shareholder-Sustainable</td>
</tr>
<tr>
<td>Not Financially Viable</td>
<td>Shareholder-Destructive</td>
</tr>
<tr>
<td></td>
<td>Destructive</td>
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</tbody>
</table>

Financial viability sets a minimum requirement for the sustainable corporation, for the simple reason that a corporation that is not financially viable will cease to exist. Such a company might be engaged in activities that do not conflict with maintaining (or enhancing) natural capital. Consider, for example, an ecotourism business that invests to restore natural habitat but which fails to secure sufficient tourist revenue - this is in the ‘shareholder-destructive’ category. From a natural capital perspective, such companies are benign, yet they are also largely irrelevant: they may do good, but they do not last. It follows that sustainability from an environmental perspective cannot be considered in isolation from financial sustainability.

If, then, financial viability is a necessary condition for the sustainable corporation, the critical boundary in the above matrix lies between financially viable companies that maintain (or enhance) natural capital and those that instead deplete it; the former are referred to in this paper as ‘sustainable’, while the latter are more narrowly ‘shareholder-sustainable’. Importantly, and as described above for the fossil fuel industry, any given company can be shareholder-sustainable for a considerable period of time. This is for the simple reason that it may not bear the consequences of its adverse impact on natural capital because the depletion of natural capital is a long-term process, or because the costs of
depletion remain as externalities for the company in question.\(^2\) It follows that while financial viability may be a necessary condition for the sustainable corporation, it is not a sufficient condition. Alternatively stated, it is dangerous to assume (as, for example, Barton and Wiseman, 2014) that if companies take care of their own long-term financial success, then they will somehow automatically take into consideration the external impact of their activities, with these ‘externalities’ somehow becoming ultimately costly to shareholders.

It is in this sense that, as described by Jones (2010, p128), the notion of sustainable development is ‘full of latent contradictions.’ The evidence of climate change and of biodiversity loss provide perhaps the clearest illustrations of this dangerous thinking: externalities have been comprehensively exploited over many years and, even at what might currently be regarded as crisis levels (e.g. IPCC, 2014), they remain lower on the corporate agenda than continued financial prosperity. Moreover, corporate decisions are not made ‘in the long run’ but instead here and now, with the additional risk of delusion from a short-term focus on financial performance being coupled with a current rhetoric of long-term thinking. In effect it is an approach that says ‘we are not sustainable at present but we take comfort in the language of long-term value creation, notwithstanding that such language has no anchor in the practical reality of current decision-making.’ In other words, a shareholder-sustainable company does not become a sustainable company by making unsubstantiated claims that it will be different in the future.

The important point here is that convergence between the sustainable and the shareholder-sustainable cannot in general be assumed, but must instead arise through conscious action, which must be judged in the present and which must either be taken by the corporation itself or else by those influencing the economic context of the corporation. It follows that there is an important role for accounting in determining whether or not a business is currently operating in a way that can be described as sustainable and, over time, whether or not it is trending towards sustainability. Note here a critical distinction between accounting and valuation. The former reports the current state of the business, while the latter deals in projections into the future. The former is grounded in reliable measurement, while the latter involves subjective estimation under conditions of uncertainty. In short, accounting is by design related to the accountability of management for decisions that have been made

\(^2\) This is more likely to be the case for an individual corporation that it is the corporate sector as a whole.
and that can be evidenced in past performance and current position, while valuation addresses only unverifiable promises about transactions and events that are yet to take place.

It is important to note that there are two distinct forms of accountability in play here. The first, which is well-established in conventional practice and the basis of financial accounting, is accountability to shareholders. The second, which we have so far described only in outline, is some form of accountability for externalities incurred with respect to natural capital. These categories must be kept distinct, for the practical and conceptual reasons that the accounting system has ‘two masters’ – shareholders and ‘society’ – and it must be designed to that end. Accordingly, we argue that (sustainability) accounting is most effectively viewed as an extension of the existing system of (financial) accounting. It remains important to report financial profit to shareholders (i.e. GAAP net income), because the demand for such a metric has not changed. In addition, however, there is a need (in the case of negative externalities) to take into account the costs that yield a measure of sustainable profit (Gray, 1994). Of course, if these costs are not hypothetical but instead actually incurred by the entity, then there is convergence between financial profit and sustainable profit, but such convergence only arises for the sustainable corporation. For the shareholder-sustainable corporation there is an integrated system of accounting, within which there are two measures of profit, with the difference between them capturing the cost of externalities.

In practice, convergence between financial profit and sustainable profit could arise in one of two ways. The first is that the corporation incurs (internalises) the costs of the externalities. In this case it is financial profit that changes, and converges towards sustainable profit. Financial profit might respond to changes in a corporation’s markets, in its economic context through for example shifts in public opinion and consumer behaviour that internalises the consequences of environmental degradation through market prices. Alternatively, environmental costs might be passed on from suppliers, or there might be a change in regulation or in taxation, for example the introduction of emissions controls or carbon taxes, which would again result in financial profit changing.
The second mechanism is that the company changes the way it operates, for example by switching to cleaner energy, such that externalities are reduced without detrimental impact on financial performance. In this case it is sustainable profit that changes, because externalities are reduced but financial profit is not. (Of course, there is also the ‘win-win’ possibility that, for example, greater energy efficiency reduces externalities while increasing financial profit (Porter and Kramer, 2011), yet such an outcome involves no insight beyond that of conventional shareholder-value maximisation (Crane et al, 2014), and so it is conceptually uninteresting for the purposes of our paper.)

Whatever the mechanism, the important point is that the boundary between the sustainable and the shareholder-sustainable is not fixed but can instead change. Moreover, any given change can either be exogenous to the corporation and so imposed upon it, or instead endogenous, initiated by the corporation itself. The key question for this paper is how accounting can be used to improve understanding of this gap, in other words whether and how accounting systems can capture both financial profit and sustainable profit. A preliminary question, however, which is the subject of the next section, is whether the corporation should act in a manner that is sustainable and not just shareholder-sustainable, and also what role accounting should in principle play in promoting such actions.

2. Is ‘sustainable profit’ incompatible with shareholder capitalism?

From the perspective of the corporation itself, the implication of the gap between the sustainable corporation and the shareholder-sustainable corporation is normative; it describes what a company ought to do if it is to be sustainable, rather than what it is required to do according to laws and social conventions. This normative perspective is demanding. If a company degrades natural capital, then it is not sustainable, in the sense defined above. It might have the highest environmental standards in the industry, doing all that it can do subject to the constraint of maximising shareholder value, but if operating under such a constraint necessitates the depletion of natural capital, then the corporation is shareholder-sustainable but not sustainable. The sustainability criterion therefore needs to be understood as absolute, not relative (Marshall and Toffel, 2005). Vigilance is required to ensure that ‘sustainability’ remains true to purpose, and is not instead misappropriated as a
'rhetorical diversion' (Milne and Gray, 2013, p14) that gives false reassurance about business-as-usual (Norman and MacDonald, 2004; Deegan, 2013; Cho, et al., 2015; Schneider, 2015). Properly applied, the sustainability criterion would be consistent, for example, with taking an external benchmark that sets out balanced perspectives of the aims of society as a whole, such as the UN’s Sustainable Development Goals or the Science-Based Targets initiative, and then ‘backs out’ the role, purpose and activities of a sustainable corporate sector (WRI-Mars, 2016).

An important issue arises here, which is whether it is wishful rather than realistic to expect corporations to do what they ‘ought’ to do, over and above what they are required to do (Kitzmueller and Shimshack, 2012). This question is perhaps best answered against the backdrop of the well-known Friedman doctrine, which at first sight contradicts directly the normative position stated above, providing an ethical argument that the corporation ought not to be sustainable in the sense described here, and that instead the corporation ought to be shareholder-sustainable (Friedman, 1970). Friedman’s premises have been challenged with respect to ethical foundations (e.g. Sandbu, 2011), legal validity (e.g. Stout, 2012), financial economic reasoning (e.g. Mayer, 2013) and assumptions of economic ‘rationality’ (e.g. Sen, 1987), yet his argument remains widely accepted in practice, and its implication for accounting seems to be that the corporation ought not to report sustainable profit. In that context, there is obvious challenge in appealing to notions of ‘obligations’ to stakeholders, whereby moral and legal status is extended beyond shareholders (Freeman et al., 2010), and corporate reporting is presumed to have a broader social purpose.3

However, whether or not a company actually acts in a sustainable way, it is a relatively simple, low-cost exercise for the management of the company to seek to understand what its profit would be if its business was sustainable. Critically, such information is useful from a shareholder perspective in understanding business risk and in forecasting profitability and so in allocating capital (TFCD, 2016). This is because of the possibility that currently-

3 The company’s ‘obligation’ to report in this context can be understood in either of two ways. On the one hand, the company might in substance be reporting a performance target, in that the externality is something that it feels an obligation to reduce. On the other hand, the reporting might be ‘for information only’, in that stakeholders are informed of externalities imposed upon them, but in the context that the shareholders’ claim on the business has priority. In turn, however, such information is likely to be essential to policy-makers and others in ‘re-balancing’ the competing claims of shareholders and other stakeholders, and in this sense reporting is a vehicle for the potential internalisation of externalities, rendering that process partly endogenous to the activities of the corporation.
externalised costs might become internalised, for example through taxation or by means of changes in consumer behaviour.

There is also an important distinction between management accounting and financial accounting which, from a shareholder (Friedman) perspective, corresponds to information used by management within the business to further shareholders’ interests and information reported externally by the management to its shareholders. A claim that accounting for sustainable profit is useful for managers, in their pursuit of shareholder value, does not depend upon any presumption of external reporting. Accounting is distinct from reporting, and management accounting for sustainable profit can be seen as consistent with the Friedman doctrine, even though it does not in itself imply either external reporting or any voluntary action by the company to close the gap between financial profit and sustainable profit; the appeal here is simply to economic self-interest. It is then only a small step to argue that shareholders would welcome the external reporting of this management accounting information; after all, it is shareholders’ capital that is at risk from the possible internalisation of externalities (Tschopp and Nastanski, 2014). Notice here the importance of risk, in that management is accountable to its shareholders not just for current financial performance but also for the inherent financial sustainability of the business model. In this context, the estimated cost of externalities imposed by the business can be understood as a currently-measurable proxy for risk exposure. This is especially the case if it is accepted that, in general, ‘business-as-usual’ is unsustainable and that tighter regulation with respect to externalities is unavoidable, for the simple reason that economic activity cannot continue indefinitely on its current trajectory with respect to climate change and biodiversity loss (Helm and Hepburn, 2012).

Whether or not the stimulus for change comes from within the corporate sector or is instead imposed upon it by government policy or by market pressure, the implication is that corporate activity must ultimately become more sustainable. It follows that whether or not it is accepted that companies themselves currently have an ethical or legal obligation to become sustainable, there is nevertheless a need to develop accounting systems to that end; there is no realistic alternative. Friedman can therefore be rejected on simple pragmatic grounds: there is no need to take a conceptual position on the question of whether he is ‘right or wrong’, but instead the need is simply to identify that an answer to
that question is irrelevant for the purposes of designing and implementing a system of sustainability accounting.

In conclusion and to recap the paper so far, a sustainable corporation has been defined as satisfying two criteria: first, financial viability and, second, a non-negative impact on society. For the specific purposes of this paper, the focus is on natural capital, whereby society is adversely affected if natural capital is depleted. It has been argued that, for shareholder-sustainable corporations that make money for shareholders but that deplete natural capital, there is a need for two measures of profit: financial profit, as currently reported, and sustainable profit, which is a hypothetical measure of how much financial profit would be if the activities of the company were sustainable. Further, we have argued that accounting for sustainable profit is important and desirable, from both a shareholder and a social perspective, meaning that all corporations should seek to understand their sustainable profitability, regardless of whether they perceive their purpose to be aligned with sustainability or instead, more narrowly, with shareholder-sustainability. How this can be done is the primary focus of this paper.

Having so far set out the context for sustainability accounting, the next section seeks to locate our paper in the literature, identifying similarities with other approaches, while also highlighting ways in which the analysis proposed here is distinctive.

3. **Sustainability accounting in the literature**

This section reviews the literature under two broad headings, which concern, first, the relationship between financial accounting and sustainability accounting and, second, the approach to monetisation. The first of these headings follows directly from the discussion above, while the second is fundamental in the design of any accounting system.

There are broadly four approaches in the literature concerning the relationship between financial accounting and sustainability accounting. As set out schematically in Figure 1, each of these approaches has a counterpart in the corporate reporting frameworks that guide practice in sustainability reporting.
As illustrated in the top half of Figure 1, the first two approaches - which we term ‘stakeholder reporting’ and ‘stakeholder accounting’ - are concerned with stakeholders in general, rather than specifically with shareholders. They differ from one another in their treatment of the financial statements. The stakeholder reporting approach treats financial accounting and sustainability accounting as essentially independent of one another, whereby corporations report on financial performance in the financial statements and, in a separate report, on environmental performance; conceptually, there are ‘two bottom lines’. The metrics used in the environmental report may, or may not, be expressed in financial terms. By design, there is therefore not necessarily commensurability with the financial statements, nor even among different metrics within the environmental report (Norman and MacDonald, 2004). Sometimes termed an ‘inventory approach’ (Gray, 1994; Lamberton, 2005), this method is most closely associated in practice with the Global Reporting Initiative (GRI, 2015). In contrast, the stakeholder accounting approach maintains a single bottom line, which is achieved by revising the financial accounts in order to accommodate considerations of sustainability (e.g. Rubenstein, 1992). So, for example, the approach here would be to recognise a liability for environmental impact, even though no such liability would be required in conventional financial accounting (NCC, 2015; Rambaud and Richard, 2015; Mayer, 2016). Essentially, the financial accounts are re-oriented towards a different audience.

The other two approaches in Figure 1 are shareholder-oriented, and again they differ in their treatment of the financial statements. The approach of ‘ESG reporting to shareholders’ is to report on environmental performance insofar as it contributes to an understanding of items in the financial statements, either those in the current period or else those expected to be reported in future periods (e.g. IIRC, 2013). In one respect, the approach here is to ‘inform’ the monetary amount in the financial statements by means of correspondence to a ‘real-world’ referent; for example, energy costs might be described in terms of amounts and efficiencies of fuel consumption, and of associated carbon emissions, thereby giving operational meaning to the corporate activity ‘behind’ the financial

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4 This would more normally be expressed, of course, as ‘triple bottom line’ (Elkington, 1997), and it is only double here for the simple reason that social capital is scoped out of the paper.
statements. In another respect, the approach is intended to highlight a conviction that ‘corporate social responsibility pays’, in that shareholders benefit ultimately from the corporation being sensitive to its stakeholders, for example because an operation with a more efficient carbon footprint would be better placed to succeed financially in a (future) world that (might) regulate carbon emissions more stringently. In this approach, there is unambiguously a single bottom line, namely financial profit for shareholders.

Finally, the approach of ‘sustainability accounting’, which is the one taken in this paper, is to maintain the existing system of financial accounting, as a record of ‘realised’ business transactions and events, but then to extend the accounting in order to include the hypothetical transactions and events that would make the business sustainable with respect to its impact on natural capital. Under this approach - sometimes termed ‘full-cost accounting’ (Gray, 1994; Antheaume, 2004; Lamberton, 2005) - financial accounting and sustainability accounting are commensurable, with both forming part of a single system of accounting, with two bottom lines that are distinct but also clearly reconciled. Unlike the third approach above, this approach accepts, both conceptually and practically, the purpose, design and implementation of financial accounting; there is no presumption that financial accountants have ‘got it wrong’. Unlike the first and second approaches, however, there is an extension of the financial accountant’s way of thinking that seeks to address the inherent limitations of financial accounting from a sustainability perspective. In this regard, note the proximity in Figure 1 between financial accounting and sustainability accounting.

In summary, stakeholder reporting positions sustainability as a separate domain, stakeholder accounting ‘corrupts’ a financial accounting system that is designed to meet a different need for information and accountability, and ESG reporting to shareholders ignores by design the critical issue of externalities; in contrast, sustainability accounting, which is developed in this paper, is a system that measures, reports and reconciles business activity from both a financial and a sustainability perspective.

The second broad heading concerns the approach to monetisation in the literature. It is arguably monetisation that enables accounting to give ‘visibility’ to natural capital (Jones, 2010), providing ‘a means to fight on the terrain of “hard” financial calculation’ (Bebbington et al. 2007). This monetisation of sustainability can be done in either of two distinct ways,
according to the notion of capital being employed and the associated method of measurement (Gray, 2010). One approach is to conceptualise natural capital in financial terms, as an economic valuation of natural resources. Measurement under this approach might be based upon observed market prices, or alternatively upon some alternative method of approximating such prices, for example through hedonistic pricing or survey-based measures of willingness to pay. Impact on natural capital can be measured here in terms of economic consequences for third parties, such as damages incurred or opportunities foreclosed (Antheaume, 2004; Bebbington et al., 2007). Alternatively, natural resources might be capitalised at some form of cost (Rambaud and Richard, 2015). A second approach is to conceptualise natural capital in physical terms, either as a stock of natural resources or as a stream of expected ecosystem services; monetary valuation is not employed, and measurement is specific to the physical properties of the natural resource in question (Gray, 1992 and 1994; Bebbington and Gray, 2001; Milne and Gray, 2013).

Of these, the second approach is the one used in this paper. While at first sight inconsistent with a model that makes sustainable profit commensurable with financial profit, the important point is that monetisation is concerned specifically with the cost of making good any physical depletion of the natural resource; at heart, therefore, the notion being employed is that of physical capital maintenance, and there is no attempt at the valuation of natural capital over and above that which is already captured in the financial statements (Barton, 1999). Again, this is an approach grounded in accounting, and not in valuation. It has several benefits.

First, and in contrast with an economic analysis (Hayek, 1935; Hicks, 1974), this approach recognises that the focus from a sustainability perspective is the physical maintenance of the natural resources themselves, and not with seeking to determine their best economic use; in this sense, the approach places nature outside the realm of the economic (Sandel, 2012). Second, while financial valuation invites notions of fungibility, and of unlimited substitutability among assets, a focus on physical natural resources themselves disciplines the analysis and demands consideration of constraints on substitutability (Bebbington et al., 2007). Third, and consistent with the precautionary principle, subjective asset valuations are not allowed to enter the accounts, and instead the accountant’s method of prudence (conservatism) is adopted. This helps ensure the reliability (and therefore credibility) of
accounting data (Barker, 2015) which, in turn, helps to ensure its relevance for decisions made under conditions of uncertainty (Barker and Penman, 2017). In this sense, the sustainability adjustments to the financial statements can be conceptualised as analogous to the liabilities of the entity rather than to equity: the entity has to settle an ‘obligation’ to make good, but not more than that, which contrasts with equity capital, which is not just returned but also remunerated (Rambaud and Richard, 2015). The effect is to set a constraint on sustainable development, whereby debt claims must be satisfied before profit can be earned (Pearce, 1988).

Finally, and related to the issue of prudence, the approach is relatively straightforward to apply and to verify, for the simple reason that it concerns the observable state of nature at the present time, thereby avoiding necessarily speculative assumptions about economic benefits expected to arise in future periods (Kaspersen and Johansen, 2016; Barker and Schulte, 2017). Also avoided are arbitrary difficulties of value allocation and unit of account (Barton, 1999). Importantly, all of these properties reinforce that accountability is undermined in the absence of a reliable system of accounting for past performance and current position. This is not to suggest an absence of subjectivity, and of opportunistic behaviour with respect to financial accounting (Chen et al., 2014), but instead to note that a strength of financial accounting is its anchor in relatively reliable measurement.

Broadly, our approach is described in brief outline in Gray (1992 and 1994), yet it remains curiously undeveloped and has instead been ‘crowded out’ by other systems of accounting, both in the literature and also in corporate practice (Deegan, 2017). To an extent, this might be explained by opportunistic appropriation of the concept of sustainability (Milne and Gray, 2013), taking it away from the purpose outlined in this paper. It is also possible that there is an underlying lack of clarity over the nature and purpose of both the corporation and of accounting, which has in turn reinforced the misappropriation of ‘sustainability’.

Whatever the cause, we seek to provide the development of sustainability accounting that we argue to be largely absent from the literature. Our next step in this process is to consider more carefully what is meant by the maintenance of natural capital, and to explore why the concept can be understood to be central in designing an accounting for sustainability.
4. Conceptualising the maintenance of natural capital

The concept of natural capital refers to ‘the stock of natural ecosystems on Earth including air, land, soil, biodiversity and geological resources ... (which) underpins our economy and society by producing value for people, both directly and indirectly.’ Corporate activity is dependent on natural capital in many ways, for example through the use of soil and water in agriculture, while it can also have an impact on natural capital, increasing or decreasing its value to society, for example through soil degradation or water pollution (NCC, 2016).

There is not obviously a role for natural capital in mainstream economic thought (Norton, 1995). This situation is described as follows by Dasgupta (2008): “I have professional colleagues who believe that the services nature provides amount at best to 2–3% of an economy’s output, which is the share of agriculture in the GDP of the United States. Why, they ask, should one incorporate a capital asset of negligible importance in macro-economic models of growth and distribution?” This is a good question, because it invites us to challenge two underlying assumptions, and as a result to be clearer about how and why natural capital should be accounted for in a distinctive way.

The first assumption is that market prices capture the value of the economic resources represented by natural capital. There are several reasons to challenge this assumption (Heal, 2016). The current market price reflects resource scarcity at the margin in a market transaction. If there are inadequate property rights to form the basis of those market transactions, as is the case with many important natural assets, such as the atmosphere, oceans and forests, then the price (if there is one at all) will undervalue the resource. This will be even more strongly the case if the resource in question is plentiful for the needs of current economic output, yet the resource is being depleted and so will not remain plentiful. This problem can be viewed through the lens of future generations, whose consumption preferences are of course not represented in current market transactions (Arrow-Debreu, 1954).

The second assumption is that natural capital does not have unique characteristics as a factor of production but is instead substitutable by other forms of capital. According to this assumption, what matters from the perspective of measuring economic growth, is that

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5 This is the definition used by the Natural Capital Coalition (NCC, 2016)
capital as a whole increases, not which components make up the increase. If, for example, an increase in human capital (e.g. knowledge and skills) and in manufactured capital (e.g. machines and roads) exceeds a depletion of natural capital, then the economist’s conclusion is that society is better off. This is in part a reasonable assumption, and in some respects natural capital can be viewed as much the same as any other capital stock in the economy. It is a subjective matter of taste, for example, whether an individual values the amenity services of a wildlife park differently from those of a theme park. And while nature is in some sense primary in any human-generated output, for example with crops needing to be grown before they can be processed and distributed, natural resources are nevertheless just one of many inputs that make up final outputs.

In other respects, however, natural capital is uniquely important (Helm, 2015). Most obviously, it is the basis of everything, and there can be no economic activity in the absence of natural capital (Arrow et al., 1995). Nature not only provides the essentials of energy, water, air, genetic materials and minerals (so acting as a ‘source’), it also absorbs and recycles waste (acting as a ‘sink’, a form of regulation that enables life to be sustained). In some fundamental sense, and unlike other forms of capital, nature has no substitute (Fitter, 2013). Natural capital is also, critically, subject to anthropogenic influence, yet not entirely subject to anthropogenic control, as the example of climate change illustrates (IPCC, 2015). Moreover, neither the extent of influence nor the limits of control are fully understood, as illustrated by uncertainty around both causal mechanisms and ‘safe’ levels of atmospheric greenhouse gases and global warming.

This combination of impact without control, coupled with uncertainty, suggests merit in a precautionary approach to the management of natural capital (Wilson, 2016). Such an approach is particularly important for four further reasons. First, some renewables have a ‘threshold’ level which may itself be uncertain and which, if crossed can cause collapse. Second, the damage done to natural capital may be irreversible. This will always be the case for non-renewables and also for renewables in cases such as species extinction or the collapse of ecosystems. Such irreversibility is rarely the case for manufactured capital, which typically can be re-built on demand. Third, there is an option value to natural capital that is difficult to price accurately (Mayer (2013). For example while a hundred years ago, considerable value would have been attached to woodlands and forests as sources of
recreation and energy, no consideration would have been given to their carbon sequestration properties that feature prominently today. Economic valuations are underestimates of the total benefits of natural capital to the extent that they fail to reflect such unpredictable future opportunities. As such a prudential approach to natural capital conservation is justified by a failure to account fully for the benefit that future generations might derive from it. Finally, natural capital resources often depend for their existence on being part of an ecosystem, yet the inter-connected properties of that system, and the consequences of partial damage to it, are rarely fully understood.

There is a wide range of natural capital assets that, in varying degrees, have the distinctive features being described here, and so the challenge is to identify which of these should be the focus of attention, viewed from the perspective of a sustainable corporate sector. In one approach to this challenge, Marshall and Toffel (2005) propose a sustainability hierarchy, with focus being given, in order of importance to (current or potential) activities that endanger human life, reduce the health-related quality of human life, cause species extinction or, finally, reduce other aspects of the quality of human life. These are of course the types of prioritisation that need to be thought through in order to understand whether and how impacts on natural capital are important. The obvious concern, however, is that quite what this categorisation implies for corporate action is challenging to determine.

Perhaps the most tractable focus for corporate activity involves the identification of ‘critical natural capital’, which Ekins et al. (2003) define to be “natural capital which is responsible for important environmental functions and which cannot be substituted in the provision of these functions by manufactured capital.” In this regard, Helm (2015) advises that special consideration should be given to renewable natural capital. This is in part because the natural property of renewing provides a perpetuity ‘free lunch’ and so is especially valuable. It is also because the risk of reaching a critical, irreversible threshold is more likely for renewables, for example in cases such as over-fishing that lead to the fish stock no longer being able to renew naturally. What makes a particular category of natural capital critical is that it has no substitute, that its loss would be irreversible, and that the consequence of its loss would be significant to human wellbeing (Ekins et al., 2003).

It is in this special case of critical natural capital that it makes sense to apply the concept of ‘strong sustainability’ as opposed to ‘weak sustainability’ (Neumayer, 2013). In its extreme
form, strong sustainability is a form of physical capital maintenance that implies that no substitutability is possible for natural capital,\(^6\) whilst an extreme version of weak sustainability implies the opposite. To the extent that weak sustainability applies, the application of mainstream economic thought is unproblematic; for strong sustainability, however, it is instead necessary to understand nature as a uniquely valuable form of capital.

It might reasonably be assumed from this discussion that, because financial accounting is aligned with mainstream economic thought in its reliance on market transactions, the difference described earlier between financial profit and sustainable profit must be the hypothetical cost of ensuring the physical capital maintenance of (critical) natural capital. This intuition must, however, be demonstrated rather than assumed. The next section of the paper therefore explores current practice in financial accounting to consider the extent to which it does, and does not, address the costs of maintaining (critical) natural capital.

5. Conceptual differences between financial capital and natural capital

At the heart of financial accounting is what can be termed ‘financial capital’, which is a measure, at any given point in time, of the value of shareholders’ claims on the net assets of a company. Corporate activity affects the value of financial capital, with resulting increases (decreases) being reported as a profit (loss) to shareholders. More precisely, profit measures the excess of the resources generated by a company during a period of time (income) over the resources it consumes during that same period (expenses), excluding transactions with shareholders in their capacity as shareholders (IASB, 2015).

Natural capital and financial capital are similar in that both represent stocks of value, changes in which increase or decrease the well-being of stakeholders. Yet there are two important differences. The first is that natural capital has a broader range of stakeholders, in terms not just of ownership but also dependency.\(^7\) The existence of natural capital is important for the activities of corporations, but it matters also to all of the other individuals

\(^6\) An “intrinsic value” view of nature is premised on such no substitutability presumptions, see for example Piccolo (2017).

\(^7\) It might also be argued that stakeholders’ interests are not purely economic, though this is a somewhat different, contestable and secondary point.
and institutions of which society is comprised. In contrast, financial capital concerns shareholders only. The second is that the term ‘capital’ is being used in two very different ways. While natural capital is a resource, financial capital is a claim on a resource: from a double-entry accounting perspective, natural capital is an asset, while financial capital is equity (Hicks, 1974; Nobes, 2015).

These two differences are of fundamental importance in understanding the relationship between, first, the existing system of accounting for financial capital and, second, the broader system of sustainability accounting proposed in this paper. This can be illustrated in the form of a balance sheet. For simplicity, it can be assumed that natural capital is the only resource that exists in society, that the only form of financial instrument is equity, and that property rights with respect to natural capital are held either privately by corporations or publicly by ‘society’. These assumptions give the following balance sheet for the economy as a whole, with the top half of the balance sheet representing the corporate (private) sector and the lower half representing what might be termed the social (public) sector.

<table>
<thead>
<tr>
<th>Assets</th>
<th>Ownership Claims</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural capital owned by companies</td>
<td>Financial Capital</td>
</tr>
<tr>
<td>Natural capital owned in common</td>
<td>Public ownership</td>
</tr>
</tbody>
</table>

Insights are suggested by changes in this balance sheet. If, for example, the value of natural capital as a whole increases over a period of time, for example through reforestation or reduced air pollution, then society as a whole becomes better off. Suppose, however, that the corporate sector is able to enhance the value of its own natural resources, leading to an increase in financial capital and so to a financial profit, yet this increase results in a negative externality, depleting natural resources that are publicly owned. In such a case, society as a whole might become worse off even though shareholder wealth is enhanced. The point here is simply that optimising for the interests of one stakeholder group might be at the expense of optimising for stakeholders as a whole, and that financial profit is a performance metric aimed at the former and not the latter. In such a case, the required adjustment to

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8 This point can be extended to include, first, future generations of individuals and institutions and, second, sentient beings other than humans.
determine sustainable profit is in principle straightforward; it is equal to the cost of restoring the public natural capital, of ‘making good’ the external impact of corporate activity. Note that there is no need for these publicly owned assets to be valued, but instead only for there to be a measure of the cost of restoration. This is because the informational need for reporting concerns the corporate income statement only, being the income or expense that comprises the difference between financial profit and sustainable profit. This is a significant practical benefit because the valuation of publicly-owned natural capital would be unavoidably highly subjective (Barton, 1999).

In practice, this adjustment for externalities would need to be considered on a case-by-case basis. There will be some clear cases of externalities, as for example when a company pollutes the atmosphere but is not legally obliged to incur any associated cost (and does not do so). Alternatively, there will be cases where a company is able to take advantage of an externality but instead decides not to, acting instead in a sustainable way. Such cases would give rise to either a cash outflow (and an expense) to make good the loss of natural capital, or else a new liability (and therefore an expense) to recognise a commitment to make good in the future. There might also be cases where atmospheric pollution is taxed, in which case a company incurs expenses as publicly-owned assets are depleted. This serves to internalise the cost, yet it might not do so entirely if the rate of tax is too low to account for the full social cost of depletion. Finally, there might be cases where, for example, there is a commercial, arm’s length transaction in the supply of goods or services from the public to the private sector, such that expenses are fully incurred within financial profit. The common feature of these examples is that while the cost of externalities always comprises the difference between financial profit and sustainable profit, the nature of that cost will vary in different contexts.

In contrast with natural capital that is publicly owned, some form of valuation is needed for natural capital assets owned by the corporate sector. This is because, in double-entry accounting, financial capital is not measured directly but is instead simply a balancing entry, with a value set equal to that of (recognised) net assets; it is a claim, not a resource. This raises practical issues of both recognition (i.e. whether assets are captured on the balance sheet) and measurement (i.e. how the value of assets is recorded). If the value of natural capital is not captured, then financial profit will be correspondingly mis-measured, because
change in natural capital values determine directly the measurement of financial profit. It follows that part of sustainable profit can be viewed as, in substance a ‘correction’ to financial profit, as an adjustment for changes in the value of natural capital that would otherwise remain unrecorded.

In practice, it is not just these differences in ownership and in methods of recognition and measurement that lead to different accounting considerations. There are also different types of natural capital, which can be broadly categorised as renewable, non-renewable and uneconomic to renew.

The most straightforward accounting treatment arises if there are renewable natural capital assets that are owned by a company and that are replaced as they are consumed. In this case, there is financial profit because the sales value of the asset is recognised as income, while consumption of the asset is expensed. There is a cash inflow from customers and an outflow to fund the replacement of the asset. Take the example of a forest, which grows each year and which is partially felled and replaced annually in such a way as to maintain a steady state. At the end of the accounting period, the trees lost to consumption have been replaced, the cash received from customers has funded their replacement, and any profit earned on the transaction has resulted in a net increase in the company’s cash and in its financial capital. In this simple case, there is no need for any separate accounting for natural capital; the physical maintenance of the forest ensures no depletion in natural capital, and financial profit is a sufficient measure of the value generated for all those affected by the company. Note, however, that this equivalence of financial profit and sustainable profit is not in itself a sufficient condition for sustainability. Also required is that the natural capital that was depleted is actually replaced. The profitability of the company implies that such replacement is economically feasible, but the maintenance of financial capital can be achieved by any combination of financial assets and natural capital assets, and it is only the

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9 There is no necessary relationship between the physical capital maintenance of natural capital and the monetary valuation that gives rise to financial capital with respect to that natural capital. It is possible, for example, for fossil fuels to be grossly overvalued if present market prices are used yet if in practice carbon emission targets will in due course make the full use of reserves infeasible.

10 There is also (unrealised) financial profit to the extent that growth in the forest is recognised as an increase in asset values.

11 If the assets are not renewed in the reporting period, the appropriate adjustment would be to provide for their renewal.
(re)investment of the former to replace the depletion of the latter that ensures the physical maintenance of natural capital.

The situation is different for assets that are either non-renewable or else for which renewing is not an economically viable option. Take the example of coal, and assume for the time being that coal is an environmentally clean source of energy. The point about an asset of this type is that once it has been consumed by the current generation, it is no longer available for consumption by future generations; its consumption constitutes a permanent loss of natural capital. This feature is not captured in financial accounting. Take the case of a mine that is privately owned. The consumption of coal is an expense, the receipt from customers is income, and the difference is profit. The balance sheet has become more liquid, as natural capital has been consumed and ‘replaced’ by cash. But future generations cannot use cash as a source of energy. Instead, and in order to restore accounting to the harmonious outcome achieved in the forest example above, there needs to be some mechanism to ‘make good’ the loss of natural capital.

One way to think about this would be to conceptualise the coal not as a unique asset that cannot be replaced but instead as a source of energy that can in effect be replaced by an alternative source of energy. In other words, while the coal itself cannot be replaced, it is possible to replace the value that it would have provided to future generations. The focus here is therefore not the income statement but instead the balance sheet. Some form of weak substitution is necessarily assumed, and the notion of ‘replacement’ on the balance sheet must be taken to mean the most economic (least cost) replacement of the service potential (economic benefits) of the asset, rather than physical replacement of the asset itself. In effect, the assumption is that coal is not in itself ‘critical’ but that its service potential is.¹²

Where the least cost of replacement is in excess of the economic value of the non-renewable asset then there is no sustainable profit and it should not be depleted. Instead, the natural capital maintenance cost is the income it generates less the cost of extraction (i.e. the economic value), implying that sustainable profits are zero. Another way of

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¹² This is obviously troublesome in so far as the substitutability of certain types of commodities such as rare earths may be low or on-existent and in light of the option value to future generations of certain commodities, it will be hard to assess the true substitutability today.
thinking about this is that where there is no viable alternative source of energy then the minimum amount that future generations would have to pay current generations to leave the non-renewable resource intact is the revenue it would generate less the cost of its extraction. Even if alternative energy sources are viable and sustainable profits of non-renewable resource extraction are non-zero, they are still substantially less than those currently reported based on amortizing the original cost of purchasing the resource.

These cases of natural asset depletion and replacement might also, of course generate externalities, and so alongside the (balance-sheet) accounting described above there would also be the (income-statement) adjustments described earlier between financial profit and sustainable profit. This can be illustrated by dropping the assumption that coal is a clean source of energy. In this case, the consumption of coal imposes an external cost in terms of atmospheric pollution, and the adjustment needed to determine sustainable profit would be for the cost of carbon offset. In general, and as described above, if external costs are imposed by the company’s activities, then financial profit inflates the apparent contribution of the company to society.

A further consideration concerns asset ownership within the corporate sector, whereby a company can either consume an asset it owns or else pay for goods and services that have been generated in part by the consumption of a similar asset by a different company. In principle, of course, it makes no difference from a sustainability perspective whether a given amount of natural capital is depleted by one legal entity or by another. In practice, however, and because different legal entities generate their own accounting information privately, there is an added complication here. The key question is whether or not the supplier company is sustainable, according to the meaning of that term in this paper. If it is not, then some adjustment is required to its cost of supply in order to determine a sustainable cost. This requires the measurement of activities taking place within a different company, so extending the boundaries of corporate responsibility and reporting beyond those traditionally applied in financial accounting. It does not, however, raise any additional conceptual issues in determining the appropriate method of measurement. There is also no problem of double-counting. If the supplier is sustainable, then no adjustment is required because all costs have been internalised. If the supplier is instead

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13 This is the problem of (upstream) ‘Scope 3’ reporting.
only shareholder-sustainable, then there are external costs in the supply chain, for which adjustment is required. The measure of sustainable profit should be the same whether any given operation is owned by the company or instead outsourced; either way, the externalities are generated by the operation in order to generate the output of the company.\textsuperscript{14}

Taken together, the implications of the discussion in this section of the paper can be summarised in terms of their impact on the financial statements. The next section of the paper therefore sets out the presentation of both the income statement and the balance sheet, as adjusted for sustainability.\textsuperscript{15}

6. A sustainability accounting framework

A sustainable accounting income statement is presented in Figure 2, using hypothetical data. For simplicity of presentation, the line items from revenue to financial profit are intended as a shorthand representation of a conventional income statement, with total expenses categorised according to relationship with natural capital.\textsuperscript{16} All other line items are concerned with adjustments that reconcile financial profit with sustainable profit.

\textit{Insert Figure 2 here}

The adjustment for changes in unrecognised net assets concerns gains or losses on assets that are owned by the company but that are not fully captured on the balance sheet. Accordingly, the subtotal ‘adjusted financial profit’ can be considered to be a ‘comprehensive’ measure of financial profit. There might, for example, be assets recorded at their historical cost on the balance sheet, for which any increase in market value during the accounting period goes unrecorded. That increase might result from either volume or

\textsuperscript{14} There is, of course, a practical challenge here, and it is only if a company looks through its supply chain to observe the accounting convention of all its constituent components that the risks of over or under-providing are avoided.
\textsuperscript{15} We do not present a cash flow statement, because the format for presenting actual (realised) exchanges of value offers little insight with respect to the hypothetical transactions discussed in this paper.
\textsuperscript{16} Financial profit can be taken to mean either Net Income, Profit after Tax or Comprehensive Income; differences in practice between these concepts are not relevant to the analysis in the paper.
price, for example either organic growth in the asset or a change in the market price at which the asset is traded.\textsuperscript{17}

Next, financial profit for the shareholder is adjusted for externalities, and thereby reconciled with sustainable profit. These are ‘expenses’ not actually incurred by the corporation but that would be required to be incurred in order to restore depleted natural capital. These externalities might arise upstream, in the company’s supply chain and therefore outside the boundary of the financial reporting entity, or else they might be consequences of activities undertaken by the reporting entity itself. These two categories are presented separately, in order that the source of the externality can be more clearly understood.

Financial profit links one balance sheet to another. This is illustrated in the first part of Figure 3, in the form of balance sheets that correspond to the above income statement; note that financial profit is the change in financial capital.\textsuperscript{18} The line items down to, and including, total assets and financial capital are intended as a shorthand representation of a conventional balance sheet.

\textit{Insert Figure 3 here}

In a similar fashion to the income statement, the balance sheet can be adjusted for the purposes of sustainability accounting; this is illustrated in the second part of Figure 3, again using the same hypothetical data, and including a (simplifying) assumption that the cost of replacing natural capital assets is equal to the expense incurred when they are consumed. Note that data are presented for the closing balance sheet only, with the financial balance sheet presented in the first column of data, sustainability adjustments in the second column, and the sustainability balance sheet in the final column.

The sustainability adjustments are of three types. The most straightforward of these is for unrecognised gains and losses on natural capital assets owned by the reporting entity, which are shown simply as a debit to the asset and a credit to equity.

\textsuperscript{17} These could in principle be disaggregated to give a current replacement cost expense: does the cost of purchased inputs measure satisfactorily the consumption of renewable natural capital owned by suppliers, and if not what adjustment is required?

\textsuperscript{18} Total Assets can be taken to mean Net Assets Financial Capital has the same meaning as shareholders’ funds, or equity. As the example does not include liabilities, financial capital is equal to total assets. In general, it would be equal to net assets.
The second type of sustainability adjustment is for the investments that the entity would need to make in order to restore depleted natural capital. In the case of critical renewables, this implies strong substitution: like-for-like replacement cost. In the case of critical non-renewables, this implies weak substitution: least-cost replacement of an equivalent asset that provides the same service potential. These adjustments concern only the assets owned by the reporting entity, and in this regard there is a difference in scope between the sustainability income statement and the sustainability balance sheet. While the generation of profit indicates that the entity can replace depleted natural capital, in the sense that it has sufficient resource to do so, this does not mean that the replacement actually takes place, and if the assets to be restored do not belong to the reporting entity, then whether or not they actually are restored is outside the control of the reporting entity. In effect, the sustainability balance sheet therefore reports, on a cumulative basis, only the investment that the reporting entity would need to make in order to ensure that its own critical natural capital is not depleted. We show the double-entry for this accounting as a debit to the carrying amount of the asset and credit to liabilities, though of course in both cases these amounts are hypothetical, being the amounts that the entity would report if it were sustainable rather than shareholder-sustainable.\(^{19}\) While we show the hypothetical commitment to replace natural capital as a liability, an alternative presentation would be to show the credit entry as a (hypothetical) deduction of cash. There is no meaningful distinction for our purposes between these alternative presentations, because the difference between them concerns the funding of the outflow, not the purpose to which the outflow is directed (i.e. the debit entry for the replacement of natural capital is the same either way).

The third, and final, type of sustainability adjustment is for the (hypothetical) outflows that would make good (internalise) the reporting entity’s externalities. The double-entry here is a credit to create a (hypothetical) liability, and a corresponding debit to reduce cumulative (sustainable) retained profit. In the event that the entity ‘settles’ the liability, the effect would simply be to reverse this double-entry.

\(^{19}\) Should the expenditure actually be incurred, these entries would simply be reversed, and the financial and sustainability balance sheets would thereby converge.
In the case of liabilities created in the sustainability balance sheet, there is an important measurement question that arises, which is whether the method of accounting is at historical cost or instead at current value. If the former is adopted, then the subsequent measurement is straightforward. It is the latter, however, that is more ‘true to purpose’ because the underlying concern is with the physical maintenance of natural capital. To illustrate, if it became less expensive over time to restore natural capital (perhaps because of improvements in technology), then the current value of the liability should be reduced, leading to a corresponding (unrealized holding) gain in sustainable retained profit. In general, the need here would be to keep track of the current cost of restoring (previously depleted) natural capital and of internalising (already incurred) externalities, and thereby to re-measure the liability in each closing balance sheet.

7. Discussion

This paper has proposed a method of accounting for natural capital. It has been argued that existing systems of financial accounting are sufficient in cases where the company itself is sustainable. In contrast, for companies that are only shareholder-sustainable, accounting for natural capital requires adjustments to both the income statement and the balance sheet. In the income statement, sustainable profit is defined as the (hypothetical) financial profit that the company would make if it internalised its externalities. In the balance sheet, sustainable assets are defined as the (hypothetical) assets that the company would own if it reinvested to ensure no depletion of critical natural capital.

In this final section of the paper, we draw attention to several important aspects of the proposed model. These are both conceptual and practical, where the former are concerned with the inherent purpose and in-principle limitations of the model, and the latter with challenges in making the model operational.

Four conceptual issues, in particular, are worth noting. The first is that the model is concerned with impacts on natural capital, rather than with dependencies. In other words, the concern is with how the activities of the corporation affect natural capital, rather than with how they are affected by it. Climate change is the obvious example. The proposed
model accounts for carbon emissions, to the extent that these are externalities, not captured already in financial accounting. In contrast, the model does not explicitly consider how climate change affects business opportunities and risks, arising for example from water scarcity in some areas and flooding in others. The approach is therefore the opposite of, for example, the Task Force on Climate-related Financial Disclosures (TFCD, 2016), which encourages to companies to report on how the (financial) sustainability of their activities are affected by climate change, but which is silent on negative externalities caused by those activities. This difference follows directly from the purpose of our model being to account for the sustainable corporation, rather than for the shareholder-sustainable corporation.20

The second conceptual issue, which is closely related to the first, is that accounting for sustainable profit does not, of course, guarantee the sustainability of the underlying business. This is for three reasons. First, there is co-dependence on natural capital, among corporations and also all other constituents of society. Take, for example, the coffee business, in which a measure of sustainable profit would take into consideration the expense and investment required to make good environmental impacts on air, soil and water. Yet the coffee business is also dependent upon the impacts that others have on these factors, and especially so because coffee is a ‘sensitive’ crop that requires reliable rainfall and is highly vulnerable to changes in climate (CDP, 2014). With the coffee industry itself having only a small impact on these environmental factors, and with any individual coffee company unlikely to have any material influence, the macro conditions will change exogenously and regardless of whether or not the coffee industry makes adjustments in its own accounts for its own influence. Related to this point is the second reason why the reporting of sustainable profit does not imply sustainability of the business. Consider, for example, a food processing business that acquires cocoa on the open market and that sells chocolate. In any given year, it will record an expense for the consumption of cocoa, as it would also do if the cocoa was sourced in-house. The profitability of such a business - as recorded in the income statement - might reasonably be expected to indicate the likely level of future profitability. In that sense, revenue and profit can be seen as ‘recurring’. Suppose, however, that some form of unexpected natural disaster occurs in cocoa production, say in

20 There is, of course, a degree of overlap here. If, for example, a company is a major user of a natural capital resource that is becoming increasingly scarce, then that scarcity is likely to impose higher costs and increasing risks to the company’s supply chain.
2017, leading either to a dramatic increase in price or to the termination of supply. The reported profitability of the business in 2016 will give no indication of this forthcoming discontinuity. This is simply because the accounts record what has happened, historically - prices and costs in 2016. Whatever the prices and costs turn out to be in 2017 has no bearing on the 2016 calculation. That said, if the company owns the asset in question, then the value of the asset would be recorded on the entity’s balance sheet, and any expected decline in the future productivity of the asset would result in an impairment loss in the current reporting period. In other words, the design of financial accounting is such that the measurement of sustainable financial performance is more comprehensive when natural capital assets are owned than when their supply is external. Finally, the third reason why sustainability accounting does not in itself imply sustainability of the underlying business is, simply, that it captures the hypothetical, and not the actual; it reports what a company would need to have done in order to be sustainable and not, in contrast with conventional, financial accounting, what the company has actually done. This is true not just for the reporting entity, but also for companies in its supply chain, and particularly so when critical thresholds that impose substantial externalities are crossed. If, for example, an upstream company fails to incur the expenditure that would maintain natural capital, and if that failure pushes the natural capital over the edge, into a critical state so that the activities of the downstream company are placed in peril, then it would make no difference whether the downstream company had fully accounted for sustainability.

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21 This recognition of economic loss would, however, be partial at best. This is for two reasons: first, and as is typical in the ‘conservative’ or ‘prudent’ world of accounting, the asset may not have been included on the balance sheet at its full economic value, but instead at a lower value, which in turn reduces the size of the impairment loss; and, second, the impact in the accounts will be restricted to the loss of the asset and not to the full extent of the loss of business caused by the loss of the asset (i.e. there is also the loss of revenue and margin resulting from the inability to supply).

22 Potentially adverse future economic events can, to some extent, be accommodated in the calculation of historical performance, and more comprehensively so in the case of sustainable profit than accounting profit. Consider the example of supply chain consequences that can be traced to anthropogenic sources, such as climate change, water or soil degradation, or disruption of the ecosystem. To the extent that business activities take place with lower negative impact on these environmental factors, such as economic activity on natural capital. It follows that sustainable profit is not just a more comprehensive measure of current business performance, but also a better indicator of shareholder-sustainable, financial profitability.
The third conceptual issue concerns an important limitation of the proposed model. The issue here, which is simple but important not to overlook, is that the proposed accounting is not comprehensive, in that it considers sustainability only up to the boundary defined by the output of the reporting entity. There is an important difference between the company’s supply chain (its ‘upstream’ activities) and the (‘downstream’) use by customers of the company’s products or services. The economic activity of the company itself terminates at the point of delivery of its output. The presumption here is that a sustainable company is responsible for all economic activity that is incurred in generating its output, but not for whatever actions are subsequently taken beyond the point of delivery. This is the case even for products where usage involves a high environmental footprint, for example a jet engine. It is the consumer who demands, and ultimately uses, the product, and it is the actions of the consumer, not of the supplier, that determine any subsequent depletion of natural capital. This is not to ignore the problem but instead to locate it correctly. The point is that a method of corporate sustainability accounting cannot, by design, incorporate sustainability that is downstream of the corporate sector.  

The fourth, and final, conceptual issue is that the model being proposed here is one of accounting, not of valuation. It is therefore concerned with the ex post evaluation of decisions, rather than with the ex ante making of decisions. Finance theory tells us that the value of an investment project can be determined by identifying and discounting the relevant, incremental cash flows. Accounting practice, in contrast, is concerned not with capitalised estimations of this kind but instead with the recognition of historical financial performance, as and when it occurs and is (conventionally) accepted as reliably measurable. 

In addition to the limitations implied by these conceptual issues, there are numerous practical challenges in implementing the accounting model proposed in this paper. These may be summarised under the accounting headings of recognition and measurement. 

The recognition question concerns what should be included in a set of accounts. Specifically, the issue here is what ‘counts’ as critical natural capital, in particular the identification of those distinctive natural capital assets that require replacement (in either strong or weak form), in contrast with all other assets that economic theory assumes are readily

23 Corporate sustainability data would, however, be essential for the determination by end consumers of the overall environmental footprint of their activities.
substitutable for one another. While the paper has hinted at the answers to this question, a comprehensive and practical answer is beyond the present scope. This is in part because the requisite analysis must be drawn from the natural sciences, and lies outside the domain of accounting. It is also because, given the locational specificity of most forms of natural capital, the question of what counts can be answered only on a case-by-case basis, and not in general.

The measurement question is closer to the skill set of the accountant, although of course here, too, measures relating specifically to issues such as biodiversity and climate are within the domain of natural science. From the perspective of the accountant, the proposed model raises two issues in particular. The first is the extent to which financial accounting captures the value of natural capital owned by any given company. In this regard, international financial reporting standards (IFRS) are helpful to the extent that accounting for ‘biological assets’ is at ‘fair value’ under (IASB, 2001). The second issue is that of the ‘measurement’ of the hypothetical transactions and events that comprise the adjustments for financial accounting to sustainability accounting. These include estimating the cost of making good negative externalities, which is required in order to express sustainable profit as an adjustment to financial profit, and the estimation of the least-cost investment that is required, in the balance sheet, to replace depleted renewable natural capital and to substitute for depleted non-renewables. For all of these items, the transactions or events in question do not actually take place, market prices might not available, and even where market prices do exist, they might anyway not capture the marginal social value of the associated asset; some degree of estimation in the accounting is therefore unavoidable.

This problem is, to some extent, addressed in the presentation formats that are proposed for the income statement and for the balance sheet. A general presumption in financial accounting is that of ‘reliable measurement’, and a reasonable presumption for the proposed sustainability adjustments is that they are inherently less reliable than the financial accounting, making it helpful that these amounts are presented separately. Moreover, and given that managerial incentives to report positive natural capital impacts presumably exceed those to report negative impacts, and that the inherent estimation in either direction allows considerable subjectivity, it is also helpful that unrecognised gains or losses on the entity’s own natural capital are presented separately from externalities; this is
for the simple reason that unrecognised amounts are more likely to be gains, while externalities are more likely to be losses.

References


Figure 1: A Taxonomy of Corporate Reporting Frameworks

Figure 2: Sustainable Income Statement

<table>
<thead>
<tr>
<th>SUSTAINABLE INCOME STATEMENT</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
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<tr>
<td>Expenses</td>
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<tr>
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<td>Externalities – owned operations</td>
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<td>110</td>
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</tbody>
</table>
**Figure 3: Financial and Sustainability Balance Sheets**

<table>
<thead>
<tr>
<th><strong>FINANCIAL BALANCE SHEET</strong></th>
<th>Start of Year</th>
<th>End of Year</th>
<th>Start of Year</th>
<th>End of Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash</td>
<td>0</td>
<td>290</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Renewable Natural Capital</td>
<td>600</td>
<td>520</td>
<td>Share Capital</td>
<td>1000</td>
</tr>
<tr>
<td>Non-Renewable Natural Capital</td>
<td>400</td>
<td>340</td>
<td>Retained Profit</td>
<td>150</td>
</tr>
<tr>
<td><strong>Total Assets</strong></td>
<td><strong>1000</strong></td>
<td><strong>1150</strong></td>
<td><strong>Financial Capital</strong></td>
<td><strong>1000</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>SUSTAINABILITY BALANCE SHEET</strong></th>
<th>Financial Balance Sheet</th>
<th>Sustainability Adjustments</th>
<th>Sustainability Balance Sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash</td>
<td>290</td>
<td>290</td>
<td></td>
</tr>
<tr>
<td>Renewable Natural Capital</td>
<td>520</td>
<td>80</td>
<td>600</td>
</tr>
<tr>
<td>Non-Renewable Natural Capital</td>
<td>340</td>
<td>60</td>
<td>400</td>
</tr>
<tr>
<td><strong>Total Assets</strong></td>
<td><strong>1150</strong></td>
<td><strong>140</strong></td>
<td><strong>1290</strong></td>
</tr>
<tr>
<td>Unrecognised Gain or Loss on Natural Capital</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Sustainable Assets</td>
<td><strong>150</strong></td>
<td><strong>1300</strong></td>
<td></td>
</tr>
<tr>
<td>Investment required to replace owned natural capital</td>
<td>140</td>
<td>140</td>
<td></td>
</tr>
<tr>
<td>Outflow required to compensate upstream externalities</td>
<td>15</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Outflow required to compensate own-operation externalities</td>
<td>35</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td><strong>Sustainable Liabilities</strong></td>
<td><strong>190</strong></td>
<td><strong>190</strong></td>
<td></td>
</tr>
<tr>
<td>Share Capital</td>
<td>1000</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>Retained Profit</td>
<td>150</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td><strong>Financial Capital</strong></td>
<td><strong>1150</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unrecognised Gain or Loss on Natural Capital</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td><strong>Cumulative Externalities</strong></td>
<td><strong>(15)</strong></td>
<td><strong>(15)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Cumulative Externalities</strong></td>
<td><strong>(35)</strong></td>
<td><strong>(35)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Sustainable Capital</strong></td>
<td><strong>(40)</strong></td>
<td><strong>1110</strong></td>
<td></td>
</tr>
</tbody>
</table>